ANNUAL REPORT

2024
2025

CENTRE FOR BASIC SCIENCES 1986 S. N. BOSE NATIONAL
1894 - 1974
विज्ञानेन परिवर्तन्ति धीराः

SATYENDRA NATH BOSE
NATIONAL CENTRE FOR BASIC SCIENCES

ANNUAL REPORT 2024-2025

CENTRE FOR S. N. BOSE NATIONAL BASIC SCIENCES 1986
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SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

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Satyendra Nath Bose
National Centre for Basic Sciences

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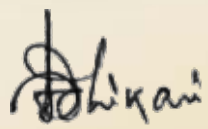
Acknowledgement

Annual Report of the 'Satyendra Nath Bose National Centre for Basic Sciences' is a brief representation of its activities for a financial year. The report reflects research activities, administrative activities, academic progress and achievement of young research scholars, development of infrastructure and facilities, and establishment of a network with advanced research groups around the world. It's the 15th time I have been assigned the job of compiling the Annual Report of the Centre. To prepare the Annual Report, all the faculty members and sections of the Centre have spent their valuable time to provide the respective data. It is a time-bound work to be completed within a short span of time. I would like to acknowledge the sincere efforts and labour of my Library staff - Gurudas Ghosh, Ananya Sarkar, and Amit Roy without whom the work could not be completed within the stipulated time. Finally, I would like to thank all the members of the Centre for their cooperation in preparation of the Annual Report of the Centre.



Saumen Adhikari
Librarian – cum – Information Officer

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MESSAGE FROM THE DIRECTOR

It is my privilege to present the Annual Report of the Satyendra Nath Bose National Centre for Basic Sciences for the year 2024-2025.

This eventful year witnessed the continuation of the centenary celebration of Bose's statistics. Two highly successful international conferences, one on Women in Quantum Science and Technologies and another on Bose-Einstein Condensation, Superconductivity, Superfluidity, and Quantum Magnetism, were held in July 2024 and November 2024. The three-day conference on Women in Quantum Science and Technologies consisted of six role-model talks from accomplished women scientists, two panel discussions, three special lectures, ten invited talks from young women scientists in the broad areas of quantum science and technologies, and a poster session by PhD students. The Bose-Einstein Condensation, Superconductivity, Superfluidity and Quantum Magnetism conference was inaugurated by Science and Technology Minister, Jitendra Singh-ji. Renowned scientists from research laboratories and universities all over the world attended and spoke about their work, shared their views on the future of the second quantum revolution and interacted with students and young researchers to ignite their minds about the expanding horizons in quantum science and technology. The conference had talks by Wolf prize winners, Buckley prize winners, Dirac medallists, Bardeen prize winners, Onsager prize winners and Europhysics prize winners. Several prominent Indian diaspora scientists from Princeton, Penn State, UIUC, Toronto, OSU, Harvard, UC Davis, Oxford, etc, attended the meeting. Besides the two conferences, several Outreach Programmes were arranged throughout the year in association with Bangiyo Bigyan Parishad and the Indian Physics Association. Public lecture was delivered by Prof. Zahid Hasan from Princton University. While the Conferences provided opportunities for experts across the globe to come together and exchange their ideas, the Outreach Programmes created momentum towards popularising science.

The Centre has signed MoU with National Physical Laboratory, New Delhi and University of Engineering &

Management (*UEM*) for strengthening collaboration and cooperation in the area of student mentorship, infrastructure sharing and entrepreneurship, etc. The observatory site at Panchet has been inaugurated in the presence of the Governing body chairman, DST finance advisor and Prof. Somak Raychaudhuri, vice-chancellor of Ashoka University and a noted astrophysicist. Centre has also initiated a Certificate course on observational astrophysics in collaboration with Sidhu-Kanuho-Birsha University. Like every year, Centre has observed the open day on the first working day in January and the foundation day with a foundation day lecture delivered by Dr. Vijayaraghavan, TIFR, on Quantum Computers.

The Centre has maintained its research excellence, being featured among the top 2 DST AI-s and the top 11 Indian Institutes in the area of physical sciences as per the Nature index. The high level of productivity is evident with about 7.7 publications per faculty in the year 2024-2025, and with 29 students graduating. Active research is being pursued in the domains of Quantum Information, Quantum Materials and Devices, Computational Materials Science, Observational Astronomy, Statistical Physics, Physical and Quantum Chemistry, interfacing with Biological Molecules, and Ionic Liquids. Several of the scientific stories of SNBNCBS researchers have been highlighted in DST media cell, as well as covered in their news magazine. The faculties of SNBNCBS have earned several recognitions. Several of the Centre's faculties have been listed in the top 2% of the scientists list by Stanford University. A few notable mentions are: Prof. Anjan Barman has been awarded SPRINGER NATURE Editor of Distinction Award 2025. Dr. Suman Chakrabarty has been awarded the Dr. A.P.J. Abdul Kalam HPC Award. Dr. Pradip S. Pachfule has been selected as one of the Thieme Chemistry Journals Awardees for 2025. Profs. Saha-Dasgupta and Mahadevan have been invited to join the Journal of Solid State Chemistry as editorial board members.

I take pride in the Centre's continuing growth in excellence in research and human resource development. I am thankful to my colleagues, staff and students of the Centre for their untiring effort in maintaining the high standard. I also gratefully acknowledge the contributions of the members of the Governing body and academic advisory committee for their guidance and advice. I am sure the Centre will reach even higher heights in future.

Tanusri Saha-Dasgupta
Director
Satyendra Nath Bose National Centre for Basic Sciences

DEAN FACULTY

In the year 2024-25, the Centre is celebrating the 100 years of Bose Statistics. To celebrate this occasion, three major International Conferences were held during the January 2024, July 2024 ["Women in Quantum Science and Technologies"] and November 2024 ["Bose-Einstein Condensation, Superconductivity, Superfluidity and Quantum Magnetism"]. Besides it, the Centre was involved in several academic activities related to scientific collaborations, hosting various national conferences, workshops, schools, organizing outreach programmes, signing of MOU with various Universities / Institutes. Our faculty members continued to publish in top quality international journals and delivered lectures/seminars in national and international conferences/schools. In this fiscal year, the total number of publications is 254.

Throughout the year, the centre organized numerous seminars as **9** nos. of Bose Colloquium, **4** nos. Institute Colloquium and **2** nos. distinguished lectures, namely *17th C. K. Majumdar Memorial Lecture* by Dr. Rupak Majumdar, Scientific Director, Max Planck Inst. For Software Systems on 17.01.2025 and *6th S. Chandrasekhar Memorial Lecture* by Prof. Viatcheslav Mukhanov, Chair of Cosmology at the Ludwig-Maximilians-Universität in Munich on 06.02.2025.

Our ongoing collaborations with various institutions in India and abroad in terms of academic visits and exchange programmes including collaborations in conferences, as well as involvement in projects supported by extramural funding further bolstered the research activities of the Centre. During the F.Y. 2024-25, the total number of externally funded projects were **28** which includes **5** no of newly sanctioned projects in that financial year.

• Awards / Recognitions received by Faculty members (Alphabetically)

1. Prof. Anjan Barman, Senior Professor –

i. Outstanding Achievement Award' by Institute of Engineering and Management at CTMSE-2025 in 2025.

ii. Featured in top 2% most cited scientists' list released by Stanford University in 2024.

iii. Associate Editor of npj Spintronics (Springer-Nature).

iv. Editorial Board Member of Nanotechnology (IOP science).

v. Editorial Board Member of Pramana Journal of Physics (Springer).

2. **Dr. Arijit Haldar, Assistant Professor –**
   i. Guest Editor for IOP Science Journal of Physics: Condensed Matter Focus issue on the Centenary of Bose Statistics
3. **Dr. Avijit Chowdhury, Associate Professor –**
   i. Elected as Associate of the West Bengal Academy of Science & Technology (WAST), 2025
   ii. Achieved IOP Trusted Reviewer status in recognition of an exceptionally high level of peer review competency, IOP Publishing, 2025
4. **Dr. Barun Ghosh, Assistant Professor –**
   i. Affiliate Assistant Professor, Quantum Materials and Sensing Institute, Department of Physics, Northeastern University, Boston, USA
5. **Prof. Manik Pradhan, Senior Professor –**
   i. Research on Polarization-controlled Optics selected for inclusion in "Spotlight on Optics" by Optica, USA (2024)
   ii. Research Work on "Oxygen-isotope Exchange" has been highlighted by the Journal of Physical Chemistry Letters.
6. **Dr. Pradip S Pachfule, Associate Professor –**
   i. Thieme Chemistry Journals Award (February 2025): Awarded the 'Thieme Chemistry Journals Award' by the Editorial Boards of Synthesis, Synlett, Synfacts and the Open Access Journals Portfolio for 2025. Individuals in this category are promising early career professors, and each year, the Editorial Boards select a few individuals to receive free subscriptions to all three subscription journals as a gesture of encouragement.
   ii. Top 2% of the world's scientists (October 2024): The Stanford University database provides standardized information on citations, h-index and a composite indicator (c-score) to better understand and celebrate the contributions of scientists in different fields. The database classifies scientists from around the world into 22 scientific fields and 174 subfields using the standard Science-Metrix classification. The selection criteria are based on being in the top 100,000 scientists by c-score or having a percentile rank of 2% or above in a sub-field (data used from a Scopus updated to the end of the 2023 citation year).
7. **Prof. Priya Mahadevan, Senior Professor –**
   i. Editorial board member of Journal of Solid State Chemistry (2025-)
   ii. Editorial board member of Journal of Magnetism and Magnetic Materials (2021-2025).
8. **Dr. Ramkrishna Das, Associate Professor –**
   i. Research paper titled "Classification of Galactic Wolf Rayet Stars using Supervised Machine Learning methods" was selected as the 'Outstanding Paper' of the 7th Regional Science and Technology Congress, January 2025, Department of Science & technology and Biotechnology, Government of West Bengal.
9. **Prof. Ranjit Biswas, Senior Professor –**
   i. Elected Fellow, National Academy of Science (Allahabad), India (2024).
10. **Dr. Saquib Shamim, Assistant Professor –**
    i. Selected for the Early Career Advisory Board of the journal Physical Review B by the American Physical Society
11. **Prof. Suman Chakrabarty, Professor –**
    i. Recipient of Bronze Medal from The Chemical Research Society of India (CRSI), 2025
    ii. Recipient of Dr. APJ Abdul Kalam HPC & AI Award - 2025 under the category Researcher in R&D in HPC Applications in India
12. **Prof. Sunandan Gangopadhyay, Professor –**
    i. India Top Cited Paper Award 2024 Physics. This award recognized the work "Investigation of circular geodesics in a rotating charged black hole in the presence of perfect fluid dark matter" as one of the top 1% most cited papers in IOP Publishing's portfolio of journals from 2021-2023.
13. **Prof. Tanusri Saha Dasgupta, Senior Professor –**
    i. AwardedSera Bangali (Best Bengali) 2024 by ABP Star Ananda for her contribution to Research and Science and as Director of the Centre.
    ii. Invited to join the Journal of Solid-State Chemistry as an Editorial Board Member.
    iii. Ranked among the top 0.5% of scholars worldwide in the list made by scholars GPS.
    iv. Featured in the top 2% most cited scientists' list released by Stanford University in 2024.

v. Appointed as Head of the Computational Section of J phys Materials.

vi. Appointed as member of European Research Council Committee.

- **Faculty Members promoted during last year**

1. Dr. Tapas Baug from Assistant Professor to Associate Professor.
2. Dr. Avijit Chowdhury from Assistant Professor to Associate Professor.
3. Dr. Pradip S Pachfule from Assistant Professor to Associate Professor.

- **New Faculty members joined last year (including Inspire, Ramanujan etc.)**

1. Dr. Bhaskar Mukherjee, DST Inspire Faculty, Dept. of CMMP – 17.09.2024.
2. Dr. Jiban Kangsabanik, DST Inspire Faculty, Dept. of CMMP – 17.09.2024.
3. Dr. Barun Ghosh, Assistant Professor, Dept. of CMMP– 04.11.2024.

- **Faculty members left / superannuated last year (including Inspire, Ramanujan etc.)**

1. Prof. Kalyan Mandal, Sr. Professor, CMMP – 30.09.2024 (Superannuated).
2. Prof. AmitabhaLahiri, Sr. Professor, AHEP – 28.02.2025 (Superannuated).
3. Prof. Prabhat Mandal, Emeritus Professor, CMMP – 09.11.2024 (Termination of contract).
4. Prof. Rabin Banerjee, Raja Ramanna Fellow, AHEP – 02.05.2024 (Termination of Contract)

- **Total numbers of Regular / Inspire / Ramanujan / Visiting / Emeritus Facultyetc as on date [30.06.2025] -**

1. Regular Faculty - 32
2. Inspire Faculty – 2
3. Ramanujan Fellow – 1
4. Visiting Hon. Faculty–3
5. Adjunct Faculty –2

- **Total no of PDRA / RA / Project Scientists etc. as on date [30.06.2025] -**

1. PDRA (SNB Funded) – 19
2. RA / NPDF / SRA etc. –6
3. Bridge Fellow (SNB Funded) - 7

Anjan Barman
Dean (Faculty)

DEAN ACADEMIC PROGRAMME

Ranjit Biswas
Dean, Academic Programme

Manoranjan Kumar
IPhD Co-ordinator

Preparing young scientists for research is an important part of the mandate of the S. N. Bose National Centre for Basic Sciences. The vibrant research atmosphere which pervades the Centre is responsible for producing many distinguished alumni, working in research and training, and also in other fields.

Students who wish to do their PhD research at the Centre must complete their MSc with high scores in the relevant subject, qualify through either a National Eligibility Test such as CSIR-NET or similar, or pass JEST or GATE with a high rank, and then pass an interview taken at the Centre. Students who have provisionally qualified for the DST-INSPIRE Fellowship may also appear for the interview if they satisfy other required academic criteria, but must win the Fellowship and also qualify in a National Level Test in order to continue their PhD. Students who wish to join the Integrated PhD programme after their BSc degree have to qualify through JEST or NGPE and then an interview at the Centre.

In the academic year 2024-25, a total of **34** scholars joined the PhD programme of the Centre. Of these, **9** joined Astrophysics and High Energy Physics, **7** joined Chemical and Biological Sciences, **14** joined Condensed Matter and Materials Physics, and **4** joined Physics of Complex Systems. Of the total, **8** came from the Centre's own Integrated PhD programme. Apart from these, **11** students joined the Integrated PhD programme of the Centre.

The Centre has recently signed MoUs with CSIR-National Physical Laboratory (NPL),IIM Calcutta Innovation Park (IIMCIP).

A total of **29** students was awarded their PhD degrees during this academic year and another **16** submitted their PhD theses.

Several conferences were organized by the Centre, including the International Conference on Women in Quantum Science and Technology and International Conference on Bose-Einstein Condensation, Superconductivity, Superfluidity and Quantum Magnetism. These were the part of theBoseStat@100 series which celebrate the centenary of the epoch-making paper on photon statistics by Satyendra Nath Bose. The Centre also held many colloquia and seminars. The annual

students' conference of the Centre, BOSE FEST, was done with a resounding success.

Finally, it is a great pleasure to acknowledge enthusiastic cooperation provided by my faculty colleagues, the administrative staff members of the Academic section, and the students, in every official academic work of the Centre. Our achievements would not have been possible without their constant support and hard work.

COURSES TAUGHT IN 2024-2025

Integrated Ph.D. Programme in Physical Sciences (IPhD-Ph)

1st Semester:

- PHY 401, *Mathematical Methods*, Sunandan Gangopadhyay & Gautam Gangopadhyay;
- PHY 403, *Classical Dynamics*, Jaydeb Chakrabarti;
- PHY 405, *Quantum Mechanics I*, Amitabha Lahiri;
- PHY 407, *Computational Methods in Physics*, Punyabrata Pradhan &Arijit Haldar;
- PHY 491, *Basic Laboratory I*, Samir Kumar Pal & Soumen Mondal.

2nd Semester:

- PHY 402, *Electromagnetic Theory*, Amitabha Lahiri;
- PHY 404, *Statistical Mechanics*,Sakuntala Chatterjee &Urna Basu;
- PHY 406, *Quantum Mechanics II*, Amitabha Lahiri & Prosenjit Singha Deo;
- PHY 408, *Electronics & Instrumentation*, Atindra Nath Pal & Avijit Chowdhury;
- PHY 492, *Basic Laboratory II*, Avijit Chowdhury & Arijit Haldar.

3rd Semester:

- PHY 501, *Atomic & Molecular Physics*, Anjan Barman & Rajib Kumar Mitra;
- PHY 503, *Condensed Matter Physics*, Thirupathaiah Setti & Nitesh Kumar;
- PHY 505, *Advanced Quantum Mechanics & Applications*, Manoranjan Kumar & Sunandan Gangopadhyay;
- PHY 507, *Nuclear & Particle Physics*, Parijat Dey
- PHY 509, *Project Research II*, Faculty Supervisors.

4th Semester:

PHY 502, *Project Research III*, Faculty Supervisors;

- PHY 592, *Methods of Experimental Physics*, Nitesh Kumar, Pradip S Pachfule, Ramkrishna Das, Ali Hossain Khan & Atindra Nath Pal (Coordinator)
- PHY 504, *Astrophysics & Astronomy*, Archan S Majumdar & Soumen Mondal;
- PHY 512, *Quantum Field Theory*, Sunandan Gangopadhyay;
- PHY 522,*Correlated Electrons & Disorder*, Priya Mahadevan;
- PHY 524, *Quantum Information Theory*, ManikBanik.

Ph.D. Course Work Programme

- PHY 601, *Research Methodology*, Saquib Shamim & Sanjoy Choudhury;
- PHY 602, *Review of the Topical Research*, Faculty Supervisors;
- PHY/CB691, *Project Research*, Faculty Supervisors;
- PHY 603,*Condensed Matter Physics*, Thirupathaiah Setti & Nitesh Kumar;
- PHY 604,*Astrophysics*, Soumen Mondal & Ramkrishna Das;
- PHY 605,*Quantum Physics (Applications)*, Manoranjan Kumar & Sunandan Gangopadhyay;
- PHY 612,*Advanced Quantum Field Theory*, Sunandan Gangopadhyay;
- PHY 616, *Observational Techniques in Astronomy*, Ramkrishna Das & Tapas Baug;
- PHY 622,*Advanced Condensed Matter Physics II*, Priya Mahadevan;
- PHY 624, *Quantum Information Theory*, ManikBanik;
- PHY 628, *Mesoscopic Physics*, Prosenjit Singha Deo & Barun Ghosh;
- CB627, *Molecular Physics & Spectroscopy*, Rajib Kumar Mitra & Anjan Barman;
- CB 640, *Study of Biomacromolecules*, Suman Chakrabarty & Subhasis Haldar;
- CB 641, Surfaces & Interfaces, PradipS Pachfule& Ali Hossain Khan;

Note: Conducted partially in combination with IPhD Programme.

Ph.D. THESIS SUBMITTED

1. ***Structural, Physical, Electronic Properties Studies on Kagome Lattice Systems,*** Achintya Low, Supervisor: ThirupathaiahSetti, in the University of Calcutta, in April, 2024
2. ***Role of Structure in Magnetic and Topological Transitions***, Prasun Boyal, Supervisor: PriyaMahadevan, in the University of Calcutta, in July, 2024

3. ***Investigation Of Electronic Transport In Topological And Correlated Materials***, Rafiqul Alam, Supervisor: Atindra Nath Pal, in the University of Calcutta, in July, 2024
4. ***Some Studies On The Conformational Stability, Hydration Dynamics And Activity Of Biomolecules In Presence Of Co-Solutes***, Ria Saha, Supervisor: Rajib Kumar Mitra, in the University of Calcutta, in July, 2024
5. ***Some Studies On Exact Solutions Of Models In Noncommutative Spaces***, Manjari Dutta, Supervisor: SunandanGangopadhyay, in the University of Calcutta, in August, 2024
6. ***Understanding the Structural and Dynamical Complexities of Neat and Multi-component Media***, Narayan Chandra Maity, Supervisor: Ranjit Biswas, in the JadavpurUniversity, in August, 2024
7. ***Ultrafast Spin Dynamics in Advanced Magnetic Structures for Applications in Spintronics***, Sudipta Chatterjee, Supervisor: Soma Dutta, in the University of Calcutta, in September, 2024
8. ***Spin Dynamics of Ferromagnetic Thin Films, Heterostructures, and Nanostructures***, Sreya Pal, Supervisor: Anjan Barman, in the University of Calcutta, in November, 2024
9. ***Study Of Quantum Resources To Devise Advanced Communication Protocols***, Ram Krishna Patra, Supervisor: ManikBanik, in the Presidency University, in December, 2024
10. ***A Study On Various Discrimination Tasks And Their Implications In Quantum Information Processing***, Samrat Sen, Supervisor: ManikBanik, in the PresidencyUniversity, in December, 2024
11. ***First-Principles Study of Emergent and Technologically Important Materials***, Samir Rom, Supervisor: TanusriSahaDasgupta, in the University of Calcutta, in December, 2024
12. ***Multi-wavelength Study of Wolf Rayet Stars***, SubhajitKar, Supervisor: Ramkrishna Das, in the University of Calcutta, in January, 2025
13. ***Synthesis, Structural, Electronic, And Magnetic Properties Studies of Two-Dimensional Magnetic Materials***, ShubhamPurwar, Supervisor: ThirupathaiahSetti, in the University of Calcutta, in January, 2025
14. ***Microscopic Studies On The Response Of Bio-Molecular Systems To Perturbations***, Anirban Paul, Supervisor: JaydebChakrabarti, in the University of Calcutta, in February, 2025
15. ***Transport and Spectroscopic Studies of Layered Magnetic and Low-Dimensional Superconducting Materials***, Riju Pal, Supervisor: AtindraNath Pal, in the University of Calcutta, in March, 2025

Ph.D. AWARD RECEIVED

1. ***Investigation on transport and magneto-transport properties of 3dtransition metal based compounds***, Sudipta Chatterjee, Supervisors: Kalyan Mandal & Barnali Ghosh (Saha), in the University of Calcutta, in April, 2024
2. ***Spectroscopic Studies On Some Biologically Important Systems***, SumanaPyne, Supervisor: Rajib Kumar Mitra, in the University of Calcutta, in April, 2024
3. ***Investigation of geodesics and shadows of black hole spacetimes***, Anish Das, Supervisor: SunandanGangopadhyay, in the University of Calcutta, in April, 2024
4. ***Ultrafast Spin Dynamics in Magnetic Thin Films and Heterostructures***, Surya Narayan Panda, Supervisor: Anjan Barman, in the University of Calcutta, in May, 2024
5. ***Studies on Biochemical and Molecular Aspects of Theranostic Redox Modulatory Nanomaterials in Preclinical Disease Model***, Susmita Mondal, Supervisor: Samir Kumar Pal, in University of Calcutta, in May, 2024
6. ***Investigation of Hybrid Opto-electronic Devices Based on Graphene-Transition Metal Dichalcogenides Heterostructures***, Shubhrasish Mukherjee, Supervisosrs: Samit Kumar Ray & Atindra Nath Pal, in the University of Calcutta, in May, 2024
7. ***Structural, Physical, and Electronic Properties Studies of Topological Materials***, Susmita Changdar, Supervisor: Thirupathaiah Setti, in the University of Calcutta, in May, 2024
8. ***Investigation of Magnetoelectric Properties in Transition Metal Oxides and Their Applications***, SwarnaliHait, Supervisor: Kalyan Mandal, in the University of Calcutta, in June, 2024
9. ***Bacterial chemotaxis in a noisy environment***, Shobhan Dev Mandal, Supervisor: Sakuntala Chatterjee, in the University of Calcutta, in June, 2024
10. ***Ultrafast Spin Dynamics in Continuous and Confined Magnetic Thin Film***, Amrit Kumar Mondal, Supervisor: Anjan Barman, in the University of Calcutta, in Mid, 2024

11. ***Femto and Picosecond Spin Dynamics of Low Dimensional Magnetic Structures***, Koustuv Dutta, Supervisor: Anjan Barman, in the University of Calcutta, in Mid, 2024
12. ***A Study Of Cosmology With Gravitational Waves And Primordial Black Holes***, Arnab Sarkar, Supervisors: Archan S Majumdar& Rajesh Kumble Nayak (IISER-K), in the University of Calcutta, in July, 2024
13. ***Structure and dynamics of modulated colloids: Theoretical studies***, Suravi Pal, Supervisor: Jaydeb Chakrabarti, in the University of Calcutta, in July, 2024
14. ***Studies Of Hydrodynamics And Fluctuations In Sandpiles***, Anirban Mukherjee, Supervisor: Punyabrata Pradhan, in the University of Calcutta, in October, 2024
15. ***Coherent And Incoherent Optical Source Based Cavity Enhanced Absorption Spectroscopy For Trace Molecule Sensing***, Ardhendu Pal, Supervisor: Manik Pradhan, in the University of Calcutta, in October, 2024
16. ***Thermodynamic Aspects of Black Holes***, Neeraj Kumar, Supervisors: SunandanGangopadhyay, in the University of Calcutta, in November, 2024
17. ***Magnetic and Microwave Properties of Transitional Metal Oxide BasedNanostructures***, AnupamGorai, Supervisor: Barnali Ghosh (Saha), in the University of Calcutta, in December, 2024
18. ***Quantum Phases in Quasi-One Dimensional Frustrated Spin Systems***, SkSaniurRahaman, Supervisor: Manoranjan Kumar, in the University of Calcutta, in December, 2024
19. ***Nonequilibrium Thermodynamic Signatures of Some Complex Dynamical System***, Premashis Kumar, Supervisor: Gautam Gangopadhyay, in the University of Calcutta, in December, 2024
20. ***Investigation of GHz and THz Frequency Dynamics of Thin Films and Micro- and Nanostructures***, Pratap Kumar Pal, Supervisor: Anjan Barman, in the JadavpurUniversity, in December, 2024
21. ***Studies Of Fluctuations And Transport In Active Matter Systems***, Tanmoy Chakraborty, Supervisor: Punyabrata Pradhan, in the University of Calcutta, in January, 2025
22. ***Investigating Electronic and Structural Properties of Hybrid Materials***, DebayanMondal, Supervisor: PriyaMahadevan, in the University of Calcutta, in January, 2025
23. ***Quasistatic and Ultrafast Magnetization Dynamics in FerromagneticNanostructures***, Arundhati Adhikari, Supervisor: Anjan Barman, in the University of Calcutta, in January, 2025
24. ***Duality In Lattice Gauge Theory***, AtulRathor, Supervisor: Manu Mathur, in University of Calcutta, in February. 2025
25. ***Magnetic and Transport Properties in Correlated Topological Materials: A first-principles study***, Jyotirmoy Sau, Supervisor: Manoranjan Kumar, in the University of Calcutta, in February, 2025
26. ***Spin Wave Dynamics In Ferromagnetic Nanostructures***, Sudip Majumder, Supervisors: Anjan Barman & Rajib Kumar Mitra, in the University of Calcutta, in February, 2025
27. ***Scattering phase-shift of electrons & its applications in mesoscopic systems***, Kanchan Meena, Supervisor: Prosenjit Singha Deo, in the University of Calcutta, in February, 2025
28. ***Photophysical Studies On Hybrid Nanomaterials For Manifold Applications***, Nivedita Pan, Supervisor: Samir Kumar Pal, in the University of Calcutta, in March, 2025
29. ***Study of Novae***, Gesesew Reta Habtie, Supervisor: Ramkrishna Das, in the University of Calcutta, in March, 2025

PhD and Integrated PhD Research Scholars of the Centre

(values within brackets indicate source of external funding)
*(names marked with * indicates scholars under Integrated PhD programme)*

NAME	DESIGNATION	BATCH (JRF)	SUPERVISOR	DATE OF LEAVING
Samir Rom *	SRF	2017-18	Tanusri Saha-Dasgupta	31/01/2025
Achintya Low *	SRF	2018-19	Thirupathaiah Setti	
Deepsikha Das	SRF	2018-19	Punyabrata Pradhan & Sakuntala Chatterjee	31/07/2024
Jyotirmoy Sau (UGC)	SRF	2018-19	Manoranjan Kumar	20/06/2024
Monalisa Chatterjee (INSPIRE)	SRF	2018-19	Manoranjan Kumar	24/06/2024
Narayan Chandra Maity (CSIR)	SRF	2018-19	Ranjit Biswas	31/07/2024
Prasun Boyal (CSIR)	SRF	2018-19	Priya Mahadevan	26/04/2024
Pratap Kumar Pal (CSIR)	SRF	2018-19	Anjan Barman	12/07/2024
Sayan Routh *	SRF	2018-19	Thirupathaiah Setti	30/04/2024
Tanmoy Chakraborty (CSIR)	SRF	2018-19	Punyabrata Pradhan	26/04/2024
Abhinandan Das	SRF	2019-20	Suman Chakrabarty	31/07/2025
Amrita Mondal	SRF	2019-20	Ranjit Biswas	
Anirban Paul (CSIR)	SRF	2019-20	Jaydeb Chakrabarti	26/02/2025
Ardhendu Pal	SRF	2019-20	Manik Pradhan	31/07/2024
Arun Kumar Das	SRF	2019-20	Archan S. Majumdar	
Gesesew Reta Habtie (TWAS-BOSE)	SRF	2019-20	Ramkrishna Das	08-12-2024
Kanchan Meena (CSIR)	SRF	2019-20	Prosenjit Singha Deo	31/07/2024
Krishnendu Patra	SRF	2019-20	Priya Mahadevan	
Krishnendu Sinha	SRF	2019-20	Suman Chakraborty	30/07/2024
Manjari Dutta *	SRF	2019-20	Sunanadan Gangopadhyay	31/07/2024
Manodip Routh	SRF	2019-20	Manoranjan Kumar	
Nivedita Pan *	SRF	2019-20	Samir Kumar Pal	31/07/2024
Ria Saha	SRF	2019-20	Rajib Kumar Mitra	31/07/2024
Riju Pal *	SRF	2019-20	Atindra Nath Pal	31/03/2024
Shubham Purwar *	SRF	2019-20	Thirupathaiah Setti	31/01/2025
Soma Dutta	SRF	2019-20	Anjan Barman	31/07/2024
Sreya Pal (CSIR)	SRF	2019-20	Anjan Barman	31/07/2024
Subhajit Kar	SRF	2019-20	Ramkrishna Das	31/01/2025
Subhankar Bera	SRF	2019-20	Archan S. Majumdar	
Aishwaryo Ghosh (INSPIRE)	SRF	2020-21	Tanusri Saha-Dasgupta	
Animesh Hazra *	SRF	2020-21	Punyabrata Pradhan	
Anirban Roychowdury *	SRF	2020-21	Sunandan Gangopadhyay	
Ariful Hoque (CSIR)	SRF	2020-21	Tapas Baug	
Arnab Chakraborty *	SRF	2020-21	Amitabha Lahiri	
Avik Sasmal *	SRF	2020-21	Jaydeb Chakrabarti	
Chandradip Khamrai (CSIR)	SRF	2020-21	Sakuntala Chatterjee	

NAME	DESIGNATION	BATCH (JRF)	SUPERVISOR	DATE OF LEAVING
Indrajit Ghose	SRF	2020-21	Amitabha Lahiri	
Ishita Jana *	SRF	2020-21	Kalyan Mandal	
Koushik Pradhan	SRF	2020-21	Tanusri Saha-Dasgupta	
Manoj Gupta (CSIR)	SRF	2020-21	Tanusri Saha-Dasgupta	
Rajdeep Biswas *	SRF	2020-21	Tanusri Saha-Dasgupta	
Rajib Kumbhakar (INSPIRE)	SRF	2020-21	Soumen Mondal	
Ramesh Pramanik (CSIR)	SRF	2020-21	Sakuntala Chatterjee	
Rik Niranjan Mukherjee (INSPIRE)	SRF	2020-21	Ranjit Biswas & Pradip K Ghorai (IISER-K)	
Ritwick Sarkar (CSIR)	SRF	2020-21	Urna Basu	
Riya Barick	SRF	2020-21	Amitabha Lahiri	
Sanuja Kumar Khuntia (UGC)	SRF	2020-21	Priya Mahadevan	
Shashank Shekhar Pandey (CSIR)	SRF	2020-21	Archan S. Majumdar	
Shinjini Paul (INSPIRE)	SRF	2020-21	Priya Mahadevan	
Soham Saha *	SRF	2020-21	Kalyan Mandal	
Soumen Mandal *	SRF	2020-21	Manik Pradhan	
Suchetana Mukhopadhyay (INSPIRE)	SRF	2020-21	Anjan Barman & Chiranjit Mitra (IISER-K)	
Sudipta Mitra	SRF	2020-21	Ranjit Biswas	
Ajay Sharma *	SRF	2021-22	Sakuntala Chatterjee and Debanjan Bose	
Arnab Mukherjee	SRF	2021-22	Archan S. Majumdar	
Arnab Paul *	SRF	2021-22	Tanusri Saha-Dasgupta	
Banik Rai *	SRF	2021-22	Nitesh Kumar	
Bikash Chandra Mishra (CSIR)	SRF	2021-22	Pradip S. Pachfule	
Bivas Mallick (INSPIRE)	SRF	2021-22	Archan S. Majumdar	
Chandan Kumar	SRF	2021-22	Anjan Barman	
Dibyendu Maity *	SRF	2021-22	Amitabha Lahiri	
J Sridhar Mohanty *	SRF	2021-22	Kalyan Mandal	
Jayarshi Bhattacharya *	SRF	2021-22	Gautam Gangopadhyay	
Sagar Kumar Maity *	SRF	2021-22	Amitabha Lahiri	
Saheli Mukherjee	SRF	2021-22	Archan S. Majumdar	
Saikat Mitra	SRF	2021-22	Avijit Chowdhury and Barnali Ghosh (Saha)	26/12/2024
Sayan Ghosh (INSPIRE)	SRF	2021-22	Manoranjan Kumar	
Shivam Jani	SRF	2021-22	Priya Mahadevan	
Soham Sen *	SRF	2021-22	Sunandan Gangopadhyay	
Soumya Ghorai (UGC)	SRF	2021-22	Thirupathaiah Setti	
Soumyadipta Chakraborty	SRF	2021-22	Manik Pradhan	
Sourabh Saha (INSPIRE)	SRF	2021-22	Manoranjan Kumar	

NAME	DESIGNATION	BATCH (JRF)	SUPERVISOR	DATE OF LEAVING
Sourav Sarkar (INSPIRE)	SRF	2021-22	Kalyan Mandal	
Aman Das (UGC)	SRF	2022-23	Tapas Baug	
Ananya Chakraborty *	SRF	2022-23	Manik Banik	
Anusree Sen	SRF	2022-23	Rajib Kumar Mitra and Jaydeb Chakrabarti	
Anutosh Biswas	SRF	2022-23	Manoranjan Kumar and Tanusri Saha-Dasgupta	
Anyesh Saraswati	SRF	2022-23	Nitesh Kumar	
Aritra Marick (UGC)	SRF	2022-23	Rajib Kumar Mitra	
Bidhan Kumbhakar (UGC)	SRF	2022-23	Pradip S. Pachfule	
Bikram Baghira (UGC)	SRF	2022-23	Anjan Barman	
Dayal Das (UGC)	SRF	2022-23	Atindra Nath Pal	
Dorothy Museo Mwanzia (TWAS-BOSE)	SRF	2022-23	Soumen Mondal	
Indrayani Patra (UGC)	SRF	2022-23	Manik Pradhan	
Madhurita Das (INSPIRE)	SRF	2022-23	Priya Mahadevan	
Muhammad Usman Shehu (TWAS-BOSE)	SRF	2022-23	Tapas Baug	
Mukul Biswas (UGC)	SRF	2022-23	Avijit Chowdhury	
Pallabi Roy	SRF	2022-23	Sakuntala Chatterjee and Gautam Gangopadhyay	
Pritam Roy *	SRF	2022-23	Archan S. Majumdar	
Prosanta Sarkar (UGC)	SRF	2022-23	Tanusri Saha-Dasgupta	
Rajesh Jana	SRF	2022-23	Avijit Chowdhury	
Sabuj Mandal	SRF	2022-23	Jaydeb Chakrabarti	
Sahil Gopalkrishna Naik (CSIR)	SRF	2022-23	Manik Banik	
Shah Imtajul Haque (UGC)	SRF	2022-23	Rajib Kumar Mitra	
Sreyan Bhowmick	SRF	2022-23	Suman Chakrabarty	
Subhajit Mondal (UGC)	SRF	2022-23	Saquib Shamim	
Subhankar De (INSPIRE)	SRF	2022-23	Atindra Nath Pal	
Sudip Chakrabarty *	SRF	2022-23	Archan S. Majumdar	
Sutanu Mukhopadhyay (INSPIRE)	SRF	2022-23	Suman Chakrabarty	
Swapnamoy Pramanik (UGC)	SRF	2022-23	Avijit Chowdhury	
Sudip Pramanik	JRF	2022-23	Soumen Mondal	30/06/2024
Anish Chaudhuri *	JRF	2023-24	Arijit Haldar	
Anupam Barik (UGC)	JRF	2023-24	Thirupathaiah Setti	
Anuradha Sett	JRF	2023-24	Manik Pradhan	
Asesh Bera	JRF	2023-24	Rajib Kumar Mitra	
Avanti Chakraborty (CSIR)	JRF	2023-24	Pradip S. Pachfule	
Avirup Chakraborty	JRF	2023-24	Soumen Mondal	

NAME	DESIGNATION	BATCH (JRF)	SUPERVISOR	DATE OF LEAVING
Debashruti Maity	JRF	2023-24	Shubhasis Haldar	
Debojit Sen	JRF	2023-24	Sakuntala Chatterjee	
Debojyoti Chowdhury (DBT)	JRF	2023-24	Shubhasis Haldar	31/03/2025
Debraj Dutta *	JRF	2023-24	Urna Basu	
Dhritisundar Paramanik (UGC)	JRF	2023-24	Atindra Nath Pal	
Dinesh Chandra Dey	JRF	2023-24	Manik Pradhan	
Kakan Deb	JRF	2023-24	Nitesh Kumar	
Maitreyee Barman (UGC)	JRF	2023-24	Priya Mahadevan	
Modhumita Sariket	JRF	2023-24	Nitesh Kumar	
Najrul Islam (UGC)	JRF	2023-24	Saquib Shamim	
Rima Ghosh (UGC)	JRF	2023-24	Tanusri Saha Dasgupta and Arijit Haldar	10/02/2025
Sayan Mathur (UGC)	JRF	2023-24	Anjan Barman	
Sayanti Mondal	JRF	2023-24	Anjan Barman	
Sayari Bhattacharya *	JRF	2023-24	Suman Chakrabarty	
Souvik Paul *	JRF	2023-24	Sunandan Gangopadhyay	
Subhadeep Mukherjee (CSIR)	JRF	2023-24	Archan S. Majumdar	
Supriti Dutta	JRF	2023-24	Pradip S. Pachfule	
Suranjana Chakraborty (CSIR)	SRF	2024-25	Anjan Barman and Anup Ghosh	
Aniket Samanta	JRF	2024-25	Punyabrata Pradhan	
Anita Ratha	JRF	2024-25	Priya Mahadevan	
Ankit Dey (UGC)	JRF	2024-25	Ramkrishna Das	14/02/2025
Antara Dey	JRF	2024-25	Manoranjan Kumar	
Anurag Paul	JRF	2024-25	Priya Mahadevan	
Arkadeb Ghosh	JRF	2024-25	Prosenjit Singha Deo and Manorajan Kumar	28/03/2025
Arpita Jana *	JRF	2024-25	Sunandan Gangopadhyay	
Arup Biswas (UGC)	JRF	2024-25	Manik Pradhan	
Ayan Jana	JRF	2024-25	Manoranjan Kumar	
Dipyendu Dhar *	JRF	2024-25	Prijat Dey	
Eveningstar Ryntathiang (UGC)	JRF	2024-25	Ranjit Biswas	28/02/2025
Gopinath Guin (CSIR)	JRF	2024-25	Sunandan Gangopadhyay	
Jayashree Karmakar (UGC)	JRF	2024-25	Manik Banik	
Mampi Maji	JRF	2024-25	Rajib Kumar Mitra	10/02/2025
Mohana Roy (UGC)	JRF	2024-25	Atindra Nath Pal	
Naglaa Ati fAlhadi Rahma (TWAS-BOSE)	JRF	2024-25	Samir Kumar Pal	
Najrul Ansary *	JRF	2024-25	Anjan Barman	
Nilesh Bauri (UGC)	JRF	2024-25	Saquib Shamim	
Partha Das (UGC)	JRF	2024-25	Rajib Kumar Mitra	

NAME	DESIGNATION	BATCH (JRF)	SUPERVISOR	DATE OF LEAVING
Premananda Chatterjee	JRF	2024-25	Atindra Nath Pal	
Rianita Mondal	JRF	2024-25	Shubhasis Haldar	
Rudra Prosad Sarkar *	JRF	2024-25	Ramkrishna Das	
Sachin Paul (CSIR)	JRF	2024-25	Avijit Chowdhury	
Sagnik Bhattacharya	JRF	2024-25	Rajib Kumar Mitra	
Sahanawaj Akhtar	JRF	2024-25	Arijit Haldar	
Sakshi Chaudhary *	JRF	2024-25	Ramkrishna Das	
Shaheerah Shahid *	JRF	2024-25	Suman Chakraborty	
Soumava Mondal (CSIR)	JRF	2024-25	Anjan Barman	
Sourav Das	JRF	2024-25	Tanusri Saha-Dasgupta	
Sourav Mandal *	JRF	2024-25	Anjan Barman	
Souvik Chowdhury	JRF	2024-25	Shubhasis Haldar	17/10/2024
Subhradeep Chakravarty (CSIR)	JRF	2024-25	Shubhasis Haldar	
Susmita Das(UGC)	JRF	2024-25	Anjan Barman	
Sutirtha Banerjee	JRF	2024-25	Thirupathaiah Setti	
Swastik Sardar (UGC)	JRF	2024-25	Ramkrishna Das	
Trisha Mishra *	JRF	2024-25	Ramkrishna Das	
Tunir Kundu	JRF	2024-25	Tapas Baug	

Research Scholars of under Extramural Projects

NAME	DESIGNATION	BATCH	SUPERVISOR	DATE OF LEAVING
Ria Ghosh	SRF	2021-22	Samir Kumar Pal	31/05/2024
Archisman Sinha	Project Assistant	2023-24	Pradip S. Pachfule	20/07/2024
Sweta Ghosh	JRF	2023-24	Tanusri Saha-Dasgupta	04/01/2025
Rafiqul Alam	SRF	2024-25	Atindra Nath Pal	19/11/2024
Arghyadip Ghosh	Project Assistant	2024-25	Tanusri Saha-Dasgupta	30/11/2024

Integrated PhD Scholars of the Centre

NAME	DESIGNATION	BATCH	DATE OF LEAVING
Keshav Saw	IPhD Student	2022-23	23/07/2024
Rakesh Ghosh	IPhD Student	2022-23	28/07/2024
Sumit Yadav	IPhD Student	2022-23	22/07/2024
Anol Bandyopadhyay	IPhD Student	2023-24	
Bipasa Hazra	IPhD Student	2023-24	
Dhananjoy Ghosh	IPhD Student	2023-24	
Indrajit Banerjee	IPhD Student	2023-24	
Kapil Gope	IPhD Student	2023-24	
Koushik Das	IPhD Student	2023-24	

NAME	DESIGNATION	BATCH	DATE OF LEAVING
Md Sanowaz Molla	IPhD Student	2023-24	
Ritam Mahanta	IPhD Student	2023-24	
Sauptik Sadhukhan	IPhD Student	2023-24	
Shibcharan Mahato	IPhD Student	2023-24	
Subhanker Dutta	IPhD Student	2023-24	
Subhransu Dey	IPhD Student	2023-24	
Sudip Ghorai	IPhD Student	2023-24	
Thansingh Jankawat	IPhD Student	2023-24	
Amrit Sagar Kar	IPhD Student	2024-25	
Anurag Agarwal	IPhD Student	2024-25	
Debdita Ghosh	IPhD Student	2024-25	
Kushal Mondal	IPhD Student	2024-25	
Partha Sarathi De	IPhD Student	2024-25	
Purnendu Khamrui	IPhD Student	2024-25	
Rishav Chakraborty	IPhD Student	2024-25	
Shib Shankar Utthasini	IPhD Student	2024-25	
Sreedevi Ajikumar	IPhD Student	2024-25	
Tamanna Khanna	IPhD Student	2024-25	
Tuhin Chatterjee	IPhD Student	2024-25	

Part Time PhD Scholars of the Centre

NAME	DESIGNATION
Soumita Chakraborty, under Prof. Soumen Mondal	Research Scholar (Part Time)

Ranjit Biswas
Dean, Academic Programme

Manoranjan Kumar
IPhD Co-ordinator

MAJOR EVENTS

International Conference on "Women in Quantum Science and Technologies" under BoseStat@100 held at the Centre during 17th to 19th July, 2024

The Convener of the international conference was Dr. Saquib Shamim, Assistant Professor, Condensed Matter and Materials Physics Department and Co-Convener was Dr. Parijat Dey, Assistant Professor, Astrophysics and High Energy Physics Department.

This was the second international conference to celebrate the centenary of the colossal work of Prof. Satyendra Nath Bose. Besides his scientific attributes, Prof. Bose had a progressive min compared to his time. In particular, he was sensitive to issues like gender diversity. Thus, in this centenary year of Bose-Einstein Statistics, it becomes relevant to celebrate the contribution of women in quantum science. This conference focused the challenges and achievements of the women scientists and their path-breaking work in modern day quantum science. The three-day conference featured several talks by role-model speakers who expressed their scientific journeys, challenges faced and career/path achievements along with their research work.

International Conference on "Bose-Einstein Condensation, Superconductivity, Superfluidity and Quantum Magnetism"

A five-days International Conference on "Bose-Einstein Condensation, Superconductivity, Superfluidity and Quantum Magnetism" was held during 12.11.2024 to 16.11.2024 at Biswa Bangla Convention Centre, Kolkata The Convener of the conference was Prof. Amitabha Lahiri, Senior Professor and Dean (Academic Programme) and Co-convener was Dr. Arijit Haldar, Assistant Professor of the Centre. The conference was a momentous event organized under BoseStat@100 by S.N. Bose National Centre for Basic Sciences, Kolkata to celebrate the centenary of the colossal work of Prof. Satyendranath Bose. The programme consisted of organizing three International Conferences and several outreach programmes throughout the year 2024. Out of these three conferences the third one was "Bose-Einstein Condensation, Superconductivity, Superfluidity and Quantum Magnetism". The conference contained plenary and invited talks, as well as contributed talks/posters on Bose-Einstein Condensation, Superconductivity, Superfluidity and Quantum Magnetism. The lectures covered topics such as (but not restricted to) cold atomic physics, frustrated spin systems, phase transitions, critical phenomena, magnetism, superconductivity, applications of Bose statistics, topological phases etc.

PARAMRUDRA BOSON National Supercomputing Facility (NSF)

PARAM Rudra, a cutting-edge supercomputing facility, was established under Phase-3 of the National Supercomputing Mission's build approach. Hon'ble Prime Minister Shri Narendra Modi launched three new supercomputers named Param Rudra on September 26, 2024. The supercomputing facility was developed in India and funded by the National super-computing Mission (NSM) under the Ministry of Electronics & Information Technology and the Department of Science and Technology, Government of India. This includes a 838 TFLOPS system at the S. N. Bose National Centre for Basic Sciences (SNBNCBS) in Kolkata, designed and commissioned by C-DAC to meet the computational needs of the Centre and various research and engineering institutes in the region.

Inauguration of Astronomical Observatory

Inaugural ceremony of Centre's Astronomical Observatory site at Sidho-Kanho-Birsa University (SKBU) campus, Purulia was held on 08.01.2025 at 4.00 p.m. where Director, SNBNCBS, dignitaries from Department of Science and Technology, Govt. of India, Chairman and Members of Governing Body of the Centre, members of Finance Committee and ARPAC participated along with Registrar, SNBNCBS, faculty members of the Centre and scholars of SKBU, Purulia.

EXTENDED VISITORS AND LINKAGE PROGRAMME

General Activities

Foundation Day

On occasion of celebration of 38th Foundation Day, a captivating scientific talk and a heartwarming musical program were organized on 13th June 2024. About 150 number of strong audience, consisting of professors, research scholars, students and administrative staff, had gathered at the Silver Jubilee Hall of the Centre in this event. Prof. B. N. Jagatap, Chairman of the Governing Body of the Centre reminded all present that the United Nations has declared 2025 as the year of Quantum Technology and he hoped that S. N. Bose Centre would play a lead role in taking India's Quantum Mission forward.

Continuing on this spirit, Dr. Rajamani Vijayraghavan, head of the QuMac (Quantum Measurement and Control) Lab at TIFR, Mumbai gave his hour long captivating talk on "How to build a quantum computer?" by outlining in very simple terms, the basic difference between classical computers and quantum computers. In the domain of quantum hardware, experiments are being carried out with trapped ions, electrons in a magnetic field, 'cold atoms' and topological qubits. He elaborated the QuMac Lab at TIFR is working with superconducting qubits. Nano step by nano step, they are progressing towards developing a fully functional quantum computer in line with National Quantum Mission of India.

On this gracious occasion, Best Teachers, IPhD Topper, Best Administrative Staff were awarded. Following this, Debayan Majumdar from Santiniketan began his rendition of Raag Bhim Palashi on the esraj, carrying forward the musical legacy of Prof. Satyendra Nath Bose. The grand finale of the evening was a program on scientific ideas in Tagore's songs by Shohochori group. It was a program rich in intellectual stimulation and aesthetic appeal, leaving the audience with rich fodder to ruminate on.

Interactive Session on Career Opportunities

The talk on "Ongoing research at IBM and Career Opportunities" held on 12th August 2024 at Silver Jubilee Hall, SNBNCBS. Dr. Ritajit Majumdar and Dr. Mostafizur Rahaman, Research Scientists of IBM India Research Lab have delivered lectures on quantum computation at IBM and interacted with scholars of the Centre.

International Women's Day

On 8th March 2025, the Centre celebrated International Women's Day at the Silver Jubilee Hall, honoring the remarkable contributions of women in science and administration. The event was a vibrant platform for inspiring stories, meaningful discussions, and a commitment to breaking barriers.

Women in Science :

Eminent panelists Dr. Dibyashree Chakraborti, Dr. Rubina Ghosh, Ms. Dorothy Museo Mwanzia, and Ms. Naglaa Atif Alhadi Rahma shared their journeys, highlighting the importance of family support and overcoming gender biases. Their stories celebrated the trailblazers shaping the future of research and innovation.

Women in Administration :

Panelists Ms. Shohini Majumder, Ms. Nibedita Konar, Ms. Urmi Chakrabarty, and Ms. Mitali Bose emphasized the need to break stereotypes and evaluate women based on their achievements, not superficial criteria. Many credited their mothers and families as their biggest inspirations.

The event was graced by a message from Prof. Tanusri Saha-Dasgupta (Director) and expertly moderated by Prof. Ranjit Biswas and Prof. Manoranjan Kumar. With enthusiastic participation and thought-provoking discussions, the celebration was truly empowering!

Report on Summer Research Programme

Name of the Student	Project Guide	University / Institute
Abha Mahato	Arijit Haldar	Delhi Technological University
Aitihya Mandal	Urna Basu	IIT Madras
Alipriya Chatterjee	Thirupathaiah Setti	IISER Berhampur
Aniket Ghosh	Parijat Dey	IIT Gandhinagar
Arijit Maji	Tanusri Saha-Dasgupta	IIT Bombay
Arivazhagan	Priya Mahadevan	IISER Tirupati
Arka Ghosh	Saquib Shamim	Jadavpur University
Atreyee Barman	Avijit Chowdhury	IISER Berhampur
Ayshi Chattaraj	Tapas Baug	NIT Rourkela
Bhaskar Mondal	Ramkrishna Das	IIT Kharagpur
Debarshi Mukherjee	Punyabrata Pradhan	IISER Berhampur
Debojyoti Dey	Rajib Kumar Mitra	IIT Kanpur
Dev Goyal	Saquib Shamim	IIT Delhi
Esha Paul	Suman Chakrabarty	NIT Rourkela
Hrithik Biswas	AtindraNath Pal	IIT Kanpur
Mahibur Rahman	Ranjit Biswas	Gauhati University
Meghasree Sen	Anjan Barman	Jadavpur University
Nirmalendu Mukherjee	Shubhasis Haldar	Rajiv Gandhi Centre for Biotechnology
Omkarnath Dogra	Avijit Chowdhury	NIT Rourkela
Pragya Agrahari	Ranjit Biswas	IISER Thiruvananthapuram
Pranjal Sarkar	Soumen Mondal	UM-DAE Centre of Excellence in Basic Science
Pritam Maity	Ali Hossain Khan	IIT Kanpur
Rwitacheta Sinha	Suman Chakrabarty	IISER Berhampur
Saswata Chatterjee	Parijat Dey	IIT Kanpur
Sathi Das	PriyaMahadevan	IIT Madras
Shreyansh Priyadarshi	Shubhasis Haldar	Ashoka University
Shreyash Bhattacharjee	Archan S Majumdar	IIT Delhi
Sneha Biswas	Ranjit Biswas	NIT Karnataka, Surathkal
Sonali Priyadarshini Swain	Pradip S Pachfule	NISER Bhubaneswar
Sreya Chatterjee	Urna Basu	RKMVERI Howrah
Subhajit Rana	Pradip S Pachfule	IIT Kanpur
Subham Pandey	Nitesh Kumar	IIT Madras
Swati Ghosh	Rajib Kumar Mitra	University of Calcutta
Tiyasha Khatua	Atindra Nath Pal	IIT Gandhinagar
Yuvraj Singh	Rabin Banerjee	Shiv Nadar Institution of Eminence

EXTENDED VISITOR AND LINKAGE PROGRAM (SCOLP): 2024-2025 [01.04.2024 – 31.03.2025]

Bose Fest

BOSE FEST 2025 – an annual celebration of science was held during 10th to 13th March 2025, filled with inspiring talks, thought-provoking discussions, and groundbreaking ideas, bringing together a community passionate about pushing the frontiers of scientific exploration. The inaugural session of Bose Fest 2025 started with lighting the lamp at Silver Jubilee Hall, SNBNCBS, and then a Welcome Address by the Director, Prof. Tanusri Saha-Dasgupta, Prof. Ranjit Biswas, Dean (Academic Programme) and Prof. Rajib Kumar Mitra, Dean (Administration and Resource Generation). The research scholars, faculty and staff members of the Centre celebrated the 'Bose Fest' with lots of scientific talks, research poster presentations, Photo Fest and finally, a cultural program. From the inauguration to the vibrant celebrations, the energy was truly unparalleled as we embarked on this journey of knowledge, innovation, and discovery.

Memorial Lectures

Type	Date	Speaker& Affiliation	Title
17th C. K. Memorial Lecture	17.01.2025	Rupak Majumdar Scientific Director, Max Planck Inst. For Software Systems	How to keep the Cloud Running: Systematic Concurrency Exploration for Distributed Services
6th S Chandrasekhar Memorial Lecture	06.02.2025	Viatcheslav Mukhanov Chair of Cosmology at the Ludwig-Maximilians Universität in Munich	The Quantum Universe

Seminar Type	Date	Speaker & Affiliation	Title
Bose Colloquium	02.05.2024	Tata Narasinga Rao Director, International Advanced Research Centre for Powder Metallurgy & New Materials (ARCI), Hyderabad	**Translational Materials Research: Crossing the Valley of Death**
	31.05.2024	Partha Pratim Chakrabarti Former Director, Indian Institute of Technology Kharagpur. He is a member of the ACM and a senior member of the IEEE.	**Artificial Intelligence and Machine Learning - Ushering a New Era in Science and Technology**
	03.06.2024	Subhrangshu Sanyal CEO - IIM Calcutta Innovation Park	**Technology Commercialization**
	26.07.2024	Satish Ogale Director at Research Institute for Sustainable Energy, TCG-CREST, Salt Lake, Kolkata and Adjunct Faculty, IISER, Pune	**Powering the New World: The Pursuit of Sustainable and Affordable Solutions**
	17.09.2024	Giridhar U Kulkarni President, JNCASR and Adjunct Professor at CeNS, Bangalore	**Neuromorphic devices based on self-formed Ag nano-labyrinth structure**
	18.12.2024	David Cahen Associate Professor in Radiology, Harvard Medical School & Associate Neuroscientist, Massachusetts General Hospital	**Unintended Consequence of Electronic Conduction via Proteins**
	24.01.2025	Puru Jena Distinguished Professor, Director, Institute for Sustainable Energy and Environment, Department of Physics, Virginia Commonwealth University	**Science at the Nanoscale**
	21.02.2025	Bikramjit Basu Director, CSIR-Central Glass and Ceramic Research Institute (CGCRI)	**Innovations at the challenging interface of Engineering, Biology and Medicine**
	28.03.2025	Venu Gopal Achanta Director of CSIR-National Physical Laboratory (CSIR-NPL)	**Light-matter interaction in the non-perturbative regimes**
Institute Colloquium	28.08.2024	Birgit Weber Professor of Inorganic Chemistry, University of Bayreuth	**Multifunctional Switchable Molecules In Polymers**
	08.11.2024	Jayasimha Atulasimha Engineering Foundation Professor, Mechanical and Nuclear Engineering, Electrical and Computer Engineering and Physics (Courtesy/Affiliate Professor) Associate Director, Institute for Sustainable Energy and Environment (ISEE) Virginia Commonwealth Univ.	**Nanoscale magnetic devices for: Energy efficient computing and scalable quantum control**
	17.12.2024	S. N. Piramanayagam Associate Professor, Division of Physics & Applied Physics,Nanyang Technological University, Singapore	**Brain-Inspired Computing Using Magnetic Domain Wall Devices**
	18.02.2025	Benjamin Jungfleisch Associate Professor of Physics and Astronomy at the University of Delaware.	**Terahertz pulse shaping and hirality control using magnetic heterostructures**

Sl. No.	Seminar Type	Department	Date	Speaker & Affiliation	Title
1.	**Departmental Seminar**	CMMP	03.04.2024	Avijit Saha Postdoctoral Research Fellow. Technische Universität Dresden	*Pb- and Cd-free Quantum Dots: Synthesis, Properties and Applications in Optoelectonic Devices*
2.	**Departmental Seminar**	AHEP	16.04.2024	Sachin Grover PhD Scholar, Harish-Chandra Research Institute, Allahabad	*Duality defects of D_n type Niemeier Lattice CFTs.*
3.	**Departmental Seminar**	CMMP	17.04.2024	Rajdeep Sensarma Associate Professor, Department of Theoretical Physics, Tata Institute of Fundamental Research	*Electronic Correlations in Moire Flat Bands*
4.	**Departmental Seminar**	AHEP	22.04.2024	Subham Dutta Chowdhury Post-Doctoral Researcher, University of Chicago	*Non-relativistic conformal field theories and (Un)nuclear physics*
5.	**Departmental Seminar**	AHEP	23.04.2024	Madhavan Varadarajan Professor, Theoretical Physics Raman Research Institute, Bengaluru	*Spherical collapse and black hole evaporation*
6.	**Departmental Seminar**	AHEP	09.05.2024	Shiladitya Mal Associate Professor Centre for Quantum Science and Technology, Chennai Institute of Technology	*Quantum correlation in time and applications to quantum science and technology*
7.	**Departmental Seminar**	CBS	14.05.2024	Ranjit Biswas Senior Professor, SNBNCBS	*Bond that Pays Dividends and Assign Identity*
8.	**Departmental Seminar**	CBS	21.05.2024	Debayan Chakraborty Reader F, The Institute of Mathematical Sciences, Chennai	*Understanding amyloid aggregation from the perspective of the monomer conformational ensemble*
9.	**Departmental Seminar**	CMMP	22.05.2024	Sudipta Bera Senior Post-Doctoral Fellow, Molecular Chemistry and Materials Science, Weizmann Institute of Science, Israel	*Protein as a Strange Conducting Medium with a Unique Electron Transport Capability*
10.	**Departmental Seminar**	AHEP	29.05.2024	Julius Julius Postdoc, HRI Allahabad	*CFT-data of N = 4 Super-Yang-Mills*
11.	**Departmental Seminar**	AHEP	30.05.2024	Santabrata Das Professor, Indian Institute of Technology Guwahati	*Unveiling the accretion scenario of black hole ultra luminous X-ray sources (BH-ULXs)*
12.	**Departmental Seminar**	PCS	04.06.2024	Ashif Akram Postdoctoral Fellow, Department of Physics, Kansas State University, Manhattan	*A minimalist model for bio-molecular condensates*
13.	**Departmental Seminar**	CMMP	05.06.2024	Subhamita Sengupta Visiting Fellow, Tata Institute of Fundamental Research, Mumbai	*Pinning Down A Liquid*
14.	**Departmental Seminar**	AHEP	20.06.2024	Shreya Banerjee Assistant Professor, Department of Physics, IIT (ISM) Dhanbad	*Primordial black holes and induced gravitational waves in non-singular matter bouncing cosmology*
15.	**Departmental Seminar**	PCS	21.06.2024	Jhih Huang Li Assistant Professor, National Taiwan University (NTU), Taiwan.	*PushASEP model on a periodic ring*

Sl. No.	Seminar Type	Department	Date	Speaker & Affiliation	Title
16.	**Departmental Seminar**	CMMP / CBS	26.06.2024	Pritam Mukhopadhyay Professor, School of Physical Sciences, Jawaharlal Nehru University	*Our Journey in JNU: Stabilization of Organic Radicals to Molecular and Supramolecular Materials*
17.	**Departmental Seminar**	CMMP	03.07.2024	Arnab Maity Post Doctoral Fellow, Department of Chemical Engineering, Technion, Israel	*Atomically thin 2D-Field Effect Transistors and Printed Chemi-resistors for Rapid biopsy of Malignant Lesion, Chirality Identification, and Aquatic Hazards Assessment*
18.	**Departmental Seminar**	AHEP	08.07.2024	Subhroneel Chakrabarti Postdoctoral Researcher, The Institute of Physics of the Czech Academy of Sciences.	*An Ode to Action*
19.	**Departmental Seminar**	CBS	09.07.2024	Krishnananda Chattopadhyay Chief Scientist and the Head of the Structural Biology and Bioinformatics Division at CSIR-Indian Institute of Chemical Biology, Kolkata	*Conformational fluctuations of proteins: from soft-matter physics to the disease biology of neuro-degenerations*
20.	**Departmental Seminar**	PCS	12.07.2024	Dibyendu Das Professor, Physics Dept, IIT Bombay	*Analytical Distribution of Released Synaptic Vesicles: Binomial or Not?*
21.	**Departmental Seminar**	CBS	13.08.2024	Neelanjana Sengupta Associate Professor, IISER - Kolkata	*Capturing Biomolecular Responses In Silico: Opportunities and (Some) Limitations*
22.	**Departmental Seminar**	AHEP	23.09.2024	Nirupam Roy Associate Professor, Department of Physics, Indian Institute of Science (IISc), Bangalore	*Atomic ISM in galaxies, near and far: Results & Surprises*
23.	**Departmental Seminar**	CBS	25.09.2024	Santosh Gupta Scientific Officer, Radiochemistry Division, BARC	*Phosphor Converted Light Emitting Diodes*
24.	**Departmental Seminar**	PCS	17.10.2024	Dibyendu Roy Associate Professor, Theoretical Physics, Raman Research Institute	*Nonreciprocal transport in linear systems with balanced gain and loss in the bulk*
25.	**Departmental Seminar**	PCS	28.11.2024	Anupam Kundu Associate professor, International Centre for Theoretical Sciences, Bangalore	*Restarting can expedite target search*
26.	**Departmental Seminar**	CMMP	11.12.2024	Ramachandrarao Yalla Assistant Professor, University of Hyderabad	*Quantum photonics with fiber-based nanophotonic platforms*
27.	**Departmental Seminar**	AHEP	03.02.2025	Srubabati Goswami Senior Professor, Physical Research Laboratory	*The Fable of the Unstable Neutrinos*
28.	**Departmental Seminar**	CBS	04.02.2025	Shilpi Kushwaha Senior Scientist in CSIR-CSMCRI, Bhavnagar (Gujarat)	*Harnessing Advanced Self-Assembled Porous Materials in Sustainable Applications*

Sl. No.	Seminar Type	Department	Date	Speaker & Affiliation	Title
29.	**Departmental Seminar**	AHEP	07.02.2025	Viatcheslav Mukhanov Chair of Cosmology at the Ludwig-Maximilians-Universität in Munich	*Gravitationally Dominated Instantons*
30.	**Departmental Seminar**	AHEP	12.02.2025	Sibasish Ghosh Professor, Institute of Mathematical Sciences, Chennai	*Quantum homogenization in Markovian and non-Markovian collisional models*
31.	**Departmental Seminar**	CBS	18.02.2025	Debashis Adhikari Associate Professor, IISER - Mohali	*Mechanistically guided catalyst development for organic transformations*
32.	**Early Career Talk**	PCS	11.07.2024	Sambarta Chatterjee Postdoctoral Research Associate, Jacobs Group, Princeton University	*Programmable design of self-assembly: A multi-objective optimization approach*
33.	**Early Career Talk**	AHEP	15.07.2024	Tanmoy Paul Assistant Professor at Visva-Bharati University, Dept. of Physics	*Cosmology, Thermodynamics and Modifie theories of gravity*
34.	**Early Career Talk**	AHEP	31.07.2024	Subhajeet Karmakar NASA Postdoctoral Program (NPP) Fellow, Exoplanets and Stellar Astrophysics Laboratory, NASA Goddard Space Flight Center (GSFC), USA	*Are we looking at the correct habitable worlds? - A stellar astrophysicist's perspective*
35.	**Early Career Talk**	PCS	06.08.2024	Jasleen Kaur PhD, IIT Bhubaneshwar	*Energetics of the dissipative quantum oscillator*
36.	**Early Career Talk**	PCS	08.08.2024	Suman Dutta PhD, NCBS-TIFR	*Persistent Active Fluids*
37.	**Early Career Talk**	AHEP	12.08.2024	Sayantani Bera Postdoctoral Research Fellow, Relativity and Gravitation Group, Universitat de les Illes Balears, Palma, Spain.	*Probing cosmic expansion with gravitational wave-large scale structure correlations*
38.	**Early Career Talk**	CMMP	16.08.2024	Sudipta Dutta Associate Professor, Department of Physics, Indian Institute of Science Education and Research (IISER) Tirupati	*Designing two-dimensional noncentrosymmetric systems for valley-polarization*
39.	**Early Career Talk**	AHEP	19.08.2024	Arpan Kundu	*New Lessons from (Generalised) BMS Symmetries & Soft Graviton Theorems*
40.	**Early Career Talk**	AHEP	20.08.2024	Kinjal Roy Research Fellow, Astronomy & Astrophysics Group, Raman Research Institute, Bengaluru	*Reprocessing environment in HMXB Pulsar*
41.	**Early Career Talk**	CBS	27.08.2024	Saswati Santra Post-doctoral Fellow, Walter Schottky Institute, Technical University of Munich, Germany	*Sub-nanoscale Engineering for Strategic Electrosynthesis of Green Chemicals*
42.	**Early Career Talk**	AHEP	03.10.2024	Ananada Maity Post Doc at Okinawa Institute of Science and Technology, Japan	*Conditions for catalytic state transformations: can they be made finite and practical?*

Sl. No.	Seminar Type	Department	Date	Speaker & Affiliation	Title
43.	**Early Career Talk**	AHEP	04.10.2024	Ruchi Pandey Postdoctoral Research Fellow, Astronomy & Astrophysics Division, Physical Research Laboratory (a Unit of Dept. of Space, Govt. of India), Ahmedabad, India	*Shock-induced dust formation in nova V2891 Cyg: A phenomenological approach*
44.	**Early Career Talk**	AHEP	21.10.2024	Suchetana Goswami Senior Researcher, Quantum Software Lab, Informatics Forum, The University of Edinburgh, UK	*Information locking and its resource-efficient extraction*
45.	**Early Career Talk**	CMMP	30.10.2024	Sourav Manna Post-doctoral Research Associate, Department of Theoretical Condensed Matter Physics, Weizmann Institute of Science, Israel	*Diagnostics of Anomalous Conductance Plateaus in Abelian Quantum Hall Regime*
46.	**Early Career Talk**	CMMP	09.12.2024	Pavan Nukala Assistant Professor, Centre for Nano Science and Engineering, Indian Institute of Science (IISc), Bangalore	*Visualizing solid state amorphization in ferroelectric In 2 Se 3*
47.	**Early Career Talk**	CBS	10.12.2024	Premashis Manna Assistant Professor, Department of Chemistry & Biochemistry, The Ohio State University Columbus, Ohio	*Energetics of protein-protein interactions in light-harvesting complexes*
48.	**Early Career Talk**	CMMP	12.12.2024	Abhishek Pandey Senior Lecturer, University of the Witwatersr and, Johannesburg, Gauteng, South Africa	*Unconventional physical properties of a few tetragonal AT 2 Pn 2 compounds*
49.	**Early Career Talk**	CMMP	24.12.2024	Mukul Kabir Professor, Department of Physics, Indian Institute of Science Education and Research, Pune	*Advancing 2D Magnetism: Room-Temperature Ordering to Quantum Topological States*
50.	**Early Career Talk**	CBS	07.01.2025	Sudip Das Post-doctoral fellow, Prof. Michele Parrinello's group, IIT Genova, Italy	*Machine Learning Meets Enzyme Catalysis*
51.	**Early Career Talk**	CBS	13.01.2025	Sanjoy Paul Postdoctoral Researcher at the Max Planck Institute of Biophysics in Germany	*Decoding Shape Regulation in COPII-Induced Membrane Budding: A Multi-Scale Simulation Approach*
52.	**Early Career Talk**	PCS	16.01.2025	Debraj Das Post doctoral fellow, ICTP, Italy	*First-Passage Processes: Martingales and the Defect Technique*
53.	**Early Career Talk**	AHEP	22.01.2025	Sumit Goswami Post-Doctoral Research Associate, Institute of Atomic and Molecular Sciences, Academia Sinica, Taiwan	*Global Quantum Communication without Quantum Memory*

Sl. No.	Seminar Type	Department	Date	Speaker & Affiliation	Title
54.	**Early Career Talk**	CMMP	22.01.2025	Subrata Chakraborty Visiting Postdoc Scientist at the Centre for Nanoscience and Engineering (CeNSE), IISc, Bengaluru,	*Gate-Controlled Superconductivity, Cryogenic Thermoelectric Radiation Detector and Reservoir-Controlled Orbital Magnetism*
55.	**Early Career Talk**	PCS	23.01.2025	Himansu Bhaumik Visiting Scientist Fellow, Theoretical Science Unit, JNCASR, Bengaluru	*Fatigue failure in computer glass*
56.	**Early Career Talk**	CBS	30.01.2025	Ketan Patel Principal Scientist in CSIR-CSMCRI, Bhavnagar (Gujarat)	*Functional microporous membranes for molecular separation*
57.	**Early Career Talk**	CMMP	31.01.2025	Dhiman Bhowmick Research Fellow in the Department of Physics at the National University of Singapore (Principal Investigator: Wen Wei Ho).	*Topology in Quantum Magnets*
58.	**Early Career Talk**	CMMP	03.02.2025	Pranab Kumar Nag Postdoctoral Associate, Associate Research Scientist, Physics Department | Yale University	*Visualizing Superconductivity Mediated by Nematic Fluctuations in the Fe-Based Superconductor FeSe1-xSx*
59.	**Early Career Talk**	CBS	25.02.2025	Sirshendu Dinda Ph.D in Solid-State Chemistry, Helmholtz Institute Ulm, KIT, Germany	*Tip-Enhanced Raman Spectroscopy (TERS): elucidate nano-scale chemical heterogeneity in thin layer*
60.	**Early Career Talk**	CBS	03.03.2025	Samik Bose Assistant Professor, Department of Computational Mathematics Science and Engineering, Michigan State University, USA.	*Integrating Markov Models with Weighted Ensemble MD Simulation : A Physics-Based Kinetic Modeling Approach Towards Accuracy and Robustness*
61.	**Early Career Talk**	CMMP	05.03.2025	Debdatta Panigrahi Ph.D., Humboldt Postdoctoral Fellow, Max Planck Institute for Polymer Research, Mainz, Germany	*Development of Organic Antiambipolar Transistors for Multivalued Logic Circuits and Logic-in-Memory Devices*
62.	**Early Career Talk**	CMMP	18.03.2025	Vivek Kumar Research Fellow, Quantum Engineering Laboratory, Department of Electronic and Electrical Engineering, University College London	*Electron Transport in Condensed Matter: From Bulk Materials to Low-Dimensional Systems*

Visitor, Associates and Students' Programme (VASP)

Outreach Activities (in house)

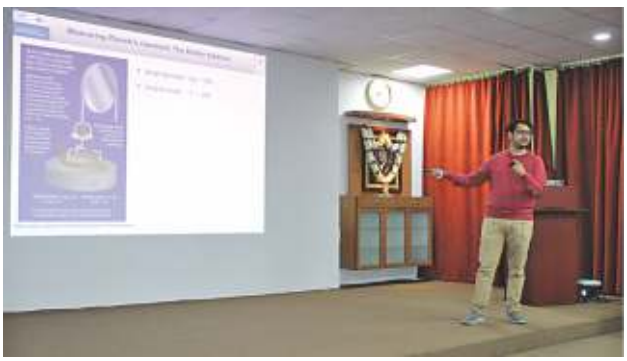
Open Day

On the occasion of the 131st birthday of Satyendra Nath Bose, the Satyendra Nath Bose National Centre for Basic Sciences (SNBNCBS) hosted an exciting and engaging Open Day 2025 on 2nd January, 2025. The Director, Prof. Tanusri Saha-Dasgupta, formally released the BoseStat@100 Coffee Table Book, celebrating a century of Bose's profound contributions to the world of science. It was a day brimming with discovery, learning, and inspiration as over 150 participants from diverse backgrounds came together to explore the wonders of science.

Highlights of the Day:

- Visit to Science Laboratories: A deep dive into cutting-edge research and experiments happening at the Centre.
- Tour of the S. N. Bose Archive: An incredible opportunity to explore the rich legacy and groundbreaking contributions of Satyendra Nath Bose.
- Planet and Star Watching Program: A mesmerizing evening under the stars, observing the wonders of the universe!

The energy, curiosity, and enthusiasm from the participants made this day truly special. As we celebrate Satyendra Nath Bose's invaluable contributions to science, we remain inspired to continue fostering innovation and nurturing the next generation of scientists.



National Science Day

National Science Day was celebrated at SNBNCBS on 28th February 2025. The event was a hub of discovery, learning, and inspiration, bringing together 150+ participants from diverse backgrounds to celebrate the wonders of science.

Event Highlights:

- Invited Talk by Prof. Biman B. Nath (RRI, Bangalore): A captivating journey into "The Dusty Universe", unraveling the mysteries of cosmic dust and its impact on the cosmos.
- Visit to the S. N. Bose Archive: A deep dive into history, exploring the legendary Satyendra Nath Bose's pioneering contributions to science.
- Solar Observation Session: A mesmerizing live viewing of the Sun's dynamic surface through a telescope.
- Inter-Institute Poster Competition: Young minds showcased their creativity under the theme "Science & Innovation for Viksit Bharat".
- Inter-Institute Quiz Competition: A thrilling battle of wits, teamwork, and scientific knowledge!

The event truly highlighted the transformative power of science and innovation in shaping a brighter future for India.

National Space Day

The Centre has celebrated the National Space Day2024 on the 23rd August 2024 at SNBNCBS in collaboration with Regional Remote Sensing Centre East (RRSC), ISRO, Salt Lake, Kolkata. About 100 B.Sc. and M.Sc. students from the surrounding colleges and universities along with the students of SNBNCBS participated in the program. In this day-long program there were three scientific talks by Dr. Tanumi Kumar of RRSC, and Dr. Soumen Mondal & Dr. Tapas Baug of SNBNCBS. In the post lunch session, participants visited the Exhibition Hall of RRSC East. Different models of rockets and space crafts were displayed in the exhibition. The participants also visited ' Bose Archive' at SNBNCBS. In the evening, a telescope demonstration was arranged by Dr. Ramkrishna Das and his students at SNBNCBS campus. The students were very much enthusiastic and enjoyed the program till its end.

IISF Curtain Raiser Ceremony

The Curtain Raiser Ceremony for the 10th India International Science Festival (IISF)-2024 has been celebrated on 6th November, 2024 at the S N Bose Centre. The program was inaugurated by the welcome address of Prof. Tanusri Saha-Dasgupta, Director, SNBNCBS. It was followed by series of scientific lectures by Prof. Rajat Kumar De, Indian Statistical Institute, Mr. Debojyoti Chowdhury, SNBNCBS, Prof. Debayan Gupta, Ashoka University (online), Mr. Dibyendu Maity, SNBNCBS, Mr. Aishwaryo Ghosh, SNBNCBS, Dr. Suman Chakrabarty, SNBNCBS, The program was successful through enthusiastic interaction and active participation.

Educational Visits

Msc students from the Berhampur University, Odisha visited the Centre on 3rd April 2024 as part of their academic visit. The students visited different laboratory facilities and they were demonstrated cutting edge research facilities like Optical Lab, Transmission Electron Microscope (TEM), Pulsed Laser Deposition (PLD), X-ray Diffractometer (XRD), Physical Property Measurement System (PPMS).

