



SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES



Newsletter

Vol. 13, Issue 1 (2023)

Editorial

A very Happy New Year 2023.

We are delighted to publish the online issue of the Newsletter, thanks to the great efforts made by the Newsletter support staff as well as the members; we also sincerely thank all the contributors, who have promptly sent their articles. The issue covers academic and non-academic events in the second half of the year 2022.

We wish you all to keep healthy and be successful in your future endeavors. All the best!



Professor Satyendra Nath Bose

News and Events (Academic)

Colloquium / Named Lectures

Series of talks on “Illustrious Indian Scientists in Pre-independence Era”

1. Dr. Kaliprasanna Dhara, Retired Associate Professor, Calcutta University, delivered a lecture on the topic “*Asima Chattopadhyay Varatiya Veshaja Udvider Ek Ananya Anweshak*” on 15.07.2022.
2. Prof. Ranjit Biswas, Senior Professor, SNBNCBS, delivered a lecture on the topic “Satyendranath: Beyond Science” on 22.07.2022

16th C.K. Majumder Memorial Lecture

Sir Anthony K. Cheetham, Professor, FRS, Materials Research Laboratory, University of California; Department of Materials Science and Engineering, National University of Singapore, delivered the 16th C K Majumder Memorial Lecture on the topic “Recent Developments in Hybrid Perovskites and Related Materials” on 08.12.2022.



Bose Colloquium



Prof. Ashutosh Sharma, Institute Chair Professor, Department of Chemical Engineering, Indian Institute of Technology, Kanpur and President elect (2023-25), Indian National Science Academy (INSA) and Former Secretary to the Government of India, Department of Science and Technology, delivered a lecture on the topic “Navigating Complexity by Scientific Common Sense” on 01.12.2022.

Institute Colloquium

1. Prof. Jayasimha Atulasimha, Professor, Virginia Commonwealth University, USA, delivered a lecture on the topic “Classical and Quantum Computing with Spins and Spin Ensembles” on 20.07.2022.



2. Prof. Bhaskaran Muralidharan, Professor, Electrical Engineering Department, Indian Institute of Technology Bombay, delivered a lecture on the topic "The search for the elusive Majorana modes: conductance gap closure and the topological gap protocol" on 25.08.2022.
3. Prof. Shankar P. Das, Professor, School of Physical Science, JNU, Delhi, delivered a lecture on the topic "Complexity and entropy crisis in the amorphous glassy state" on 30.09.2022.
4. Prof. Partha Ghose, NASI Senior Scientist, delivered a lecture on the topic "Unification of Gravity and Electrodynamics" on 30.11.2022
5. Prof. Dipankar Bhattacharya, Distinguished Astrophysicist Professor, Ashoka University, delivered a lecture on the topic "Astrosat: The Indian Astronomy Mission" on 09.12.2022.
6. Prof. Sibasish Ghosh, Professor, The Institute of Mathematical Sciences, Chennai, delivered a lecture on the topic "Negativity of Wigner distribution function as a measure of incompatibility" on 13.12.2022

