

Newsletter

S N Bose National Centre for Basic Sciences



Volume: 3

Issue: 1 & 2

Period: May - Dec 2010

Published on: 25.03.2011

Editorial

The third volume of the Newsletter comes to light, despite slight delay. The coverage of this issue extends for a long period, namely, May to December 2010. It was not easy to collate the data for all the events that happened in the Centre for such a long period.

However, we observe a strange fact: Although there has been a large number of publications from the Centre during this period, there is hardly any communication to us on the published works. This is not desirable from an Academic Institution.

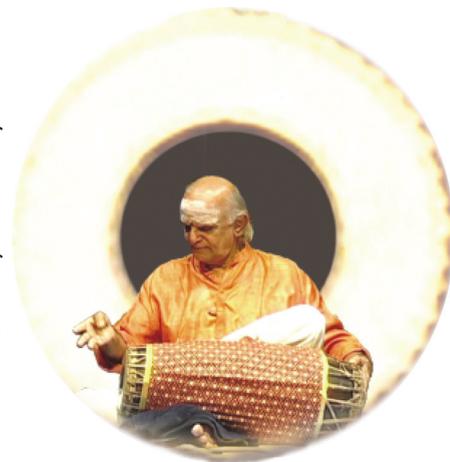
The participation of the students in the publication of the Newsletter has been appalling, too. Unless the student community comes up to share a major responsibility, it would be a futile task to publish the Newsletter.

Inside

Dr. Priya Mahadevan ...	Page 2	Topological Insulators ...	Page 4	Fluorescence Spectroscopic ...	Page 6
Best Poster Award ...	Page 2	Orbital order in ...	Page 4	Study of Protein-Nucleic ...	Page 7
A new glass blowing ...	Page 2	Symmetry reduced ...	Page 4	Intellectual Property Rights ...	Page 7
AMRU School ...	Page 2	Discussion meeting on ...	Page 5	Bad basic science is not ...	Page 7
AMRU School Vacuum ...	Page 2	Elastoplastic theory of ...	Page 5	Photography ...	Page 8
Hindi Mahina Samaroh...	Page 3	Quantum Tunneling in ...	Page 5	In Nature ...	Page 8
Rajat Jayanti Udghatan ...	Page 3				

21st S. N. Bose Memorial Lecture by Vidwan Dr. Umayalpuram K. Sivaraman and Dr. T Ramasami with Dr. M. D. Naresh

The title of the S. N. Bose Memorial Lecture this year was "Science for Musical Excellence", held on 10th December 2010, in Vivekananda Hall, The Ramakrishna Mission Institute of Culture, Golpark, Kolkata. Dr. T. Ramsami, along with Vidwan Dr. Umayalpuram K. Sivaraman and Dr. M. D. Naresh, delivered an illuminating talk on the scientific aspects of 'sound from Mridangam', an ancient musical instrument of India. Vidwan Dr. Umayalpuram K. Sivaraman, a Padma Vibhushan, is the topmost Mridangam Vidhan in the country. Besides his professional career, he had undertaken the very laudable task of doing original research in the art of Mridangam. Dr.



Dr. T. Ramasamy, a Padma Shri, currently the Secretary to the Government of India, (DST) is known among the scientific establishments in the country for his leadership to the Central Leather Research. There have been efforts to develop mathematical models for analyzing the harmonic vibrations of Mridangam by several groups of researchers. However, there has been no reported experimental study for understanding "Naadham" and the melody of Mridangam. Dr. Umayalpuram K Sivaraman, one of the co-authors of this work, wondered whether "Naadham" could be better understood using scientific principles even beyond those discovered already by Sir C. V. Raman. He approached Dr. T Ramasami for collaboration in science for musical excellence. The work presented here is an outcome of joint research over a period of six years. Majority of the work has not yet been published and some aspects may have relevance for the creation of intellectual properties.

Events

1st G N Ramachandran Memorial Lecture By Prof. Raghavendra Gadagkar

Prof. Raghavendra Gadagkar, Indian Institute of Science, Bangalore delivered the 1st G N Ramachandran Memorial Lecture on 3rd November 2010 in Rabindra Okakura Bhavan Auditorium, Salt Lake, Kolkata. Title of his talk was "Interrogating an Insect Society". Many species of insects organize themselves into societies that parallel if not better human societies in their social organization, integration, communication, division of labour and



even in their caste systems. Such societies consist of one or a small number of reproductives (queens) and a large number of sterile or nearly sterile workers. While the queens engage in laying eggs, the workers perform all the tasks required for nest building, acquisition and processing of food and brood care. How do such societies function in a coordinated and efficient manner? What are the rules that individuals follow? How are these rules made and enforced? In this lecture Dr. Gadagkar described research designed to seek answers from insect societies to questions of obvious interest to us. He has chosen the Indian paper wasp *Ropalidia marginata* for this purpose, a species that is abundantly distributed in peninsular India and that serves as an excellent model system. He has shown how such questions can indeed be investigated and emphasized the need for a whole range of different techniques of “interrogation”. In his closing remarks, he discussed, what we can learn from understanding such insect societies.