Outreach Activities (Off Campus)

India International Science Festival

The 10th edition of the India International Science Festival (IISF-2024) began with great enthusiasm on 30th November 2024 at IIT Guwahati! This significant event highlights the theme: "*Transforming India into an S&T-driven global manufacturing hub*."Aimed at showcasing India's scientific capabilities and innovations, the festival brings together scientists, researchers, students, entrepreneurs, and policymakers to explore the potential of science and technology in reshaping the nation's manufacturing landscape.

A BRIEF REPORT OF CONFERENCES, WORKSHOPS AND EXTENSION PROGRAMMES (CWEP) HELD DURING 01.04.2024 TO 31.03.2025

As per available records, during the period under reference, the following conferences / workshops/discussion meetings held at Centre and outside of Centre. A brief report of the programmes are as below:

1) Two-days Discussion Meeting with Ashoka University held at Centre during 20th and 21st June, 2024

The Convener of the meeting was Dr. Shubhasis Haldar, Associate Professor, department of Chemical and Biological Sciences and Dr. Pradip S. Pachfule, Assistant Professor, Department of Chemical and Biological Sciences.

S. N. Bose National Centre for Basic Sciences (SNBNCBS) and Ashoka University (AU) have signed a Memorandum of Understanding (MoU) to foster collaborative research endeavours between the two institutions. Following the first meeting organized by the Department of Physics at Ashoka University, the second joint meeting was held to discuss future research collaboration plans and initiate cross-disciplinary dialogues between the two institutions. In this meeting there were 17 speakers, 4 females and 13 males.

On the first day (20th June 2024), oral presentations were delivered by faculty from SNBNCBS and Ashoka University, focusing primarily on the research conducted by the respective faculty members. The sessions were categorized into Chemistry & Catalysis, Soft Matter, Materials Sciences, and Molecules, with respective experts presenting their work. Additionally, discussions about potential collaborations took place after each presentation.

On the second day (21st June 2024), the program featured a discussion on 'Collaborative options between Ashoka University and SNBNCBS'. In this session, Prof. Tanusri Saha-Dasgupta (Director, SNBNCBS), Prof. Somak Raychaudhury (Vice-Chancellor, Ashoka University), Prof. Sourav Pal (Dean, Ashoka University), Prof. Amitava Lahiri (Dean Academic, SNBNCBS), Prof. Anjan Barman (Dean Faculty, SNBNCBS), Prof. Rajib Mitra (Dean Administration& Resource Generation, SNBNCBS), and attending faculty from both institutions discussed potential collaboration opportunities and decided to foster future research efforts. This session was followed by presentations by faculty from SNBNCBS and Ashoka University on Computational and AI & Technologies. Subsequently, visits to research labs at SNBNCBS were organized.

2) C. K. Majumdar Memorial Summer Workshop in Physics 2024 held at Centre during 22nd July to 31st July, 2024

The Conveners of this Summer Workshop were Dr. Bhupati Chakrabarti, Former Associate Professor, City College, Kolkata and Dr. Saswati Dasgupta, Former Associate Professor, Rammohan College, Kolkata. The Co-Conveners were Prof. Sunandan Gangopadhyay and Dr. Avijit Chowdhury from the Centre.

The purpose of this workshop was to give exposure to a group of outgoing final year (3rd year) B.Sc. (due to get their B.Sc. degree in 2024) and the M.Sc. physics students (who completed their B.Sc. in 2023) on different emerging fields of theoretical and experimental physics. The focus of the meeting was centered mainly around quantum physics, biological physics and their related areas.

3) A one-day discussion meeting titled "Magnetism and Topology: A Materials Physics Perspective" was held on 01.08.2024 at Centre

The Convener of the meeting was Prof. Manoranjan Kumar, Professor of the Centre. The main purpose of this meeting was to bring together experts in the fields of magnetism and topological materials from the Centre and neighbouring institutes. The aim of this meeting was to foster collaboration, share the latest research findings and discuss future directions in these exciting areas of materials physics.

4) A one-day discussion meeting titled "Stat.Mech. Meeting Kolkata (SMMK-2024)" held on 27.09.2024 at S.N. Bose National Centre for Basic Sciences

The Conveners of the meeting were Prof. Punyabrata Pradhan, Professor and Prof. Jaydeb Chakrabarti, Senior Professor.

The discussion meeting was the purpose to highlight research activities in the broad area of statistical mechanics, going on in and around Kolkata and to introduce young researchers and students to the recent developments in the statistical mechanics methods in physics.

5) Public lectures under BoseStat@100 Celebration

S. N. Bose National Centre for Basic Sciences and Bangiya Bijnan Parishad jointly organized public lectures by two distinguished speakers held at Eastern Zonal Cultural Centre, Kolkata on 17th November 2024. This gathering marked the conclusion of a year-long celebration of the centenary of Bose-Einstein Statistics.

Professor B.N. Jagatap from IIT Bombay inaugurated the event by highlighting the groundbreaking contributions of Satyendra Nath Bose to quantum science and technology.

Professor Atri Mukhopadhyay, formerly of the Saha Institute of Nuclear Physics, reflected on the profound academic partnership between two towering figures of Indian science—Satyendra Nath Bose and Meghnad Saha. Their friendship, forged during India's struggle for independence, laid the foundation for significant advancements in diverse fields of physics.

Professor M. Zahid Hasan, Eugene Higgins Professor of Physics at Princeton University, captivated the audience with a simple yet profound exploration of quantum statistics, symmetry, and topology. He discussed the emergence of new states of matter through topological insights, revolutionizing quantum technology. Drawing connections from fundamental particles to human brains and quantum computers, he emphasized the role of the second quantum revolution and AI-driven systems in enhancing human intelligence.

Students, researchers, and science enthusiasts from diverse backgrounds participated in the occasion.

6) A three-days conference on "National Conference on Electronic Structure (NCES-2024)" was held during 21.11.2024 to 23.11.2024 at SRM University, Amaravati, Andhra Pradesh

One of the National Convener was Dr. Thirupathiah Setti, Associate Professor, S.N. Bose National Centre for Basic Sciences, Kolkata. The 7th National Conference on Electronic Structure (NCES 2024) held at SRM University, Amaravati, Andhra Pradesh.

NCES is an annual national conference with the main objective of providing a unique platform for discussions and interactions on the recent advances in electron spectroscopy, microscopy and related theoretical approaches to understanding the electronic structure of materials. NCES is also aimed at capacity building in the field of electronic structure. Scientists from Universities and Research Institutes working in spectroscopy, microscopy and related theory are invited to discuss their results and brainstorm future developments. The conference's topics include ARPES, XPS, STS, EXAFS, XANES, DFT, Strongly

Correlated Systems, Superconductivity, Topological Materials and Quantum Solids. The conference had in total of 23 talks and one special lecture delivered by renowned national speakers. Out of the 24 speakers, 4 are women speakers and 5 speakers were from the reserved category. All speakers attended the conference physically. About 45 students and 30 faculty have attended the conference as participants. The students presented 25 poster presentations.

7) A two-days discussion meeting on the topic "First Academic Meeting on the Consortium for Quantum Condensed Matter" was held in the Centre during 18-19 November, 2024 at Centre

The Convener of the meeting was Prof. Manoranjan Kumar, Professor, S.N. Bose National Centre for Basic Sciences and Co-Convener was Dr. Nitesh Kumar, Assistant Professor, S.N. Bose National Centre for Basic Sciences, Kolkata. The aim of this meeting was to unite faculty members engaged in quantum materials and many-body physics, facilitating discussions on current research topics and potential collaborations.

8) A four-days conference on "7th Annual Conference on Quantum Condensed Matter (QMAT-2024)" held during 20.12.2024 to 23.12.2024 at IIT, Guwahati

The Convener was Subhradip Ghosh, IIT, Guwahati, Dr. Uday Narayan Maiti, IIT, Guwahati, Dr. Pankaj Kumar Mishra, IIT, Guwahati and Co-Convener was Dr. Saquib Shamim, Assistant Professor, S.N. Bose National Centre for Basic Sciences, Kolkata.

The conference aims to serve as a unifying platform for both national and international researchers involved in theoretical, experimental and technological studies across various condensed matter systems and models. By bringing these diverse experts together, the conference was held to facilitate the exchange of ideas and the sharing of crucial research techniques that are essential for advancing state-of-the-art research in this field. The aim of the conference was to accelerate progress in both fundamental understanding and practical applications within the realm of condensed matter physics.

ADVANCED POST DOCTORAL RESEARCH PROGRAM (APRP): 2024-2025 [01.04.2024 - 31.03.2025]

Sl. No.	NAME	STATUS	DEPT.	MENTOR
1.	Achintya Low	PDRA-SNB (From 02.12.2024)	CMMP	Dr. Nitesh Kumar
2.	Akhtar Alam	PDRA –I (Till 14.11.2024)	CBS	Dr. P. S. Pachfule
3.	Amar Nath Pal	PDRA –I (From 14.06.2024 —)	CBS	Dr. Shubhasis Haldar
4.	Amit Kundu	PDRA –I (From 09.09.2024 —)	AHEP	Prof. Archan S Majumdar
5.	Anannya Bhattacharya	PDRA –I (From 20.01.2025 —)	CBS	Prof. Rajib K Mitra
6.	Anish Das	PDRA-SNB (Till 10.05.2024)	AHEP	Dr. Tapas Baug
7.	Anupam Gorai	PDRA-SNB (Till 30.09.2024)	CMMP	Prof. Kalyan Mandal
8.	Arun Kumar Maurya	PDRA –I (Till 30.11.2024)	CMMP	Prof. Tanusri SahaDasgupta
9.	Ashadul Halder	PDRA – I (Till 17.05.2024)	AHEP	Prof. Archan Majumdar
10.	Ashis Saha	PDRA – I (from 10.10.2023 —)	AHEP	Prof. Sunandan Gangopadhyay
11.	Asmita Kumari	PDRA – II (Till 19.07.2024)	PCS	Dr. Arijit Haldar
12.	Atul Rathore	PDRA-SNB (Till 25.09.2024)	PCS	Prof. P. S. Deo
13.	Atul Rathore	PDRA-I (From 04.10.2024 —)	PCS	Dr. Arijit Haldar
14.	Bikash Gajar	PDRA -I (From 09.08.2023)	CMMP	Dr. Atindra Nath Pal
15.	Chandan Patra	PDRA -I (Till 17.10.2024)	CMMP	Dr. Nitesh Kumar
16.	Debayan Mondal	PDRA-SNB (Till 05.11.2024)	CMMP	Prof. Priya Mahadevan
17.	Dibyashree Chakraborti	PDRA -I (from 26.10.2023 —)	CMMP	Dr. Saquib Shamim
18.	Dibyajyoti Saikia	PDRA – I (From 13.02.2025 —)	CMMP	Prof. Manoranjan Kumar
19.	Dhrubajyoti Maji	PDRA-SNB (From 10.06.2024 —)	PCS	Dr. Arijit Haldar
20.	Jayeta Banerjee	PDRA –II (Till 31.01.2025)	CBS	Prof. Ranjit Biswas
21.	JayantaMondal	PDRA-SNB (From 18.06.2024 —)	CBS	Dr. Pradip Pachfule

Sl. No.	NAME	STATUS	DEPT.	MENTOR
22.	Jyotirmoy Sau	PDRA-SNB (Till 11.03.2025)	CMMP	Prof. Manoranjan Kumar
23.	Kanchan Meena	PDRA-SNB (Till 03.03.2025)	PCS	Prof. P. S. Deo
24.	Koushik Mondal	PDRA –I (Till 26.08.2024)	CBS	Prof. Manik Pradhan
25.	Krishnendu Sinha	PDRA-SNB (From 02.09.2024 —)	CBS	Dr. Suman Chakrabarty
26.	Manjari Dutta	PDRA-SNB (From 07.10.2024 —)	AHEP	Prof. Sunandan Gangoapdhyay
27.	Monalisa Chatterjee	PDRA-SNB (From 10.07.2024 —)	CMMP	Prof. Manoranjan Kumar
28.	MilyKundu	PDRA – I (Till 02.08.2024)	CMMP	Prof. Kalyan Mandal
29.	Narayan Ch. Maity	PDRA-SNB (From 20.09.2024—)	CBS	Prof. Ranjit Biswas
30.	Nivedita Pan	PDRA-SNB (Till 21.03.2025)	CBS	Prof. S. K. Pal
31.	Olivia Mallick	PDRA – I (From 21.01.2025 —)	PCS	Prof. Punyabrata Pradhan
32.	PekhamChakrabortty	PDRA – I (From 24.02.2025 —)	CBS	Dr. Pradip Pachfule
33.	Prasun Boyal	PDRA-SNB (Till 24.09.2024)	PCS	Dr. Urna Basu
34.	Pratik Ghosal	PDRA – I (from 05.02.2024 —)	PCS	Dr. Manik Banik
35.	Pratap Kumar Pal	PDRA-SNB (Till 13.12.2024)	CMMP	Prof. Anjan Barman
36.	Premashis Kumar	PDRA-SNB (Till 20.08.2024)	AHEP	Dr. ParijatDey
37.	Ramu K Yadav	PDRA – I (from 03.07.2023 —)	PCS	Prof. Sakuntala Chatterjee
38.	Ranjini Bhattacharya	PDRA – I (From 27.05.2024 —)	CMMP	Prof. Priya Mahadevan
39.	Ria Saha	PDRA-SNB (From 02.09.2024 —)	CBS	Prof. Rajib K Mitra
40.	Ritamay Bhunia	PDRA –III (Till 31.07.2024)	CMMP	Dr. Avijit Chowdhury
41.	Rubina Ghosh	PDRA -I (From 27.05.2024 —)	CMMP	Prof. Anjan Barman
42.	Saheb Dutta	PDRA – II (From 01.06.2023—)	CBS	Dr. Suman Chakrabarty
43.	Samir Rom	PDRA-SNB (From 12.02.2025 —)	CMMP	Prof. Tanusri Saha Dasgupta
44.	Sayan Routh	PDRA-SNB (Till 06.02.2025)	CMMP	Dr. Avijit Chowdhury

Sl. No.	NAME	STATUS	DEPT.	MENTOR
45.	Sk. Md. Obaidulla	PDRA – II (Till 30.11.2024)	CMMP	Dr. Atindra Nath Pal
46.	Sk. Samir Ahamed	PDRA – I (Till 31.01.2025)	CBS	Dr. Suman Chakrabarty
47.	Semanti Dutta	PDRA – I (From 07.10.2024 —)	AHEP	Dr. ParijatDey
48.	Shobhan Dev Mandal	PDRA-SNB (Till 14.06.2024)	PCS	Prof. Sakuntala Chatterjee
49.	Shubham Purwar	PDRA-SNB (From 12.02.2025 —)	CMMP	Dr. Barun Ghosh
50.	Soumi Das	PDRA – I (Till 19.06.2024)	PCS	Prof. Jaydeb Chakrabarti
51.	Souvik Manna	PDRA –I (From 01.06.2023—)	AHEP	Dr. Tapas Baug
52.	Sourav Chakraborty	PDRA –I (Till 26.11.2024)	CMMP	Prof. Manoranjan Kumar
53.	Sourav Kanthal	PDRA – I (From 20.01.2025 —)	CMMP	Dr. Nitesh Kumar
54.	Suchismita Banerjee	PDRA – I (From 24.06.2024 —)	PCS	Dr. Urna Basu
55.	Sudipta Chatterjee	PDRA-SNB (Till 30.09.2024)	CMMP	Prof. Kalyan Mandal
56.	Sumana Pyne	PDRA-SNB (Till 03.05.2024)	CBS	Prof. Rajib K Mitra
57.	Suman K Mandal	PDRA –I (From 01.06.2023—)	AHEP	Prof. Soumen Mondal
58.	Suma Das	PDRA –I (From 17.03.2025—)	CMMP	Dr. Avijit Chowdhury
59.	Susmita Mondal	PDRA-SNB (Till 31.05.2024)	CBS	Prof. S. K. Pal
60.	Sutapa Saha	PDRA – I (Till 29.07.2024)	AHEP	Prof. Archan S Majumdar
61.	Swarnali Hait	PDRA-SNB (Till 14.06.2024)	PCS	Prof. P. S. Deo
62.	Tanushree Das	PDRA –I (Till 27.09.2024)	CBS	Prof. Rajib K Mitra
63.	Tanmoy Chakrabarty	Bridge Fellow (Till 17.01.2025)	PCS	Prof. Punyabrata Pradhan
64.	Tonima Nandy	PDRA –I (Till 05.05.2024)	CBS	Prof. Ranjit Biswas
65.	Tirthendu Sinha	PDRA – I (Till 31.10.2024)	AHEP	Dr. Tapas Baug
66.	Tridib Roy	PDRA – I (Till 16.01.2025)	AHEP	Dr. Ramkrishna Das
67.	Tushar Kanti Bhowmik	PDRA – I (Till 01.02.2025)	CMMP	Dr. T. Setti

NPDF / RESEARCH ASSOCIATE (EXTERNAL FUND) / DST (INSPIRE) / RAMANUJAN FELLOW etc: 2024-2025

SL. NO.	NAME	DESIGNATION	DEPT.	MENTOR / HOST	Title of the Project	STATUS
1	Mr. Achintya Low	Research Associate – I (Ad-hoc)	CMMP	Prof. Tanusri Saha Dasgupta	Search for Novel Magnetic and Topological Materials	Till 01.08.2024
2	Dr. Ananda Gopal Maity	Senior Project Scientist (DST-NQM)	PCS	Dr. Manik Banik	Design and development of quantum entanglement – enhanced imaging systems	From 21.02.2025
3	Dr. Arun K Maurya	Research Associate – I (Ad-hoc)	CMMP	Prof. Tanusri Saha Dasgupta	JC Bose Award Fellowship	Till 31.05.2025
4	Dr. Ali Hossain Khan	Ramanujan Fellow	CBS	Prof. Rajib K Mitra	Doped 2D Nanocrystals for Photonic Applications	From 01.11.2021
5	Dr. Bhaskar Mukherjee	DST INSPIRE FACULTY	CMMP	Prof. Manoranjan Kumar	Exploration of non-ergodic quantum many body systems without disorder	From 17.09.2024
6	Dr. Gargee Bhattacharyya	National Post-Doctoral Fellow	CMMP	Prof. Priya Mahadevan	Proximity induced spin-orbit coupling and magnetism on graphene from magnetic topological quantum matter (MTQM)	Till 05.01.2025
7	Dr. Indrani Bhattacharyya	National Post-Doctoral Fellow	CBS	Prof. Rajib K Mitra	Exploring Hydration Dynamics of Protein Aggregation and Its Connection with Liquid-Liquid Phase Separation Triggered by Modulation in Local Environmental Parameters Employing Terahertz Spectroscopy and Complementary Experimental Techniques	Till 27.12.2024
8	Dr. Indrani Bhattacharyya	Project Associate – I (Ad-hoc)	CBS	Prof. Rajib K Mitra	Biomolecular Condensates: Exploring the associated hydration and energetics using Thz spectroscopy	From 10.01.2025
9	Dr. Jiban Kangsabanik	DST INSPIRE FACULTY	CMMP	Prof. Tanusri Saha Dasgupta	Optimization of point defects and associated	From 17.09.2024
10	Dr. Mir Alimuddin	Chanakya PDF	PCS	Dr. Manik Banik	Devising Practically implementable enhanced means of communication with the aid of quantum resources	Till 28.06.2024
11	Dr. Milan Patra	DBT - RA I	CBS	Dr. Shubhasis Haldar	Investigation of cellular senescence of beta cells and interferon response in Aging and Diabetes	From 25.11.2024
12	Mr. Prasun Boyal	Research Associate – I (Ad-hoc)	CMMP	Prof. Priya Mahadevan	Twistronics with transition metal dichalogenides	From 04.10.2024
13	Dr. Sanku Paul	DST INSPIRE FACULTY	PCS	Dr. Arijit Haldar	Hidden quantum criticality and its application in data hiding	From 22.05.2023
14	Dr. Soumya Bhattacharya	Research Associate – I	AHEP	Prof. Rabin Banerjee	Gauge and Gravitational Symmetries in Nonrelativistic Theories : Formalism and Applications	Till 03.04.2024

SL. NO.	NAME	DESIGNATION	DEPT.	MENTOR / HOST	Title of the Project	STATUS
15	Ms. Soma Dutta	Chanakya PDF (Ad-hoc)	CMMP	Prof. Anjan Barman	Two-dimensional Ferromagnetic and Organic Molecule Spinterfaces as Molecular Spin Qubits for Quantum Technologies and Energy Harvesting Applications	From 21.10.2024
16	Dr. Subhendu Bikash Ghosh	Project Post-doctoral Fellow (DST-NQM)	PCS	Dr. Manik Banik	Design and development of quantum entanglement – enhanced imaging systems	From 07.02.2025
17	Dr. Sumaiya Parveen	Chanakya PDF	CMMP	Prof. Anjan Barman	Two-dimensional Ferromagnetic and Organic Molecule Spinterfaces as Molecular Spin Qubits for Quantum Technologies and Energy Harvesting Applications	Till 28.06.2024
18	Dr. Tusita Sau	Research Associate – I	CMMP	Prof. Tanusri Saha Dasgupta	Search for Novel Magnetic and Topological Materials	Till 02.04.2024

EMERITUS / Others Contractual Faculty: 2024-2025

SL. NO.	NAME	STATUS	DEPT.
1	Prof. Rabin Banerjee	Raja Ramanna Fellow till 02.05.2024	AHEP
2	Prof. Prabhat Mandal	Emeritus Professor till 09.11.2025	CMMP
3	Dr. Subhro Bhattacharjee	Adjunct Faculty	CMMP
4	Dr. Indranil Sarkar	Adjunct Faculty	CMMP
5	Prof. AmitabhaLahiri	Visiting (Hon.) Fellow	AHEP
6	Prof. Gautam Gangopadhyay	Visiting (Hon.) Fellow	CBS
7	Prof. Prabhat Mandal	Visiting (Hon.) Fellow	CMMP

Nibedita Konar

Debashish Bhattacharjee

Rupam Porel

THEORETICAL PHYSICS SEMINAR CIRCUIT

Outreach activities under TPSC

Details of programmes organized under TPSC

1) **National Conference on Recent Advances in Physical and Chemical Sciences.**
Place: Kandi Raj College, Murshidabad
Date: 12-13 December, 2024

2) **শতবর্ষে বোস পরিসংখ্যান তত্ত্ব**

100 Years of Bose Statistics
Place: Presidency University
Date: 24 November, 2024

Manik Banik

Manik Banik
Convener, Theoretical Physics Seminar Circuit

REGISTRAR

Report on Administrative Matters

The Centre has rendered administrative support to its academic activities through its administrative and technical staff members who have professionally and sincerely carried out their duties for making the various events held in the Centre in the year 2024-2025 successful. The Centre has 23 permanent staff, 8 in temporary status and 21 staff members in contractual category as on 31st March 2025, who have performed their duties efficiently under the able leadership of the Director and the Registrar. The smooth running of the day to day administrative activities of the Centre including running of facilities like guest house (Bhagirathi), creche (Kishalay), security, EPABX, transport, canteen, electrical maintenance, AC maintenance, campus maintenance and various other services have been made possible due to the professional support provided by the various service agencies working closely with the administration of the Centre. The Centre has maintained close liasion with the Department of Science and Technology and other ministries and has complied with all time-bound queries. All parliament information/reports, compliance reports, quarterly queries regarding Audit Paras and annual reports on various matters, different reports regarding GEM, LIBMS etc. and other service matters have been prepared and submitted on time to DST. The Centre has successfully co-ordinated audit visits of the CAG Audit Team, carrying out different types of Audits and has timely replied to Audit Queries. The Hindi Cell of the Centre has been functioning effectively and the Centre has undertaken substantial administrative work in hindi and made sincere efforts to implement and follow the provision of Official Language Act in the year 2024-25, which are separately reported here.

Meetings of the Statutory Committees of the Centre held during FY 2024-25:

(i) The 70th (*the meeting was held in online mode*) and 71st Governing Body (GB) meetings of the Centre were held on 14.05.2024 and 24.09.2024 respectively.

(ii) The 47th (*the meeting was held in hybrid mode*) and 48th Finance Committee (FC) meetings of the Centre were held on 20.09.2024 and 29.01.2025 respectively.

(iii) The 34th (*the meeting was held in online mode*) and 35th Academic & Research Programme Advisory Committee (ARPAC) meetings of the Centre were held on 20.05.2024 and 20.03.2025 - 21.03.2025 respectively.

Right to Information (RTI) Act:

The Centre has adhered to the norms of the Right to Information Act and received (17) seventeen cases under the said Act in the last financial year, all of which have been processed within stipulated time and successfully disposed off. All quarterly / annual progress reports pertaining to Rajbhasha, Vigilance & RTI have been submitted to the concerned authorities timely.

Vigilance Matters:

As part of Vigilance Awareness Week 2024 during 28th October 2024 to 3rd November 2024, the Centre organised Vigilance Pledge and an Essay Competition (Topic: "Culture of Integrity for Nation's Prosperity"). The essay competition carried a cash award of Rs.5,000/- (1st prize), Rs.3,000/- (2nd prize) and Rs.1,000/- (3rd prize) with winners as:

- 1st Prize – Ms. Sweta Ghosh, Junior Research Fellow.
- 2nd Prize – Ms. Madhurita Das, Senior Research Fellow.
- 3rd Prize – Ms. Renu Singh, Office Assistant (Hindi).

No cases related to vigilance have been reported during 2024-2025.

Swachhta Pakhwada:

The Centre celebrated 'Swachhta Pakhwada' from 1st May 2024 to 15th May 2024. As part of the Pakhwada on 01.05.2024 the Centre organised Swachhta pledge taking ceremony and carried out mass cleaning of Main Office Building, Guest House, Students' Hostels and other Centre premises. Collection of wastes at different points and awareness campaign about no use of plastics was carried out. Posters titled "Zero Plastic, Green Campus" were pasted on all notice boards and all prominent places of the Centre. Weeding out of old records was done. A motivational talk/lecture on the occasion of 'World Technology Day' titled "Electric Vehicles (EV) and their Future" was delivered by Dr. Pradip Pachfule, Assistant Professor of the Centre. An Essay Writing Competition on "Biological Waste and its Disposal" was organised alongwith an invited lecture by Shri Swarup Brahma, Vice President, Webel and Shri Anindya Banerji, Webel on 'Sensitization on Effective Implementation of E-waste Management'.

The Centre also observed "Swachhata Hi Seva" Special Campaign 4.0 with the theme "Swabhav Swachhata – Sanskaar Swachhata" from 14th September 2024 – 1st October 2024 in its premises. Swachhata Pledge was taken on 17.09.2024 as a part of the Special Campaign 4.0. The following activities were carried out during the above period viz. Preventative Health Check-up for Safai Mitra of the Centre, Plantation of Tree, One Act Play /Mime, Weeding of old records, Shramdaan at Target Area, Cleaning and Beautification of the Centre, LED light installation, Creation of facility to convert food / biodegradable waste into Vermicompost, distribution of safety gears and cleanliness tools to sanitation workers, disinfection of sewage lines/manhole/drains of the Centre.

Integrated Government Online Training (IGOT) Karmayogi Platform:

The permanent and contractual employees of the Centre have enthusiastically participated and completed certificate courses available in the Integrated Government Online Training (IGOT) Karmayogi Platform throughout the financial year 2024-25 as per the directives received from DST, New Delhi. The Centre has been timely submitting reports to DST regarding the Karmayogi Platform.

International Yoga Diwas:

The Centre celebrated the International Yoga Day; Theme: "Yoga for Self and Society" on 21st June 2024 and conducted yoga session with great zeal and enthusiasm.

Special Days of Celebration:

The Centre celebrated the following events:

- The national flag was hoisted by the Director on 76th Republic Day on 26th January 2025 and 78th Independence Day on 15th August 2024. Both the occasions were attended by staff and students of the Centre and national anthem was sung to mark the occasions.
- On 1st January 2025, the Centre celebrated 131st Birth Anniversary of Prof. Satyendra Nath Bose by garlanding the bust of the eminent scientist. The Centre organised 'Open Day' on 2nd January 2025 to commemorate the 131st Birth Anniversary of Prof. Satyendra Nath Bose. Several visitors from outside the Centre attended the 'Open Day' Programme. The programme comprised of organised visits to the various Scientific Labs and S N Bose Archive. Planet & Star watching was organised in the evening to mark the occasion.
- Swachhta Pledge on 1st May 2024 & 17th September 2024;
- E-Pledge on "Vikasit Bharat Ka Mantra, Bharat ho Nashe se Swatantra" in Nasha Mukht Bharat Abhiyan (NMBA) on 12.08.2024;
- Vigilance Pledge on 28th October 2024;
- Rashtriya Ekta Diwas Pledge on 31st October 2024;
- Foundation Day of the Centre was observed on 13th June 2024 comprising of Welcome Address by Prof. B.N.Jagatap, Chairman, Governing Body, SNBNCBS, Address by Prof. Tanusri Saha-Dasgupta, Director, SNBNCBS, Scientific Talk on

"How to build a quantum computer?" by Dr. Rajamani Vijayaraghavan, TIFR, Mumbai, Prize Distribution Ceremony and Cultural Session – Esraj Performance by Debayan Majumder and Scientific thoughts in music of Tagore "Rabindra Gaan-e Bigyan Chetana" by 'Sohochari' group (led by Ishita Mukherjee).

- On the occasion of 'BOSE FEST 2025' held during 10th March 2025 – 13th March 2025, Family Day was celebrated on the evening of 13th March 2025. The In-house Bose Fest programme was followed by a gala dinner for family members of the staff and students of the Centre. On the evening of 12th March 2025, musical band 'Taalpatar Shepai" performed on the occasion of Bose Fest. An Art & Photography Fest consisting of photography, craft & sculpture, alpona design, paintings / creative work by the students and staff was held during the Fest. Oral & Poster presentations by the students were held during the above period. Scientific talks also took place during the above period.

Facilities

The Centre follows Contributory Medical Scheme (CMS) under which the Centre extends medical facilities (both outdoor and indoor) to all its staff members and to the scholars. The scheme reimburses medical bills as per CGHS rates. The Centre has its own medical unit for CMS beneficiaries where Allopathic and Homeopath physicians are available for regular consultation. Facilities like oxygen, wheel chair, stretcher, rest bed etc. are readily available apart from First Aid treatments. The Centre has cashless tie ups with some of the renowned hospitals in Kolkata viz. Manipal Hospitals, B.M. Birla Heart Research Centre, Medica Superspeciality Hospital, Peerless Hospitex Hospital and Research Centre Limited, Desun Hospital & Heart Institute, North City Hospital & Neuro Institute (P) Ltd., Suraksha Diagnostic Private Limited, Institute of Neurosciences, Kolkata, Techno India Dama Healthcare & Medical Centre etc. for indoor hospitalisation facility. These hospitals also extend OPD treatments to CMS members as per CGHS rates.

The Centre houses a modern Guest House by the name of 'Bhagirathi' comprising of 57 air conditioned rooms (including Single Bed, Double Bed & Transit rooms), 5 air conditioned suites and a fully AC Seminar cum Dining Hall and Kitchen with modern facilities and Seminar room. 'Bhagirathi' also has an equipped Doctor's chamber and two Air Conditioned office rooms. The Centre has two hostels - 'Radhachura' and 'Krishnachura' which provides hostel accommodation to approximately 160 students and small flatlets named 'Subarnarekha' providing accommodation to students and staff on emergency duty. The students residing in the Centre run their own mess and the hostels have facilities like dining rooms, common rooms etc. There is a gymnasium in the Centre. The Centre has limited transit accommodation for faculty members and Post Doctoral Fellows at 'Basundhara'. 'Basundhara' also houses facilities for larger groups, stay of students and summer students, administrative offices, offices of Post Docs etc.

The Bose Archive dedicated to the life of Professor S. N. Bose, has personal artefacts and collections donated by the family of S. N. Bose. It also exhibits the life story of Prof. Bose and is visited throughout the year by many. There is also a virtual tour of the Archive available in the Centre's website.

The Centre has modernly equipped Lecture Halls / Seminar Halls namely : Silver Jubilee Hall (120 sitting capacity), BOSON (60 sitting capacity) and FERMION (80 sitting capacity) with latest lecture facilities to cater to the various events organised viz. Lectures, Seminars, Colloquiums, Symposiums, Training programmes, Cultural Programmes, etc. These facilities are also available for external users on rental basis.

Recreational Activities under 'Muktangan':

- Rabindrajayanti' was celebrated on 8th May 2024;
- An Intra-Institute Football & Chess Tournament on 25-26 October 2024 & 28-29 October 2024;
- Fresher's Welcome on 25.09.2024;
- An Intra-Institute Table Tennis Tournament on 21-22 January 2025;
- An Intra-Institute Carrom Tournament on 27-28 January 2025;
- On 13th March 2025, the Performing Arts Group of 'Muktangan' organised an in-house programme comprising of individual and group performances of singing, recitation and play. The programmes were attended by friends and family members of staff and students.

While concluding, I express my sincere thanks to the three Deputy Registrars of Administration, Finance and Academic Sections, the Section Incharges and the administrative and academic staff members of the Centre for their unfailing dedication and cooperation in successfully organising various activities and programmes held throughout the year and for facilitating day to day smooth functioning of the administration. I am also grateful to Prof. Tanusri Saha-Dasgupta, Director for her valuable guidance and advice on administrative matters.

Shohini Majumder
Registrar

Staff Members of the Centre

Staff Members, Administrative Section

Staff Members, Purchase Section

Staff Members, Technical Cell

HINDI (RAJBHASHA) IMPLEMENTATION IN THE CENTRE

Activities of the Hindi Cell

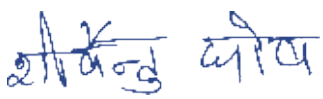
The Centre implemented the provisions of the Official Language Act in the year 2024-25. According to Rajbhasha Rule 5, reply to Hindi letters was given in Hindi only. All the official registers, forms, visiting cards, letter heads, and seals are in bilingual format. Advertisements, tender notices, office orders and notices were circulated in Hindi also and uploaded in the Centre's website. Internal notings and signing in the Attendance Register (on the first of every month) are done in Hindi. The Centre has its official website in Hindi where all the information and important policy documents of the Centre are available. The Centre has also carried out correspondences in Hindi with the Ministry and other government organisations. The Centre is a member of Town Official Language Implementation Committee (Office-2), Kolkata and has a Hindi Implementation Committee which meets regularly. All the administrative staff and many of the academic staff members possess working knowledge of Hindi and the administrative staff have been successfully trained in the 'Praveen' and 'Pragya' courses of the Department of Official Language, Government of India. The Centre has also initiated training of staff in the 'Parangat' course. The Centre timely submits quarterly progress report in hindi to the Dept of Official languages. The Centre carries out many of its routine administrative jobs in hindi eg. notings, letters etc.

'Hindi Mahina' was celebrated by organising Hindi Essay Competition & Hindi Quiz in September 2024. The essay competition carried a cash award of Rs.5,000/- (1st prize), Rs.4,000/- (2nd prize) and Rs.3,000/- (3rd prize). The winners of Essay Competition were:

Essay Competition:

- 1st Prize – Ms. Sakshi Choudhury, Junior Research Fellow.
- 2nd Prize – Mr. Than Singh Jankawat, IPhD.
- 3rd Prize – Ms. Mitali Bose, Office Assistant.
- On 17th September 2024 "Hindi Pakhwada Udghatan Samaroh" was organised; Guest Lecturer, Prof. Reshmi Panda Mukherjee, Gokhele Memorial Girls College and Shri L.K.Singh, Pradhyapak, Rajbhasha Bibhag, Kolkata delivered a talk on the said occasion.

The Centre also organised the following 'Hindi Workshops' pertaining to each quarter during 2024-2025: i) Talk on "Karyalin Kaam Kaaj me Rajbhasha Hindi Karyavyan" by Shri Nirmal Dubey, Assistant Director (Rajbhasha), Nizam Palace, Kolkata on 27.06.2024; ii) Talk on "Rajbhasha Niti aur Karyavyan" by Shri. Ajay Shankar Mishra, Varishtha Hindi Adhikari, SAIL on 20.09.2024; iii) Talk on "Karyaleen Hindi Mein Kaamkaaj Mein Samanya Trutiyo ka Nirakaran" by Shri. Narayan Sav, Mukhyya Prabandak (Rajbhasha), Power Grid Corporation of India Limited on 23.12.2024; iv) Talk on "Rajbhasha Hindi aur Uske Vikas me Sahayak Takniki Sadhan" by Shri Kamal Kant, Assistant Director (Rajbhasha), Science & Technology Division on 20.03.2025.



Sirsendu Ghosh
In-charge Hindi Cell

COMMITTEES (As on 31.03.2025)

Governing Body

Prof. B.N.Jagatap Professor Department of Physics IIT Bombay, Mumbai	Chairman
Secretary Department of Science & Technology Government of India, New Delhi	Member
Prof. Prasanta K Panigrahi, Professor Department of Physical Sciences (DPS) Indian Institute of Science Education and Research, Kolkata	Member
Prof. Pallab Banerjee Professor Materials Science Centre, IIT, Kharagpur	Member
Dr. D.S. Ramesh Former Director IIG, Navi Mumbai	Member
Prof. Manoj Kumar Harbola Professor Dept. of Physics, IIT, Kanpur	Member
Additional Secretary & Financial Advisor Department of Science & Technology Government of India, New Delhi	Member
The Chief Secretary, Govt. of West Bengal	Member
Prof. Tanusri Saha-Dasgupta Director S. N. Bose National Centre for Basic Sciences Kolkata	Member
Director Bose Institute, Kolkata	Member
Director Indian Association for Cultivation of Science Kolkata	Member
Ms. Shohini Majumder Registrar S. N. Bose National Centre for Basic Sciences Kolkata	Non-Member Secretary

Finance Committee

Prof. Tanusri Saha-Dasgupta Director S. N. Bose National Centre for Basic Sciences Kolkata	Chairperson
Additional Secretary & Finance Advisor Department of Science & Technology Government of India, New Delhi	Member
Prof. Somak Raychaudhury Vice-Chancellor, Ashoka University (One Nominee of the Academic & Research Programme Advisory Committee	Member
Prof. Pallab Banerjee Professor Materials Science Centre, IIT, Kharagpur	Member
Ms. Shohini Majumder Registrar S. N. Bose National Centre for Basic Sciences Kolkata	Member Secretary

Academic & Research Programme Advisory Committee

Prof. D.D.Sarma — Chairman
Professor,
Indian Institute of Science, Bengaluru

Prof. Shobhana Narasimhan — Member
Professor, Jawaharlal Nehru Centre
For Advanced Scientific Research, Bengaluru

Prof. Arindam Ghosh — Member
Professor,
Indian Institute of Science, Bengaluru

Prof. Annapurni Subramaniam — Member
Director,
Indian Institute of Science, Bengaluru

Prof. Jayanta Kumar Bhattacharjee — Member
Distinguished Visiting,
Professor, IACS, Kolkata

Prof. Srabani Taraphder — Member
Professor, IIT, Kharagpur

Prof. Amitava Raychaudhuri — Member
Professor Emeritus,
University of Calcutta, Kolkata

Prof. Kaushik Biswas — Member
Professor, Bose Institute, Kolkata

Prof. Bushra Ateeq — Member
Joy Gill Chair Professor, IIT, Kanpur

Prof. Tanusri Saha-Dasgupta — Member
Director
S. N. Bose National Centre for Basic Sciences
Kolkata

Prof. Anjan Barman — Member
Dean (Faculty)
S. N. Bose National Centre for Basic Sciences
Kolkata

Prof. Ranjit Biswas — Member
Dean (Academic Programme)
S. N. Bose National Centre for Basic Sciences
Kolkata

Ms. Shohini Majumder — Non –Member Secretary
Registrar
S. N. Bose National Centre for Basic Sciences
Kolkata

Prof.Sunandan Gangopadhyay — Permanent Invitee
Head, Department of Astrophysics
and High Energy Physics
S. N. Bose National Centre for Basic Sciences
Kolkata

Prof. Punyabrata Pradhan — Permanent Invitee
Head, Department of Physics of
Complex Systems
S. N. Bose National Centre for Basic Sciences
Kolkata

Prof. Manoranjan Kumar — Permanent Invitee
Head, Department of Condensed
Matter and Materials Physics
S. N. Bose National Centre for Basic Sciences
Kolkata

Prof. Rajib Kr. Mitra — Permanent Invitee
Head, Department of Chemical
and Biological Sciences
S. N. Bose National Centre for Basic Sciences
Kolkata

Building Committee

Prof. Tanusri Saha-Dasgupta — Chairperson
Director
S. N. Bose National Centre for Basic Sciences
Kolkata

Mr. Asim Sinha — Member
Chief Engineer (Retired), Electrical, CPWD

A nominee of the DST — Member
Autonomous Institution Division
Department of Science & Technology,
New Delhi

Dr. Tapash Kr. Roy — Member
Associate Professor, Dept. of Civil Engineering
and Superintending Engineer (Acting),
Indian Institute of Engineering Science and Technology
Shibpur.

Ms. Shohini Majumder — Member- Secretary
Registrar
S. N. Bose National Centre for Basic Sciences
Kolkata

Mr. Mithilesh Pande — Special Invitee
Campus Engineer cum Estate Officer,
SNBNCBS, Kolkata

Mr. Suman Saha — Special Invitee
Deputy Registrar (Finance)
SNBNCBS, Kolkata

Consultative Advisory Committee

Prof. Tanusri Saha-Dasgupta — Chairperson
Director
S. N. Bose National Centre for Basic Sciences
Kolkata

Prof. Anjan Barman — Member
Dean (Faculty)
S. N. Bose National Centre for Basic Sciences
Kolkata

Prof. Ranjit Biswas — Member
Dean (Academic Programme)
S. N. Bose National Centre for Basic Sciences
Kolkata

Prof. Punyabrata Pradhan — Member
Head, Department of Physics of Complex Systems
S. N. Bose National Centre for Basic Sciences
Kolkata

Dr. Sunandan Gangopadhyay — Member
Head, Department of Astrophysics and High Energy Physics
S. N. Bose National Centre for Basic Sciences
Kolkata

Prof. Rajib Kr. Mitra — Member
Head, Department of Chemical and Biological Sciences and Macromolecular Sciences
S. N. Bose National Centre for Basic Sciences
Kolkata

Prof. Manoranjan Kumar — Member
Head, Department of Condensed Matter and Materials Physics
S. N. Bose National Centre for Basic Sciences
Kolkata

Ms. Shohini Majumder — Member
Registrar
S. N. Bose National Centre for Basic Sciences
Kolkata

Mr. Debashish Bhattacharjee — Member
Deputy Registrar (Administration)
S. N. Bose National Centre for Basic Sciences
Kolkata

Mr. Suman Saha — Member
Deputy Registrar (Finance)
S. N. Bose National Centre for Basic Sciences
Kolkata

Ms. Nibedita Konar — Member - Secretary
Deputy Registrar (Academic)
S. N. Bose National Centre for Basic Sciences
Kolkata

Official Language Implementation Committee

Prof. Tanusri Saha-Dasgupta — Chairperson
Director
S. N. Bose National Centre for Basic Sciences
Kolkata

Ms. Shohini Majumder — Member
Registrar
S. N. Bose National Centre for Basic Sciences
Kolkata

Prof. Manoranjan Kumar — Member
Professor & Head, Department of Condensed Matter and Materials Physics
S. N. Bose National Centre for Basic Sciences
Kolkata

Dr. Nitesh Kumar — Member
Assistant Professor
S. N. Bose National Centre for Basic Sciences
Kolkata

Mr. Debashish Bhattacharjee — Member
Deputy Registrar (Administration)
S. N. Bose National Centre for Basic Sciences
Kolkata

Ms. Nibedita Konar — Member
Deputy Registrar (Academic)
S. N. Bose National Centre for Basic Sciences
Kolkata

Mr. Suman Saha — Member
Deputy Registrar (Finance)
S. N. Bose National Centre for Basic Sciences
Kolkata

Mr. Mithilesh Kumar Pande — Member
Campus Engineer cum Estate Officer
S. N. Bose National Centre for Basic Sciences
Kolkata

Mr. Sirsendu Ghosh — Member
In-charge, Hindi Cell
S. N. Bose National Centre for Basic Sciences
Kolkata

ACADEMIC MEMBERS 2024-25

ACADEMIC MEMBERS (REGULAR FACULTIES): 2024-2025 [01.04.2024 - 31.03.2025]

Sl. No.	Name of the faculty	Designation
1	Tanusri Saha Dasgupta	Director & Senior Professor : CMMP
2	Archan S Majumdar	Senior Professor : AHEP
3	Kalyan Mandal [Retired on 30.09.2024]	Senior Professor : CMMP
4	Amitabha Lahiri [Retired on 28.02.2025]	Senior Professor : AHEP
5	Priya Mahadevan	Senior Professor : CMMP
6	Ranjit Biswas	Senior Professor : CBS
7	Samir Kumar Pal	Senior Professor : CBS
8	Anjan Barman	Senior Professor : CMMP
9	Jaydeb Chakrabarti	Senior Professor : PCS
10	Rajib Kumar Mitra	Senior Professor : CBS
11	Prosenjit Singha Deo	Professor : PCS
12	Soumen Mondal	Professor : AHEP
13	Manik Pradhan	Professor : CBS
14	Punyabrata Pradhan	Professor : PCS
15	Manoranjan Kumar	Professor : CMMP
16	Sakuntala Chatterjee	Professor : PCS
17	Sunandan Gangopadhyay	Professor : AHEP
18	Ramkrishna Das	Associate Professor : AHEP
19	Suman Chakrabarty	Associate Professor : CBS
20	Atindra Nath Pal	Associate Professor : CMMP
21	Thirupathaiah Setti	Associate Professor : CMMP
22	Manik Banik	Associate Professor : PCS
23	Urna Basu	Associate Professor : PCS
24	Shubhasis Haldar	Associate Professor : CBS
25	Tapas Baug	Associate Professor : AHEP
26	Avijit Chowdhury	Associate Professor : CMMP
27	Pradip S Pachfule	Associate Professor : CBS
28	Sanjoy Choudhury	Scientist 'E'
29	Nitesh Kumar	Assistant Professor : CMMP
30	Arijit Haldar	Assistant Professor : PCS
31	Saquib Shamim	Assistant Professor : CMMP
32	Parijat Dey	Assistant Professor : AHEP
33	Barun Ghosh [From 04.11.2024]	Assistant Professor : CMMP

AHEP : Department of Astrophysics and High Energy Physics
CBS : Department of Chemical and Biological Sciences
PCS : Department of Physics of Complex Systems
CMMP : Department of Condensed Matter and Materials Physics

ADMINISTRATIVE AND TECHNICAL STAFF MEMBERS

Shohini Majumder	Registrar
Kalyan Mandal	Vigilance Officer [till 17.09.2024]
Suman Chakrabarty	Part-time Chief Vigilance Officer [w.e.f. 18.09.2024]
Debashish Bhattacharjee	Public Information Officer

OTHER MEMBERS

Saumen Adhikari	Librarian cum Information Officer
Nibedita Konar	Deputy Registrar (Academic)
Debashish Bhattacharjee	Deputy Registrar (Administration)
Suman Saha	Deputy Registrar (Finance)
Mithilesh Kumar Pande	Campus Engineer cum Estate Officer
Santosh Kumar Singh	Assistant Registrar (Purchase)
Sirsendu Ghosh	Programme Coordinating Officer
Achyut Saha	Personal Assistant to Director
Swapnamoy Datta	Stenographer
Sanchari Dasgupta	Assistant (General)
Jaydeep Kar	Programme Assistant
Prosenjit Talukdar	Programme Assistant
Subham Paul	Pump Operator
Bijoy Kumar Pramanik	Junior Assistant (Guest House) *[superannuated on 30.06.2024]*
Bhupati Naskar	Library Stack Assistant
Siddhartha Chatterjee	Upper Division Clerk
Swarup Dutta	Project Assistant
Amit Ghosh	Attendant
Swapan Ghosh	Attendant
Rajarshi Barman	Attendant
Suprobhat Naskar	Attendant
Tufan Maitra	Driver *[joined w.e.f. 01.05.2024]*
Anirban Bhattacharya	Attendant *[joined w.e.f. 19.06.2024]*

PERSONNEL WITH TEMPORARY STATUS

Dulal Chatterjee	Attendant (Maintenance)
Sudhanshu Chakraborty	Attendant (Technical Cell)
Hiralal Das	Cleaner
Kartick Das	Cleaner
Motilal Das	Cleaner
Prakash Das	Cleaner
Ramchandra Das	Cleaner
Nimai Naskar	Gardener

PERSONNEL ON CONTRACT WORKING IN THE ADMINISTRATION

A.K.Sarkar	Advisor (Finance) *[released w.e.f. 13.06.2024]*
B.S.Panda	Consultant (Legal)
Sutapa Basu	PS to Registrar
Deblina Mukherjee	Junior Computer Engineer
Amit Roy	Technical Assistant (Library)

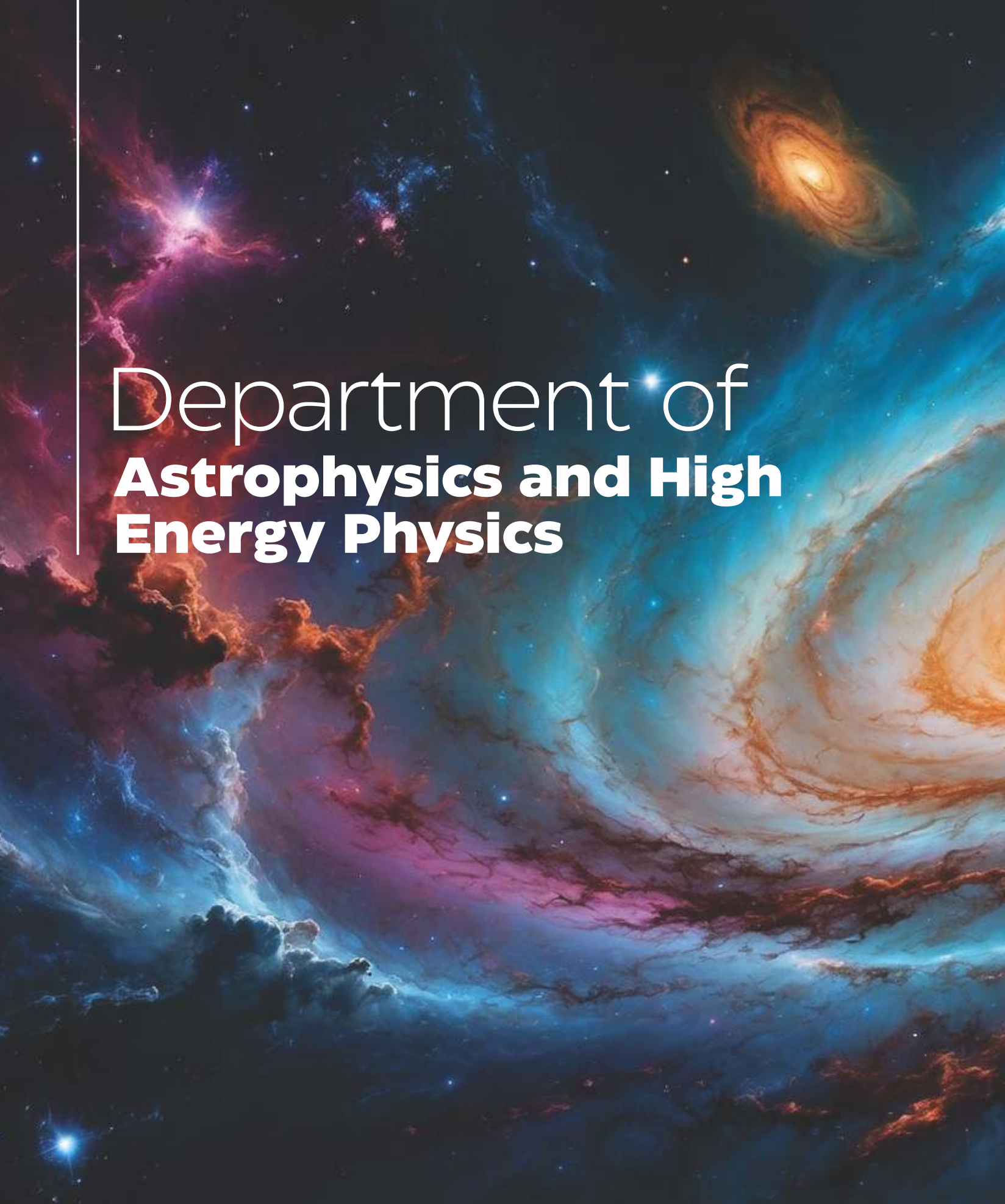
Gurudas Ghosh	Technical Assistant (Library)
Ananya Sarkar	Technical Assistant (Library)
Shakti Nath Das	Technical Assistant
Urmi Chakraborty	Technical Assistant
Amit Kumar Chanda	Technical Assistant
Joy Bandopadhyay	Technical Assistant
Ganesh Gupta	Junior Engineer (Electrical)
Supriyo Ganguly	Junior Engineer (Electrical)
Amitava Palit	Junior Engineer (Civil)
Lakshmi Chattopadhyay	Junior Engineer (Civil)
Chandrakana Chatterjee	Office Assistant
Rupam Porel	Office Assistant
Mitali Bose	Office Assistant
Suvodip Mukherjee	Office Assistant
Sonali Sen	Office Assistant *[resigned w.e.f. 29.11.2024]*
Lina Mukherjee	Jr. Office Assistant
Debasish Mitra	Telephone Operator *[released w.e.f. 29.08.2024]*
Sani Amed Ali Molla	Technician (AC & Refrigeration)
Suranjan Deb	Telephone Technician
Harishikesh Nandi	Glass Blower (Part-time) *[released w.e.f. 12.12.2024]*

STAFF OF OUTSOURCED AGENCY WORKING IN ADMINISTRATION

Mr. Krishnendu Patra	Clerk (Accounts)
Ms. Sanchari Chatterjee	Clerk (Accounts)
Mr. Sourav Roy	Clerk (Accounts) *[resigned w.e.f. 25.01.2025]*
Ms. Renu Singh	Office Assistant (Hindi)
Mr. Arnab Saha	Project Associate II
Mr. Jagadish Prasad Sahoo	Project Associate II
Mr. Debarghya Ghosh	Project Associate II
Mr. Sushanta Sutradhar	Project Associate II *[joined w.e.f. 22.08.2024]*
Mr. Sourav Sinha	Technical Assistant
Mr. Aditya Maitra	Technical Assistant
Mr. Subhabrata Das	Mechanic
Mr. Gobinda Das	Driver
Mr. Prabir Patra	Caretaker
Mr. Subhajit Das	Clerk (Record Keeper)
Mr. Ankit Saha	Clerk (Purchase)

MEDICAL CELL (CONSULTANT PHYSICIANS)

Dr. Chayan Bhattacharya	Authorised Medical Officer
Dr. Sarbani Bhattacharya	Medical Officer
Dr. Tridib Kumar Sarkar	Doctor of Homeopathy



Department of
Astrophysics and High Energy Physics

Amitabha Lahiri

Visiting (Honorary) Fellow
Astrophysics and High Energy Physics
amitabha@bose.res.in

Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Indrajit Ghose; Effect of space-time torsion on fermion dynamics; Ongoing
2. Riya Barick; Neutrino mixing and oscillation via torsional four-fermi interaction; Ongoing
3. Arnab Chakraborty; Spacetime geometry, quantum fields, and discrete symmetries; Ongoing
4. Sagar Maity; Aspects of Fermion Dynamics in Curved Space-time; Ongoing
5. Trisha Mishra; Aspects of dynamically generated torsion (tentative); Ongoing; Jointly with Dr. Parijat Dey

Teaching

1. 2024 Autumn; Quantum Mechanics; (PHY 405); IPhD; 11
2. 2025 Spring; Electromagnetic Theory (PHY 402); IPhD; 11
3. 2025 Spring; Quantum Mechanics II (PHY 406); IPhD; 11; P. Singha Deo

Publications

a) In journals

1. Riya Barick, Indrajit Ghose & **Amitabha Lahiri**, *Effect of spacetime geometry on neutrino oscillations*, The European Physical Journal Plus, 139, 461, 2024
2. Balasubramanian Ananthanarayan, Souradeep Das, **Amitabha Lahiri**, Suhas Sheikh & Sarthak Talukdar, *Group theory in physics: an introduction with mathematica*, European Physical Journal Special Topics, 233, 1443-1513, 2024
3. Arnab Chakraborty & **Amitabha Lahiri**, *Parity nonconservation induced by spacetime geometry*, The European Physical Journal Plus, 139, 955, 2024
4. Shibendu Gupta Choudhury, Sagar Kumar Maity & **Amitabha Lahiri**, *Torsional four-fermion interaction and the Raychaudhuri equation*, The European Physical Journal C, 84, 1304, 2024

b) Other Publications

I Conference proceedings / Reports / Monographs

1. Indrajit Ghose, Riya Barick, and Amitabha Lahiri, Neutrino Oscillation in Curved Spacetime, 25th DAE-BRNS High Energy Physics Symposium, Mohali, Springer Proc. Phys. 304, 977, (2024)

Talks / Seminars Delivered in reputed conference / institutions

1. Gravity as a theory of connections on a frame bundle; Workshop on University of Connecticut; July 2024
2. Torsional four-fermion interaction: phenomenological implications; Conference on Classical and Quantum Gravity; Cochin University of Science and Technology; November 2024

Conference / Symposia / Schools organized

1. Superconductivity, Superfluidity and Quantum Magnetism; SNBNCBS/ Bishwa Bangla Convention Centre, Kolkata; Organizer; November 12-16, 2024

Scientific collaborations with other national / international institutions (based on joint publications)

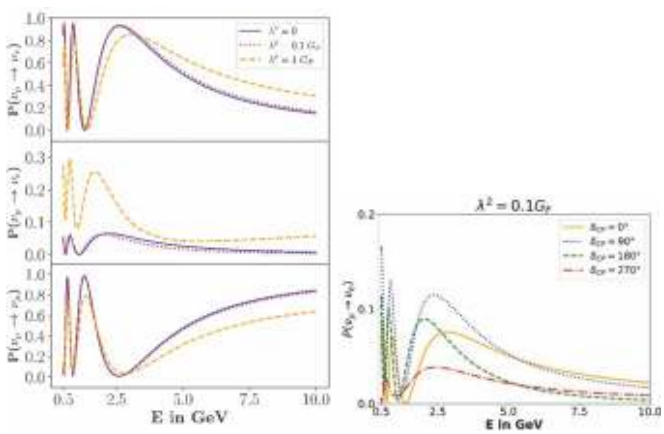
1. Sl. No. 2; National

Areas of Research

Fermions on curved spacetime and dynamically generated torsion; effect of torsion on the gravitational collapse of a fermion gas; torsional four-fermion interaction and its effect on neutrino oscillations; parity violation in electron-electron scattering and electron-deuteron scattering due to torsion.

The description of fermion dynamics on a curved spacetime requires a spin connection, which is analogous to the gauge field of Yang-Mills theory. This naturally leads to what is called a first order formulation of gravity, which contains, in addition to the metric, a spacetime torsion field. The coupling of fermions to this torsion field is generically chiral and non-universal. Furthermore, this torsion field does not have any dynamics and can be eliminated from the action, leaving behind a parity-violating four-fermion interaction in addition to ordinary Einstein gravity. In several of my papers this year, I have looked at various aspects of the four-fermion interaction.

In the paper [1] with two students, I wrote down the Hamiltonian for the evolution of neutrino flavors after matter affects due to the torsional four-fermion interaction are added to the usual weak interactions. By taking the torsional interaction in the mass basis of the neutrinos, we considered the conversion of neutrino flavors in the upcoming DUNE experiment. We found that even when the strength of this new interaction is no more than 10% of that of weak interactions, there are visible differences in probabilities of conversion of muon neutrinos to other flavors. Furthermore, the interaction violates Parity, so the effect of the CP phase in flavor mixing should be affected by the strength of this interaction. We found that that indeed the effect of the CP phase on conversion probabilities is highly enhanced.



Parity violation due to the torsional interaction should be observable in scattering processes. With a student, I looked into electron-electron and electron-deuteron elastic scattering processes which show parity violation due to weak interactions. We found that the new interaction contributed to these processes and it was possible to calculate bounds on the coupling constants, based on the error bars of observed Parity violation. These findings were published in the paper [3].

The new interaction being non-classical – it couples to the spin of fermions – it is interesting to investigate how it affects the gravitational collapse of a gas of fermions. With a post-doc and a student, I studied the collapse by treating the interaction in a semi-classical manner with the gas being taken as dilute and at high temperature. Assuming a plane wave decomposition of the fermion fields and taking a thermal average of the currents, we looked at the Raychaudhuri equation and found that for suitable choices of the coupling constants, this interaction could slow down or speed up gravitational collapse. The results were published in the paper [4].

Plan of Future Work Including Project

We will continue to investigate, with students and collaborators, both the structure and the phenomenological implications of the torsional four-fermion interaction. Since this is a current-current interaction, it is more likely to have observable effects in neutrino processes, as neutrinos are electrically neutral. Therefore we plan to look into various phenomena associated to neutrino oscillations.

Neutrinos are copiously produced in supernovae collapse and interact very weakly with the matter in the star, so they provide an excellent probe into the inner structure of the collapsing supernova. The self-interaction of neutrinos induced by torsion affects the passage of neutrinos through the collapsing star. We plan to look at its effect on the flavor dynamics of neutrinos in models of core-collapse supernova. We also plan to look at its effect on atmospheric neutrinos and their oscillations as they propagate upward through the earth. We will also study how the neutrino spectrum depends on the CP phase angle in the presence of this interaction. We also plan to do a deeper investigation into DUNE neutrinos – specifically, getting estimates of the torsional coupling constants using a chi-square analysis and then using those, probing the hierarchy, octant and CP sensitivity at DUNE.

We also plan to look at the effect of this interaction in settings without neutrinos, for example in processes involving quarks, whose flavor eigenstates and mass eigenstates are related by the Cabbibo-Kobayashi-Maskawa matrix. We plan to look for signatures of the torsional interaction in scattering processes involving hadrons and also charged leptons. We also plan to look at geodesics in presence of this interaction.

In other topics, we plan to finish and publish a couple of papers, based on work that was done in the past couple of years, on vortex strings in bulk matter. One of them is about electron-vortex interactions in presence of a parity violating (axion) term, another one is about the formation and properties of a Skyrmion-vortex composite in bulk ferromagnetic superconductors.

Any other Relevant Information including social impact of research

1. Member, Editorial Board, Physics News (Indian Physical Association)
2. **Social impact of research:** Like all research in basic science, my work will add to what we know about the universe and the theories that describe it. We have proposed the existence of a new fundamental interaction which is weak enough that it is not seen in everyday phenomena, but not so weak that it cannot be discovered through precision experiments. It will lead to new descriptions of the motion of fermions in curved spacetime and will suggest precision measurements of Parity and CP violation. It will lead to an understanding of the interaction of electrons with magnetic flux tubes in type-II superconductors and may also help in understanding the confinement of quarks inside mesons and baryons. During the course of my research, many new students are trained who in turn will train more students in future and carry forward scientific research in the country.

Archan Subhra Majumdar

Senior Professor
Astrophysics and High Energy Physics
archan@bose.res.in

Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Arnab Sarkar; Gravitation and Cosmology; Awarded
2. Subhankar Bera; Quantum Information; Thesis Submitted
3. Arun Kumar Das; Quantum Information; Under Progress
4. Shashank Sekhar Pandey; Gravitation and Cosmology; Under Progress
5. Bivas Mallik; Quantum Information; Under Progress
6. Saheli Mukherjee; Quantum Information; Under Progress
7. Pritam Roy; Quantum Information; Under Progress
8. Sudip Chakraborty; Quantum Information; Under Progress
9. Subhadeep Mukherjee; Gravitation and Cosmology; Under Progress

b) Post-Docs

1. Amit Kundu; Quantum Information

c) External Project Students / Summer Training

1. Shreyas Bhattacharjee; Scalar fields in high energy physics and cosmology

Teaching

1. Autumn Semester; Project Research PHY 691; PhD; 1 student
2. Spring Semester; Project Research III PHY 502; Integrated PhD; 2 students
3. Spring Semester; Astrophysics and Astronomy PHY 504; Integrated PhD; 10 students; Shared with Soumen Mondal

Publications

a) In journals

1. Pritam Roy, Subhankar Bera, Shashank Gupta & **A. S. Majumdar**, *Device-independent quantum secure direct communication under non-Markovian quantum channels*, Quantum Information Processing, 23, 170, 2024
2. Arindam Mitra, Debashis Saha, Samyadeb Bhattacharya and **A. S. Majumdar**, *Relating completely positive divisibility of dynamical maps with compatibility of channels*, Physical Review A, 109, 062213, 2024
3. Shashank Shekhar Pandey, Ashadul Halder, and **A. S. Majumdar**, *Analyzing the 21-cm signal brightness temperature in the Universe with inhomogeneities*, Physical Review D, 110, 043531, 2024
4. Partha Nandi, Nandita Debnath, Subhajit Kala and **A. S. Majumdar**, *Magnetically induced Schrödinger cat states: The shadow of a quantum space*, Physical Review A, 110, 032204, 2024
5. Arnab Mukherjee, Sunandan Gangopadhyay and **Archan S. Majumdar**, *Single and Entangled Atomic Systems in Thermal Bath and the Fulling-Davies-Unruh Effect*, Quanta, 14, 1-27, 2025

6. Bivas Mallick; Sudip Chakrabarty; Saheli Mukherjee, Ananda G. Maity and **A. S. Majumdar**, *Efficient detection of nonclassicality using moments of the Wigner function*, Physical Review A, 111, 032406, 2025

Independent publications of student/s

7. Bivas Mallick and Sumit Nandi, *Genuine entanglement detection via projection map in multipartite systems*, Physica Scripta, 99, 10, 2024
8. Saheli Mukherjee, Bivas Mallick, Sravani Yanamandra, Samyadeb Bhattacharya and Ananda G. Maity, *Interplay between the Hilbert-space dimension of a control system and the memory induced by a quantum switch*, Physical Review A, 110, 042624, 2024

b) Other Publications

i) Conference proceedings / Reports / Monographs

1. S. S. Pandey, A. Sarkar, A. Ali, and A. S. Majumdar, "Effect of Inhomogeneities on the Propagation of Gravitational Waves from Binaries of Compact Objects", Proceedings of the XXV DAE-BRNS High Energy Physics (HEP) Symposium 2022, Eds., S. Jena, et al., Springer Nature Singapore, p. 538 (2024)

Talks / Seminars Delivered in reputed conference / institutions

1. International Conference on Classical and Quantum Optics; 16/12/2024; IISST Thiruvananthapuram; 40 minutes
2. QM Centennial Seminar; 19/02/2025; CQuERE TCG Crest; 60 minutes
3. Bose - 130 Workshop; 28/02/2025; IIT Kharagpur Research Park; 30 minutes
4. Recent Trends in Applied Mathematics; 07/03/2025; Calcutta University; 45 minutes

Conference / Symposia / Schools organized

1. XXVI DAE BRNS Symposium on High Energy Physics (Member, National Organizing Committee); 16/12/2024; BHU Varanasi; 5 days
2. National Symposium on Quantum Information and Foundations (Member, Advisory Committee); 10/02/2025; PAMU, ISI Kolkata; 3 days

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. QuNu Labs, Bengaluru; Sl. No. 1; National
2. IISER Thiruvananthapuram; Sl. No. 2; National
3. IIIT Hyderabad; Sl. No. 2; National
4. Univ. Stellenbosch; Sl. No. 4; International
5. IIIT Hyderabad; Sl. No. 8; National

Outreach program organized / participated

1. Interdisciplinary Workshop on Quantum Metaphysics, Kalyani University, September 2024

Areas of Research

Quantum Information and Foundations; Gravitation and Cosmology

The role of CP-indivisibility and incompatibility as valuable resources for various information-theoretic tasks is widely acknowledged. We explore the intricate relationship between CP-divisibility and channel compatibility. Our investigation focuses on the behaviour of incompatibility robustness of quantum channels for a pair of generic dynamical maps. We show that the incompatibility robustness of channels is monotonically non-increasing for a pair of generic CP-divisible dynamical maps. Further, our explicit study of the behaviour of incompatibility robustness with time for some specific dynamical maps reveals non-monotonic behaviour in the CP-indivisible regime. Additionally, we propose a measure of CP-indivisibility based on the incompatibility robustness of quantum channels. Our investigation provides valuable insights into the nature of quantum dynamical maps and their relevance in information-theoretic applications.

Schrodinger cat states, which are superpositions of macroscopically distinct states, are potentially critical resources for upcoming quantum information technologies. We introduce a scheme to generate entangled Schrodinger cat states in a non-relativistic electric dipole system situated on a two-dimensional plane, along with an external potential and a uniform strong magnetic field perpendicular to the plane. Additionally, our findings demonstrate that this setup can lead to the phenomenon of collapse and revival of entanglement for a specific range of our model parameters.

States with negative Wigner function, a significant subclass

of non-classical states, serve as a valuable resource for various quantum information processing tasks. Here, we provide a criterion for detecting such quantum states characterized by negative Wigner function. Our method relies on evaluating moments of the Wigner function which involves computing simple functionals and can be implemented in a real experiment without the need for full state tomography or Wigner function reconstruction. We provide explicit examples to support our detection scheme. Further, we propose an experimental method utilizing the continuous variable SWAP operator to realize these moments in a real experiment.

We explore the 21-cm signal in our Universe containing inhomogeneous matter distribution at considerably large scales. Employing Buchert's averaging procedure in the context of a model of spacetime with multiple inhomogeneous domains, we evaluate the effect of our model parameters on the observable 21-cm signal brightness temperature. Our model parameters are constrained through the Markov Chain Monte Carlo method using the Union 2.1 supernova Ia observational data. We find that a significant dip in the brightness temperature compared to the ΛCDM prediction could arise as an effect of the inhomogeneities present in the Universe.

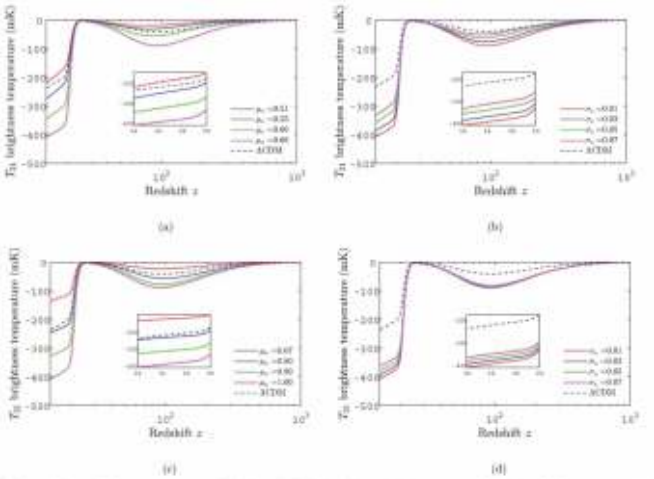


FIG. 4. Plots of brightness temperature T_{21} for the ΛCDM model and our backreaction model for the redshift range $14-1000$. Our backreaction model has 4 parameters that can be varied: $\mu_v, \sigma_v, \mu_\alpha, \sigma_\alpha$. In (a) μ_v is varied with $\sigma_v = \sigma_\alpha = 0.01$ and $\mu_\alpha = 1$ fixed. In (b) σ_v is varied with $\mu_v = 0.66$, $\sigma_\alpha = 0.01$ and $\mu_\alpha = 1$ fixed. In (c) μ_α is varied with $\sigma_v = \sigma_\alpha = 0.01$ and $\mu_v = 0.66$ fixed. In (d), σ_v is varied with $\sigma_\alpha = 0.01$, $\mu_v = 0.66$ and $\mu_\alpha = 1$ fixed. The value of H_0 (Hubble parameter at the present time) used is $100\,h$ km s^{-1}Mpc^{-1} where $h = 0.7$. The insets show the plot lines in the redshift range of our interest.

Plan of Future Work Including Project

Measurement incompatibility has proved to be an important resource for information processing. We present an operational approach that leverages classical operations on the inputs and outputs of measurement devices to explore different layers of incompatibility among the measurements performed by the device. We study

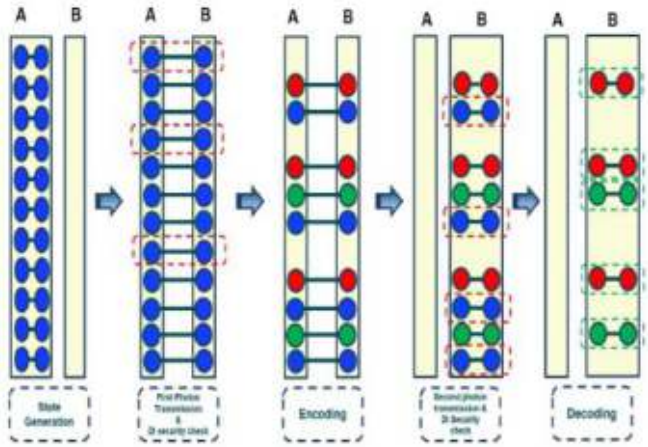


FIG. 2: Schematic diagram for QSDC protocol (Red colour entangled pair photons are $|\psi^+\rangle$, green colour entangled pair photons are $|\psi^-\rangle$ and blue colour entangled pair photons are $|\phi^+\rangle$.).

classifications of measurement incompatibility with respect to two types of classical operations, *viz.*, coarse-graining of measurement outcomes and disjoint-convex-mixing of different measurements. We derive analytical criteria for determining when a set of projective measurements is fully incompatible with respect to coarse-graining or disjoint-convex-mixing. Robustness against white noise for different layers of incompatibility for mutually unbiased bases is investigated. Furthermore, we study operational witnesses for incompatibility subject to these classical operations, using the input-output statistics of Bell-type experiments as well as for experiments in the prepare-and-measure scenario.

Finding a set of empirical criteria fulfilled by any theory that satisfies the generalized notion of noncontextuality is a challenging task of both operational and foundational importance. The conventional approach of deriving facet inequalities from the relevant noncontextual polytope is computationally demanding. An alternative methodology consists of constructing a polytope that encompasses the actual noncontextual polytope while ensuring that the dimension of the polytope associated with the preparations remains constant regardless of the number of measurements and their outcome size. The facet inequalities of the latter polytope serve as necessary conditions for noncontextuality. Here we present a detailed analysis of the outlined methodology. We next apply it to nine distinct contextuality scenarios involving four to nine preparations and two to three measurements to obtain the respective sets of facet inequalities. Additionally, we elaborate on the techniques used to retrieve the maximum quantum violations of these inequalities. Our investigation uncovers many novel non-trivial noncontextuality

inequalities and reveals intriguing aspects and applications of quantum contextual correlations.

Higher-dimensional entanglement is a valuable resource for several quantum information processing tasks, and is often characterized by the Schmidt number and specific classes of entangled states beyond qubit-qubit and qubit-qutrit systems. We propose a criterion to detect high-dimensional entanglement, focusing on determining the Schmidt number of quantum states and identifying significant classes of PPT and NPT entangled states. Our approach relies on evaluating moments of generalized positive maps which can be efficiently simulated in real experiments without the requirement of full-state tomography. We demonstrate the effectiveness of our detection scheme through various illustrative examples. As a direct application, we explore the implications of our moment-based detection schemes in identifying useful quantum channels such as non-Schmidt number breaking channels and non-entanglement breaking channels. Finally, we present an operational implication of our proposed moment criterion through its manifestation in channel discrimination tasks.

Quantum networks offer a compelling platform for probing nonlocal correlations beyond the Bell scenario. While network nonlocality has been well studied in discrete-variable (DV) systems, its exploration in continuous-variable (CV) systems remains limited. We study the bilocal scenario, the simplest quantum network, in a CV framework using pseudospin measurements. We show that two-mode squeezed vacuum (TMSV) states violate the bilocality inequality for any nonzero squeezing, with the violation increasing monotonically and reaching the algebraic maximum in the infinite squeezing limit. The robustness of this violation is explored in presence of local thermal noise. Next, we demonstrate nonbilocality in two key non-Gaussian states, *viz*., the entangled coherent state and the CV Werner state. Finally, we investigate the enhancement of nonbilocal correlations through photon subtraction applied to the TMSV state. We show that a coherent superposition of single-photon subtractions across modes enables maximal bilocality violation even at zero squeezing, demonstrating non-Gaussianity as a strong resource in the low-squeezing regime. Our findings underscore the potential of CV systems for realizing network-based quantum correlations.

We consider the 21 cm brightness temperature as a probe of the Hubble tension in the framework of an inhomogeneous cosmological model. Employing Buchert's averaging formalism to study the effect of inhomogeneities on the background evolution, we consider scaling laws for the backreaction and curvature consistent with structure formation simulations. We calibrate the effective matter density using MCMC analysis using Union 2.1 Supernova Ia data. Our results show that a higher Hubble constant $\sim$ 73 km/s/Mpc leads to a shallower absorption feature in the brightness temperature versus redshift curve. On the other hand, a lower value $\sim$ 67 km/s/Mpc produces a remarkable dip in the brightness temperature T_{21}. Such a substantial difference is absent in the standard CDM model. Our findings indicate that inhomogeneities could significantly affect the 21 cm signal, and may shed further light on the different measurements of the Hubble constant.