Other Seminars

1. Dr. Debasish Chaudhuri, Associate Professor, Inst. Of Physics, Bhubaneswar, delivered a lecture on the topic "Active matter: from single particle trajectory to collective behavior" on 05.07.2022
2. Dr. Tamas Kr. Panda, Assistant Professor, Vellore Institute of Technology, Vellore campus, Tamilnadu, India, delivered a lecture on the topic "Mechanochemistry: An Opportunity to do Engineering in Metal Organic Frameworks (MOFs)" on 05.07.2022.
3. Dr. Ali Hossain Khan, Ramanujan Fellow, SBNBCBS, delivered a lecture on the topic "Designing Two-dimensional Colloidal Nanocrystals for Opto-electronic Applications" on 12.07.2022
4. Prof. Banibrata Mukhopadhyay, Professor, Department of Physics, Indian Institute of Science, Bangalore, delivered a lecture on the topic "Magnetically Dominated Accretion Flows to probe Black Hole Properties" on 21.07.2022.
5. Dr. M. Venkata Kamalakar, Associate Professor & Team Leader, Quantum Material Devices Group, Department of Physics and Astronomy, Uppsala University, delivered a lecture on the topic "Two-dimensional spin circuits: exploring interfaces and substrates for efficient spin currents and novel devices" on 10.08.2022
6. Dr. Tirthankar Banerjee, Research Associate, Department of Applied Mathematics and Theoretical Physics, Centre for Mathematical Sciences, University of Cambridge, delivered a lecture on the topic "Initial conditions and single-file diffusion: compressibility, hyperuniformity and everlasting memory" on 11.08.2022.
7. Dr. Sumit Dey, Senior Research Fellow, Department of Physics, Indian Institute of Technology Guwahati, India, delivered a lecture on the topic "Thermodynamic and fluid dynamical interpretation of the Einstein-Cartan field equations with respect to a generic null hypersurface" on 19.08.2022
8. Dr. Samrat Ghosh, Scientist, CSIR-CLRI, Chennai, India, delivered a lecture on the topic "Why Charge Transport is Pivotal for the Photocatalytic Hydrogen Evolution in Two-dimensional Porous Organic Semiconductors?" on 23.08.2022
9. Dr. Paramita Dutta, Assistant Professor, Theoretical Physics Division, Physical Research Laboratory, Ahmedabad, delivered a lecture on the topic "Bogoliubov Fermi surface and exotic Cooper pairs in $j=3/2$ superconductors" on 24.08.2022
10. Dr. Ankur Sen Sharma, Associate Professor of Physics, University of Gour Banga, delivered a lecture on the topic "Percolation in Distorted Square and Simple Cubic Lattices" on 26.08.2022.
11. Dr. Supratim Banerjee, Associate Professor, Department of Chemical Sciences (DCS), IISER, Kolkata, delivered a lecture on the topic "Aqueous Self-assembly of Chromophore-appended Amphiphiles: Bio-analyte Sensing, Photo-reactivity Modulation and Energy Transfer Studies" on 30.08.2022
12. Dr. Anupam Kundu, Associate professor, International Centre for Theoretical Sciences, Bangalore, delivered a lecture on the topic "Hydrodynamics and crossover from diffusive to anomalous transport" on 05.09.2022
13. Prof. Gautam De, Emeritus Professor, SBNBCBS, delivered a lecture on the topic "Sharing My Experience as an Associate Editor of Journal of Materials Chemistry A" on 27.09.2022
14. Dr. Sumanta Kundu, Postdoctoral Research Fellow, Department of Physics and Astronomy "Galileo Galilei", University of Padova, delivered a lecture on the topic "Machine learning predictions of complex polymer topologies" on 30.09.2022.
15. Dr. Aniket Patra, Postdoctoral Researcher, Aarhus University, Department of Physics and Astronomy, Denmark, delivered a lecture on the topic "Single-Shot Determination of Quantum Phases via Continuous Measurements" on 10.10.2022

16. Dr. Riya Sebait, Ph. D. Student, Department of Physics, Sungkyunkwan University, Republic of Korea, delivered a lecture on the topic “Defect-Induced Trion in Monolayer WS₂ at Room Temperature” on 12.10.2022
17. Dr. Milan Sil, Post Doctoral Researcher, SNBNCBS, delivered a lecture on the topic “Exploring Noble Gas Species in the Radiation-Dominated Region” on 14.10.2022.
18. Dr. Rahul Debnath, Post Doctoral Researcher, Quantum Materials and Devices Group, Department Of Physics, Indian Institute Of Science, Bangaluru, delivered a lecture on the topic “Study on optical and electrical transport properties of twisted bilayer transition metal dichalcogenides” on 17.10.2022
19. Dr. Shreyasi Chattopadhyay, MRSC Research fellow, JTSI group, School of Chemistry, University of St. Andrews, delivered a lecture on the topic “Exsolution: approach for emergent nanoparticles towards photo/electro catalysts designing” on 20.10.2022
20. Dr. Biplab Sanyal, Associate Professor (Universitetslektor), Division Head, Materials Theory Division, Department of Physics and Astronomy, Ångströmlaboratoriet, Uppsala University, delivered a lecture on the topic “Challenges and prospects in two-dimensional Fe_nGeTe₂ (n=3, 4, 5) magnets” on 31.10.2022
21. Dr. Samik Duttagupta, Associate Professor (E), CMP Division, Saha Institute of Nuclear Physics, delivered a lecture on the topic “Spin-orbitronics with metallic antiferromagnets” on 10.11.2022
22. Dr. Prasanta Nayak, Post-Doctoral Fellow, TIFR, Mumbai, delivered a lecture on the topic “The first UVIT study of T-Tauri Stars” on 10.11.2022
23. Prof. Malay Banerjee, Professor, Department of Mathematics and Statistics, IIT Kanpur, delivered a lecture on the topic “Systematic local and global bifurcation analysis for ecological models” on 11.11.2022
24. Prof. Naresh Dadhich, formerly at Inter-University Center for Astronomy and Astrophysics. Former Director of IUCAA, delivered a lecture on the topic “On the Buchdahl Stars” on 17.11.2022
25. Prof. Arnab Mukherjee, Professor, Chemistry Department, Indian Institute of Science Education and Research, Pune, delivered a lecture on the topic “Approaching de-novo drug-design using a combination of physics-based and machine learning algorithms” on 22.11.2022
26. Dr. Mir Alimuddin, Chanakya PDF, SNBNCBS, delivered a lecture on the topic “Thermodynamic signatures of Quantum Entanglement” on 24.11.2022
27. Dr. Bijoy K Agarwalla, Assistant Professor, Department of Physics, Indian Institute of Science Education and Research, Pune, delivered a lecture on the topic “Universal bounds on fluctuations in continuous and discrete thermal machines” on 28.11.2022
28. Dr. Somesankar Bhattacharya, Post Doc Fellow, Adiunkt, ICTQT, Gdansk, Poland, delivered a lecture on the topic “Arbitrary Separation in One-way Zero-error Quantum Communication Complexity of Relations with Finite Set of Inputs” on 02.12.2022
29. Dr. Arnab Bose, Postdoctoral Fellow, Dept. of Physics, Johannes Gutenberg Universität, Mainz, delivered a lecture on the topic “Electric field induced novel spin-current generation” on 06.12.2022
30. Dr. Ankit Raj, Postdoctoral Researcher at USIL-NYCU, Taiwan, delivered a lecture on the topic “Towards standardization of Raman spectroscopy : Accurate wavenumber and intensity calibration schemes for absolutely quantitative analysis” on 07.12.2022
31. Dr. Sourav Bhattacharya, Associate Professor, Department of Physics, Jadavpur University, delivered a lecture on the topic “Loops and non-perturbative effects in primordial cosmic inflation” on 15.12.2022
32. Dr. Tamaghna Hazra, Postdoctoral Researcher, Rutgers University, delivered a lecture on the topic “Triplet pairing mechanisms from Hund's-Kondo models - applications to heavy fermion superconductors” on 16.12.2022
33. Dr. Kapildeb Dolui, Post-Doctoral Fellow, Department of Materials Science & Metallurgy, University of Cambridge, UK, delivered a lecture on the topic “Ab-initio spin torque and spin-pumping in spin-orbit-proximitized antiferromagnets” on 21.12.2022
34. Mr. Vishnu Rajagopal, Ph. D. Student, School of Physics, University of Hyderabad, Central University P.O, Hyderabad, delivered a lecture on the topic “Maximal acceleration in non-commutative space-times” on 22.12.2022
35. Dr. Vijaykumar Chikkadi, Assistant Professor, Physics Division, Indian Institute of Science Education and Research Pune, delivered a lecture on the topic “Phase separation of colloidal particles in active suspensions of bacteria” on 22.12.2022