Dr. Priya Mahadevan has been awarded the TWOWS Award



Dr. Priya Mahadevan has been awarded the TWOWS (Third World Organisation for Women in Science) Award for Young Women Scientists in Physics / Mathematics for the Asia region for 2010. Dr. Priya Mahadevan, born in India in 1970, received her Ph.D in 1998 in Indian Institute of Science, Bangalore. She is a Condensed Matter theorist working as an Associate Professor at S.N. Bose National Centre for Basic Sciences, Kolkata. Her interests encompass the study of properties of materials using a combination of tools. A key component of her research has been in using first principle

electronic structure calculations to construct basic models for magnetism. One of the recent work has been highlighted on page 4

Best Poster Award to Kapil Gupta



The International conference on quantum effects in solids of today (I-Conquest) was organised by NPL, Delhi from December the 20th to 23rd. The Conference started with a keynote lecture by nobel laureate Prof. Klaus v. Klitzing. There were about 50 invited talks and more than 100 poster presentations. Kapil Gupta, a student of Dr. Mahadevan, was awarded the third best poster for his poster on “Strain tuned magnetism in nonmagnetic LaCoO₃”.

A new glass blowing facility at the centre

P. K. Mukhopadhyay



A new glass blowing facility has been inaugurated by the Director on 9th December, 2010 in our Centre. The present facilities include – table and hand-held burners, evacuation and gas handling system for quartz and glass ampoule sealing. Depending on the need and demand, it may be further

augmented in future.

AMRU School

The Advanced Materials Research Unit of our Centre organised a week long (6th to 10th December 2010) meeting on Computational Techniques in Soft Condensed Matter Physics. The school aimed at giving a state-of-art exposure to young researchers in Soft Condensed Matter Physics. The speakers included eminent scientist in the field, like Chandan Dasgupta, IISc, Bangalore, India, S. Sastry, JNCASR, India, J. Horbach, DLR, Koeln, Germany among many others. The school was attended by young researchers from all over the country.

18th International Vacuum congress

Chhayabrita Biswas

The 18th International Vacuum Congress (IVC-18) is a joint international conference including ICN+T (2010), ICSS-14 and VASSCAA-5. The congress took place at the Beijing International Convention Center in August, 2010. About 2000 delegates attended the congress. The congress plenary lecture



speakers included Prof. Heinrich Rohrer (Nobel Laureate in Physics 1986 for design of the scanning tunneling microscope) and Prof. Andre K. Geim (Nobel Laureate in Physics 2010 for Graphene). The congress provides a good opportunity for the professionals within the academic, research, and industrial communities to exchange and share the latest scientific findings and technology development. The topics included Surface Science, Nanoscience and Technology, Applied Surface Science, Thin Films, Electronic Materials and Processing, Surface Engineering, Plasma Science and Technology, Vacuum Science and Technology, and Bio-Interfaces. I am glad to represent S. N. Bose National Centre through my oral presentation of the work done at the Centre. For IVC-19 please visit <http://www.ivc19.com/>