Parijat Dey

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Guidance of Students/Post-Docs

a) Ph.D. Students

1. Dipyendu Dhar; Constraining correlation functions in conformal field theory; Renormalisation group flow analysis in conformal field theories with wedge; Under Progress
2. Trisha Mishra; Neutrino physics; Under Progress

b) Post-Docs

1. Semanti Dutta; Entanglement entropy in periodically driven systems

c) External Project Students / Summer Training

1. Aniket Ghosh; Spherically symmetric solution to Einstein's equation
2. Saswata Chatterjee; Aspects of curved space-time
3. Bipasa Hazra; Critical Exponent Calculation of Ising Model From Conformal Field Theory

Teaching

1. Autumn Semester; Nuclear and Particle Physics PHY 507; Integrated PhD; 14 students
2. Spring Semester; Project Research III (PHY 502); Integrated PhD; 1 student
3. Autumn Semester; Project Research I (PHY 509); Integrated PhD; 1 student

Publications

a) In journals

1. **Parijat Dey** and Kausik Ghosh, *Bootstrapping conformal defect operators on a line*, Journal of High Energy Physics, 2024, 129, 2924

Talks / Seminars Delivered in reputed conference / institutions

1. Invited talk at ICTS Bengaluru on "Correlators in conformal field theory with defect"; 08/05/2024; International Centre for Theoretical Sciences of the Tata Institute of Fundamental Research (ICTS-TIFR), Bengaluru; 07-09 May, 2024
2. Invited talk at IISER Pune in the workshop on "Future Perspectives on QFT and Strings"; 24/07/2024; Workshop on "Future Perspectives on QFT and Strings", at IISER Pune; July 24-27, 2024
3. Invited talk at Women in Quantum Science and Technologies conference held at SNBNCBS; 19/07/2024; Women in Quantum Science and Technologies conference held at SNBNCBS; July 17-19, 2024
4. Invited talk at SINP, Kolkata on "Correlators in conformal field theory with defect"; 29/10/2024; Saha Institute of Nuclear Physics, Kolkata; October 29, 2024

Administrative duties

1. Participated in the Leadership Development Workshop " Women in Space and Allied Sciences Leadership Programme", February 11-14, 2025 at JNCASR, Bengaluru, organised by WISE-KIRAN Division, DST, in collaboration with the British Council under the UK-India, Education and Research Initiative (UKIERI)
2. Member of Syllabus modification Committee, SNBNCBS

3. Annual evaluation committee member of several research scholars
4. IPhD and PhD interview committee member, June 2024
5. Member of ARPAC brochure committee, 2025

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. Prime Minister Early Career Research Grant ANRF; Anusandhan National Research Foundation (ANRF); 3 years; PI

Conference / Symposia / Schools organized

1. Women in Quantum Science and Technologies conference (co-convener); 17/07/2024; S. N. Bose National Centre for Basic Sciences, Kolkata; July17-19, 2024

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. Published a paper titled "Bootstrapping conformal defect operators on a line" in Journal of High Energy Physics, 10 (2024) 129, 2024 with Dr. Kausik Ghosh from ENS, Paris; Sl. No. 1; International

Outreach program organized / participated

1. Delivered a lecture on "Scattering in quantum mechanics" in the C K Majumdar Memorial Summer Workshop in Physics, held at SNBNCBS in July 2024
2. Delivered a seminar on "Journey of physics: from classical foundations to relativity" at the IAP-WiSTEMM programme "Interaction with the undergraduate girl students studying Sciences"- on February 1, 2025 at the SNBNCBS

Areas of Research

Theoretical High energy physics:

1. Conformal field theory (Exploring cosmological correlators using the tools of conformal field theory, Understanding renormalisation group flows in theories with conformal defects)
2. Quantum gravity (Bulk reconstruction in the context of black holes)
3. Holographic techniques (Holographic entanglement entropy and its quantum correction)

Plan of Future Work Including Project

We aim to investigate whether a holographic correspondence can be established between a quantum gravity theory in de Sitter (dS) spacetime and a conformal field theory (CFT) living on its boundary. Since the inflationary universe closely resembles dS spacetime, such a holographic framework could provide deeper insights into our actual universe. To explore this, we will analyze cosmological correlators of conformally coupled, interacting scalar fields in dS space. Using the Schwinger-Keldysh formalism, this theory can be reformulated as an effective field theory in Euclidean Anti-de Sitter space. By applying conformal bootstrap techniques, we can extract the CFT data associated with these scalar fields, particularly focusing on their Mellin space sum rules. Subsequently, we will use these correlators-along with principles from dS/CFT-to constrain possible local bulk interactions in de Sitter spacetime.

We aim to investigate how entanglement entropy evolves in a conformal field theory (CFT) subjected to periodic driving. These driven CFTs provide a simplified framework for studying black hole scrambling, thermalization in quantum systems, and quantum circuit complexity. Such systems exhibit three distinct dynamical phases: a heating phase, a non-heating phase, and a critical phase transition point. Using holographic methods, we seek to analyze the entanglement properties in each of these regimes. Specifically, we interpret the entanglement entropy through its dual geometric description in the bulk, where it corresponds to the area of a minimal surface. Furthermore, we explore quantum corrections to this entropy-as proposed by Faulkner, Lewkowycz, and Maldacena-from the bulk perspective. This involves computing holographic entanglement entropy for time-dependent surfaces in the gravitational dual.

Many body quantum systems with restricted geometries appear in different physical systems. Such deformed geometry leads to partial breaking of translational invariance which makes it challenging to predict the dynamics in a controllable way. These systems are described by conformal field theories (CFTs) with intersecting boundaries that capture the corner and edge effects at criticality. This setup is known as wedge CFT (WCFT). In addition to bulk observables, the wedge-shaped geometry gives rise to new set of observables localised on the edge or surface. The dynamics of WCFT is captured by

the spectrum and expansion coefficients of local operators, known as wedge CFT data. The interplay between bulk, surface and edge observables makes the structure richer than the usual CFT without boundaries or edges. The WCFT data can be computed by probing the correlation functions of local operators. This area of research is largely unexplored and general results related to edge observables are missing. We aim to explore WCFT using the framework of quantum field theory and renormalisation group. We consider scalar fields in the bulk perturbed by a relevant interaction on the edge or the boundary. The goal is to identify the fixed points of WCFTs and how they are connected by RG flows from ultaviolet to infrared. The renormalisation of the Lagrangian can be studied using dimensional regularisation. The running of the edge coupling constant, namely the beta function and fixed point can be computed. This will help us compute the correlation functions in presence of running edge couplings using the Feynman diagrams. From the explicit expressions of the bulk one point functions and bulk-edge two point functions we can extract the WCFT data. We will also tune boundary interactions and understand the dependence of the interplay between edge and boundary renormalizations. We would like to understand if these RG flows are irreversible.

Ramkrishna Das

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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Swastik Sardar; Multi-wavelength study of Wolf-Rayet stars; Under Progress
2. Gesesew Reta Habtie; Study of Novae; Awarded
3. Subhajit Kar; Multi-wavelength study of Wolf-Rayet stars; Thesis Submitted
4. Avijit Mondal; Multi-wavelength study of Planetary Nebulae; Under Progress
5. Sakshi Chaudhary; Multi-wavelength study of Novae; Under Progress

b) Post-Docs

1. Tridib Roy; Study of pulsars

c) External Project Students / Summer Training

1. Sujoy Banerjee; Cepheid Variable stars and estimation of distances
2. Bhaskar Mondal; Telescope and Detectors

Teaching

1. Spring Semester; Astrophysics; PhD; 8 students; Shared with Prof. Soumen Mondal
2. Spring Semester; Techniques in Observational Astronomy; PhD; 8 students; Shared with Dr. Tapas Baug
3. Spring Semester; Advanced Laboratory Course: Experiments in Observational Astronomy; Integrated PhD; 15 students
4. Spring Semester; Astronomy & Astrophysics; Integrated PhD; 15 students; Shared with Prof. Soumen Mondal

Publications

a) In journals

1. Samrat Ghosh, Soumen Mondal, Somnath Dutta, Rajib Kumbhakar, **Ramkrishna Das**, Santosh Joshi, and Sneh Lata, *Dynamic Photometric Variability in Three Young Brown Dwarfs in Taurus: Detection of Optical Flares with TESS Data*, Astrophysical Journal, 981, 75, 2025
2. Gesesew R Habtie, **Ramkrishna Das**, *Spectroscopic study of the quiescent stages in between the 2006 and 2021 outbursts of RS Ophiuchi*, Monthly Notices of the Royal Astronomical Society, 537, 2046-2060, 2025
3. Tridib Roy, Mayuresh Surnis, and **Ramkrishna Das**, *Multiband Polarization Profile Analysis of Three-component Radio Pulsars by Implementing a Relativistic Phase-shift Method*, The Astrophysical Journal, 980, 214, 2025
4. Tridib Roy, Mageshwaran Tamilan, and **Ramkrishna Das**, *Determination of the Analytical Solutions of the Radio Emission Geometry and Polar Cap Structure of Pulsars Having Perturbed Dipole*, The Astrophysical Journal, 980, 65, 2025
5. Subhajit Kar, Rajorshi Bhattacharya, **Ramkrishna Das**, Ylva Pihlström, and Megan O. Lewis, *Classification of Wolf–Rayet Stars Using Ensemble-based Machine Learning Algorithms*, The Astrophysical Journal, 977, 170, 2024
6. M. Sil, A. Das, **R. Das**, R. Pandey, A. Faure, H. Wiesemeyer, P. Hily-Blant, F. Lique and P. Caselli, *Fate and detectability of rare gas hydride ions in nova ejecta: A case study with nova templates*,

Astronomy & Astrophysics, 692, 15, 2024

7. Subhajit Kar, **Ramkrishna Das**, Blesson Mathew, Tapas Baug, and Avijit Mandal, *Detection of High-frequency Pulsation in WR 135: Investigation of Stellar Wind Dynamics*, The Astronomical Journal, 168, 5, 199, 2024
8. Tridib Roy, Mayuresh Surnis & **Ramkrishna Das**, *Absolute emission height determination of the radio emission components of PSR B2111+46 at multiple bands by relativistic phase shift method*, Astrophysics and Space Science, 369, 91, 2024
9. Subhajit Kar, **Ramkrishna Das**, and Tapas Baug, *Investigation of [KSF2015] 1381-19L, a WC9-type Star in the High-extinction Galactic Region*, Astrophysical Journal, 968, 60, 2024

b) Other Publications

i) Conference proceedings / Reports / Monographs

1. The Astronomer's Telegram: G. R. Habtie, R. Das, R. Pandey, "T CrB on the Verge of an Outburst: H alpha Profile Evolution and Accretion Activity", No. 17041, 2025
2. The Astronomer's Telegram: G. R. Habtie, R. Das, "He II Emission Line Became the Most Intense Line in the Optical Spectrum of Nova V1405 Cas", No. 16496, 2024
3. The Astronomer's Telegram: G. R. Habtie, R. Das, "Optical Photometry and Spectroscopy of Nova V1723 Sco (2024) ", No. 16454, 2024

Talks / Seminars Delivered in reputed conference / institutions

1. Invited talk on "Challenges in Observational Astronomy", C K Majumdar Memorial Summer Workshop in Physics; 30/07/2024; S N Bose National Centre for Basic Sciences, Kolkata; 1 hour
2. Talk on "In search of Life in Universe"; 13/12/2024; Gourbanga Mahavidyalaya, Malda, West Bengal; 1 hour
3. Talk on "Role of small Telescopes"; 31/01/2025; Sutragarh M N High School, Shantipur, West Bengal; 1 hour

Administrative duties

1. Liason Officer & Chairperson of the Reservation Cell, SNBNCBS
2. Chairperson, Outreach Programme for the students of SC/ST community, SNBNCBS
3. Member, Conference Workshop and Extension Programmes (CWEP), SNBNCBS
4. Member, Newsletter Committee, SNBNCBS
5. Member, Media Cell, SNBNCBS
6. Member, Library Committee, SNBNCBS

Awards, Recognitions, if any

1. Our research paper titled "Classification of Galactic Wolf Rayet Stars using Supervised Machine Learning methods" was selected as the 'Outstanding Paper' of the 7th Regional Science and Technology Congress, January 2025, Department of Science & technology and Biotechnology, Government of West Bengal.

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. A new Astronomical Observatory under S. N. Bose National Centre for Basic Sciences (S. N. Bose Astronomical Observatory); Submitted to the Department of Science & Technology (DST); 5 years; Co-PI

Conference / Symposia / Schools organized

1. Inauguration of the S N Bose Astronomical Observatory, Panchet, Purulia; 08/01/2025; Purulia, West Bengal; 2 days (8-9 January, 2025)

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. Mayuresh Surnish,Department of Physics, IISER Bhopal; Sl. No. 3, 8; National
2. Mageswaran Tamilan, Department of Space Science and Astronomy, Chungbuk National University, Cheongju 361-763, South Korea; Sl. No. 4; International
3. M. O. Lewis, Leiden Observatory, The Netherlands; Sl. No. 5; International
4. Y. Philstrom, National Radio Astronomy Observatory, Pete V. Domenici Science Operations Center, Socorro, USA; Sl. No.5; International

5. Rajarshi Bhattacharya, Department of Physics and Astronomy, University of New Mexico, 87131 Albuquerque, NM, USA; Sl. No. 5; International
6. Ankan Das, Institute of Astronomy Space and Earth Science, Kolkata, India; Sl. No. 6; National
7. Ruchi Pandey, Physical Research Laboratory, Ahmedabad, India; Sl. No. 6; National
8. A. Faure, Univ. Grenoble Alpes, CNRS, Grenoble, France; Sl. No. 6; International
9. H. Wiesemeyer, Max-Planck-Institut für Radioastronomie, Bonn, Germany; Sl. No. 6; International
10. P. Hily-Blant, Univ. Grenoble Alpes, CNRS, Grenoble, France; Sl. No. 6; International
11. F. Lique, Univ Rennes, CNRS, IPR (Institut de Physique de Rennes) - UMR, Rennes, France; Sl. No. 6; International
12. P. Caselli, Max-Planck-Institute for extraterrestrial Physics, Germany; Sl. No. 6; International
13. Blesson Mathew, Christ University, Bangalore, India; Sl. No. 7; National
14. Soumen Mondal, Department of Astrophysics & High Energy Physics, S N Bose National Centre for Basic Sciences, Kolkata; Sl. No. 1; National
15. Tapas Baug, Department of Astrophysics & High Energy Physics, S N Bose National Centre for Basic Sciences, Kolkata; Sl. No. 7, 9; National

Outreach program organized / participated

1. Organized and participated in the outreach program at the Department of Physics, Gour Mahavidyalaya, Malda, West Bengal on 13 December 2024
2. Organized and participated in the outreach program at Sutragarh MN High School, Shantipur, West Bengal on 31 January 2025
3. Organized "National Space Day" on the 23rd August 2024 at SNBNCBS in collaboration with Regional Remote Sensing Centre East (RRSC), ISRO, Salt Lake, Kolkata. About 100 B.Sc. and M.Sc. students from the surrounding colleges and universities along with the students of SNBNCBS participated in the program
4. Organized sky watching program for the participants of C K M Memorial Summer Workshop on 30 July 2024

Areas of Research

Dr. Ramkrishna Das works in the field of Observational Astronomy. His prime interest is in spectroscopic study of various objects, e.g., Novae, Planetary Nebulae, Massive stars etc. He is also deeply involved in the Centre's Telescope project and working for setting up an Astronomical Observatory on Panchet hill-top, Purulia.

In the previous year he has studied a few such objects (e.g. Novae, Wolf-Rayet stars etc.) with proper scientific aims. The results have been published in the peer reviewed journals . A few interesting results are discussed below.

1. We studied the quiescent stages of the recurrent nova RS Ophiuchi in between the 2006 and 2021 outbursts. We modeled the quiescent phase spectra to understand how the white dwarf primary accretes matter and evolves with time in between two consecutive outbursts. The key finding is that the the accretion rate rose substantially in the later phase. In case of RS Ophiuchi, more than 88% of the critical mass was accreted in the last three years and the accreted mass exceeds 47% of the critical mass in the 16 months, preceding the 2021 outburst (Figure 1) .
2. We studied possibilities of formation of some hydride ions associated with the noble gases in harsh environments like the novae outburst region. We used a photoionization modeling of the moderately fast ONe type nova, QU Vulpeculae (1984), and the CO type novae, RS Ophiuchi and V1716 Scorpii as templates. Our steady-state modeling reveals formation of a convincing amount of HeH^+, especially in the dense clump of RS Ophiuchi and V1716 Scorpii. The calculated upper limit on the surface brightness of HeH^+ transitions suggests that it could be detected with the James Webb Space Telescope (JWST), particularly in the sources like RS Ophiuchi and V1716 Scorpii, which have similar physical and chemical conditions and evolution.
3. We detected high-frequency pulsations in the Wolf-Rayet star WR 135 from short-cadence optical photometric and spectroscopic time series surveys. The harmonics up to the sixth order are detected from the integrated photometric flux variations, while the comparatively weaker eighth harmonic is detected from the strengths of the emission lines. We found that the optically thick subsonic layers of the atmosphere are close to the

Eddington limit and are launched by the Fe opacity. The outer optically thin supersonic winds are launched by the He II and C IV opacities. The stratified winds above the sonic point undergo velocity perturbation that can lead to clumps. In the optically thin supersonic winds, dense clumps of smaller size pulsate with higher-order harmonics. The larger clumps oscillate with lower-order harmonics of the pulsation and affect the overall wind variability.

4. We made a full analysis of the pulsar PSR B2111+46 and estimated the height for both core and conal components at radio wave length regime by using a generalized formula of the relativistic phase shift method, which combines aberration-retardation (A/R) and polar cap current effect (PCC). From the location of the component, we can calculate colatitude and and trace the origin or root of the magnetic field lines. We also have shown the properties and variation of different geometrical parameters and phase shifts concerning the rotation phase.

Plan of Future Work Including Project

1. We are studying few specific novae, planetary novae and massive stars. We already have observed and collected spectroscopic data of those objects. Currently, we are modeling the spectra to understand the system and the related phenomena. We are expecting to complete the analysis and publish the paper soon.
2. The Centre has taken an initiative to build S. N. Bose Observatory at Panchet Hilltop, Purulia, in which I am working as one of the Principal Investigators (PI). A considerable progress has already been made. An Automatic Weather Station, a Mobile Observatory and a Differential Image Motion Monitor (DIMM) system have been installed on the Panchet hilltop for detailed characterization of the weather and sky conditions and data are being taken regularly using the instruments. We will analyze the data and work towards publication of the research paper on the observatory site characteristics.
3. We are testing the back end instruments which will be used with the telescopes installed at Panchet for regular scientific observations.
4. It has been planned to submit a DST SEED proposal in association with Indian Institute of Bio Social Research and Development (IBRAD). As a part of the team, I am working to make a base line study of the villages around Panchet hill which will be used to prepare the proposal.

Any other Relevant Information including social impact of research

1. Dr. Ramkrishna Das is acting as the Coordinator of the Certificate Course in Observational Astronomy introduced by SNBNCBS in association with Sidho-Kanho-Birsha University, Purulia. It includes preparation of the syllabus, assigning courses to the instructors, monitoring the participants, pursuing administrative jobs related to the course etc.
2. In addition to taking regular classes for the IPhD and PhD students of the Centre, he is also regularly taking classes for the students of the above mentioned Certificate course
3. He is regularly reviewing of Observational proposals submitted to Giant Metre Radio Telescope (GMRT), 2-m Himalaya Chandra Telescope (HCT) and 3.6-m Devesthal Optical Telescope (DOT)
4. He has been working as a member of the PhD Committee, Presidency University, Kolkata

Soumen Mondal

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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Siddhartha Biswa (Inspire); Understanding Stellar Activity in M dwarfs; Under Progress
2. Diya Ram (CSIR); Understanding Stellar Activity in M dwarfs; Under Progress
3. Rajib Kumbhakar (Inspire); Studies of Atmospheric Properties of Brown Dwarfs and Low Mass Stars; Under Progress
4. Aman Das (CSIR); M Dwarfs and their planetary companion's atmospheric characterisation in JWST and TESS era; Under Progress
5. Dorothy Museo Mwanzia (TWAS-Bose); Understanding the Atmospheric Properties of Brown Dwarfs and Low Mass Stars; Under Progress; Dr, Geoffrey Okeng'o, University of Nairobi, Supervisor; Dr. Snehlata, ARIES, Co-Supervisor; Dr. John Buers, University of Nairobi, Co-Supervisor
6. Soumita Chakraborty; Understanding of Galactic Star forming Region with Multiwavelength Data; Under Progress
7. Avirup Chakraborty; Mechine Learning on Determination of Stellar Fundamental Parameters; Under Progress

b) Post-Docs

1. Suman Mondal; Physical properties and chemical complexity of Young Stellar Objects in star-forming regions, using observational data

c) External Project Students / Summer Training

1. Soumita Chakraborty; Spectroscopic studies of Adulteration of Milk
2. Sagnik Banerjee; Fundamental of Observational Astronomy

Teaching

1. Spring Semester; Astrophysics and (PHY 604); 4 students; Shared with Dr. Ramkrishna Das
2. Autumn Semester; Basic Laboratory - I (PHY 491); Integrated PhD; 12 students; Shared with Prof. S. K. Pal
3. Spring Semester; Astrophysics and Astronomy (PHY 504); Integrated PhD; 14 students; Shared with Prof. A. S. Majumdar

Publications

a) In journals

1. Diya Ram, **Soumen Mondal**, Dusmanta Patra, Samrat Ghosh, and Rajib Khumbhakar, *Magnetic Activities of AD Leonis: Flares in TESS Data and Optical Spectra*, The Astrophysical Journal, 980, 196, 2025
2. Samrat Ghosh, **Soumen Mondal**, Somnath Dutta, Rajib Kumbhakar, Ramkrishna Das, Santosh Joshi, and Sneh Lata, *Dynamic Photometric Variability in Three Young Brown Dwarfs in Taurus: Detection of Optical Flares with TESS Data*, Astrophysical Journal, 981, 75, 2025
3. Bhaswati Mookerjea, G. Maheswar, Kinsuk Acharyya, Tapas Baug, Prasun Datta, Jessy Jose, D. K. Ojha, Jagadheep D. Pandian, Nirupam Roy,

Manash Samal, Saurabh Sharma, Archana Soam, Sarita Vig, Ankan Das, Lokesh Dewangan, Somnath Dutta, C. Eswariah, Liton Majumdar, Kshitiz Kumar Mallick, **Soumen Mondal**, Joe P. Ninan, Neelam Panwar, Amit Pathak, Shantanu Rastogi, Dipen Sahu, Anandmayee Tej & V. S. Veena, *Research on the interstellar medium and star formation in the Galaxy: An Indian perspective*, Journal of Astrophysics and Astronomy, 46, 3, 2025

4. Dorothy M. Mwanzia, Sneh Lata, W. P. Chen, **Soumen Mondal**, Geoffrey Okeng'o, John Buers, Samrat Ghosh, Athul Dileep, Arjav Jain, Alisher S. Hojaev, and Santosh Joshi, *Stellar Variability toward the Galactic Open Cluster NGC 7209*, Astrophysical Journal, 985, 26, 2025
5. Lopamudra Roy, Amrita Banerjee, Nivedita Pan, Ria Ghosh, Susmita Mondal, Monojit Das, Md Nur Hasan, Soumendra Singh, Arpita Chattopadhyay, Kallol Bhattacharyya, **Soumen Mondal**, Samir Kumar Pal, *A spectroscopy-based proof-of-concept (POC) for developing loading of pathogen analyzer (LOPA) for dairy products*, Heliyon, 10(19), e38735, 2024
6. Rajib Kumbhakar, **Soumen Mondal**, Samrat Ghosh, and Diya Ram, *Starspot Distribution and Flare Events in Two Young Low-mass Stars Using TESS Data*, The Astrophysical Journal, 981, 169, 2025

b) Other Publications

i) Conference proceedings / Reports / Monograph

1. Kumbhakar, Rajib; Mondal, Soumen; Ghosh, Samrat; Ram, Diya; Pramanik, Sudip, - "Rotational Variability and Detection of Superflares in a Young Brown Dwarf by TESS " , Bull. Soc. R. Sci. Liège (BSRSL) , Volume 93, No 2 ,pp. 370-380. 2024
2. Diya Ram, Soumen Mondal, Samrat Ghosh, Santosh Joshi, Dusmanta Patra and Rajib Kumbhakar, - "Understanding the Magnetic Activity of M dwarfs : Optical and Near-Infrared Spectroscopic Studies", Bull. Soc. R. Sci. Liège (BSRSL), Volume 93, No 2 , pp. 358-369, 2024
3. Soumita Chakraborty, Soumen Mondal, Alik Panja, Siddhartha Biswas, Sudip pramanik, Dorothy Museomwanzia and Santosh Joshi,-" Census of Young Stars in Galactic Star Forming Region Sh2-88", Bull. Soc. R. Sci. Liège (BSRSL), Volume 93, No 2, pp. 613-622, 2024
4. Ghosh, Samrat; Mondal, Soumen; Joshi, Santosh; Lata, Sneh; Kumbhakar, Rajib - "Photometric Variability of Low Mass Stars and Brown Dwarfs in IC ~ 348 and Taurus Star-Forming Regions" , Bulletin de la Société Royale des Sciences de Liège (BSRSL), 2024, Volume 93, No 2, pp. 623-6359, 2024
5. Hoque, Ariful; Baug, Tapas; Dewangan, Lokesh; Wang, Ke; Liu, Tie; Mondal, Soumen -"Influence of Mid-infrared Galactic Bubble on Surroundings: A Case Study on IRAS 16489-4431", Bull. Soc. R. Sci. Liège (BSRSL), Volume 93, No 2, pp. 601-612, 2024

Talks / Seminars Delivered in reputed conference / institutions

1. Invited talk "Exploration of Astrophysics using Space Technology" at National Space Day Celebration during 2 to 23 August 2024 on 16.08.2023; 16/08/2024; National Atlas & Thematic Mapping Organization (NATMO) under DST, Govt. of India Sector-V, Saltlake, Kolkata-70091; 45 minutes
2. Invited talk "Astrophysics using Space Technology" at National Space Day on 23rd August 2024 held at SNBNCBS; 23/08/2024; National Space Day on 23rd August 2024 held at SNBNCBS; 30 minutes

Administrative duties

1. Nodal Officer, Technical Research Centre (TRC), SNBNCBS (up to January 2025)
2. External Committees: (i) Member of Academic committee (Board of Studies), School of Astrophysics, Presidency University, Kolkata
3. Internal Committees: Chairman of Internal Standing Technical Committee (ISTC); member in the Project and Patent Cell, and the Faculty search committee members

Patents Taken and Process Developed with Details

1. "A portable point-of-care LOPA-Device (Loading of Pathogen Analyzer) for quantitative detection of pathogens"; Patent Application No: 202431039104, dated 18.05.2024; Applied

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. Technical Research Centre - Phase I and Phase II; DST; January 2016 - December 2020 (Phase I) and January 2021 to December 2025 (Phase II); PI
2. A new Astronomical Observatory under S. N. Bose National Centre for Basic Sciences (S. N. Bose Astronomical Observatory); Submitted to the DST; 5 years; PI

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. Mookerjea, Bhaswati, TIFR, Mumbai; SL. No. 4; National
2. Anandmayee Tej, IIST, Trivandrum; Sl. No. 4; National
3. Maheswaran Gopinath, IIA, Bangalore; Sl. No. 4; National
4. Santosh Jishi, ARIES, Nainital; Sl. No. 5; National
5. Sneh Lata, ARIES, Nanital; Sl. No. 5; National
6. Wen-Ping Chen, National Central Univ., Taiwan; Sl. No. 5; International
7. Okeng'o, Geoffrey, University of Nairobi, Kenya; Sl. No. 5; International
8. Buers, John, University of Nairobi, Kenya; SL. No. 5; International
9. Samrat Ghosh, ARIES, Nainital; Sl. No. 1, 2, 3, 5; National
10. Lokesh Dewangan, PRL, Ahmedabad; SL. No. 4; National
11. Manash Ranjan Samal, PRL, Ahmedabad; Sl. No. 4; National
12. Jessy Jose, IISER, Tirupati; Sl. No. 4; National
13. Sarita Vig, IIST, Trivandrum; Sl. No. 4; National
14. Liton Majumdar, NISER, Bhuveneshwar; Sl. No. 4; National
15. Somnath Dutta, ASIAA, Taiwan; Sl. No. 4; International
16. D. K. Ojha; Sl. No. 4; National

Outreach program organized / participated

1. Participated in the outreach programs of Celebration of National Space Day at NATMO on 16.08.2024 and at SNBNCBS on 23.08.2024

Areas of Research

(i) Time-domain Astronomy of Very Low Mass stars (VLMs) and Brown dwarfs: variability, flares, star-spots, etc.; (ii) Multi-wavelength studies on Galactic star-forming regions; (iii) iii. Spectroscopic studies of Low-Mass dwarfs and AGB giants; (iv) Atmospheric characterization of Extra-solar Planets; (v) Astronomical Instrumentation

A. Magnetic Activities of AD Leonis: Flares in TESS Data and Optical Spectra (Diya Ram et al., The Astrophysical Journal, 980:196 (13pp), 2025)

The main-sequence M dwarfs are interesting targets in the search for habitable planets and life beyond our solar system. M dwarfs are the smallest cool hydrogen-burning objects, with masses in the range of 0.075-0.60 mass of the Sun and effective temperatures in the range 2400-3800 K, and the most abundant and long-lived objects), comprising ~75% of the total stellar population in the Milky Way. Many of these planets are placed in their star's canonical habitable zone, which is the region around a star where an orbiting planet can support an Earth-like atmosphere. A turbulent dynamo might generate the magnetic fields in the fully convective M dwarf stars, which leads to more frequent and powerful flaring activities. We studied the flaring activities of a M4.5 dwarf, AD Leo, to understand its stellar atmospheres and magnetic activities using time-series Transiting Exoplanet Survey Satellite (TESS) photometric data, time-series optical spectra, and Giant Meter Radio Telescope 325 MHz radio data. In occasional radio detection with a flux density of 9.46 $\pm$ 1.63 mJy at a frequency of 325 MHz might be coherent emission in the presence of the magnetic field, giving a hint of star-planet interaction.

B. Starspot Distribution and Flare Events in Two Young Low-mass Stars Using TESS Data (Rajib Kumbhakar et al. The Astrophysical Journal, 981:169 (22pp), 2025)

Wide-field high-precision photometric observations such as the Transiting Exoplanet Survey Satellite (TESS) allowed the investigation of the stellar magnetic activity of cool stars. M dwarf starspots and stellar flares are the main indicators of magnetic activity. The present study focuses on modeling light curves (LCs) to analyze the distribution and characteristics of starspots, e.g., location, temperature, and spot size. The TESS LCs of two selected young M dwarfs, i.e., GJ 182 and 2MASS 05160212 +2214528, were reconstructed using the Best rAndom StarSpots Model calculAtioN (BASSMAN) software, obtaining a three-spot model for GJ 182 and two-spot model for 2MASS J05160212+2214528, describing their LCs. For GJ 182, the mean spot temperature was estimated to be

approximately 3279 K, covering 5%-8.5% of the stellar surface, while for 2MASS 05160212+2214528, the average spot temperature was approximately 2631 K, with a mean spottedness of about 5.4%. Using the 2 minute cadence LC data, we identified and analyzed 48 flare events from GJ 182, while no flares were detected in 2MASS J05160212+2214528.

Plan of Future Work Including Project

1. Scientific programs in observational Astronomy :

I Time-domain Astronomy in Low-mass stars, brown dwarfs, and extra-solar planets: Low-mass stars represent a vital test of theoretical models of stellar evolution, structure, and atmospheres. Time-domain astronomy and Optical/Near-IR spectroscopic studies of these classes of objects are undertaken to understand their atmospheres, exoplanets, and pulsation.

ii. Multi-wavelength studies of Galactic star-forming regions: Multi-wavelength studies of such regions provide a census of Young Stellar Objects, their fundamental parameters and starformation. Variability in young Very Low Mass (VLM) objects and brown dwarfs provide information on their atmospheres.

iii. Astronomical Instrumentation: With our expertise in the Optical/IR instrument design and building, we are working for building the state-of-art backend instruments for our National and own telescopes collaborating with other Institutes.

2. Establishment of the S. N. Bose Astronomical Observatory at Panchet Hilltop, Purulia:

The S. N. Bose Astronomical Observatory project, a new professional Astronomical telescope observing facility at the eastern part of India, is planned at Panchet Hill, West Bengal to install a 1.5-meter class telescope. Since 2012, the efforts were undertaken to acquire the forest land at Panchet hill-top for the observatory project as a lead role. The forest land of two hectares were sanctioned by the Forest department of the Govt. of India and the state Govt. of West Bengal. A project proposal for the new observatory with the 1.5-meter telescope and backend instruments was submitted to the Department of Science and Technology (DST), Govt. of India for approval and funding.

The site characterization is being conduced at hill-top. An automated weather is installed at the site during November 2022, and data is collected regular basis at 7 x 24 since then. A small observatory with a roll-off-roof including a telescope control cabin is already installed at the site. The installation of the DIMM system with the 12-inch telescope for measuring the Astronomical seeing for site characterization is done and seeing data is recorded more than 6 months. A 14-inch telescope with a backend CCD camera for time-domain as well as transient science operation is installed at the roll-off-roof observatory. All these activities are related for building the professional observatory project in near-future.

Any other Relevant Information including social impact of research

1. A societal upliftment project on "Astro-tourism for Socioeconomic Upliftment of Tribal People around Panchet Hill, Purulia" is being formulated by collaborating with Sidho-Kanho-Birsha University, Purulia for submitting to the SEED, DST for funding.
2. Scientific awareness programs like "Astro-Quest" is organized for college, school students, and the public.
3. A spectroscopic-based low-cost instrument "Mil-Q-Way" and "LOPA" is being developed under the Technical Research Centre (TRC), SNBNCBS for the detection of adulteration of milk. The prototype instruments have already been developed at the Centre, which is looking for potential technology takers. Such a project is intended for societal benefit and valuable Knowledge resources for the food sector and security.
4. For community services : time-to-time reviewing of scientific telescope proposals were carried out for the upgraded Giant Meter Radio Telescope (uGMRT) of NCRA-TIFR; 3.6-m Devasthal Optical telescope (DOT) of ARIES, and 2-m Himalayan Chandra Telescope (HCT) of IIA.
5. Reviewed the Ph.D. thesis of of IIT Gandhinagar (PRL); Pondichery University (IIA) and Sidho-Kanho University (SKBU) and external expert in those thesis Viva-Voce examinations.

Sunandan Gangopadhyay

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Astrophysics and High Energy Physics
sunandan.gangopadhyay@bose.res.in

Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Anish Das; Investigation of geodesics and shadows of black hole spacetimes; Awarded
2. Neeraj Kumar; Thermodynamic aspects of black holes; Awarded
3. Manjari Dutta; Some studies on exact solutions of models in noncommutative spaces; Thesis Submitted
4. Sukanta Bhattacharyya; Aspects of minimal length scale physics in quantum systems; Awarded
5. Aslam Halder; Some effects of nocommutativity on quantum mechanical systems; Awarded
6. Saumya Ghosh; Quantization in cosmology: Studies in Wheeler-De Witt and path integral methods; Awarded
7. Aniban Roy Chowdhury; Information theoretic quantities from gauge/gravity correspondence; Under Progress
8. Soham Sen; Quantum gravity phenomenology; Under Progress
9. Arnab Mukherjee; Quantum heat engines and Unruh-DeWitt detectors; Under Progress
10. Souvik Paul; Information theoretic quantities from gauge/gravity correspondence; Under Progress
11. Jayarshi Bhattacharya; Some studies on the dynamics of quantum systems; Under Progress
12. Gopinath Guin; Physical cosmology; Under Progress
13. Arpita Jana; Black hole thermodynamics; Under Progress

b) Post-Docs

1. Ashis Saha; Gauge/gravity duality
2. Manjari Dutta; Open quantum systems

c) External Project Students / Summer Training

1. Ritam Mahanta; Study on Wormhole geometry

Teaching

1. Autumn Semester; Mathematial Methods; Integrated PhD; 14 students; Shared with Prof. Gautam Gangopadhyay
2. Autumn Semester; Advanced Quantum Mechanics; Integrated PhD; 9 students; Shared by Prof. Manoranjan Kumar
3. Spring Semester; Quantum Field Theory; Integrated PhD; 13 students
4. Spring Semester; Advanced Quantum Field Theory; PhD; 5 students

Publications

a) In journals

1. Neeraj Kumar and **Sunandan Gangopadhyay**, *Effects of Gauss–Bonnet Gravity on Thermodynamics of (3+1)-D AdS Black Holes*, Gravitation and Cosmology, 30, 149-159, 2024
2. Soham Sen, Ashis Saha & **Sunandan Gangopadhyay**, *Signatures of quantum geometry from exponential corrections to the black hole*

entropy, General Relativity and Gravitation, 56, 57, 2024

3. Sukanta Bhattacharyya, Soham Sen & **Sunandan Gangopadhyay**, *Resonant detectors of gravitational wave in the linear and quadratic generalized uncertainty principle framework,* European Physical Journal C, 84, 425, 2024
4. Manjari Dutta, Shreemoyee Ganguly and **Sunandan Gangopadhyay**, *Quantum Harmonic Oscillator in a Time Dependent Noncommutative Background*, International Journal of Theoretical Physics, 63, 169, 2024
5. Ashis Saha and **Sunandan Gangopadhyay**, *Quantum chaos in the presence of nonconformality*, Physical Review D, 110, 026025, 2024
6. Souvik Paul, **Sunandan Gangopadhyay** and Ashis Saha, *Gauss-Bonnet AdS planar and spherical black hole thermodynamics and holography*, Classical and Quantum Gravity, 41, 235010, 2024
7. Soham Sen and **Sunandan Gangopadhyay**, *Probing the quantum nature of gravity using a Bose-Einstein condensate*, Physical Review D, 110, 026014, 2024
8. Arpita Jana, Soham Sen, and **Sunandan Gangopadhyay**, *Atom falling into a quantum corrected charged black hole and HBAR entropy*, Physical Review D, 110, 026029, 2024
9. Soham Sen, **Sunandan Gangopadhyay** and Sukanta Bhattacharyya, *Quantum gravity signatures in gravitational wave detectors placed inside a harmonic trap potential*, Physical Review D, 110, 026008, 2024
10. Arnab Mukherjee, Soham Sen, and **Sunandan Gangopadhyay**, *Quantum coherence measures for generalized Gaussian wave packets under a Lorentz boost*, Physical Review A, 110, 052413, 2024
11. Souvik Paul, Anirban Roy Chowdhury, Ashis Saha and **Sunandan Gangopadhyay**, *Information theoretic measures for Lifshitz system*, Journal of High Energy Physics, 2024, 33, 2024
12. Arnab Mukherjee, **Sunandan Gangopadhyay** and Archan S. Majumdar, *Single and Entangled Atomic Systems in Thermal Bath and the Fulling-Davies-Unruh Effect*, Quanta, 14, 1-27, 2025
13. Jayarshi Bhattacharya, Gautam Gangopadhyay and **Sunandan Gangopadhyay**, *Current, quantum transport and entropic force of bosonic system interacting with two thermal reservoirs*, Physica Scripta, 100, 025103, 2025
14. Soham Sen, Abhijit Dutta & **Sunandan Gangopadhyay**, *Thermodynamics of a Schwarzschild black hole surrounded by quintessence in the generalized uncertainty principle framework*, The European Physical Journal C, 85, 117, 2025
15. Soham Sen and **Sunandan Gangopadhyay**, *Quantum nature of gravity in a Bose-Einstein condensate*, Physical Review D, 111, 066002, 2025

Talks / Seminars Delivered in reputed conference / institutions

1. Talk given in "DAE-HEP 2024, XXVI DAE-BRNS HIGH ENERGY PHYSICS SYMPOSIUM 2024" on "Noise of gravitons and the uncertainty principle"; 19/12/2024; Banaras Hindu University, Varanasi; 5 days
2. Lecture given in "C.K. Majumdar Memorial Summer Workshop in Physics 2024" on "Uniformly accelerated observer, equivalence principle and clocks in gravitational field"; 26/07/2024; S.N. Bose National Centre for Basic Sciences, Salt Lake, Kolkata; 10 days
3. Invited talk given at at NISER, Bhubaneswar on "Basics of Bose-Einstein condensation"; 18/10/2024; NISER, Bhubaneswar; 1 day

Administrative duties

1. Head of the Department of Astrophysics and High Energy Physics
2. Chairman of the Library Committee
3. Member of the Consultative Advisory Committee (CAC)
4. Permanent Invitee of the Academic and Research Programme Advisory Committee (ARPAC)
5. Hostel Warden

Awards, Recognitions, if any

1. India Top Cited Paper Award 2024 Physics. This award recognized the work "Investigation of circular geodesics in a rotating charged black hole

in the presence of perfect fluid dark matter" as one of the top 1% most cited papers in IOP Publishing's portfolio of journals from 2021-2023

Conference / Symposia / Schools organized

1. C.K. Majumdar Memorial Summer Workshop in Physics 2024; 22/07/2024; S.N. Bose National Centre for Basic Sciences, Salt Lake, Kolkata; 10 days

Outreach program organized / participated

1. Distinguished Speaker at the "Outreach Workshop for BoseStat@100" at NISER, Bhubaneswar, 18th October, 2024. An Invited talk given on "Basics of Bose-Einstein condensation"

Areas of Research

Quantum gravity, applications of gauge/gravity duality, open quantum systems

My research work during this assessment year has primarily been in the following areas :

1. In the quantum gravity side, we have looked at the effect of noise induced by gravitons on a Bose-Einstein condensate [Phys. Rev. D 110, 026014, (2024)]. Earlier we had investigated the effects of graviton while detecting a gravitational wave using a Bose-Einstein condensate. In this work, we have explicitly calculated the decoherence due to the noise of gravitons for maximally entangled momentum states of the Bose-Einstein condensate. This decoherence happens due to Bremsstrahlung from the Bose-Einstein condensates due to the effect of the noise induced by gravitons. It was observed that the maximally entangled state becomes entangled with the graviton state and it decays over time as a result of this gravitational Bremsstrahlung. This new entangled state is termed as a Bose-Einstein supercondensate. Using this property of the Bose-Einstein condensate in a quantum gravity background, we propose an experimental test via the use of atom lasers (generated from the condensate) which would, in principle, help to detect gravitons in future generations of very advanced ultracold temperature experiments.

2. We have developed a novel approach to obtain the possible form of the spacetime geometry from the entropy of the black hole for a given horizon radius [Gen.Rel.Grav. 56, 57, (2024)]. The uniqueness of this solution for a given energy-momentum tensor has also been discussed. Remarkably, the black hole geometry reconstructed has striking similarities to that of noncommutative-inspired Schwarzschild black holes. We also obtained the matter density functions using Einstein field equations for the geometries we reconstruct from the thermodynamics of black holes. These also have similarities to that of the matter density function of a noncommutative-inspired Schwarzschild black hole. The conformal structure of the metric is briefly discussed and the Penrose-Carter diagram is drawn. We then computed the Komar energy and the Smarr formula for the effective black hole geometry and compared it with that of the noncommutative-inspired Schwarzschild black hole. We also discussed some astrophysical implications of the solutions. Finally, we propose a set of quantum Einstein vacuum field equations, as a solution of which we obtained one of the spacetime solutions.

Any other Relevant Information including social impact of research

1. The areas of research in which I am engaged in along with my Ph.D. students are related to the understanding of the fundamental laws of nature that govern our universe. The problem of quantizing gravity remains an unsolved and most important problem in theoretical physics. Our research makes an attempt to understand this problem and in the process get some insights about it. Fundamental studies are important in their own right as they may find applications much later in the development of technology. Research in theoretical physics also leads to the development of human resource which is extremely important for the development of our country.

Tapas Baug

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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Ariful Hoque; Protostellar outflows in Galactic star-forming regions; Under Progress
2. Muhammad Usman Shehu; Role of filaments in Galactic star formation; Under Progress
3. Tunir Kundu; Study the chemistry and evolution of hot cores; Under Progress
4. Antara Dey; Application of machine learning on astronomical data; Under Progress
5. Rudro Prasad Sarkar; Role of magnetic fields in star formation; Under Progress
6. Alphesunny Sarkar; Star formation rate and efficiency from Galactic to extra-galactic scale; Under Progress; shared with Dr. Suchetana Chatterjee, Presidency University, Supervisor

b) Post-Docs

1. Tirthendu Sinha (finished in October 2024); Study of protostellar outflows and knots in several Galactic star-forming regions
2. Souvik Manna; Study of extra-galactic star formation using data from Giant Metrewave Radio Telescope (GMRT)

c) External Project Students / Summer Training

1. Soumya Paul; Effect of Wolf-Rayet stars on their surrounding gas
2. Ausmita Bairi; Role of filaments in a hub-filament system
3. Ayshi Chattaraj; Relation between star-forming filaments and Cores: a statistical view
4. Sanjana Gupta; Identification and modelling of protostellar outflows

Teaching

1. Autumn Semester; Astronomical Techniques; PhD; 8 students; Shared with Dr. Ramkrishna Das
2. Autumn Semester; Observational Techniques; 18 (Certificate course in collaboration with SKBU, Purulia) students; Shared with Dr. Ramkrishna Das
3. Autumn Semester; Hands-on observations; 18 (Certificate course in collaboration with SKBU, Purulia) students; Shared with Dr. Ramkrishna Das, Dr. Sushanta K. Mondal and Dr. Chiranjib Barman
4. Spring Semester; Semester project; Integrated PhD; 2 students
5. Autumn Semester; Semester project; Integrated PhD; 2 students

Publications

a) In journals

1. N. K. Bhadari, L. K. Dewangan, O. R. Jadhav, A. Hoque, L. E. Pirogov, P. F. Goldsmith, A. K. Maity, S. Sharma, A. Haj Ismail and **T. Baug**, *JWST-ALMA study of a hub-filament system in the nascent phase*, Astronomy & Astrophysics, 694, L18, 2025
2. Bhaswati Mookerjea, G. Maheswar, Kinsuk Acharyya, **Tapas Baug**, Prasun Datta, Jessy Jose, D. K. Ojha, Jagadheep D. Pandian, Nirupam Roy, Manash Samal, Saurabh Sharma, Archana Soam, Sarita Vig, Ankan Das, Lokesh Dewangan, Somnath Dutta, C. Eswariah, Liton Majumdar, Kshitiz Kumar Mallick, Soumen Mondal, Joe P.

Ninan, Neelam Panwar, Amit Pathak, Shantanu Rastogi, Dipen Sahu, Anandmayee Tej & V. S. Veena, *Research on the interstellar medium and star formation in the Galaxy: An Indian perspective*, Journal of Astrophysics and Astronomy, 46, 3, 2025

3. Souvik Manna, Subhashis Roy, and **Tapas Baug**, *Radio Continuum Halos of Seven Nearby Large Galaxies Using uGMRT*, The Astrophysical Journal, 976, 216, 2024

4. Xuefang Xu, Ke Wang, Qian Gou, **Tapas Baug**, Di Li, Chunguo Duan, Juncheng Lei, *The Milky Way atlas for linear filaments – II. Clump rotation versus filament orientation*, Monthly Notices of the Royal Astronomical Society, 535, 940-948, 2024

5. Swagat R Das , Manuel Merello , Leonardo Bronfman , Tie Liu , Guido Garay , Amelia Stutz , Diego Mardones , Jian-Wen Zhou , Patricio Sanhueza , Hong-Li Liu , Enrique Vázquez-Semadeni , Gilberto C Gómez , Aina Palau , Anandmayee Tej , Feng-Wei Xu , **Tapas Baug** , Lokesh K Dewangan , Jinhua He , Lei Zhu , Shanghuo Li , Mika Juvela , Anindya Saha , Namitha Issac , Jihye Hwang , Hafiz Nazeer , L Viktor Toth, *ATOMS: ALMA three-millimetre observations of massive star-forming regions–XVII. High-mass star-formation through a large-scale collapse in IRAS 15394-5358*, Monthly Notices of the Royal Astronomical Society, 534, 3832-3852, 2024

6. Subhajit Kar, Ramkrishna Das, Blesson Mathew, **Tapas Baug**, and Avijit Mandal, *Detection of High-frequency Pulsation in WR 135: Investigation of Stellar Wind Dynamics*, The Astronomical Journal, 168, 5, 199, 2024

7. F. Louvet, P. Sanhueza, A. Stutz, A. Men'shchikov, F. Motte, R. Galván-Madrid, S. Bontemps, Y. Pouteau, A. Ginsburg, T. Csengeri, J. Di Francesco, P. Dell'Ova, M. González, P. Didelon, J. Braine, N. Cunningham, B. Thomasson, P. Lesaffre, P. Hennebelle, M. Bonfand, A. Gusdorf, R. H. Álverez-Gutiérrez, T. Nony, G. Busquet, F. Olguin, L. Bronfman, J. Salinas, M. Fernandez-Lopez, E. Moraux, H. L. Liu, X. Lu, V. Huei-Ru, A. Towner, M. Valeille-Manet, N. Brouillet, F. Herpin, B. Lefloch, **T. Baug**, L. Maud, A. López-Sepulcre and B. Svoboda, *ALMA-IMF XV. Core mass function in the high-mass star formation regime*, Astronomy & Astrophysics, 690, 15, 2024

8. Roberto Galván-Madrid, Daniel J. Díaz-González, Frédérique Motte, Adam Ginsburg, Nichol Cunningham, Karl M. Menten, Mélanie Armante, Mélisse Bonfand, Jonathan Braine, Timea Csengeri, Pierre Dell'Ova, Fabien Louvet, Thomas Nony, Rudy Rivera-Soto, Patricio Sanhueza, Amelia M. Stutz, Friedrich Wyrowski, Rodrigo H. Álvarez-Gutiérrez, **Tapas Baug**, Sylvain Bontemps, Leonardo Bronfman, Manuel Fernández-López, Antoine Gusdorf, Atanu Koley, Hong-Li Liu, Javiera Salinas, Allison P. M. Towner, and Anthony P. Whitworth, *ALMA-IMF. XIV. Free–Free Templates Derived from H41 and Ionized Gas Content in 15 Massive Protoclusters*, The Astrophysical Journal, 274, 15, 2024

9. R. H. Álvarez-Gutiérrez, A. M. Stutz, N. Sandoval-Garrido, F. Louvet, F. Motte, R. Galván-Madrid, N. Cunningham, P. Sanhueza, M. Bonfand, S. Bontemps, A. Gusdorf, A. Ginsburg, T. Csengeri, S. D. Reyes, J. Salinas, **T. Baug**, L. Bronfman, G. Busquet, D. J. Díaz-González, M. Fernandez-Lopez, A. Guzmán, A. Koley, H.-L. Liu, F. A. Olguin, M. Valeille-Manet and F. Wyrowski, *ALMA-IMF XIII. N_2H^+ kinematic analysis of the intermediate protocluster G353.41*, Astronomy & Astrophysics, 689, 23, 2024

10. Anindya Saha, Anandmayee Tej, Hong-Li Liu, Tie Liu, Guido Garay, Paul F. Goldsmith, Chang Won Lee, Jinhua He, Mika Juvela, Leonardo Bronfman, **Tapas Baug**, Enrique Vázquez-Semadeni, Patricio Sanhueza, Shanghuo Li, James O. Chibueze, N. K. Bhadari, Lokesh K. Dewangan, Swagat Ranjan Das, Feng-Wei Xu, Namitha Issac, Jihye Hwang, and L. Viktor Tóth, *Direct Observational Evidence of Multi-epoch Massive Star Formation in G24.47+0.49*, Astrophysical Journal Letters, 970, L40, 2024

11. P. Dell'Ova, F. Motte2, A. Gusdorf, Y. Pouteau, A. Men'shchikov, D. Díaz-González, R. Galván-Madrid, P. Lesaffre, P. Didelon, A. M. Stutz, A. P. M. Towner, K. Marsh, A. Whitworth, M. Armante, M. Bonfand T. Nony, M. Valeille-Manet, S. Bontemps, T. Csengeri, N. Cunningham, A. Ginsburg F. Louvet, R. H. Álvarez-Gutiérrez, N. Brouillet, J. Salinas, P. Sanhueza, F. Nakamura, Q. Nguyen Luong, **T. Baug**, M. Fernández-López16, H.-L. Liu and F. Olguin, *ALMA-IMF XII. Point-process mapping of 15 massive protoclusters*, Astronomy & Astrophysics, 687, A217, 2024

12. Arijit Manna, Sabyasachi Pal, **Tapas Baug** and Sougata Mondal, *Study of Complex Nitrogen and*

Oxygen-bearing Molecules toward the High-mass Protostar IRAS 18089-1732, Research in Astronomy and Astrophysics, 24, 065008, 2024

13. Subhajit Kar, Ramkrishna Das, and **Tapas Baug**, *Investigation of [KSF2015] 1381-19L, a WC9-type Star in the High-extinction Galactic Region*, Astrophysical Journal, 968, 60, 2024

14. Ke Wang, Yifei Ge and **Tapas Baug**, *The Milky Way atlas for linear filaments*, Astronomy & Astrophysics, 686, 14, 2024

b) Other Publications

i) Conference proceedings / Reports / Monographs

1. Ariful Hoque, Tapas Baug, Lokesh Dewangan, Ke Wang, Tie Liu, and Soumen Mondal, "Influence of Mid-infrared Galactic Bubble on Surroundings: A Case Study on IRAS 16489-4431", Bulletin de la Societe Royale des Sciences de Liege, 93, 601-612, 2024

2. Santosh Joshi, Peter De Cat, Michaël De Becker, Katrien Kolenberg, Soumen Mondal, Shashikiran Ganesh, Laurent Mahy, Drisya Karinkuzhi, Abhay Pratap Yadav, Tapas Baug, Jeewan C. Pandey, Kuntal Misra, Chelliah Subramonian Stalin, Nilakshi Veerabathina, Bhuwan Joshi, David Berghmans, and Tom Van Doorsselaer, "Proceedings of the 3rd BINA Workshop: Scientific Potential of Indo-Belgian Co-operation", Bulletin de la Societe Royale des Sciences de Liege, 93, 1-31, 2024

Talks / Seminars Delivered in reputed conference / institutions

1. Invited talk at Positional Astronomy Centre, IMD, Kolkata; 22/05/2024; Positional Astronomy Centre, IMD, Kolkata; 1 hour

2. Presentation on Planets on the occasion of National Space Day; 23/08/2024; SNBNBCBS, Kolkata; 1 hour

3. Presentation on History of telescope on the occasion of National Science Day; 28/02/2025; St. Xavier's College (Autonomous), Kolkata

Administrative duties

1. Committee Member of Computer Service Cell-Working Group

2. Member of Technical Cell Working Group

3. Member of SCOLP Committee and managing DAHEP seminars

4. Member of "Syllabus modification Committee" (for IPhD and PhD courses)

5. Member of 2 Interview Panels (PhD and IPhD) and several other evaluation committee of research scholars

Conference / Symposia / Schools organized

1. Inauguration of S. N. Bose Astronomical Observatory site; 08/01/2025; Sidho-Kanho-Birsha University and Panchet Hill, Purulia; 2 days

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. L. K. Dewangan (Physical Research Laboratory, Ahmedabad, India); Sl .no. 1, 4, 9, 14; National

2. Ramkrishna Das (S. N. Bose National Centre for Basic Sciences, Kolkata, India); Sl. No. 5; National

3. Ke Wang (Kavli Institute for Astronomy and Astrophysics, Beijing, China); Sl. No. 3, 13; International

4. Tie Liu (Shanghai Astronomical Observatory, Shanghai, China); Sl. No. 4, 9; International

5. Fabien Louvet (Univ. Grenoble Alpes, CNRS, Grenoble, France); Sl. No. 6, 7, 8, 10; International

6. Alison P. M. Towner (University of Florida, USA); Sl. No. 6, 7, 10; International

Outreach program organized / participated

1. 2025 January 2, "Sky-watching Program", Open Day, SNBNCBS, Kolkata

2. 2025 February 28, "Sky-watching Program" on the occasion of National Science day at SNBNCBS, Kolkata

3. 2024 August 23, "Sky-watching Program" on the occasion of National Space day at SNBNCBS, Kolkata

Areas of Research

Formation of Galactic massive stars, Protostellar outflows in Galactic star-forming regions

Filamentary structure is the dominant morphology of the interstellar medium (ISM), and molecular filaments can play an important role in star formation (Hacar et al. 2023).

The Galactic distribution of filaments may regulate the global star formation rate in the Milky Way. The inherent complexity and hierarchy of molecular filaments make it challenging to characterize the structure and dynamics important for star formation. Variety of filaments are found in the Galaxy starting from simple filaments of linear L-shape, C-shape, and S-shape to a network of filamentary structure of X-shape (Wang et al. 2015) and hub-filament systems (Myers 2010). A meaningful comparison of these filaments is thus difficult because they are intrinsically different entities.

We identified and characterized the first catalog of 42 large-scale linear filaments across the full Galactic plane. Among all the morphology types, linear filaments are the simplest, and can be treated as building blocks of more complicated filamentary structures. We reported several fundamental properties of these filaments, including extreme linearity and velocity-coherence, velocity oscillation and filamentary gas flows, and diverse star formation activity. We found that one-third of them are associated with the spiral arms, and two-thirds are located inter-arm, but only one is located at the arm center (the Milky Way skeleton); none were found near the Galactic center and in the Central Molecular Zone. A few filaments extend perpendicular to the Galactic plane, while no obvious trend is found in the orientation of the full sample. The filaments also appear to be randomly orientated compared to ambient magnetic fields. The physical characterization of these unit filaments can pave the way toward a unified understanding of filaments.

A connection between the extraplanar halo and the interstellar medium (ISM) of the underlying galactic disk has been reported in the past using observations in a wide range of frequency bands, from X-ray to radio (e.g., R. Tullmann et al. 2006). Radio frequency observations also reveal that the propagation scale lengths of cosmic-ray electrons (CREs) in the vertical direction are larger than the scale length in the disk region (e.g., M. Dahlem et al. 2006; D. D. Mulcahy et al. 2014), providing evidence of the transport of CREs from the disk into the halo region. It is thus important to identify the extent of the extraplanar halos and their underlying cause of the energy transportation in extraplanar halos. We utilized the large bandwidth of uGMRT to observe seven galaxies For the first time, we have detected elongated radio disks for two edge-on galaxies. The detected halo sizes in the vertical directions of four edge-on galaxies at 0.4 GHz are significantly larger than those detected at 1.5 GHz. We also found evidence of the high magnetic fields (about 20 micro-Gauss) at galactic disks even more than 5 kpc away from the galactic disk in one of the galaxies. Such a strong magnetic field strength at that distance has not been reported in literature before.

Plan of Future Work Including Project

Herschel Observations revealed ubiquitous elongated filamentary structures in Galactic molecular clouds. Although filaments are believed to play important role in star formation, the property of filaments in transporting gas varies with their length-scale (Hacar et al., 2022). The gas flow in filaments become more streamline and rapid at the sub-parsec scale. Exact length-scale and origin of such behavior of filaments should be verified in detail. Thus, I would like to study the role of filaments at sub-parsec scale using the mm/sub-mm data from Atacama Large Millimeter/submillimeter Aarray (ALMA). Identification of filaments in molecular clouds is not trivial. we are developing a method to identify and characterize the filaments from the 3D cube data of the Galactic molecular cloud.

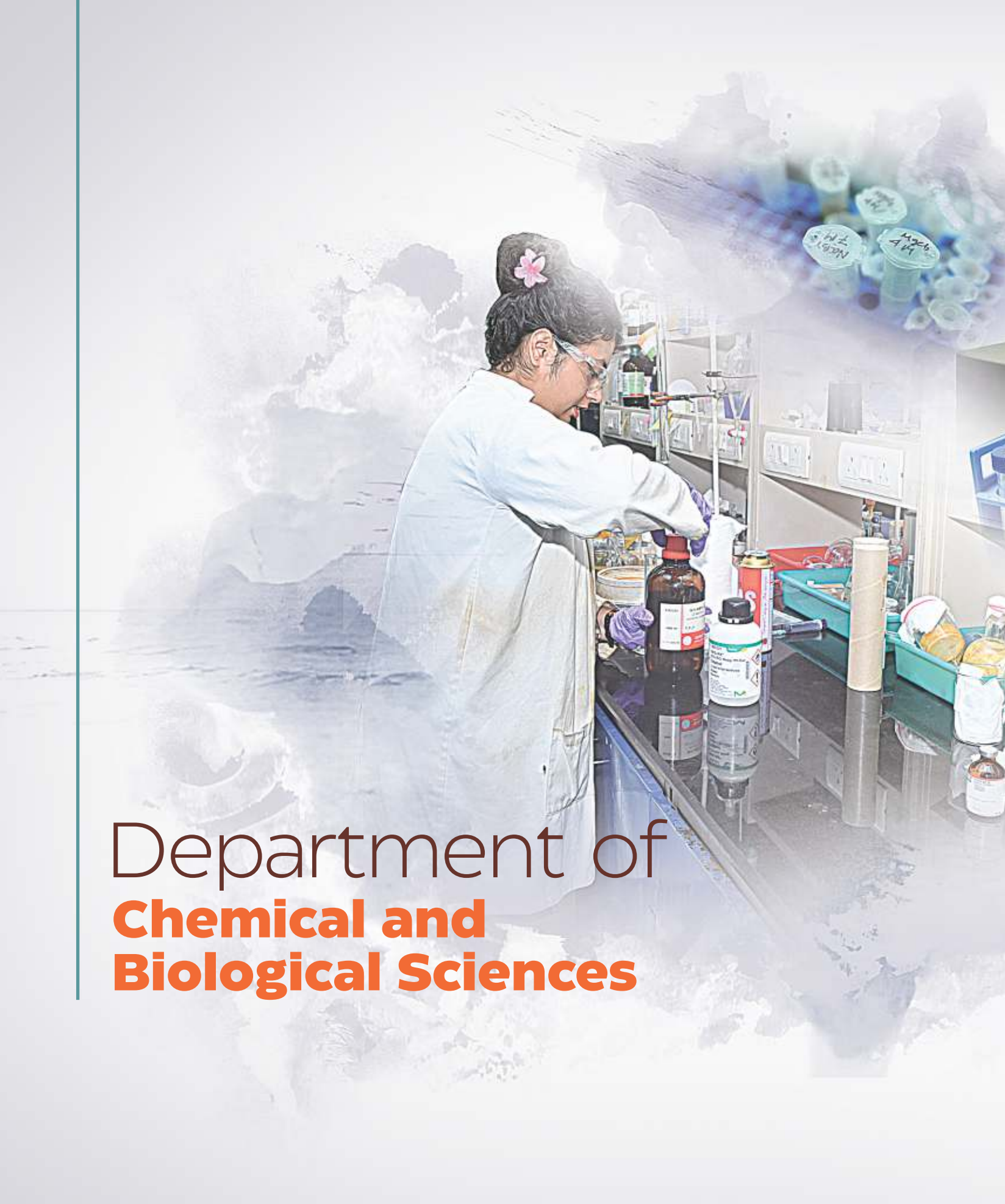
Protosellar jets and outflows are ubiquitous phenomena in the early phase of star formation, irrespective of their mass. Probing these outflows may help us in understanding the finer details of the outflow parameters and their launching mechanisms. Our group is working on different aspects of outflows. For example, knots in the outflows help us to assess the accretion history of the protostars. Also, how the power of the bipolar jet is connected with the associated outflows, and hence, the entrained outflows mass.

The Centre has started the initial foundation to build S. N. Bose Astronomical Observatory at Panchet Hilltop, Purulia. Recently, a weather station and a mobile observatory have been installed at the hilltop. We already have gathered observational data for astronomical seeing measurements. We shall now start scientific operation of mobile observatory. I would like to keep on contributing in the development of this telescope project.

Any other Relevant Information including social impact of research

1. Member of national committee for the proposal of National Large Optical Telescope, leading by Indian Institute of Astrophysics
2. Member of national committee for the proposal of National Sub-millimeter Telescope, leading by Tata Institute of Fundamental Research
3. Reviewer of the observational proposals for 2-m Himalayan Chandra Telescope, 3.6-m Devasthal Optical Telescope and Giant Metrewave Radio Telescope


वसुधारा
BASUDHARA
বসুধারা



Department of
Chemical and Biological Sciences


TARSONS

Ali Hossain Khan

Ramanujan Fellow
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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Sourik Dutta; Doped 2D Nanocrystals for Photonic Applications; Under progress; shared with Prof. Rajib Kumar Mitra
2. Bikram Das; Heavy-Metal-Free Photonic Colloidal 2D Nanocrystals; Under progress; shared with Prof. Rajib Kumar Mitra

b) External Project Students / Summer Training

1. Pritam Maity; Control over Size and Shape of Indium Phosphide Semiconductor Nanocrystals
2. Farhin Islam; Synthesis of Copper Indium Selenide Semiconductor Nanocrystals

Teaching

1. Spring semester 2025; "Surfaces & Interfaces" (Code: CB 641); PhD; 8 students; shared with Dr. Pradip S. Pachfule

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. Doped 2D Nanocrystals for Photonic Applications; Ramanujan Fellowship, SERB, India; 5 years (01-04-2021 – 31-03-2026); PI
2. Heavy-Metal-Free Photonic Colloidal 2D Nanocrystals; CRG, SERB, India; 3 years (08-02-2023 – 07-02-2026); PI

Areas of Research

At present, I am leading two research projects. The first one focuses on doped 2D nanocrystals, funded by the Ramanujan Fellowship. The second project, funded by the SERB Core Research Grant (CRG), centered around the non-toxic 2D nanocrystals for optoelectronic applications. The focus of our first project is on the doping of transition metal ions in the host 2D nanoplatelets (NPLs) to modulate key optical and electronic properties, such as emission wavelength and lifetime, exciton binding energy, and exciton dynamics, through controlled doping. To this end, we have standardized the synthesis of CdSe NPLs with varying thicknesses, which serve as host materials. As proposed, we have successfully introduced indium into the CdSe NPLs using a growth doping strategy. The presence of indium dopants was confirmed through a series of spectroscopic characterizations. This advancement reveals novel photophysical and electronic behaviors not previously observed in colloidal nanocrystals (Figure 1). The resulting n-type In-doped CdSe NPLs exhibit several notable features:

- Donor-bound exciton, with emission lifetimes nearly two orders of magnitude shorter than those of known acceptor-bound excitons.
- Narrowband dopant emission, with a spectral width more than twice as narrow as those observed in p-type doped system.
- Stable dopant emission wavelength, independent of dopant concentrations, in contrast to the concentration-dependent shift seen in acceptor-bound emission.
- Intersubband mid-infrared absorption, enabled by the electronic transitions involving donor states.
- Resistive switching behavior, attributed to the close energetic alignment between donor states and the conduction band.

This study explores the photophysics of a previously inaccessible system. Previous attempts to achieve dopant emission using *n*-type dopants in quantum dot systems were largely unsuccessful. We addressed this challenge by replacing quantum dots with 2D NPLs and ensuring precise control over their thickness homogeneity. As a result, 2D NPLs offer an optimal platform for studying donor-bound excitons, an area that has remained unexplored due to the lack of suitable model systems. Furthermore, the observed intersubband transitions in the mid-infrared spectral range are particularly relevant, given their importance in quantum cascade laser development and other emerging mid-infrared optoelectronic technologies. Thus, we have completed a study on indium-doped 2D CdSe nanocrystals and have submitted the manuscript for publication. The title of the manuscript is "Observation of Donor-Bound Excitons and Intersubband Excitation-Induced Resistive Switching in Indium-Doped CdSe Nanoplatelets." In parallel, another study focusing on copper doping in 2D indium selenide nanocrystals is currently in progress.

The focus of the CRG project is on two material systems, InP and CuInS/Se, using a colloidal synthesis approach. We have successfully synthesized copper indium selenide (CISe) NPLs and conducted a systematic investigation into how precursor chemistry, reaction conditions, and core/shell engineering influence their structural and optical characteristics. The ultra-thin nature of the NPLs is evident

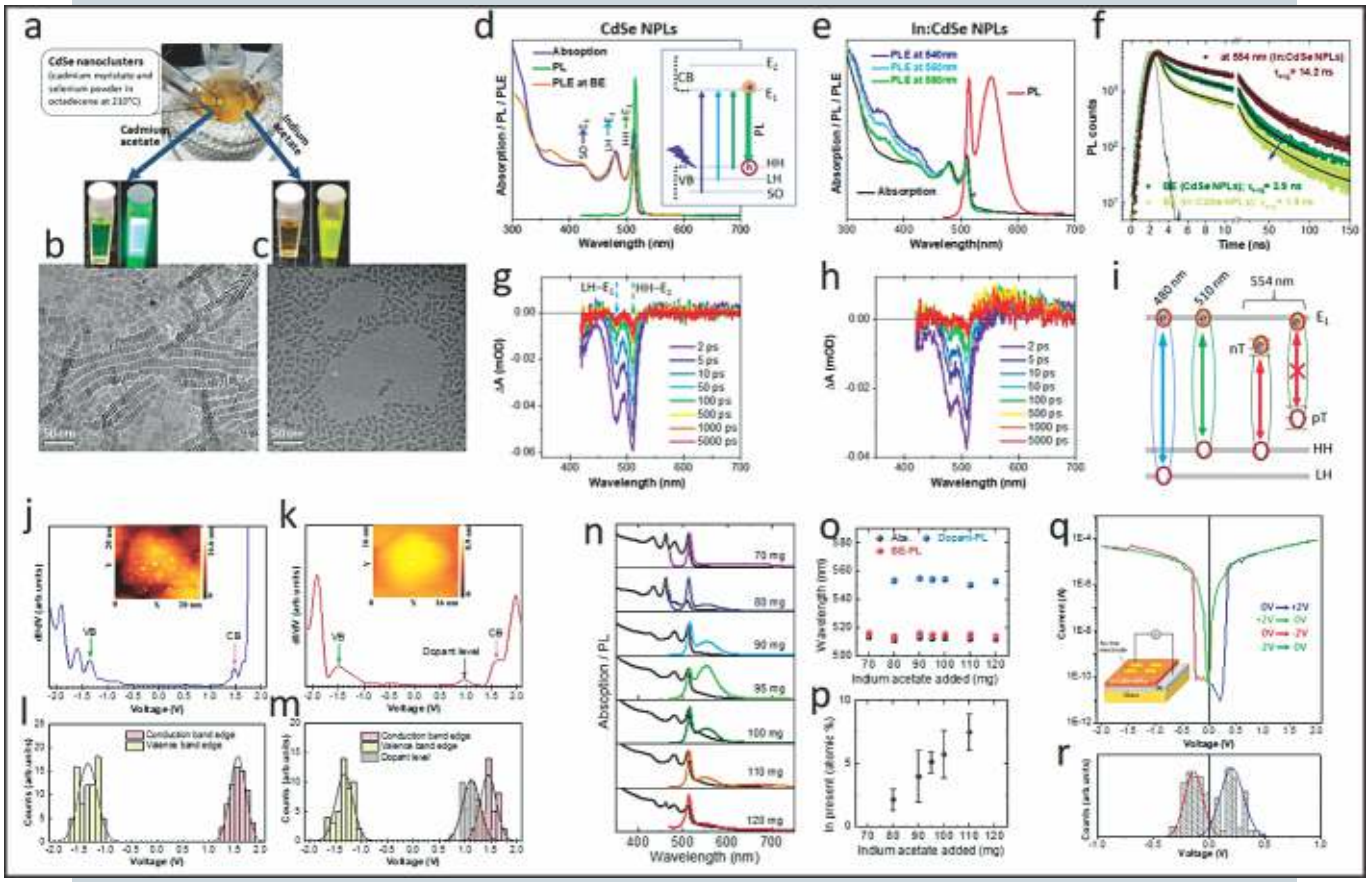
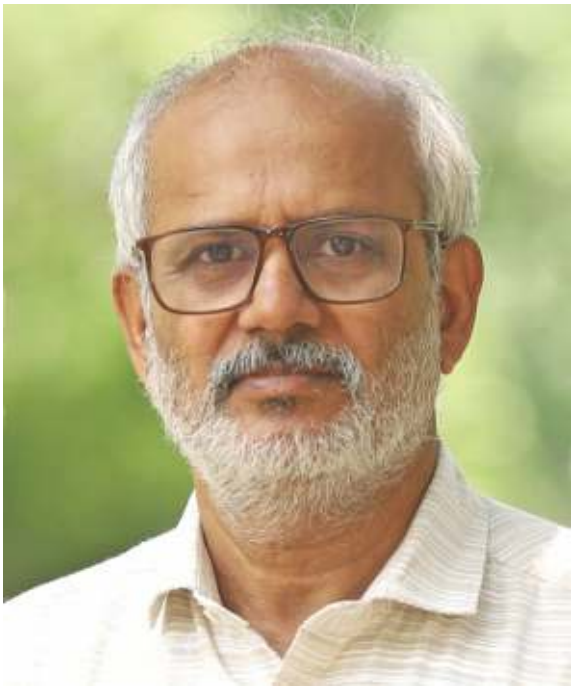


Figure 1. (a) Schematic representation of the synthesis of CdSe and In:CdSe NPLs. TEM images of the (b) CdSe NPLs and (c) In:CdSe NPLs. (d) Absorbance (blue lines), steady-state PL (green lines, excited at 400 nm), and PL excitation spectra (orange line, measured at 514 nm) of CdSe NPLs. Inset: Schematic illustration of the conduction and valence band energy levels, and optical transitions in NPLs. (e) Absorbance (black lines), steady-state PL (red lines, excited at 400 nm), and PL excitation spectra (measured at three different monitoring wavelengths of the dopant emission) of In:CdSe NPLs. (f) Normalized time-resolved PL decay traces of CdSe NPLs and In:CdSe NPLs measured at band-edge emission and dopant emission (at 554 nm) using 3.34 eV excitation. Transient absorption spectra of (g) CdSe and (h) In:CdSe NPLs at varying time delays upon 400 nm pump excitation. (i) Band diagram of In:CdSe NPLs, showing various excitons and optical transitions, indicated by arrows. Both HH-E_1 and LH-E_1 excitons share the same electron subband, so the changes in spectral dynamics at 510 nm and 480 nm correspond to the dynamics of HH and LH, respectively. Tunneling spectra of (j) CdSe and (k) In:CdSe NPLs measured at room temperature showing their density of states. Inset: STM topographic image of the measured NPLs. (l) Histogram of the CB and VB band edges, constructed from STS of CdSe NPLs. (m) Histogram of the CB and VB band edges, and the location of the dopant level in In:CdSe NPLs. (n) Investigation of the tunability of n-type donor states in In:CdSe NPLs. Absorption and PL spectra of In:CdSe NPLs synthesized with varying amounts of indium acetate. (o) Shifts in the absorption maxima, band-edge PL, and dopant PL peaks as a function of the added indium acetate amounts. (p) Indium atomic percentages, determined by energy dispersive X-ray (EDX) spectroscopy, for samples synthesized with increasing amounts of indium acetate. (q) Observation of resistive switching behavior in In:CdSe NPLs for n-type donor states. Semilogarithmic I-V curve of the device. Inset: Schematic drawing of the Al/In:CdSe/Au device. (r) Histogram of the cycle-to-cycle distribution of the low-resistance state (LRS).

from TEM images and is further supported by their absorption and emission spectra. We have enhanced their fluorescence by creating core/shell heterostructures and are actively exploring their application in bioimaging through collaboration. In parallel, we are also investigating their potential for optoelectronic applications.

Plan of Future Work Including Project

We have successfully established n-type doping of CdSe NPLs using In^{3+} dopant ions. The next step is incorporating p-type dopants such as Ag^{+} to explore co-doping effects. So, the next plan is to dope these ions either simultaneously or sequentially within the same host material. Once a co-doping method is established, next we will investigate other metal ion combinations, like Ag^{+}/Cu^{+}, with $In^{3+}/Ga^{3+}/Al^{3+}$. To improve the PL QY and optical stability, crown or shell deposition will be employed in the co-doped system. For a deeper understanding of carrier dynamics and dopant states, we will investigate the electron and hole relaxation process using a combination of steady-state and transient spectroscopic techniques. This will help us map excited-state transitions in detail. Another key focus will be the development of 2D InP nanocrystals. In parallel, we will continue device-related research, including the development of a phototransistor based on Cu-doped InSe NPLs.



Gautam Gangopadhyay

Honorary Visiting Fellow
Chemical and Biological Sciences
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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Jayarshi Bhattacharya; Quantum Transport problems in bosonic and fermionic systems
2. Pallabi Roy; Stochastic Response of Some Biochemical and Biophysical Systems

Teaching

1. PH 401, Mathematical Methods in 1st Sem IPHD students; Shared course with Prof. Sunandan Gangopadhyay

Publications

a) In journals

1. Jayarshi Bhattacharya, **Gautam Gangopadhyay** and Sunandan Gangopadhyay, *Current, quantum transport and entropic force of bosonic system interacting with two thermal reservoirs*, Physica Scripta, 100, 025103, 2025
2. Pallabi Roy, Sakuntala Chatterjee, **Gautam Gangopadhyay**, *Stochastic response of ultrasensitivity: Optimized switching of mitogen activated protein kinase (MAPK) cascade*, Chemical Physics, 584, 112327, 2024
3. Anirban Karmakar and **Gautam Gangopadhyay**, *Nonzero current due to coherent dynamic electron transport through a dimer with no external bias*, Physica Scripta, 99, 075016, 2024

Outreach program organized / participated

1. A series of Lectures delivered at RKVC, Rahara, West Bengal for Msc.(Physical Chemistry) students

Areas of Research

Stochastic Response of Some Biochemical and Biophysical Systems

Our recent investigation is into the intricate dynamics of biochemical and biophysical systems, shedding light on their behaviour far from equilibrium. The application of stochastic dynamics to these systems offers a fruitful understanding of their complexities which can be extended to the study of the thermodynamic cost of energy and entropy. From ultrasensitive transitions in MAPK circuits to the energetics of non-equilibrium chemical processes and the collective behaviours of active matter, stochastic approaches unveil the hidden dynamics of these intricate systems.