Special Lectures / Conferences

Seminar Series of Statistical Mechanics

1. Seminar on “Elucidating the mechanisms of synthesis of zeolites using molecular simulation” was held on 19.07.2022. The Speaker was Prof. Valeria Molinero, The University of Utah.
2. Seminar on “Active Matter: Applying the materials physics paradigm to biology” was held on 13.09.2022. The Speaker was Dr. Aparna Baskaran, Brandeis University, USA.
3. Seminar titled “What is the entropy of a tiger? Was held on 10.11.2022. The Speaker was Prof. Christian Maes, KU Leuven, Belgium.



4. Seminar on “Stochastic Resetting” was held on 26.12.2022. The Speaker was Prof. Satya Majumdar, Laboratoire de Physique Theorique et Modeles Statistiques (LPTMS), France.

Seminar Series of Quantum Materials and Devices

1. Seminar on “Cooper-pairs are nice, but split ones are even nicer! Why it is interesting to “unpair” a Cooper-pair” was held on 17.08.2022. The Speaker was Prof. Christian Schonenberger, Department of Physics and Swiss Nanoscience Institute, University of Basel.
2. Seminar on “Ionic Gating of 2D Semiconductors” was held on 19.10.2022. The Speaker was Prof. Alberto Morpurgo, University of Geneva.

Workshop

APCTP-IACS-SNBNCBS Workshop on Computational Methods for Emergent Quantum Matter: From Theoretical Concepts to Experimental Realization was organized at the Centre. The workshop was held during 17-25 November, 2022.

Special Lecture

Dr. Marie-Gabrielle MEDICI, Scientist, University of Nice delivered a special lecture on the topic “Dew

condensation and harvesting: potential source of drinking water. New challenge for some arid countries.” On 09.12.2022

Academic Events

National Exhibition-cum-Fair 2022

Centre has participated as exhibitor in the 9th Indian National Exhibition-cum-Fair 2022 at Patuli, Kolkata during 4-8 August, 2022.

Curtain Raiser Ceremony of documentary film on Illustrious Indian Scientists in Pre-Independence Era

Centre organized a series of lectures on ‘Illustrious Indian Scientists in Pre-Independence Era’ based on the lives and contributions of the eminent scientists to the country’s freedom struggle on the eve of celebrating 75th year of Independence. The Curtain Raiser Ceremony of the documentary film was held at Silver Jubilee Hall, SNBNCBS on 14.08.2022 in. The programme took place in both physical and virtual mode.