हिन्दी महीना समारोह सितम्बर 2010

सौजन्य: सुभिता दासगुप्ता

प्रतिवर्ष की तरह इस वर्ष भी केन्द्र में सितम्बर के महीने को राजभाषा हिन्दी महीना के रूप में मनाया गया। इस अवसर पर विभिन्न प्रशासनिक एवं सांस्कृतिक कार्यक्रमों का आयोजन किया गया। सर्वप्रथम सितम्बर के महीने की पहली तारीख से ही केन्द्र के सभी सदस्यों ने बड़े ही उत्साह के साथ उपस्थिति रजिस्टर पर प्रतिदिन हिन्दी में हस्ताक्षर किए। हिन्दी दिवस के अवसर पर विभिन्न कार्यालयों में कार्ड के द्वारा शुभकामनाएँ प्रेषित की गईं। राजभाषा हिन्दी के कार्यान्वयन से संबंधित प्रगति के उद्देश्य से केन्द्र के सभी सदस्यों को अधिक से अधिक हिन्दी में कार्य करने के लिए प्रेरित करने के उद्देश्य से केन्द्र के स्वागत कक्ष में एक श्वेत पट्ट रखा गया जिसमें प्रतिदिन एक हिन्दी शब्द तथा उसका अंग्रेजी अनुवाद लिखा गया। दिनांक 10 सितम्बर 2010 शुक्रवार को इस कार्यक्रम को और भी अधिक रोचक बनाने के लिए हिन्दी में एक प्रश्नोत्तरी (किचज़) प्रतियोगिता का आयोजन किया गया। सही उत्तर देने वाले सभी विद्यार्थियों तथा केन्द्र के सदस्यों को पुरस्कृत भी किया गया। दिनांक 14 सितम्बर हिन्दी दिवस के शुभ दिन में इस कार्यक्रम का औपचारिक उद्घाटन केन्द्र के निदेशक प्रो. अरुण कुमार रायचौधुरी जी द्वारा सारगर्भित भाषण के माध्यम से सम्पन्न हुआ। इस कार्यक्रम में श्री रामनारायण सरोज, श्री विपती जी तथा प्रेसिडेंसी विश्वविद्यालय के हिन्दी विभाग की विभागाध्यक्ष श्री मती तनुजा मजुमदार जी को आमंत्रित किया गया। इन सभी गुणी जनों ने अपने-अपने व्याख्यानों के माध्यम से इस कार्यक्रम को सफलता की चरम सीमा पर पहुँचा दिया। दिनांक 17 सितम्बर को शाम छः बजे केन्द्र के व्याख्यान कक्ष-2 में हिन्दी चलचित्र दिखाया गया। दिनांक 23 सितम्बर शाम 5 बजे से लेकर 6 बजे तक रबीन्द्र ओकापुरा भवन में श्री अशोक त्रिपाठी जी ने सुमधुर हिन्दी गीतों को प्रस्तुत कर उपस्थित केन्द्र के सभी सदस्यों तथा अतिथियों का दिल जीत लिया। शाम साढ़े छह बजे से रात साढ़े आठ बजे तक पश्चिम बंगाल के स्वर्गीय मुख्य मंत्री श्री ज्योति बसु जी की पुत्रवधू श्रीमती डॉली बसु जी ने अपने नाट्य समूह 'चुप कथा' के सदस्यों के साथ मिलकर भावना प्रदान नाटक **अंतर होते उदासी** के मंचायन के द्वारा सभी के हृदय पर एक अमिट छाप छोड़ी। राजभाषा हिन्दी महीना समारोह के अवसर पर आयोजित कार्यक्रमों में केन्द्र के निदेशक, कार्यकारी कुलसचिव, संकायों, संकाय सदस्यों, विद्यार्थियों, प्रशासनिक सदस्यों कर्मचारियों ने उपस्थित रहकर कार्यक्रम को सफलता प्राप्त करने में महत्वपूर्ण भूमिका अदा की। इस प्रकार प्रतिवर्ष की तरह इस वर्ष भी हिन्दी महीना समारोह बहुत ही सफल रहा।

सत्येन्द्र नाथ बसु राष्ट्रीय मौलिक विज्ञान केन्द्र रजत जयंती उद्घाटन समारोह 1 अक्टूबर 2010

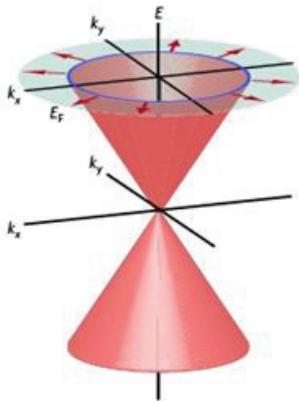
सौजन्य: सुभिता दासगुप्ता

जून 2010 से मई 2011 तक केन्द्र का रजत जयंती वर्ष मनाया जा रहा है। इस अवसर पर 1 अक्टूबर 2010 को ईजोडसीसी भवन में एक सांस्कृतिक कार्यक्रम का आयोजन किया गया। इस कार्यक्रम में हिस्सा लेने के लिए केन्द्र के शैक्षिक तथा प्रशासनिक सदस्यों, कर्मचारियों तथा विद्यार्थियों ने बड़े ही उत्साह के साथ करीब 2 महीने पहले से ही नियमित अभ्यास करना शुरू कर दिया। अंततः 1 अक्टूबर 2010 के दिन शाम साढ़े पाँच बजे कार्यक्रम का शुभारंभ केन्द्र के निदेशक महोदय के हाथों दीप प्रज्ज्वलन के माध्यम से सुसम्पन्न हुआ। इसके पश्चात केन्द्र की स्थापना से लेकर उसकी क्रमागत प्रगति के ऊपर एक वृत्त-चित्र प्रस्तुत किया गया तथा विभिन्न संकाय, संकाय सदस्यों, विद्यार्थियों, प्रशासनिक सदस्यों तथा कर्मचारियों ने बंगला, हिन्दी, अंग्रेजी में कविताएँ, गीत प्रस्तुत किए, तबला वादन, चुटकुले तथा हास्य-व्यंग पर आधारित रेडियों समाचार प्रसारण आदि प्रस्तुत किए। अंत में देवी दुर्गा माँ के महिषासुर वध पर आधारित 'आगमनी' संक्षिप्त नृत्यनाटिका के प्रस्तुतिकरण ने तो कार्यक्रम को सफलता की चरम पराकाष्ठा तक पहुँचा दिया। इस कार्यक्रम की सफलता तथा निपुणता को देख कर ऐसा भ्रम होने लगा कि ये किसी वैज्ञानिक अनुसंधान केन्द्र के सदस्यों द्वारा प्रस्तुत किया गया कार्यक्रम न होकर पेशेदार कलाकारों द्वारा प्रस्तुत किया गया कार्यक्रम है। इस प्रकार विज्ञान और कला का अपूर्व समागम देखकर आमंत्रित सभी दर्शक अभिभूत हो उठे। सत्येन्द्र नाथ बसु जी स्वयं भी एक वैज्ञानिक होते हुए भी इसराज वादन करते थे। अतः प्रशासनिक सदस्यों कर्मचारियों के साथ ही साथ महान वैज्ञानिकों तथा विज्ञान के विद्यार्थियों द्वारा प्रस्तुत किए गए इस कार्यक्रम के माध्यम से उस महान वैज्ञानिक के प्रति सच्ची श्रद्धांजली अर्पित करके ही रजत जयंती उद्घाटन उत्सव सार्थक हुआ है। कार्यक्रम की समाप्ति पर केन्द्र के सभी शैक्षिक तथा प्रशासनिक सदस्यों, विद्यार्थियों तथा उनके आमंत्रित मित्रों एवं परिवारी जनों के लिए आयोजित रात्रि भोज ने तो सम्पूर्ण केन्द्र को एक पारिवारिक सूत्र में बाँधकर आज के व्यस्त जीवन में भी कुछ क्षण की खुशी प्रदान की ताकि आगे भी केन्द्र निरंतर उन्नति करते-करते उन्नति के सर्वोच्च शिखर पर पहुँच सके।