Manik Pradhan

Professor
Chemical and Biological Sciences
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Guidance of Students/Post-Docs

a) Ph.D. Students

1. Soumen Mandal; Optical Beam Shifts; Under progress
2. Soumyadipta Chakraborty; High-resolution Molecular Spectroscopy; Under progress
3. Indrayani Patra; Molecular Spectroscopy; Under progress
4. Anuradha Sett; Weak Measurements and Optical Beam Shifts; Under progress
5. Dinesh Chandra Dey; Geometric Phase and Weak Measurements; Under progress
6. Arup Biswas; Laser Spectroscopy; Under Progress

Teaching

1. Spring Semester; Project Research III (PHY 502); Integrated PhD; 1 student

Publications

a) In journals

1. Soumen Mandal, Anuradha Sett, Dinesh Chandra Dey, Akash Das, and **Manik Pradhan**, *Observation of the Goos-Hänchen shift in monolayer WSe_2 for an arbitrary linearly polarized incident light beam using weak measurement*, Journal of the Optical Society of America B, 41, 2714-2720, 2024
2. Soumen Mandal, Akash Das, **Manik Pradhan**, *Simultaneous observation of transverse and longitudinal photonic spin splitting in monolayer WSe_2 via quantum weak measurement*, Journal of Applied Physics, 135, 203103, 2024
3. Soumyadipta Chakraborty, Indrayani Patra, Ardhendu Pal, Koushik Mondal, **Manik Pradhan**, *Development of a semi-supervised machine learning based noise filter for quantum cascade laser-coupled mid-infrared spectrometer*, Infrared Physics & Technology, 141, 105452, 2024
4. Indrayani Patra, Soumyadipta Chakraborty, Ardhendu Pal, **Manik Pradhan**, *High-resolution investigation of the spin-rotation doublets of $^{14}NO_2$ at 6.2 μm mid-infrared region using cavity ring-down spectroscopy*, Infrared Physics & Technology, 139, 105317, 2024
5. Indrayani Patra, Soumyadipta Chakraborty, Ardhendu Pal, Biswajit Panda, **Manik Pradhan**, *High-resolution spectroscopic probing of allowed and forbidden ortho- and para-nuclear spin-isomers of NH_3*, Journal of Chemical Sciences, 136, 46, 2024
6. Ardhendu Pal, Koushik Mondal, Soumen Mandal, Soumyadipta Chakraborty, Indrayani Patra & **Manik Pradhan**, *LED-based broadband cavity-enhanced spectrometer for high-sensitive optical detection of diacetyl in gas phase*, Journal of Chemical Sciences, 136, 87, 2024
7. Koushik Mondal, Ardhendu Pal, Biswajit Panda, **Manik Pradhan**, *Oxygen-Isotope Exchange between CO_2 and NO_2 with Implications for Atmospheric Chemistry*, Journal of Physical Chemistry Letters, 15, 4430-4436, 2024

Talks / Seminars Delivered in reputed conference / institutions

1. Invited Lecture in 33rd DAE-BRNS National Laser Symposium (NLS-33); 06/03/2025; Indore; 6-9th March, 2025
2. Invited Talk at International Conference on Optics within Life Sciences (OWLS-17); 18/11/2024; IIT Bombay; 18-21 November, 2024
3. Invited Lecture in Physical Chemistry Symposium (SoPhyC)-2024; 22/10/2024; IIT Bombay; 22-25th October, 2024

Administrative duties

1. Member of Works Committee
2. Member of Reservation Cell
3. Convener of Pest Control Monitoring Committee
4. Member of Project and Patent Cell
5. Member of Technical Cell Advisory Committee (TCAC)

Awards, Recognitions, if any

1. Research on Polarization-controlled Optics selected for inclusion in "Spotlight on Optics" by Optica, USA (2024)
2. Research Work on "Oxygen-isotope Exchange" has been highlighted by the Journal of Physical Chemistry Letters

Membership of Learned Societies

1. Fellow of the Royal Society of Chemistry (FRSC), London, UK
2. Fellow of the Institute of Physics (FInstP), IOP, London, UK
3. Fellow of Linnean Society of London (FLS), London, UK
4. Member of Chemical Research Society of India (CRSI)
5. Member of Indian Physics Association (IPA)
6. Member of Indian Laser Association (ILA)
7. Member of Indian Society of Chemistry and Biologists (ISCB)
8. Member of Research Society for the Study of Diabetes in India (RSSDI)
9. Member of American Association for the Advancement of Science (AAAS)

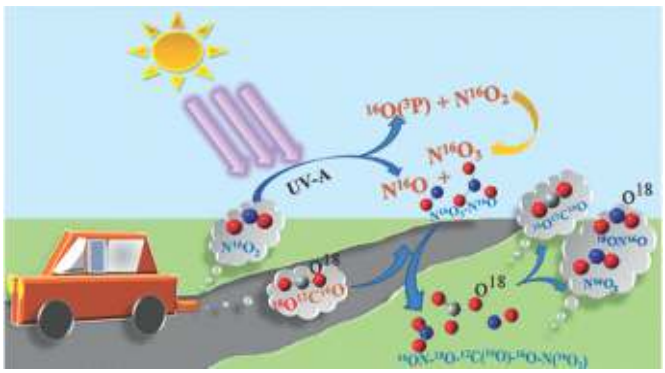
Conference / Symposia / Schools organized

1. 33rd DAE-BRNS National Laser Symposium; 06/03/2025; RRCAT Indore (Medi-Caps University); 6-9th March, 2025

Areas of Research

1. Oxygen-Isotope Exchange between CO_2 and NO_2 with Implications for Atmospheric Chemistry:

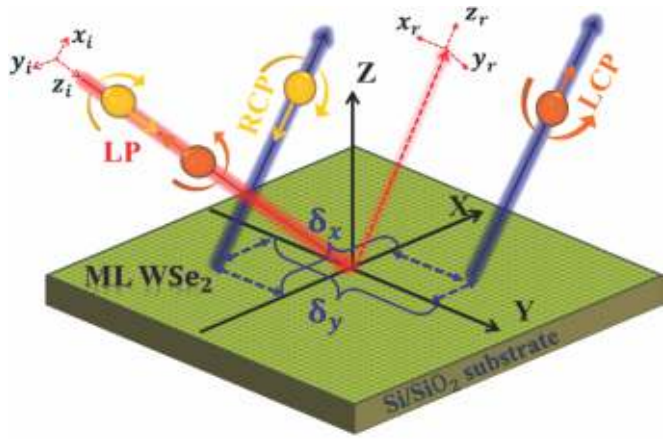
Elucidating isotope exchange between atmospheric trace molecular species is important for environment monitoring, climate control studies, and a fundamental understanding of atmospheric chemistry. Here, we provide direct experimental evidence of oxygen-isotopic exchange between carbon dioxide (CO_2) and nitrogen dioxide (NO_2), which are simultaneously emitted into the atmosphere from common sources. A combined near-infrared and UV–vis optical cavity-enhanced experimental investigation along with quantum-chemical calculations followed by a reaction modeling study revealed that CO_2 and NO_2 can communicate isotopically by near-ultraviolet-driven NO_2 photolysis. Our results found evidence for a near-barrierless (1.67 kcal/mol) nitrate-containing complex having a very short lifetime (~13 ns) which facilitates the transfer of ^{18}O-isotopes from $^{18}O^{12}C^{16}O$ to $N^{16}O^{16}O$, leading to isotopic depletion of ^{18}O in $^{18}O^{12}C^{16}O$, thus opening a new gas-phase isotope-selective chemical transformation mechanism in the lower atmosphere. This isotope exchange study may serve as a new window into the fundamental understanding of isotopic photochemistry, oxygen isotopic fractionations, and climate modeling.



2. Simultaneous observation of transverse and longitudinal photonic spin splitting in monolayer WSe_2 via quantum weak measurement:

We report on the observation of longitudinal (in-plane) and transverse (out-of-plane) spin splitting of incident linearly polarized (p and s) light beams reflected at the interface of tungsten di-selenide, a monolayer transition metal

dichalcogenide material deposited on a Si/SiO_2 substrate, near the Brewster angle of incidence employing the quantum weak measurement technique. The amplified longitudinal and transverse shift values reach up to hundreds of micrometers. The transverse shift value, measured approximately at 400 m, dominates over the longitudinal shift value at Brewster incidence. In this work, we found positive and negative shift values for the same angle of incidence but distinct polarization states revealing the explicit dependencies upon the angle of incidence and the post-selection angle. The modified weak measurement model provides an excellent interpretation of these experimental findings. This work, thus, provides novel insights into the effects of light–matter interactions and could find important applications in optical switches, nano-photonics, and the non-destructive study of material properties.



Plan of Future Work Including Project

1. Development of quantum weak measurements using single photon light source for studying photonic spin Hall effect and optical beam shifts at the quantum level in various exotic materials
2. Explore geometric phases and spin splitting of light in various 2D materials
3. Investigation of orbital angular momentum sidebands in anisotropic materials
4. Photonic spin splitting with orbital angular momentum pointer states via modified weak measurement
5. High-resolution molecular spectroscopy in various isotopic species

Pradip S Pachfule

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Guidance of Students/Post-Docs

a) Ph.D. Students

1. Bikash Mishra; Covalent organic frameworks for energy storage; Under Progress
2. Bidhan Kumbhakar; Covalent organic frameworks for energy storage and catalysis; Under Progress
3. Avanti Chakraborty; Hydrogen peroxide generation using Covalent organic frameworks as photocatalysts; Under Progress
4. Supriti Dutta; Organic transformation using Covalent organic frameworks as photocatalysts; Under Progress
5. Jose´ Ignacio Herna´ndez Garci´a; Macrocyclic covalent organic frameworks; Under Progress; Prof. David Diaz Diaz, University of La Laguna, Tenerife (Spain), Supervisor
6. Asis Sethi; Carbon-based materials for Electrocatalysis; Thesis Submitted; Dr. Vishal Dhavale, Scientist, Central Electro-Chemical Research Institute (CECRI), Supervisor

b) Post-Docs

1. Akhtar Alam (Till November 2024); Covalent organic framework-based photocatalysts for water-spitting
2. Pekham Chakrabortty (From February 2025); Nitrogen-rich Covalent Organic Frameworks for Heterogeneous Photoreduction of Carbon Dioxide

c) External Project Students / Summer Training

1. Archisman Sinha; Covalent organic framework-based photocatalysts for water-spitting
2. Chowdhury Ismat Nurani; Covalent organic framework-based photocatalysts for water-spitting and energy storage
3. Sonali Priyadarshani Swain; Hydrogen peroxide generation using Covalent organic frameworks as photocatalysts
4. Nandita Das; Covalent organic frameworks for energy storage
5. Subhajit Rana; Hexaazatriphenylene-Incorporated Covalent Organic Framework for Photocatalysis
6. Sudipa Mondal; Covalent organic frameworks for hydrogen peroxide generation

Teaching

1. Spring Semester; Surface & Interface (CB-641): Compulsory elective course from the CBS department; PhD; 9 students; Shared with Dr. Ali Hossain Khan
2. Spring Semester; Methods of Experimental Physics [PHY 592]; Integrated PhD; 13 students; Shared equally with Atindra Nath Pal, Ramkrishna Das, Nitesh Kumar and Ali Hossain Khan

Publications

a) In journals

1. Supriti Dutta, José Ignacio Hernández García, Bikash Mishra, David Díaz Díaz, **Pradip Pachfule**, *Synthesis and Applications of Cage-Based Covalent Organic Frameworks*, Crystal Growth & Design, 24, 6081-6094, 2024

2. Akhtar Alam, Bidhan Kumbhakar, Avanti Chakraborty, Bikash Mishra, Samrat Ghosh, Arne Thomas, **Pradip Pachfule**, *Covalent Organic Frameworks for Photocatalytic Hydrogen Peroxide Generation*, ACS Materials Letters, 6, 2007-2049, 2024
3. Avanti Chakraborty, Monojit Roy, Akhtar Alam, Debashis Adhikari and **Pradip Pachfule**, *Covalent organic frameworks as heterogeneous photocatalysts for cross-coupling reactions*, Green Chemistry, 26, 9619-9651, 2024
4. Avanti Chakraborty, Akhtar Alam, Uttam Pal, Archisman Sinha, Subhadip Das, Tanusri Saha-Dasgupta and **Pradip Pachfule**, *Enhancing photocatalytic hydrogen peroxide generation by tuning hydrazone linkage density in covalent organic frameworks*, Nature Communications, 16, 503, 2025
5. Amit Nagar, Gulshan Singh, Akhtar Alam, **Pradip Pachfule** and C. M. Nagaraja, *Design of donor-acceptor covalent organic frameworks for photocatalytic hydrogen generation*, Materials Chemistry Frontiers, 9, 1421-1430, 2025
6. Amit Nagar, Gulshan Singh, Akhtar Alam, **Pradip Pachfule** and C. M. Nagaraja, *Benzothiadiazole-based donor-acceptor covalent organic framework for photocatalytic hydrogen generation*, Sustainable Energy and Fuels, 9, 1885-1894, 2025
7. Arpita Das, Bidhan Kumbhakar, **Pradip Pachfule**, Gurunathan Baskar, Hu Li, Pravin Kodgire, Samuel Lalthazuala Rokhum, *Valorization of Bambusa striata shavings into functional superparamagnetic material and its application in biodiesel production: Response surface optimization, kinetics, thermodynamics and economic assessment*, Process Safety and Environmental Protection, 189, 894-910, 2024
8. Monojit Roy, Bikash Mishra, Shyamali Maji, Archisman Sinha, Supriti Dutta, Sukanta Mondal, Abhik Banerjee, **Pradip Pachfule**, Debashis Adhikari, *Covalent Organic Framework Catalyzed Amide Synthesis Directly from Alcohol Under Red Light Excitation*, Angewandte Chemie, 63, e202410300, 2024

Talks / Seminars Delivered in reputed conference / institutions

1. An oral presentation entitled 'Functionalized Covalent Organic Frameworks for Photocatalysis' was delivered on 17th January, 2025 at "Processability and Applications of Reticular Advanced Materials (PARAM-2025)" workshop arranged at NISER, Bhubaneswar. This workshop was arranged to bring young researchers from diverse backgrounds from academia and industry together to contribute to the theme of advanced materials; 17/01/2025; NISER, Bhubaneswar; 25 minutes
2. An oral presentation entitled 'Functionalized Covalent Organic Frameworks for Photocatalysis' was delivered on 22nd July, 2024 at "International Conference on Sustainable Catalysis: Synthesis, Theory, and Applications (SusCat-STA 2024)" held in Udaipur, Rajasthan, India. This conference brings all like-minded researchers from diverse backgrounds from academia and industry together to contribute to the theme of sustainability; 22/07/2024; Udaipur, Rajasthan, India; 25 Minutes
3. An oral presentation entitled 'Functionalized Covalent Organic Frameworks for Photocatalysis' was delivered on 11th July, 2024 at "the International Conference on Materials and Membranes for Water and Energy (ICMMWE-24)" organized at CSIR-CSMCRI, Bhavnagar, Gujarat, India. This conference on Materials and membranes for water and energy provides an opportunity for technocrats/researchers to discuss stable membrane and sustainable membrane technologies and their potential applications for energy and water purifications; 11/07/2024; CSIR-CSMCRI, Bhavnagar, Gujarat, India; 25 Minutes
4. An oral presentation titled 'Harnessing the Sunlight for Photocatalytic Water Splitting' was given on 08th March 2025 at the 'Current Advances in Chemical Science (CACS)' conference organized at Ashoka University, Delhi, India. This conference, covering all aspects of materials and synthetic chemistry, including inorganic, organic, and hybrid systems, was organized to bring together young researchers from diverse backgrounds from academia to contribute to the chemical science; 08/03/2025; Ashoka University, Delhi, India; 30 minutes

Administrative dutie

1. Member of the Committee named 'Outreach Programmes for the Students of SC/ST Communities under VASP', which was involved in organizing outreach programs at the following locations:

OUTREACH PROGRAM 1:

A One Day Science Outreach Program was organized by the Dept. of Physics, Gour Mahavidyalaya, Mangalbari, Malda

Date: 13/12/2024

OUTREACH PROGRAM 2:

Sutragarh M. N. High School, Shantipur, Nadia

Date: 31/01/2025

2. Member of the "Hazardous Waste Disposal of the Centre" Committee responsible for the treatment and disposal of hazardous and other wastes generated at SNBNCBS
3. Member of the "Library Committee" at SNBNCBS which is responsible for advising on the management and development of a library. This committee plays a crucial role in shaping library policies, collection development, and ensuring the library effectively serves its users.

Patents Taken and Process Developed with Details

1. Chromium Telluride polycrystalline material as a catalyst for electrocatalytic hydrogen generation; Pradip Pachfule, Nitesh Kumar, Suchetana Manna, Archisman Sinha, and Banik Rai; Indian Patent (Filed); Applied
2. Photosynthesis of hydrogen peroxide from water using hydrazone-based covalent organic frameworks (COFs); Indian Patent, 2025, Application No. 202531010086A; Applied

Awards, Recognitions, if any

1. Thieme Chemistry Journals Award (February 2025):

   Awarded the 'Thieme Chemistry Journals Award' by the Editorial Boards of Synthesis, Synlett, Synfacts and the Open Access Journals Portfolio for 2025. Individuals in this category are promising early career professors, and each year, the Editorial Boards select a few individuals to receive free subscriptions to all three subscription journals as a gesture of encouragement.

2. Top 2% of the world's scientists (October 2024):

   The Stanford University database provides standardized information on citations, h-index and a composite indicator (c-score) to better understand and celebrate the contributions of scientists in different fields. The database classifies scientists from around the world into 22 scientific fields and 174 subfields using the standard Science-Metrix classification. The selection criteria are based on being in the top 100,000 scientists by c-score or having a percentile rank of 2% or above in a sub-field (data used from a Scopus updated to the end of the 2023 citation year).

Membership of Learned Societies

1. Young Associate of Maharashtra Academy of Sciences:

   For the significant contributions to the field of Chemical Sciences, I was awarded a Young Associate from the Maharashtra Academy of Sciences, which is a premier scientific society established in 1976 with the specific aim of promoting science and technology. The selection of a 'Young Associate' is a rigorous process, for which the applicant needs to have a significant contribution and publication record in the respective research area.

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. Olefin-linked Covalent Organic Frameworks (COFs) for Photocatalytic Water Splitting for Hydrogen Generation (FILE NO.SRG/2022/000217); DST-SERB, India; 2.5 years; PI
2. Tunable Micro-Mesoporous Covalent Organic Frameworks for CO_2 Reduction; Spanish Ministry of Science and Innovation; 3 Years; Co-PI

Conference / Symposia / Schools organized

1. SNBOSE-ASHOKA 2nd Meeting: Role - Co-convener, Number of speakers – 17, Number of Participants – 40; 20/06/2024; S. N. Bose National Centre for Basic Sciences, Kolkata; 2 Days

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. Prof. Samuel Lalthazuala Rokhum - Department of Chemistry, National Institute of Technology Silchar, Silchar, Assam 788010, India; National
2. Prof. Abhik Banerjee - Research Institute for Sustainable Energy (RISE), TCG Centres for Research and Education in Science and Technology Sector V, Salt Lake, Kolkata, 700091, India; National

3. Dr. Debashis Adhikari - Department of Chemical Science, Indian Institute of Science Education and Research Mohali, SAS Nagar-140306, Mohali, India; National
4. Prof. David Díaz Díaz - Departamento de Química Orgánica, Universidad de La Laguna, Avenida Astrofísico Francisco Sánchez 3, La Laguna 38206, Tenerife, Spain; International
5. Dr. Samrat Ghosh - Inorganic and Physical Chemistry Laboratory, Council of Scientific and Industrial Research (CSIR), Central Leather Research Institute (CLRI), Chennai 600020, India; National
6. Prof. Arne Thomas - Department of Chemistry/ Functional Materials, Technische Universität Berlin, Hardenbergstr. 40, 10623 Berlin, Germany; International
7. Dr. Debashis Adhikari - Department of Chemical Science, Indian Institute of Science Education and Research Mohali, SAS Nagar-140306, Mohali, India; National
8. Dr. Subhadip Das - Department of Chemistry, Chaudhary Ranbir Singh University, Jind, 126102, Haryana, India; National
9. Prof. C. M. Nagaraja - Department of Chemistry, Indian Institute of Technology Ropar, Rupnagar 140001, Punjab, India; National
10. Prof. C. M. Nagaraja - Department of Chemistry, Indian Institute of Technology Ropar, Rupnagar 140001, Punjab, India; National

Outreach program organized / participated

1. Invited Speaker, Research and Innovation-Series of Events (RISE) Lecture Series, Vellore Institute of Technology (VIT), India (Online):

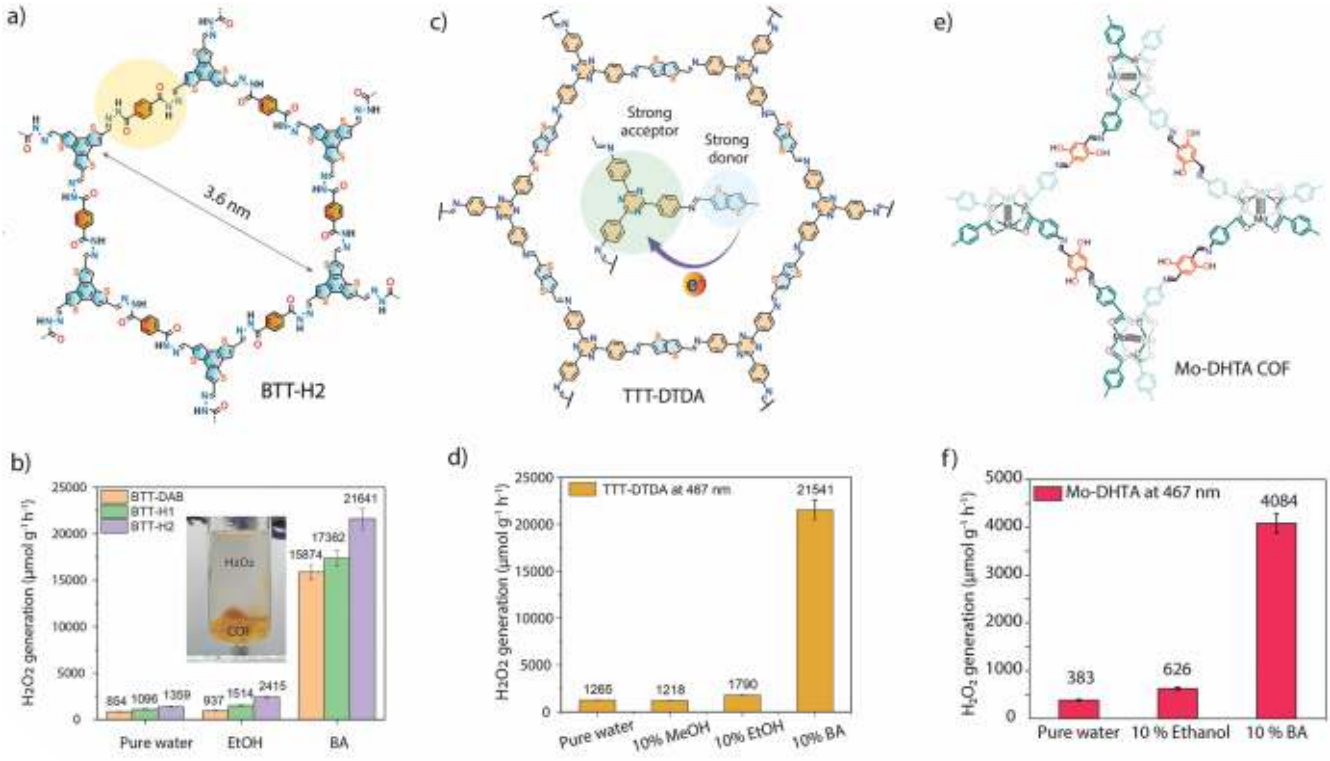
   Date: 11th September 2024

   Time: 2:00 PM to 4:00 PM

   Delivered an outreach talk on "Emerging Materials for Clean Energy and Environment" as part of VIT's RISE lecture series, aimed at engaging faculty members, PhD scholars, and undergraduate/ graduate students. The session highlighted recent advances in functional porous materials and polymers for sustainable energy and environmental applications. The talk was attended by over 100 participants from diverse academic backgrounds.

2. In an outreach program for guiding college students, I gave the online presentation entitled 'Research and Career Opportunities in India and Abroad' at Nowrosjee Wadia College, Pune, Maharashtra.

   Date: 18th November 2024



Duration: 2:00 hours

Attendees: 50

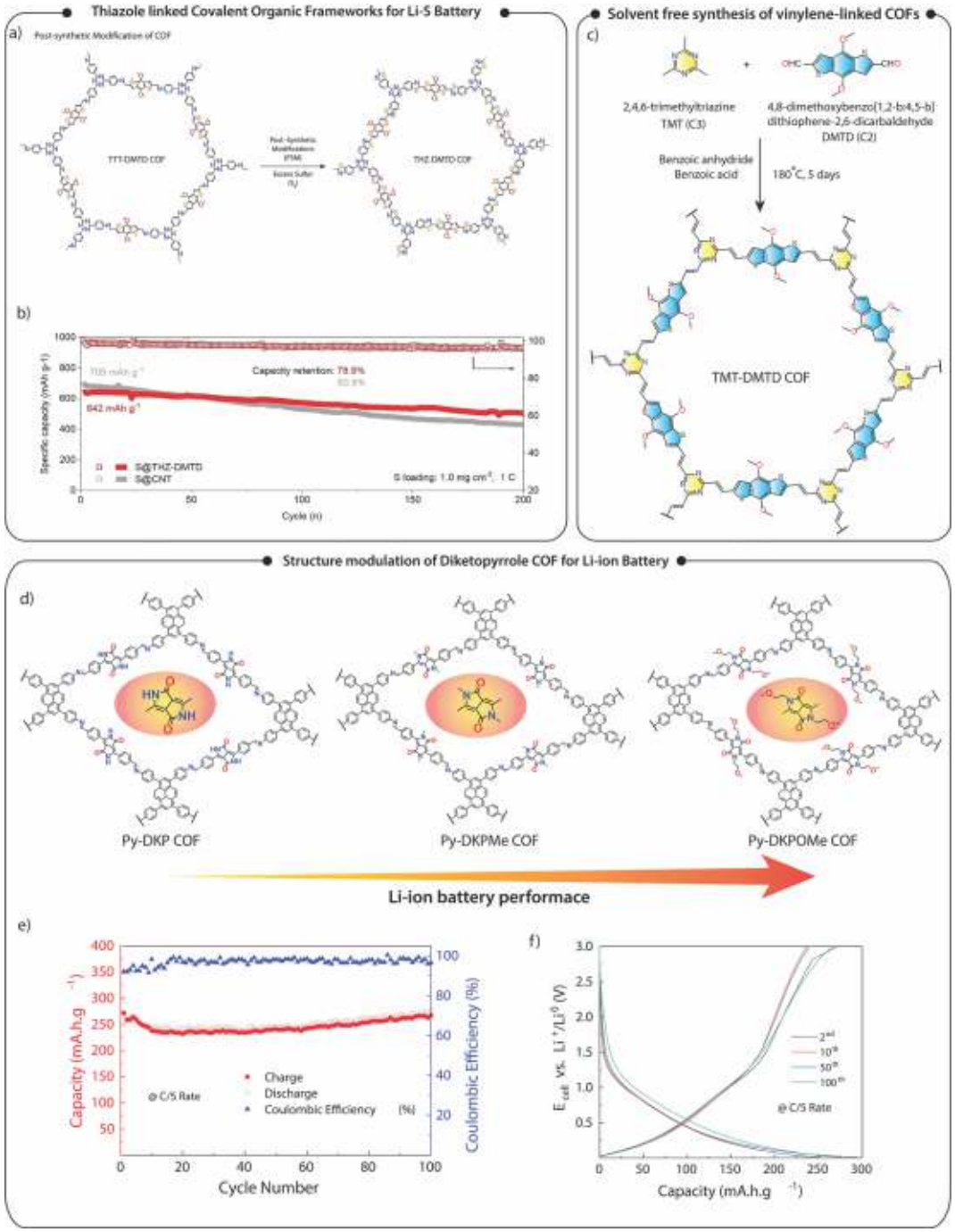
Host: Dr. Shashikant D. Shinde

Areas of Research

Transition metal chalcogenide for water splitting: Hydrogen (H_2) is a highly valuable chemical that is widely used in various industries as a clean fuel source, a feedstock for ammonia production, and in numerous hydrogenation processes. To overcome the conventional energy-intensive steam methane reforming process, which dominates the production of hydrogen gas, there is a need for alternative materials and processes to achieve sustainable hydrogen production and meet the growing demand for clean energy sources. Currently, we are working on a class of transition metal chalcogenides that can be synthesized on a large scale for electrocatalytic hydrogen production.

Covalent organic frameworks for photocatalysis: Covalent organic frameworks (COFs), porous and crystalline materials composed of organic moieties linked by covalent bonds, are used as photocatalysts. This photochemical phenomenon involves exciting electrons in the COFs by photon absorption, generating electron-hole pairs that facilitate redox reactions with reactant species. The use of COFs as photocatalysts holds great promise in various fields, particularly in energy conversion and environmental remediation processes. Potential applications include photocatalytic water splitting, CO_2 reduction, hydrogen peroxide generation and organic transformations, providing opportunities for sustainable energy production under environmentally benign conditions.

Covalent organic frameworks for energy storage: Covalent organic frameworks (COFs) are emerging as promising porous materials, offering a crystalline structure with tunable properties that are highly attractive for various



energy storage applications. COFs can be used as electrode materials in supercapacitors - energy storage devices that charge and discharge rapidly. Beyond supercapacitors, COFs show promise for advanced batteries, including lithium-ion and sodium-ion types. Considering interesting properties, efficiency and durability, COFs could play a significant role in making future batteries more efficient and sustainable.

Plan of Future Work Including Project

1. Photocatalytic H_2O_2 Generation:

Building on our current findings, we plan to systematically investigate the role of organic bridging linkages and functional groups in tuning the photocatalytic efficiency of COFs for H_2O_2 generation. Specifically, we aim to explore how different linkages influence hydrophilicity, structural stability, and interfacial interactions with water and oxygen. Preliminary results suggest that amide-linked COFs, exhibit enhanced hydrophilicity and robustness compared to their non-polar azo-bridged counterparts, leading to significantly improved H_2O_2 production in pure water (528 μmol g-1 h-1). We are currently synthesizing the remaining members of this COF series to complete the structure-activity relationship study. Detailed mechanistic investigations, including photophysical analyses and theoretical modeling, are underway to elucidate the charge transfer dynamics and active sites involved in the photocatalytic H_2O_2 generation process.

2. Post-synthetically modified Covalent Organic Frameworks for Photocatalytic Organic Transformation:

Moving forward, we aim to further exploit the structural tunability and post-synthetic modifiability of covalent organic frameworks (COFs) to develop next-generation heterogeneous photocatalysts for complex organic transformations. Given their long-range periodicity, permanent porosity, and chemically modifiable frameworks, COFs offer an ideal platform for creating confined, functional environments tailored for catalytic activity. Building on our prior success with electron-deficient backbones, redox-active functionalities, and metal-incorporated systems, we plan to design and synthesize COFs with precisely engineered active sites for challenging bond activations and selective oxidative transformations.

Future efforts will focus on expanding the scope of post-synthetic modification (PSM) strategies to introduce diverse catalytic centers-including multifunctional ligands, transition metals, and redox-mediating units-without compromising structural integrity or porosity. Special attention will be given to tailoring the electronic environment within the COF channels to facilitate single-electron transfer (SET) processes and multi-electron redox cycles. We are particularly interested in activating strong chemical bonds, such as C-F and C-H, and enabling photocatalytic C-C and C-X coupling reactions under mild, sustainable conditions.

Additionally, mechanistic studies involving advanced spectroscopic tools and theoretical modeling will be employed to understand structure-activity relationships, charge separation dynamics, and the role of confined microenvironments in enhancing catalytic efficiency. Ultimately, our goal is to establish rational design principles for PSM-enabled COFs as versatile, recyclable, and high-performing photocatalysts for a broad spectrum of sustainable organic reactions.

Rajib Kumar Mitra

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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Ria Saha; Studies on the Effects of Different Crowding agents on Protein Folding Unfolding Process and its Kinetics as well as Activity; Thesis Submitted
2. Aritra Marik; Biomolecular hydration in presence of solutes; Under Progress
3. Shah Imtajul Haque; Membrane hydration; Under Progress
4. Asesh Bera; Small molecules in biology; Under Progress
5. Partha Das; Physicochemical Mechanisms of Phase Separation: Insights into Solvation Structure and Dynamics; Under Progress
6. Anushree Sen; Computational Biology; Under Progress; shared with Jaydeb Chakrabarti
7. Sourik Dutta; Nanoparticles for Optoelectronic applications; Under Progress; shared with Ali Hossain Khan
8. Bikram Das; Applications of Nanocrystal; Under Progress; shared with Ali Hossain Khan

b) Post-Docs

1. Indrani Bhattacharya; Bimolecular hydration
2. Ananya Bhattacharya; Biophysics and nano-biology

c) External Project Students / Summer Training

1. Jez Vibiezonuo Rupre-o; Protein-ligand interaction

Teaching

1. Autumn Semester; PHY 301 (Atomic and Molecular Physics); Integrated PhD; 14 students; shared with Prof. Anjan Barman
2. Autumn Semester; CB 527 (Molecular Physics & Spectroscopy); PhD; 4 students; shared with Prof. Anjan Barman

Publications

a) In journals

1. Prabhat Sahu, Sk Imadul Islam, **Rajib Kumar Mitra** and Dipak K. Palit, *A Complete Description of the Ultrafast Proton Transfer Dynamics in the Excited State of D-Luciferin*, The Journal of Physical Chemistry B, 129, 1046-1060, 2025
2. Swapnil Barman, **Rajib Kumar Mitra**, *Reconfigurable spin-wave properties in two-dimensional magnonic crystals formed of diamond and triangular shaped nanomagnets*, Physica E: Low-dimensional Systems and Nanostructures, 165, 116104, 2025
3. Indrani Bhattacharya, Ria Saha, Sumana Pyne, Asesh Bera, **Rajib Kumar Mitra**, *Excipient Induced Unusual Phase Separation in Bovine Serum Albumin Solution: An Explicit Role Played by Ion-Hydration*, Langmuir, 40, 25822-25833, 2024
4. Ria Saha, Indrani Bhattacharya, Sumana Pyne, **Rajib Kumar Mitra**, *Thiocyanate Ion (SCN^-) Offers a Major Impact in Rapid Protein Amyloidosis: A Salient Role Played by Protein Solvation*, The Journal of Physical Chemistry B, 129, 1946-1955, 2025
5. Ria Saha, Subhadip Chakraborty, Krishnendu Sinha, Partha Pyne, Sreya Pal, Anjan Barman, Suman Chakrabarty, **Rajib Kumar Mitra**, *Ion-Pairing Propensity in Guanidinium Salts Dictates*

Their Protein (De)stabilization Behavior, The Journal of Physical Chemistry Letters, 15, 10341-10348, 2024

Talks / Seminars Delivered in reputed conference / institutions

1. Invited talk entitled "Role of Hydration in Biomolecular Condensation: Insight from THz Spectroscopy" in the CTMSE, 2025 conference; 01/03/2025; Institute of Engineering and Management, Kolkata; 1 hour
2. Invited talk entitled "Impact of Ion Solvation on Biomolecular Condensation: The Hofmeister Series and Beyond" at Optics for Life Sciences (OWLS) conference at IIT Mumbai; 19/11/2024; IIT Mumbai; 30 minutes
3. Invited talk entitled "Application of Terahertz Spectroscopy in Chemistry and Biology" at International Workshop on (AGTaX2024); 08/10/2024; IUAC, New Delhi; 30 minutes
4. Invited talk entitled "Impact of Ions on Biomolecular Condensation" at Ruhr University, Bochum, Germany; 18/09/2024; Ruhr University, Bochum, Germany; 1 hour

Administrative duties

1. Dean (Administration and Resource Generation)
2. Nodal Officer (TRC-SNBNCBS)
3. Chairman, SCOLP Committee
4. Chairman, Technical Cell
5. Chairman, External Standing Technical Committee
6. Head, Department of Chemical and Biological Sciences (additional charge)

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. Biomolecular condensates: Exploring the associated hydration and energetics using THz spectroscopy; SERB-DST (ANRF); 2024-2027; PI

Conference / Symposia / Schools organized

1. Member of the organizing committee of the conference "Women in Quantum Science and Technologies"; 17/07/2024; S N Bose Centre, Kolkata; 2 days
2. Member of the organizing committee of the conference "International Conference on Bose-Einstein Condensation, Superconductivity, Superfluidity and Quantum Magnetism"; 12/11/2024; Biswa Bangla Convention Centre, Kolkata; 5 days

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. Collaboration with Prof. Dipak K. Palit at CEBS, Mumbai; Sl. No. 1; National

Outreach program organized / participated

1. Participated in an outreach pregame at Kandi Raj College, Murshidabad during 12-13th December 2024 and delivered a talk

Areas of Research

Terahertz spectroscopy, time-resolved spectroscopy, biomolecular condensation, thermodynamics, self-aggregated systems, light-matter interaction

Plan of Future Work Including Project

1. We aim to experimentally in-vitro and ex-vivo realize and establish the concept that biomolecular (protein, membrane etc.) condensation process is associated with a definite modification in the structure and dynamics of the interfacial solvation. We will monitor the explicit change in protein/lipid hydration at the different aggregated state(s) during the condensation process using THz time domain (TTDS) and FIR-FTIR spectroscopic technique(s) combined with other complementary spectroscopy/microscopy techniques and its possible modulation by altering the solvent physical parameter(s) upon the addition of excipient(s). THz spectroscopy probes the low frequency collective vibration modes of water, and therefore is very sensitive to the global network dynamics of water around the different polar and nonpolar moieties of biomolecules. We expect that the different aggregated state(s) would render different solvation imprint(s), which can be traced and detected in real time using THz spectroscopy. We will extend our studies in presence of externally added excipient(s), which is expected to change the physical properties of water, and thus also the condensation dynamics; this study could lead to find a strategy to modulate the aggregate formation process. Finally, we will estimate the energetic parameters (entropy and enthalpy) associated with the condensation process using temperature dependent TTDS and FIR-FTIR measurements following a recently developed concept of THz calorimetry. Our study would result in a fundamental and molecular level apprehension on the otherwise less studied aspect of solvation change during biomolecular condensation. The output of this proposal would render positive impetus for further research on the condensation associated bio-physical phenomenon.

Ranjit Biswas

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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Narayan Maity; Experimental Studies ofMetastable and Self-Organised Systems; Thesis Submitted
2. Jayanta Mondal; Experimental Studies of Ionic andNeutral Deep Eutectics; Awarded
3. Dhrubajyoti Maji; Computer Simulations of DeepEutectics; Awarded
4. Amrita Mondal; Experimental Studies of ComplexChemical Systems; Thesis Submitted
5. Sudipta Mitra; Computer Simulations of Relaxation Dynamics inCondensed Phases; Under Progress
6. Rik NMukherjee; Computer Simulations of IonicDeep Eutectic and Other Systems; Under Progress
7. Abdul Aziz; Computer Simulations of Biomolecular Aggregation; Under Progress

Teaching

1. Spring Semester; Physical Chemistry: Theory & Experiments; PhD; 4 students

Publications

a) In journals

1. Sudipta Mitra, **Ranjit Biswas**, Suman Chakrabarty, *WeTICA: A directed search weighted ensemble based enhanced sampling method to estimate rare event kinetics in a reduced dimensional space*, Journal of Chemical Physics, 162, 034106, 2025
2. Hideaki Shirota, Maharoof Koyakkat, Juriti Rajbangshi, **Ranjit Biswas**, *Temperature Dependence of Intermolecular Dynamics and Liquid Properties of Deep Eutectic Solvent, Reline*, Journal of Physical Chemistry B, 129, 965-978, 2025
3. Amrita Mondal, Kajal Kumbhakar, **Ranjit Biswas**, *Correlating Ionic Conductivity to Structure and Dynamics of Li-Ion Battery Electrolyte Systems: Raman Spectroscopy, Dielectric Relaxation Measurements, and Streak Camera Solvation Data Analysis*, The Journal of Physical Chemistry B, 128, 48, 11924-11937, 2024
4. Jayanta Mondal, Dhrubajyoti Maji, Sudipta Mitra, **Ranjit Biswas**, *Temperature-Dependent Dielectric Relaxation Measurements of (Betaine + Urea + Water) Deep Eutectic Solvent in Hz-GHz Frequency Window: Microscopic Insights into Constituent Contributions and Relaxation Mechanisms*, Journal of Physical Chemistry B, 128, 6567-6580, 2024
5. Sudipta Mitra, **Ranjit Biswas**, *Exploring the capabilities and limitations of the Van Hove function to understand directional correlations in ion movements within Li-ion battery electrolytes*, Journal of Chemical Physics, 161, 064501, 2024
6. Dhrubajyoti Maji, **Ranjit Biswas**, *Solvation structure of paracetamol in ChCl-based polyol deep eutectic solvents: Microscopic insights into increased solubility*, Journal of Molecular Liquids, 423, 127042, 2025

7. Tonima Nandy, **Ranjit Biswas**, *Inhibition of amyloid fibrillation of single amino acid tryptophan by tannic acid: An insight into targeted therapy of hypertryptophanemia disorder*, Journal of Photochemistry and Photobiology A: Chemistry, 453, 115660, 2024

Talks / Seminars Delivered in reputed conference / institutions

1. Presented an invited talk in the inaugural local chapter of the Society of Physical Chemistry, SoPhyC 2024, Kolkata Chapter, on 3rd December, 2024, entitled "Interspecies Interaction and Entropy: Relevance to Deep Eutectics."; 03/12/2024; IISER Kolkata; 20 minutes
2. Presented an Invited Poster in the second annual meeting of the Society of Physical Chemistry (SoPhyC), India during October 22-25, 2024 at the IIT Mumbai, entitled "Exploring Directional Correlations in Ion Movements within Li-ion Battery Electrolytes, and Temporal Correlations of Conductivities to Solvent Matrix Polarization Relaxation."; 23/10/2024; IIT Mumbai; 60 minutes
3. Invited talk in an DAE-BRNS symposium on "Current Trends in Theoretical Chemistry (CTTC 2024)" during 26-28 September, 2024, entitled "Liquid Phase of Deep Eutectics: Enthalpy versus Entropy"; 26/09/2024; BARC Mumbai; 25 minutes
4. Invited talk in a conference "Advances in Chemical Sciences (ACS-I)" at the North-Eastern Hill University (NEHU), Shillong, during March 10-11, 2025, entitled "Interspecies Interaction and Entropy: Relevance to Deep Eutectics."; 10/03/2025; NEHU Shillong; 30 minutes
5. Invited talk at the Bose Institute during Science Day Celebration, February, 28, 2025, entitled "Why Do We Celebrate 28 February as National Science Day?"; 28/02/2025; Bose Institute Kolkata; 40 minutes
6. Invited Talk in an Outreach Activity at the Khamra-Bhabki High School on 31 January 2025, entitled "Satyendranath Bose: A Scientist Who Set the Trend and Drove the Future in Both Physics and Chemistry Research."; 31/01/2025; Khamra-Bhabki High School, Murshidabad; 75 minutes
7. Invited talk at the Chemistry Department, Kalyani University, February 27, 2025, entitled "C. V. Raman: A Scientist per Excellence"; 27/02/2025; Kalyani University; 60 minutes
8. Invited talk at the Aliah University in an one day meeting "International Conference on Advances in Chemical Sciences" (ICACS -2025) on 30 January 2025, entitled "Physical Chemistry of Energy Materials: What Determines Battery Electrolyte Concentration and Imparts Uniqueness to Matrix Composition?"; 30/01/2025; Aliah University; 30 minutes
9. Invited talk in the conference "Chem 24" at the Indian Association for the Cultivation of Science during 27-29 December, 2024, entitled "Water As a Component in Naturally Abundant Deep Eutectic Solvent: How does It's Structure Correlate to Dynamics?"; 28/12/2024; IACS Kolkata; 20 minutes
10. Invited talk in "Statistical Mechanics in Chemistry and Biology (SMCB - 2024)" conference, at the Department of Chemistry, IIT Tirupati, Tirupati, India, during 17-19 December 2024, entitled "Water in (Betaine + Urea + Water) Deep Eutectic Solvent: How Does It Behave in Hz-GHz Frequency Window?"; 18/12/2024; IIT Tirupati; 20 minutes

Administrative duties

1. Chairperson, APRP (Post-Doctoral) Program

Awards, Recognitions, if any

1. Elected Fellow, National Academy of Science (Allahabad), India (2024)

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. A Theoretical Approach to Predict Deep EutecticFormation: Locating the Lowest Melting Point(DST(MATRICS_SERB); 3 years; PI

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. Journal of Physical Chemistry Letters 2024, 15, 3078-3088; Sl. No. 2; National
2. Journal of Physical Chemistry B 2025, 129, 4410-4419; Sl. No. 3; National
3. Journal of Chemical Physics, 2025, 162, 164903(1-13); Sl. No. 4; National

4. Journal of Chemical Physics, 2025, 162, 034106 (1-11); Sl. No. 5; National
5. International Journal of Biological Macromolecules, 2023, 241, 124470(1-11); Sl. No. 7; National

Outreach program organized / participated

1. Invited Talk in an Outreach Activity at the Khamra-Bhabki High School on 31 January 2025, entitled "Satyendranath Bose: A Scientist Who Set the Trend and Drove the Future in Both Physics and Chemistry Research."

Areas of Research

Physical Chemistry/ Chemical Physics; Theory, Experiments & Computer Simulations. Spectroscopic (ultrafast and steady state fluorescence) measurements, dielectric relaxation experiments, and other physicochemical measurements; Azeotropes, Deep Eutectic Solvents, Energy Materials, Cryoprotectants, multicomponent mixtures, and protein aggregation. Our aim is to develop a thorough understanding of structure and dynamics of condensed phases by integrating theory, experiments and computer simulations. We strive for developing procedures that would be useful to chemical industry for engineering designer solvent for tailoring reaction product and setting up protocols for solvent extraction and purification from contaminated mixtures.

Plan of Future Work Including Project

(i) Understanding Structure & Dynamics of Cryoprotectants via Dielectric Relaxation Measurements, Time-resolved Fluorescence Measurements and Simulations (ii) Exploring the Interaction & Dynamics of Azeotropes via Simulations & Experiments (iii) Prediction of the Lowest Melting Points of Probable Deep Eutectic Mixtures via Theory and Simulations (iv) Understanding Water Dynamics in Aquoeus Solutions of Copolymers (v) Understanding the Enzyme Promiscuity by Probing the Kinetics via Simulations & Experiments

Samir Kumar Pal

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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Susmita Mondal; Studies on Biochemical and Molecular aspects of Redox Modulatory Theranostic Nanomaterials in Preclinical Disease Model; Awarded
2. Nivedita Pan; Photophysical Studies on Hybrid Nanomaterials for Manifold Applications; Awarded
3. Ria Ghosh; In vitro and in vivo Investigations on Self-organized Assemblies for Their Potential Drug Delivery Activity; Awarded
4. Lopamudra Roy; Exploration of Optical Methodologies for the Development of Prototypes in the Real-World Applications; Awarded
5. Monojit Das; Preclinical studies on the mechanism of redox modulation and its therapeutic applications in physiological milieu; Awarded
6. NAGLAA ATIF ALHADI RAHMAA; Spectroscopic studies on applied nano materials; Under Progress

Teaching

1. Spring Semester; PHY491; Integrated PhD; 13 students; shared with Prof. Soumen Mondal

Publications

a) In journals

1. Lopamudra Roy, Amrita Banerjee, Nivedita Pan, Ria Ghosh, Susmita Mondal, Monojit Das, Md Nur Hasan, Soumendra Singh, Arpita Chattopadhyay, Kallol Bhattacharyya, Soumen Mondal, **Samir Kumar Pal**, *A spectroscopy-based proof-of-concept (POC) for developing loading of pathogen analyzer (LOPA) for dairy products*, Heliyon, 10(19), e38735, 2024
2. Gourab Ghosh, Ria Ghosh, Dipanjan Mukherjee, Md. Nur Hasan, Nivedita Pan, Lopamudra Roy, Suman Biswas, Ranjan Das, **Samir Kumar Pal**, *Excited-state Photoacid: A molecular reporter for sensing vesicle to micelle transition*, Journal of Molecular Liquids, 407, 125181, 2024
3. Rincy Anto, Ria Ghosh, **Samir Kumar Pal**, Uttam K. Bhui, *Micellar solubilization of petroleum crudes in surfactant solution under different physicochemical conditions*, Journal of Molecular Liquids, 414. Part A, 126068, 2024
4. Lopamudra Roy, Amrita Banerjee, Ria Ghosh, Kallol Bhattacharya, **Samir Kumar Pal**, *Combined Experimental and Simulation Studies for Potential Classification of Inorganic and Organic Suspended Particulates in Indoor Air*, IEEE Sensors Letters, 8, 3502304, 2024
5. Monojit Das, Susmita Mondal, Ria Ghosh, Soumendra Darbar, Lopamudra Roy, Anjan Kumar Das, Debasish Pal, Siddhartha Sankar Bhattacharya, Asim Kumar Mallick, Jayanta Kumar Kundu, **Samir Kumar Pal**, *A study of scarless wound healing through programmed inflammation, proliferation and maturation using a redox balancing nanogel*, Journal of Biomedical Materials Research, 112, 1594-1611, 2024
6. Ria Ghosh, Monojit Das, Susmita Mondal, Amrita Banerjee, Lopamudra Roy, Anjan Kumar Das, Debasish Pal, Siddhartha Sankar Bhattacharya,

Maitree Bhattacharyya, **Samir Kumar Pal**, *Targeted Redox Balancing through Pulmonary Nanomedicine Delivery Reverses Oxidative Stress Induced Lung Inflammation*, ChemMedChem, 19, e202400037, 2024

7. Nivedita Pan, M. Nur Hasan, Sangeeta Ghosh, Lopamudra Roy, Chinmoy Bhattacharya, Debjani Karmakar, **Samir Kumar Pal**, *Near-Infrared Active Tri-nanohybrid for Enhanced Energy Harvesting*, Chemistry Select, 9, e202400968, 2024

b) Other Publications

Books / Book Chapters

1. L. Roy, S. Mondal, R. Ghosh, M. Das, M. N. Hasan, A. Banerjee, N. Pan, A. Chattopadhyay, and S. K. Pal; " Recent progress in the synthesis of nanozymes and their functionalization ", (Book Chapter) in " Nanozymes - Approachable Bio-applications" Edited by Ravi Mani Tripathi, Ramesh Namdeo Pudake, Peng Huang, Nesrin Horzum, ELSEVIER, ISBN: 9780443137891, 2024.

Talks / Seminars Delivered in reputed conference / institutions

1. A Keynote Speaker. Talk entitled "Probing" Spectroscopic Probes for Non-invasive Simultaneous Disease Diagnosis: The Challenges; 03/10/2024; BRICS WORKSHOP ON BIOPHOTONICS-2024 at Manipal Academy of Higher Education, Karnataka-576104; 60 mins
2. A plenary speaker in a UGC-DEB funded Two-Day National Seminar on IPR: Demystifying Intellectual Property. Talk entitled "Detection, Intervention and Management of Pediatric Learning Disorder: Innovation to Access of Common Man"; 15/07/2024; Netaji Subhas Open University Headquarters, DD-26, Sector-I, Salt Lake, Kolkata-700064.; 60 Mins

Administrative duties

1. Chairman of Pest control committee
2. Chairman of Security monitoring committee

Membership of Learned Societies

1. Indian Association for the Cultivation of Science, Life Member
2. Indian Physical Society
3. Member of Governing Council Indian National Academy of Engineering: INAE
4. Programme Advisory Committee (PAC): 2021-2024 in Electrical, Electronics and Computer Engineering of Science and Engineering Research Board (SERB)
5. Fellow of Indian National Academy of Engineering (FNAE)

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. Development of a Non-Invasive Spectroscopic Device for The Assessment of Urinary Bladder Cancer (UBC) and Large-Scale Clinical Trial for Early Diagnosis; Department of Science & Technology and Biotechnology, Government of West Bengal funded (Sanction order no: 1472 (Sanc.)/STBT-11012(19)/2/2025-ST SEC) R&D project; 3 Years; Co-PI

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. Professor Asim Kumar Mallick, NRS Medical College, Kolkata, 700014, India; Sl. No. 5; National
2. Professor Ranjan Das, Department of Chemistry, West Bengal State University, Kolkata, India; Sl. No. 2; National
3. Dr. Arpita Chattopadhyay, Department of Basic Science and Humanities, Techno International New Town, Kolkata, 700156, India; Sl. No. 1, 7; National
4. Dr. Debjani Karmakar, Bhabha Atomic Research Centre, Trombay, Mumbai, India; Sl. No. 7; National
5. Dr. Siddhartha Sankar Bhattacharya, Department of Zoology, Uluberia College, Uluberia, Howrah-711315, India; Sl. No. 5, 6; National
6. Dr. Debasish Pal, Department of Zoology, Uluberia College,Uluberia, Howrah-711315, India; Sl. No. 5, 6; National
7. Dr. Anjan Kumar Das, NRS Medical College, Kolkata, 700014, India; SL. No. 5, 6; National

Areas of Research

Optical Spectroscopy of Molecules and Materials for real world application

Plan of Future Work Including Project

1. Development of low-cost instruments for the nation.
2. Development of point of care diagnosis.
3. Development of bio-compatible nanohybrids for treating different diseases.
4. Development of low-cost sensors for environmental applications.
5. Basic experimental photophysical studies on bio-mimetic systems.
6. Basic studies on energy harvesting materials.
7. Clinical Trial of Nanomedicine in Human Subject
8. Pre-clinical Studies of Nanomedicines in Animal Model

Shubhasis Haldar

Associate Professor
Chemical and Biological Sciences
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Guidance of Students/Post-Docs

a) Ph.D. Students

1. Soham Chakraborty; Role of Talin studied by single molecule magnetic tweezers; Awarded (Co-supervisor: Dr. Balaji Chattopadhyay, Ashoka University)
2. Souradeep Bannerjee; Mechanisms of chaperones studied by single molecule technologies; Awarded (Co-supervisor: Dr. Shivani Krishna, Ashoka University)
3. Deep Chaudhuri; Mechanical role of chaperone; Under Progress (Co-supervisor: Dr. Aryya Ghosh, Ashoka University)
4. Debashruti Maity; Role of Histone chaperones in Cancer; Under Progress
5. Rianita Mondal; Role of NESPERIN Protein in Cell signaling; Under Progress
6. Subhradeep Chakravarty; Cell signaling; Under Progress

b) Post-Docs

1. Amarnath Pal; Investigating the impact of PLK - 4
2. Milan Patra; Understanding the sensation phenomenon
3. Subhas Chandra Bera; Development of temperature controlled magnetic tweezers

c) External Project Students / Summer Training

1. Shreyansh Priyadarsi; Robust Prediction of Patient-Specific Cancer Hallmarks Using Neural Multi-Task Learning: a model development and validation study

Teaching

1. Spring Semester; Study of Biomacromolecules; PhD; 6 students; Shared

Publications

a) In journals

1. Souradeep Banerjee, Debojyoti Chowdhury, Soham Chakraborty, **Shubhasis Haldar**, *Force-regulated chaperone activity of BiP/ERdj3 is opposite to their homologs DnaK/DnaJ*, Protein Science, 33, e5068, 2024

Talks / Seminars Delivered in reputed conference / institutions

1. Invited lecture in Indian Biophysical society-2025, IIT Madras March 6-9, 2025; 06/03/2025; IIT Madras; March 6-9, 2025
2. Invited lecture in CNCI, Kolkata, February 28, 2025; 28/02/2025; CNCI, Kolkata; February 28, 2025
3. Invited lecture in Drug discovery 2025: emerging trends and future prospects, Jamia Millia Islamia, Delhi, February 24-26, 2025; 24/02/2025; Jamia Millia Islamia, Delhi; February 24-26, 2025
4. Invited lecture in Interdisciplinary Approach to Biological Sciences-2025, IACS January 6-9, 2025; 06/01/2025; IACS; January 6-9, 2025
5. Invited lecture in Interdisciplinary Applications of Magnetic and Optical Tweezers (MTOT2024), December 17-21, IIT Bombay; 17/12/2024; IIT Bombay; December 17-21, 2024

6. Invited lecture in OWLS-17, Nov 18-21, 2024 IIT Bombay; 18/11/2024; IIT Bombay; 18-21, 2024

Administrative duties

1. Nodal Officer for the Curtain Raiser Event of the India International Science Festival (IISF) 2024, conducted on behalf of S.N. Bose National Centre for Basic Sciences
2. Member Secretary of the Institutional Biosafety Committee

Patents Taken and Process Developed with Details

1. OncoMark: A Deployable AI Framework for Precision Oncology; Applied
2. System to Determine Stem-Like State Profiling of Tumor Samples and A Method Thereof; Patent No. 202411074804; Applied

Membership of Learned Societies

1. Member of National Committee for International Union of Pure & Applied Biophysics (IUPAB)
2. Member of Indian Biophysical Society of India

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. Investigating the Mechano-Interactome Network of Talin Using Novel Single-Molecule Fluorescence-Force Spectroscopy (BT/PR45564/MED/30/2413/2022); DBT; 3years; PI

Conference / Symposia / Schools organized

1. Curtain Raiser Event, IISF, 2024; 06/11/2024; Silver Jubilee Hall, SNBNCBS; 1 day

Outreach program organized / participated

1. Chemistry Outreach Program Dinabandhu Andrews College, Garia, March 25, 2025

Areas of Research

My research group integrates advanced single-molecule techniques with computational modeling to investigate molecular chaperones, antibody-antigen mechanics, and AI-based cancer diagnostics.

Plan of Future Work Including Project

To advance our understanding of protein quality control and translocation under mechanical stress, we propose to investigate how chaperones modulate force-dependent protein extraction and folding during translocation events in both eukaryotic and bacterial systems.

One key direction will be to elucidate the mechanistic role of p47, a cofactor of the AAA+ ATPase p97, in retrotranslocation from the endoplasmic reticulum (ER) to the cytosol. While forward protein translocation into the ER is well-characterized, retrotranslocation - essential for ER-associated degradation (ERAD) - remains poorly understood. We hypothesize that p47 may function beyond its canonical cofactor role and act as a chaperone-like regulator of mechanical extraction. Using single-molecule magnetic tweezers, we plan to examine how p47 interacts with model substrates such as talin and whether it modulates their mechanical stability to facilitate retrotranslocation. We aim to quantify the work generated during chaperone-assisted unfolding and explore how this mechanical input contributes to substrate extraction across the ER membrane.

In a complementary line of inquiry, we propose to dissect the mechanical roles of periplasmic chaperones in protein translocation across the bacterial SecYEG translocon. Protein export in Gram-negative bacteria is driven not only by SecA-mediated ATP-driven pushing but also by folding forces at the periplasmic exit. However, how periplasmic chaperones contribute to this mechanically challenging environment remains largely unexplored. We plan to use single-molecule force spectroscopy to investigate the activity of tunnel-associated chaperones such as PpiD and DsbC, which we hypothesize may act as mechanical foldases, accelerating folding under tension. In contrast, chaperones like Spy and Skp may function as mechanical holdases, stabilizing unfolded substrates during translocation. This work will quantify the mechanical work output of different chaperones and define their roles in shaping folding pathways under mechanical stress.

Together, these studies will establish a mechanobiological framework for chaperone-assisted protein translocation in both eukaryotic and bacterial systems. They will not only fill critical gaps in our understanding of retrotranslocation and periplasmic folding but may also reveal new therapeutic targets in diseases associated with protein misfolding and bacterial pathogenesis.

Suman Chakrabarty

Associate Professor
Chemical and Biological Sciences
sumanc@bose.res.in

Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Abhinandan Das; Rational design and mechanism of action of inhibitors for Acetylcholinesterase; Under Progress
2. Dibyendu Maity; Machine learning in physics: prediction, identification and enhanced sampling; Under Progress
3. Sreyan Bhowmick; Computational investigation of allosteric regulation in proteins; Under Progress
4. Sutanu Mukhopadhyay; Computational approaches towards drug discovery; Under Progress
5. Sayari Bhattacharya; Computational Study of Misfolding and Aggregation in Proteins and Peptides; Under Progress
6. Shaheerah Shahid; Development of enhanced sampling methods and AI/ML for molecular simulations; Under Progress
7. Krishnendu Sinha; Computer Simulation Study of Molecular Recognition and Signalling; Awarded

b) Post-Docs

1. Sk. Samir Ahamed; Quantum chemical studies of complex molecules and their solvation behavior
2. Saheb Dutta; QM/MM and classical simulations of enzymes and protein-protein interactions

c) External Project Students / Summer Training

1. Esha Paul; Effect of co-solvents on peptide conformational landscape
2. Rwitacheta Sinha; Structure based models for simulating protein folding

Teaching

1. Spring Semester; Study of Bio-Macromolecules (CB 640); PhD; 8 students; Shared with Dr. Shubhasis Haldar

Publications

a) In journals

1. Dibyendu Maity and **Suman Chakrabarty**, *IceCoder: Identification of Ice Phases in Molecular Simulation Using Variational Autoencoder*, Journal of Chemical Theory and Computation, 21, 1916-1928, 2025
2. Sudipta Mitra, Ranjit Biswas, **Suman Chakrabarty**, *WeTICA: A directed search weighted ensemble based enhanced sampling method to estimate rare event kinetics in a reduced dimensional space*, Journal of Chemical Physics, 162, 034106, 2025
3. Sayari Bhattacharya, **Suman Chakrabarty**, *Mapping conformational landscape in protein folding: Benchmarking dimensionality reduction and clustering techniques on the Trp-Cage mini-protein*, Biophysical Chemistry, 319, 107389, 2025
4. Ria Saha, Subhadip Chakraborty, Krishnendu Sinha, Partha Pyne, Sreya Pal, Anjan Barman, **Suman Chakrabarty**, Rajib Kumar Mitra, *Ion-Pairing Propensity in Guanidinium Salts Dictates Their Protein (De)stabilization Behavior*, The

Journal of Physical Chemistry Letters, 15, 10341-10348, 2024

5. Abhinandan Das, Krishnendu Sinha and **Suman Chakrabarty**, *Elucidating the molecular mechanism of noncompetitive inhibition of acetylcholinesterase by an antidiabetic drug chlorpropamide: identification of new allosteric sites*, Physical Chemistry Chemical Physics, 26, 28894-28903, 2024
6. Dhiman Ray, Dipak Chamlagai, Sugam Kumar, Sutanu Mukhopadhyay, **Suman Chakrabarty**, Vinod K. Aswal, Sivaprasad Mitra, *Molecular Insights into the Conformational and Binding Behaviors of Human Serum Albumin Induced by Surface-Active Ionic Liquids*, Journal of Physical Chemistry B, 128, 6622 – 6637, 2024
7. Supriyo Santra, Rabindra Nath Manna, **Suman Chakrabarty**, Debashree Ghosh, *Conformational Effects on the Absorption Spectra of Phytochromes*, Journal of Physical Chemistry B, 128, 3614-3620, 2024
8. Krishnendu Sinha, Ipsita Basu, Zacharia Shah, Salim Shah, **Suman Chakrabarty**, *Leveraging Bidirectional Nature of Allostery To Inhibit Protein-Protein Interactions (PPIs): A Case Study of $PCSK_9$-LDLR Interaction*, Journal of Chemical Information and Modeling, 64, 3923-3932, 2024

Talks / Seminars Delivered in reputed conference / institutions

1. Sustainable Development in Chemical and Material Sciences (SDCMS); 04/04/2024; Central University of Jammu, Jammu; 2 days
2. Kaleidoscope: A Discussion Meeting in Chemistry; 29/06/2024; Udaipur, Rajasthan; 4 days
3. CHEMDOJO: A Students' Discussion Meeting in Chemistry; 01/10/2024; Sillari, Maharashtra; 4 days
4. 2nd annual meeting of the Society of Physical Chemistry (SoPhyC), India; 22/10/2024; IIT Bombay, Mumbai; 4 days
5. (Chemistry) Meet 2024: Connecting at Konark; 11/11/2024; Konark, Odisha; 4 days
6. Departmental Seminar at Department of Chemical Engineering, IIT Bombay; 25/09/2024; IIT Bombay, Mumbai; 1 day
7. Current Trends in Theoretical Chemistry (CTTC-2024); 26/09/2024; Bhabha Atomic Research Centre (BARC), Mumbai; 3 days
8. Annual Meeting of Biophysical Society, USA; 15/02/2025; Los Angeles, USA; 5 days
9. Chemistry Colloquium, Chemistry Department at Syracuse University, USA; 11/02/2025; Chemistry Department at Syracuse University, USA; 1 day
10. Annual Meeting of Indian Biophysical Society; 06/03/2025; IIT Madras, Chennai; 4 days
11. Recent Advances in Modeling Rare Events (RARE): Methods and Applications; 09/03/2025; Khajuraho, Madhya Pradesh; 4 days
12. Annual Meeting of Statistical Mechanics in Chemistry and Biology (SMCB); 17/12/2024; IIT Tirupati, Tirupati; 3 days
13. 7th Regional Science & Technology Congress (Region-4); 03/01/2025; Midnapore College, West Bengal; 2 days

Administrative duties

1. Part-time Chief Vigilance Officer (CVO), SNBNCBS
2. Member, Media Cell
3. Member, Committee for management of the Param Rudra Boson supercomputing facility under NSM hosted at SNBNCBS, Kolkata

Awards, Recognitions, if any

1. Bronze Medal from The Chemical Research Society of India (CRSI), 2025
2. Dr. APJ Abdul Kalam HPC & AI Award - 2025 under the category Researcher in R&D in HPC Applications in India

Membership of Learned Societies

1. Biophysical Society, USA
2. American Chemical Society (ACS), USA
3. Chemical Research Society of India (CRSI), India

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. Development of Artificial Neural Network (ANN) based models for rapid prediction of physicochemical properties of drug-like molecules; SERB, India; 3 years; PI

2. Computational prediction of binding site characteristics and protein-drug interactions for therapeutically important drug targets; Sarfez Cure, India (industrial project); 2 years; PI

Conference / Symposia / Schools organized

1. Recent Advances in Modeling Rare Events (RARE): Methods and Applications; 09/03/2025; Khajuraho, Madhya Pradesh; 4 days

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. Collaboration with Prof. Sivaprasad Mitra, Department of Chemistry, North-Eastern Hill University (NEHU), Shillong; Sl. No. 6; National
2. Collaboration with Prof. Debashree Ghosh, Indian Association for the Cultivation of Science, Kolkata; Sl. No. 7; National
3. Collaboration with Dr. Salim Shah, Hingez Therapeutics, USA; Sl. No. 8; International

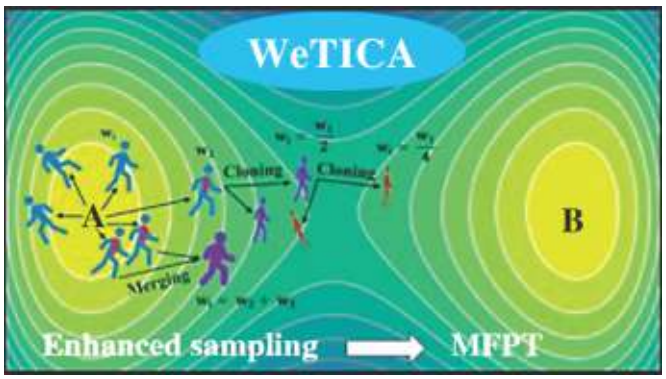
Outreach program organized / participated

1. Delivered an invited lecture at the Science Camp organised by the Jagadis Bose National Science Talent Search (JBNSTS) on 29th October 2024
2. Delivered an invited lecture at the Science Camp organised by the Jagadis Bose National Science Talent Search (JBNSTS) on 25th March 2025

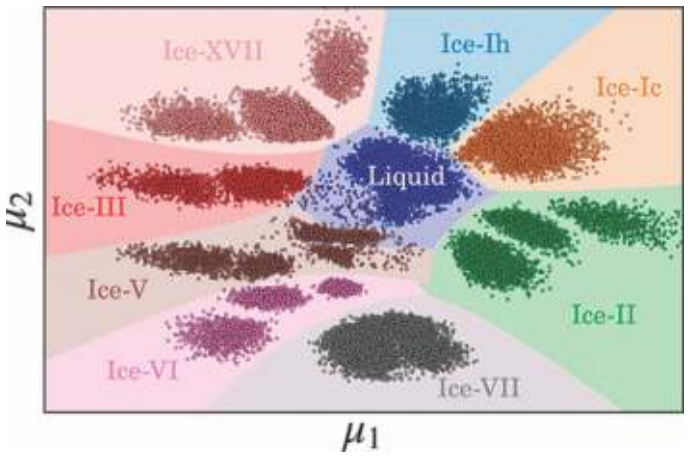
Areas of Research

Our research activities can be broadly classified into three major themes: (A) Advancements in computational methodologies for molecular simulation, (B) Elucidating molecular mechanisms of regulation of biomolecular activities, and (C) Investigation of structure and dynamics of other soft matter systems and phenomena including self-assembly and phase transitions.

(i) Development of a Weighted Ensemble (WE) based enhanced sampling method (WeTICA): Estimating the kinetics of rare events, such as protein unfolding or ligand dissociation, directly from MD simulations remains a formidable challenge due to the vast timescale differences between molecular motions and the events themselves. While Weighted Ensemble (WE) simulation strategies offer a powerful framework for directly calculating kinetic rate constants without perturbing the system's energy landscape, conventional WE implementations often necessitate complex and system-dependent binning procedures to partition the relevant configuration space. To address this, our group (in collaboration with Prof. Ranjit Biswas, SNBNCBS) has developed WeTICA, a "binless" WE simulation algorithm. WeTICA employs a low-dimensional collective variable (CV) space, derived from Time-lagged Independent Component Analysis (TICA), to intelligently guide the simulation trajectories towards a predefined target state, thereby circumventing the often cumbersome process of optimising binning schemes. Its efficacy was demonstrated through closely recovering the unfolding kinetics for several benchmark systems like the Trp-cage mutants (TC5b, TC10b) and Protein G, whose unfolding times span the microseconds range.



(ii) A Variational Autoencoder Framework for Ice Phase Identification (IceCoder): Water ice presents a fascinating challenge for structural characterisation due to its remarkable polymorphism, encompassing over twenty crystalline phases and multiple amorphous forms. Accurately identifying and classifying these often structurally similar phases within the dynamic environment of a molecular simulation using traditional geometry-based order parameters is exceptionally difficult, especially given thermal fluctuations. Addressing this challenge, our group



developed IceCoder, an innovative machine learning-based framework. IceCoder synergistically combines the power of the Smooth Overlap of Atomic Positions (SOAP) descriptor, which captures detailed information about the local atomic environment, with a Variational Autoencoder (VAE), a type of deep learning model adept at dimensionality reduction. The VAE compresses the high-dimensional SOAP feature vectors representing the local environment around each water molecule into a continuous, low-dimensional (typically 2D) latent space. This compressed representation facilitates clear visualization and robust classification of a large number of distinct ice phases as well as liquid water, directly from simulation data.

(iii) Leveraging the bidirectional nature of allostery towards identifying allosteric hotspots for modulating protein-protein interactions (PPIs): The interaction between PCSK9 and the Low-Density Lipoprotein Receptor (LDLR) is a major target for cholesterol-lowering therapies. In collaboration with a pharmaceutical company, our group explored how the principles of allostery could be leveraged to inhibit this crucial PPI. Computational analyses focused on identifying allosteric hotspots and potentially druggable cryptic sites, including investigating the role of apparently unstructured loop regions in mediating allosteric communication and binding. This research contributes to identifying novel strategies for modulating this therapeutically important interaction.

Plan of Future Work Including Project

1. An international collaborative project is in progress with Prof. Ruth Nussinov, National Cancer Institute, USA on phosphorylation code of RhoGDIs.
2. A national collaborative project is in progress with Prof. Soumya De, IIT Kharagpur on understanding the mechanism of the enzyme Intein.