The programme started with the National Anthem followed by the welcome address by Prof. Tanusri Saha-Dasgupta, Director, S. N. Bose National Centre for Basic Sciences. Messages were delivered by Dr. Srivari Chandrasekhar, Secretary, DST, Govt. of India; Dr. B. N. Jagatap, Professor, IIT Bombay and Chairman, Governing Body, SNBNCBS; Prof. Chandrima Shaha, J. C. Bose Distinguished Chair Professor of NAS at IICB and President, INSA; Dr. Nakul Parashar, Director, Vigyan Prasara. The Trailer of the Documentary film was screened. Prof. Partha P. Majumdar, Founder Director and Distinguished Professor, NIBG; Prof. Kankan Bhattacharyya, Adjunct Faculty, IISER, Bhopal; Prof. Sibaji Raha, Raja Ramanna Fellow, Bose Institute; Prof. Goutam Gangopadhyay, Professor, University of Calcutta and the Secretary, Bangiya Bijnan Parishad also delivered messages. Ms. Subha Das Mollick, Science Communicator of the Centre delivered the Vote of Thanks.



25th National Science Exhibition

The Centre has participated as exhibitor in the 25th National Science Exhibition on the theme “Self Reliant India: Progress, Prosperity & Sustainability” during 24 - 27 August, 2022 at Central Park Maidan, Salt Lake City, Kolkata.



Academic visit from Manipur

The Students and teachers from the Department of Electronics, Dhanamanjuri University, Manipur visited S. N Bose National Centre for Basic Sciences, Kolkata during 10-11 October, 2022 as part of their academic visit. Scientific talks, exposure to research laboratories, visit to S N Bose Archive and astronomical observation were parts of their visit.



Lecture on Mental Health

An Interactive Session titled “Is my mental health important? a conversation about mental health” held on 16.11.2022. The Speaker was Ms. Navnita Bose, Guest Lecturer, Dept. of Psychology, WBSTU and Clinical Psychologist.



National Space Science Exhibition

The Centre has participated as Exhibitor in the National Space Science Exhibition (NSSS) during 06-12 December, 2022 at Science City, Kolkata.

MoU signed by the Centre

A MoU was signed between C-DAC, Pune and SNBNCBS, Kolkata on 22.12.2022 at MeitY, New Delhi for setting up a 650TF HPC system under NSM Phase 3. It will consist of Rudra based servers indigenously developed by C-DAC and manufactured in India.



Scientific Stories

Understanding debilitating diseases at a molecular level:

*Liquid liquid phase separation holds the key
to neuro-degenerative diseases*

Rajib Kumar Mitra

The human body consists of ~37.2 trillion cells. Every cell is programmed to do specific task(s). The form and shape of the cell is suitable to the task(s) it performs. However, the basic structure of all cells is the same - a cell membrane that controls what enters and what leaves the cell, the gel like plasma called cytoplasm within the cell membrane and other organelles like nucleus, nucleolus, Golgi bodies, mitochondria, ribosome etc. in the cytoplasm. Each organelle is like a little organ keeping the cell alive. Healthy organelles ensure healthy cells. Healthy cells ensure healthy living beings. Proteins, the key components of most of the organelles, are long chains of amino acids folded into a variety of three-dimensional structures. Dimensions of these structures are typically 3 to 10 nanometres.

Interestingly, many of these organelles like P bodies, nucleolus etc. are membrane-less. A phenomenon called 'liquid liquid phase separation' (LLPS)

underlines the formation of these membrane-less compartments in the cytoplasm of cells. When multivalent proteins interact (specifically in presence of external stress like temperature, pressure, pH etc.), they undergo rapid transformation from small complexes to large polymeric assemblies with increase in protein concentration. This dense phase often resembles liquid droplets and it coexists with the dilute phase. These droplet like structures are also called bio molecular condensates. They exhibit higher protein density and weaker molecular motion than the surrounding medium. These condensates play critical roles in various cellular processes like innate immune signalling, messenger RNA (mRNA) splicing, cell adhesion and migration and more.

The process of liquid liquid phase transfer also plays crucial role in inducing human diseases, especially age-related neuro-degenerative diseases like Alzheimer's disease, Parkinson's disease and cataract. LLPS also has a role to play in the growth of cancer cells. Therefore, understanding the process of phase separation at a molecular level has become an emergent area of research in molecular biology fraternity. Although most proteins have well defined 3D structures, there is a class of proteins called intrinsically disordered proteins or IDP that lack an ordered 3D structure because they lack macromolecular interaction partners such as other proteins or RNA. The IDPs are more prone to LLPS.

A protein solution can undergo phase change when the enthalpy of the protein-solvent interaction becomes larger than the protein-protein and solvent-solvent interactions. The positive free energy causes an instability of the solution, which is resolved by a phase separation. LLPS is achievable in test tubes using simple procedures. It is possible to study the process in-vitro by changing external parameters like pH, temperature etc. Some factors have been found to promote LLPS while some inhibit the formation of the condensates. LLPS can also induce proteins to self-aggregate over time and form amyloid fibrils. These insoluble fibres are resistant to degradation and cause debilitating diseases like Alzheimer's. Pathogenic amyloids form when otherwise healthy proteins lose their normal structure due to misfolding. Enzymes cannot act on a wrongly folded protein molecule. So they lose their physiological functions. They form fibrous deposits around cells and disrupt the healthy functions of tissues and organs.