Topological Insulators : A New Enigma

Arghya Dutta

Condensed matter physics in recent times is marked by a frenzy of activities devoted to the discovery of new materials.



Though this search is gaining new momentum primarily for industrial reasons, it also provides some very intricate problems which pose considerable challenge (and subsequent delight) to both theoretical and experimental physicists. While trying to make some meaning out of the plethora of material phases in condensed matter physics, we

generally look for a order parameter which demarcates different phases of a single substance and then take recourse to some Landau-Ginzburg type of free energy to extract various response functions of the system. A major conceptual departure from this “Symmetry Breaking” scenario was introduced in 1973 by Kosterlitz and Thouless, who showed that topological defects can bring disorder in a quasi-long range ordered phase (the term “quasi-long” being reminiscent of Mermin-Wagner theorem). The subtle and yet robust effect of the topological order manifested again in Fractional Quantum Hall Effect (FQHE) discovered in 1980s by Tsui, Störmer and Laughlin. The latest candidate in this line is “Topological Insulator”. The idea of topological insulator was inspired by 2D FQHE. Because of the topological properties of the electronic wave function (for electrons confined to 2D and subject to a strong magnetic field) edge current flows along the boundary of a two dimensional quantum Hall droplet. The search for a similar current in 3D resulted in topological insulator that shows insulating band gap in the bulk and a conducting surface! In other words, topological insulator is an insulator that has a metallic boundary when kept in proximity of vacuum or an ordinary insulator. The quantity which has some non-trivial topology is the momentum-space wavefunction of the electrons. The robustness of this surface metallic behaviour comes out of topological invariants (integrals of the electronic wavefunction) which do not change as long as the material remains insulating. The first candidate showing this behaviour was $\text{Bi}_x\text{Sb}_{1-x}$ whose surface bands were determined using an Angle-Resolved PhotoEmission Spectroscopy (ARPES) experiment, while Bi_2Se_3 , Bi_2Te_3 quickly followed suit.

Among other applications, the most exciting application of the topological insulator is the following. Consider we have placed a topological insulator and a superconductor in close proximity. Then the metallic surface of the insulator becomes superconducting because of the proximity effect. Now if a vortex line runs from the superconductor into the topological insulator, then it has been shown that a zero-energy Majorana fermion will be trapped near the vortex core. If this proposal materializes then one will be able to directly observe the

evasive Majorana fermion which also have some important applications in quantum computers that will be well protected from errors.

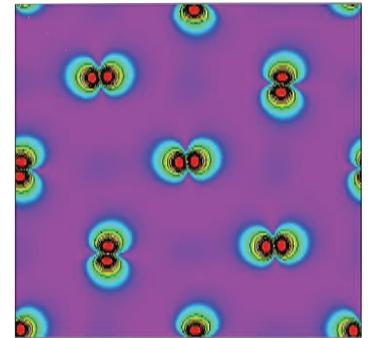
Reference: J.E. Moore, *Nature* 464, 194-198(11 March 2010)

Academic Report

Orbital order in a p-band system?