Department of
Condensed Matter and Materials Physics


LabRAM HR Evolution
RAMAN SPECTROMETER
HORIBA

Anjan Barman

Senior Professor
Condensed Matter and Materials Physics
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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Pratap Kumar Pal; Spin Wave Dynamics in Ferromagnetic Nanostructures and Heterostructures; Awarded
2. Soma Dutta; Ultrafast Spin Dynamics in Advanced Magnetic Structures for Applications in Spintronics; Awarded
3. Sreya Pal; Spin Dynamics of Ferromagnetic Thin Films, Heterostructures and Nanostructures; Thesis Submitted
4. Suchetana Mukhopadhyay; Ultrafast spin dynamics in quantum materials/ ferromagnet heterostructures; Under Progress; Prof. Chiranjib Mitra, IISER Kolkata (Co-Supervisor)
5. Chandan Kumar; Spin Dynamics in Emerging Magnetic Materials; Under Progress
6. Bikram Baghira; Magnetization Dynamics and Spin Waves in Engineered Magnetic Structures; Under Progress
7. Suranjana Chakaborty; Spectroscopic Studies of Molecules; Under Progress
8. Sayan Mathur; Spin Wave Dynamics in Advanced Magnetic Textures; Under Progress
9. Sayanti Mondal; Ultrafast Spin Dynamics in Low Dimensional Magnetic Systems; Under Progress
10. Najrul Ansari; Ultrafast spin dynamics in Ferroic Materials; Under Progress
11. Sourav Mandal; Hybrid Magnonics in Nanoscale Magnetic Systems; Under Progress
12. Soumava Mondal; Ultrafast spin dynamics in antiferromagnets; Under Progress
13. Susmita Das; Ultrafast spin dynamics in van der Waals magnets; Under Progress

b) Post-Docs

1. Rubina Ghosh; Spintronics at organic/inorganic interface
2. Soma Dutta; Spin transport driven spin dynamics in quantum materials/ferromagnet heterostructures

c) External Project Students / Summer Training

1. Meghashree Sen; Ferromagnetic resonance studies of two-dimensional magnonic crystals
2. Subhashree Patra; A Two-dimensional Perovskite Material Based Non-Volatile Memory Device

Teaching

1. Autumn Semester; Atomic and Molecular Physics (PHY401); Integrated PhD; 14 students; Shared with Prof. Rajib Kumar Mitra
2. Autumn Semester; Molecular Physics and Spectroscopy (CB627); PhD; 7 students; Shared with Prof. Rajib Kumar Mitra

Publications

a) In journals

1. Amrit Kumar Mondal, Suchetana Mukhopadhyay, Peter Heinig, Ruslan Salikhov, Olav Hellwig, **Anjan Barman**, *Femtosecond Laser-Induced Transient Magnetization Enhancement and Ultrafast Demagnetization Mediated by Domain Wall Origami*, ACS Nano, 18, 16914-16922, 2024

2. D. Panda, K. K. Behera, S. Madhur, B. Rana, A. Gloskovskii, Y. Otani, **Anjan Barman**, and I. Sarkar, *Role of the nonmagnetic underlayer in controlling the electronic structure of ferromagnet/nonmagnetic-metal heterostructures*, Physical Review B, 110, 094424, 2024

3. Pratap Kumar Pal, Amrit Kumar Mondal and **Anjan Barman**, *Using magnons as a quantum technology platform: a perspective*, Journal of Physics: Condensed Matter, 36, 441502, 2024

4. Anulekha De, Semanti Pal, Olav Hellwig and **Anjan Barman**, *Spin–wave dynamics in perpendicularly magnetized antidot multilayers*, Journal of Physics: Condensed Matter, 36, 415802, 2024

5. Amrit Kumar Mondal and **Anjan Barman**, *String phase driven reconfigurable magnonics in Santa Fe ice*, Physical Review B, 109, 184433

6. Payal Bhattacharjee, **Anjan Barman**, Saswati Barman, *Spectrum of Gyrotropic Modes and Energy Transfer between Dipolar-Coupled Magnetic Vortices in a Square Lattice via Triggered Vortex Gyration: A Promise for Spintronics Technology*, Advanced Quantum Technologies, 7, 2300441, 2024

7. Benedetta Flebus, Dirk Grundler, Bivas Rana, YoshiChika Otani, Igor Barsukov, **Anjan Barman**, Gianluca Gubbiotti, Pedro Landeros, Johan Akerman, Ursula Ebels, Philipp Pirro, Vladislav E Demidov, Katrin Schultheiss, Gyorgy Csaba, Qi Wang, Florin Ciubotaru, Dmitri E Nikonov, Ping Che, Riccardo Hertel, Teruo Ono, Dmytro Afanasiev, Johan Mentink, Theo Rasing, Burkard Hillebrands, Silvia Viola Kusminskiy, Wei Zhang, Chunhui Rita Du, Aurore Finco, Toeno van der Sar, Yunqiu Kelly Luo, Yoichi Shiota, Joseph Sklenar, Tao Yu, Jinwei Rao, *The 2024 magnonics roadmap*, Journal of Physics: Condensed Matter, 36, 363501, 2024

8. Arundhati Adhikari, Bipul Kumar Mahato, Sourav Sahoo, Suchetana Mukhopadhyay, Mainak Palit, Satyabrata Bera, Subhadeep Datta, Mintu Mondal, **Anjan Barman**, *Room Temperature Evolution of Laser-Induced Ultrafast Spin and Phonon Dynamics in 2D van der Waals Magnets* Fe_xGeTe_2 *(x = 3, 4, 5)*, Advanced Functional Materials, 35, 2418006, 2025

9. Gianluca Gubbiotti, **Anjan Barman**, Sam Ladak, Cristina Bran, Dirk Grundler et al., *2025 roadmap on 3D nanomagnetism*, Journal of Physics: Condensed Matter, 37, 143502, 2025

10. Sumaiya Parveen, Pratap Kumar Pal, Suchetana Mukhopadhyay, Sudipta Majumder, Swapneswar Bisoi, Atikur Rahman and **Anjan Barman**, *Hot carrier dynamics in the* BA_2PbBr_4/MoS_2 *heterostructure*, Nanoscale, 17, 2800 – 2809, 2025

11. Bikram Baghira, Amrit Kumar Mondal, Ajit Kumar Sahoo, Chandan Kumar, Nalin Prashant Poddar, Jeyaramane Arout Chelvane, **Anjan Barman**, *Interfacial Dzyaloshinskii-Moriya interaction in Ta/FeGa/Ta heterostructures: Effects of strain on structural phase change of Ta*, Journal of Alloys and Compounds, 1014, 178689, 2025

12. Suchetana Mukhopadhyay, Pratap Kumar Pal, Subhadip Manna, Chiranjib Mitra, and **Anjan Barman**, *Large temperature-dependent spin pumping in topological insulator–ferromagnet bilayers probed by ferromagnetic resonance spectroscopy*, Physical Review Applied, 23, 014038, 2025

13. S. Pal, P. K. Pal, R. Fabiha, S. Bandyopadhyay, **Anjan Barman**, *Tripartite phonon–magnon–plasmon coupling, parametric amplification, and formation of a phonon–magnon–plasmon polariton in a two-dimensional periodic array of magnetostrictive/ plasmonic bilayered nanodots*, Journal of Applied Physics, 136, 243101, 2024

14. Chandan Kumar, Rahul Sharma, Sreya Pal, Gopal Datt, Tapati Sarkar, M. Venkata Kamalakar, and **Anjan Barman**, *Additive interfacial Dzyaloshinskii-Moriya interaction in the monolayer-*MoS_2*/Co/Pt asymmetric trilayer system*, Physical Review Applied, 22, 064088, 2024

15. Soma Dutta, Surya Narayan Panda, Anastasios Markou, Claudia Felser, Edouard Lesne, **Anjan Barman**, *Role of Spin Transport on Ultrafast Spin Dynamics in Magnetic Weyl Semimetal* (Co_2MnGa)*/Pt Heterostructures with High Spin-Mixing Conductance*, Advanced Functional Materials, 35, 2413194, 2025

16. Ria Saha, Subhadip Chakraborty, Krishnendu Sinha, Partha Pyne, Sreya Pal, **Anjan Barman**, Suman Chakrabarty, Rajib Kumar Mitra, *Ion-Pairing Propensity in Guanidinium Salts Dictates Their Protein (De)stabilization Behavior*, The

Journal of Physical Chemistry Letters, 15, 10341-10348, 2024

17. Amrit Kumar Mondal, Avinash Kumar Chaurasiya, Kilian D. Stenning, Alex Vanstone, Jack C. Gartside, Will R. Branford, **Anjan Barman**, *Brillouin light scattering spectral fingerprinting of magnetic microstates in artificial spin ice*, Nanotoday, 59, 102497, 2024

b) Other Publications

i) Conference proceedings / Reports / Monographs

1. S. Bandyopadhyay and A. Barman, Nanomagnets as Dynamical Systems: Physics and Applications, Cham, Springer Nature Switzerland, 2024

Talks / Seminars Delivered in reputed conference / institutions

1. Invited Talk: All-Optical Study of Ultrafast Magnetization Dynamics in Quantum Material/Ferromagnet Heterostructures, A. Barman, India-UChicago Workshop on Quantum Materials; 27/03/2025; UChicago Centre, New Delhi; 45 minutes
2. Invited Talk: Hybrid Magnonics in Nanomagnonic Crystals for Quantum Technology, A. Barman, Recent Trends in Biophysics and Spintronics; 10/03/2025; Ashoka University; 30 minutes
3. Invited Talk: Role of Spin Texture on Ultrafast Magnetization Dynamics in Advanced Spintronic Materials, A. Barman, International Conference on Magnetic Materials and Applications (ICMAGMA 2025); 12/02/2025; IISc Bangalore; 30 minutes
4. Invited Talk: 4. Probing the Origin of Ultrafast Spin Dynamics in Ferromagnetic Thin Films and Heterostructures, A. Barman, International Symposium on Ultrafast Spintronics and Magnonics (ISUSM); 03/02/2025; IIT (ISM) Dhanbad; 45 minutes
5. Invited Talk: Ultrafast Magnetization Dynamics in 2D Material/Ferromagnet Heterostructures, A. Barman, QMAT2024; 20/12/2024; IIT Guwahati; 30 minutes
6. Invited Talk: Hybrid Magnonics Using Nanoscale Magnetic Structures, A. Barman, The 14th Annual Symposium on Magnetics, ABS-LT8; 14/10/2024; Nanyang, Singapore; 45 minutes
7. Invited Talk: Role of Spin Texture on Magnetization Dynamics in Magnetic Thin Films and Nanostructures, A. Barman, International Workshop on Materials and Devices for Post-CMOS Computing; 21/10/2024; INST Mohali; 30 minutes
8. Invited Talk: Nanoscale Hybrid Magnonics for Quantum Science and Technology, Anjan Barman, Frontiers in Physics 2024; 27/09/2024; University of Hyderabad; 30 minutes
9. Invited Talk: Spin Texture Driven Magnetization Dynamics in Magnetic Nanostructures, Anjan Barman, Magnetism and Topology: A Materials Physics Perspective; 01/08/2024; S. N. Bose National Centre for Basic Sciences; 30 minutes
10. Invited Talk: Spin Texture Driven Magnetizaton Dynamics in Advanced Magnetic Materials, Anjan Barman, Symposium on Magnetism and Spintronics (SMS-2); 18/07/2024; IIT Bombay; 30 minutes
11. Invited Talk: Spin Texture Driven Magnetization Dynamics in Magnetic Nanostructures, Anjan Barman, 35th Mid-Year Meeting of Indian Academy of Sciences; 28/06/2024; IISc Bangalore; 30 minutes
12. Invited Talk: Ultrafast Spin Manipulation in Engineered Magnetic Systems for Application in Next Generation Computing, Anjan Barman, Glimpses of Experimental Physics; 23/04/2024; Department of Physics, Razabazar Science College, University of Calcutta; 60 minutes
13. Keynote Lecture: 3. Nanoscale Hybrid Magnonics for Quantum Technology, A. Barman, 5th International Conference on Current Trends in Materials Science and Engineering (CTMSE-2025); 28/02/2025; Institute of Engineering and Management, Kolkata; 45 minutes

Administrative duties

1. Dean Faculty
2. Member of CAC
3. Member of ARPAC
4. Chairman of Works Committee
5. Chairman of Annual Procurement Committee
6. Chairman of Space Committee
7. Member of Faculty Search and Selection Committee

Awards, Recognitions, if any

1. 'Outstanding Achievement Award' by Institute of Engineering and Management at CTMSE-2025 in 2025

2. Featured in top 2% most cited scientists' list released by Stanford University in 2024

3. Associate Editor of npj Spintronics (Springer-Nature)

4. Editorial Board Member of Nanotechnology (IOPscience

5. Editorial Board Member of Pramana Journal of Physics (Springer)

Membership of Learned Societies

1. Member of the American Physical Society
2. Member (Fellow) of Institute of Physics (UK)
3. Life Member of Materials Research Society of India (MRSI)

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. Development of strongly spin-orbit coupled topological quantum hetero-structures for spintronic application; Nano-Mission, DST; 2021-2026; PI
2. Two-dimensional Ferromagnetic and Organic Molecule Spinterfaces as Molecular Spin Qubits for Quantum Technologies and Energy Harvesting Applications; I-HUB Quantum Technology Foundation, IISER Pune; 2023-2025; PI

Conference / Symposia / Schools organized

1. 3rd International conference in the celebration of Centenary of Bose Statistics: Bose-Einstein Condensation, Superconductivity, Superfluidity and Quantum Magnetism (ICBEC24); 12/11/2024; Biswa Bangla Convention Centre, Kolkata; 5 days

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. Prof. Supriyo Bandyopadhyay, Virginia Commonwealth University, USA; Sl. No. 6; International
2. Prof. Venkata Kamalakar Mutta, Uppsala University, Sweden; Sl. No. 7; International
3. Prof. Claudia Felser, Max Planck Institute Chemical Physics of Solids, Germany; Sl. No. 8; International
4. Prof. Will. R. Branford, Imperial College London, UK; Sl. No. 10; International
5. Prof. Olav Hellwig, HZDR and TU Chemnitz, Germany; Sl. No. 11, 14; International
6. Prof. Subhadeep Dutta and Prof. Mintu Mondal, IACS, Kolkata; Sl. No. 1; National
7. Prof. Atikur Rahman, IISER Pune; Sl. No. 3; National
8. Dr. Jeyaramane Arout Chelvane, Defence Metallurgical Research Laboratory Hyderabad; Sl. No. 4; National
9. Prof. Chiranjib Mitra, IISER Kolkata; Sl. No. 5; National
10. Prof. Rajib Kumar Mitra, SNBNCBS; Sl. No. 9; National
11. Prof. Indranil Sarkar, INST Mohali; Sl. No. 12; National
12. Prof. Saswati Barman, IEM Kolkata; Sl. No. 16; National

Areas of Research

Ultrafast spin dynamics, magnonics, spintronics and spin-orbitronics in magnetic thin films, multilayers, nanostructures and quantum materials

We studied the ultrafast spin dynamics and spin-waves in advanced magnetic materials and heterostructures involving quantum and topological materials, van der Waals magnets. We determined the role of spin transport and spin-flip scattering in ultrafast demagnetization and precessional dynamics. Furthermore, we also studied the spin-wave dynamics in advanced magnetic textures like artificial spin ice (ASI), magnetic vortex domain walls and hybrid magnonic systems. Some key results are described below.

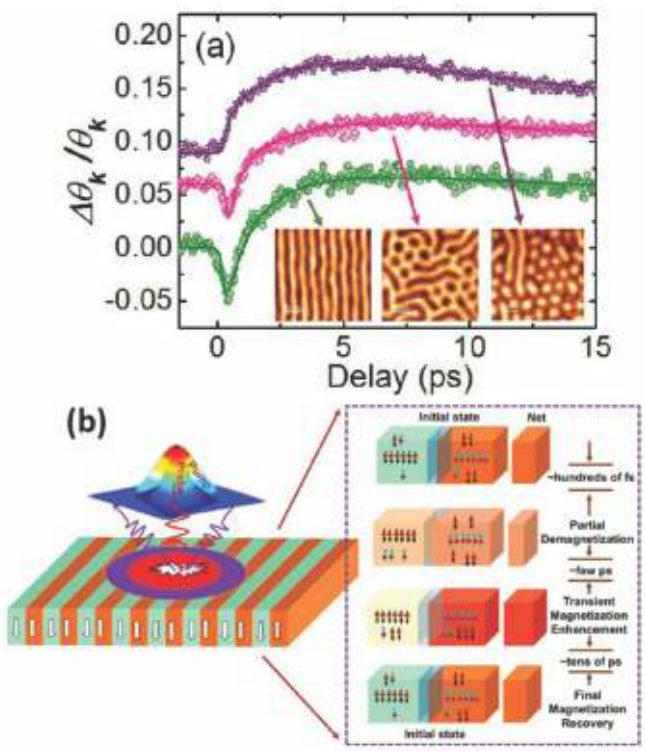
A. Femtosecond Laser-Induced Transient Magnetization Enhancement and Ultrafast Demagnetization Mediated by Domain Wall Origami: Femtosecond laser-induced ultrafast spin dynamics were probed for different magnetic domain states of a [Co/Pt]22 multilayer sample, thus revealing the tunability of the direct spin transport across domain walls. Depending on the underlying domain landscape, the spin-transport-driven magnetization

dynamics showed a transition from ultrafast demagnetization to being fully dominated by an anomalous transient magnetization enhancement (TME) via a state where both TME and demagnetization coexist (Fig. 1). Thereby, the study uncovers a new extrinsic channel for the modulation of spin transport, which will open up new perspectives for the development of spin-texture-driven ultrafast spintronics devices.

B. Room Temperature Evolution of Laser Induced Ultrafast Spin and Phonon Dynamics in 2D van der Waals Magnets FexGeTe2 (x = 3, 4, 5): We demonstrated emergence of spin dynamics in association with phonon dynamics at room temperature in chemically exfoliated FexGeTe2 (x = 3,4,5) flakes employing time-resolved magneto-optical Kerr effect microscope. The high intense femtosecond laser pulse established magnetic ordering. This photoinduced magnetization has been modulated in the ultrafast demagnetization and GHz frequency precessional dynamics. Furthermore, coherent phonon excitation at optical regime is observed which subsequently triggers THz frequency magnon modes via spin-phonon coupling. This study unfolds all-optical routes to control optomagnetic properties and the future perspectives of 2D vdW magnets for multidisciplinary applications.

C. Brillouin Light Scattering Spectral Fingerprinting of Magnetic Microstates in ASI: ASI possesses a vast range of metastable magnetic microstates exhibiting exotic fundamental physics and applications in reconfigurable magnonics and neuromorphic computing. However, open questions remain on the role of microstate imperfections or angular disorder. We investigated GHz dynamics of a series of carefully prepared microstates in the same ASI, with coexistence of vortex and uniformly magnetized macrospins, and disorder in the orientation of the macrospins at different vertices. We observed microstate-specific mode frequency shifting, mode creation and mode crossing (Fig. 2). This versatility of characteristic spin-wave (SW) peaks for specific magnetic microstates in ASI enabled identification of microstate configurations via SW spectral characterization.

D. Role of Spin Transport on Ultrafast Spin Dynamics in Magnetic Weyl Semimetal (Co2MnGa)/Pt Heterostructures with High Spin-Mixing Conductance: We investigated ultrafast demagnetization and precessional dynamics of Co2MnGa/Pt thin films of varying thicknesses and determined the exchange stiffness constant of Co2MnGa and information about spin-transport across the Co2MnGa/Pt interface. From the modulation of Gilbert damping of Co2MnGa with Pt thickness, a very high intrinsic spin-mixing conductance and spin diffusion length

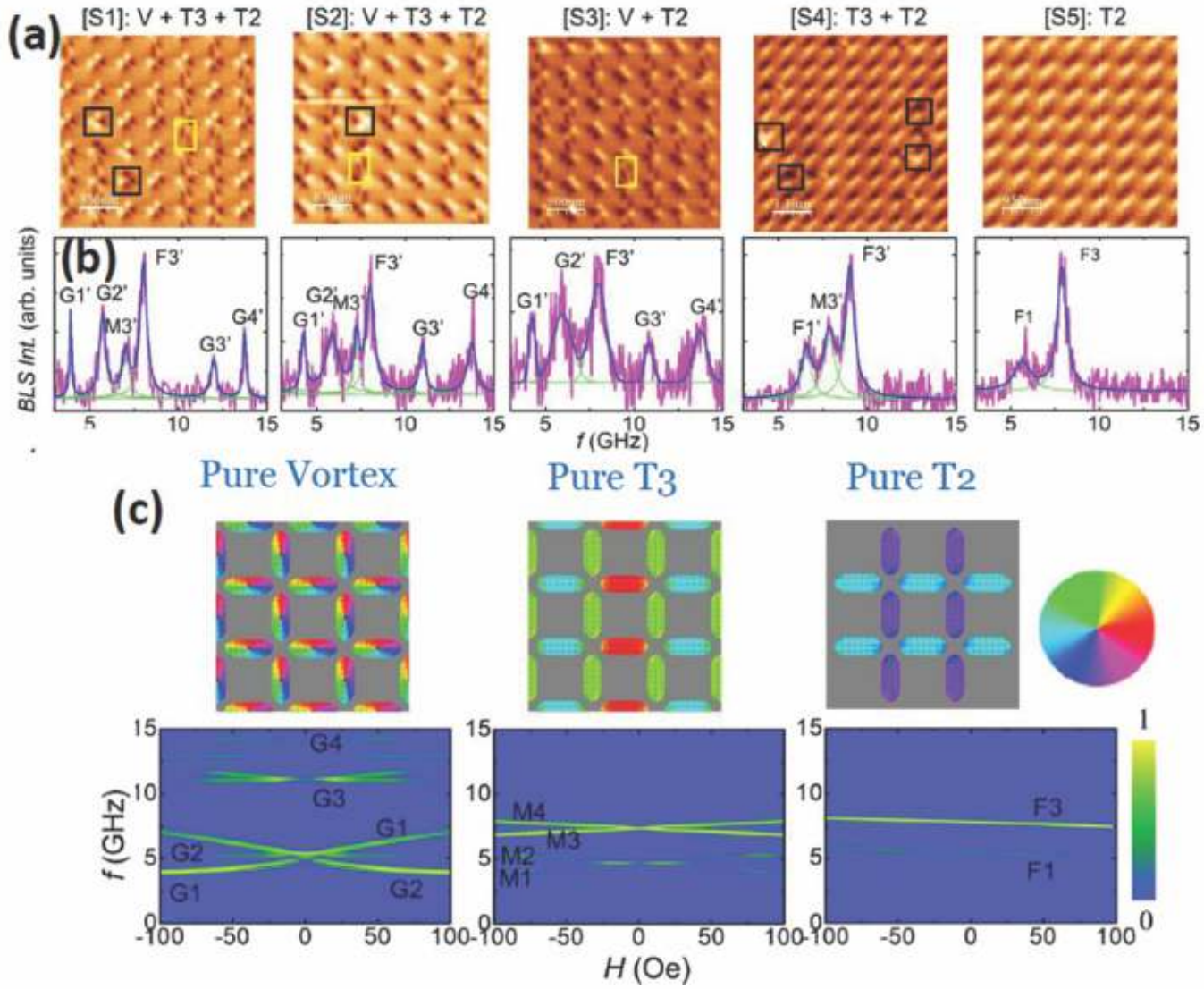


of Pt of 2.9±0.2 nm are found. The interfacial spin transparency reached a large value of 83%, in the perfect spin-sink regime.

Plan of Future Work Including Project

Deciphering Interfacial Dzyaloshinskii-Moriya Interaction in Transition-Metal Dichalcogenide/Permalloy Heterostructures by Brillouin Light Scattering and First-Principles Calculations: Understanding the relative strengths of Heisenberg exchange and interfacial DMI (iDMI) and its scaling with spin-orbit coupling (SOC) is key to stabilize chiral spin textures in nonmagnet/ferromagnet heterostructures. We will use Brillouin light scattering spectroscopy to determine the iDMI and Heisenberg exchange stiffness constants in large-area chemical vapor-deposited monolayer 2D transition metal dichalcogenides (TMDs) (MoS2, MoSe2, WS2, and WSe2) interfaced with ferromagnetic thin films. The origin of the interfacial exchange interaction will be underpinned with the help of first-principles-based analysis of TMD/FM interfaces, in which, the intersite exchange parameters and the respective adiabatic magnon spectra will be calculated to compare with the experimental results.

Spin Pumping in Magnetostrictive Galfenol Interfaced with heavy metal layer: In view of their advantages for memory and storage applications, the quest to find suitable magnetic thin film heterostructures that can exhibit strong spin pumping effect persists in the scientific community. We will investigate the spin pumping phenomenon in highly



magnetostrictive Galfenol (FeGa) thin films by systematically varying the thickness of heavy metallic. The effects of strain on the Gilbert damping and the spin pumping effect will be investigated using time-resolved magneto-optical Kerr effect technique.

Control Over Ultrafast Spin Dynamics by Tunnel Barrier-Mediated Tunable Spin Transport in Single-Layer Graphene/TiOx/Co Heterostructures: Ultrafast spin dynamics in single layer graphene/ferromagnet has shown remarkable properties due to spin transport mediated variation of ultrafast demagnetization time and Gilbert damping. Here, we plan to take one step ahead by controlling these properties by tunnel barrier mediated spin transport in a single-layer graphene/TiOx/Co heterostructures. The use of insulating TiOx barrier layers (BLs) can structurally modify interfacial spin conductance, disentangle spin pumping and magnetic proximity effects (MPE), and further establish external control over ultrafast magnetization dynamics in single-layer graphene/TiOx/Co systems. We predict that that appropriately chosen ultrathin BLs can prevent interfacial alterations from ferromagnetic metals, facilitating efficient spin detection in graphene and enhancing control over spin angular momentum dissipation in graphene/FM interfaces.

Electrical Control of Ultrafast Magnetic Speeds in Graphene Spin Field Effect Junctions: We will further investigate ultrafast graphene spin field-effect junctions, where gate-tunable superdiffusive spin currents across graphene-ferromagnet interfaces may enable electric control of magnetization dynamics in the ferromagnet. By electrostatically tuning the Fermi level in graphene under a cobalt thin film, we will try to modulate the ultrafast spin transport across graphene-cobalt interfaces. Supported by superdiffusive spin transport calculations, our findings will

unlock field-tunable magnetic speeds in devices, paving the way for innovations in sub-picosecond spintronic memory-logic operations.

Development of Spin-Hall nano Antenna: The spin Hall effect is a celebrated phenomenon in spintronics and magnetism that has found numerous applications in digital electronics, but very few in analog electronics. Practically, the only analog application in widespread use is the spin Hall nano-oscillator (SHNO) that delivers a high frequency alternating current or voltage to a load. We plan to develop its analogue - a spin Hall nano-antenna (SHNA) that radiates a high frequency electromagnetic wave (alternating electric/magnetic fields) into the surrounding medium. It can also radiate an acoustic wave in an underlying substrate if the nanomagnets are made of a magnetostrictive material. That will make it a dual electromagnetic/acoustic antenna. The SHNA will be made of an array of ledged magnetostrictive nanomagnets deposited on a substrate, with a heavy metal nanostrip underlying/overlying the ledges. An alternating charge current passed through the nanostrip will generate an alternating spin-orbit torque in the nanomagnets via the spin Hall effect which will makes their magnetizations oscillate in time with the frequency of the current, producing confined spin waves (magnons), which will radiate electromagnetic waves (photons) in space with the same frequency as the ac current. We will study the anisotropy and frequency dependence in the radiation pattern.

Atindra Nath Pal

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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Subhankar De; Effect of external stimuli on Single molecular junction; Under Progress
2. Dayal Das; Transport in 2D hybrid devices; Under Progress
3. Dhritisundar Paramanik; Electronic transport and shot noise in single atomic/molecular junction; Under Progress
4. Premananda Chatterjee; Low dimensional magnets and their heterostructure; Under Progress
5. Mohana Roy; Transport in 2D semiconductor devices; Under Progress
6. Rafiqul Alam; Transport in topological semimetal; Thesis Submitted
7. Riju Pal; Electronic transport and ESR spectroscopy in van der Waal magnets; Under Progress

b) Post-Docs

1. Md. Sk. Obaidulla; 2D/Organic hybrid
2. Bikash Gajar; Transport in topological semimetal

c) External Project Students / Summer Training

1. Anumita Saha; Master thesis: DLTS spectroscopy on 2D semiconductor
2. Tiyasha Khatua; Summer project: Fabrication and characterization of 2D tellurene devices
3. Sudip Ghorai; Centre Summer student: fabrication of van der Waal's hybrid

Teaching

1. Spring Semester; PHY 408-Electronics and Instrumentation; Integrated PhD; 11 students; Shared with Dr. Avijit Chowdhury
2. Spring Semester; PHY 592 - Experimental Methods; Integrated PhD; 14 students; Shared with other four faculties
3. Autumn Semester; Project Research II (PHY 509); Integrated PhD; 1 student
4. Spring Semester; Project Research III (PHY 502); Integrated PhD; 1 student

Publications

a) In journals

1. Shubhrasish Mukherjee, Gaurab Samanta, Md Nur Hasan, Shubhadip Moulick, Ruta Kulkarni, Kenji Watanabe, Takashi Taniguchi, Arumugum Thamizhavel, Debjani Karmakar & **Atindra Nath Pal**, *Achieving nearly barrier free transport in high mobility ReS_2 phototransistors with van der Waals contacts*, npj 2D Materials and Applications, 8, 71, 2024
2. Shubhadip Moulick, Dipanjan Maity, Gaurab Samanta, Kalyan Mandal and **Atindra Nath Pal**, *Charge noise in low Schottky barrier multilayer tellurium field-effect transistors*, Nanoscale, 17, 2259-2268, 2025
3. Riju Pal, Joyal John Abraham, Alexander Mistonov, Swarnamayee Mishra, Nina Stilkerich, Suchanda Mondal, Prabhat Mandal, **Atindra Nath Pal**, Jochen Geck, Bernd Büchner, Vladislav Kataev, Alexey Alfonsov, *Disentangling the Unusual Magnetic Anisotropy of the Near-Room-Temperature Ferromagnet Fe_4GeTe_2*, Advanced Functional Materials, 34, 2402551, 2024

4. Riju Pal, Buddhadeb Pal, Suchanda Mondal, Rajesh O. Sharma, Tanmoy Das, Prabhat Mandal, **Atindra Nath Pal**, *Spin-reorientation driven emergent phases and unconventional magnetotransport in quasi-2D vdW ferromagnet* Fe_4GeTe_2, npj 2d materials and applications, 8, 30, 2024

b) Other Publications

i) Conference proceedings / Reports / Monographs

1. Shatabda Bhattacharya, Shubhadip Moulick, Chinmoy Das, Hirokazu Tada, Pradip Chakraborty, Atindra Nath Pal, Magnetic field induced cooperativity tuning in a Fe (II)-based hybrid spin crossover network grown on 2D surfaces, MRS Advances, 8, 894-900, (2023), Correction was made on 03/02/2025
2. S Mukherjee, AN Pal, SK Ray, Characterizations of a few layered MoS2 phototransistor using a homebuilt cost-effective measurement setup, AIP Conference Proceedings 3067 (1) (2024)
3. R Alam, S Moulick, AN Pal, Flicker noise in an electrolyte gated large area GrFET, AIP Conference Proceedings 3067 (1), (2024).
4. R Pal, S Bera, B Pal, M Mondal, AN Pal, Intrinsic room temperature ferromagnetism in van der Waals Fe5GeTe2 crystal, AIP Conference Proceedings 3067 (1) (2024)
5. S Moulick, S Mukherjee, S Raha, A Singha, AN Pal, G phonon mode splitting in doped bilayer graphene probed by in-situ transport measurement and Raman spectroscopy, AIP Conference Proceedings 3067 (1) (2024)

Talks / Seminars Delivered in reputed conference / institutions

1. Invited talk at Ashoka University related to the MOU; 01/04/2024; Ashoka University, Delhi; 2 days
2. Invited talk at ICFM, 2024; 09/04/2024; IIT Kharagpur; 3 days
3. Invited departmental seminar at IISER Kolkata; 15/05/2024; IISER Kolkata; 1 day
4. Invited colloquium at NPL; 19/06/2024; NPL, New Delhi; 1 day
5. Invited talk at Engineered 2D Quantum Material, ICTS, Bangalore; 22/07/2024; ICTS Bangalore; 3 days
6. Invited talk at One day meeting on Magnetism and Topology: A Materials Physics Perspective, August 1, 2024; 01/08/2024; SNBNCBS Kolkata; 1 day
7. Invited talk at SPARC Workshop on 2D Materials, 24th - 25th August 2024; 24/08/2024; IIT Kharagpur; 2 days
8. Invited talk at MTMM, IISc, 2024; 05/11/2024; IISc Bangalore; 3 days
9. Invited talk at AFS 2024, IIT Kharagpur; 11/11/2024; IIT Kharagpur; 2 days
10. Invited talk at AC2MP, IIT Patna; 09/12/2024; IIT Patna; 3 days
11. Invited talk at QMAT 2024, IITGuwahati; 21/12/2024; IIT Guwahati; 3 days
12. Invited talk at Quantum Magnetism at IACS Kolkata; 15/01/2025; IACS Kolkata; 1 day

Administrative duties

1. In charge of Ellipsometry system, AFM, Helium plant, Mechanical workshop, Oxford system, 3K measurement system and Joint in-charge of clean room
2. Member of Project & Patent Cell, Member of purchase sub-committee and several other committees time to time

Patents Taken and Process Developed with Details

1. A patent draft submitted to the institute under the TRC.

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. DST/NM/TUE/QM-10/2019; DST-Nanomission; 14065189; March 2023- March, 2028 (5 years); PI

Conference / Symposia / Schools organized

1. SNBNCBS-Horiba joint Raman workshop; 08/08/2024; SNBNCBS; 2 days

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. Dr. Watanabe, Kenji and Dr. Taniguchi, Takashi; National Institute for Materials Science, Japan; Sl. No. 1; International

2. Dr. Debjani Karmakar, BARC; Dr. A. Thamizhavel, TIFR Mumbai; Sl. No. 1; National
3. Prof. Kalyan Mandal; SL. No. 2; National
4. Prof. Bernd Buechner, Dr. Vladislav Kataev, Dr. Alexey Alfonsov; Sl. No. 3; International
5. Prof. Prabhat Mandal, SNBNCBS; Sl. No. 3 and 4; National
6. Prof. Tanmoy Das, IISC; Sl. No. 4; National

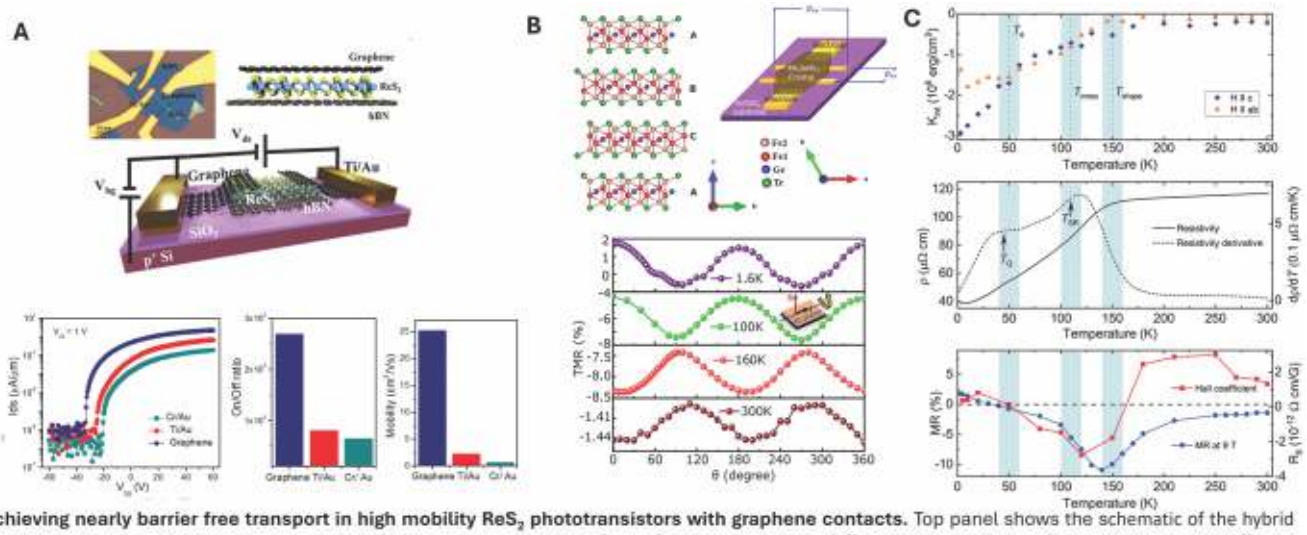
Areas of Research

Experimental Condensed Matter Physics: Low temperature transport, 2D materials, emergent phases in quantum materials, single atomic/molecular transport

A. Molecule assisted chain and tunability of atomic/molecular structure in single molecular junction: Several new results have been obtained in this direction. (1) We have been able to create Ferrocene assisted gold atomic chain and observe nonmonotonic conductance evolution under mechanical strain. This can be explained by the change in hybridization due to the molecular rotation inside the chain that is missing in the absence of atomic chain (under review, Nano letters) (2) In another work, we have observed that the electronic state of the molecule can be switched by the application of electric field. Theoretical calculations show that high electric field can change the dihedral angle of the molecule. (to be submitted). (3) We have been able to optimize reactive metals (Cu, Ag) inside a glove box-based room temperature set up. We are trying to understand the effect of structure property relation in atomic junction with temperature and bias for different metals. At present there are two PhD students working in this direction. They are optimizing the shot noise set up and liquid helium based low temperature insert.

B. Electronic transport and noise in 2D hybrid: In this area, we have the following development: (1) We have fabricated Tellurene based FETs which exhibit ambipolar behavior. Furthermore, we investigated the temperature dependent transport and low frequency noise characteristics (Nanoscale, 2024) (2) In another project, we looked at the transport characteristics of n-type ReS2. We have been able to create barrier free contact on ReS2 by contacting it with graphene, exhibiting superior electronic and optoelectronic behavior. (npj 2D Materials and Applications, 2024). (3) We also observe RTN type noise through which we can identify the defects in hBN (to be submitted). (4) We have also been able to create 2D/Organic semiconductor hybrid, which shows almost epitaxial growth on any 2D substrate and formation of hybrid charge transfer exciton (to be submitted). Mr. Shubhradip Moulick working in this area, has defended his thesis.

C. Emerging phases in 2D ferromagnet: (1) Building on the initial work on unusual electronic transport, we uncovered unusual temperature-dependent magnetic anisotropy through ESR measurements in Fe4GeTe2, conducted as



A. Achieving nearly barrier free transport in high mobility ReS_2 phototransistors with graphene contacts. Top panel shows the schematic of the hybrid device along with the optical image. Bottom panel shows the comparison of transfer characteristic, on/off ratio and mobilities of the ReS_2 FETs with different contacts at V_{ds} = 1 V (adapted from *npj 2D Materials and Applications volume 8, 71 (2024)*). **B. Spin-reorientation driven emergent phases and unconventional magnetotransport in quasi-2D vdW ferromagnet Fe_4GeTe_2.** Top panel shows the crystal structure and schematic of the thin-flake device of Fe_4GeTe_2. Bottom panel demonstrates the angle-dependent transverse magnetoresistance (TMR) at 9 T at different temperatures, exhibiting a definite spin-reorientation between 100 K and 160 K, and it confirms the anisotropic behavior of the crystal. Adapted from *npj 2D Mater Appl 8, 30 (2024).* **C. Disentangling the Unusual Magnetic Anisotropy in Fe_4GeTe_2 through ESR measurements.** Top panel shows the temperature evolution of the intrinsic magnetic anisotropy constant K_{int} estimated from the ESR spectra. Middle panel depicts the Resistivity and resistivity derivative as a function of temperature. Bottom panel shows the temperature dependence of magnetoresistance for two measured devices, showing enhanced MR near the spin-reorientation transition. Adapted from *Advanced Functional Materials, 2402551, (2024).*

part of an ongoing collaboration under the SNBNCBS-IFW Dresden MoU (Advanced Functional Materials, 2024). (2) We have performed temperature dependent Raman spectroscopy and unveil the lattice dynamics and spin phonon coupling in this material (to be submitted).

D. Correlation and Topology in CDW system: We are investigating correlation-driven topological transitions through electron transport. (1) Focusing now on 1T-TaS2, we observe Berry curvature-driven planar and nonlinear Hall effects confined to its commensurate CDW phase, where broken inversion symmetry leads to persistent Berry curvature, supported by model Hamiltonian analysis (Advanced Functional Materials, 2025). (2) We are now investigating the electron transport at the low temperature phase of 1T-TaS2.

Plan of Future Work Including Project

In parallel, we target superconducting spintronics using superconductor/ferromagnet heterostructures, aiming to generate spin-polarized triplet Cooper pairs. These systems combine superconductivity and magnetism to enable low-dissipation spin transport. We plan to integrate conventional and 2D materials (e.g., NbSe2 with CoFeB, CrO2, or hBN barriers) to create clean S-F interfaces. Using tunneling spectroscopy and magnetotransport, we will explore spin relaxation and ultimately develop vertical/lateral spin valve devices incorporating topological or graphene-based layers for tunable quantum functionality.

We are advancing molecular-scale transport studies by developing a setup for single-molecule junction measurements from room temperature down to 4.2 K. Ferrocene-based molecules have shown promise as highly conductive candidates, and we plan to explore their structural asymmetry and dipole effects on transport. In this year we aim to investigate the effect of external stimuli like electric field and temperature on these junction. Also, we are in the process of developing shot noise measurements through these atomic/molecular junctions.

In optoelectronics, we are building on our prior success with broadband photodetection using CVD graphene and WS2 quantum dots. In particular, we will focus on 2D/organic hybrid for functional optoelectronic devices.

Under the DST-CONCEPT initiative, we are investigating proximity-induced phenomena in layered heterostructures. In the spintronics domain, we aim to study 2D magnetic heterostructures, particularly graphene-based systems, to probe the roles of interface anisotropy, Rashba effect, and spin injection dynamics. We will explore how graphene's interface with 2D ferromagnets (e.g., Fe4GeTe2, CrI3) affects spin lifetime, spin Hall effects, and non-local voltages via lateral spin valve geometry.

Avijit Chowdhury

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Guidance of Students/Post-Docs

a) Ph.D. Students

1. Nipom Sekhar Das; Organic-Inorganic Layered Nanohybrid Dispersed Ferroelectric Polymer Blend For Nonvolatile Resistive Memory Applications; Awarded
2. Suma Das; Studies on magnetically separable g-C3N4-based heterojunctions for solar photocatalytic dye degradation and H2 production; Awarded
3. Saikat Mitra; Hallide perovskite for optoelectronic applications; Under progress
4. Swapnamay Paramanik; Solar Photocatalysis for dye degradation and H2 evolution; Under progress
5. Rajesh Jana; 2D materials for optoelectronic synaptic devices; Under progress
6. Mukul Biswas; 2D material based triboelectric nanogenerator; Under progress
7. Sachin Paul; 2D halide perovskitebased memristor and memtransistor devices; Under progress
8. Rahul Mondal; Self-powered flexible TENG to estimate the pressure distribution inside a prosthetic socket; Under progress

b) Post-Docs

1. Ritamay Bhunia; Artificial Optic-Synaptic Organ for Different Colored Long-Time Perception

c) External Project Students / Summer Training

1. Atreyee Barman; Efficient Photocatalytic Activity of gC3N4/MnO nanocomposite for Dye Degradation Under Visible Light
2. Omkarnath Dogra; Flexible Triboelectric Nanogenerators using Metal Nanoparticle-grafted Graphitic Carbon Nitride (gC3N4) for Efficient Mechanical Energy Harvesting
3. Thansingh Jankawat; Study of Bipolar Resistive Switching Using Electrolyte-based Polymer Composites

Teaching

1. Spring semester; Electronics & Instrumentation (PHY408); Integrated PhD; 11 students; Atindra Nath Pal (Co-teacher)
2. Spring semester; Basic Laboratory II (PHY492); Integrated PhD; 11 students; Arijit Haldar (Co-teacher)

Publications

a) In journals

1. Mukul Biswas, Didhiti Bhattacharya, Rahul Mondal, Ritamay Bhunia, Ashish Garg, **Avijit Chowdhury**, *Surface Engineered MoS2-Based Novel Vertical Triboelectric Nanogenerator (V-TENG) for Wireless Information Processing*, Small, 21, 2410608, 2025
2. Suma Das, Swapnamoy Pramanik, Ranjith G Nair, **Avijit Chowdhury**, *Mesoporous $NiFe_2O_4$@g-C_3N_4-Based p–n Heterostructures for Boosting Solar-Driven Photocatalytic Dye Degradation and Hydrogen Evolution*, Chemistry: An Asian Journal, 20, e202401402, 2025

3. Rajesh Jana, Ritamay Bhunia, Swapnamoy Paramanik, Kinsuk Giri, **Avijit Chowdhury**, *Conductive Islands Assisted Resistive Switching in Biomimetic Artificial Synapse for Associative Learning and Image Recognition*, Advanced Functional Materials, 35, 2412804, 2025
4. Suma Das, Swapnamoy Pramanik, Ranjith G Nair, **Avijit Chowdhury**, *Heterointerface engineering in mesoporous g-C_3N_4@$MnFe_2O_4$ photocatalysts for superior hydrogen (H2) evolution*, Surfaces and Interfaces, 54, 105226, 2024
5. Didhiti Bhattacharya, Shubhrasish Mukherjee, **Avijit Chowdhury,** Samit Kumar Ray, *Novel TMDC/Si Heterojunction Based Direct Current UV Sensitive Tribovoltaic Nanogenerator and Visual-Image Sensors*, Advanced Functional Materials, 34, 2403705, 2024
6. Suma Das, Swapnamoy Paramanik, Ranjith G. Nair, **Avijit Chowdhury**, *Rational Design of Mesoporous $ZnFe_2O_4$@g-C_3N_4 Heterojunctions for Environmental Remediation and Hydrogen Evolution*, Chemistry: A European Journal, e202402512, 2024
7. Saikat Mitra, Parushottam Majhi, Avisek Maity, Snehamoyee Hazra, **Avijit Chowdhury** and Barnali Ghosh, *Direct & efficient detection of x-ray radiation using thermally evaporated 2D hybrid lead halide perovskite (BA_2PbBr_4)(BA = n-Butylammonium = $C_4H_9NH_3$) film*, Physica Scripta, 99, 075969, 2024

b) Other Publications

i) Conference proceedings / Reports / Monographs

1. Anupriya Nyayban, Subhasis Panda, and Avijit Chowdhury, The Mechanical and Transport Properties of RbPbX3 (X = I, Br, and Cl) by First Principle Calculations, AIP Conference Proceeding 3067, 020009, 2024

Talks / Seminars Delivered in reputed conference / institutions

1. Delivered an invited talk on "2D Hybrid Materials for Brain-inspired Computing and Associative Learning" in the 32nd Edition of the National Conference on Condensed Matter Days (CMDAYS-2024); 05/11/2024; Department of Physics, Dibrugarh University; 1hour
2. Delivered a talk on "Electronically Controlled 2D Materials-Based Synaptic Devices for Bio-inspired Applications" at SNBNCBS-Ashoka University Meeting during 20-21/06/2024; 20/06/2024; SNBNCBS; 30 minutes

Administrative duties

1. Member of Theoretical Physics Seminar Circuit, SNBNCBS
2. Faculty In-charge, CKM Laboratory
3. Faculty In-charge, ALD, PLD, RTA
4. Committee member for the selection of an Attendant at SNBNCBS

Awards, Recognitions, if any

1. Elected as Associate of the West Bengal Academy of Science & Technology (WAST), 2025
2. Achieved IOP Trusted Reviewer status in recognition of an exceptionally high level of peer review competency, IOP Publishing, 2025

Membership of Learned Societies

1. Life member of MRSI
2. Life Member of Indian Association for the Cultivation of Science

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. Development and testing of broadband optoelectronic synaptic devices employing ferroelectric/photoelectric 2D material hybrid system; DST-SERB; 3 Years (March, 2023- March 2026)

Conference / Symposia / Schools organized

1. One of the Conveners of the C.K. Majumdar Memorial Summer Workshop in Physics 2024, held at SNBNCBS; 22/07/2024; SNBNCBS, Kolkata; July 22, 2024 to July 31, 2024

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. Sl. No. 5; National
2. Sl. No. 2, 4, 6; National

Outreach program organized / participated

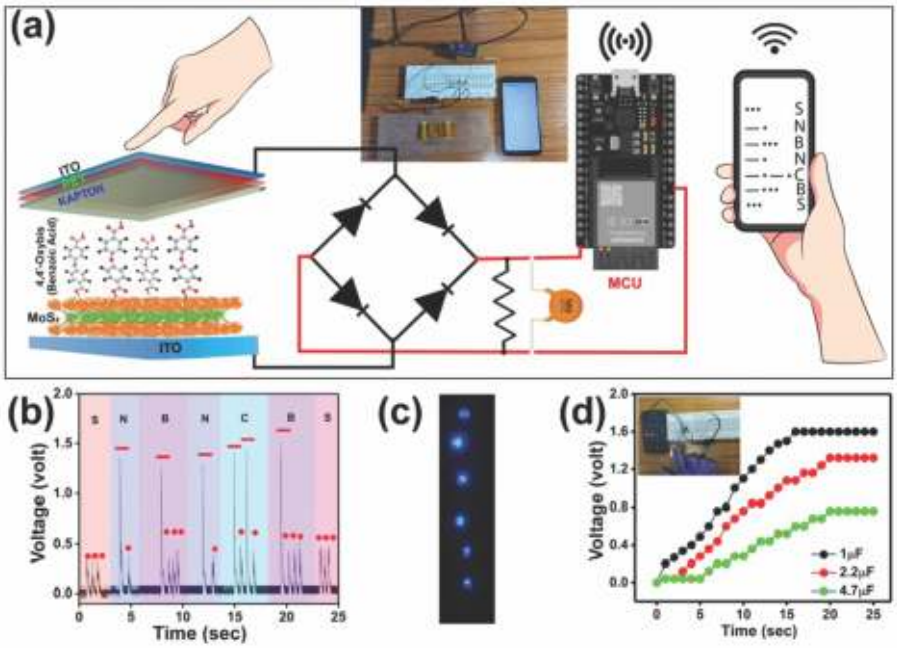
1. Delivered a talk on "Electronic Synapses: Bridging the Gap Between Biology and Technology" in a outreach program under Visitors, Associates and Students' Programme (VASP) on December 13, 2024 at the Department of Physics, Gour Mahavidyalaya, Malda
2. Attended a one-day workshop on "Essentials of Scientific Entrepreneurship: A half day workshop on the journey from Lab to Market" held at Bose Institute, Kolkata on 22/11/2024

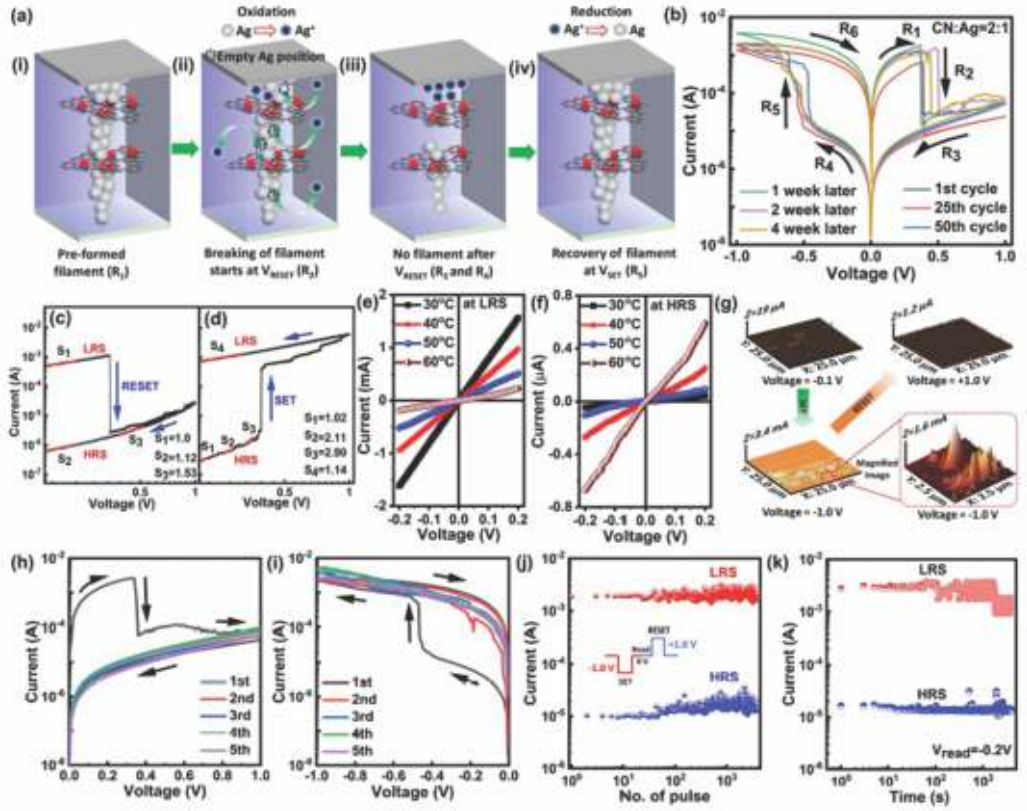
Areas of Research

Work 1: This study discusses a vertical triboelectric nanogenerator (V-TENG) designed for improved energy harvesting and wireless communication (Figure 1). Its enhanced performance stems from two key modifications: first, surface engineering of the MoS2 active layer with 4,4'-Oxybis(benzoic acid) to boost charge density and work function; and second, the strategic insertion of a PET dielectric layer to improve charge storage. The optimized device, named "PET-Kapton@4,4'-MoS2", shows a fivefold increase in output compared to unmodified versions, achieving 30 V open-circuit voltage, 202 nA short-circuit current, and 399 mW cm-2 peak power density. This superior performance is attributed to the combined effects of enhanced electron affinity after the organic modification and improved dielectric properties of the PET layer. The V-TENG exhibits excellent stability, durability, and scalability. It successfully powers small electronics like LEDs and calculators and can wirelessly transmit data, demonstrating its potential as a self-powered, multifunctional platform for wearable devices, IoT, and energy-autonomous communication technologies. This work highlights significant progress in using 2D materials and surface functionalization for high-performance triboelectric systems.

Work 2: This work introduces a solution-processed memristor using exfoliated graphitic carbon nitride (g-C3N4) nanosheets embedded with silver nanoparticles (Ag NPs), forming a conductive islands-assisted resistive switching (CIARS) structure for neuromorphic applications. The Ag NPs enable the formation of metallic conduction filaments (CFs) at low operating voltages (±0.5 V), allowing stable and repeatable bipolar switching with a current ON/OFF ratio of ~300. The device exhibits both short-term and long- term synaptic plasticity, including paired-pulse facilitation/depression (PPF/PPD), spike-timing-dependent plasticity (STDP), and spike-number-dependent plasticity (SNDP), mimicking key brain functions. It successfully emulates associative learning (Pavlov's experiment), Morse code detection, and image recognition tasks using artificial neural network (ANN) simulations on the MNIST dataset, achieving up to 97% recognition accuracy. The device also demonstrates excellent endurance and data retention.

Work 3: This work explores a strategic approach to designing mesoporous g-C3N4@ZnFe2O4 heterojunctions for efficient solar-driven environmental and energy applications. Using thermal etching and impregnation techniques, exfoliated g-C3N4 nanosheets were integrated with various loadings of magnetic ZnFe2O4 nanoparticles. The optimized 20% ZnFe2O4@CN600 composite exhibited the highest surface area (62.5 m2/g), small mesopores (<4 nm), and intimate interfacial contact, facilitating charge separation and redox activity. Under solar illumination, the catalyst achieved a hydrogen evolution rate of 1752 mol g-1 h-1 and a maximum photo-Fenton degradation rate constant of 0.147 min-1 for methylene blue. Band structure analysis revealed a type-I heterojunction that efficiently suppressed charge recombination, while scavenger tests identified superoxide and hydroxyl radicals as key reactive species. The catalyst demonstrated strong magnetic recovery,





reusability over five cycles, and stability in structure and activity. This work underscores the synergy of mesoporous architecture and heterojunction engineering in developing multifunctional photocatalysts for clean energy and environmental sustainability

Plan of Future Work Including Project

1. Our future research in the area of photocatalysis is aimed at exploring 2D- 0D hybrid materials platforms with suitable band alignments and high charge carrier mobility to enhance solar H^2 production. Explore emerging 2D photocatalysts beyond traditional g-C3N4, such as novel MXenes (e.g., specific transition metal carbides/nitrides with optimized surface terminations), graphdiyne, etc. Systematically integrate various 0D nanomaterials, including plasmonic quantum dots, non-noble metal phosphides/sulfides, or specific carbon dots (CDs) for tunable light absorption and electron reservoirs. Focus on precise control over the 2D-0D interface (e.g., through strong electrostatic interactions, covalent bonding, or optimized van der Waals contacts) to facilitate rapid charge separation and transfer, minimizing recombination.

2. Another research plan focuses on developing advanced energy-harvesting TENGs utilizing ionic liquid (IL)-2D materials and conducting polymers for high-performance sensors and seamless human-machine interfaces. Investigate the synergistic benefits of integrating ionic liquids (ILs) with various 2D materials (e.g., graphene, MXenes, MoS2) to create novel triboelectric layers. ILs offer high ionic conductivity, tunable surface charge properties, and enhanced charge screening, while 2D materials provide high surface area, robust mechanical properties, and excellent electron mobility. Research will focus on optimizing IL-2D material ratios, exfoliation techniques, and interfacial engineering to maximize charge generation and transfer. Our aim is to design and fabricate novel device architectures incorporating micro/nano-patterning and porous structures (e.g., nanofibers) to significantly enhance effective contact area, increase triboelectric charge density, and improve mechanical-to-electrical energy conversion efficiency, particularly for subtle ambient motions.

3. Our future research on the optoelectronic synaptic devices is focused on the integration of highly photosensitive inorganic nanomaterials (e.g., 2D transition metal dichalcogenides, 2D halide perovskites, COFs, quantum dots, etc.) with flexible and processable organic semiconductors/polymers in memristor and memtransistor structures. This will enable synergistic control over charge generation, transport, and ion/defect migration, allowing for light-tunable resistive switching and synaptic weight modulation.

Barun Ghosh

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Teaching

1. Spring Semester; Mesoscopic Physics (PHY 628); PhD; 3 students; Shared
2. Spring Semester; Project Research III (PHY 502); Integrated PhD; 2 students

Administrative duties

1. Member of the Computer Centre Working Group
2. Served as judge for the poster presentation in the International Conference on Bose-Einstein Condensation, Superconductivity, Superfluidity and Quantum Magnetism, November 2024
3. Served as a judge for the poster presentation in the Bose Fest 2025

Awards, Recognitions, if any

1. Affiliate Assistant Professor, Quantum Materials and Sensing Institute, Department of Physics, Northeastern University, Boston, USA

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. Material Specific Modeling of Novel Response in Quantum Materials (Approved); ANRF (PM-ECRG); 3yrs; PI

Areas of Research

Theoretical Condensed Matter Physics, Density Functional Theory, Topology, Quantum geometry, Transport, Plasmons, Optical response, Quantum Materials

After joining the department on 4th November 2024, my academic activities have been focused on advancing research in theoretical modelling of different aspects of quantum materials and contributing to student development/manpower training. My research involves developing material-specific models to investigate the novel responses (transport, optical, plasmonic response) of quantum materials, including low dimensional materials, topological materials, Kagome materials, Axion insulators, magnetic materials. We have started multiple projects related to the above-mentioned research areas during this period, some of which are currently under communication with various journals, although none published during this duration with the SNBNCBS affiliation (4 publications without SNBNCBS affiliation). In addition to this, I have been actively mentoring two integrated Ph.D. students (Mr. Kapil Gope and Mr. Sudip Ghorai), for their Project-Research course (PHY-502) and providing them with the training in computational methods based on Density Functional Theory (DFT). This training will help them to model complex material classes effectively during their Ph.D. tenure. During this period, my teaching contributions include co-instructing (shared with Prof. P.S. Deo) the Ph.D.-level course "Mesoscopic Physics" (PHY-628). We have also initiated new academic collaborations with experimentalists from SN Bose centre and outside.

Plan of Future Work Including Project

In the near future, our group will continue working on various aspects of modelling the response of quantum materials using different theoretical approaches. We will continue to work in close collaboration with various experimental groups within and outside the centre. A few specific projects that we plan to continue working on include:

1. Modelling the Axion insulator phase and the dynamical Axion quasi particle in $MnBi_2Te_4$ and other antiferromagnetic topological materials
2. Exploring the role of quantum geometry in transport, optical and plasmonic responses of quantum

materials

3. Modelling the electronic structure and novel responses of 134 family of distorted Kagome materials, namely $LaTi_3Bi_4$, $NdTi_3Bi_4$, $PrTi_3Bi_4$ etc.
4. Understanding the physics of Kagome material Ga doped $ScMn_6Sn_6$
5. Exploring the physics of UOTe, a high temperature antiferromagnetic topological material
6. Exploring the possibility of integrating machine-learning and AI based approaches in modeling the quantum materials
7. Continue training new students

Any other Relevant Information including social impact of research

1. Referee of APS journals including Physical Review B, Physical Review Letters
2. Referee of Nature Physics

Bhaskar Mukherjee

DST INSPIRE Faculty
Condensed Matter and Materials Physics
bhaskar.mukherjee@bose.res.in

Guidance of Students/Post-Docs

a) External Project Students / Summer Training

1. Binayak Mondal; Fermi-Pasta-Ulam-Tsingou problem
2. Sayan Bhattacharya; Single particle quantum scars in Bunimovich stadium

Talks / Seminars Delivered in reputed conference / institutions

1. Delivered a talk at ISI, Kolkata on "Quantum many body scars: a new route to break ergodicity"; 11/12/2024; ISI, Kolkata; 1hour
2. Delivered a talk at IACS, Kolkata on "Symmetric Tensor Scars with tunable entanglement from volume to area law"; 10/03/2025; IACS, Kolkata; 1hour
3. Visit to IMSC, Chennai (invited by Prof. Ajit C. Balram) and IIT Madras to deliver a talk "Symmetric Tensor Scars with tunable entanglement from volume to area law"; 12/03/2025-15/03/2025; IMSC, IIT Madras; Total 2 hours (1 + 1)

Administrative duties

1. I have attended Condensed Matter & Materials Physics (CMMP) departmental meetings. Based on the decision taken on these meetings, I am organizing regular journal club meeting in the CMMP department.

Outreach program organized / participated

I have given invited pedagogical talks on my research titled

1) "Absence of Chaos in quantum many-body systems" in a seminar celebrating "International Year of Quantum Science and Technology" on 15/01/2025 at the department of Physics, Acharya Prafulla Chandra College, Kolkata-700131
2) "Absence of chaos in classical and quantum systems" in a seminar "International Conference on Frontiers in Physics" (funded by ANRF (previously SERB), Govt of India) on 28/09/2024 at the department of Physics, Aghorekamini Prakashchandra Mahavidyalaya, West Bengal-712611

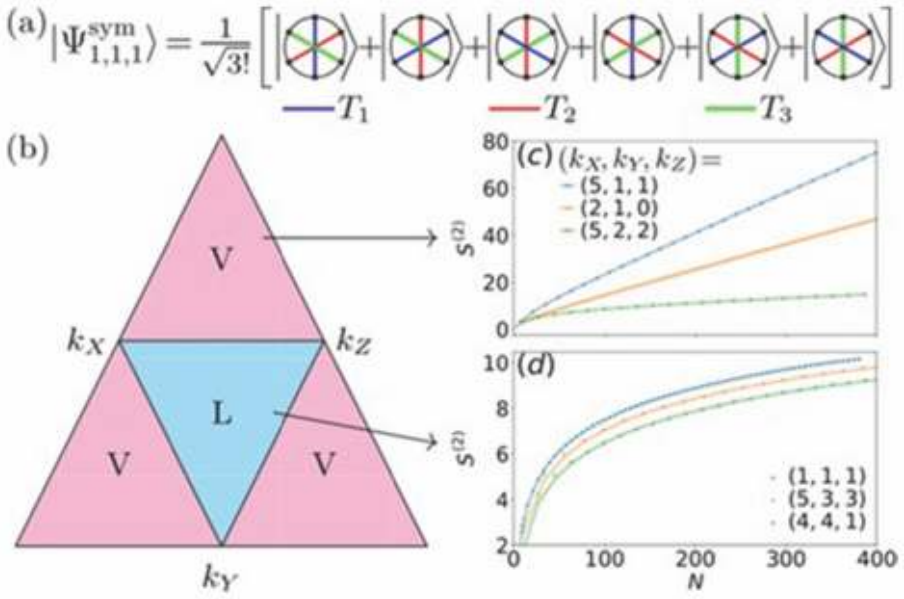
Areas of Research

Condensed matter theory, quantum information, many-body physics, quantum non-equilibrium systems

I work on condensed matter and many-body physics using ideas and tools from quantum information theory. Currently, I am most interested in ergodicity-breaking phenomena in clean non-integrable quantum systems, e.g via Quantum many-body scars (QMBS). I briefly describe two of my recent work along this direction.

QMBS via Bethe ansatz (arXiv:2501.14017):

Bethe ansatz has been the standard technique to solve integrable models like the Heisenberg chain. Recently, the construction of exact eigenstates at finite energy density of non-integrable models, the so-called quantum many-body scars (QMBS) has gained intense research attention since



the existence of exact QMBS was considered to be impossible for a long time. We find exact eigenstates at infinite temperature of the non-integrable staggered Heisenberg model via the Generalized Bethe ansatz up to three magnon sectors and numerically in four magnon sector. These states are found to follow area-law of entanglement scaling. Our work suggests that the Bethe ansatz can be useful to find atypical eigenstates in non-integrable models also.

Symmetric Tensor Scars with tunable entanglement (B Mukherjee et al, arxiv: 2501.14024v2):

Extension of Bethe ansatz in higher magnon sectors to obtain exact QMBS in the staggered Heisenberg model is notoriously difficult. To circumvent this problem, we have found a complementary approach to construct exact QMBS in the high-magnon sectors by taking symmetric superposition of triplet coverings. The number of such symmetric tensor scars (STS) scales quadratically with system size, and their entanglement is highly tunable, which ranges from volume to logarithmic to area law. The spin-spin correlations in STS show a flat behavior, indicating ferromagnetic ordering, which is a hallmark of scar states. Our work constitutes the first example (to the best of our knowledge) where QMBS with all three kinds of entanglement scaling (volume, log, area, and maybe more) co-exist in a single platform. This work also demonstrates how superposition of volume law states can reduce entanglement (downgrading the entanglement scaling) in a controlled manner.

Plan of Future Work Including Project

We will continue to work on clean non-integrable quantum systems, looking for the existence of quantum many-body scars (QMBS) in them. The existence of such states violates ergodicity, having both fundamental and practical importance. Our particular focus will be on the construction of exact QMBS in the zero energy manifold of non-integrable models, a feat no less than finding a needle in a haystack. We will also explore the stability of such non-ergodic phases against various perturbations, disorder, and time-dependent driving. Recently, other ways of violating ergodicity in clean non-integrable systems, such as Hilbert space fragmentation, have been proposed. We aim to have a unified description of all these different mechanisms of ergodicity violations.

We also aim to implement some of our interesting findings on non-ergodic effects in the available Noisy intermediate-scale quantum (NISQ) devices such as those possessed by companies like IBM, Google, QuERA etc. Currently, we are working with the Aquila (a 256 atoms Rydberg quantum simulator) machine of QuERA to study the enhancement of drive induced freezing via two-frequency drive protocol.

Kalyan Mandal

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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Soham Saha; Photoelectrochemical water-splitting; Under progress
2. Ishita Jana; Multiferroic materials; Under progress
3. J Sridhar Mohanty; Magnetocaloric effect; Under progress
4. Sourav Sarkar; Magnetic properties of ferrite nanoparticles; Under progress
5. Susanta Ghosh; Electronic and magnetic properties of topological quantum materials; Thesis submitted; shared with Thirupathaiah Setti

b) Post-Docs

1. Mily Kundu; Magnetic phase transition

Teaching

1. Second semester; Electronics and Instrumentation (PHY 408); IPHD; 13 students; shared with Avijit Chaudhuri
2. Second semester; Basic Laboratory (PHY 492); IPHD; 13 students; shared with Avijit Chaudhuri

Publications

a) In journals

1. Sourav Sarkar, Priyanka Saha, MilyKundu, Sudip Chakraborty, **Kalyan Mandal**, *Morphology dependent negative dielectric permittivity in spinel ferrite nanostructures*, Journal of Alloys and Compounds, 978, 173513, 2024
2. Soham Saha, Dipanjan Maity, Debasis De, Gobinda Gopal Khan, **Kalyan Mandal**, *Graphene Quantum Dots as Hole Extraction and Transfer Layer Empowering Solar Water Splitting of Catalyst-Coupled Zinc Ferrite Nanorods*, ACS Applied Materials & Interfaces, 16, 28441-28451, 2024
3. J. Sridhar Mohanty, Saheli Samanta and **Kalyan Mandal**, *Subjugating extensive magnetostructural temperature window and giant magnetocaloric effect in B-doped* $(MnNiSi)_{0.67}(Fe_2Ge)_{0.33}$ *hexagonal system*, Physical Review Materials, 8, 094407, 2024
4. Souvick Das, Ayan Mitra, Sukhendu Sadhukhan, Amit Kumar, Amitabh Das, Ishita Jana, **Kalyan Mandal**, Pabitra Kumar Chakrabarti, *Exploring the room temperature multiferroic behavior and negative exchange bias effect in* $Ho_{0.05}Y_{0.95}Fe_{0.90}Ti_{0.10}O_3$ *nanoceramic*, Journal of Alloys and Compounds, 1002, 175163, 2024
5. Anupam Gorai, Alo Dutta, **Kalyan Mandal**, *Enhancement of Microwave Absorption Properties of Crystal-Engineered Perovskite Oxide Using Cobalt Ferrite*, Advanced Engineering Materials, 26, 2401173, 2024
6. Ishita Jana, Swarnali Hait, Anupam Gorai, **Kalyan Mandal**, *Enhanced microwave absorption in* $GaFeO_3$ *coated* $CoFe_2O_4$ *nano-hollowsphere*, Journal of Applied Physics, 136, 084101, 2024
7. Mily Kundu, Santanu Pakhira, Shuvankar Gupta, Renu Choudhary, Sourav Sarkar, N.

Lakshminarasimhan, R. Ranganathan, **Kalyan Mandal**, Duane D. Johnson and Chandan Mazumdar, *Defect-induced formation and frustration-driven multiple magnetic transitions in* $Gd_2Co_{0.90}Si_{2.90}$, Journal of Materials Chemistry C, 12, 12292-12303, 2024

8. Sourav Sarkar, Priyanka Saha, Mily Kundu, Rupali Rakhshit, **Kalyan Mandal**, *Geometry mediated spin relaxation in* $ZnFe_2O_4$ *spinel ferrite nanostructures*, Journal of Applied Physics, 136, 214303, 2024

b) Other Publications

i) Conference proceedings / Reports / Monographs

1. Sourav Sarkar, Priyanka Saha, Kalyan Mandal, "Correlation between negative dielectric permittivity and magnetism in spinel ferrite nano-structures", Proceedings of the International Conference on Nanostructured Materials and Nanocomposites, organized by Mahatma Gandhi University, Kottayam, Kerala during 10-12 May 2024, Pg.196-199

Administrative duties

1. Vigilance Officer, SNBNCBS

Awards, Recognitions, if any

1. ACS Best Oral Presentation by Sourav Sarkar for the paper entitled, "Correlation between negative dielectric permittivity and magnetism in spinel ferrite nano-structures" by Sourav Sarkar, Priyanka Saha, Kalyan Mandal in the conference International Conference on Nanostructured Materials and Nanocomposites, organized by Mahatma Gandhi University, Kottayam, Kerala during 10-12 May 2024

Membership of Learned Societies

1. Life Member of IEEE (USA), Indian Association for the Cultivation of Science, Indian Society for Non-Destructive Testing, Indian Physical Society, Humboldt Club-Calcutta, Magnetics Society of India, Indian Association of Physics Teachers, Materials Research Society of India

Conference / Symposia / Schools organized

1. Young Scientist Colloquium-2024 (YSC-2024); 11th December 2024; Ramakrishna Mission Vidyamandir, Belur Math, Howrah-711202; 1day

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. Professor Gobinda Gopal Khan, Tripura Central University; Sl. No. 1; National

Areas of Research

Leakage Current Suppression and Enhanced Magneto-Dielectric Response in $GaFe_{0.95}Co_{0.05}O_3 - Gd_3Ga_5O_{12}$ **Composites**

Multiferroic-garnet composites of (1-x) $GaFe_{0.95}Co_{0.05}O_3$ (GFCO5) – $xGd_3Ga_5O_{12}$ (GGG), with varying GGG concentrations (x = 0.0, 0.1, 0.2, and 0.3), were synthesized via the sol-gel method to investigate their tunable magnetodielectric properties. Structural characterization and Rietveld refinement confirm the coexistence of orthorhombic GFCO5 and cubic garnet phases. Scanning electron microscopy reveals a systematic decrease in average grain size with increasing GGG content. Notably, the x = 0.2 composite exhibits a five-order reduction in leakage current density, consistent with the observed grain size refinement. The incorporation of high-resistive garnet leads to improved dielectric properties with a lower dielectric tangent loss and a significant decrease in electrical conductivity. Magnetic (M–H) and ferroelectric (P–E) loop measurements at room temperature confirm the coexistence of magnetic and electric orderings in all samples. All compositions display magnetodielectric (MD) coupling, with a maximum MD response of ~8.56% observed for x = 0.1 at room temperature. These results demonstrate strong coupling between electric and magnetic order parameters, attributed to the coexistence of both structural phases, the orthorhombic phase of GFCO5 and the cubic phase of GGG. The enhanced multifunctional properties suggest that these composites hold promise for applications in magnetically tunable energy devices, magnetoelectric sensors, and memory applications.

Plan of Future Work Including Project

The work on multiferroic materials will be continued. Use of ferrite nanostructures in microwave frequency is also going on. The research work on photo-electrochemical water splitting will also be continued.

Manoranjan Kumar

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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Anutosh Biswas; Quantum Spin Liquid in Low Dimensional System; Under Progress
2. Ayan Jana; Studying the electronic properties of materials using Density Functional Theory (DFT); Under Progress
3. Jyotirmoy Sau; Topology in Correlated Systems; Awarded
4. Monalisa Chatterjee; Topological aspect of Frustrated low dimensional Spin Systems; Thesis Submitted
5. Manodip Routh; Thermal and quantum fluctuations in low dimensional strongly correlated systems; Thesis Submitted
6. Sayan Ghosh; Exploring the Quantum & Thermal Fluctuations in Frustrated Strongly Correlated Low Dimensional Systems; Under Progress
7. Sourabh Saha; Study of exotic phases in multi-band correlated systems; Under Progress

b) Post-Docs

1. Dibyajyoti Saikia; Topological properties in Condensed Matter Physics

c) External Project Students / Summer Training

1. Prabhakar; Dynamical properties of trimers

Teaching

1. Autumn Semester; Advance Quantum Mechanics and Applications; Integrated PhD; 24 students; Shared
2. Spring Semester; Many Body Aspects of Quantum Computing; PhD; 10 students; Shared

Publications

a) In journals

1. Sourabh Saha, Hosho Katsura and **Manoranjan Kumar**, *Phase diagram of a coupled trimer system at half filling using the Hubbard model*, Physical Review B, 111, 094425, 2025
2. Prasanta Chowdhury, Jyotirmay Sau, Mohamad Numan, Jhuma Sannigrahi, Matthias Gutmann, Saurav Giri, **Manoranjan Kumar** and Subham Majumdar, *Suppression of intrinsic Hall effect through competing Berry curvature in* $Cr_{1+d}Te_2$, Physical Review Materials, 9, 024407, 2025
3. Sayan Ghosh, Rajiv R. P. Singh and **Manoranjan Kumar**, *Frustrated spin-1/2 Heisenberg model on a kagome-strip chain: Dimerization and mapping to a spin-orbital Kugel-Khomskii model*, Physical Review B, 111, 045115, 2025
4. Samanta Pal, Parushottam Majhi, Jyotirmoy Sau, Suvadip Masanta, Prabir Pal, **Manoranjan Kumar**, Achintya Singha, P D Babu, Barnali Ghosh and A K Raychaudhuri, *Charge density wave transition and unusual resistance hysteresis in vanadium disulfide (1T-*VS_2*) microflakes*, Physica Scripta, 99, 095957, 2024
5. Manoj Gupta, Manodip Routh, **Manoranjan Kumar**, and Tanusri Saha Dasgupta, *Interchain interactions, multimagnon condensation, and*

strain effect in the chain compound $NaVOPO_4$, Physical Review B, 110, 054441, 2024

6. Mahima Singh, Jyotirmoy Sau, Banik Rai, Arunanshu Panda, **Manoranjan Kumar**, and Nitesh Kumar, *Tuning intrinsic anomalous Hall effect from large to zero in two ferromagnetic states of $SmMn_2Ge_2$*, Physical Review Materials, 8, 084201, 2024
7. Sumit Haldar, Sk Saniur Rahaman and **Manoranjan Kumar**, *Study of the Berezinskii–Kosterlitz–Thouless transition: an unsupervised machine learning approach*, Journal of Physics: Condensed Matter, 36, 415804, 2024
8. S. M. Hossain, S. S. Rahaman, H. Gujrati, Dilip Bhoi, A. Matsuo, K. Kindo, **Manoranjan Kumar**, and M. Majumder, *Evidence of random spin-singlet state in the three-dimensional quantum spin liquid candidate $Sr_3CuNb_2O_9$*, Physical Review B, 110, L020406, 2024
9. Manodip Routh, Sayan Ghosh, Jeroen van den Brink, Satoshi Nishimoto, and **Manoranjan Kumar**, *Emergent quadrupolar order in the spin-1/2 Kitaev-Heisenberg model*, Physical Review B, 109, L220403, 2024
10. Monalisa Singh Roy and **Manoranjan Kumar**, *Fulde-Ferrel-Larkin-Ovchinnikov phase in a one-dimensional Fermi gas with attractive interactions and transverse spin-orbit coupling*, Physical Review B, 110, 085159, 2024

Talks / Seminars Delivered in reputed conference / institutions

1. Gave a talk in the conference on 'Emerging trends in Quantum Condensed Matter Physics (EQCMP-2024)'; 21/08/2024; Institute of Physics (IOP) Bhubaneswar, India; Three days
2. Delivered a talk in the conference on 'Advances in Functional Solids (AFS)'; 09/11/2024; IIT Kharagpur; Four days
3. Delivered a lecture in the conference on 'Modern Trends in Molecular Magnetism and 3rd edition of Spins in Molecular Systems (MTMM / SiMS)'; 05/11/2024; IISc Bangalore; Four days

Administrative duties

1. Head of the Department of Condensed Matter and Materials Physics, IPhd Coordinator, Chairman of the National Super Computing Mission (NSM) facility and many others

Conference / Symposia / Schools organized

1. Magnetism and Topology: A Materials Physics Perspective; 02/08/2024; S. N. Bose National Centre for Basic Sciences; One day
2. Consortium for Quantum Materials; 18/11/2024; S. N. Bose National Centre for Basic Sciences; Two days

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. Professor Hosho Katsura,University of Tokyo,Tokyo; International
2. Professor Satoshi Nishimoto,Institute for Theoretical Solid State Physics,IFW Dresden; International
3. Professor Jeroen van den Brink, Institute for Theoretical Solid State Physics,IFW Dresden; International
4. Professor Rajiv R.P. Singh, University of California, Davis; International
5. Professor Nitesh Kumar, S.N. Bose National Centre for Basic Sciences, Kolkata; National
6. Professor Tanusri Saha Dasgupta, S.N. Bose National Centre for Basic Sciences, Kolkata; National
7. Professor Subham Majumdar, School of Physical Sciences, Indian Association for the Cultivation of Science, Kolkata; National
8. Professsor A.K. Raychaudhuri, INSA Senior Scientist, UGC-DAE Consortium for Scientific Research, Kolkata; National
9. Professor Mayukh Majumder, Assistant Professor, Department of Physics, Shiv Nadar University; National

Areas of Research

Study of electronic properties of strongly correlated low dimensional systems. Developing and implementing numerical methods including DMRG methods, exact diagonalization, and quantum Monte Carlo methods for

solving strongly correlated model Hamiltonians. Transport properties of metal-organic and organic-organic interfaces.

My area of research can be described in following major headings:

1. Strongly Correlated Electron Systems

   Investigating the behavior of electrons in low-dimensional systems where interactions dominate over kinetic energy

2. Quantum Magnetism

   Exploring various magnetic ground states and excitations in spin chains, ladders, and frustrated lattices

3. Frustrated Spin Systems

   Studying systems where competing interactions prevent conventional magnetic order, leading to exotic quantum phases

4. Quantum Phase Transitions

   Understanding transitions between different quantum phases at zero temperature driven by quantum fluctuations

5. Topological Phases and Edge States

   Characterizing phases of matter that are defined by global topological properties rather than local order parameters

6. Spin-Orbit Coupling in Low Dimensions

   Analyzing the effects of spin-orbit interaction on the electronic and magnetic properties of 1D and 2D systems

7. Numerical Techniques in Quantum Many-Body Physics

   Applying advanced methods like DMRG (Density Matrix Renormalization Group), exact diagonalization, and tensor network techniques to simulate quantum systems

8. Entanglement and Quantum Information in Condensed Matter

   Using entanglement entropy and related measures to study quantum criticality and correlations in many-body systems

9. Quantum computation

   Solving the many body system using the quantum computation

Plan of Future Work Including Project

1. 2D Topological MA_2Z_4 Monolayers & Janus Variants-Building on $MoSi_2N_4$, I will explore the stability and electronic topology of Hf- and Zr-centered MA_2Z_4 (A = Si, Ge; Z = P, As) monolayers using density functional theory (DFT). Special focus will be placed on A/Z-swapped Janus bilayers. After identifying the lowest-energy T-phase stacking, we will compute Z^2 topological invariants via Wannier-based methods under external perturbations such as strain, doping, and interlayer asymmetry. This will establish the regimes where robust quantum spin Hall (QSH) phases ($Z^2 = 1$) emerge, offering insights into low-power electronics and spintronics.