Our group at the S.N Bose National Centre for Basic Sciences are exploring how the hydration of proteins, gets altered as LLPS sets in. Water at the surface of biomolecules behave very differently compared to

bulk water owing to their specific interaction(s) with the protein surface; such water molecules are commonly reckoned as "Biological Water". Using the terahertz spectroscopy, they have explored the alteration of protein hydration during the fibrillation pathway of a model protein, lysozyme.

Terahertz spectroscopy, a rather non-conventional spectroscopic technique owing to its experimental challenges, detects properties of matter with electromagnetic fields that are in the frequency range between a few hundred gigahertz to several terahertz. The THz region is responsive towards various inter-molecular and collective vibration of water molecules, and thus can label-free detect changes in such modes, which makes this unique compared to conventional techniques.

In this work we have tried to address a fundamental question related to the LLPS process: 'since excipients alter water network dynamics, what effect would such a perturbation have on the stability of the LLPS?' Four excipients were chosen (arginine, glucose, ubiquitin, and bovine serum albumin) and each excipient was found to have different impact(s) on the LLPS process. Some excipients like sucrose were found to stabilize the LLPS process while Bovine Serum Albumin (BSA) was found to inhibit the process. Figure 1 shows the microscopic image of lysozyme under different conditions.

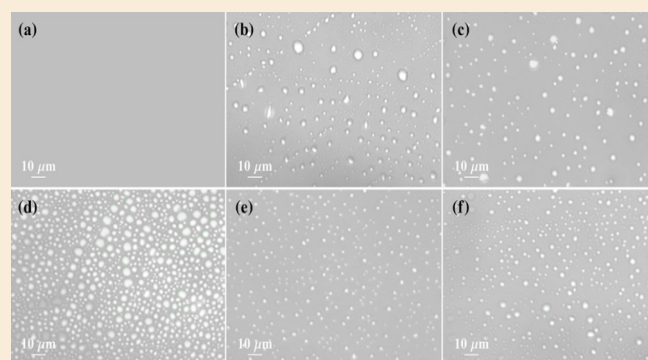


Figure 1: Microscopic image of Lys under different conditions: (a) No phase separation, (b) only Lys (600 μ M), (c) Lys–100 mM Arg solution, (d) Lys–10 mM sucrose solution, (e) Lys–50 μ M BSA solution, and (f) Lys–100 μ M Ubi solution. All of the measurements were carried out after 6 h of incubation at 50 $^{\circ}$ C. The concentration of Lys was kept fixed at 600 μ M, and the pH of the solution was 12.6.

The effect of concentration and temperature on phase separation was also studied and a phase diagram was prepared on the basis of solution turbidity. Stability of the LLPS phase was determined based on the turbidity measurement results. The corresponding protein hydration was measured using Terahertz spectroscopy in the

frequency range (1.5 - 21 THz). Two distinct bands in the water structure were demarcated, one at $\sim 130 \text{ cm}^{-1}$ (intermolecular H-bond vibration) and another at $\sim 550 \text{ cm}^{-1}$ (libration mode). A detailed statistical analysis was made to conclude the specific change(s) in these two frequencies in presence of the excipients (figure 2).

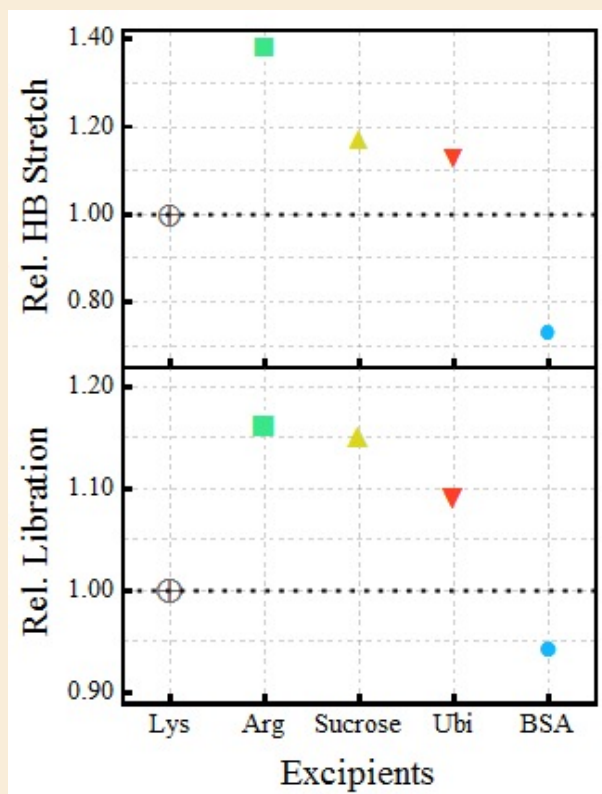


Figure 2. Relative change in the overall hydration during the LLPS formation of Lysozyme in presence of excipients (considering LLPS in Lys as the unity for both HB stretching and librational mode)

The experimental results clearly identify that both protein and excipient hydration play decisive roles in regulating the LLPS process. Monitoring a change in hydration could therefore act as a potential marker for an early and easy detection of LLPS onset. These in-vitro studies are a small step towards understanding of how LLPS occurs in-vivo, that is inside the living cells. However, a living cell is a much more complex system than an in-vitro system created in the laboratory. This in-vitro investigation might pave ways to in-vivo insights which can be translated into therapeutic discoveries.