Priya Mahadevan

Magnetic, charge and orbital ordering are various phenomena that one associates with strongly correlated systems – usually systems with d and f shell electrons. In a recent work we have examined an entire class of alkali metal oxides, and not only did we find them to be magnetic, we also found an orbital ordering transition in them. Considering the example of one such member, KO_2 , we found that high magnetic ordering temperatures were predicted within our calculations in the



absence of the orbital ordering. However, after the orbital ordering transition, one found that all the energies of all magnetic states collapsed to an energy window of less than 1-2 meV, precluding any possibility of a high magnetic transition temperature. The microscopic considerations driving the orbital ordering were also different from the Kugel-Khomskii model which is usually used to discuss orbital ordering in the manganites and a host of systems. This has appeared in Ref. 1. [1] Ashis Kumar Nandy, Priya Mahadevan, Prasenjit Sen and D. D. Sarma, *Phys. Rev. Lett.* 105, 056403 (2010).

Symmetry reduced or intact, Physics remains same : A Study through black hole entropy

Rudranil Basu

It has been more than a decade since the first calculation of black hole entropy in a full non-perturbative quantum theory of gravity was performed. The full quantum theory (otherwise known as Loop Quantum Gravity) finds out a sub leading correction, $-3/2 \ln A/l_p^2$, l_p being the Plank length, to the leading order classical result of $A/4l_p^2$. This calculation relies heavily upon a very important result which states that for an uncountably infinite number of black holes satisfying some geometric conditions (isolated horizons), the horizon degrees of freedom are governed by a gauge theory. In the classical regime itself it was shown that the geometric conditions break the local Lorentz invariance firstly to $\text{SU}(2)$ (symmetries which are related to length preserving transformations of 3d euclidean space) and then to a still smaller one, namely $\text{U}(1)$ (the symmetry in electromagnetism which is required for conservation of electric charge). A naive quantum version of this gauge theory produces a $-1/2 \ln A/l_p^2$ correction in the entropy, in apparent contradiction to previously found $-3/2$ coefficient (considering unbroken $\text{SU}(2)$ invariance) of the log term. But one must be careful enough to consider the left out symmetries, which one has broken from going from $\text{SU}(2)$ to $\text{U}(1)$. These left out or broken symmetries appear as constraint operators in quantum theory. We show that

these quantum constraints do participate in the micro canonical state counting program (for black hole ensembles with fixed area) and reinstates the $-3/2$ factor, thus resolving the tension between two different takes on the same problem. *Reference : R Basu, R K Kaul, P Majumdar. Phys.Rev. D82 (2010) 024007.*

Discussion meeting on “Fundamental aspects of quantum theory and quantum information” with Professor Girish S. Agarwal on 16th-17th August, 2010.

Archan S. Majumdar

A Discussion Meeting on “Fundamental Aspects of Quantum Theory and Quantum Information” with Professor G. S. Agarwal was organized in the Centre on 16th-17th August, 2010. Professor Agarwal (Noble Foundation Chair and Regents Professor, Department of Physics, Oklahoma State University) is distinguished for his pioneering work in quantum optics. He is a Fellow of the Royal Society, London, and was awarded the prestigious Max Born Prize from the Optical Society of America. The Discussion meeting focussed on frontier issues of the foundational and information theoretic aspects of quantum physics. Archan S. Majumdar gave an overview of the main directions or research being pursued here as part of a DST project, including the topics of ‘time in quantum mechanics’, ‘information transfer using hybrid entangled states’, and ‘continuous variable entanglement’. Ashutosh Rai gave a talk on the importance of ‘nonlocal and crypto-nonlocal inequalities for mixed entangled states’. Tanumoy Pramanik spoke on a recent work on demonstrating nonlocality for single photon states. Dipankar Home (Bose Institute) talked on the role of ‘indistinguishability and contextuality in quantum theory’. The Discussion Meeting had about twenty participants including members from other Institutes and students of the Centre. Partha Ghose (former faculty) took active part in the discussions. Overall, this was a very fruitful meeting in terms of generating new ideas for research and motivating students at the onset of the Silver Jubilee Year of the Centre.



Thesis title: Elastoplastic theory of the structure and dynamics of the austenite - martensite interface: stick-slip motion and correlated noise without external pinning

Arya Paul

As a direct consequence of breaking of translational and orientational symmetry, a solid, with a fixed composition, can exist in several forms with distinct crystallographic symmetries. Changing thermodynamic parameters like temperature, pressure, external stress, magnetic or electric fields one can cause transitions between these structures. Unlike most kinds of phase transitions, solids, however, rarely go to equilibrium following a quench across a structural transition, often getting arrested in long lived metastable states called “microstructures”. One should, in principle, be able to derive upon quenching all the microstructures that arise from high temperature phase from a single theory.