2. DMRG of Multiorbital & SOC-Enabled Chains and Ladders-Multiorbital Hubbard chains with Spin-Orbit Coupling (SOC) and Hund's interactions can host exotic states like orbital-selective Mott phases and unconventional pairing. We plan to extend matrix product state (MPS)/density matrix renormalization group (DMRG) codes to handle orbital degeneracy and SOC ($\sim$U, J), targeting phase diagrams of 1D chains and two-leg ladders (e.g. Fe_3GeTe_2 fragments). Additionally, we will explore single-orbital chains with SOC, aiming to reveal edge states such as fractionalized modes or Majoranas. The role of moderate doping and Hund's coupling in tuning magnetism and topology will also be studied.

3. DFT + Wannier Tight-Binding for Fe_3GeTe_2 Spintronics-Fe_3GeTe_2 is a van der Waals ferromagnet with promising spintronic potential. I will perform DFT (+U, SOC) calculations to construct maximally localized Wannier functions, enabling tight-binding models that capture essential physics. These models will be used to study how strain, gating, and stacking affect key observables like Chern numbers, magnon bands, and spin-orbit torques. The goal is to guide experimental realization of topological magnonics and voltage-controlled switching in 2D ferromagnets.

4. Unified Pseudospin-½ Model for $TmVO_4$ & Elastocaloric Cooling - we will extend our pseudospin-½ framework to model the interplay of ferroquadrupolar (electronic) and nuclear orders in $TmVO_4$ under B^{2g} shear strain, transverse magnetic

fields, and hyperfine coupling. By tracking entropy changes across quadrupolar (T ~ 4 K) and nuclear (T ~ 0.3 K) transitions, I aim to characterize a two-step elastocaloric effect, identifying TmVO4 as a potential low-temperature solid-state refrigerant.

5. Field-Driven Quantum Phases in Frustrated Ladders & J_1-J_2 Chains-Frustrated spin ladders under magnetic fields can host bound magnon condensates forming multipolar phases-quadrupolar, octupolar, hexadecapolar-detectable as magnetization plateaus. Using exact diagonalization and DMRG, we will map out the full quantum phase diagrams of two-leg ladders and reanalyze the J_1-J_2 chain to search for overlooked phases. Finite-size scaling and entanglement entropy will be used to pinpoint quantum critical points and characterize the nature of emerging orders.
6. Kitaev-Heisenberg Model with Dzyaloshinskii-Moriya Interaction (DMI)-In realistic 2D materials, Kitaev and Heisenberg interactions coexist with DMI. We will study the Kitaev-Heisenberg model augmented with DMI on two-leg ladders and honeycomb lattices. By analyzing how DMI modifies the ground-state phase diagram, we aim to assess its effect on stabilizing or destabilizing the Kitaev spin liquid (KSL) and identify new emergent phases arising from the interplay of bond-directional anisotropy and chiral interactions.
7. Spin-1 Trimer Dynamics and Quasiparticle Excitations-Motivated by recent interest in fractional excitations in spin-½ trimer chains, we will investigate the isotropic spin-1 trimer chain using DMRG. The focus will be on the dynamic structure factor (DSF), revealing gapped magnon bands and weakly dispersive excitations such as singletons, triplons, pentons, and heptons. This work will enhance our understanding of quasiparticle dynamics in integer-spin low-dimensional magnets.

Nitesh Kumar

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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Banik Rai; Anomalous transport of quasi-two dimensional ferromagnets; Under Progress
2. Anyesh Saraswati; Single crystal growth and transport of noncentrosymmetric antiferromagnetic Weyl semimetals; Under Progress
3. Modhumita Sariket; Electrical transport of quantum materials under high pressure; Under Progress
4. Kakan Deb; Magnetism and transport properties of kagome and distorted kagome compounds; Under Progress

b) Post-Docs

1. Chandan Patra; Electrical transport in rare-earth based intermetallic compounds
2. Sourav Kanthal; Single crystal growth of $HfFe_6Ge_6$-type kagome intermetallic compounds and their physical properties

c) External Project Students / Summer Training

1. Suchetana Manna; Electrochemical water splitting by Cr_5Te_8 single crystals and powder
2. Subham Pandey; Crystal structure of V-doped CrSb

Teaching

1. Autumn Semester; PHY 503, PHY 603; Integrated PhD; 30 students; shared with Dr. T. Setti
2. Spring Semester; PHY 592; Integrated PhD; 13 students; shared with 3 other co-instructors

Publications

a) In journals

1. Banik Rai, Sandip Kumar Kuila, Rana Saha, Sankalpa Hazra, Chandan De, Jyotirmoy Sau, Venkatraman Gopalan, Partha Pratim Jana, Stuart S. P. Parkin and **Nitesh Kumar**, *Peculiar Magnetic and Magneto-Transport Properties in a Noncentrosymmetric Self-Intercalated van der Waals Ferromagnet Cr_5Te_8*, Chemistry of Materials, 37, 746-755, 2025
2. Mahima Singh, Jyotirmoy Sau, Banik Rai, Arunanshu Panda, Manoranjan Kumar, and **Nitesh Kumar**, *Tuning intrinsic anomalous Hall effect from large to zero in two ferromagnetic states of $SmMn_2Ge_2$*, Physical Review Materials, 8, 084201, 2024
3. Changjiang Yi, Xiaolong Feng, **Nitesh Kumar**, Claudia Felser and Chandra Shekhar, *Tuning charge density wave of kagome metal ScV_6Sn_6*, New Journal of Physics, 26, 052001, 2024
4. Maksim Litskevich, Md Shafayat Hossain, Song-Bo Zhang, Zi-Jia Cheng, Satya N. Guin, **Nitesh Kumar**, Chandra Shekhar, Zhiwei Wang, Yongkai Li, Guoqing Chang, Jia-Xin Yin, Qi Zhang, Guangming Cheng, Tyler A. Cochran, Nana Shumiya, Yu-Xiao Jiang, Xian P. Yang, Daniel Multer, Xiaoxiong Liu, Nan Yao, Yugui Yao, Claudia Felser, Titus Neupert & M. Zahid Hasan, *Boundary modes of a charge density wave state in a topological material*, Nature Physics, 20, 1253-1261, 2024

5. M. M. Piva, R. Wawrzyńczak, **Nitesh Kumar**, L. O. Kutelak, G. A. Lombardi, R. D. dos Reis, C. Felser, and M. Nicklas, *Importance of the semimetallic state for the quantum Hall effect in $HfTe_5$*, Physical Review Materials, 8, L041202, 2024

Talks / Seminars Delivered in reputed conference / institutions

1. Advances in Functional Solids (AFS); Talk Title: Goniopolarity in CrSb, an altermagnetic candidate; 10/11/2024; IIT Kharagpur; 9-12th November, 2024
2. 7th Annual Conference on Quantum Condensed Matter (QMAT-2024); Talk Title: Goniopolarity in an altermagnetic system; 23/12/2024; IIT Guwahati; 20-23rd December, 2024

Administrative duties

1. Conferences, Workshops and Extension Programme: To review the details of the proposal submitted to organize conferences, workshops and schools
2. Media Cell: To enhance the visibility of the Centre by advertising research highlights, research stories. Improving the Centre's presence in social media and online forums
3. Disposal of hazardous chemicals: Efficient disposal of hazardous and non-hazardous wastes generated in the Centre
4. Hindi Cell: To organize Hindi-workshops and other events to increase the use of Hindi language in the administrative and academic spheres
5. Creche Management Committee: To maintain and the oversee the smooth running of Creche facility

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. From three-dimensional to two-dimensional quantum anomalous Hall effect in ferromagnetic topological quantum materials; DST, SERB, India; 2. Novel quantum states in quasi-one-; 2022-2025; PI
2. Novel quantum states in quasi-one-dimensional materials; Max Planck Society, Germany; 2022-2027; PI
3. Search for novel magnetic and topological materials; DST-RSF (Indo-Russian); 2022-2025; Co-PI

Conference / Symposia / Schools organized

1. One-day meeting on "Magnetism and Topology: A Materials Physics Perspective; 01/08/2024; SNBNCBS; 1 Day

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. Dr. Partha Pratim Jana, IIT Kharagpur; Sl. No. 1; National
2. Prof. Claudia Felser, Max Planck Institute for Chemical Physics of Solids, Dresden, Germany; Sl. No. 4; International
3. Prof. Stuart S. P. Parkin, Max Planck Institute of Microstructure Physics, Halle, Germany; SL. No. 1; International
4. Prof. Venkatraman Gopalan, Pennsylvania State University, USA; Sl. No. 1; International
5. Prof. M. Zahid Hasan, Princeton University, USA; Sl. No. 1; International

Areas of Research

Single crystal growth and electronic properties of correlated materials based on R(Al,Ga)Si (R = Nd and Si) family of intermetallics; Goniopolar effect in altermagnetic candidate CrSb; High pressure electrical transport studies to attain probable quantum critical point in $CeFe_2$ and $LaCrGe_3$; Search of flat bands and their effect on transport properties of kagome compounds

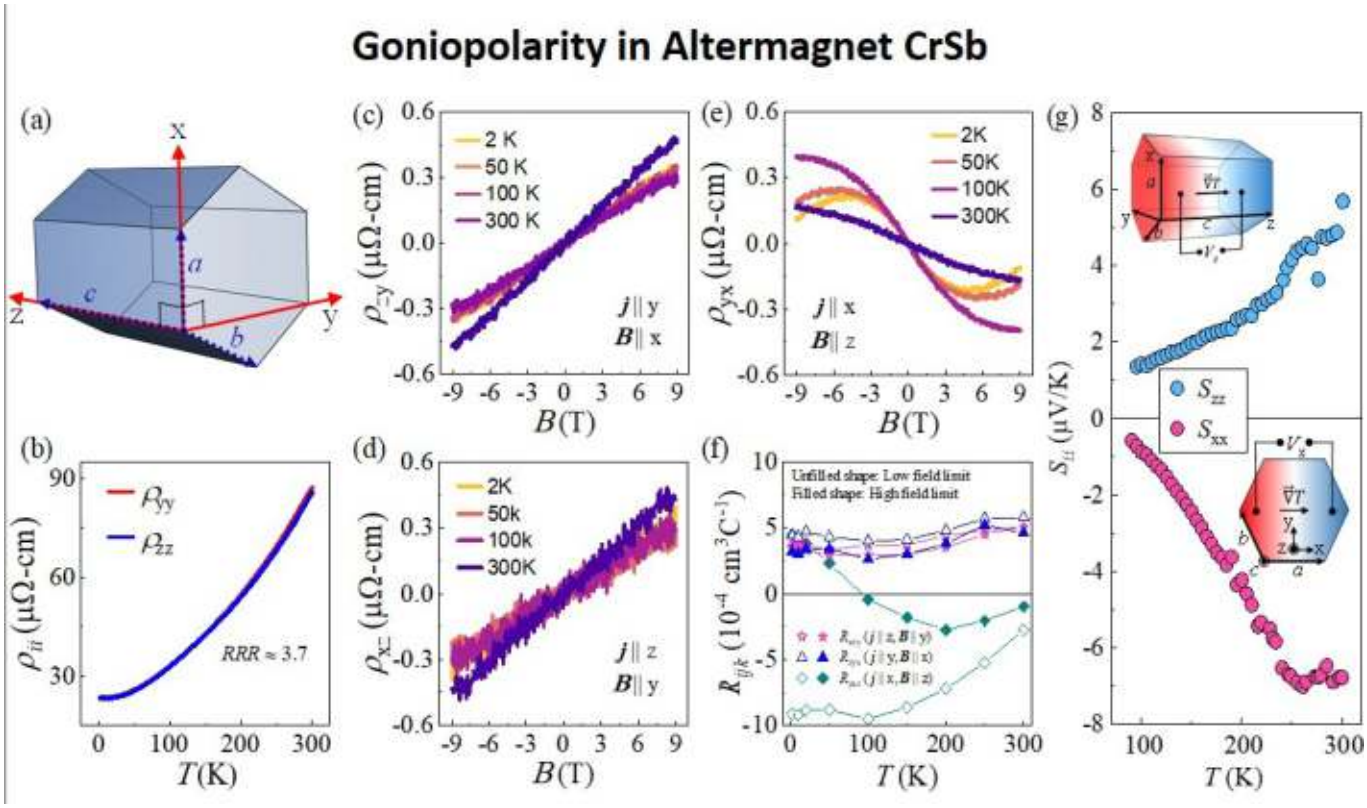
With my PhD students and PDRA, I was involved in the research of single crystal growth and electronic properties of correlated electron quantum materials by electrical transport at high and ambient pressure. We studied NdGaSi which is a sister compound of a well-known Weyl semimetal NdAlSi. We established it to be a centrosymmetric compound by extensive crystallographic studies and therefore might not be a Weyl semimetal. However, it shows extraordinarily large anomalous Hall conductivity which is in contrast to the observation in NdAlSi. Through detailed analysis of specific heat, electrical resistivity and first principles calculations, we demonstrate that the flat bands originating from f-electrons

reside below Fermi energy. These localized bands function as the source of large Berry curvature. We carried out the experimental observation of direction-dependent conduction polarity (DDCP) in altermagnetic CrSb through Hall and Seebeck thermopower measurements. Conduction is dominated by holes along the c-axis and by electrons in the ab-plane of the hexagonal crystal of CrSb. DDCP in CrSb arises from a multicarrier mechanism, where electrons and holes living in distinct bands dominate conduction along different crystallographic directions. DDCP exists within a narrow energy window near the Fermi level and is sensitive to small doping levels.

LaCrGe3 has emerged as an ideal ferromagnet to test quantum critical phenomena. However, the recent focus as been the possible existence of two ferromagnetic phases in the ordered state which has been a subject of debate. We have undertaken extensive electrical transport studies to uncover the various magnetic phase transitions by tracking the Hall resistivity with respect to temperature and magnetic field. We find clear indications of two ferromagnetic phases which supports the hypothesis of a transition in pinning strengths across the magnetic phase transitions. Additionally, we observe the existence of large intrinsic anomalous Hall conductivity in this compound. Another inter-penetrating kagome-lattice compound which is known to be a fragile ferromagnet due to competing antiferromagnetic interaction is CeFe2. This exhibits extremely large anomalous Hall conductivity which is unknown in the literature for this compound. We undertook the high-pressure study of this compound which shows lowering of ferromagnetic transition temperature with increasing pressure and eventually becomes an antiferromagnet above 1.9 GPa hydrostatic pressure. We also observe signature of topological Hall effect when in the antiferromagnetic state which suggests spin-canting. Recently, kagome lattice compounds which exhibits geometrical frustration through its corner-sharing triangles gained lot of attention, as they tend to display correlated topological band structures including flat bands (FBs); Dirac cones, which bring non-trivial topology; and van Hove singularities. We have carried out investigation of the magnetotransport properties of kagome compound MgMn6Sn6. The intrinsic anomalous Hall conductivity (AHC) exhibits similar values for different magnetic field orientations, and is predominantly governed by the Berry curvature of the electronic band structure. I was also involved in teaching. I taught the course PHY 503 containing 30 students with Dr. T. Setti as a co-instructor. I also taught the experimental course PHY 592 with 3 other course instructors.

Plan of Future Work Including Project

1. We are undertaking research to tune the Néel vector of the collinear antiferromagnets and



altermagnets by chemical substitution to induce anomalous Hall effect despite net zero magnetization.

2. Understanding the role of quasi-flat band in the transport properties of rare earth-based intermetallic compounds in particular NdGaSi. Whether the magnetic structure is also responsible for presence of localized f-electron bands in such system is a major area of focus.
3. Electronic properties of kagome and distorted kagome compounds by electrical transport and angle resolved photoemission spectroscopy.
4. Understanding the resistivity anomaly above antiferromagnetic transition in $EuCd2P_2$ and related systems and how does it evolve under hydrostatic pressure

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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Debayan Mondal; Investigating electronic and structural properties of hybrid perovskites; Awarded
2. Prasun Boyal; Role of structure in magnetic and topological transitions; Thesis Submitted
3. Krishnendu Patra; Examining unusual ground states in transition metal compounds; Under Progress
4. Shinjini Paul; Electronic, structural and magnetic properties of few layer transition metal compounds; Under Progress
5. Sanuja Kumar Khuntia; Examining the functionality of hybrid perovskites through ab-initio calculations; Under Progress
6. Shivam Mukeshbhai Jani; Electronic structure of nanoplatelets of hybrid perovskites; Under Progress
7. Madhurita Das; Electronic structure of twisted graphene bilayers; Under Progress
8. Maitreyee Barman; Electronic structure of lateral heterostructures of transition metal dichalcogenides; Under Progress
9. Anita Ratha; Magnetism in frustrated systems; Under Progress
10. Koustav Maiti; Excited properties of transition metal dichalcogenide systems; Under Progress
11. Anurag Paul; Electronic and structural properties of twisted bilayers of graphene; Under Progress

b) Post-Docs

1. Gargee Bhattacharyya; Examining charge density wave systems
2. Ranjini Bhattacharyya; Transport in single molecules

c) External Project Students / Summer Training

1. Vivekanand Prajapati; Electronic structure of curved sheets of graphene
2. Sathi Das; Understanding models for exchange interactions

Publications

a) In journals

1. Debayan Mondal, **Priya Mahadevan**, *Structural Distortions in Hybrid Perovskites Revisited*, Chemistry of Materials, 36, 4254-4261, 2024
2. Ripudaman Kaur, Anamika Kumari, Shinjini Paul, Mohd Anas, Bibek Ranjan Satapathy, Sanjeev Kumar, V. K. Malik, **P. Mahadevan**, D. D. Sarma, *Suvankar Chakraverty, Room-temperature transparent oxide spin electronics: A conducting interface in $LaFeO_3$-$SrTiO_3$*, Physical Review B, 109, L201114, 2024
3. Rejaul Sk, Bijoy Nharangatt, Imrankhan Mulani, **Priya Mahadevan**, Aparna Deshpande, *Adsorption of FePc on Bi_2Se_3*, The Journal of Physical Chemistry C, 128, 17651-17657, 2024
4. Shyamashis Das, Biswajit Bhattacharyya, Ashutosh Mohanty, Poulomi Mukherjee, Arpita Mukherjee, Anirban Dutta, Anshu Pandey, **Priya Mahadevan**, Ranjani Viswanatha and D. D. Sarma, *Boosting quantum efficiency and suppressing self-*

absorption in CdS quantum dots through interface engineering, Nanoscale, 17, 276-286, 2025

5. Prasun Boyal and **Priya Mahadevan**, *Persistence of antiferromagnetic ordering after pressure-induced gap closure in the Slater insulator* $NaOsO_3$, Physical Review B, 111, L020403, 2025
6. Shubham Purwar, Shinjini Paul, Kritika Vijay, R. Venkatesh, Soma Banik, **P. Mahadevan** and S. Thirupathaiah, *Metal-insulator transition in FeSe originating in an anomalous lattice effect*, Physical Review B, 111, 085123, 2025
7. A. R. Shelke, C. N. Kuo, Shishir K. Pandey, T. L. Nguyen, Y. X. Chen, Y. T. Cheng, F. H. Chang, M. Yoshimura, N. Hiraoka, T. W. Pi, H. J. Lin, C. T. Chen, A. Fujimori, **Priya Mahadevan**, C. S. Lue and A. Chainani, *Electron spectroscopy study of single-crystal CrTe*, Physical Review B, 111, 085142, 2025
8. Tara Shankar Bhattacharya, Sumanti Patra, Shib Shankar Singha, Sreemanta Mitra, **Priya Mahadevan**, and Achintya Singha, *Optical intensity driven mid-gap transitions in few-layer* MoS_2, Physical Review B, 111, 115412, 2025

Talks / Seminars Delivered in reputed conference / institutions

1. Understanding the electronic structure of twisted semiconductor bilayers; 09/05/2024; IISER Bhopal; 1 day
2. An Introduction to density functional theory; 19/05/2025; IOP Bhubaneshwar; 2 weeks
3. Understanding the electronic structure of twisted bilayers of semiconductors; 28/06/2024; Indian Academy of Sciences mid-year meeting; 2 days
4. Understanding the electronic structure of twisted semiconductor bilayers; 19/07/2024; ICTS Bengaluru; 2 weeks
5. Why do twisted semiconductor bilayers behave differently from their untwisted counterparts?; 09/08/2024; IISER Trivandrum; 1 day
6. Revisiting the Slater transition; 14/11/2024; IITB Mumbai; 3 days
7. Understanding the Slater metal-insulator transition; Coorg; 3 days
8. Why do twisted semiconductors behave differently from their untwisted counterparts?; 01/12/2025; 1 week
9. Revisiting the Slater transition; IIT Dhanbad; 2 days
10. Revisiting the Slater transition; 28/02/2025; Kolkata; 2 days

Administrative duties

1. Member of various thesis committees of the Centre
2. Member of various review committees of DST, SERB

Awards, Recognitions, if any

1. Editorial board member of Journal of Solid State Chemistry (2025-)
2. Editorial board member of Journal of Magnetism and Magnetic Materials (2021-2025)

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. Twistronics with transition metal dichalcogenides; SERB/ANRF; 2021-2026; PI

Conference / Symposia / Schools organized

1. Engineered 2D materials; 14/07/2024; ICTS Bengaluru; 14 to 25 July (2024)

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. S. Chakravarthy, R. Viswanatha, D.D. Sarma, A. Singha, T. Setti, A. Deshpande; Sl. No. 2, 3, 4 , 6, 8; National
2. Ashish Chainani; Sl. No. 7; International

Areas of Research

The primary area of the research in my group has been in examining two-dimensional materials, exploring their structural, electronic and optical properties. Another area that the group is actively involved in is the study of hybrid perovskites, where we have examined the factors that lead to the structural distortions here.

Structural distortions in hybrid perovskites:

The structure plays an important role in determining the ensuing properties of a compound. Therefore an understanding of the microscopic considerations that favour a particular structure is essential to control its properties. The perovskite structure is found in a wide range

of crystalline materials with the chemical formula ABX_3 , where A and B are usually two different cations and X is an anion. Certain empirical considerations have emerged to determine if a system would occur in the perovskite structure. One such empirical parameter has been the tolerance factor. This is a quantity which depends on the ionic radii of the atoms involved.

Considering the hybrid perovskites, which are members in which the A site is occupied by a molecule, earlier work has shown that the hydrogens of the molecule formed hydrogen bonds with the anions of the inorganic cage, which led to the observed structural distortions. These ideas were extended by us in an earlier work where we showed that an asymmetric molecule at the A-site led to an increased interaction of the hydrogens attached to one end of the molecule with the inorganic cage, usually the anions. This led to the molecule moving towards one end of the inorganic cage, thereby also contributing to the dipole moment associated with the structure. This increased interaction also led to the anions moving towards the hydrogens, thereby resulting in the octahedral tilts.

Recently, we have extended these ideas further by considering all possible molecules at the A site which lead to three dimensional perovskite structures. Certain generic features emerge. We first considered a molecule that has the same functional group at either end, and asked the question whether a symmetric molecule would lead to the absence of octahedral tilts, and hence a cubic perovskite structure. This would then imply that the symmetry of the molecule would become an additional parameter determining the presence or absence of structural distortions. Indeed the Pb-Cl-Pb bond angles in $FAPbCl_3$ are found to be near 180° in the plane parallel to the C_2 symmetry axis of the molecule. However, other factors come into play while determining the structural distortions for other three-dimensional hybrid perovskites, with a key parameter being the orientation of the molecule in the cage. This is determined by the number of bonds that the hydrogens can form with the anions, and so two symmetric molecules may favour very different orientations. Further in contrast to the inorganic perovskites, where one finds structural changes across a series (when only the A site was varied), could be well described by the tolerance factor, here, such a monotonic evolution of structural properties with tolerance factor is no longer be valid.

Photoluminescence of few layer MoS_2 : We have examined the photoluminescence of few layer MoS_2 as a function of laser intensity. Apart from the features expected for MoS_2, we find additional mid-gap states which are traced to the presence of S vacancies. These mid gap states are found to exhibit an increase in intensity with laser fluence. The reversibility of the experiments suggests that this is not due to the creation of additional S vacancies, but the fact that non-direct transitions become possible. Additional features are also seen with increased fluence. These can be related to the formation of biexcitons. This has appeared in Physical Review B.

Plan of Future Work Including Project

1. Heterobilayers of transition metal dichalcogenides: In the future we will be examining the untwisted as well as twisted heterobilayers of Mo and W based transition metal dichalcogenides. The idea is to examine the consequences on the electronic structure, in addition to predict the evolution in the ground state properties on doping.
2. Hybrid perovskites: We will extend our understanding of what drives the structural distortions in three dimensional perovskites to two-dimensional ones and identify the main descriptors that drive the transition.

Saquib Shamim

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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Subhajit Mondal; Topological phenomena in atomically thin materials; Under Progress
2. Najrul Islam; Strongly correlated phases in transition metal dichalcogenides; Under Progress
3. Nilesh Bauri; Electrical and thermal transport in topological materials; Under Progress

b) Post-Docs

1. Dibyashree Chakraborti; Low-frequency noise in TMDCs
2. Subhadip Moulick; Bridge fellow

c) External Project Students / Summer Training

1. Kapil Gope; Electrical transport in $MoTe_2$
2. Shibcharan Mahato; Edge contacts to 2D Materials
3. Dev Goyal; Cross-Correlation Technique to measure Johnson Noise
4. Arka Ghosh; Fabrication and Characterization of Twisted Van der Waals Heterostructures from Graphene
5. Shibangshu Sen; An Undergraduate Study on The Properties of Graphite using Pencil and Paper
6. Shreetama Pradhan; Low-frequency noise in topological materials
7. Suman Halder; Low-frequency noise in topological materials

Teaching

1. Autumn Semester; PHY 494 Summer Research Project I; Integrated PhD; 1 student
2. Autumn Semester; PHY 509 Project Research II; Integrated PhD; 1 student
3. Spring Semester; PHY 601 RESEARCH METHODOLOGY; PhD; 33 students; Shared with Sanjoy Choudhury
4. Autumn Semester; PHY 494 Summer Research Project I; Integrated PhD; 1 student
5. Autumn Semester; PHY 509 Project Research II; Integrated PhD; 1 student

Publications

a) In journals

1. Wouter Beugeling, Florian Bayer, Christian Berger, Jan Böttcher, Leonid Bovkun, Christopher Fuchs, Maximilian Hofer, **Saquib Shamim**, Moritz Siebert, Li-Xian Wang, Ewelina M. Hankiewicz, Tobias Kießling, Hartmut Buhmann, Laurens W. Molenkamp, *kdotpy: k·p theory on a lattice for simulating semiconductor band structures*, SciPost Physics Codebases, 47, 2025

Talks / Seminars Delivered in reputed conference / institutions

1. Invited talk delivered at Ashoka University: Frontiers in Physics; 01/04/2024; Ashoka University, India; 2 days
2. Invited talk delivered at the conference "Magnetism and Topology: A Materials Physics

Perspective"; 01/08/2024; S. N. Bose National Centre for Basic Sciences; 1 day

Administrative duties

1. Member of Scolp and Departmental Seminar Coordinator (Continuing from 01-04-2023)
2. Member of Placement and Alumni Cell (Continuing from 13-07-2023)
3. Member of the Space Committee of the Centre
4. Member of the Brochure Committee
5. Faculty in-charge of HRTEM
6. Faculty in-charge of XRD

Awards, Recognitions, if any

1. Selected for the Early Career Advisory Board of the journal Physical Review B by the American Physical Society

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. CRG/2023/002082: Quantum spin Hall insulators: Investigation of electrical and thermal properties; SERB, DST; 36 months; PI

Conference / Symposia / Schools organized

1. BoseStat@100: International Conference on Women in Quantum Science and Technologies; Role: Convener; 17/07/2024; S. N. Bose National Centre for Basic Sciences; 3 days
2. BoseStat@100: Organizing Committee for International Conference on Bose-Einstein Condensation, Superconductivity, Superfluidity, and Quantum Magnetism; Role: Organizing Committee; 12/11/2024; Biswa Bangla Convention Centre; 5 days

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. Prof. Laurens Molenkamp, Experimental Physik III, University of Wuerzburg, Germany, Ewelina M. Hankiewicz, Institut fuer Theoretische Physik und Astrophysik (TP4), Universitaet Wuerzburg, Germany; Sl. No. 1; International

Outreach program organized / participated

1. Lecture delivered for the C. K. Majumdar Memorial lectures for B.Sc and M.Sc. students of various colleges on 26th July, 2024
2. Member of the organizing Committee for the Public Outreach program celebrating BoseStat@100 on Nov 17th Nov, 2024
3. Popular talk "Redefining the kilogram using two macroscopic quantum phenomena: the quantum Hall effect and the Josephson effect " delivered for college students and general public on the occasion of 131st Birth day of Prof. Satyendra Nath Bose

Areas of Research

Experimental Condensed Matter Physics

1. Cross-correlation technique to measure Johnson's noise: Noise measurements provide can provide valuable information about the dynamic defects in a system as well as probe fundamental symmetries of the Hamiltonian. Johnson's noise measurement can be used as a thermometry technique to measure the temperature of electrons in the devices. The major bottleneck in these measurements is the background noise of the amplifiers used. Standard lock-in amplifiers used for this purpose have input noise around 3-4 nV/sqrt(Hz). We have developed a cross-correlation technique to measure noise an order of magnitude below the limit of the lock-in amplifier.
2. kdotpy: k.p theory on a lattice for simulating semiconductor band structures: A python based k.p code has been developed for simulating semiconductor band structures with our collaborators. We contributed in validating the calculated band structures and Landau level fan diagram using electrical transport measurements for HgTe and (Hg,Mn)Te quantum wells of varying thicknesses and concentration so Mn atoms.
3. Higher-order moments of resistance fluctuations across the superconducting transition in FeSe thin films: MBE-grown FeSe thin films (obtained from our collaborators at Penn State) show a superconducting transition where the critical temperature can be tuned from 2 K to 20 K by varying the annealing conditions. We have measured low-frequency noise as a function of temperature across the superconducting transition

in FeSe thin films with varying critical temperatures. The power spectral density of noise increases by more than four orders of magnitude as the films transition of superconducting phase. We are calculating the second spectrum of noise to understand the correlations and possible non-Gaussianity in the noise spectrum.

Plan of Future Work Including Project

Novel physics in van der Waals heterostructures: The research on stacking materials with different properties to create systems with desired functionalities has gained momentum in the last decade with several exciting results such as superconductivity and correlated states in magic-angle twisted bilayer graphene, etc. We plan to explore the possibilities of new atomically thin quantum spin Hall insulators in 1T' phase of TMDCs as well as in graphene proximitized with high spin-orbit coupled material. We plan to study electrical and thermal transport in twisted bilayer graphene proximitized with high spin-orbit coupled material, where initial investigations have revealed broken symmetry states at half-integer band filling. Another interesting direction that we want to pursue is stack 2D materials with layered 2D magnets to realize Chern insulators and quantum spin liquids.

Novel phases in van der Waals heterostructures of TMDCs: We will investigate the topological phases in 1T' phase of transition metal dichalcogenides (TMDCs). We will employ electrical transport measurements at low temperatures and high magnetic fields to explore topological physics in these materials. The devices fabricated from monolayers TMDCs will be used for investigating quantum spin Hall phases, while the multilayer devices will be used to investigate higher-order topology and Weyl physics.

Tanusri Saha Dasgupta

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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Samir Rom; First Principles Study of Emergent and Technologically Important Materials; Completed
2. Sourav Kanthal (jointly with Sudipta Bandyopadhyay); Investigation of Structure Property Correlation In Complex Magnetic Materials; Completed
3. Aishwaryo Ghosh; Application of Machine learning approach in solving Materials Science problems; Completed
4. Koushik Pradhan; Electronic Structure of Transition Metal (TM) Compounds; Ongoing
5. Manoj Gupta; Electronic Structure of Correlated electrons; Ongoing
6. Rajdeep Biswas; Electronic Structure of Materials; Ongoing
7. Proshanta Sarkar (jointly with Goutam Dev Mukherjee); First principles study of Oxides; Ongoing
8. Sourav Das (jointly with Arijit Haldar); DFT + DMFT study of materials; Ongoing
9. Avik Sasmal (jointly with Jaydeb Chakraborty); Large scale simulation of Confined Systems; Ongoing
10. Sweta Ghosh (jointly with Sudipta Kanungo); Topolgical Materials; Ongoing
11. Anutosh Biswas (jointly with Manoranjan Kumar); Quantum spin systems; Ongoing

b) Post-Docs

1. Arun Maurya
2. Dipayan Sen

c) External Project Students / Summer Training

1. Arijit Maji; Tight Binding models

Publications

a) In journals

1. Bikash Mishra, Supriti Dutta, Uttam Pal, Subhajit Rana, Sandeep Kumar Mishra, **Tanusri Saha-Dasgupta,** Pradip Pachfule, *Diketopyrrolopyrrole-based Donor–Acceptor Covalent Organic Frameworks for Iodine Capture*, Small, 21, 2411199, 1015
2. Aishwaryo Ghosh, Amitava Moitra and **Tanusri Saha-Dasgupta**, *Ab-initio trained machine learning potential for MAX compound Ti2AlC: construction, validation, and study of non linear elasticity*, JPhys Materials, 8, 025001, 2025
3. Samir Rom and **Tanusri Saha Dasgupta**, *Trend in interfacial charge transfer, emergent electronic and magnetic structure and topological properties in the 3d/5d superlattices $LaBO_3/SrIrO_3$ (B = Mn, Fe, Co, Ni)*, Physical Review Materials, 9, 035003, 2025
4. A.V. Moskin, M.A. Belareva, A.F. Murtazoev, K.A. Lyssenko, V.A. Tafeenko, P.S. Berdonosov, A. Iqbal, B. Rahaman, **Tanusri Saha-Dasgupta**, A.N. Vasiliev, *Synthesis and thermodynamic properties of layered selenites-halides $Ln_2Fe(SeO_3)_4X$ (Ln = La,*

Ce, Pr; X = Cl, Br), Journal of Alloys and Compounds, 1020, 179396, 2025

5. Rabindranath Mondal, Chirantan Pramanik, Swastika Chatterjee, Prosenjit Ghosh, **Tanusri Saha-Dasgupta**, *Lithium isotopic fractionation in olivine crystal in presence of iron at variable temperatures: A first-principles study*, Geochimica et Cosmochimica Acta, 391, 144-157, 2025
6. Avanti Chakraborty, Akhtar Alam, Uttam Pal, Archisman Sinha, Subhadip Das, **Tanusri Saha-Dasgupta** and Pradip Pachfule, *Enhancing photocatalytic hydrogen peroxide generation by tuning hydrazone linkage density in covalent organic frameworks*, Nature Communications, 16, 503, 2025
7. Avik Sasmal, Edwine Tendong, **Tanusri Saha-Dasgupta** and Jaydeb Chakrabarti, *Ligand-mediated interaction in a dispersion of lead-halide perovskite nanocubes: implications on directed structures in equilibrium*, Physical Chemistry Chemical Physics, 27, 5098-5108, 2025
8. **Tanusri Saha-Dasgupta** and Koushik Pradhan, *Kinetic energy driven two-sublattice double-exchange: a general mechanism of magnetic exchange in transition metal compounds*, Journal of Physics: Condensed Matter, 37, 023001, 2024
9. Himanshu Sharma, Bhawna Sahni, **Tanusri Saha-Dasgupta**, and Aftab Alam, *$Cu_2ZnSiTe_4$: A potential thermoelectric material with promising electronic transport*, Physical Review Applied, 22, 044075, 2024
10. Shiladitya Karmakar, Pradip Chakraborty, **Tanusri Saha-Dasgupta**, *Understanding Cooperativity in Tetrazole-Based Fe(II) Spin-Crossover Coordination Networks: Effects of Alkyl Linkers*, Journal of Physical Chemistry C, 128, 16179-16188, 2024
11. Manoj Gupta, Manodip Routh, Manoranjan Kumar, and **Tanusri Saha Dasgupta**, *Interchain interactions, multimagnon condensation, and strain effect in the chain compound $NaVOPO_4$*, Physical Review B, 110, 054441, 2024
12. Zeinab Gholamimahmoodabadi, Rabindranath Mondal, Swastika Chatterjee and **Tanusri Saha-Dasgupta**, *Can increased pressure induce cross-over of Fe partitioning in olivine under upper mantle P-T conditions?*, Journal of Earth System Science, 133, 194, 2024
13. Koushik Pradhan, Arun Paramekanti and **Tanusri Saha-Dasgupta**, *Multipolar magnetism in $5d^2$ vacancy-ordered halide double perovskites*, Physical Review B, 109, 184416, 2024
14. Koushik Pradhan, Prabuddha Sanyal, **Tanusri Saha-Dasgupta**, *Magnetism in Cation-Ordered Multicomponent Oxide Perovskites*, Chemistry of Materials, 36, 3829-3836, 2024
15. Abhisek Bandyopadhyay, Debu Das, A Chakraborty, S Bhowal, Vinod Kumar, G B G Stenning, C Ritter, D T Adroja, M Moretti Sala, A Efimenko, C Meneghini, F Bert, P K Biswas, I Dasgupta, **Tanusri Saha Dasgupta**, A V Mahajan and Sugata Ray, *Disordered magnetic ground state in a quasi-1-D d^4 columnar iridate Sr_3LiIrO_6*, Journal of Physics: Condensed Matter, 36, 425804, 2024

b) Other Publications

i) Conference proceedings / Reports / Monographs

1. T Saha-Dasgupta, Robust half-metallicity and topological properties in square-net potassium manganese chalcogenides, APS March Meeting Abstracts 2024, K03. 011 (2024)
2. S Chatterjee, R Mondal, C Pramanik, P Ghosh, T Saha-Dasgupta, Influence of Fe on the distribution and isotopic fractionation of Li in olivine: A first-principles study, EGU24 (2024)

Talks / Seminars Delivered in reputed conference / institutions

1. Quantum Materials by Computation, Invited Talk in the Sypmposium – SymPhy24 – IIT Bombay, March 2024.
2. Machine learning in Materials Science - Invited Talk at iSNIOE2 2024 – Shiv Nadar Institution of Eminence, Gautam Budha Nagar, March 2024.
3. New Materials by Machine learning, Recent Trends in Quantum Condensed Matter – IISER-Kolkata, Mohanpur, April 2024.
4. Engineered 2D materials by Computation, Invited Talk at ICTS Program - "Engineered 2D Quantum Materials" – ICTS, Bangalore, July 2024.
5. Invited Colloquium on Quantum Materials in the "Friday Colloquium Series" at CSIR-NPL, New Delhi, August 2024.
6. Vacancy ordered double perovskites – Route to Unconventional Magnetism, International

Meeting (Conference) on "70 Years of the Tanabe-Sugano Diagrams" – Waseda University, Tokyo, Japan.

7. Invited Talk at the International Workshop on "Materials and Devices for Post-CMOS Computing" – INST Mohali, October 2024.
8. Two-sublattice Double exchange – A new mechanism of magnetism, Invited Talk in Indo-Swedish Conference on "Electronic Structure: Theory and Practice" – Coorg, November 2024.
9. Novel phenomena at Interfaces, Invited Talk in AEMI 24 Conference – IISER Pune, December 2024.
10. Quantum Materials, Invited Plenary Talk at DAE-SSPS 2024 – BARC Mumbai, December 2024.
11. Computationally Engineered functional 2D materials - Invited Lecture at the "Trilateral Conference on Advances in Materials Research", Materials Research Society, Singapore, March 2025.

Awards, Recognitions, if any

1. Sera Bangali Award by ABP Star Ananda

Membership of Learned Societies

1. American Physical Society
2. Indian Physics Association

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. JC Bose National Fellowship, SERB, 2021-2025
2. Indo-Russian Project, DST, 2023-2025
3. Technical Research Centre, DST, 2017-2026

Conference / Symposia / Schools organized

1. Women in Quantum Science and Technologies (BoseStat100) - Chair, Organizing Committee; 17/07/2024; Kolkata; 17 - 19 July, 2024
2. International Conference on Bose-Einstein Condensation, Superconductivity, Superfluidity and Quantum Magnetism (BoseStat100) - Chair, Organizing Committee; 12/11/2024; Kolkata; 12 - 16 November, 2024

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. Sl. No. 14; National, Prabuddha Sanyal, MAUT
2. Sl. No. 1, 6; National, Pradip Pachfule, SNBNCBS
3. Sl. No. 2; National, Amitava Maitra, Rajdanga College
4. Sl. No. 4; International, A Vasiliev, Moscow State University
5. Sl. No. 5, 12; National, Swastika Chatterjee, IISER Kolkata
6. Sl. No. 7; National, Jaydeb Charabarti, SNBNCBS
7. Sl. No. 9; National, Aftab Alam, IIT B
8. Sl. No. 10; National, Pradip Chakraborty, IIT KGP
9. Sl. No. 11; National, Manoranjan Kumar, SNBNCBS
10. Sl. No. 13; International, Arun Paramekanti, Univ Toronto
11. Sl. No. 15; National, Sugata Ray, IACS

Outreach program organized / participated

1. Women Empowerment: Career Opportunities in Science - Organized by Gender In Physics Working Group, Indian Physics Association and Department of Physics, IIT Indore.
2. 7th Lecture of SOAFAL-IV Oration, Siksha 'O' Anusandhan, Deemed to be University, Bhubaneswar – "Women in Science: A braided trail"
3. Invited Talk in IISF at Guwahati – Session on "Empowering Women as Leaders and Innovators - Nari Shakti"
4. Lecture at St. Joseph's University, Bangalore

Areas of Research

Computational Materials Physics – Quantum Materials, Machine learning for Materials Informatics, Earth materials, Energy Materials

Kinetic energy driven two-sublattice double-exchange: a general mechanism of magnetic exchange in transition metal compounds

One of the most important phenomena in magnetism is the exchange interaction between magnetic centres. In this topical review, we focus on the exchange mechanism in transition-metal compounds and establish kinetic-energy-

driven two-sublattice double-exchange as a general mechanism of exchange, in addition to well-known mechanisms like superexchange and double exchange. This mechanism, which was first proposed (Sarma et al 2000 Phys. Rev. Lett. 85 2549), in the context of Sr_2FeMoO_6, a double-perovskite compound, later found to describe a large number of 3d and 4d or 5d transition metal-based double perovskites. The magnetism in multi-sublattice magnetic systems like double-double and quadrupolar perovskites involving 3d and 4d or 5d transition-metal ions have also been found to be governed by this as a primary mechanism of exchange. For example, the numerical solution of a two-sublatice double exchange with additional superexchange couplings for the FeRe-based double double and quadrupolar perovskites are found to reproduce the experimentally observed magnetic ground state as well as the high transition temperature of above 500 K. The applicability of this general mechanism extends

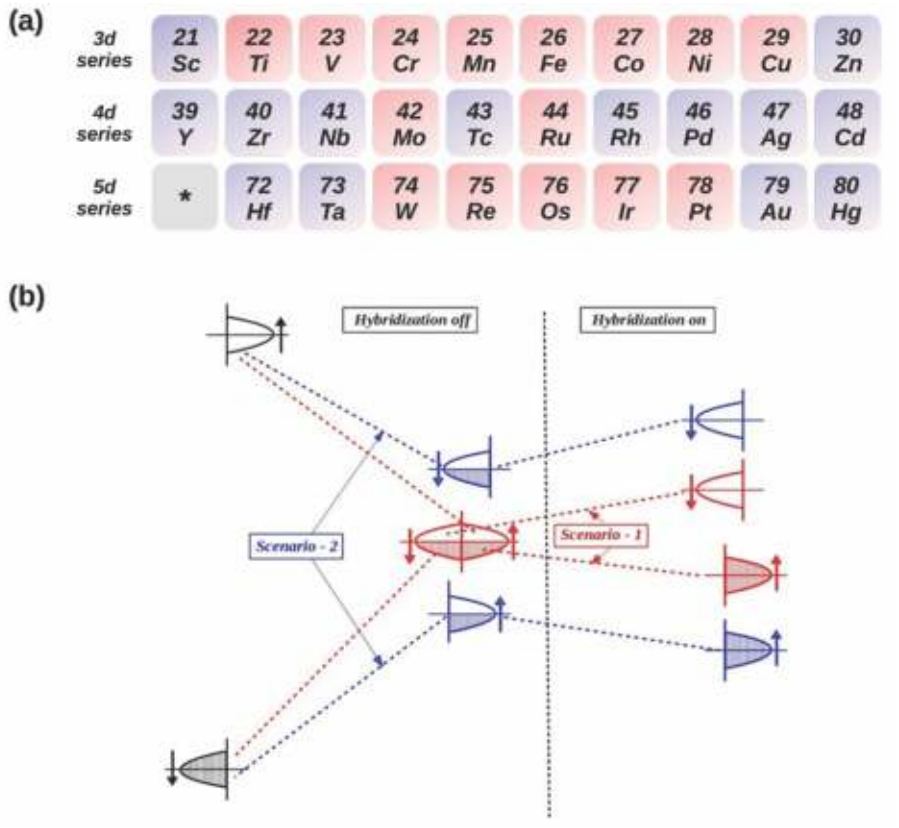


Fig1: (a) The 3d, 4d and 5d transition metal series of the periodic table. The reported 3d-4d/5d double perovskites are primarily constituted from elements marked in red. (b) The two-sublattice double exchange mechanism (Scenario-1) and the two-sulattice double exchange coupled with super-exchange in presence of intrinsic spin splitting of the itinerant band (Scenario-2)

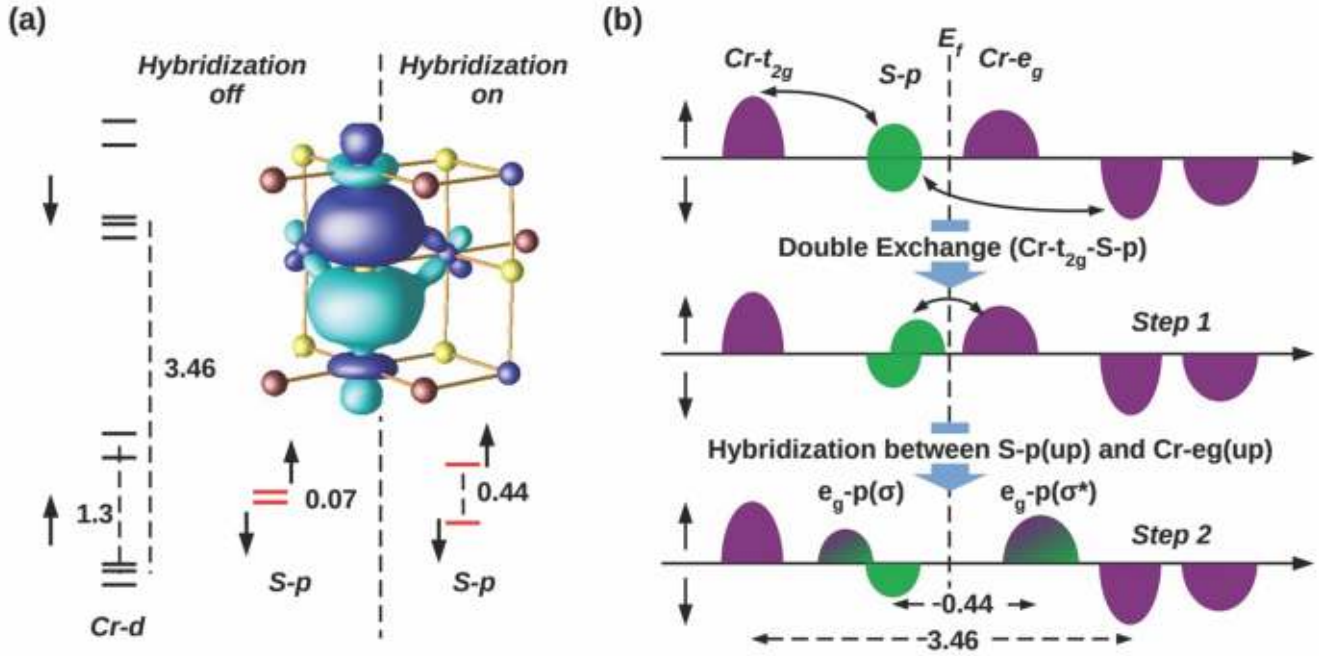


Fig2: Left: The energy levels of Cr-d and S-p states in CrSBr, as given in muffin-tin orbital-based downfolding calculations. Right: Renormalized S-p states, obtained by massive downfolding by keeping only S-p degrees of freedom active. The crystal field and spin splittings (in eV) are marked. The inset shows the up-spin Wannier function of S pz in the massively downfolded basis. Plotted are the isovalue surface with lobes of opposite signs colored blue and cyan. (b) Schematic band diagram of Cr-d and S-p states, demonstrating the mechanism of magnetism

beyond the perovskite crystal structures, and oxides, as demonstrated for the pyrochlore oxide, $Tl_2Mn_2O_7$ and the square-net chalcogenides $KMnX_2$ (X = S, Se, Te). The counter-intuitive doping dependence and pressure effect of magnetic transition temperature in $Tl_2Mn_2O_7$ is explained, while $KMnX_2$ (X = S, Se, Te) compounds are established as half-metallic Chern metals guided by two sublattice double exchange. While the kinetic energy-driven two-site double-exchange mechanism was originally proposed to explain ferromagnetism, a filling-dependent transition can lead to a rare situation of the antiferromagnetic metallic ground state, as found in La-doped Sr_2FeMoO_6, and proposed for computer predicted double perovskites $Sr(Ca)_2FeRhO_6$. This opens up a vast canvas to explore. Tanusri Saha-Dasgupta and Koushik Pradhan 2025 *J. Phys.: Condens. Matter* **37** 023001(Topical Review)

Two-sublattice double exchange driven magnetism in Cr-based two-dimensional magnets

Focusing on the recently discussed two-dimensional (2D) ferromagnetic compound, CrSBr, with a larger than 100 K transition temperature, we analyze its unusual electronic structure using a combination of numerical techniques. Our findings indicate magnetism to be driven by a two-sublattice double exchange mechanism. Our results reproduce the large magnetic transition temperature of CrSBr, as well as the significantly suppressed transition temperature in the related compound. The same mechanism rationalizes the observed negative, hysteretic magnetoresistance in bilayer CrSBr. Based on the discussed mechanism, we predict that the magnetic transition temperature may be further increased for the 2D semiconducting magnet CrSeBr and 2D metallic magnet CrTeBr. K Pradhan, D. Sen, P Sanyal and T. Saha-Dasgupta, Phys. Rev. B **111**, L180404 (2025)

Plan of Future Work Including Project

1. Superconductivity in H-bearing nickelates
2. Universal Model of Machine learning
3. Unconventional superconductivity in low dimensional systems
4. Strong coupling Hamiltonian of d1 halides – Quantum Spin Liquids
5. Giant Magntostructural coupling of Rare-earth ferrites

Thirupathaiah Setti

Associate Professor
Condensed Matter and Materials Physics
setti@bose.res.in

Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Shubham Purwar; 2D Magentism; Under Progress
2. Sayan Routh; Topological Superconductors; Thesis Submitted; Prasenjit Singha Deo (Supervisor)
3. Susanta Ghosh; Topological Quantum Materials; Under Progress; Kalyan Mondal, Supervisor
4. Anupam Barik; Topological Quantum Materials; Under Progress
5. Soumya Ghorai; Oxide Double Perovskite; Under Progress
6. Ankita Das; 2D Magnetism; Under Progress
7. Suthirtha Banerjee; Topological Quantum Materials; Under Progress

b) Post-Docs

1. Thushar Kanti Bhowmik; Investigation of the electronic band structure of topological semimetals

c) External Project Students / Summer Training

1. Alipriya Chatterjee; Synthesis and Electronic Properties Studies of Topological Semimetal

Teaching

1. Autumn Semester; Condensed Matter Physics: PHY 503; Integrated PhD 31 (IPhD + PhD); Shared with Dr. Nitesh Kumar

Publications

a) In journals

1. Shubham Purwar, Shinjini Paul, Kritika Vijay, R. Venkatesh, Soma Banik, P. Mahadevan and **Setti Thirupathaiah**, *Metal-insulator transition in FeSe originating in an anomalous lattice effect*, Physical Review B, 111, 085123, 2025
2. Achintya Low, Susanta Ghosh and **Setti Thirupathaiah**, *Topological Hall effect instigated in kagome $Mn_{3-x}Sn$ due to Mn-deficit induced noncoplanar spin structure*, Journal of Physics: Condensed Matter, 37, 065701, 2024
3. Shubham Purwar, Tushar Kanti Bhowmik, Soumya Ghorai, **Setti Thirupathaiah**, *3D-Ising-type magnetic interactions stabilized by the extremely large uniaxial magnetocrystalline anisotropy in layered ferromagnetic Cr_2Te_3*, Materials Today Physics, 46, 101522, 2024
4. Shubham Purwar, Anumita Bose, Achintya Low, Satyendra Singh, R. Venkatesh, Awadhesh Narayan, **Setti Thirupathaiah**, *$Sn_{0.06}Cr_3Te_4$: A skyrmion superconductor*, Applied Materials Today, 39, 102328, 2024
5. Shubham Purwar, Tushar Kanti Bhowmik, Tijare Mandar Rajesh, Anupam Gorai, Bheema Lingam Chittari and **Setti Thirupathaiah**, *Experimental and computational Insights Into the magnetic anisotropy and magnetic behaviour of layered room-temperature ferromagnet $Cr_{1.38}Te_2$*, Physica Scripta, 99, 085949, 2024
6. Achintya Low, Tushar Kanti Bhowmik, Susanta Ghosh, and **Setti Thirupathaiah**, *Anisotropic nonsaturating magnetoresistance observed in $HoMn_6Ge_6$: A kagome Dirac semimetal*, Physical Review B, 109, 195104, 2024
7. Shubham Purwar, Susmita Changdar, Susanta Ghosh, Tushar Kanti Bhowmik, **Setti**

Thirupathaiah, *Intricate magnetic interactions and topological Hall effect observed in itinerant room-temperature layered ferromagnet* $Cr_{0.83}Te$, Acta Materialia, 271, 119898, 2024

Talks / Seminars Delivered in reputed conference / institutions

1. Electronic, Magnetic and Topological Properties of Kagome Antiferromagnets; 26/10/2024; IEM Kolkata; 20-30, September 2024; $Sn_{0.06}Cr_3Te_4$: A Skyrmion Superconductor
2. $Sn_{0.06}Cr_3Te_4$: A Skyrmion Superconductor; 01/08/2024; SNBNCBS; 30/06/2024 to 01/07/2024
3. $Sn_{0.06}Cr_3Te_4$: A Skyrmion Superconductor; 23/12/2024; IIT Guwahati; 20-23, December 2024
4. Colloquium on A Skyrmion Lattice Superconductor; 18/03/2025; SRM AP, Amaravati; 18/03/2025

Administrative duties

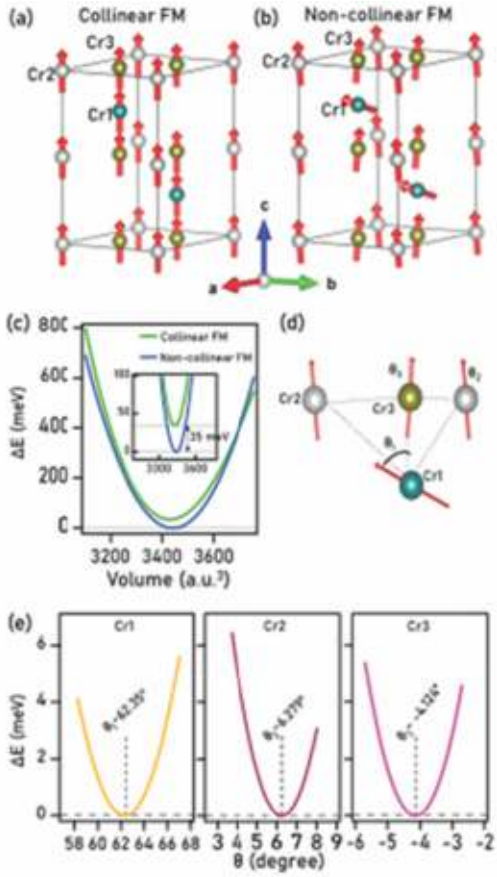
1. I served as a member and as a chairperson in several of the committees formed by the competent authority of the Centre time to time.

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

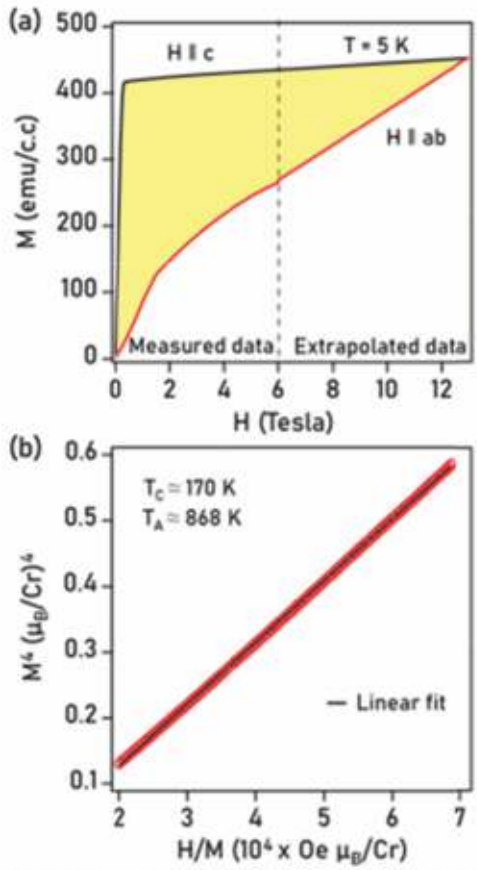
1. Investigation of Magnetotransport, Magnetic, and Electronic Band Structure in Transition-metal Monosilicides (MSi; M = Fe, Cr, Co, Mn, and Rh) under Time Reversal Symmetry Breaking; ANRF; 2024-2027; PI
2. Indo-Russian Project; DST-RSF; 2022-2025; Co-PI

Conference / Symposia / Schools organized

1. NCES 2024; 21/11/2024; SRM Amaravathi in Collaboration with SN Bose; 21/11/2024-24/11/2024



Schematic representations of the collinear ferromagnetic (FM) (a) and noncollinear ferromagnetic (b)configurations. (c) Relativistic total energy (ΔE), with respect to the ground state energy, plotted as a function of unit cell volume for both magnetic configurations, obtained using the DFT calculations. (d) (d) Schematic diagram of the canting spin angles of Cr(1),Cr(2),and Cr(3)atoms with respect to the c-axis. (e) Relative total energy(ΔE), with respect to the ground state energy, plotted as a function of spin angles for Cr(1), Cr(2), and Cr (3)atoms



(a) Magnetization isotherms [M(H)] measured at 5K for H ∥ c and H ∥ ab. The yellow shaded area represents the magnetocrystalline anisotropy energy (MAE). (b) Plot of M^4 vs. H/M.

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. UGC-DAE Indore; Sl. No. 4; International
2. IISc Bangalore; Sl. No. 4; International
3. IISER Kolkata; Sl. No. 5; International

Outreach program organized / participated

1. The Outreach Program was organized and participated in Gitam University on the 27th September 2024. In this outreach Program, I presented a talk on Photoelectric Effect: History, Theory, and Scientific Applications

Areas of Research

Investigation of Structural, Electrical, and Magnetic Properties and Electronic Band Structure Studies of Topological Quantum Materials

1. 3D-Ising-type Magnetic Interactions Stabilized by the Extremely Large Uniaxial Magnetocrystalline Anisotropy in Layered Ferromagnetic Cr_2Te_3

We investigate the magnetocrystalline anisotropy, critical behavior, and magnetocaloric effect in ferromagnetic-layered Cr_2Te_3. We have studied the critical behavior around the Curie temperature (T_c) using various techniques, including the modified Arrott plot (MAP), the Kouvel-Fisher method (KF), and critical isothermal analysis (CI). The derived critical exponents b = 0.353(4) and g = 1.213(5) fall in between the three-dimensional (3D) Ising and 3D Heisenberg type models, suggesting complex magnetic interactions by not falling into any single universality class. On the other hand, the renormalization group theory, employing the experimentally obtained critical exponents, suggests 3D-Ising-type magnetic interactions decaying with distance as $J(r) = g^{-4.89}$. We also observe an extremely large uniaxial magnetocrystalline anisotropy energy (MAE) of K_u = 2065 kJ/m^3, the highest ever found in any Cr_xTe_y based systems, originating from the noncollinear ferromagnetic ground state as predicted from the first-principles calculations. The self-consistent renormalization theory (SCR) suggests Cr_2Te_3 to be an out-of-plane itinerant ferromagnet. Further, a maximum entropy change of - 2.08 J/kg – K is estimated around T_c for the fields applied parallel to the c-axis.

2. Anisotropic Nonsaturating Magnetoresistance Observed in $HoMn_6Ge_6$: A Kagome Dirac Semimetal

We report the magnetic and magnetotransport properties and electronic band structure of the kagome Dirac semimetal $HoMn_6Ge_6$. Temperature-dependent electrical resistivity demonstrates various magnetic-transition-driven

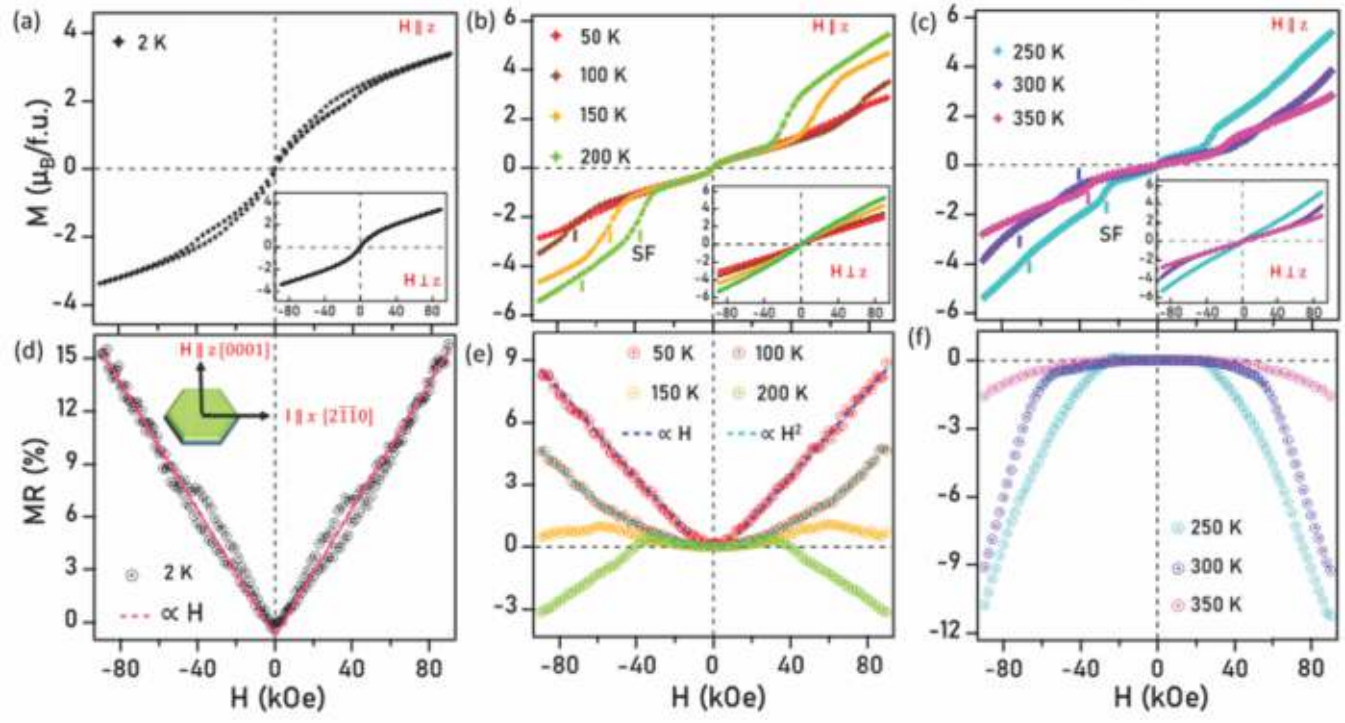


FIG. 3. (a)–(c) Isothermal magnetization $M(H)$ measured at different temperatures for the fields applied parallel to the z axis ($H \parallel z$). Insets in (a)–(c) show the same thing for $H \perp z$. (d)–(f) Field-dependent magnetoresistance [$MR(\%) = \frac{\rho_{xx}(H)-\rho_{xx}(0)}{\rho_{xx}(0)} \times 100(\%)$] measured for different temperatures.

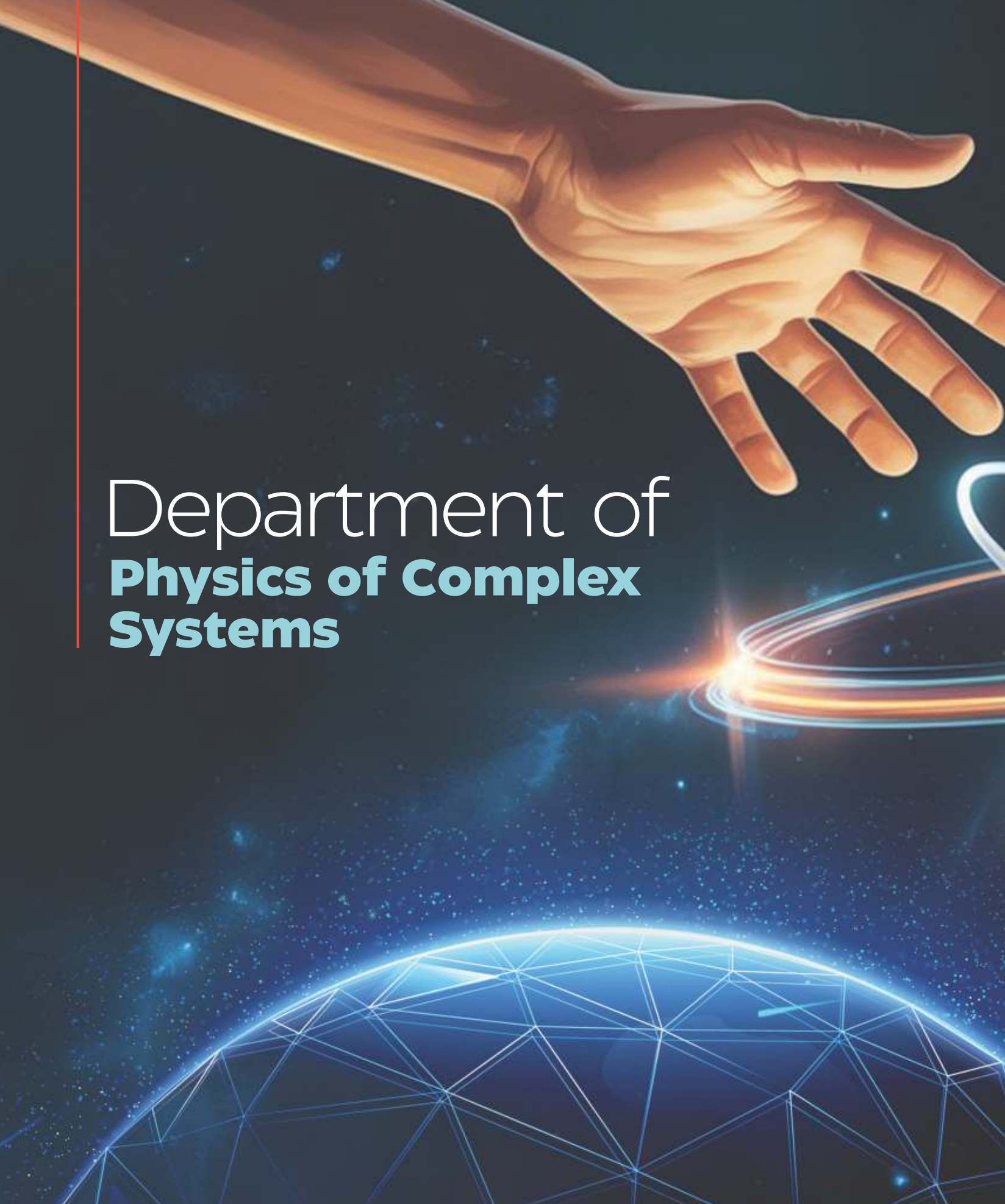
anomalies. Notably, a crossover from negative to positive magnetoresistance (MR) is observed at around 150 K. While the linear nonsaturating positive MR in the low-temperature region is mainly driven by the linear Dirac-like band dispersions as predicted by the first-principles calculations, the negative MR observed in the high-temperature region is due to the spin-flop-type magnetic transition. Consistent with anisotropic Fermi surface topology, we observe anisotropic magnetoresistance at low temperatures. A significant anomalous Hall effect has been noticed at high temperatures in addition to a switching of the dominant charge carrier from electron to hole at around 215 K.

3. Intricate magnetic interactions and topological Hall effect observed in itinerant room-temperature layered ferromagnet $Cr_{0.83}Te$

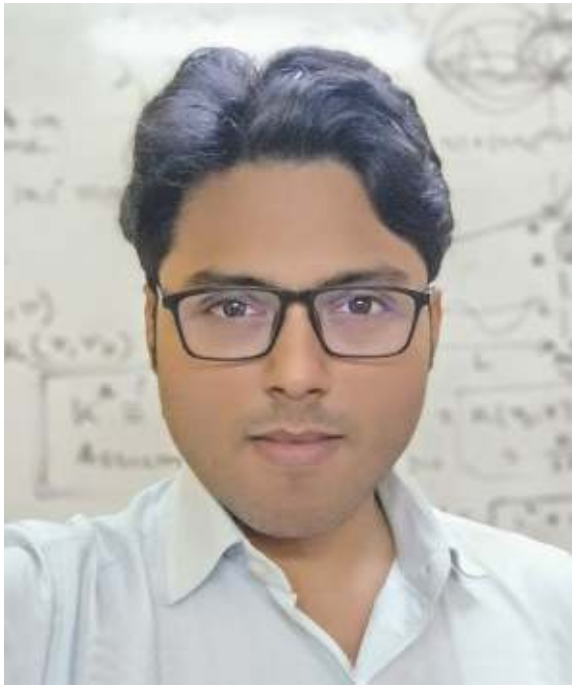
We reported the magnetic, electrical, and magnetotransport (Hall effect) properties of the hexagonal itinerant ferromagnet $Cr_{0.83}Te$. Further, a comprehensive study of the magneto-entropy scaling behavior has been done around the Curie temperature of 338 K. A maximum entropy change of 2.77 J/kg–k and relative cooling power (RCP) of 88.29 J/kg near the T_c have been achieved under an applied magnetic field of 5 T. The critical exponents, $\beta = 0.4739(4)$, $\gamma = 1.2812(3)$, and $\delta = 3.7037(5)$, have been extracted using the magneto-entropy scaling analysis. The obtained critical exponents indicate the presence of intricate magnetic interactions in $Cr_{0.83}Te$. On the other hand, the magnetotransport study reveals a topological Hall effect attributed to the noncoplanar spin structure coexisting with a robust magnetocrystalline anisotropy. Further, we observe that the extrinsic skew-scattering mechanism gave rise to the anomalous Hall effect. Our experimental findings of the anomalous and topological Hall effect properties in the presence of intriguing high-temperature itinerant ferromagnetism and magnetocaloric effect in $Cr_{0.83}Te$ can offer potential technological applications at room temperature.

Plan of Future Work Including Project

1. Currently, our group focuses on the topological properties of Dirac and Weyl semimetals, Transition metal dichalcogenides (TMDC), Quantum spin liquids (QSL), and Two-dimensional (2D) magnetic materials. We grow high-quality single crystals and study their physical & electronic properties to understand the physics of these materials. To achieve this, we grow high-quality single crystals using the solid-state reaction route of molten-growth, flux-growth, and chemical vapor transport (CVT) techniques. As grown samples will be extensively studied for their electrical, magnetic properties, and electronic band structure to understand the underlying physics of these exotic materials.



Department of
Physics of Complex Systems



Arijit Haldar

Assistant Professor
Physics of Complex Systems
arijit.haldar@bose.res.in

Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Anish Chaudhuri; Kinematic constraints, conservation laws and emergent gauge theories in many body systems; Under progress
2. Sahanawaj Akhtar; Topology and transport in quantum spin systems; Under progress
3. Sourav Das; Application of DFT + DMFT to strongly correlated systems; Under progress; Tanusri Saha-Dasgupta (Supervisor)
4. Arnab Paul; Phenomena at Oxide interfaces; Under progress; Tanusri Saha-Dasgupta (Supervisor)

b) Post-Docs

1. Atul Rathor; Quantum Magneto Transport
2. Dhrubajyoti Maji; Investigation of Interaction and Dynamics in Complex Liquids: Theory and Computer Simulations

c) External Project Students / Summer Training

1. Abha Mahato; Quantum Entanglement Witness Operators
2. Sauptik Sadhukhan; Visualizing Excitations of Quantum Spins in 1, 2 and 3-dimensions

Teaching

1. Spring semester; Quantum Mechanics 2 (PHY 406, Core course); Integrated PhD; 14 students
2. Autumn semester; Review of the topical research (PHY 602); PhD; 1 student
3. Autumn semester; Introduction to Programming and Computational Methods in Physics (PHY 407, Core course); Integrated PhD; 12 students
4. Autumn semester; Project Research II (PHY 509, Core course); Integrated PhD; 1 student

Publications

a) In journals

1. Atul Rathor, Saurav Kantha, and **Arijit Haldar**, *Spin injection route to the magnon Berry curvature dipole*, Physical Review B, 110, 214441, 2024

Talks / Seminars Delivered in reputed conference / institutions

1. Delivered two invited talks at the CKM lectures; 27/07/2024; SNBNCBS Kolkata; 6 days
2. Presented an invited talk at the "Frontiers in Physics" conference; 01/04/2024; Ashoka University; 2 days
3. Delivered invited talk at one-day meeting on "Magnetism and Topology: A Materials Physics Perspective"; 01/08/2024; SNBNCBS Kolkata; 1 day
4. Delivered invited talk at IISER-Kolkata for DPS day 2025; 19/03/2025; Department of Physical Sciences, IISER Kolkata, Mohanpur Campus; 1 day

Administrative duties

1. Active member of the committee for NSM Paramrudra Supercomputing Facility
2. Member of the CSC Working Group Committee
3. Active member of the ARPAC 2024-2025 report

committee: This committee was tasked with the creation of a comprehensive academic report for the centre which was presented to the members of ARPAC for evaluation

4. Active member of the Bhagirathi Guesthouse Committee: Surveyed, prepared a report, and meticulously supervised the renovation of the guesthouse infrastructure for the 2nd and 3rd Bose Statistics Centenary conference and in general
5. Sports Coordinator for the centre: Supervised the setup for the centre's gym facilites at Radhachura Hostel. Supervising the ongoing process of installing new equipment in the gym based on feedback and organizing year round sports events
6. Active member of the Bhagirathi Rooftop Cafeteria Committee: The committee has been formed to oversee the setup of a cafeteria in the 1st floor premises of Bhagirathi Guesthouse
7. Organizer for conducting "Outreach Programmes for the students of SC/ST communities under VASP"
8. Interview panel member for the IPhD admissions 2024, and PhD admissions 2024
9. Member of the PDRA selection committees
10. Member of the committee formed to assess the workings of the Centre's facebook page and other social handles
11. Active member of website committee
12. Organizing committee member for the "Women in Quantum Sciences 2024" conference, which was the 2nd conference held to honor the occasion of Bose-Statistics Centenary

Awards, Recognitions, if any

1. Guest Editor for IOP Science Journal of Physics: Condensed Matter Focus issue on the Centenary of Bose Statistics

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. Harnessing the Interplay of Quantum Entanglement, Topology, and Strong Correlations in Condensed Matter Systems for Near-term Quantum Applications and Beyond; DST-India, ANRF India; 2 years; PI

Conference / Symposia / Schools organized

1. International Conference on Bose-Einstein Condensation, Superconductivity, Superfluidity and Quantum Magnetism (ICBEC-24); 12/11/2024; Biswa Bangla Convention Centre, Kolkata. and SNBNCBS Kolkata; 5 days

Outreach program organized / participated

1. Organized and presented scientific lectures and demonstrations at outreach program held at Gour Mahavidyalaya, Malda, West Bengal on 13th December, 2024
2. Organized and presented scientific lectures and demonstrations at outreach program held at Sutragarh MN High School, Shantipur, Nadia, on 31st January, 2025

Areas of Research

Theoretical condensed matter physics. Sub-fields: quantum many-body theory, physics of disordered systems, quantum entanglement, transport, quantum non-equilibrium phenomena, quantum field theory and topological phases.

Plan of Future Work Including Project

1. Quantum Entanglement and Strong Correlations

a. Deepen the fundamental understanding of quantum entanglement and strong electronic correlations, and explore their potential applications in future quantum technologies and devices.

b. Develop analytical and computational frameworks to characterize quantum entanglement in condensed matter systems exhibiting strong electron-electron interactions.

2. Magnons and Novel Quasiparticles in Quantum Spin Systems. Investigate the role of magnons and other emergent quasiparticles in quantum spin systems and related platforms, with an emphasis on unconventional magneto-transport phenomena in quantum materials.
3. Topology and Strong Interactions in Quantum Systems. Explore topological aspects of quantum systems and their interplay with strong correlations across a range of condensed matter systems.
4. Correlated Electrons in Layered and Moiré Materials. Study strongly correlated electronic behavior in layered materials, particularly those

exhibiting Moiré superlattices, to uncover novel quantum phases.

5. Emergent Gauge Theories in Lattice Systems. Investigate the effective gauge theories in lattice models as a framework for understanding complex collective phenomena in condensed matter systems.