Studying a Nova to get closer to Supernova

Ramkrishna Das

In the 21st century, astrophysicists are turning their attention to one particular star system in the constellation Ophiuchus, imagined as a man grasping a snake. The 'star' is called RS Ophiuchi. It is a binary system of a white dwarf star and a red giant, 5000 light

years away. The white dwarf orbits within the wind of the red giant. The companion star supplies the white dwarf with fresh, hydrogen-rich fuel for the nova eruption. With enough fuel, the material on the surface of the white dwarf achieves a critically high temperature and pressure, and a thermonuclear runaway (TNR) ensues, which lasts for about 1000 seconds. This explosion generates more than 10^{45} ergs of energy. Hence, the system becomes visible from a far distance.

The eruptions of RS Oph have been observed and recorded since 1898. Lately, there was an eruption in 1985, then in 2006 and then again in August 2021, when it reached a peak visual magnitude of 4.6 bright enough to be seen with the naked eye. But in India the August sky was overcast with monsoon clouds. So the astrophysics team at S.N. Bose National Centre for Basic Sciences acquired data from Astronomical Ring for Access to Spectroscopy Database (ARASD) to study the evolving spectra of the RS Ophiuchi Nova.

Dr. Ramkrishna Das, leader of the astrophysics team at the S.N. Bose Centre, believes that RS Oph may hold the key to understanding the formation of Type Ia supernovae. Spectra of the Type Ia supernovae do not show any hydrogen line. It is conjectured that if a white dwarf crosses the Chandrasekhar Limit of 1.4 Solar Mass, then the electron degeneracy pressure in the core of the star is no longer sufficient to balance the gravitational pressure, the white dwarf collapses under its own gravitational pressure and gives birth of a Type Ia supernova. The mass of the white dwarf in the RS Oph binary is estimated to be 1.2 to 1.38 solar mass.

With every eruption, the WD likely accretes about 10% of the ejected mass. It is possible that eventually its mass will exceed the Chandrasekhar Limit and it will explode as a Type Ia supernova. This event, if and when it occurs, will be the final proof of the conjecture around Type Ia supernova.

In 2021, soon after the outburst of RS Oph was detected on August 8, 2021, intensive spectroscopic studies of the eruption began. Different teams, equipped with different kinds of telescopes, observed different parts of the spectrum, right from radio waves to gamma rays of GeV range. For the first time studies were stretched to gamma rays of TeV range too. The expansion velocity estimated from the H-alpha and H-beta P Cygni profiles was 4200 Km/sec.

These studies formed the backdrop for the project undertaken by Dr. Ramkrishna Das and his team.

From the ARAS database, they took 18 optical spectra recorded between August 9 and August 30, 2021. The spectra were in the range of 3600 to 9000 Angstrom Unit. Their model shows the presence of a hot, central ionizing white dwarf with a constant luminosity of 1.0×10^{37} ergs/second, but temperature rising from 4.16 to 6.60×10^4 deg K within the span of a month. The estimated mass of ejected hydrogen in the shell was 3.54 to 3.83×10^{-6} solar mass. The estimated abundance of elements from the best fit models indicates increasing abundance of the heavier elements.

In order to understand and visualize the RS Oph better, the team at S.N. Bose Centre used the August 2021 data to create a 3D morpho kinematic model of the ejecta. Since hydrogen alpha lines are the brightest lines in the visible spectral range, normalized H-alpha profiles of the nova on August 16 and August 30, 2021 were used to reconstruct the 3D model. The aim was to fit the characteristic features observed in the profile so that the final modeled profile would reproduce the observed shape, intensity and velocity as closely as possible. The final model showed a bipolar morphology with an inclination of 30 degrees.

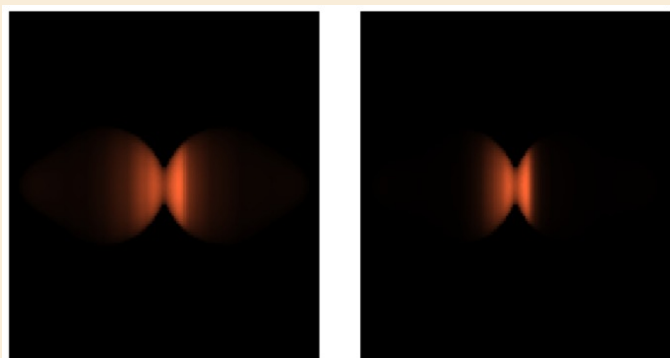


Fig 1: The model images of the ejecta of RS Oph 2021 obtained from the best-fitted 3D morpho-kinematic models for Aug. 16.83 (left column) and 30.87 (right column), 2021.