Such an approach is however lacking. In this thesis, we attempt to formulate such a phenomenological Elastoplastic coarse-grained Theory which successfully mimics the dynamics of two extreme microstructure transformation products starting from the high temperature phase. We begin by recognizing that the dynamical selection of microstructure happens extremely fast. There is therefore no fundamental reason to restrict the dynamical variables to hydrodynamic variables alone. The coupling between the dynamics of these faster degrees of freedom and the conventional hydrodynamic variables could in principle give rise to a criterion for microstructure selection. The problem is – what constitutes the relevant faster degree of freedom. In the absence of an a-priori fundamental principle, we used a coarse-grained MD simulation for a square to rhombic structural transition in a model solid to explore all possible deformations left out by the earlier theories, namely, non-affine deformations, vacancies and dislocations. Among these candidate fast-variables, we have seen from our MD simulations, that the most relevant ones are transient and localized non-affine deformations, which inevitably accompany the transformation regions. The transformation is accompanied by internal stress production which produces non-affine deformations. We start formulating the theory by writing an appropriate Lagrangian of the system along with Rayleigh dissipation to take care of the dissipative effects. We then derive the evolution equations of the strain fields (order parameter and non-order parameter) and phenomenologically write the dynamics of the non-affine strain. An extension of existing theories to include the dynamical effects of non-affine deformations of the parent lattice results in (i) a proper theory of microstructure selection and (ii) elastic compatibility only when averaged over some physically relevant coarse graining distance. (iii) Possibility of stick-slip dynamics of the parent-product interface even in the absence of any quenched disorder and external drive. (iv) Possibility of wetting of the interface by the non-affine variable. (v) Criterion for shape-reversibility.

Thesis title: Quantum Tunneling in Black Holes

Bibhas Ranjan Majhi

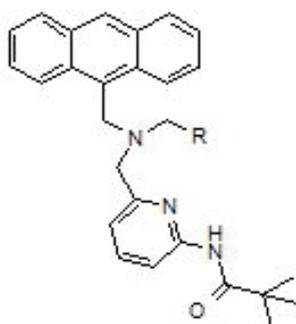
This thesis focuses towards the applications of field theory to study black holes mainly the Hawking effect. This is discussed by the quantum tunneling mechanism. Here we give a general discussion of the existing tunneling mechanisms, both the radial null geodesic and Hamilton–Jacobi methods. On the radial null geodesic method side, we study the modifications to the tunneling rate, Hawking temperature and the Bekenstein-Hawking area law by including the back reaction as well as non-commutative effects in the space-time. A major part of the thesis is devoted to different aspects of the Hamilton-Jacobi (HJ) method. A reformulation of this method is first introduced. Based on this, a close connection between the quantum tunneling and the gravitational anomaly mechanisms to discuss Hawking effect, is put forward. An interesting advantage of this reformulated HJ method is that one can get directly the emission spectrum from the event horizon of the black hole, which was missing in the earlier literature. Also, the quantization of the entropy and area of a black hole is discussed in this method. Another part of the thesis is the introduction of a new type of global embedding in Minkowskian space-time (GEMS).

Using this a unified description of the Hawking and Unruh effects is given. Advantage of this approach is that it simplifies as well as generalises the conventional embedding. In addition to the well studied spherically symmetric space-times, the Kerr-Newman black hole is exemplified. Finally, following the above ideas and the definition of partition function for gravity, it is shown that extremization of entropy leads to Einstein's equations of motion. A relation between the entropy, energy and the temperature of a black hole is given where energy is shown to be the Komar expression. Interestingly, this relation is the Smarr formula. In this analysis, the GEMS method provides the law of equipartition of energy as an intermediate step.

Thesis title: Fluorescence Spectroscopic Studies of Charge Transfer and Dynamics in Solution Phase: Effects of Solvent, Electrolyte and Molten Salts

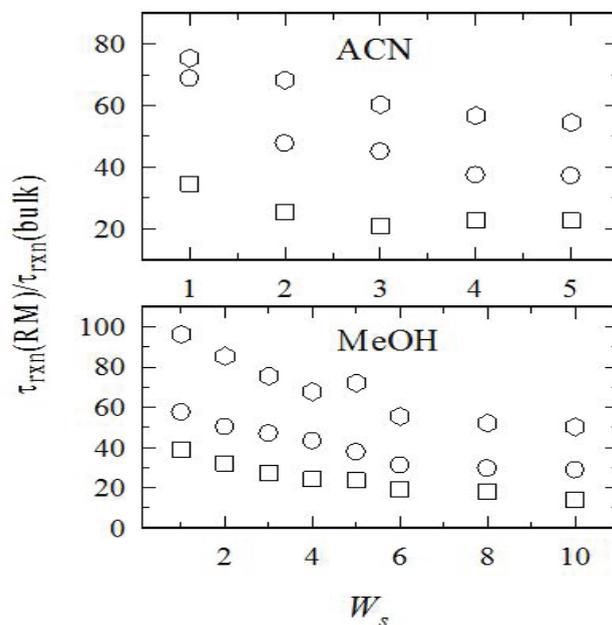
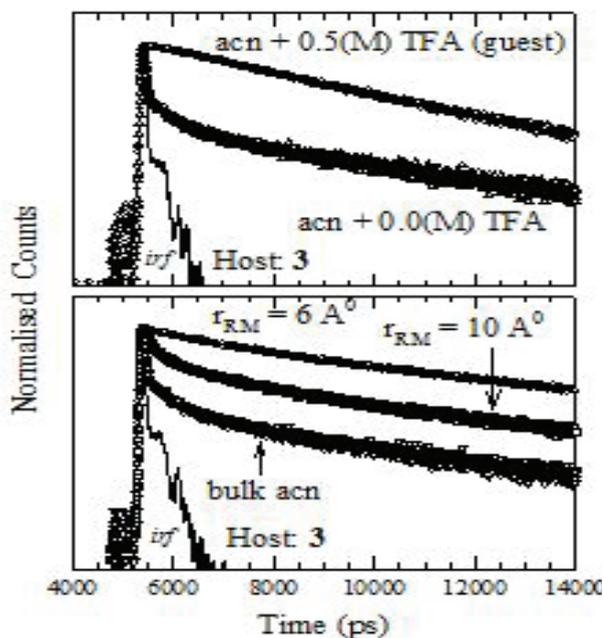
Harun Al Rasid Gazi