Any other Relevant Information including social impact of research

1. Guest Editor for IOP Science Journal of Physics: Condensed Matter Focus issue on the Centenary of Bose Statistics
2. Referee for the Physical Review B journal
3. Referee for the Physical Review Letters journal
4. Referee for the journal Pramana
5. Co-convenor and organizer for "International Conference on Bose-Einstein Condensation, Superconductivity, Superfluidity and Quantum Magnetism 2024" which was the 3rd and final conference organized to mark the occasion of Bose-Statistics Centenary.

Jaydeb Chakrabarti

Senior Professor
Physics of Complex Systems
jaydeb@bose.res.in

Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Suravi Pal; Soft matter systems; Awarded
2. Kanika Kole; Biomolecular systems; Thesis Submitted.
3. Anirban Pal; Biomolecular systems; Thesis Submitted
4. Avik Sasmal; Soft matter systems; Under Progress; Tanusri Saha Dasgupta, Co-Supervisor
5. Anusree Sen; Biomolecular systems; Under Progress; Rajib Kumar Mitra, Supervisor
6. Sabuj Mandal; Soft matter systems; Under Progress; Punyabrata Pradhan, Supervisor

b) Post-Docs

1. Ayatti Mallik; Biomolecular systems
2. Soumi Das; Biomolecular systems

Teaching

1. Autumn Semester; PHY 403: Classical Dynamics; Integrated PhD; 11 students

Publications

a) In journals

1. Suravi Pal, **Jaydeb Chakrabarti**, Srabani Chakrabarty, *Anisotropic remixing of a phase separated binary colloidal system with particles of different sizes in an external modulation*, Journal of Chemical Physics, 160, 214902, 2024
2. Kanika Kole and **Jaydeb Chakrabarti**, *Binding of Homeodomain Proteins to DNA with Hoogsteen Base Pair*, The Journal of Physical Chemistry B, 129, 1544-1554, 2025
3. Avik Sasmal, Edwine Tendong, Tanusri Saha-Dasgupta and **Jaydeb Chakrabarti**, *Ligand-mediated interaction in a dispersion of lead-halide perovskite nanocubes: implications on directed structures in equilibrium*, Physical Chemistry Chemical Physics, 27, 5098-5108, 2025

b) Other Publications

i) Conference proceedings / Reports / Monographs

1. Structural changes in binary colloidal system in an external modulation, Suravi Pal, J Chakrabarti, Srabani Chakrabarty Nee Sarkar, AIP Conference Proceedings , 2025
2. The effect of protein binding on conformational stability and order of DNA duplex with Hoogsteen base pairing , Kanika Kole, Aayatti Mallick Gupta, Jaydeb Chakrabarti , AIP Conference Proceedings , 2025
3. Book Chapter: Soft-Material-Based Devices and Technologies, Rahul Karmakar, J. Chakrabarti, in Soft Materials for Functional Applications, Ed: Vijay Kumar and Y. K. Mishra, STRUCTMAT, volume 225, Springer, 2024

Talks / Seminars Delivered in reputed conference / institutions

1. ICN-2024 (online); 08/05/2024; MGU-Kottayam, Kerala; 03 days
2. SPCM-2024; 03/04/2024; ICTS-Bangalore; 03 days
3. Seminar: Bose Institute; 29/08/2024; Bose Institute
4. Seminar: Presidency University; 12/03/2025; Presidency University
5. Kanika Kole, poster presentation at RARE 2025; 09/03/2025; Wyndham, Khajuraho, Madhya Pradesh, India; 3 days
6. Avik Sasmal, poster presentation at CompFlu-2024; 16/12/2024; IIT Hydrabad; 3 days
7. Sabuj Mandal, Condensed matter, material science & statistical physics (CMMSSP); 09/08/2024; Presidency University, Kolkata; 2 days
8. Anusree Sen, poster presentation, Indian Biophysical Society meeting 2025; 06/03/2025; IIT Madras, Chennai; 3 days

Administrative duties

1. Chairman, Faculty Search Committee, S N Bose National Centre for Basic Sciences
2. Chairman, Medical Cell

Membership of Learned Societies

1. Indian Biophysical Society

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. TRC; Co-PI

Conference / Symposia / Schools organized

1. Stat. Mech. Meet Kolkata (SMMK) 2024; 27/09/2024; S N Bose National Centre for Basic sciences; 2 days

Areas of Research

Statistical mechanics of soft matter systems

Statistical Mechanics of Biomolecular systems

1. Binding of Homeodomain Proteins to DNA with Hoogsteen Base Pairs:

(Kanika Kole and Jaydeb Chakrabarti, Binding of Homeodomain Proteins to DNA with Hoogsteen Base Pair. Ref: The Journal of Physical Chemistry B, 2025, 129, 1544-1554. (https://doi.org/10.1021/acs.jpcb.4c08054))

In DNA double helices, Hoogsteen (HG) base pairing is an alternative mode of Watson-Crick (WC) base pairing. HG base pair (bp) has a different hydrogen bonding pattern than WC bp. We investigate here the binding energy of homeodomain proteins with a HG-DNA duplex, where DNA adopts a HG bp in its sequence. We observe that the presence of the HG bp increases the binding energy of both the specific and nonspecific homeodomain proteins compared to WC-DNA bps. The neutral mutation in the N-terminal basic arm of the nonspecific protein significantly changes the binding energy between nonspecific protein and HG-DNA only, while the acidic mutation significantly changes the binding energy of both the specific and nonspecific proteins with HG-DNA. The significant variation in the binding energy of the homeodomains within distinct DNA-protein complexes can be ascribed to the differences in the number of intermolecular contacts between DNA bases and protein residues. Our conformational thermodynamics calculations based on the fluctuation of microscopic conformational variables at the interface show that with increasing conformational stability and order at the interface, the binding of the homeodomain protein gets stronger.

2. "Dynamics of an aqueous suspension of short hyaluronic acid chains near a DPPC bilayer", Anirban Pal and Jaydeb chakrabarti

Phys. Chem. Chem. Phys., 2024, 26, 20440-20449

The synergy between hyaluronic acid (HA) and lipid molecules plays a crucial role in synovial fluids, cell coatings, etc. Diseased cells in cancer and arthritis show changes in HA concentration and chain size, impacting the viscoelastic and mechanical properties of the cells.

Although the solution behavior of HA is known in experiments, a molecular-level understanding of the role of HA in the dynamics at the interface of HA-water and the cellular boundary is lacking. Here, we perform atomistic molecular dynamics simulation of short HA chains in an explicit water solvent in the presence of a DPPC bilayer, relevant in pathological cases. We identify a stable interface between HA-water and the bilayer where the water molecules are in contact with the bilayer and the HA chains are located away without any direct contact. Both translation and rotation of the interfacial waters in contact with the lipid bilayer and translation of the HA chains

exhibit subdiffusive behavior. The diffusive behavior sets in slightly away from the bilayer, where the diffusion coefficients of water and HA decrease monotonically with increase in HA concentration. On the contrary, the dependence on HA chain size is only marginal due to enhanced chain flexibility as their size increases.

Plan of Future Work Including Project

1. The description of bi-macromolecules at the level of full atomistic resolution is a daunting task due to the presence of a huge number of atoms. Sometimes bio-macromolecule like proteins deviate from native structure and form aggregates which are pathogenic. The aggregation behaviour of dispersion of proteins is usually described by coarse grained models which cannot take into account the structural aspects of the protein molecules. Here we plan to work on a coarse-grained bead-spring polymeric model for proteins where the beads are taken to have structural degrees of freedom associated with the backbone. The interactions among the degrees of freedom are extracted from all-atom simulation data and used in Monte Carlo simulations of the coarse-grained model. The model is expected to reproduce the crystal structure so that the deviation from native structure can be addressed. The models will be applied to calculate effective interaction between two protein molecules which can be used to describe the phase behaviour of a system of many proteins. The proposed model is expected to give statistical mechanically sound scheme to describe a system of macromolecules with large number of internal degrees of freedom.

Any other Relevant Information including social impact of research

1. External expert of the PhD committee, Department of physics, Presidency University

Manik Banik

Associate Professor
Physics of Complex Systems
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Guidance of Students/Post-Docs

a) Ph.D. Students

1. Ram Krishna Patra; Study of Quantum Resources to Devise Advanced Communication Protocols; Thesis submitted
2. Samrat Sen; A Study on Various Discrimination Tasks and Their Implications in Quantum Information Processing; Thesis submitted
3. Sahil Gopalkrishna Naik; A comprehensive study on composite physical systems and their application in information protocols; Writing thesis
4. Ananya Chakraborty; Study of Information Processing Protocols and Exploring Quantum Advantages in Communication Task; Ongoing
5. Kunika Agarwal; Study of Quantum Information Theoretic Protocols and Their Implications in Quantum Foundations; Ongoing
6. Jayashree Karmakar; Recently joined; Thesis title is not yet decided
7. Snehasish Roy Chowdhury; Exploring Non-classical Correlations: Insights from Thermodynamics and Information Theory; Ongoing; Prof. Guruprasad Kar, ISI Kolkata, Supervisor

b) Post-Docs

1. Mir Alimuddin; Quantum Information Theory and Quantum Foundations
2. Pratik Ghosal; Quantum Information Theory and Quantum Foundations
3. Ananda Gopal Maity; Quantum Sensing and Quantum Imaging
4. Subhendu Bikash Ghosh; Quantum Sensing and Quantum Imaging

Teaching

1. Spring 2025; Quantum Information Theory [PHY 524]; I-PhD, 12 students
2. Spring 2025; Quantum Information Theory [PHY 624]; PhD, 07 students

Publications

a) In journals

1. Ram Krishna Patra, Sahil Gopalkrishna Naik, Edwin Peter Lobo, Samrat Sen, Tamal Guha, Some Sankar Bhattacharya, Mir Alimuddin, and **Manik Banik**, *Classical analogue of quantum superdense coding and communication advantage of a single quantum system*, Quantum, 8, 1315, 2024
2. Saronath Halder, Alexander Streltsov, and **Manik Banik**, *Identifying the value of a random variable unambiguously: Quantum versus classical approaches*, Physical Review A, 109, 052608, 2024
3. Subhendu B. Ghosh, Snehasish Roy Chowdhury, Guruprasad Kar, Arup Roy, Tamal Guha, and **Manik Banik**, *Quantum Nonlocality: Multicopy Resource Interconvertibility and Their Asymptotic Inequivalence*, Physical Review Letters, 132, 250205, 2024
4. Govind Lal Sidhardh and **Manik Banik**, *One-time-pad encryption model for nonlocal correlations*, Physical Review A, 110, 012229, 2024

5. Abhishek Banerjee, Pratapaditya Bej, Amit Mukherjee, Sahil Gopalkrishna Naik, Mir Alimuddin, **Manik Banik**, *When Mei-Gu Guan's 1960 postmen get empowered with Bell's 1964 nonlocal correlations: Nonlocal advantage in vehicle routing problem*, APL Quantum, 1, 036105, 2024
6. Chen Ding, Edwin Peter Lobo, Mir Alimuddin, Xiao-Yue Xu, Shuo Zhang, **Manik Banik**, Wan-Su Bao, and He-Liang Huang, *Quantum Advantage: A Single Qubit's Experimental Edge in Classical Data Storage*, Physical Review Letters, 133, 200201, 2024
7. Mayalakshmi Kolangatt, Thigazholi Muruganandan, Sahil Gopalkrishna Naik, Tamal Guha, **Manik Banik**, and Sutapa Saha, *Bipartite polygon models: entanglement classes and their nonlocal behaviour*, Quantum, 9, 1599, 2025
8. Ananya Chakraborty, Sahil Gopalkrishna Naik, Edwin Peter Lobo, Ram Krishna Patra, Samrat Sen, Mir Alimuddin, Amit Mukherjee and **Manik Banik**, *Unlocking the advantage of qubit communication in multi-node network configurations*, New Journal of Physics, 27, 023027, 2025
9. Ananya Chakraborty, Ram Krishna Patra, Kunika Agarwal, Samrat Sen, Pratik Ghosal, Sahil Gopalkrishna Naik, and **Manik Banik**, *Scalable and noise-robust communication advantage of multipartite quantum entanglement*, Physical Review A, 111, 032617, 2025
10. Anandamay Das Bhowmik, Tathagata Gupta, Preeti Parashar, Guruprasad Kar, and **Manik Banik**, *Generalized no-flipping theorem as a consequence of commutation of spacelike operations*, Physical Review A, 111, 032431, 2025

b) Other Publications

i) Independent publications of student(s)

1. Tanmay Saha, Pratik Ghosal, Pratapaditya Bej, Abhishek Banerjee, Prasenjit Deb, *Thermalization of isolated quantum many-body system and the role of entanglement*, Physics Letters A, 509, 129501, 2024
2. Pratik Ghosal, Arkaprabha Ghosal, Subhendu B. Ghosh, and Amit Mukherjee, *Locally unidentifiable subset of quantum states and its resourcefulness in secret password distribution*, Physical Review A, 109, 052617, 2024
3. Pratik Ghosal, Arkaprabha Ghosal and Somshubhro Bandyopadhyay, *Distribution of quantum gravity induced entanglement in many-body systems*, Journal of Physics A: Mathematical and Theoretical, 57, 445302, 2024

Talks / Seminars Delivered in reputed conference / institutions

1. Asymptotic Birkhoff-Violation in Operational Theories: Thermodynamic Implications and Information Processing; 16th QCMC organized by IIT Chennai, 29th August, 2024
2. On Composition in Quantum World: Nonclassical Features & Information Processing; International conference "Quantum Many-Body Physics in the Age of Quantum Information" organized by ICTS, Bangalore, 26th November, 2024
3. বেল-এর উপপাদ্য; Two-days National conference organized by Kandi Raj College, Kandi, Murshidabad, 12th December, 2024
4. No-Go Theorem for Generic Simulation of Qubit Channels with Finite Classical Resources; National Symposium on Quantum Information and Foundations (NSQIF2025) organized by Physics & Applied Mathematics Unit, ISI Kolkata, 20th February, 2025
5. Nonlocality-Assisted Enhancement of Error-Free Communication in Noisy Classical Channels; Recent Trends in Applied Mathematics and Computing – 2025(RTAMC - 25) organized by Department of Applied Mathematics, University of Calcutta, 12th March, 2025

Administrative duties

1. Committee member & Chairman of Media Cell
2. Member of Annual Report (2024-25) Committee
3. Convener of Theoretical Physics Seminar Circuit (TPSC)
4. Convener for conducting outreach programmes for the students of SC/ST communities under VASP
5. Member of Seminar & Colloquia Programme (SCOLP) sub-committee under EVLP
6. Member of Computer Service Cell Advisory Committee (CSA-AC)

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. Design and Development of Quantum Entanglement- Enhanced Imaging Systems; Quantum Sensing & Metrology Technology Vertical under National Quantum Mission (NQM); Department of Science and Technology; 6 years

Conference / Symposia / Schools organized

1. Two days National Conference on "recent Advances in Physical and Chemical Sciences"

   Place: Kandi Raj College, Kandi, Murshidabad

   Date: December 12th - 13th, 2024

   Role: Convener

2. Foundations of Quantum Mechanics: An International Conference On the occasion of A Century of Quantum Mechanics

   Place: Indian Institute of Science Education & Research Kolkata

   Date: December 18th – 21st, 2024

   Role: National Organizing Committee Member

Scientific collaborations with other national / international institutions (based on joint publications)

National

1. Indian Statistical Institute, Kolkata (Prof G. Kar and Prof. P. Parashar)
2. Indian Institute of Technology Jodhpur (Dr. A. Mukherjee)

International

1. Centre for Quantum Optical Technologies, Centre of New Technologies, University of Warsaw, Poland (Prof. A. Streltsov & Dr. S. Halder)
2. Henan Key Laboratory of Quantum Information and Cryptography, Zhengzhou, China (Prof. He-Liang Huang and Group)
3. International Centre for Theory of Quantum Technologies, University of Gdansk, Poland (Dr. S. S. Bhattacharya)
4. Department of Computer Science, The University of Hong Kong (Dr. T. Guha)

Outreach program organized / participated

1. One day outreach program at Sutragarh MN High School, Shantipur, Nadia, on 31st January, 2025

Areas of Research

Dr. Banik and his group are currently investigating a range of non-classical features of quantum systems-including nonlocality, entanglement, measurement incompatibility, and non-classicality beyond the stabilizer framework—from a foundational perspective. On the practical side, their research focuses on leveraging these features to develop novel information-processing protocols, with particular emphasis on entanglement-enhanced quantum imaging schemes.

- ***Quantum Advantage: A Single Qubit's Experimental Edge in Classical Data Storage [PRL 133, 200201 (2024)]:-*** Quantum advantages are often constrained by fundamental no-go theorems, making them difficult to identify and even more challenging to demonstrate experimentally. For example, in the presence of shared classical randomness, Holevo's theorem and the Frenkel–Weiner result assert that a qubit (a two-level quantum system) offers no advantage over a classical bit in any single-sender, single-receiver classical communication task. In one of our recent works, published as an Editors' Suggestion in Physical Review Letters, we, however, demonstrate that a single qubit can surpass a classical bit in a communication task without any shared randomness. Our experimental realization employs a variational triangular polarimeter to implement the necessary positive operator-valued measurements

(POVMs), which are crucial for establishing the observed quantum advantage.

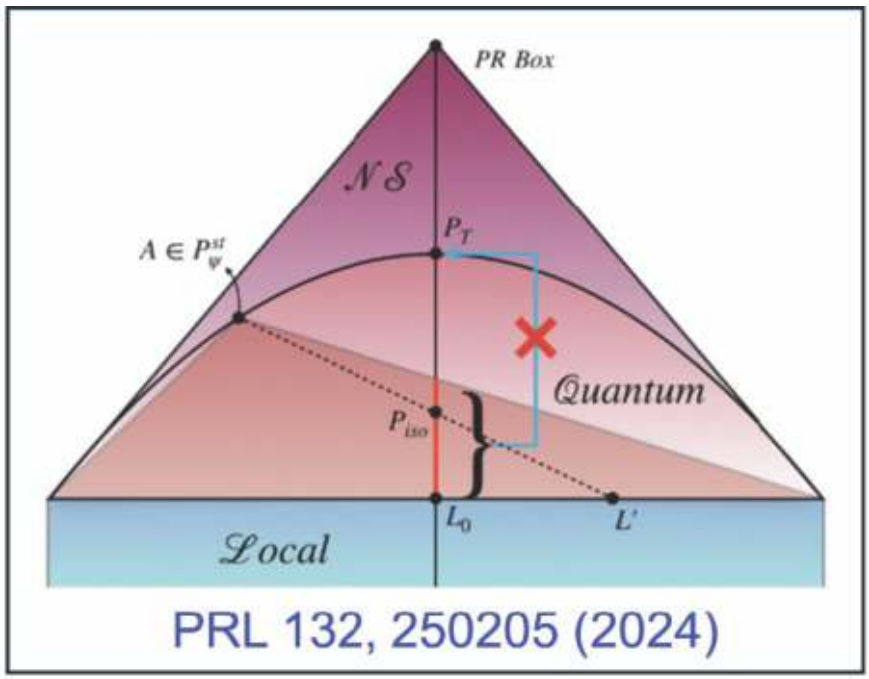
Beyond demonstrating a robust one-qubit advantage, our work opens promising avenues for near-term quantum technologies. It provides a semi-device-independent certification scheme for quantum encoding-decoding processes and introduces an efficient approach to information loading and transmission in quantum networks.

- ***Quantum Nonlocality: Multicopy Resource Interconvertibility and Their Asymptotic Inequivalence [PRL 132, 250205 (2024)]:-*** Quantum nonlocality, first identified by John Stewart Bell in his seminal 1964 theorem, has attracted enduring interest across the natural sciences and remains central to recent advances in device-independent quantum technologies. Its foundational importance was formally recognized with the 2022 Nobel Prize in Physics. Today, quantum nonlocality is regarded as a key resource for tasks such as secure communication, certified randomness generation, and cryptographic key distribution—making the task of quantifying and comparing nonlocal correlations both urgent and nontrivial.

  In a recent work published in Physical Review Letters, we show that a universal standard for measuring quantum nonlocality is fundamentally impossible. Our findings reveal that the structure of nonlocality is inherently task-dependent: the boundary of nonlocal correlations contains infinitely many inequivalent extremal points, each representing a unique form of nonlocal resource. Consequently, no single nonlocal correlation can serve as a universal unit from which all others can be derived. This result deepens our understanding of the resource theory of nonlocality, underscoring its rich structure and the intrinsic diversity of quantum correlations.

Plan of Future Work Including Project

Quantum estimation theory: Estimation theory broadly comes under quantum metrology. It has gained significant attention in recent years due to its wide-ranging applications in quantum sensing and imaging. Currently, we are planning to develop a novel estimation protocol for characterizing an unknown measurement device, performing measurements along an unknown direction. We aim to exploit a recently proposed anti-parallel spin configuration, which enables the perfect joint measurability of three mutually incompatible measurements. This approach has the potential to yield an efficient estimation strategy that saturates the ultimate precision limit dictated by the Cramér-Rao bound and the associated Fisher information. Our future plans also include an experimental realization of this protocol, demonstrating how this foundational quantum concept—the enhanced joint measurability enabled by anti-parallel spin configurations—can be harnessed for high-precision estimation tasks.



Utility of quantum magic in communication complexity: Non-stabilizerness, or the presence of magic resources, quantifies the extent to which non-Clifford operations are required for quantum information processing, and it is widely recognized as essential for realizing quantum computational advantage. The foundational Gottesman–Knill theorem shows that quantum circuits composed solely of Clifford operations—despite generating significant superposition and entanglement—can be efficiently simulated on a classical computer. However, the inclusion of even a single non-Clifford gate, such as the T-gate, makes the circuit universal for quantum computation and enables a quantum speed-up, thereby identifying the T-gate

as a fundamental unit of magic. While this role of magic is well studied in the context of computation, its implications for quantum communication remain relatively unexplored. Therefore, we plan to demonstrate whether the same notion of magic also underpins the quantum advantage in communication complexity tasks. Specifically, we aim to explore whether non-stabilizer states and/or non-stabilizer measurements are necessary to obtain a quantum advantage in such communication tasks.

Any other Relevant Information including social impact of research

1. Received the Best Teacher Award

2. Quantum Advantage Unveiled: From Theory to Real-World Demonstration

   https://dst.gov.in/quantum-advantage-unveiled-theory-real-world-demonstration

3. New study on quantum nonlocality expands scope of its use

   https://dst.gov.in/new-study-quantum-nonlocality-expands-scope-its-use

4. Experiment realizes quantum advantage in data storage with a photonic quantum processor

   https://phys.org/news/2024-11-quantum-advantage-storage-photonic-processor.html

Prosenjit Singha Deo

Professor
Physics of Complex Systems
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Guidance of Students/Post-Docs

a) Ph.D. Students

1. Kanchan Meena; Mesoscopic physics; Awarded
2. A. Ghosh; Mesoscopic physics; Under progress

Teaching

1. Spring Semester; Quantum 2; Integrated PhD; 11 students; shared with A. Lahiri
2. Spring Semester; Mesoscopic physics; PhD; 3 students; shared with B. Ghosh

Publications

a) In journals

1. Kanchan Meena, Souvik Ghosh and **P S Deo**, *Negative Local Partial Density of States*, Journal of Condensed Matter, 3 (1), 16-21, 2025

b) Other publications

i) Book

1. Prosenjit Singha Deo and Kanchan Meena; Time travel: a reality in mesoscopic physics; Springer-Nature; February 2025

Administrative duties

1. Served as library committee member

Outreach program organized / participated

1. Participated in outreach program to Malda Gourh Vidyalaya 15th December 2024 and delivered a talk

Areas of Research

Mesoscopic physics

Plan of Future Work Including Project

1. Working on quantum measurement problem

Punyabrata Pradhan

Professor
Physics of Complex Systems
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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Aniket Samanta; Fluctuating hydrodynamics of conserved-mass transport processes; Under Progress
2. Sabuj Mandal; Equilibrium and non- equilibrium phenomena in the presence of impurities on a colloidal system; Under Progress
3. Tanmoy Chakraborty; Studies of fluctuations and transport in active matter systems; Awarded
4. Animesh Hazra; Studies of dynamic properties of mass transport processes; Under Progress

b) Post-Docs

1. Olivia Mallick; Large-scale properties of nonequilibrium systems and soft matter physics

c) External Project Students / Summer Training

1. Debarshi Mukherjee; Studies of simple and interacting random walk
2. Koushik Das; Relaxation properties of interacting self-propelled particles

Teaching

1. Autumn Semester; PHY 509 (Project Research II, core course); Integrated PhD; 1 student
2. Autumn Semester; PHY 407 (Computational Methods in Physics, core course); Integrated PhD; 12 students; Shared with Arijit Haldar
3. Autumn Semester; PHY 494 (Summer Project Research I); Integrated PhD; 1 student

Publications

a) In journals

1. Tanmoy Chakraborty and **Punyabrata Pradhan**, *Time-dependent properties of run-and-tumble particles. II. Current fluctuations*, Physical Review E, 109, 044135, 2024
2. Tanmoy Chakraborty, **Punyabrata Pradhan**, and Kavita Jain, *Current fluctuations in the symmetric zero-range process below and at critical density*, Physical Review E, 110, L052103, 2024
3, Anirban Mukherjee, Dhiraj Tapader, Animesh Hazra and **Punyabrata Pradhan**, *Anomalous relaxation and hyperuniform fluctuations in center-of-mass conserving systems with broken time-reversal symmetry*, Physical Review E, 110, 024119, 2024
4. Animesh Hazra, Anirban Mukherjee and **Punyabrata Pradhan**, *Dynamic fluctuations of current and mass in nonequilibrium mass transport processes*, Journal of Statistical Mechanics: Theory and Experiment, 2024, 083205, 2024
5. Animesh Hazra, Anirban Mukherjee and **Punyabrata Pradhan**, *Hyperuniformity in mass transport processes with center-of-mass conservation: some exact results*, Journal of Statistical Mechanics: Theory and Experiment, 2025, 023201, 2025

Talks / Seminars Delivered in reputed conference / institutions

1. Contributed talk in the "Indian Statistical Physics Community Discussion Meeting"; Talk title: "Collective diffusion in hardcore run-and-tumble particles"; 04/04/2024; International Centre for Theoretical Sciences (ICTS), Bengaluru; 15 minutes
2. Invited talk in an international conference on "Centennial Celebration of Bose-Einstein Statistics"; Talk title: "Anomalous relaxation and hyperuniform fluctuations in center-of-mass conserving systems with broken time-reversal symmetry"; 07/11/2024; Dhaka University, Dhaka; 30 minutes
3. Invited departmental seminar entitled "Anomalous relaxation and hyperuniform fluctuations in center-of-mass conserving systems with broken time-reversal symmetry"; 02/04/2024; Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru; 1 hour

Administrative duties

1. HOD, PCS
2. Chairperson of newsletter committee
3. Chairperson of the computer service cell working group (CSC-WG)
4. PhD and IPhD interview / admission committees
5. Media cell member
6. Various other technical committees (member as well as a chairperson)

Conference / Symposia / Schools organized

1. "Stat. Mech. Meet Kolkata 2024 (SMMK-2024)"; 27/09/2024; S. N. Bose National Centre for Basic Sciences, Kolkata; One-day discussion meeting

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. Collaboration with Prof. Kavita Jain; Theoretical Sciences Unit, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore 560064, India; Sl. No. 2; National
2. Collaboration with Dr. Anirban Mukherjee, Institute of Physics, Academia Sinica, Taipei 11529, Taiwan; Sl. No. 3; International
3. Collaboration with Dr. Anirban Mukherjee, Institute of Physics, Academia Sinica, Taipei 11529, Taiwan; Sl. No. 5; International

Areas of Research

Fluctuation Relations in Systems Driven far from Equilibrium

Mass Transport Processes: Simple Exclusion Processes, Mass Chipping Models, Mass Aggregation Models, and Finite Range Processes, etc.

Single-File Diffusion

Characterization of Hyperuniform State of Matter

We have been working in the broad area of nonequilibrium statistical physics, including problems relevant to biology. The central theme of our current research involves characterization of out-of-equilibrium systems through studies of hydrodynamic characterization of mass transport processes, fluctuation relations in driven systems, and single-file transport through confined geometry in the presence of external driving (time-independent and time-dependent), etc.

Recently, we have mainly focused on three aspects of interacting-particle systems: (i) Hyperuniform state of matter, (ii) Clustering transition and (iii) role of persistence on fluctuations. Our main aim has been to characterize various dynamic quantities, such as density relaxation and mass and current fluctuations, in the system as discussed below.

(i) in the first class of models exhibiting hyperuniformity, microscopic dynamics conserve both mass and center of mass (CoM), but lack time-reversal symmetry (TRS). We show that, despite having highly constrained dynamics due to CoM conservation, the system does not show subdiffusive relaxation of density fluctuation, which is the case when there is TRS. However, the CoM conservation severely restricts particle movement, causing the mobility to vanish exactly. Indeed, the steady-state temporal growth of current fluctuation is qualitatively different from that observed in diffusive systems with a single conservation law. For certain models (mass chipping models), we have exactly determined the decay (or growth) exponents for various dynamic and static correlation functions.

(ii) For the second class of models, we have characterized current fluctuations in a steady state

of a symmetric zero-range process on a ring that is known to show a phase transition in the steady state. We analytically calculate two density-dependent transport coefficients, namely, the bulk-diffusion coefficient and the particle mobility, that characterize the first two cumulants of the time-integrated current. Far from criticality (below), we have found an expression of the full scaling function for the variance of the time-integrated current and thereby the amplitude of the temporal growth of the current fluctuations. At the critical point, using a scaling theory, we found that, while the above-mentioned long-time scaling of the variance of the cumulative current continues to hold, the short-time behavior is anomalous in that the growth exponent is larger than one-half and varies continuously with the model parameters.

(iii) For the third class of systems - hardcore run-and-tumble particles (RTPs), we characterize steady-state current fluctuations by using a microscopic approach. We have introduced a truncation (closure) scheme in our microscopic dynamical framework to analytically calculate various dynamic quantities, which have been of significant interest in the past. We have shown that the time-integrated bond-current fluctuation exhibits subdiffusive growth at moderately large time, before crossing over to a diffusive growth regime at very long time. Remarkably, in the long-time and large-system-size limit, the growth of time-integrated bond-current fluctuation is shown to obey a scaling law, that is presumably universal, i.e., independent of the dynamical rules of the models and parameter values. our study elucidates the large-scale hydrodynamic structure of hardcore RTPs and could initiate further studies concerning interacting SPPs in general.

Plan of Future Work Including Project

1. Characterization of long-range correlations in mass transport processes in higher dimensions
2. Further studies of hyperuniformity: Role of anisotropy and several conservation laws
3. Dynamic characterization of clustering transition in nonequilibrium systems, such as active matter and lattice gases with long-ranged hopping

Any other Relevant Information including social impact of research

1. Some of our recent research works have been highlighted through the press release of the Ministry of Science of Technology and the X handle of the journal Physical Review E

Sakuntala Chatterjee

Professor
Physics of Complex Systems
sakuntala.chatterjee@bose.res.in

Guidance of Students/Post-Docs

a) Ph.D. Students

1. Shobhan Dev Mandal; Bacterial Chemotaxis in noisy environment; Completed
2. Deepsikha Das; Interacting particle systems with time-periodic drive; Under progress; Punyabrata Pradhan, Co-Supervisor
3. Chandradip Khamrai; Ordered and disordered states in coupled driven systems; Under progress
4. Ramesh Pramanik; Bacterial chemotaxis in time-verying environment; Under progress
5. Pallabi Roy; Stochastic Response of Some Biochemical and Biophysical Systems; Under progress
6. Debojit Sen; Clustering and declustering in interacting particle systems; Under progress
7. Ajay Sharma; Study of Blazars in High Energy Regime; Under progress; Debanjan Bose, Central University of Kashmir, Co-Supervisor

b) Post-Docs

1. Ramu K Yadav; Bacterial Chemotaxis in time-periodic environment

Teaching

1. Spring semester; Statistical Physics PHY 404; Integrated PhD; 11 students; Shared with Urna Basu

Publications

a) In journals

1. Kavita Jain and **Sakuntala Chatterjee**, *Run-and-tumble particle with saturating rates*, Physical Review E, 110, 064110, 2024
2. Pallabi Roy, **Sakuntala Chatterjee**, Gautam Gangopadhyay, *Stochastic response of ultrasensitivity: Optimized switching of mitogen activated protein kinase (MAPK) cascade*, Chemical Physics, 584, 112327, 2024
3. Chandradip Khamrai and **Sakuntala Chatterjee**, *Effect of relative timescale on a system of particles sliding on a fluctuating energy landscape: Exact derivation of product measure condition*, Physical Review E, 109, 054125, 2024
4. Ramesh Pramanik, Shradha Mishra, and **Sakuntala Chatterjee**, *Run-and-tumble chemotaxis using reinforcement learning*, Physical Review E, 111, 014106, 2025
5. Deepsikha Das and **Sakuntala Chatterjee**, *Persistent exclusion process with time-periodic drive*, Physical Review E, 111, 034122, 2025

Talks / Seminars Delivered in reputed conference / institutions

1. Bacterial chemotaxis in time-varying environment; IIT BHU; 1 lecture; Varanasi; July 2024

Administrative duties

1. Served in many internal committees of the center

Membership of Learned Societies

1. Co-editor of the journal EuroPhysics Letters
2. Member of Editorial Board of Journal of Biosciences
3. Member of C6 commission of IUPAP

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. Bacterial Chemotaxis in presence of spatio-temporal variation in extra-cellular environment and of intra-cellular noise: a theoretical study; ANRF India; 11.6.24 - 10.6.27

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. Shraddha Mishra (IIT BHU, Varanasi); Sl. No. 4; National
2. Gautam Gangpadhyay (SNBNCBS, Kolkata); Sl. No. 2; National
3. Kavita Jain (JNCASR, Bangalore); Sl. No. 1; National

Outreach program organized / participated

1. Arranged a visit of 50 girl students from schools in East Midnapore district to IISER Kolkata, under Vigyan Jyoti Scheme, in September 2024
2. Arranged a visit of 50 girl students from schools in West Midnapore district to Bose Institute, Kolkata, under Vigyan Jyoti Scheme, in September 2024

Areas of Research

Nonequilibrium Statistical Physics, Biological Systems

Effect of relative timescale on coupled driven systems

We consider a system of hardcore particles advected by a fluctuating potential energy landscape, whose dynamics is in turn affected by the particles. We introduce a relative timescale ω between the particle and landscape dynamics, and study its effect on the steady state properties. We find there exists a critical value ω_c when all configurations of the system are equally likely in the steady state. We prove this result exactly in a discrete lattice system and obtain an exact expression for ω_c in terms of the coupling parameters of the system. We show that ω_c is finite in the disordered phase, diverges at the boundary between the ordered and disordered phase, and is undefined in the ordered phase. We also derive ω_c from a coarse-grained level description of the system using linear hydrodynamics. We start with the assumption that there is a specific value ω^* of the relative timescale when correlations in the system vanish, and mean-field theory gives exact expressions for the current Jacobian matrix A and compressibility matrix K. Our exact calculations show that Onsager-type current symmetry relation can be satisfied if and only if $\omega^*=\omega_c$. Our coarse-grained model calculations can be easily generalized to other coupled systems.

Run-and-tumble particle with saturating rates

We consider a run-and-tumble particle whose speed and tumbling rate are space dependent on an infinite line. Unlike most of the previous work on such models, here we make the physical assumption that at large distances, these rates saturate to a constant. For our choice of rate functions, we show that a stationary state exists, and the exact steady-state distribution decays exponentially or faster and can be unimodal or bimodal. The effect of boundedness of rates is seen in the mean-squared displacement of the particle that displays qualitative features different from those observed in the previous studies where it approaches the stationary-state value monotonically in time; in contrast, here we find that if the initial position of the particle is sufficiently far from the origin, then the variance in its position either varies nonmonotonically or plateaus before reaching the stationary state. These results are captured quantitatively by the exact solution of the Green's function when the particle has uniform speed but the tumbling rates change as a step function in space; the insights provided by this limiting case are found to be consistent with the numerical results for the general model.

Plan of Future Work Including Project

1. Continuing the study of bacterical chemotaxis in spatio-temporally varying attractant environment
2. Understanding the phase ordering dynamics in coupled driven systems with multiple conserved quantities

Sanku Paul

DST INSPIRE Faculty
Physics of Complex Systems
paulsank@bose.res.in

Publications

a) In journals

1. **Sanku Paul**, Paraj Titum and Mohammad Maghrebi, *Hidden quantum criticality and entanglement in quench dynamics*, Physical Review Research, 6, L032003, 2024
2. **Sanku Paul**, J. Bharathi Kannan and M. S. Santhanam, *Faster entanglement driven by quantum resonance in many-body kicked rotors*, Physical Review B, 110, 144301, 2024
3. Akash Mitra, **Sanku Paul**, and Shashi C. L. Srivastava, *Quantum criticality and universality in the stationary state of the long-range Kitaev model*, Physical Review B, 111, 104308, 2025

Talks / Seminars Delivered in reputed conference / institutions

1. Talk on "Hidden quantum criticality and entanglement in quench dynamics"; 10/01/2025; Shiv Nadar University; 1hour
2. Talk on "Hidden quantum criticality and entanglement in quench dynamics"; 06/03/2025; J C Bose Institute; 1hour
3. Talk on "Hidden quantum criticality and entanglement in quench dynamics"; 20/03/2025; IIT Dharwad; 1hour

Administrative duties

1. Judge for the poster presentation at "BOSE FEST 2025" at SNBNCBS, Kolkata

Areas of Research

Non-equilibrium Physics, Quantum Information, Quantum chaos

- **Faster entanglement production driven by quantum resonance in many-body rotors:** Entanglement is a crucial resource in quantum information and computation, and its faster generation is highly desirable. As of today, typical fastest entanglement generation is linear in time. In contrast, our work reports super-linear entanglement generation in many-body kicked rotor as shown in Fig. 1. We further show that the late time dynamics displays high Q-factor, ideal for high precision measurements.

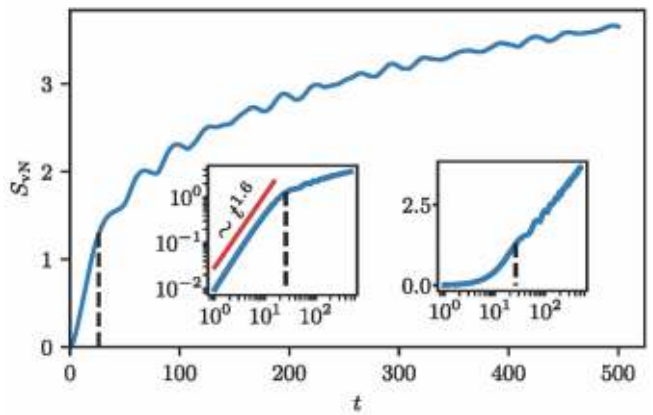

Figure 1: Plot displays generation of von Neumann entropy (a measure of entanglement) as a function of time. Left inset shows initial superlinear entanglement production while right inset displays logarithmic growth which commences after a critical time.

ii) **Detecting classical and quantum localization using Krylov complexity:** Recently, many-body quantum chaos has attracted a significant interest. Several quantities, e.g., level spacing ratio, out-of-time ordered correlator, and others have been devised to detect it. Our work focusses on a recently formulated quantity, the Krylov complexity. It reveals that Krylov complexity not only probe chaos but can also successfully probe different types of localization, namely, the classically induced localization, quantum dynamical localization, power-law localization, and localization due to anti-resonance. Our work thus demonstrates that Krylov complexity has broader applicability, extending even to the detection of localization phenomena.

iii) **Infering ground state universality from the long-time stationary state:** Universality of fluctuations is a profound concept in physics, where seemingly different physical systems exhibit identical behavior near a critical point. In quantum systems, such universal behavior is typically associated with ground state properties and quantum criticality. Remarkably, our study shows that the universality class of the ground state can be inferred from the properties of the long-time stationary state which is far above the ground state obtained through a specific quench protocol. This type of states could be useful in quantum information as it retains quantum correlations in a state far from the ground state (see Fig. 2).

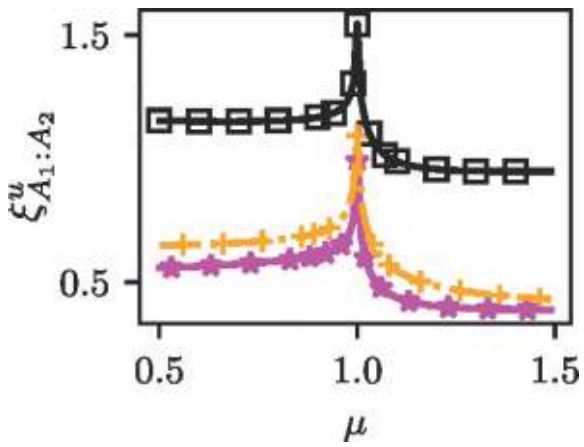

Figure 2: Logarithmic negativity(an entanglement monotone) as a function of system parameter is plotted. The kink represents the persistence of quantum critical behavior in a state far above the ground state obtained through non-equilibrium dynamics.

Plan of Future Work Including Project

a. Quantum battery:

One key aspect of quantum technology is energy storage and transfer at the quantum level. Within this context, an intriguing area of research is the study of "quantum batteries", which are quantum mechanical systems designed for energy storage. Quantum batteries (QBs) leverage quantum effects to achieve more efficient and faster charging processes compared to classical systems. We are working on protocols to efficiently charge and extract useful work. We are also focusing on the effect of coherence in charging rate, power and work extraction. The system we are studying is the coupled kicked rotor system.

b. Quantum Mpemba Effect:

Systems out of equilibrium often shows phenomena which are beyond our conventional prediction. One such puzzling example is the Mpemba effect, a phenomenon where hot water freezes faster than cold water. This has also been observed in quantum system, termed quantum Mpemba effect. A state that is far from equilibrium relaxes faster than the one closer to it. Recently, quantum Mpemba effect has attracted huge attention. Our goal is to investigate the role of chaos in quantum Mpemba effect. For this, we consider the coupled kicked top model and Aubry-Andre Model.

Any other Relevant Information including social impact of research

M.Sc. thesis guided:

i) Bipasa Hazra: "Localization and delocalization in interacting quantum chaotic system", (3rd semester), December 2024

ii) Indrajit Banerjee, "An overview on Fractals", (3rd semester), December 2024

iii) Indrajit Banerjee, "Subsystem dependence entanglement in transverse field fractal Ising chain", (4th semester), May 2025

iv) Subhransu Dey, "Efficient Simulation of Stabilizer Circuits", (4th Semester), May 2025 (Co-supervisor)

Urna Basu

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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Ritwick Sarkar; Activity driven transport; Under Progress
2. Debraj Dutta; Inertial active matter; Under Progress

b) Post-Docs

1. Suchismita Banerjee; Characterization of air pollutant fluctuations through statistical physics measures

c) External Project Students / Summer Training

1. Aitihya Mondal; Diffusion in a harmonic trap
2. Sreya Chatterjee; Harmonically coupled pair of active Brownian particles

Teaching

1. Spring Semester; PHY 404; Integrated PhD; 11 students; Shared with Prof. Sakuntala Chatterjee
2. Spring Semester; PHY 494; Integrated PhD; 2 students
3. Autumn Semester; PHY 509; Integrated PhD; 1 student

Publications

a) In journals

1. Debraj Dutta, Anupam Kundu, **Urna Basu**, *Inertial dynamics of run-and-tumble particle*, Chaos, 35, 033109, 2025
2. **Urna Basu**, P. L. Krapivsky, and Satya N. Majumdar, *Universal dynamics of a passive particle driven by Brownian motion*, Physical Review E, 110, 064105, 2024
3. Ritwick Sarkar, Ion Santra and **Urna Basu**, *Harmonic chain driven by active Rubin bath: transport properties and steady-state correlations*, Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences; 480, 2300, 2024
4. Debraj Dutta, Anupam Kundu, Sanjib Sabhapandit, and **Urna Basu**, *Harmonically trapped inertial run-and-tumble particle in one dimension*, Physical Review E, 110, 044107, 2024
5. Shashank Prakash, **Urna Basu** and Sanjib Sabhapandit, *Tagged particle behavior in a harmonic chain of direction-reversing active Brownian particles*, Journal of Statistical Mechanics: Theory and Experiment, 2024, 083211, 2024

b) Other Publications

i) Conference proceedings / Reports / Monographs

1. Urna Basu, Sanjib Sabhapandit, Ion Santra, Target search by active particles, in "Target Search Problems" edited by Denis Grebenkov, Ralf Metzler, Gleb Oshanin, Springer Cham (2024)

Talks / Seminars Delivered in reputed conference / institutions

1. Contributed talk at the 9th Indian Statistical Physics Community Meeting; 03/04/2024; ICTS-TIFR Bengaluru, India; 3 days

2. Invited talk at Indo-French workshop on Classical and quantum dynamics in out of equilibrium systems; 16/12/2024; ICTS-TIFR, Bengaluru, India; 5 days
3. Invited talk at IoP Golden Jubilee Young Women Scientists' Meet; 13/11/2024; IoP, Bhubaneshwar, India; 2 days
4. Invited talk at at Dynamics Days Asia Pacific 13/YKIS2024; 01/07/2024; YITP, Kyoto University, Japan; 5 days
5. Invited talk at New Vistas in Stochastic Resetting; 17/06/2024; University of Edinburgh, UK; 3 days

Administrative duties

1. Member, Internal Complaints Committee
2. Member, Faculty Search Committee
3. Hostel Warden
4. Member, CWEP subcommittee of EVLP
5. Member, Admission Committee
6. Member, Computer Working Cell (until December 2024)
7. Member, Syllabus Modification Committee
8. Member, Media Cell
9. Member, Annual Report Committee
10. Member, Brochure committee for ARPAC
11. Several tender committees

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. MATRICS; ANRF (formerly SERB); 3 years; PI

Scientific collaborations with other national / international institutions (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

1. Collaboration with Prof. Sanjib Sabhapandit, RRI, Bengaluru; Sl. No. 4, 5, 6; National
2. Collaboration with Prof. Anupam Kundu, ICTS-TIFR, Bengaluru; Sl. No. 1, 4; National
3. Collaboration with Prof. S. N. Majumdar, Univ. Paris-Saclay; SL. No. 2; International
4. Collaboration with Prof. P. L. Krapivsky, Boston University; Sl. No. 2; International

Outreach program organized / participated

1. Seminar at the department of Physics, University of Calcutta on the occasion of National Science Day 2025
2. Member, organizing committee of the outreach programs of the Centre for the year long programs under Bosestat@100

Areas of Research

Statistical physics -- nonequilibrium phenomena, active particle dynamics, critical phenomena, stochastic processes

I work in the general area on nonequilibrium statistical physics with current focus in the areas of active particle dynamics, nonequilibrium transport and general properties of stochastic processes.

One of my main research interests is to study and characterize the properties of active particles, using simple, analytically tractable models. In a couple of recent works we have investigated the properties of inertial run-and-tumble particles (RTP), both in free space and in the presence of a harmonic trap. In free space, the inertial motion of an RTP is characterized by two intrinsic timescales, namely, an inertial and an active timescale. We show that interplay of these two times-scales leads to the emergence of four distinct regimes, characterized by different dynamical behavior of mean-squared displacement and survival probability. We analytically compute the position distributions in these regimes when the two timescales are well separated. We show that in the large-time limit, the distribution has a large deviation form and compute the corresponding large deviation function analytically. We also find the persistence exponents in the different regimes theoretically. For an inertial RTP in an external potential, the presence of inertia leads to two distinct dynamical scenarios, namely, overdamped and underdamped, characterized by the relative strength of the viscous and the trap timescales. We find that inertial nature of the active dynamics leads to the particle being confined in specific regions of the phase plane in the overdamped and underdamped cases, which we compute analytically. Moreover, the interplay of the inertial and active timescales gives rise to several subregimes, which show very different behavior of position and velocity fluctuations. In particular, in the underdamped regime, both the position and velocity undergo transitions from a novel multipeaked structure in the strongly active limit to a single-peaked Gaussian-like distribution in the passive limit. On the other hand, in the overdamped scenario, the position distribution shows a

transition from a U shape to a dome shape, as activity is decreased. Interestingly, the velocity distribution in the overdamped scenario shows two transitions-from a single-peaked shape with an algebraic divergence at the origin in the strongly active regime to a double-peaked one in the moderately active regime to a dome-shaped one in the passive regime.

In another recent work, we show that heterogeneity in self-propulsion speed can lead to the emergence of a robust effective short-range repulsion among active particles interacting via long-range attractive potentials. Using the example of harmonically coupled active Brownian particles, we analytically derive the stationary distribution of the pairwise distances and reveal that the heterogeneity in propulsion speeds induces a characteristic scale of repulsion between particles. This length scale algebraically increases with the difference in their self-propulsion speeds. In contrast to the conventional view that activity in active matter systems typically leads to effective attraction, our results demonstrate that activity can give rise to an emergent repulsive interaction. This phenomenon is universal, independent of the specific dynamics of the particles or the presence of thermal fluctuations.

Plan of Future Work Including Project

Presently, we are studying the effect of inertia and speed diversity in short-range interacting active systems with thermodynamically large particle numbers. Numerical simulations suggest that such a system shows a range of intriguing features, including transition to a novel ordered phase. We plan to characterize these phases using a simple model of truncated harmonic interactions.

Another long-term project focuses on the study of transport properties of extended anharmonic systems driven by active reservoirs. We use the nonequilibrium response formalism to quantitatively obtain the energy current flowing through a system generated by an active drive. The generic nature of the formalism makes it applicable to systems with nonlinear interactions as well as disorders, which are hard to treat analytically otherwise.

Facilities


BRAUN
PANTHER
PANTHER
PANTHER
Rigaku
SmartLab

LIBRARY

About Library

Library of the Centre is the hub of learning and research activities. Since inception of the Centre in 1986, library has been playing an important role in providing information and various academic services to its users. The library also provides service to outside students, researchers and professionals working throughout the country and abroad in all possible ways.

Resources

The Library has a good and useful collection of documents. Presently library possesses more than 17488 books and 8000 bound volume journals. The Library subscribes to many useful journals published by reputed publishers mostly in electronic version. In addition, being a member of the National Knowledge Resource Consortium (NKRC), the library gets access to a wide range of online journals. The library is also equipped with databases like Web of Science, Mathscinet , SciFinder Scholar, ICSD (Inorganic Crystal Structure Database) etc. Library has a Fiction Section with popular books on English, Hindi and Bengali literature. It includes novels, short stories, biographies, dramas, and books on general interests aiming to satisfy all type of readers. The library has a good collection of audio-visual materials. In the magazine and newspaper reading section,25 popular magazines and 13 daily newspapers in different languages have been subscribed regularly. The library is enriched with a valuable archive of S N Bose. This archive includes some personal belongings of S N Bose and some of his personal book collections. A digital version of the archive is available on the website.

Library Hours

The Library is open during Monday to Saturday from 8.00 AM to 12.00 at night. However, during examinations, Library is kept open for the whole night. Circulation counter is open during Monday to Friday from 9.30 AM to 6.00 PM. Library is closed on Sundays and national holidays.

Library Users

On average, 50 users visit the library per day. Online journals and databases are accessible within the campus through the campus LAN and outside the campus through VPN. Therefore, users may use those online resources from their convenient places.

Services

1. **Reading Facility:** Library provides reading facility to its members as well as outside visitors. All the books including reference collections are classified and open-accessed.
2. **Document Lending Service:** Each member is entitled to issue 6 books and 2 bound volumes of journals at a time.
3. **Reference and Article delivery Service:** Reference service is provided via e-mail, telephone or personal interaction with the help of different reference tools like Web of Science, Annual Report etc. Non accessible journals' articles are collected from other libraries and provided to the faculty members and students on request.
4. **English language writing assistant software tool** : It is an AI-based software to review the spelling, grammar, and tone of a piece of writing as well as identifying possible instances of plagiarism.
5. **OPAC:** Library offers Online Public Access Catalogue (OPAC) which allows user to browse library collection by author, title, subject, classification number, etc. through web OPAC.
6. **E-resources and Internet Facility:** Library is well equipped with sufficient number of computers with internet connectivity through cable LAN and wireless networking facility for laptop users. The library has access to plenty of electronic journals, databases, archives, and consortium resources. Users have full access to the subscribed e-resources.
7. **Reprographic Services:** Library has printer cum copier, good colour printer, photocopy machine and poster printer for providing extensive reprographic services.
8. **Bibliometric Services:** Library helps to prepare various bibliometric reports, especially usage statistics, citation analysis, h-index, Impact factor of Journals, etc., as per users' requirements.
9. **Library Resource Sharing Activities:** The library

shares its resources with all important academic/research institutions in India. As a member of the National Knowledge Resource Consortium (NKRC), the library keeps close contact with libraries under DST and CSIR. SNB library has institutional membership in the British Council Library (BCL), Kolkata and American Library Kolkata.

10. **Library is for Leisure:** Library has a separate section for Bengali, Hindi, and English literature, fiction, classic literature, novel, history, and books on general interest.

11. **Documentation Service:** Library has been compiling the Annual Report in Hindi and English versions, Diary, and Calendar of the Centre, and coordinating the process of printing. Printing and designing of different documents of the Centre like poster, conference brochure etc.

12. **New arrival Section:** The Library has a section where newly processed books are displayed for users every month. The same list is uploaded on the website every month, and an email notification is given to all library members.

13. **Research publication status and citation received:** Every month Library has been preparing pictorial research publication status of the Centre and citation received by those publications. The report also includes h-index, citation received per year etc. It is being uploaded to the website on a regular basis.

14. **S N Bose Archive and Museum:** The library has been maintaining the S N Bose Archive and Museum, where documents and articles related to S N Bose have been preserved. Library staff guide the visitors to explore the museum.

15. **Plagiarism detection facility:** Library is equipped with an international standard plagiarism detection facility.

Resources and Services Added in the F.Y. 2024-25

1 Approximately 257 new books and some new journals have been added to the library collection during the above-mentionedfinancial year.

2 Library has developed an institutional digital repository for PhD thesis.

3. In the Financial Year 2024-25, the Fiction Section has been enriched by procuring12 books of classic literature, novels, short stories, biographies, and books of general interest.

4. 6 Hindi books have been added to the Library collection for the mentioned financial year.

5. The library has been getting access to major journals and databases through the 'One Nation One Subscription (ONOS)' scheme under the Ministry of Education.

Saumen Adhikari
Librarian – cum – Information Officer

ENGINEERING SECTION

(Infrastructure Development, Maintenance & Housekeeping and Support Services)

A) Civil Work

1. Civil Works at Astronomical Observatory Site Located at Panchet Hill, Purulia.
2. This room have been modified with clean room panels to maintain aseptic environment to avoid contamination. It is built with false ceiling and wall panelling with coving which has accommodate wirings and pipelines. One localized HVAC system to maintain positive pressure, optimum temperature and humidity throughout the culture zone have been installed. The main entrance has been modified to airlock door with an air curtain and interlocking system.CO_2 supply line with cylinders are also there.
3. Replacing of Roof Sheet of Car Parking Area and facelifting.
4. Replacing of Damaged Roof Sheet and Minor Civil Works at Liquid Helium Plant, AHU Room Adjacent of Clean Room of the Centre.
5. Replacing of Damaged Doors and Minor Repairing Works at Krishnachura Hostel
6. Face lifting work of Silve Jubilee Hall.
7. Relocation of washrooms to accommodate the NSM-Supercomputer in Bashundhara Building at ground floor.

B) Estate

1. Maintenance and developing of landscaping and horticulture to upkeep the aesthetic look of the campus
2. Maintaining "Zero Plastic Green Campus" by preventing the usages of plastic carry bags of less than 75 micron.
3. Successfully organized Swachata Pakhwada from 01/05/2024 to 15/05/2024.

C) Electrical

1. Dedicated earthing system was installed at various laboratories to protect the sophisticated research equipments/instruments and also for the proper electrical installation.

Panchat Observatory

Cell Culture Lab of BSL-II (ISO-7 & 8)

2. Electrical installation work for Basundhara Building.
3. Various procurement of electrical items through GeM portal and upkeep the inventory/electrical store.
4. Modification of feeder pillars and new cable laying work from new Substation block.
5. Installation of LED lighting systems replacing the conventional lighting system including street lights.
6. E-waste management- Based on the approval from the Competent Authority, The e-waste work with WEBEL was taken up by Engineering Section.
7. Installation of one no. new Passenger (8nos.) Lift at Main Building
8. Organized Fire drill and training to all the AMC, Security, Administrative Staff and Students of the Centre.
9. Successfully completed the Electrical and Airconditioning infrastructure work of 630 TF Param Rudra Supercomputer installation in the Bashundhara Building.

Mithilesh Kumar Pande

Campus Engineer cum Estate Officer

COMPUTER SERVICES CELL

Dr. Sanjoy Choudhury

Scientist – E

The nature of work has two distinct regions:

1. **Administrative Responsibilities:**
   - o Overseeing Central Computational Facilities under the Computer Services Cell as the Scientist In-Charge of the Cell.
2. **Academic & Research Activities:**
   - o Conducting independent and collaborative research initiatives.

a) Academic Work - General research areas and problems worked on:

Areas of Research: IoT, Machine Learning, Edge/Fog Computing, Smart Cities

Brief research work: The key objectives of this research on edge/fog computing and renewable energy optimization are as follows:

Completed my Ph.D., Computer Science and Technology, National Institute of Technology, Meghalaya, on 2024

The primary objectives of this research are to explore and optimize the integration of edge/fog computing with renewable energy systems, ensuring sustainable, efficient, and economically viable solutions. The key focus areas include:

Interdisciplinary Computational Scientist bridging HPC, IoT, and AI/ML to solve challenges in:

- Energy-Aware Edge Computing: Optimizing Resource Allocation for IoT-Driven Environments and Applications.
- Artificial Intelligence (AI) and Machine Learning (ML) are revolutionizing basic
- scientific research across Neural networks model, AI analyzes DNA sequences to identify disease
- markers and predict gene functions, ML decodes neural activity patterns and models and AI develops
- new algorithms for solving complex optimization problems etc.
- Integrating computational methods with domain-specific applications across diverse focus areas in interdisciplinary research.
- Bridging High-Performance Computing (HPC) and Machine Learning for Molecular
- Modeling Advanced Methods: Developed hybrid AI/classical MD workflows to accelerate free-energy calculations and reaction pathway predictions.
- Parallel Algorithm Design: GPU/CUDA-accelerated simulations for meteorology, genomics, and materials science.
- AI/ML for Autonomous Systems: Real-time perception models for autonomous vehicles
- Sustainable HPC: Green computing strategies for large-scale scientific workloads.

By addressing these objectives, my research can significantly contribute to the practical implementation and optimization of computing environment, ensuring efficient resource utilization, cost-effective service delivery, and sustainable computing solutions globally.

COMPUTER SERVICES CELL

The Computer Centre at S.N. Bose National Centre for Basic Sciences (SNBNCBS) functions as a core facility dedicated to supporting the academic departments and administrative units of the institute. Its primary objective is to develop and sustain a high-performance computing infrastructure that enhances research, learning, and institutional operations, thereby fostering academic excellence.

Central Computational Resources (2024-25):

As part of **India's National Supercomputing Mission (NSM)**, the S.N. Bose National Centre for Basic Sciences (SNBNCBS) operates an **838 TF supercomputing facility** dedicated to academic research and administrative operations.

High-Performance Computing (HPC) Infrastructure

Ranked among **India's top 50 supercomputers**, the facility includes:

- **PARAM RUDRA – BOSON SSM** Supercomputing Facility
- **CRAY XC50** and **Baryon CPU/GPU Clusters**
- **Theoretical peak performance: 1060.40 TF**

This infrastructure supports the Centre's extensive computational demands in scientific research and data processing.

Key Strengths

- Development and implementation of cutting-edge technologies
- Advanced database management
- In-house design and development of Windows/Linux-based software

Core Activities

- Software Development **(In-house solutions)**
- Database Management
- Networking Solutions & Services
- IT Infrastructure Procurement, Installation & Maintenance
- Information Security & Storage Solutions
- Web Services & User Support
- Training & Technical Assistance

In-House Developed Software

- Personnel Information System
- Back Office Automation (Accounts, Purchase, Stores)
- Includes billing, salary, pension, GPF, NPS, income tax, e-payments
- ERP & Web-Based Personal Information Management
- Gateway Protection & Data Security
- Email Services under Institute Domain
- Web Portals: E-learning, intranet, internet
- Biometric Attendance & Timekeeping System
- **Online Admission & Staff/Student Leave Management**
- **MIS Dashboard & Library Management**
- **Gate Pass & Project Monitoring Portal**
- **Student Payment Gateway**
- **File Tracking System**
- **Academic Progress Reporting Software**
- **Video Conferencing & Virtual Classroom Tools**

Licensed Software

- Mathematica, MATLAB, MS 365
- ChemDraw, Overleaf, Antivirus Endpoint Protection

Computational Facilities Summary

Machine Name	Processor Cores	Storage	Active Users
Photon	84	-	55
Phonon	84	-	27
UNANST	480	12 TB	25
UNANST	96	12 TB	30
Polaron	416	64 TB	35
New HPC	1312	80 TB	15
NEW GPU	6 Nodes	-	5
PARAM RUDRA – BOSON	**172 Nodes**	**1 PB**	100
Hybrid System (CPU + GPU)	24 CPU + 14,336 GPU cores	4 TB	8
ATHENA	320	-	12
TRC CRAY	960	120 TB	30

Network & IT Infrastructure

- State-of-the-art Data Centre with:
  - 1000 Mbps leased line internet
  - NKN Connectivity + 100 Mbps BSNL backup
- Wi-Fi-enabled campus (1200 nodes)
- Eduroam global roaming access (via ERNET, India)
- Server & Network Assets:
  - Web Servers: 4
  - Email Server: 1
  - Application/Management/Terminal Servers: 14
  - Network Security Devices: 2
  - Routers/Switches: 89
  - Wireless Controllers: 1, Access Points: 50
- End-User Devices:
  - Printers: 128 Laser, 38 Deskjet
  - Scanners: 7
  - PCs: 383
  - Surveillance Cameras: 55 (NVR: 2)
- Dedicated Computer Labs:
  - 20 PCs in main lab
  - 20 PCs in library browsing facility

IT Support & Services

- Comprehensive User Support (Hardware/Software Maintenance)
- Research Computational Assistance
- Server & Network Monitoring (Firewalls, IDS, Patch Management)
- Security Audits & Emergency Response

Best Practices

- User-Centric Service Delivery
- Vendor-Neutral Hardware/Software Solutions
- Cost & Energy Efficiency
- Scalable & Secure Infrastructure
- Centralized Service Management

sanjoy choudhury

Sanjoy Choudhury
In-charge, Computer Services Cell

PROJECT AND PATENT CELL

The Project and Patent Cell acts as the record keeping Cell of the Projects and Patents of the Centre. It keeps tracks of the project proposals submitted for extramural funding, the sanctioned projects, the patent proposals filed and the patents granted to the Centre. It also coordinates with the Committee(s) constituted by the Authority for evaluating proposals to be filed for grant of patent and also takes care of the administrative matters during the filing of patents under the instruction of the inventor(s).

The members of the Project and Patent Cell during the year 2024-25:

Prof. Amitabha Lahiri	Convener
Prof. Gautam Gangopadhyay	Member
Prof. Soumen Mondal	Member
Dr. Atindra Nath Pal	Member
Deputy Registrar (Administration)	Member
Deputy Registrar (Finance)	Member
Dealing Assistant, Office of Dean (Faculty)	Member
Office Assistant, Academic Section	Member

Mr. Achyut Saha, PA to Director will render Secretarial Assistance to the Project & Patent Cell.

The following table summarizes the details of the externally funded projects in the Centre, for the last five years:

Year	No. of Projects	Amount Received (Rs.)
2020-2021	30	2,21,97,328=00
2021-2022	34	3,22,95,557=00
2022-2023	40	3,55,46,511=00
2023-2024	33	2,49,73,471=00
2024-2025	28	2,19,59,593=00

Details of Externally Funded Projects at SNBNCBS (2024-25)

Project Title	PI / Co – PI	Funding Agency	Duration of the Project	Total Sanctioned	Remarks
ICAR/SKP/18-19/230 – "Development of nano sensor and its application through cloud based network for real time irrigation to soil and plant"	Prof. S.K. Pal (Co-PI from SNBNCBS) Lead Centre: ICAR–IISS Other Co Centre: ICAR-CIAE	ICAR (NASF) NASF/NRM-8031/2020-21/214 dated 31-05-2021	01-06-2021 to 31-05-2024	41,00,000/- (Non Recurring) 59,04,278/- (Recurring Cost) For SNBNCBS	
DST/AB/19-20/246 – "Development of strongly spin orbit coupled topological quantum heterostructures for spintronic applications"	Prof. Anjan Barman	DST DST/NM/TUE/QM-3/2019-1G-SNB	21-10-2021 to 20-10-2026	1,28,43,000/-	
DST/TSD-AP/19-20/249 – "Consortium for Collective and Engineered Phenomena in Topology Concept"	Investigators from SNBNCBS: Dr. Atindra Nath Pal	(DST) DST/NM/TUE/QM-10/2019 (C)/2 (Nano Mission)	28-03-2023 to 27-03-2028	97,92,549/-	
PM/SERB/19-20/250 – "Twistronics with Transition Metal Dichalcogenides"	Prof. Priya Mahadevan	SERB IPA/2020/000021	30-03-2020 to 29-03-2025 Extended till 29-03-2026	2,17,60,250/-	
SERB(DST)/ANP/19-20/255 – "Probing orbital hybridization and structural asymmetry in atomic and molecular nano-contact via inelastic electron spectroscopy and shot noise"	Dr. Atindra Nath Pal	SERB CRG/2020/004208	17-02-2021 to 16-05-2024	36,12,421/-	
SERB/TSD/20-21/260 – "J.C. Bose Fellowship"	Prof. Tanusri Saha Dasgupta	SERB JCB/2020/000004 Dairy No. SERB/F/3797/2020-2021	12-10-2020 to 11-10-2025	95,00,000/-	
SERB/NK/20-21/264 – "From three-dimensional to two-dimensional quantum anomalous Hall effect in ferromagnetic topological quantum materials"	Dr. Nitesh Kumar	SERB CRG/2021/002747	10-03-2022 to 09-03-2025	27,26,791/-	
SERB/SC/20-21/266 – "Development of Artificial Neural Network (ANN) based models for rapid prediction of physicochemical properties of drug-like molecules"	Dr. Suman Chakrabarty	SERB MTR/2021/000859	24-02-2022 to 23-02-2025	6,60,000/-	
RSF-DST/TSD/21-22/268 – "Search for Novel Magnetic and Topological Materials"	Prof. Tanusri Saha-Dasgupta	DST DST/INT/RUS/RSF/P-53/2021 (G)	20-01-2023 to 19-01-2026	82,52,170/-	

Project Title	PI / Co – PI	Funding Agency	Duration of the Project	Total Sanctioned	Remarks
Max Planck/NK/21-22/275 - "Novel quantum states in quasi-one-dimensional materials"	Dr. Nitesh Kumar	Max Planck	01-09-2022 to 31-08-2027	Euro 1,00,000	
SERB/AHK/21-22/278 – "Doped 2D Nanocrystals for Photonic Applications (Ramanujan Fellowship)	Dr. Ali Hossain Khan	SERB RJF/2020/000091	01-11-2021 to 31-03-2026	Credited Till Date: 11,62,598/- + 19,14,000/-+ 23,70,000/-	
DAE(RRF)/RB/21-22/279 – "Gauge and Gravitational Symmetries in Nonrelativistic Theories: Formalism & Applications" – DAE Raja Ramanna Fellowship	Prof. Rabin Banerjee	DAE (RRF) 1003/6/2021/RRF/ R&D-II/10348 Dated 2-9-2021	03-05-2021 to 02-05-2024	13,50,000/- (1st Release) 7,56,280/- (2nd Release) 12,07,442/- (3rd Release) 13,44,558/- (4th Release) 7,23,438/- (5th Release)	
SERB/PSP/21-22/281 – "Olefin-linked Covalent Organic Frameworks (COFs) for Photocatalytic Water Splitting for Hydrogen Generation"	Dr. Pradip Shashikant Pachfule	SERB SRG/2022/000217 Dated 9-9-2022	27-09-2022 to 26-09-2024 Extended till 26-01-2025	32,35,560/-	
SERB/AHK/22-23/283 – "Heavy-Metal-Free Photonic Colloidal 2D Nanocystals"	Dr. Ali Hossain Khan	SERB CRG/2022/006225	08-02-2023 to 07-02-2026	42,26,428/-	
SERB/AC/22-23/284 – "Development and testing of broadband optoelectronic synaptic devices employing ferroelectric / photoelectric 2D material hybrid system"	Dr. Avijit Chowdhury	(SERB) CRG/2022/001145	09-03-2023 to 08-03-2026	22,08,600/-	
IHQTF/MB/22-23/290 – "Devising practically implementable enhanced means of communication with the aid of quantum resources – Chanakya Post Doctoral Alimuddin Fellowship under mentorship of Dr. Manik Banik"	Dr. Manik Banik	I-Hub Quantum Technology Foundation (IHQTF) I-HUB/PDF/2021-22/008	13-06-2022 to 31-03-2025 (At SNBNCBS)	Amount Received till date: 11,10,653/-+ 1,38,896/-+ 9,38,028/-	Chanakya Post-Doctoral Research Fellow: Dr. Mir Resigned on 28-06-2024
SERB(NPDF)/IB/22-23-293 – "Exploring Hydration Hydration Dynamics of Protein Aggregation and Its Connection with Liquid-Liquid Phase Separation Triggered by Modulation in Local Environmental Parameters Employing Terahertz Spectroscopy and Complementary Experimental Techniques"	Dr. Indrani Bhattacharya	SERB (NPDF) PD/2022/000540	28-12-2022 to 27-12-2024	22,36,800/-	

Project Title	PI / Co – PI	Funding Agency	Duration of the Project	Total Sanctioned	Remarks
SERB(NPDF)/GB/22-23/294 – "Proximity induced spin-orbit coupling and magnetism on graphene from magnetic topological quantum matter (MTQM)"	Dr. Gargee Bhattacharyya	SERB (NPDF) PDF/2022/002839	06-01-2023 to 05-01-2025	22,36,800/-	
SERB/AH/22-23/295 – "Harnessing the Interplay of Quantum Entanglement, Topology, and Strong Correlations in Condensed Matter Systems for Near-term Quantum Applications and Beyond"	Dr. Arijit Haldar	SERB (SRG)SRG/2023/000118	22-12-2023 to 21-12-2025	19,33,200/-	
SERB/SC/22-23/296 – "Bacterial Chemotaxis in presence of spatio-temporal variation in extra-cellular environment and of intra-cellular noise : a theoretical study"	Dr. Sakuntala Chatterjee	ANRF (SERB) CRG/2023/000159	Sanction Date: 28-05-2024 3 Years	27,62,650/-	
SERB/TS/22-23/297 – "Investigation of Magnetotransport, Magnetic, and Electronic Band Structure in Transition-metal Monosilicides (MSi; M = Fe, Cr, Co, Mn, and Rh) under Time Reversal Symmetry Breaking"	Dr. T. Setti	ANRF (SERB) CRG/2023/000748	Sanction Date: 24-05-2024 3 Years	34,49,905/-	
SERB/RKM/22-23/298 – "Biomolecular condensates: Exploring the associated hydration and energetics using THz spectroscopy"	Prof. Rajib Kumar Mitra	SERB CRG/2023/001034	Sanction Date: 23-02-2024 3 Years	44,49,597/-	
SERB/SS/22-23/300 – "Quantum spin Hall insulators: Investigation of electrical and thermal properties"	Dr. Saquib Shamim	ANRF (SERB) CRG/2023/002082	Sanction Date: 24-05-2024 3 Years	41,94,126/-	
SERB/UB/22-23/301 – "Activity driven transport in low dimensional systems"	Dr. Urna Basu	SERB MTR/2023/000392	Sanction Date: 23-01-2024 3 Years	6,60,000/-	
SERB/RB/22-23/302 – "A Theoretical Approach to Predict Deep Eutectic Formation: Locating the Lowest Melting Point"	Prof. Ranjit Biswas	SERB MTR/2023/000336	Sanction Date: 30-01-2024 3 Years	6,60,000/-	
IHQTF/AB/23-24/304 – "Two-dimensional ferromagnetic and organic molecule spinterfaces as molecular spin qubits for quantum technologies and energy harvesting applications – Chanakya Post Doctoral Fellowship under mentorship of Dr. Anjan Barman"	Prof. Anjan Barman	I-Hub Quantum Technology Foundation (IHQTF) I-HUB/PDF/2022-23/001	17-08-2023 to 16-08-2025	12,60,000/-	Chanakya Post-Doctoral Research Fellow: Sumaiya Parveen 17-11-2023 to 28-06-2024 Soma Dutta 21-10-2024 to 20-04-2025

Project Title	PI / Co – PI	Funding Agency	Duration of the Project	Total Sanctioned	Remarks
Sarfez/SC/19-20/232(II) – "Tuning electrostatics and dynamics of the flexible areas of PCSK9 protein towards controlling interactions with LDLR: A computational approach"	Dr. Suman Chakrabarty	Sarfez Cure India	01-07-2024 to 30-06-2025	8,80,000/-	
"Design and Development of Quantum Entanglement – Enhanced Imaging Systems" Vertical: "Quantum Sensing & Metrology"	Dr. Manik Banik	DST (NQM) DST/FFT/NQM/QSM/2024/3	From 06-12-2024	8,00,000/-	

*** Apart from this, the Centre has also received the TRC project during January 2016.

Postdocs & Scientists under Projects; DST INSPIRE Faculty & Others (2024-25)

Sl.	Name	Designation	Project Name	P. I. of Project	Joined on	Appt. upto
1	Mr. Achintya Low	Research Associate – I (Ad-hoc), CMMP	*Search for Novel Magnetic and Topological Materials*	Prof. Tanusri Saha-Dasgupta	01.05.2024	Resigned on 01.08.2024
2	Dr. Ananda Gopal Maity	Senior Project Scientist (DST-NQM), PCS	*Design and development of quantum entanglement – enhanced imaging systems*	Dr. Manik Banik	21.02.2025	Till 2027
3	Dr. Arun K Maurya	Research Associate – I (Ad-hoc), CMMP	*JC Bose Award Fellowship*	Prof. Tanusri Saha-Dasgupta	02.01.2025	31.05.2025
4	Dr. Indrani Bhattacharyya	National Post-Doctoral Fellow, CBS	*Exploring Hydration Dynamics of Protein Aggregation and Its Connection with Liquid-Liquid Phase Separation Triggered by Modulation in Local Environmental Parameters Employing Terahertz Spectroscopy and Complementary Experimental Techniques*	Self [Prof. Rajib K Mitra, Mentor]	28.12.2022	27.12.2024
5	Dr. Indrani Bhattacharyya	Project Associate – I (Ad-hoc), CBS	*Biomolecular Condensates: Exploring the associated hydration and energetics using THz spectroscopy*	Prof. Rajib K Mitra	10.01.2025	09.07.2025
6	Dr. Gargee Bhattacharyya	National Post-Doctoral Fellow, CMMP	*Proximity induced spin-orbit coupling and magnetism on graphene from magnetic topological quantum matter (MTQM)*	Self [Prof. Priya Mahadevan, Mentor]	06.01.2023	05.01.2025
7	Dr. Mir Alimuddin	Chanakya PDF, PCS	*Devising Practically implementable enhanced means of communication with the aid of quantum resources*	Dr. Manik Banik, Mentor	13.06.2022	Resigned on 28.06.2024
8	Mr. Prasun Boyal	Research Associate – I (Ad-hoc), CMMP	*Twistronics with transition metal dichalogenides*	Prof. Priya Mahadevan	04.10.2024	03.04.2025
9	Dr. Soumya Bhattacharya	Research Associate – I, AHEP	*Gauge and Gravitational Symmetries in Nonrelativistic Theories : Formalism and Applications*	Prof. Rabin Banerjee	04.04.2022	03.04.2024
10.	Ms. Soma Dutta	Chanakya PDF (Ad-hoc), CMMP	*Two-dimensional Ferromagnetic and Organic Molecule Spinterfaces as Molecular Spin Qubits for Quantum Technologies and Energy Harvesting Applications*	Prof. Anjan Barman	21.10.2024	20.04.2025

Sl.	Name	Designation	Project Name	P. I. of Project	Joined on	Appt. upto
11	Dr. Subhendu Bikash Ghosh	Project Post-doctoral Fellow (DST-NQM), PCS	*Design and development of quantum entanglement – enhanced imaging systems*	Dr. Manik Banik	07.02.2025	Till 2027
12	Dr. Sumaiya Parveen	Chanakya PDF, CMMP	*Two-dimensional Ferromagnetic and Organic Molecule Spinterfaces as Molecular Spin Qubits for Quantum Technologies and Energy Harvesting Applications*	Prof. Anjan Barman	17.11.2023	Resigned on 28.06.2024
13	Dr. Tusita Sau	Research Associate – I, CMMP	*Search for Novel Magnetic and Topological Materials*	Prof. Tanusri Saha-Dasgupta	03.04.2023	02.04.2024

Sl.	Name	Designation	Project Name	P. I. of Project	Joined on	Appt. upto
1	**Dr. Ali Hossain Khan**	Ramanujan Fellow (Transferred from INST, Mohali)	*Doped 2D Nanocrystals for Photonic Applications*	Self	01.11.2021	31.03.2026
2	**Prof. Rabin Banerjee**	Raja Ramanna Fellow	*Gauge and Gravitational Symmetries in Nonrelativistic Theories : Formalism and Applications*	Self	03.05.2021	02.05.2024
3	**Dr. Bhaskar Mukherjee**	DST INSPIRE FACULTY	*Exploration of non-ergodic quantum many body systems without disorder*	Self	17.09.2024	16.09.2029
4	**Dr. Jiban Kangsabanik**	DST INSPIRE FACULTY	*Optimization of point defects and associatednonradiative recombination in two-dimensional Van der Waals bonded layered semiconductors for Ultrathin Photovoltaics*	Self	17.09.2024	Resigned on 22.04.2025
5	**Dr. Sanku Paul**	DST INSPIRE FACULTY	*Hidden quantum criticality and its application in data hiding*	Self	22.05.2023	21.05.2028
6	**Dr. Milan Patra**	DBT - RA I, CBS	*Investigation of cellular senescence of beta cells and interferon response in Aging and Diabetes*	Self [Dr. Shubhasis Haldar, Mentor]	25.11.2024	24.11.2026

LIST OF STUDENTS UNDER PROJECT

F.Y. 2024-2025

Sl	Name of The Student	Current Designation	Project Instructor	Dept.	Name of The Project	Tenure of The Project	Date of Admission	Continuing / Resigned On
1	Sweta Ghosh	Project JRF	Tanusri Saha Dasgupta	CMMP	Search for Novel Magnetic and Topological Materials	19.01.2026	08.11.2023	04.01.2025
2	Arghyadip Ghosh	Project Assistant (Ad-hoc)	Tanusri Saha Dasgupta	CMMP	J C Bose Fellowship Scheme	11.10.2025	04.07.2024	30.11.2024
3	Payal Bhattacharjee	Project JRF (Ad-hoc)	Anjan Barman	CMMP	Quantum heterostructures for spintronic development of strongly spin-orbit coupled topological applications	20.10.2026	20.01.2025	Continuing
4	Ria Ghosh	Project SRF	Samir Kumar Pal	CBS	Development of nano sensor and its application through cloud based network for real time irrigation to soil and plant	31.05.2024	14.01.2022	Tenure Completed

Sl	Name of The Student	Current Designation	Project Instructor	Dept.	Name of The Project	Tenure of The Project	Date of Admission	Continuing / Resigned On
5	Bikram Das	Project JRF	Ali Hossain Khan	CBS	Heavy-Metal-Free Photonic Colloidal 2D Nanocrystals	07.02.2026	12.06.2023	Continuing
6	Sourik Dutta	Project JRF	Ali Hossain Khan	CBS	Doped 2D Nanocrystals for Photonic Applications	31.03.2026	13.06.2023	Continuing
7	Archisman Sinha	Project JRF	Pradip S Pachfule	CBS	Olefin-linked Covalent Organic Frameworks (COFs) for Photocatalytic Water Splitting for Hydrogen Generation	26.01.2025	22.09.2023	20.07.2024
8	Sudipa Mondal	Project JRF (Ad-hoc)	Pradip S Pachfule	CBS	Olefin-linked Covalent Organic Frameworks (COFs) for Photocatalytic Water Splitting for Hydrogen Generation	26.01.2025	12.11.2024	Tenure Completed

Patents Granted / Applied (2024-25)

Patents Granted:

(1)

Patent No.: 539260

Application No.: 202031038150

Date of Filing: 04/09/2020

Date of Grant: 24/05/2024

A TRIBO-ELECTROCUETICAL PERSONAL PROTECTIVE SYSTEM AND ITS FABRICATION FOR POTENTIAL APPLICATION IN SELF SANITIZING PROPERTY

Patents Applied:

(1)

A portable point-of-care LOPA-Device (Loading of Pathogen Analyzer) for quantitative detection of pathogens

(Prof. Soumen Mondal, Prof. S.K. Pal)

Patent Application No: 202431039104 dated 18/05/2024

(2)

Hydrazone-based catalytic covalent organic frameworks (COFs) and materials thereof enabling photosynthesis of hydrogen peroxide from water

(Dr. Pradip S. Pachfule, Prof. Tanusri Saha-Dasgupta)

Patent Application No: 202531010086 dated 06/02/2025

Amitabha Lahiri

Amitabha Lahiri
Convenor, Project & Patent Cell

TECHNICAL RESEARCH CENTRE (TRC)

The Technical Research Centre (TRC), funded by the Department of Science & Technology, Ministry of Science & Technology, Government of India, at S. N. Bose National Centre for Basic Sciences, was launched on 01st January 2016. The aim is to establish an innovation cum translational research centre within the S. N. Bose National Centre that would build and harness able science and technology platforms by leveraging on its existing core strength in materials science and spectroscopic techniques. The extension phase of TRC (Phase-II) has started formally since January 2021, though the budget funding for Phase-II was sanctioned in February 2023 by the DST.