Dr. Ramkrishna Das informs that there are ten recurrent novae in the Milky Way Galaxy, but there has not been a supernova explosion in the Milky Way during past four hundred years. Perhaps the next explosion of RS Oph will take us closer to understanding the mechanism of the Type Ia supernova.

Ph.D. Awarded/Submitted

Ph.D. degree awarded

1. Anuvab Banerjee, Thesis Title: Spectral and Timing Properties of Class Variable Source GRS 1915+105 Using Two-Component Advective Flow Solution. Supervisor: Sandip K Chakrabarti

2. Prantik Nandi, Thesis Title: Spectral And Temporal Properties Of Super-Massive Black Holes In Light Of Two Component Advective Flows. Supervisor: Sandip K Chakrabarti
3. Rahul Bandyopadhyay, Thesis Title: Multiwavelength Studies of Planetary Nebulae. Supervisor: Ramkrishna Das
4. Sourav Karar, Thesis Title: Aspects of Holographic Entanglement Entropy and Complexity. Supervisors: Sunandan Gangopadhyay & Archan S Majumdar
5. Sk Imadul Islam, Thesis Title: Studies On Ultrafast Dynamics And Spectroscopic Investigations On Fluorescent Probes In Bimolecular And Biomimetic Recognition. Supervisor: Rajib Kumar Mitra
6. Arnab Samanta, Thesis Title: Synthesis And Characterization Of Nanoscale Alloys And Metal Oxides For Potential Application In Catalysis. Supervisors: Samir Kumar Pal & Subhra Jana
7. Akash Das, Thesis Title: Investigation Of Optical Beam Shifts For Two-Dimensional (2D) Materials. Supervisor: Manik Pradhan
8. Dipanjan Mukherjee, Thesis Title: Microfluidic-Assisted Optical Spectroscopic Studies on Biomolecular Recognition in Physiologically Relevant Engineered Environments. Supervisor: Samir Kumar Pal
9. Anulekha De, Thesis Title: Ultrafast Spin Dynamics in Ferromagnetic Patterned Nanostructures and Multilayers. Supervisors: Anjan Barman & Rajib Kumar Mitra
10. Sudip Kumar Saha, Thesis Title: Thermodynamics of Low-Dimensional Interacting Quantum Systems: A Hybrid Exact Diagonalization and Density Matrix Renormalization Group Study. Supervisor: Manoranjan Kumar
11. Shreya Das, Thesis Title: First Principles Study On Novel and Functional Materials. Supervisor: Tanusri Saha-Dasgupta
12. Partha Nandi, Thesis Title: Some aspects of quantum mechanics and quantum field theory on quantum space-time. Supervisor: Biswajit Chakraborty
13. Sasthi Charan Mandal, Thesis Title: Microscopic studies on biomolecular complexes. Supervisor: Jaydeb Chakrabarti.

Ph.D. thesis submitted

1. Ruchi Pandey, Thesis title: Study of Novae

Properties. Supervisor: Ramkrishna Das

2. Shounak Datta, Thesis title: Aspects of Quantum Correlations in Information Processing. Supervisor: Archan S Majumdar
3. Rituparna Mandal, Thesis title: Applications of the functional renormalization group in cosmology and black hole thermodynamics. Supervisor: Sunandan Gangopadhyay
4. Riddhi Chatterjee, Thesis title: Relativistic quantum systems in the framework of quantum information and quantum foundations. Supervisor: Archan S Majumdar
5. Vishal Kumar Aggarwal, Thesis title: Growth, Characterization, Optoelectronic And Thermal Properties Of Novel Germanium Nanostructures. Supervisors: Manik Pradhan & Arup K Raychaudhuri
6. Surya Narayan Panda, Thesis title: Ultrafast Spin Dynamics in Magnetic Thin Films and Heterostructures. Supervisor: Anjan Barman
7. Edwine Tendong, Thesis title: Properties of materials at interfaces. Supervisors: Tanusri Saha-Dasgupta & Jaydeb Chakrabarti
8. Didhiti Bhattacharya, Thesis title: Opto-electronic, Electrical and Spectroscopic Studies of Some Two-Dimensional Materials. Supervisors: Samit Kumar Ray & Rajib Kumar Mitra
9. Indrani Kar, Thesis title: Synthesis, Characterization, Transport and Electronic Structure Studies of Transition Metal Dichalcogenides. Supervisor: Thirupathaiah Setti
10. Saheli Samanta, Thesis title: Large Magneto-functional responses in transition metal-based alloys: Protocol dependence across martensitic phase transition. Supervisor: Kalyan Mandal
11. Snehamoyee Hazra, Thesis title: Investigation On Nanostructured Piezoelectric Materials For Energy Harvesting. Supervisor: Barnali Ghosh (Saha).