In this Thesis we have studied excited state intramolecular charge transfer (ICT) and photo-induced electron transfer (PET) reactions in bulk solvents as well as in confined environments in order to investigate the effects of medium dynamics, solvent structure, and specific interaction between solute and ions. The relevant experiments have been carried out using fluorescence



- 1 R = CH₃
- 2 R = (CH₂)₁₀CH₃
- 3 R = CH₂OH

steady state and time resolved spectroscopic techniques. While studying the medium effects, spectroscopic signatures of medium structure and dynamics have been separately measured and characterized. The media used are: neat solvents, mixed solvents in the absence and presence of electrolyte, molten mixtures and encased polar solvents inside reverse micelles. Various complex media are chosen in such a manner that system's response time scale ranges between a few picoseconds to several hundreds of picoseconds or even to nanoseconds. This span of time scale provides an opportunity to investigate dynamic solvent effects on a chemical reaction. Solvent static effects, which originate mainly from the average polarity of a medium, are also scanned by choosing different systems. Reactant molecules (undergoing ICT and PET reactions) have been synthesized by following literature methods.



The first chapter of the Thesis provides an Introduction of the present work with a brief review of the relevant literature. The first half (chapter 2 – 7) of the Thesis contains medium dynamics and charge transfer reaction in the bulk media whereas the chapter 8 reflects the same in confined media. In chapter 2, solution dynamics and solute diffusion (rotational) in mixed solvents have been explored in the absence and presence of a fixed electrolyte concentration. Chapter 3 describes the results of an ICT reaction in these mixed solvent systems. In chapter 4, solute-solvent coupling and medium dynamics in molten mixtures of acetamide and calcium nitrate have been explored. In chapter 5, clustering of alcohol molecules in aqueous solutions have been studied by using reaction rate constant of an ICT reaction as a probe. Effects of hetero atom in the donor moiety in an ICT molecule has been studied in chapter 6. Host-guest chemistry has been explored in chapter 7 by following the rate constant of a photo induced electron transfer (PET) reaction in different media. Chapter 8 then reports dramatic reduction of ICT reaction rate constant when studied in polar solvent pools encased in methanol and acetonitrile reverse micelles. Chapter 9 then ends the thesis after providing concluding remarks and discussing a few research problems for future study.

Thesis title: Study of Protein-Nucleic Acid Interaction related to Gene-Expression

Navin Chandra

In this thesis we present the report of the works done broadly in the fields of Molecular Biophysics and Bioinformatics in the period from 2003 to 2009. Works were carried out in parts at (i) S. N. Bose National Centre for Basic Sciences, (ii) Structural Biology and Bioinformatics Division, Indian Institute of Chemical Biology and (iii) Department of Biophysics, Bose Institute; all in Kolkata, India. In these works we have addressed some biologically and medically important questions viz. (1) What are the roles of electrostatics and salts in Protein-Nucleic acid (Protein-DNA and Protein-RNA) interactions and what could be their implications on different cellular processes, (2) How a 7-mer peptide KYKETDL which is a determinant of human La protein and/or its mutants could be efficient as a drug against hepatitis C virus infection and (3) For the site-specific DNA-binding proteins like Lambda repressor cI and Galactose repressor which bind specifically to their operator sites on genomes, are there present some other so called semi-specific sites on genomes where they bind relatively tightly compared to an ordinary non-specific sites and what is the number of such sites and what could be the implication of presence of these semi-specific sites to the process of target search by protein over a genome. The present thesis is a report of above three distinct works which we present in the latter three chapters (Chapters 2, 3 and 4) of the thesis. In order to find answers to the raised questions we did make use of some techniques like the numerical solution of the non-linear Poisson-Boltzmann (PB) equation as implemented in Delphi software package, the Molecular Dynamics simulation technique as implemented in NAMD and the results from some earlier works like the results of systematic base substitution experiment by Sarai et al. 1989. Here in the current chapter we give introduction and brief descriptions to the materials and techniques we have utilized as well as to other such things whose basic knowledge we believe would be helpful for the understanding of the following chapters. Hence among other things, we talk about biomolecules, biomolecular interactions, PB equation, Delphi, PDB, Hepatitis C virus, La protein, Molecular Dynamics, forcefields, NAMD, genome, target search, specific and non-specific protein-DNA binding and work of Sarai et al. etc., in this chapter.