Major Target Areas in the Extended Phase (Phase II) :

- **Computational Materials Sciences**: Computational modelling for technologically important indigenous new materials and new functionalities, etc.
- **Nano-fabrication for Quantum Technology & Nanodevices**: Innovation in technology development - nano-fabrication for quantum technology & nanodevices, development of sensors and opto-electronic devices using ultra-thin layered materials, prototyping thin film devices using functional oxide patterned films, etc.
- **Bio-medical Instrumentation**: Spectroscopic and optical techniques, triboelectric nanogenerators for biomedical and health care applications, an optical emission spectroscopy-based sensor for minimally invasive detection of essential electrolytes in the human body, like sodium, lithium and potassium (NaLiK); modulation of THz-FIR radiation using patterned materials and its application to authenticate pharmaceutics, etc.
- **Food Adulteration and Environmental Mitigation**: Prototype development of Optical/NIR spectroscopic instrumentation for applications - A spectroscopy-based fluoride sensor in drinking water (FeFlu), adulteration in milk using spectroscopic techniques (Mil-Q-Way), etc.

Project Investigators (TRC Phase II) :

Prof. Rajib K. Mitra (Nodal Officer), Dr. Pradip Pachfule (Associate Nodal Officer), Prof. Tanusri Saha Dasgupta, Prof. Anjan Barman, Prof. Soumen Mondal, Prof. Jaydeb Chakrabarti, Dr. Atindra Nath Pal, Dr. Suman Chakrabarty, Dr. Avijit Chowdhury, Dr. Nitesh Kumar, Dr. Saquib Shamim, Dr. Shubhasis Haldar and Dr. Ali Hossain Khan.

Manpower details (phase II) :

- Number of Scientists (C & D): 8
- Number of Project Students: 13
- Number of Project Assistants: 6
- Number of Project Officers: 01

A few Research Activities undertaken under TRC (Phase II) :

1. Computation modelling for technologically important indigenous new materials and new functionalities
2. New semiconductor materials with unique optoelectronic properties.
3. Novel COF materials for hydrogen peroxide (H_2O_2) generation
4. Development of GHz to THz frequency nanoscale ferroic and multiferroic structures and devices for wave-based computation, communication and extreme sub-wavelength antenna application
5. Molecular dynamics simulations of polymer nanocomposites.
6. Modulation of THz-FIR radiation using patterned materials and its application to authenticate pharmaceuticals
7. Design and building of a low-cost Sun photometer to measure Aerosol Optical Depth and its effect on the environment
8. Adulteration in Milk using spectroscopic techniques (Mil-Q-Way).
9. Pathogen detection in dairy products
10. Towards flexible optoelectronic sensors and wearable self-powered health-monitoring devices.

11. Antimicrobial resistance (AMR): Novel inhibitors for beta-lactamase.
12. Low-noise devices for applications in quantum circuits.
13. The only high-throughput CSC quantifier and identifier.
14. Design and development of a self-powered flexible triboelectric nanogenerator for real-time monitoring of internal pressure distribution inside a prosthetic socket.
15. Functional covalent organic frameworks (COFs) for water splitting and energy storage
16. Testing of topological semimetals for catalytic activity.

A Few Highlighted Research Outputs:

- **Number of Research Publications: 73**
- **Number of Ph.D. produced/ongoing: 05**
- **Number of Patents Filed/Granted: 18**

Number of patents filed during 2024 – 2025:

Sl.	Title	Inventors	Country	Status
1.	Redox-active porous materials for metal-free alcohol dehydrogenation	Dr. Pradip Pachfule	India	Filed
2.	Photosynthesis of hydrogen peroxide from water using hydrazone-based covalent organic frameworks (COFs)	Dr. Pradip Pachfule	India	Filed

A few prototypes developed under TRC ready for Transfer of Technology:

- Ammonia gas sensor and a method for manufacturing the same **(Ammo-Watch)**
- A spark spectrometry-based point of care portable device for simultaneous detection of Na^+, Li^+ and K^+ concentration in body fluid **(NaliK)**
- A Spectroscopy-based optical device for estimation of milk quality **(Mil-Q-Way)**
- A spectroscopy-based fluoride sensor for drinking water **(Feflu)**
- A chromogenic nanocomposite-based optical device CapNanoScope, for detection and quantification of CO_2 **(CapNanoScope)**
- Piezo-electric nanowires for energy harvesting and sensitive motion **(PIEZOcell)** - Technology and prototype are ready to be transferred to Indian start-ups/Companies.

Knowledge-based services at TRC:

The TRC offers knowledge-based services in a number of highly sophisticated instrumentation, ranging from several spectroscopic to microscopic instruments. For more information, please visit our website**:** http://newweb.bose.res.in/departments/TRC

Rajib Kumar Mitra
Nodal Officer
Technical Research Centre

TECHNICAL CELL

Technical cell was established in the year of 2008 to maintain the central experimental facilities of SNBNCBS which can be availed by any researcher from our Centre as well as from other institutions / laboratories. The details of the available experimental facilities and the terms and conditions for using the s e facilities are mentioned in the website : https://newweb.bose.res.in/facilities/TechnicalCell/. The activities of Technical Cell during April 2024 - March 2025 are reported in the following sections:

I. Equipments available under technical cell

Sl. No.	**Name of the equipment**
1.	Transmission electron Microscope (TEM) with other attachments
2.	Thermo Gravimetry/Differential Thermal Analyzer (TG-DTA)
3.	Dynamic Light Scattering (DLS)
4.	Clean Room
5.	E-beam evaporator
6.	ICP-RIE
7.	Dual beam FIB/SEM
8.	Wire Bonder
9.	Mask aligner
10.	3K Resistivity Measurement Setup
11.	Field Emission Scanning Electron Microscopy (FESEF) Quanta FEG 250
12.	X-ray Diffraction
13.	UV Visible Spectrometer (UV-VIS) (2600)
14.	UV Visible Spectrometer (UV-VIS) (2450)
15.	Circular Dichroism (CD)
16.	Chemical Lab
17.	Ellipsometer
18.	Viscometer
19.	Densitymeter
20.	X-ray Diffractometer (XRD)(PANalytical X-PERT PRO
21.	Pulsed Laser Deposition (PLD) Unit
22.	Helium Leak Detector
23.	Liquid Nitrogen and Gases for Laboratory Use
24.	Fluorescence spectrometer (Fluorolog)
25.	Spevtrofluorometer (Fluoromax)
26.	Fourier Transform Infrared Spectrometer (FTIR)
27.	Mechanical workshop, Sputtering Unit, Millipore Water
28.	Vibrating Sample Magnetometer (VSM)
29.	Differential Scanning Calorimeter (DSC)
30.	Atomic Force Microscope (AFM)
31.	X-ray photo absorption spectroscopy (XPS)

II. Support to research activities:

Around 100 students and post-doctoral fellows of the Centre avail the above-mentioned experimental facilities extensively for their Ph.D. thesis work. 10 students completed their M.Sc. / M.Tech. project work; 15 students completed their summer projects performing extensive work using the equipment under the Technical Cell. About 80 external users used the Technical Cell facilities for their research work.

III. Support to the teaching activities of SNBNCBS

Students of the Centre's IPhD programme use the Technical Cell facilities and perform some of the experiments like Xray diffraction, UV – VIS spectroscopy, Differential Scanning Calorimetry as a part of their Advanced Experimental course (PHY 391). Also, they did their project works as a part of their IPhD curriculum.

IV. Major maintenance and up-gradation:

PLD: Replaced new LCB inside laser and EP-ROM supplied with LCB inside laser remote control. New installation of Millipore water purification system.

V. Utilization of some major equipment

ITEM	USAGE (time in hours)	UP TIME%	DOWN TIME%	NO. of External Users
PLD	250	40%	60%	NIL
FESEM	1000	90%	10%	20
XPERT PRO	700	70%	30%	NIL
MINI XRD	300	90%	10%	NIL
TG/DTA	500	95%	5%	20
AFM	400	60%	40%	10
HRTEM	1040	75%	25%	20
XPS	240	95%	5%	NIL

VI. Revenu Generation

Some revenue has been generated from the external users for using the facilities of Technical Cell.

Rajib Kumar Mitra
In-charge, Technical Cell

MECHANICAL WORKSHOP

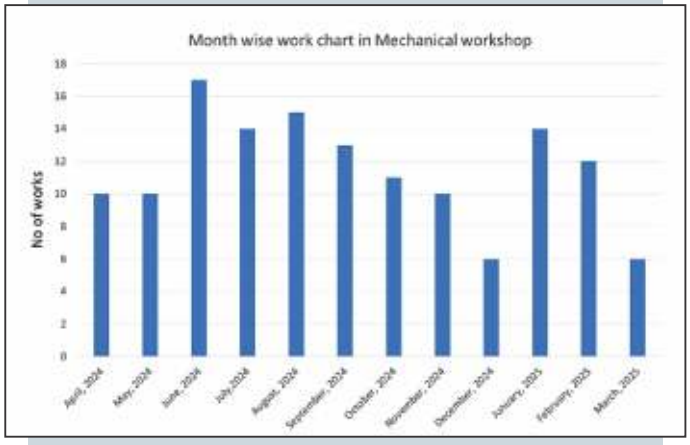
Mechanical workshop at the center is an important part, particularly to the experimental faculties. Throughout the year mechanical workshop functioned and catered to the demands of different departments and to the outside. It is handled by a mechanic in all days of the week and the users are required to enter their demands of major jobs in a log book for record, along with at least a rough sketch each. Total number of jobs finished: mechanical workshop – 138.

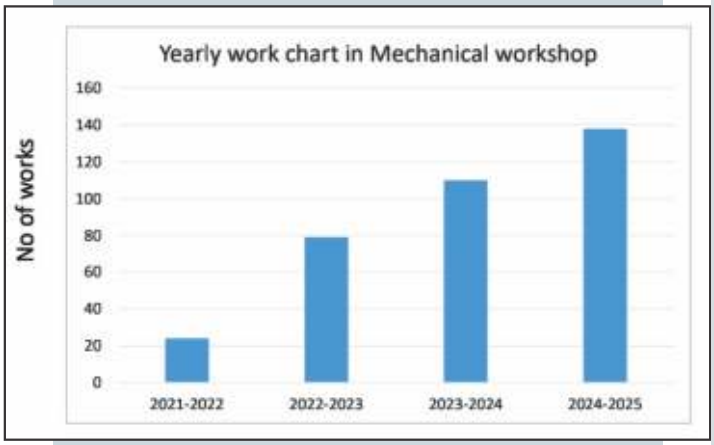
Month wise breakups are given below: (2024 – 2025). Three major equipment were procured during this time: CNC Milling Machine, All Gear Lathe Machine and Welding Machine from Center's TRC project. Also, whole workshop has moved to the old AC plant in the main building premises. With these new facilities will definitely help to make more sophisticated research equipment in future.

All Gear Lathe Machine

CNC Milling Machine

Welding Machine





TOTAL JOB DONE ON 01 APRIL 2024 TO 31 MARCH 2025: 138 nos

Pictures of the work have been done in work shop:

Atindra Nath Pal

Dr. Atindra Nath Pal
In charge of the Mechanical Workshop

GUEST HOUSE

BHAGIRATHI – THE GUEST HOUSE

The Centre has its own upfront modern guest house named 'Bhagirathi' located within the premises. It houses eight fully air-conditioned suites, each having attached bath and kitchenette. The kitchenettes are equipped with refrigerators, microwave-ovens & toasters. There are also eight (8) double-bedded rooms and forty-six (46) single bedded rooms. All the double-bedded rooms and single-bedded rooms are air-conditioned and are fully furnished and have attached baths. All rooms are provided with basic amenities like hot and normal water, intercom telephone, television with DTH connection, electric kettle etc. The Guest House is Wi-Fi enabled. A state-of-the-art display unit is installed in the Guest House Front Desk displaying various information about the Guest House & the Centre. These guests' rooms spread across the ground floor, first floor and second floor of the Bhagirathi building. Presently, the third floor of the building comprising of twenty-two (22) single bedded rooms and four (4) double bedded rooms are being used as hostel rooms for accommodating Centre's students. There is a seminar room within the guest house for hosting small conferences, meetings etc with separate dining facility. The Guest House also hosts the Medical Cell where doctor consultations are available for Centre's staff and students. The Dining Hall with a state-of-art Kitchen is housed in the guest house building. Apart from serving regular meals to the staff members of the Centre and to the visitors, the Dining Hall also serves as a venue for hosting lunches, dinners and high-tea on special occasions. A Rooftop Cafeteria has started functioning above the Dining Hall which serves snacks & beverages. Apart from accommodating Centre's guests and visitors, the Centre extends its guest house facilities to various government departments, organizations, research laboratories, universities, academic institutes etc based on availability of guest house rooms. The guest house extends efficient service and warm hospitality to the guests availing the services.

Smajumder

Shohini Majumder
Registrar

Crèche

Kishlay, the Creche facility of the Centre is functional for children of staff of the Centre upto the age of 6years. Kishlay is presently operating from 9.30 a.m. to 6.00 p.m. and closed on Sunday and Centre' sholidays. In this facility an array of toys, books for kids and other activity items are kept. At present there are three kids in the Creche (two children and one toddler). The Centre has arranged Caregivers to takecare of the children. To monitor the activities of the kids, CCTVs have been installed in the Creche and parents are given the access to check to the same.

Smajumder

Shohini Majumder
Registrar

List of **Publications**

Publications

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1. S. Bandyopadhyay and A. Barman, Nanomagnets as Dynamical Systems: Physics and Applications, Cham, Springer Nature Switzerland, 2024
2. Shatabda Bhattacharya, Shubhadip Moulick, Chinmoy Das, Hirokazu Tada, Pradip Chakraborty, Atindra Nath Pal, Magnetic field induced cooperativity tuning in a Fe (II)-based hybrid spin crossover network grown on 2D surfaces, MRS Advances, 8, 894-900, (2023), Correction was made on 03/02/2025
3. S Mukherjee, AN Pal, SK Ray, Characterizations of a few layered MoS2 phototransistor using a homebuilt cost-effective measurement setup, AIP Conference Proceedings 3067 (1) (2024)
4. R Alam, S Moulick, AN Pal, Flicker noise in an electrolyte gated large area GrFET, AIP Conference Proceedings 3067 (1), (2024).
5. R Pal, S Bera, B Pal, M Mondal, AN Pal, Intrinsic room temperature ferromagnetism in van der Waals Fe5GeTe2 crystal, AIP Conference Proceedings 3067 (1) (2024)
6. S Moulick, S Mukherjee, S Raha, A Singha, AN Pal, G phonon mode splitting in doped bilayer graphene probed by in-situ transport measurement and Raman spectroscopy, AIP Conference Proceedings 3067 (1) (2024)
7. Anupriya Nyayban, Subhasis Panda, and Avijit Chowdhury, The Mechanical and Transport Properties of RbPbX3 (X = I, Br, and Cl) by First Principle Calculations, AIP Conference Proceeding 3067, 020009, 2024
8. Sourav Sarkar, Priyanka Saha, Kalyan Mandal, “Correlation between negative dielectric permittivity and magnetism in spinel ferrite nano-structures”, Proceedings of the International Conference on Nanostructured Materials and Nanocomposites, organized by Mahatma Gandhi University, Kottayam, Kerala during 10-12 May 2024, Pg.196-199
9. T Saha-Dasgupta, Robust half-metallicity and topological properties in square-net potassium manganese chalcogenides, APS March Meeting Abstracts 2024, K03. 011 (2024)
10. S Chatterjee, R Mondal, C Pramanik, P Ghosh, T Saha-Dasgupta, Influence of Fe on the distribution and isotopic fractionation of Li in olivine: A first-principles study, EGU24 (2024)

Department of Physics of Complex Systems

1. Structural changes in binary colloidal system in an external modulation, Suravi Pal, J Chakrabarti, Srabani Chakrabarty Nee Sarkar, AIP Conference Proceedings , 2025
2. The effect of protein binding on conformational stability and order of DNA duplex with Hoogsteen base pairing , Kanika Kole, Aayatti Mallick Gupta, Jaydeb Chakrabarti , AIP Conference Proceedings , 2025
3. Book Chapter: Soft-Material-Based Devices and Technologies, Rahul Karmakar, J. Chakrabarti, in Soft Materials for Functional Applications, Ed: Vijay Kumar and Y. K. Mishra, STRUCTMAT, volume 225, Springer, 2024
4. Prosenjit Singha Deo and Kanchan Meena; Time travel: a reality in mesoscopic physics; Springer-Nature; February 2025
5. Urna Basu, Sanjib Sabhapandit, Ion Santra, Target search by active particles, in "Target Search Problems" edited by Denis Grebenkov, Ralf Metzler, Gleb Oshanin, Springer Cham (2024

Total number of Other Publications: 28

IMPACT FACTOR FOR PUBLICATIONS IN THE FINANCIAL YEAR 2024-25

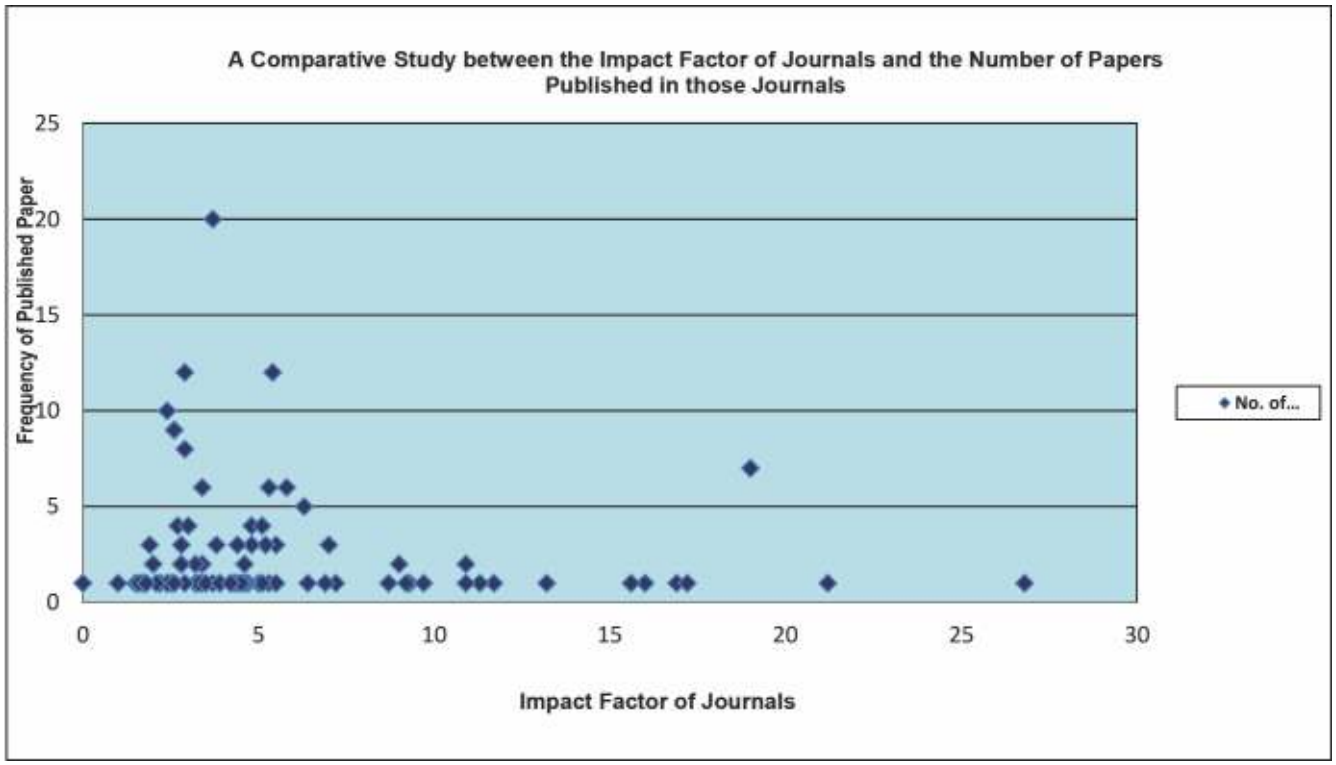
Sl No.	Name of Journal	Journal Impact Factor	No. of Papers Published	Total of Impact Factor in the Journal
1	ACS Applied Energy Materials	5.5	1	5.5
2	ACS Applied Materials & Interfaces	8.2	1	8.2
3	ACS Materials Letters	8.7	1	8.7
4	ACS Nano	16	1	16
5	ACS Omega	4.4	1	4.4
6	Acta Materialia	9.3	1	9.3
7	Advanced Engineering Materials	3.3	1	3.3
8	Advanced Functional Materials	19	7	133
9	Advanced Materials	26.8	1	26.8
10	Advanced Optical Materials	7.2	1	7.2
11	Advanced Quantum Technologies	4.3	1	4.3
12	Angewandte Chemie	16.9	1	16.9
13	APL Quantum	New Journal	1	New Journal
14	Applied Materials Today	6.9	1	6.9
15	Applied Physics A	2.8	3	8.4
16	Astronomical Journal	5.1	1	5.1
17	Astronomy & Astrophysics	5.8	6	34.8
18	Astrophysical Journal	5.4	12	64.8
19	Astrophysical Journal Letters	11.7	1	11.7
20	Astrophysics and Space Science	1.7	1	1.7
21	Biophysical Chemistry	2.2	1	2.2
22	Chaos	3.2	1	3.2
23	Chemical Engineering Journal	13.2	1	13.2
24	Chemical Physics	2.4	1	2.4
25	Chemistry: A European Journal	3.7	1	3.7
26	Chemistry: An Asian Journal	3.3	1	3.3
27	Chemistry of Materials	7	3	21
28	Chemistry Select	2	2	4
29	Chem Med Chem	3.4	2	6.8
30	Chem Nano Mat	2.6	1	2.6

Sl No.	Name of Journal	Journal Impact Factor	No. of Papers Published	Total of Impact Factor in the Journal
31	Classical and Quantum Gravity	3.7	1	3.7
32	Crystal Growth & Design	3.4	1	3.4
33	Dalton Transactions	3.3	1	3.3
34	European Physical Journal C	4.8	4	19.2
35	European Physical Journal Special Topics	2.4	1	2.4
36	General Relativity and Gravitation	2.8	2	5.6
37	Geochimica et Cosmochimica Acta	5	1	5
38	Gravitation and Cosmology	1	1	1
39	Green Chemistry	9.2	1	9.2
40	Heliyon	3.9	1	3.9
41	Infrared Physics & Technology	3.4	2	6.8
42	IEEE Sensors Letters	2.2	1	2.2
43	IEEE Transactions on Plasma Science	1.5	1	1.5
44	International Journal of Theoretical Physics	1.7	1	1.7
45	Journal of Alloys and Compounds	6.3	5	31.5
46	Journal of the American Chemical Society	15.6	1	15.6
47	Journal of Applied Physics	2.7	4	10.8
48	Journal of Astrophysics and Astronomy	1.6	1	1.6
49	Journal of Biomedical Materials Research Part A	3.9	1	3.9
50	Journal of Chemical Information and Modeling	5.3	1	5.3
51	Journal of Chemical Physics	3.8	3	11.4
52	Journal of Chemical Sciences	2	2	4
53	Journal of Chemical Theory and Computation	5.5	1	5.5
54	Journal of Condensed Matter	NA	1	NA
55	Journal of Earth System Science	1.8	1	1.8
56	Journal of Electronic Materials	2.5	1	2.5
57	Journal of Hazardous Materials	11.3	1	11.3
58	Journal of Heterocyclic Chemistry	2.4	1	2.4
59	Journal of High Energy Physics	5.5	3	16.5
60	Journal of Macromolecular Science Part A	2.4	1	2.4
61	Journal of Materials Chemistry C	5.1	1	5.1
62	Journal of Molecular Liquids	5.2	3	15.6
63	Journal of Non-Crystalline Solids	3.5	1	3.5
64	Journal of the Optical Society of America B	1.8	1	1.8
65	Journal of Photochemistry and Photobiology A: Chemistry	4.7	1	4.7

Sl No.	Name of Journal	Journal Impact Factor	No. of Papers Published	Total of Impact Factor in the Journal
66	Journal of Physical Chemistry B	2.9	8	23.2
67	Journal of Physical Chemistry C	3.2	2	6.4
68	Journal of Physical Chemistry Letters	4.6	2	9.2
69	Journal of Physics: Condensed Matter	2.6	9	23.4
70	Journal of Physics A: Mathematical and Theoretical	2.1	1	2.1
71	Journal of Statistical Mechanics: Theory and Experiment	1.9	3	5.7
72	JPhys Materials	4.3	1	4.3
73	Langmuir	3.9	1	3.9
74	Materials Chemistry and Physics	4.7	1	4.7
75	Materials Chemistry Frontiers	6.4	1	6.4
76	Materials Science and Engineering: B	4.6	1	4.6
77	Materials Today Communications	4.5	1	4.5
78	Materials Today Physics	9.7	1	9.7
79	Monthly Notices of the Royal Astronomical Society	4.8	3	14.4
80	Nanoscale	5.1	4	20.4
81	Nanotoday	10.9	1	10.9
82	Nature Communications	17.2	1	17.2
83	Nature Physics	21.2	1	21.2
84	New Journal of Physics	2.8	2	5.6
85	npj 2D Materials and Applications	10.9	2	21.8
86	Physica B: Condensed Matter	2.8	2	5.6
87	Physica E	2.9	1	2.9
88	Physica Scripta	2.6	9	23.4
89	Physica Status Solidi B: Basic Solid State Physics	1.8	1	1.8
90	Physical Chemistry Chemical Physics	3	4	12
91	Physical Review A	2.9	12	34.8
92	Physical Review Applied	4.4	3	13.2
93	Physical Review B	3.7	20	74
94	Physical Review D	5.3	6	31.8
95	Physical Review E	2.4	10	24
96	Physical Review Letters	9	2	18
97	Physical Review Materials	3.4	6	20.4
98	Physical Review Research	4.2	1	4.2

Sl No.	Name of Journal	Journal Impact Factor	No. of Papers Published	Total of Impact Factor in the Journal
99	Physics Letters A	2.6	1	2.6
100	Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences	3.3	1	3.3
101	Process Safety and Environmental Protection	7.8	1	7.8
102	Protein Science	5.2	1	5.2
103	Quanta	NA	1	NA
104	Quantum	NA	2	NA
105	Quantum Information Processing	2.2	1	2.2
106	Renewable and Sustainable Energy Reviews	16.3	1	16.3
107	Research in Astronomy and Astrophysics	2.8	1	2.8
108	SciPost Physics Codebases	12.43	1	12.43
109	Small	12.1	3	36.3
110	Solid State Communications	2.4	1	2.4
111	Surfaces and Interfaces	6.3	2	12.6
112	Sustainable Energy and Fuels	4.1	1	4.1
113	Ultrasonics	4.1	1	4.1
	TOTAL		**254**	**1263.33**

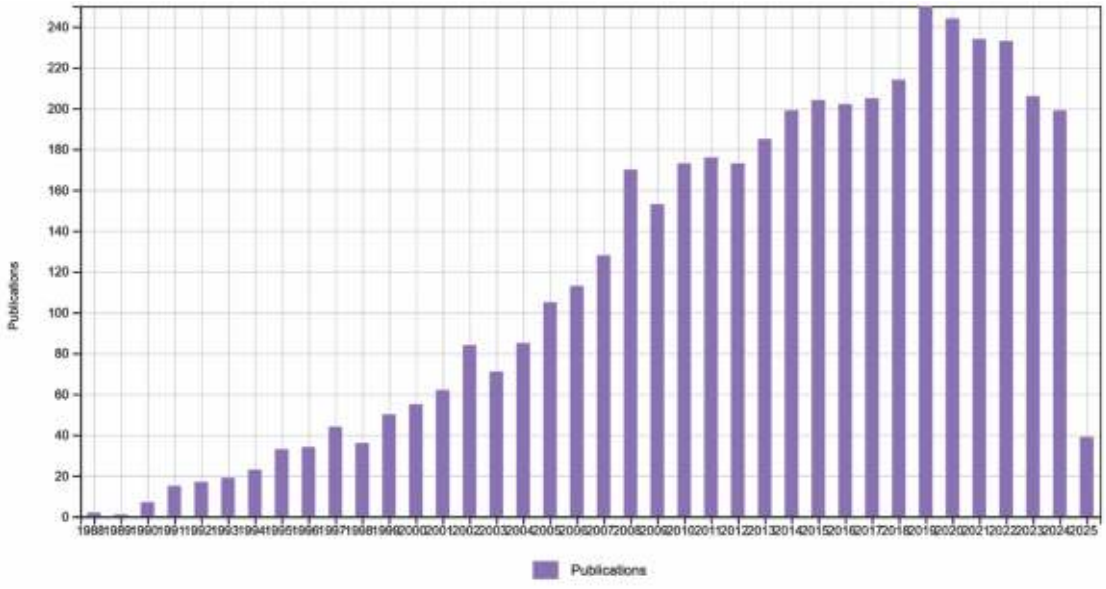
Average Impact Factor Per Paper	**5.07**

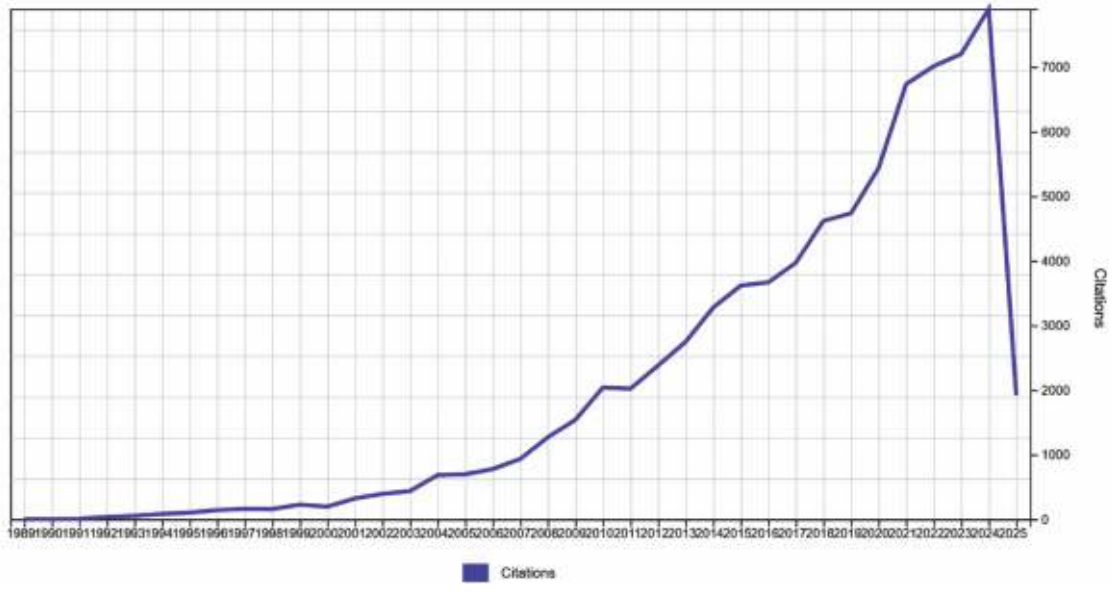


RESEARCH PUBLICATION STATUS

Citation Report (On 8th April, 2025)

Time span = All years. Database = SCI-EXPANDED, CPCI-S, CPCI-SSH, CCR-EXPANDED, IC.





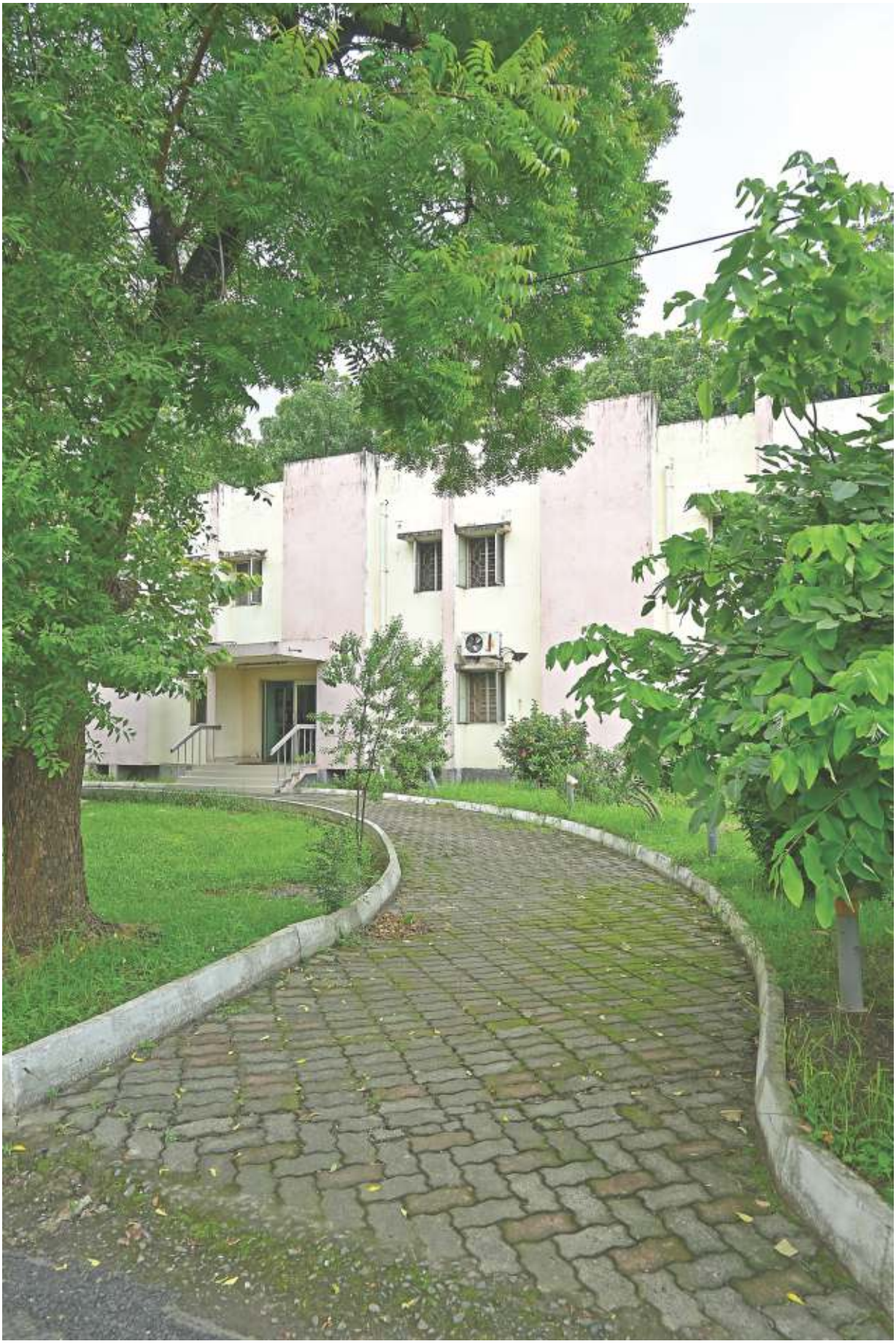
No. of Publications	:	4443
Sum of the Times Cited	:	77469
Sum of Times Cited without self-citations	:	65240
Citing Articles	:	52372
Citing Articles without self-citations	:	49228

Total no. of Papers published	Total no. of Citation received	Citations per paper	Citation per year*	h-index
4443	77469	77469/4443 = 17.44	77469/ 38 = 2038.66	93

* Year of establishment of the Centre is 1986. Citations received after 1987 to 2025 = 38 years

Source : web of science

Prepared by : Dr. Saumen Adhikari, Librarian cum – Information Officer



Accounts

Satyendra Nath Bose National Centre for Basic Sciences

Block JD, Sector-III, Salt Lake, Kolkata - 700 106

BUDGET SUMMARY 2024-2025

The funds come from Department of Science and Technology, New Delhi. The following is the summary of budget estimates for the year 2024-2025

(Figure in Lakhs)

	Actuals 2023-2024	Budget Estimate 2024-2025	Revised Estimate 2024-2025
Plan	5084.87	5628.19	5711.29

Plan

Sl no.	Sanction Letter No.	Dated	Amount (Rs. in Lakh)
1	AI/SNBNCBS/SAL/003/2024/1	05.04.2024	425.00
2	AI/SNBNCBS/SAL/003/2024/2	01.07.2024	320.00
3	AI/SNBNCBS/SAL/003/2024/3	04.09.2024	650.00
4	AI/SNBNCBS/SAL/003/2024/4	01.01.2025	350.00
5	AI/SNBNCBS/GEN/003/2024/1	05.04.2024	500.00
6	AI/SNBNCBS/GEN/003/2024/2	01.07.2024	410.00
7	AI/SNBNCBS/GEN/003/2024/3	04.09.2024	700.00
8	AI/SNBNCBS/GEN/003/2024/4	01.01.2025	600.00
9	AI/SNBNCBS/CAP/003/2024/1	05.04.2024	300.00
10	AI/SNBNCBS/CAP/003/2024/2	01.07.2024	220.00
11	AI/SNBNCBS/CAP/003/2024/3	04.09.2024	200.00
12	AI/SNBNCBS/CAP/003/2024/4	28.03.2025	250.00
	Total		**4925.00**

INDEPENDENT AUDITOR'S REPORT

To the Members of

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

Opinion

We have audited the financial statements of **SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES ("the Centre"),** which comprise the Balance Sheet as at 31st March, 2025, the statement of Income & Expenditure, Receipts and Payments Account for the year ended and notes to the financial statements, including a summary of significant accounting policies and other explanatory information.

In our opinion and to the best of our information and according to the explanations given to us, the aforesaid financial statements give a true and fair view in conformity with the accounting principles generally accepted in India, of the state of affairs of the Centre as at 31st March, 2025, **Surplus** for the year ended on that date

Basis for Opinion:

We conducted our audit in accordance with the Standards on Auditing (SAs) issued by the Institute of Chartered Accountants of India. Our responsibilities under those Standards are further described in the Auditor's Responsibilities for the Audit of the Financial Statements section of our report. We are independent of the Society in accordance with the Code of Ethics issued by the Institute of Chartered Accountants of India together with the ethical requirements that are relevant to our audit of the financial statements under the Act, and the Rules there-under, and we have fulfilled our other ethical responsibilities in accordance with these requirements and the Code of Ethics. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Emphasis of matter

We draw attention to the matters stated in the following note numbers to the financial statements. Our opinion is not modified in respect of this matter: -

Due to recognition of Accrued Interest on Term Deposit (created against earmarked fund) as part of Corpus Fund, the comparative figures for the previous year 2023-24 have been restated to reflect consistency in Accounting Policy as mentioned in 10.1. The impact of such treatment arising during such period resulted in Reduction in Revenue Surplus and Increase in Corpus Fund.

Responsibilities of the Members for the Financial Statements

The Members are responsible with respect to the preparation of these financial statements that give a true and fair view of the financial position, financial performance of the firm in accordance with the accounting principles generally accepted in India, including the Accounting Standards specified under the relevant Act. This responsibility also includes maintenance of adequate accounting records in accordance with the provisions of the Act for safeguarding of the assets of the business and for preventing and detecting frauds and other irregularities; selection and application of appropriate accounting policies; making judgments and estimates that are reasonable and prudent; and design, implementation and maintenance of adequate internal financial controls, that were operating effectively for ensuring the accuracy and completeness of the accounting records, relevant to the preparation and presentation of the financial statements that give a true and fair view and are free from material misstatement, whether due to fraud or error.

The Members are also responsible for overseeing the Centre's financial reporting process.

Auditor's Responsibility for the Audit of the Financial Statements

Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with SAs will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

As part of an audit in accordance with SAs, we exercise professional judgment and maintain professional skepticism throughout the audit. We also:

- Identify and assess the risks of material misstatement of the financial statements, whether

INDEPENDENT AUDITOR'S REPORT (Contd...)

due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.

- Obtained an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances. We are also responsible for expressing our opinion on whether the firm has internal financial controls with reference to financial statements system in place and the operating effectiveness of such controls.
- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by the partners.
- Conclude on the appropriateness of use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Firm's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report. However, future events or conditions may cause the Firm to cease to continue as a going concern.
- Evaluate the overall presentation, structure and content of the financial statements, including the disclosures, and whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation.

Report on Other Legal and Regulatory Requirements

1. We further report, that:

a) We have sought and obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purposes of our audit.

b) In our opinion, proper books of account as required by law have been kept by the Centre so far as it appears from our examination of those Books;

c) The Balance Sheet and the Statement of Income and Expenditure dealt with by this Report are in agreement with the Books of Account;

d) In our opinion, the aforesaid Financial Statements comply with the Accounting Standards issued by the Institute of Chartered Accountants of India.

e) The Centre has pending litigations which will have no impact on its financial position.

f) The Centre did not have any Long-Term contracts including derivative contracts for which there were any material foreseeable losses.

For Roy & Bagchi
Chartered Accountants
FRN No. 301053E

(CA AMIT MITRA)
Partner
Membership No 060694
UDIN: 25060694BMILWN2795

Place: Kolkata
Date: 22.08.2025

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 106

BALANCE SHEET AS AT 31ST MARCH 2025 **Amount (Rs.)**

	Schedule	Current Year (2024-25)	Previous Year (2023-24)
FUNDS AND LIABILITIES			
Capital / Corpus Fund	**1**	1458261893.77	1418973973.93
Reserves And Surplus	**2**	-	-
Earmarked/Endowment Funds	**3**	346803696.63	311619114.79
Secured Loans And Borrowings	**4**	-	-
Unsecured Loans And Borrowings	**5**	-	-
Deferred Credit Liabilities	**6**	-	-
Current Liabilities And Provisions	**7**	53008349.33	36096214.22
TOTAL		**1858073939.73**	**1766689302.94**
ASSETS			
Fixed Assets	**8**	770871085.30	698192577.26
Investments-From Earmarked/Endowment Funds	**9**	241883613.00	204957371.00
Investments - Others	**10**	457885726.00	432314479.00
Current Assets, Loans, Advances Etc.	**11**	387433515.43	431224875.68
Miscellaneous Expenditure			
TOTAL		**1858073939.73**	**1766689302.94**
Significant Accounting Policies	**24**		
Contingent Liabilities And Notes On Accounts	**25**		

As Per our report of even date

Date: 05/09/2025
Place: Kolkata

For **Roy & Bagchi**
Chartered Accountants
FRN: 301053E

(**Amit Mitra**)
Partner
Membership no:060694

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 106

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2025 **Amount (Rs.)**

	Schedule	Current Year	Previous Year
INCOME			
Income from Services	12	16330039.03	9692814.00
Grants/Subsidies	13	395499984.00	398299846.00
Fees/Subscriptions(Student Admission & Semester Fees)	14	1652550.00	1545300.00
Income from Investments (Income on Investment/ Earmarked/ Endowment Funds transferred to Funds)	15	-	-
Income from Technology Transfer & Contract Project	16	-	-
Interest Earned on Term Deposits (including in on HBA)	17	435465.00	101478.00
Other Income	18	2179393.96	1435080.38
Increase/(decrease) in stock of finished goods and works-in-progress	19	-	
TOTAL (A)		**416097431.99**	**411074518.38**
EXPENDITURE			
Establishment Expenses	20	174957272.00	159685687.00
Other Administrative Expenses etc.	21	239995677.44	223607928.12
Expenditure on Grants, Subsidies etc.	22	-	-
Interest Expenses	23	-	-
TOTAL (B)		**414952949.44**	**383293615.12**
Balance being excess of Income over Expenditure(A-B)		1144482.55	27780903.26
Prior period adjustments (Credit)		-	53096.12
Transfer to/from Capital Fund			
BALANCE BEING SURPLUS/(DEFICIT) CARRIED TO CORPUS/CAPITAL FUND		1144482.55	27833999.38
Significant Accounting Policies	24		
Contingent Liabilities And Notes On Accounts	25		

As Per our report of even date

Date: 04/09/2025
Place: Kolkata

For **Roy & Bagchi**
Chartered Accountants
FRN: 301053E

(**Amit Mitra**)
Partner
Membership no:060694

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

RECEIPTS AND PAYMENTS ACCOUNTS

For the year ended 31st March 2025

Amount (Rs.)

RECEIPTS	Current Year	Previous Year	PAYMENTS	Current Year	Previous Year
I. Opening Balances			**I. Expenses :**		
a) Cash in hand	0.00	4934.00	a) Establishment Expenses	184419278.00	243678714.00
b) Bank Balances :			b) Administrative Expenses	240106106.00	102352205.00
i. In current accounts(Schd 11A)	27770569.94	33929134.53	c) Maintenance	0.00	71118030.96
ii. In deposit accounts			**II. Payments made against funds for**		
Schedule - 10	432314479.00	479577646.00	**various Projects**		
Schedule - 11A	71512546.00	0.00			
iii. Savings accounts (Schd 11A)	60180153.49	64387626.00	**III. Investments and deposits made**		
iv. Remittance-in-Transit			a) Out of Earmarked/Endowment	0.00	0.00
II. Grants Received			b) CPWD Deposit and NBCC Deposit		
a) From Government of India			c) Bank Gurantee & LC A/C	39862789.00	46705855.00
-For the year	537080065.64	593864623.00	d) Out of Own Fund	76968194.58	87966655.00
-For the previous year					
b) From State Government			**IV. Expenditure on Fixed Assets &**		
c) From Other sources (details)			**Capital Work-in-Progress**		
(Grants for capital & revenue exp.			a) Purchase of Fixed Assets	116942483.65	159114325.00
To be shown separately)			b) Expenditure on Capital Work-in-Progress	16318488.00	
			V. Refund of Interest		
III. Interest Received			a) To the Government of India		
a) On Bank deposits	44858524.00	2605024.00	b) To the State Government		
			c) To other providers of funds		
IV. Other Income	20274690.96	16051330.15	**VI. Finance Charges (Interest)**		
V. Amount Borrowed			**VII. Other Payments**	28162773.32	69808471.29
VI. Any other receipts	0.00	0.00	**VIII. Closing Balances**		
			a) Cash in hand	0.00	0.00
VII. Amount transferred from Current Account/	11156176.00	112216034.00	b) Bank Balances :		
Savings Account to Deposit Account.			i. In current accounts(Schd 11A)	37019594.85	27770569.94
			ii. In deposit accounts		0.00
VIII. Amount transferred from Deposit Account	69907653.00	69885653.00	Schedule - 10	457885726.00	432314479.00
to Savings Account & Currect Account.			Schedule - 11A	39862789.00	71512546.00
			iii. Savings accounts(Schd.11A)	37506635.63	60180153.49
			iv. Remittance-in-Transit		
	1275054858.03	**1372522004.68**		**1275054858.03**	**1372522004.68**

Per our report of even date
For Roy & Bagchi
Chartered Accountants
FRN: 301053E

(Amit Mitra)
Partner
Membership no: 060694

Date : 05.09.2025
Place: Kolkata

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK-JD, SECTOR III, SALT LAKE CITY, KOLKATA 700 106

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31.03.2025 **Amount (Rs.)**

	Current Year		Previous Year	
SCHEDULE 1 -CAPITAL FUND:				
Balance as at the beginning of the year	1418973973.93		1348893098.36	
Add : Contributions towards Corpus/ Capital Fund	95664865.00		102759663.00	
Less: Depreciation for the year	60582464.39		63197153.34	
Add: Prior Period Adjustment during the year	3061036.68		2684366.53	
Add : Surplus / Deficit during the year	1144482.55		27833999.38	
		1458261893.77		1418973973.93
BALANCE AS AT THE YEAR - END		**1458261893.77**		**1418973973.93**

	Current Year		Previous Year	
SCHEDULE 2 - RESERVES AND SURPLUS:				
1. **Capital Reserve:** As per last Account Addition during the year Less: Deductions during the year				
2. **Revaluation Reserve:** As per last Account Addition during the year Less: Deductions during the year				
3. **Special Reserves:** As per last Account Addition during the year Less: Deductions during the year				
4. **General Reserve:** As per last Account				
Add : Surplus during the year		-		-
TOTAL		**-**		**-**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK-JD, SECTOR III, SALT LAKE CITY, KOLKATA 700 106

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31.03.2025

SCHEDULE 3 - EARMARKED/ENDOWMENT FUNDS

Amount (Rs.)

	FUND-WISE BREAK UP					TOTAL	
	Technical Research Centre	Project Fund	Retirement Benefits Fund	Staff Medical Fund	Corpus Fund	Current Year	Prev. Year
a) Opening balance of the funds	2342566.31	116677534.98	126560494.00	12835102.00	53203417.50	311619114.79	296187801.93
b) Additions to the Funds							
i) Donations/grants/ Contributions	51973123.00	9232237.84	-		-	61205360.84	95831606.00
ii) Income from investments made on account of funds	-	-	5290489.00	1188250.00	727905.00	7206644.00	10817886.00
iii) Total Interest on Earmarked/ Endowment Fund during the year	-	3233871.00	-	-	41301896.00	44535767.00	27721981.00
TOTAL (a + b)	**54315689.31**	**129143643.82**	**131850983.00**	**14023352.00**	**95233218.50**	**424566886.63**	**430559274.93**
c) Utilisation/Expenditure towards objectives of funds							
i) Capital Expenditure							
Fixed Assets	137000.00	39890981.00	-	-	-	40027981.00	49775755.76
Others	-	-	-	-	-	-	-
ii) Revenue Expenditure							
Salaries, Stipend and allowances etc.	6534737.00	2927269.00				9462006.00	36817689.00
Rent	-	-	-	-	-	-	-
Other Administrative expenses	-	110429.00				110429.00	21234515.38
Other Payments	-	28162774.00	-	-	-	28162774.00	10376856.00
iii) Adjustment	-	-	-	-	-	-	-
Interest Refunded to DST	-	-	-	-	-	-	735344.00
Unspent balance refunded to DST	-	-	-	-	-	-	-
TOTAL (c)	**6671737.00**	**71091453.00**	**-**	**-**	**-**	**77763190.00**	**118940160.14**
NET BALANCE AS AT THE YEAR-END (a+b-c)	**47643952.31**	**58052190.82**	**131850983.00**	**14023352.00**	**95233218.50**	**346803696.63**	**311619114.79**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK-JD, SECTOR III, SALT LAKE CITY, KOLKATA 700 106

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31.03.2025 **Amount (Rs.)**

Particulars	Current Year		Previous Year	
SCHEDULE 4 - SECURED LOANS AND BORROWINGS:				
1. Central Government				
2. State Government (Specify)				
3. Financial institutions				
a) Term Loans b) Interest accrued and due				
4. Banks:				
a) Term Loans Interest accrued and due b) Other Loans (Specify) Interest accrued and due				
5. Other Institutions and Agencies				
6. Debentures and Bonds				
7. Others (Specify)				
TOTAL	**Nil**	**Nil**	**Nil**	**Nil**

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31.03.2025 **Amount (Rs.)**

Particulars	Current Year		Previous Year	
SCHEDULE 5 - UNSECURED LOANS AND BORROWINGS				
1. Central Government				
2. State Government (Specify)				
3. Financial Institutions				
4. Banks:				
a) Term Loans b) Other Loans (Specify)				
5. Other Institutions and Agencies				
6. Debentures and Bonds				
7. Fixed Deposits				
8. Others (Specify)				
TOTAL	Nil	Nil	Nil	Nil

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK-JD, SECTOR III, SALT LAKE CITY, KOLKATA 700 106

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31.03.2025 **Amount (Rs.)**

	Current Year		Previous Year	
SCHEDULE 6 - DEFERRED CREDIT LIABILITIES:				
a) Acceptances secured by hypothecation of capital equipment and other assets				
b) Others				
TOTAL	Nil	Nil	Nil	Nil

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31.03.2025 **Amount (Rs.)**

		Current Year		Previous Year
SCHEDULE 7 - CURRENT LIABILITIES AND PROVISIONS				
A. CURRENT LIABILITIES				
1. Acceptances				
2. Sundry Creditors:				
a) For Capital expenditure		-		30000.00
b) Others - Revenue expenditure (including TRC & Project)		69080.97		59000.00
3. Other Liabilities		22655907.02		6299893.88
4. Deposit from Contractors (including Project & TRC)		10840024.50		11388273.50
5. Deposit from Students and other		2671500.00		2384500.00
6. Deposit from Contractual Employees		1458486.00		1445207.00
7. Provident Fund Account (Payable)		4725014.80		4043941.80
8. Project Overhead Fund		7507693.53		7456720.53
9. Refundable to DST		-		-
10. Employees Welfare Fund		221394.00		129429.00
11. EVLP Overhead Fund		2859248.51		2859248.51
TOTAL (A)		**53008349.33**		**36096214.22**
B. PROVISIONS				
1. For Taxation		-		-
2. Gratuity		-		-
3. Superannuation/Pension		-		-
4. Accumulated Leave Encashment		-		-
5. Trade Warranties/Claims		-		-
6. Others - Ad hoc Bonus		-		-
TOTAL (B)		**-**		**-**
TOTAL (A + B)		**53008349.33**		**36096214.22**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK-JD, SECTOR III, SALT LAKE CITY, KOLKATA 700 106

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31.03.2025

Amount (Rs.)

SCHEDULE 8 -FIXED ASSETS

DESCRIPTION	GROSS BLOCK				DEPRECIATION				NET BLOCK	
	Cost/valuation As at begin. of the year	Additions during the year	Adjustment during the year	Cost/valuation at the year-end	As at the beginning of the year	Additions during the year	Adjustment during the year	Total up to the Year-end	Current year-end	Previous year-end
A. FIXED ASSETS:										
1. LAND:										
a) Freehold										
b) Leasehold	10950654.60	-	-	10950,654.60	-	-		-	10950654.60	10950654.60
2. BUILDINGS:										
a) On Leasehold Land	459493644.86	3666134.00	-	463159778.86	95131048.23	7283450.70		102414498.93	360745279.93	364362596.63
b) On Freehold Land	-	-	-	-	-	-		-	-	-
c) Ownership Flats/Premises	-	-	-	-	-	-		-	-	-
d) Superstructures on Land not belonging to the entity	-	-	-	-	-	-		-	-	-
3. PLANT MACHIENRY & EQUIPMENT	734944478.27	132833063.68	33871519.68	833906022.27	505991217.57	38785231.21		544776448.78	289129573.49	228953260.70
4. VEHICLES	721186.00	-	-	721186.00	481465.76	85640.84		567106.60	154079.40	239720.24
5. FURNITURE, FIXTURES	44090054.71	1506481.00	2700.00	45593835.71	32873687.08	1238893.71		34112580.79	11481254.92	11216367.63
6. OFFICE EQUIPMENT	5570436.08	-	-	5570436.08	4701295.36	180031.17		4881326.53	689109.55	869140.72
7. COMPUTER & LAN INSTALLATION	127977434.20	14087788.30	5596493.30	136468729.20	52425274.24	13063802.61	126983.40	65362093.45	71106635.75	75552159.96
8. ELECTRIC INSTALLATIONS	12786567.00	-	-	12786567.00	11145725.22	72397.55		11218122.77	1568444.23	1640841.78
9. LIBRARY BOOKS	-	-	-	-	-	-		-	-	-
10. TUBEWELLS & W.SUPPLY	-							-	-	-
11. OTHER FIXED ASSETS	10000.00	-	-	10000.00	9500.00	-		9500.00	500.00	500.00
TOTAL OF CURRENT YEAR	1396544455.72	152093466.98	39470712.98	1509167209.72	702759213.46	60709447.79	126983.40	763341677.85	745825531.87	693785242.26
PREVIOUS YEAR	1445319480.52	194651305.75	319846255.51	1320124530.76	741596613.48	35240634.38	107066771.07	669770476.79	650354053.97	703722867.04
B. CAPITAL WORK IN PROGRESS	4407335.00	16318488.78		20725823.78	-	-	-	-	20725823.78	4407335.00
C. Intangable Assest under Development	-	4319729.65	-	4319729.65	-	-	-	-	4319729.65	-
TOTAL (A + B)	1400951790.72	172731685.41	39470712.98	1534212763.15	702759213.46	60709447.79	126983.40	763341677.85	77087108530	698192577.26

Note: 1. Assets held for Disposal transferred to Non Current Assets - Rs.6,22,356.20 in schedule -11 (Previous year - Rs.622356.20), see note in 11B

2. Previous year figure regrouped/ re arranged where ever necessary.

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK-JD, SECTOR III, SALT LAKE CITY, KOLKATA 700 106

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31.03.2025 **Amount (Rs.)**

SCHEDULE 9 - INVESTMENTS FROM EARMARKED/ENDOWMENT FUNDS

		Current Year	Previous Year
1.	In Government Securities		
2.	Other approved Securities		
3.	Shares		
4.	Debentures and Bonds		
5.	Subsidiaries and Joint Ventures		
6.	Project Fund Investment	71882181.00	68690866.00
7.	Retirement Benefit Fund Investment	141458192.00	113393971.00
8.	Staff Medical Fund Investment	12166085.00	8140719.00
9.	Corpus Fund Investment (Project Overhead)	16377155.00	14731815.00
10.	TRC Fund Investment	-	-
	TOTAL	**241883613.00**	**204957371.00**

SCHEDULE 10 - INVESTMENTS - OTHERS

		Current Year	Previous Year
1.	In Government Securities		
2.	Other approved Securities		
3.	Shares		
4.	Debentures and Bonds		
5.	Subsidiaries and Joint Ventures		
6.	Others - Fixed Deposit with Indian Overseas Bank (including Project Overhead Investment)	287093848.00	280658745.00
	Fixed Deposit with Union Bank of India	160791878.00	151655734.00
	Fixed Deposit with HDFC	10000000.00	-
	TOTAL	**457885726.00**	**432314479.00**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK-JD, SECTOR III, SALT LAKE CITY, KOLKATA 700 106

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31.03.2025 **Amount (Rs.)**

SCHEDULE 11 - CURRENT ASSETS, LOANS, ADVANCES ETC.

	Current Year	Previous Year
A. CURRENT ASSETS:		
1. Inventories:		
a) Stores and Spares	44203.53	145,787.91
2. Cash balances in hand		
3. Bank Balances:		
a) With Scheduled Banks:		
On Current Accounts:	37019594.85	27770569.94
On Deposit Accounts for LC&BG:	39862789.00	71512546.00
On Savings Accounts:	37506636.63	60180153.49
5. Remittance - in - Transit		
6. Post Office-Savings Accounts		
TOTAL (A)	114433223.01	159609057.34

SCHEDULE 11 - CURRENT ASSETS, LOANS, ADVANCES ETC. (Contd.)

	Current Year		Previous Year	
B. LOANS, ADVACNES AND OTHER ASSETS				
1. Loans:				
a) Staff including HBA ,Vehicle &PC Advance		700852.00		251598.00
b) Project Account		2693926.54		-
2. Advances and other amounts recoverable in cash or in kind or for value to be received:				
a) On Capital Account - CPWD Deposit Account	438840.00		438840.00	
b) GST payment	-		-	
c) Others	3918549.54		373359.00	
d) Contractors & Suppliers	17103562.00	21460951.54	17762941.00	18575140.00
3. Income Accrued:				
a) On Investments from Earmarked/Endowment Funds(Including Project)	16,312,735.00		18,111,709.00	
b) On investments - Others	7601081.00		11316471.00	
c) Income tax (TDS) Refundable	-	23913816.00		29428180.00
4. Sundry Debtors		306191.00		2125566.00
5. Security Deposit (including Project)		-		88618.00
6. Non Current Assets (Library books)		223302199.06		220524360.06
7. Other Non current Assets (Assets held for disposal)		622356.28		622356.28
TOTAL (B)		**273000292.42**		**271615818.34**
TOTAL (A + B)		**387433515.43**		**431224875.68**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK-JD, SECTOR III, SALT LAKE CITY, KOLKATA 700 106

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31.03.2025

SCHEDULE 12 - INCOME FROM SALES/SERVICES

Amount (Rs.)

	Current Year	Previous Year
1. Income from Sales		
a) Sale of Finished Goods	-	-
b) Sale of Raw Material	-	-
c) Sale of Scraps	560160.80	-
2) Income from Services		
a) Guest House Rent	1294063.23	1553100.00
b) Hostel Charges (Recovery of HRA)	4097439.00	4690,790.00
c) Equipment Utilisation Fees	675500.00	521,000.00
d) Hostel Maintenance Fees	1580586.00	1394452.00
e) Project Overhead	1502185.00	293942.00
f) Income from BSNL	182850.00	123570.00
g) Course fees	53500.00	12000.00
h) Dining Hall Rent	-	-
i) Reimbursement of Infrastructural Maintenance (NSM)	4599390.00	-
j) Conference Registration Fee	1758942.00	1103960.00
k) Sale of assets	25423.00	-
TOTAL	**16330039.03**	**9692814.00**

SCHEDULE 13 - GRANTS/SUBSIDIES
(Irrevocable Grants & Subsidies Received)

	Current Year	Previous Year
1. Central Government	395499984.00	398299846.00
2. State Government(s)		
3. Government Agencies		
4. Institutions/Welfare Bodies		
5. International Organsations		
6. Others		
TOTAL	**395499984.00**	**398299846.00**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK-JD, SECTOR III, SALT LAKE CITY, KOLKATA 700 106

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31.03.2015

SCHEDULE 14 - FEES/SUBSCRIPTIONS

Amount (Rs.)

		Current Year	Previous Year
1)	Student Admission Fee	95800.00	111550.00
2)	Annual Fees/Subscriptions	-	-
3)	Student Semester Fee	1445500.00	1433750.00
4)	Consultancy Fees	-	-
5)	Conference fees	111250.00	-
	TOTAL	**1652550.00**	**1545300.00**

Amount (Rs.)

SCHEDULE 15 - INCOME FROM INVESTMENTS

(Income on Invest. From Earmarked/ Endowment Funds transferred to Funds)

		Investment from Earmarked Fund		Investment - Others	
		Current Year	Previous Year	Currnet Year	Previous Year
1)	Interest				
	a) On Govt. Securities	-	-	-	-
	b) Other Bonds/Debentures	-	-	-	-
2)	Dividents:				
	a) On Shares	-	-	-	-
	b) On Mutual Fund Securities	-	-	-	-
3)	Rents	-	-	-	-
4)	Others	-	-	-	-
	a) Interest on Fixed Deposits with Banks	-	-	-	-
	b) Interest on SB Accounts	-	-	-	-
	TOTAL	**Nil**	**Nil**	**Nil**	**Nil**
	TRANSFERRED TO EARMARKED/ ENDOWMENT FUNDS	**Nil**	**Nil**	**Nil**	**Nil**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK-JD, SECTOR III, SALT LAKE CITY, KOLKATA 700 106

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31.03.2025

SCHEDULE 16 - INCOME FROM TECHNOLOGY TRANSFER & CONTRACT PROJECT

Amount (Rs.)

		Current Year	Previous Year
1.	Income from Technology Transfer	-	-
2.	Income from Contract Project		
3.	Others		
	TOTAL	-	-

SCHEDULE 17 - INTEREST EARNED

		Current Year	Previous year
1)	On Term Deposits:		
	a) With Scheduled Banks	-	-
	b) With Institutions	-	-
	c) Others	-	-
2)	On Savings Accounts:		
	a) With Scheduled Banks	322757.00	101478.00
	b) Post Office Savings Accounts	-	-
	c) Others	-	-
3)	On Loans:		
	a) Employees/Staff (Interest on HBA etc.)	-	-
	b) Others	-	-
4)	On Others	112708.00	-
	TOTAL	**435465.00**	**101478.00**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK-JD, SECTOR III, SALT LAKE CITY, KOLKATA 700 106

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31.03.2025

SCHEDULE 18 - OTHER INCOME

Amount (Rs.)

		Current Year	Previous Year
1)	Profit on Sale/disposal of Assets:		
	a) Owned assets		
	b) Assets acquired out of grants, or received free of cost		
3)	Fees for Miscellaneous Services		
4)	Miscellaneous Income	2179393.96	1435080.38
	TOTAL	**2179393.96**	**1435080.38**

SCHEDULE 19 - INCREASE/(DECREASE) IN STOCK OF FINISHED GOODS & WORK IN PROGRESS

		Current Year	Previous Year
a)	Closing stock		
	Finished Goods		
	Work-in-progress		
b)	Less: Opening Stock		
	Finished Goods		
	Work-in-progress		
	NET INCREASE/(DECREASE) [a-b]	**Nil**	**Nil**

SCHEDULE 20 - ESTABLISHMENT EXPENSES

		Current Year	Previous Year
a)	Salaries and Wages	152621933.00	139479059.00
b)	Other Allowances and Bonus	-	-
c)	Employer's Contribution to Provident Fund	2799227.00	3144559.00
d)	Contribution to Retirement Benefits Fund	-	-
e)	Staff Welfare Expenses (Medical)	5744213.00	3936972.00
f)	Employer's Contribution to NPS	12133267.00	9233663.00
g)	Others (including Retirement Benefits Expeneses)	1658632.00	3891434.00
	TOTAL	**174957272.00**	**159685687.00**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK-JD, SECTOR III, SALT LAKE CITY, KOLKATA 700 106

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31.03.2025

SCHEDULE 21 - OTHER ADMINISTRATIVE EXPENSES ETC.

Amount (Rs.)

	Current Year	Previous Year
a) Extended Visitors Programme.(Including Seminars & Workshops)	31171745.63	38555191.00
b) Meeting Expenses	1534402.06	1998604.00
c) Library General Expenses	63031.12	281325.00
d) Electricity and Power	37761516.00	34445571.00
e) Laboratory Expenses	14721591.64	10619564.00
f) Insurance	23338.00	35813.00
g) Repairs and Maintenance	76932226.09	62962165.66
h) TPSC Programme	40000.00	200000.00
j) Vehicles Hire Charges	1883476.00	1762447.00
k) Postage, Telephone and Communication Charges	1101196.00	546762.00
l) Printing and Stationary	1355922.00	1214290.00
m) Travelling and Conveyance Expenses	2156857.00	3288733.00
n) Contingency to Faculty	35739.00	-
o) Auditors' Remuneration	146910.00	59000.00
p) Bank Charges	75635.85	363989.61
q) Professional Charges (Legal Charges)	300130.00	101480.00
r) Staff Training & Welfare	817268.00	860046.00
s) Patent & Trademark	25500.00	106256.00
t) Integrated Ph.D.	1820787.25	2618125.00
u) Hindi Programme	79168.00	113781.00
v) Advertisement and Publicity	331600.00	286883.00
w) Others	3970776.46	2218878.85
x) Municipal Tax	141388.00	141388.00
y) Contract Services	21625728.34	19143440.00
z) Stipend (Post BSc. & Post MSc.)	41879745.00	41684195.00
TOTAL	**239995677.44**	**223607928.12**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK-JD, SECTOR III, SALT LAKE CITY, KOLKATA 700 106

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31.03.2025

SCHEDULE 22 - EXPENDITURE ON GRANTS, SUBSIDIES

Amount (Rs.)

	Current Year	Previous Year
a) Grants given to Institutions/Organisations b) Subsidies given to Institutions/Organisations		
TOTAL	**Nil**	**Nil**

SCHEDULE 23 - INTEREST EXPENSES

	Current Year	Previous Year
a) On Fixed Loans b) On Other Loans (including Bank Charges) c) Others		
TOTAL	**Nil**	**Nil**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK-JD, SECTOR III, SALT LAKE CITY, KOLKATA 700 106

SCHEDULE 24 - SIGNIFICANT ACCOUNTING POLICIES

1. ACCOUNTING CONVENTION

The Financial Statements are prepared on the basis of Historical Cost Convention, unless otherwise stated and on accrual method of accounting. Interest on Interest bearing Loans and Advances granted to the Staff are accounted for on cash basis and Guest House Rent are accounted for on accrual basis. For Capitalization of Fixed Assets under Project is accounted for in line with applicable provisions of GFR Rule 2017.

2. INVENTORY VALUATION

Stores, Spares and Consumables are valued at Cost.

3. INVESTMENTS

Investments are valued at Cost.

4. FIXED ASSETS

4.1. Fixed Assets are stated at Cost of Acquisition inclusive of Inward Freight, Duties and Taxes and Incidental and Direct Expenses related to Acquisition as well as Custom Duty and Clearing & Forwarding Charges on Imported Equipment are also capitalised.

4.2. Fixed Assets Purchased by way of Non- Monetary Grants (other than towards the Capital Fund) are capitalised at value agreed/ stated by corresponding Credit to Capital Fund. Incomplete Work is shown as Capital Work in Progress and to be capitalised on completion.

5. CAPITAL WORK IN PROGRES

Capital work-in-progress includes Intangible Asset under development which includes associated tangible components, specifically hardware procured for and utilized exclusively during the development phase. Depreciation on such tangible assets will commence upon their readiness for intended use, which coincides with the successful completion and operationalization of the related intangible asset.

6. NON-CURRENT ASSETS

6.1. Library Books have been shown under Non-Current Assets.

6.2. No Depreciation /Amortization are provided on Assets held for disposal. Short/Excess over book value on disposal of such assets is provided in the year of sale.

7. DEPRECIATION

7.1. Depreciation on Capitalization has been charged on the value determined /estimated at the time of takeover and as and when on further items were added subsequently to Assets.

7.2. Depreciation is provided on Straight Line Method as per rates specified in the Companies Act,2013

7.3. In respect of Addition to Fixed Assets/ Deletion from Fixed Assets during the Financial Year, Depreciation is considered on Pro-rata basis. Depreciation is provided from the date of Acquisition of the Assets.

7.4. Depreciation arising on Fixed Assets is deducted from Fixed Assets and also from Capital Fund out of

which Fixed Assets are created and not passed through the Income and Expenditure and directly debited to Capital Fund.

7.5. Depreciation on Part of Office Building funded by TRC Fund is not provided but Depreciation on part of the Building funded by Centre Fund is provided.

7.6. No Depreciation has been charged on Fixed Assets procured out of Project Fund.

8. FOREIGN CURRENCY TRANSACTIONS

Transactions denominated in Foreign Currency are accounted for at the exchange rate prevailing at the date of transactions.

9. RETIREMENT BENEFITS

9.1. Investments are valued at cost.

9.2. Retirement benefit Expenditure arising due to super superannuation are accounted for at the time of Retirement.

10. INTEREST ON TERM DEPOSIT

10.1. Interest accrued on Term Deposit credited to Corpus Fund of the Centre.

10.2. Interest on Term Deposit for the F.Y.2023-2024 had been reclassified to Corpus Fund as per applicable accounting policy stated in 10.1.

11. Corresponding figures for the previous year have been re-grouped/re-arranged/ re-classified wherever necessary.

Kolkata

Dated: 22.08.2025

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK-JD, SECTOR III, SALT LAKE CITY, KOLKATA 700 106

SCHEDULE 25 : CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS

1. CONTINGENT LIABILITIES

1.1. Claims against the Centre not acknowledged as Debts are NIL (Previous Year was also NIL).

1.2. Bank Guarantee given by /on behalf of the Centre is Rs.1,05, 00,000.00 against 100% margin money by way of Fixed Deposit (Previous Year amount was Rs.1,05,00,000.00).

Letter of Credit opened by the Bank on behalf of the Centre and Project and balance pending as on 31-03-2025 is NIL (Previous Year amount was Rs.5, 87, 86,857.00).

1.3. Bill Discounted with Banks is NIL (Previous Year was also NIL).

1.4. Disputed Demands in respect Income Tax and GST are Nil (Previous Year amount ware also NIL).

1.5. In respect of Claims from Parties for non-execution of Orders but contested by the Centre is NIL (Previous Year amount was also NIL).

2. NOTES ON ACCOUNTS

2.1. Capital Commitments: - Estimated value of Contracts remaining to be executed on Capital Account for Rs. 1,60,91,395.00 (Previous Year Rs. 36,00,000.00).

2.2. The Unadjusted Travelling Advances of Rs.63, 000.00 paid to Mr. Amartya Sarkar during FY 2012-13 and this amount has been lying unadjusted since FY 2012-13.

2.3. In view of there being no taxable income under the Income Tax Act 1961, no provision for Income Tax has been considered necessary.

2.4. Foreign Currency Transactions

(i) Value of Imports calculated on C.I.F. basis:

	Current Year	Previous Year
Capital Goods:	Rs.43985827.00	Rs. 5753385.80
Consumables:	Rs. 363113.00	Rs. 1211656.00

(ii) Other Expenditure in Foreign Currency: NIL

(iii) Earnings: Value of Exports on FOB basis: NIL

2.5 The Centre had incurred during FY 2022-2023 Rs. 286.33 Lakhs under following budget head out of its own source, which is yet to be disbursed by DST:

Budget Head	Amount
SALARY	Rs. 79.06 Lakhs
GENERAL	Rs. 207.27 Lakhs

Para-Wise Replies to the Audit Observations

As reported by the Statutory Auditor of the Centre, No Audit Qualification has been given in their Auditor's Report for the FY 2024-25.

Considering above, Para-wise reply to the audit observations will not arise in such instance matter for said reporting period and may be considered as 'NIL'.

SATYENDRA NATH BOSE
NATIONAL CENTRE FOR BASIC SCIENCES

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