News and Events (Administrative)

2 days training by ISTM

A training programme on “Organisational Behaviour and Interpersonal Effectiveness” for officers and staffs of administrative departments of the Centre held during 4th-5th August, 2022 in collaboration with Institute of Secretariat Training & Management (ISTM), New Delhi at Silver Jubilee Hall of the Centre. Shri A. Jaikumar Menon, Guest Faculty from Institute of Secretariat Training & Management (ISTM), New Delhi was the Course Coordinator.



Centre celebrated the 75th year of independence

The Centre celebrated the 75th year of independence (Azadi Ka Amrit Mahotsav) at its premises on 15th August, 2022 (Monday) by following Covid-19 restrictions. At 10.30 a.m. the National Flag was hoisted by the Director. At 10.40 a.m. prizes were distributed to the winners of Yoga Competition and Essay Writing Competition held on the occasion of Swachhata Pakhwada. At 10.50 a.m. saplings were planted at Centre premises by the faculty and staff of the Centre.



Hindi Pakhwada Celebrated

Hindi Pakhwada was observed at Centre during 14th to 29th September, 2022. On this occasion on 14th September, 2022 'Hindi Diwas' was celebrated at Silver Jubilee Hall of the Centre. On 19th September, 2022 a Hindi Essay Competition was organized on the topic “Azadi Ka Amrit Mahotasav : Objectives and Significance”. On 29th September, 2022 a “Hindi Quiz Competition” was organized on the occasion of Hindi Pakhwada-2022. The staff and

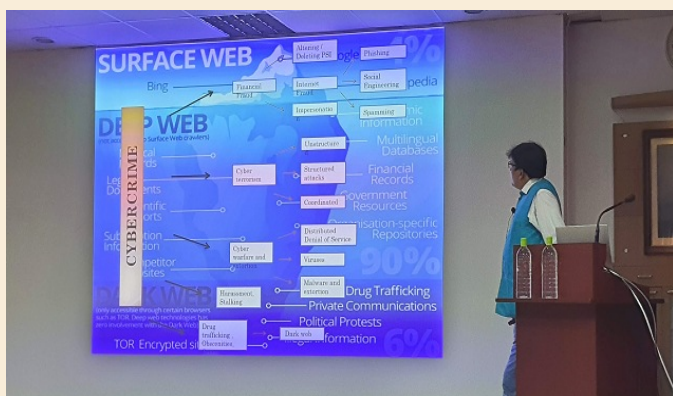
students participated in all the events.

Hindi Workshop was also organized on 26th September, 2022 at Silver Jubilee Hall of the Centre on the topic “The challenges and solutions for usage of Hindi and other Indian languages in Science and Technology sector in today's perspective”. The lecture was delivered by Dr. Rajeev Kumar Rawat, Senior Hindi Officer, IIT, Kharagpur.

Cyber Jagrookta Diwas 2022



In a bid to raise awareness regarding safety against cyber crimes and how to deal with them, “Cyber Jagrookta Diwas 2022” was observed at Silver Jubilee Hall of the Centre on 6th October, 2022. Dr. Abhishek Roy, Head of State e-Governance Mission Team (SeMT), Department of Information Technology & Electronics, Govt. of West Bengal and Mr. Bhaskar Banerjee, Scientist 'D', National Institute of Electronics & Information Technology, Kolkata delivered the lectures on this occasion.



Vigilance Awareness Week 2022

Centre observed the Vigilance Awareness Week 2022 during 31st October to 6th November, 2022. The theme was “Corruption free India for a developed Nation”. The observation was commenced with the pledge taking ceremony on 31st October, 2022 at Silver Jubilee Hall. The academic, administrative and technical staff members of the Centre participated in this event.

An Essay Writing Competition titled “Corruption free India for a Developed Nation” was held on this occasion. The staff and students participated in this event.

Also, an invited talk on “Corruption free India for a Developed Nation” was delivered by Shri S. K. Sadangi, IRSS, Principal Chief Material Manager, Chittaranjan Locomotive Works as part of the celebration of Vigilance Awareness Week-2022 on 4th November, 2022 at Silver Jubilee Hall of the Centre.

Rashtriya Ekta Diwas 2022

The Centre celebrated the birth anniversary of Sardar Vallabhbhai Patel as “Rashtriya Ekta Diwas (National Unity Day)” on 31st October, 2022 through a pledge taking ceremony. The pledge taking ceremony was held on 31st October, 2022 at Silver Jubilee Hall of the Centre and the academic, administrative and technical staff of the Centre took the pledge.



Hindi Workshop on Technical Terminology

A Hindi Workshop was organized on 6th December, 2022 at Silver Jubilee Hall of the Centre. Shri Ajay Kumar Prasad, Rajbhasha Prabandhak, Regional Office, Reserve Bank of India, Kolkata delivered the lecture on the topic “Importance of Technical Terminology for the Development of Hindi Language”.

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