News and Views

Intellectual Property Rights (IPR) BY

Kapil Gupta

Intellectual Property refers to various creation of mind such as work of literature, art, designs corresponding to particular industry, scientific invention. Intellectual property (IP) has two sub classes namely industrial property, which covers patents, trademarks, designs and copyright, works of literature and art, such as poetry, films, music or novels etc. Important thing to be noted is that different IP rights provide different protection they provide. Patent is an intellectual property right (IPR) related to an invention, which grants patentee exclusive rights provided

by the government for a certain period, in exchange of full disclosure of his/her invention, which excludes others from use, sale, production or import of the patented product. The goal of such system is to encourage inventions by ensuring their protection and utilization in order to make contributions towards the development of industries, which consequently contributes back to the technology innovation. Patents ensure property rights (legal title) for the invention for which patent has been granted, which may be extremely valuable to an individual or a company. One can make the fullest use of the patent system to exploit the benefits of the patented product. Patent rights are territorial in nature and patent obtained in one country is not enforceable in other country. Inventors or their assignees may file separate patent application in different countries to obtain patent rights in respective country. The Patent System in India is governed by the Patents Act, 1970 (No. 39 of 1970) as amended by the Patents (Amendment) Act, 2005 and the Patents Rules, 2003, as amended by the Patents (Amendment) Rules 2006 effective from 05-05-2006. India is a member-state of World Intellectual Property Organisation (WIPO), an International Organisation, responsible for the promotion of the protection of intellectual property throughout the world. Not everything is patentable. There are laws, which restrict the patentability of a product or invention. There are proper rules for filing, as well as withdrawing a patent application, for further details one may log on to the INDIAN PATENT OFFICE website. Note: this article is an abstract of the text provided on various websites of patent services by Govt. Of India, information above may not be complete.

Ref: INDIAN PATENT OFFICE (www.patentoffice.nic.in)

Bad basic science is not applied science and its corollary

Arup Kumar Raychaudhuri

A noted news paper editor wrote an article few years back with the head line “Bad basic science is not applied science”. He was lamenting on the lack of quality science base in some laboratories in the country whose emphasis on delivery of tangible and “useable” output, has resulted in more development and less research with obvious conclusion that the science base has diminished significantly. A good number (but definitely not all) of the practitioners of science in India and some of whom in their mature age become ‘technology/science’ managers believe in a paradigm that relevance or utility of science is inversely proportional to the basic science content in that work. An automatic corollary is to have the paradigm applied in the “other limits” that science becomes good or excellent if it does not have a broad relevance and have no scope to harness it. Endless pursuit of science for science’s sake may be a way to define excellence - such can be a corollary of this when it is taken to its logical end. I do respect peoples’ view on this but then nothing prevents me to have a viewpoint that differs significantly from this paradigm: Excellent Science need to have a broad relevance if not immediate utility. Long back during my first year of graduate studies, I had the opportunity to listen to Dr. C.K.N Patel of the Bell Labs, Murray Hill, who was the discoverer of CO₂ laser. He was talking about research on Solitons. I did ask him at the end of the talk why Bell Labs, a telephone company, had to do research on nonlinear dynamics and solitons. He

answered that this is the mode of propagation of information package in an optical fiber. No wonder Bell Labs was the world leader in heralding optical fiber communication.

Photography



“Wings of Desire”
Photography by Kapil Gupta

In Nature

Black red start

Prosenjit Singha Deo

This sparrow sized brightly plumaged bird was snapped right inside our campus on the west side of our makeshift canteen. It is called phirira or lal girdi in Bengali. Its call -”a sharp mousy whit - whit - whit, reminiscent of a squeaking un-oiled bicycle wheel revolving at a moderate speed” (Salim Ali). It is a trans-himalayan bird, namely, it migrates beyond the Himalayas in the summer. This bird is a great skulker and does not like city areas. So its record in our campus, which is in the very outskirts of our city is very interesting. I have seen it last year too. So probably it is coming to our campus every year and when this happens it generally means the same individual is coming every year. It has been reported from our city at least once before. So it may be possible that the bird is adapting to city environment slowly. Similar reports in the future can throw some more light on this. So look out for it.



Editorial Board: J. Chakrabarti, R. K. Mitra, K. Acharyya, C. Biswas, R. Basu, K. Gupta, M. Mitra, M. Bose, A. T. B. Aman, A. K. Paul.

- The opinions expressed here are opinion of individuals. The administration of the Centre and the Editorial Board are not responsible for these opinions.