



Newsletter

S N Bose National Centre for Basic Sciences



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Editorial

This is the last issue of the current volume. This year marks the Silver Jubilee celebration of our Centre. Several academic and non-academic events took place in commemoration of the Silver Jubilee. We have covered some of these events in the current issue. However, it seems that the enthusiasm for this celebration is in general somewhat lacking. This is the year we should make retrospection and try to make over the deficiencies that we have over the years. Primarily the infrastructural facilities should improve quite a bit which includes the pressing need for better internet facilities, more computation facilities and better amenities for the residential students.

We sincerely take an oath on this occasion that our works at the Centre will make mark nation wide.

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Silver Jubilee celebration of the S. N. Bose National Centre for Basic Sciences

International Symposium on 75 Years of Quantum Entanglement

A. S. Majumdar

The SNBNCBS Silver Jubilee International Symposium on 75 Years of Quantum Entanglement : foundations and information theoretic applications, was organized at the Neotia Centre of Excellence for Leadership, Salt Lake, Kolkata during January 6th to 10th 2011. Quantum entanglement which is the key ingredient for the storage and distribution of quantum information among the fundamental physical constituents, was first noticed as a key feature of the quantum world seventy-five years ago by Schrodinger. Since then, the long road of development of the theory and applications of entanglement has led to remarkable concepts and prospects such as quantum teleportation, cryptography and computation which are set to revolutionize the field of communication and information transfer. Along this long road have also sprung up many surprises, paradoxes and fascinating puzzles, such as quantum nonlocality, and the collapse and revival of entanglement. The major topics covered in the symposium included applications of quantum entanglement in computation, cryptography and teleportation, continuous variable entanglement, entanglement in black holes and cosmology, information causality, nonlocality and contextuality, quantum discord, time of arrival, quantum trajectories, wave packet dynamics and novel quantum phenomena. Leading theorists such as A. J. Leggett (Illinois), R. Penrose (Oxford), C. H. Bennett (IBM), S. Braunstein (York) and A. Ekert (Oxford and NUS) and experimentalists such as A. Aspect (CNRS), H. Rauch and Y. Hasegawa (Atominstutit), P. Mataloni (Rome) and L. A. - Wu (Beijing) were brought together for a stimulating exchange of views on the recent state of art of this subject. Some of the other notable plenary talks were on "Quantum pseudotelepathy" by G. Brassard, "Information causality" by V. Scarani, "Interferometry of independent systems" by G. S. Agarwal, and "Entanglement in spin chains" by V. Korepin. Eminent speakers from India included N. Mukunda (IISc), S. M. Roy (TIFR), R. Simon (IMSc), A. Kumar (IISc), N. D. Hari Dass (CMI), S. Chaturvedi (Hyderabad), and many others. In addition to forty keynote



and invited talks there were about twentyfive poster presentations by young researchers from India and abroad. Some of the contributed papers which received much attention were those by S. Adhikari (IOPB), M. R. Gazi (ISI Kolkata), Y. T. Haur (NUS), M. Kucherov (SFU), T. Pramanik and A. Rai (SNBNCBS) and R. Rahman (Bregen).

The conference proceedings will be published by the American Institute of Physics. Video recordings of the lectures are available in the SNBNCBS library and also in the Archive for Mathematical Sciences, Fougères, France. Topical interest and the presence of leading scientists in the Symposium attracted popular attention leading to several featured articles and interviews in the national and local media. [Conveners : A. S. Majumdar (SNBNCBS) and D. Home (Bose Institute); Co-sponsors: Bose Institute, CSIR, DST-INSPIRE, INSA, ISI Kolkata, IISER Mohali, IISER Pune, QSC-IMSc Chennai, BESCO, Daya Engineering Works, Shah Alloys, Vishal Nirmitti Pvt Ltd., Calcutta Club (Cultural Partner), The Telegraph (Media Partner)].

2nd S Chandrasekhar Memorial Lecture

Himadri Ghosh

Prof. Sir Roger Penrose of the Mathematical Institute Oxford England, delivered the 2nd S Chandrasekhar Memorial Lecture



on 7 January at the the mini auditorium Science City, Kolkata. Sir Roger Penrose, Order of Merit and the Fellow of the Royal Society is a mathematical physicist and Emeritus Rouse Ball Professor of Mathematics. He is renowned for his contribution to our understanding of the Universe via general relativity and cosmology. He is also a recreational

mathematician and philosopher. Prof. Penrose was the winner of prestigious Wolf Prize of physics in 1988, which he shared with Sir Stephan Hawking. In this seminar he talked about “Mathematical Beauty : Its Power in Scientific Research”. It has been long recognized by many great scientists that mathematical beauty provides a powerful guide to the truth, especially in fundamental physics. In his lecture Sir Penrose, stressed another aspect of mathematics in which beauty plays a crucial role, namely geometry, especially conformal geometry which has distinctive applications in Einstein’s general relativity. He talked about, how geometry guides us to a novel cosmological picture, in which our Big Bang is preceded by a universe aeon similar to our own. The black-hole encounters leave their characteristic signature on the cosmic

microwave background of our own aeon, a signature which appears actually to be present according to recent analysis. His illuminating talk generated lots of interest among the young researchers in the centre and the people in the area in general.

The lecture was a joint venture of our Centre and the Science City. Prior to his talk, Prof. Penrose inaugurated an exhibition at the Science City which was on the life and times of Prof. S. Chandrasekhar on the occasion of his birth centenary.

MagMA 2011

P. K. Mukhopadhyay



The National Conference on Magnetic Materials and Applications, MagMA2011 was held at S. N. Bose National Centre on 24th and 25th January, 2011, as a part of Silver Jubilee celebration of the Centre. The meeting was organized together with the Magnetic Society of India as their annual technical meeting. The conference was represented by about 50 poster papers from young researchers, and about 25 oral presentations from senior and emerging experts in the field of magnetism. The conference brought together experimentalists, technologists, and the theoretical scientists. Thus, this national conference served the purpose of promoting and encouraging the blend of basic science with technology in the field of magnetism.

Events

Sujoy K Modak receives APS-IUSSTF Award

Mr. Sujoy Kumar Modak, a P.MSc-Ph.D student of this centre, has been awarded the American Physical Society’s IUSSTF-India-United States Physics Student Visitation Award (Fall 2010). Through this award he would be able to visit and collaborate in research with Prof. Douglas Singleton of California State University at Fresno to carry out proposed research project “Studies of microscopic black holes in view of LHC experiments”. He joined this centre in 2007 and is working at the Department of Theoretical Sciences under the supervision of Prof. Rabin Banerjee. His research interests are General Theory of Relativity (GTR), Black Hole Physics and Interface of Quantum



Field Theory and GTR. So far he has published eight research papers in this field with three more communicated.

NASI-SCOPUS Award for Dr. Priya Mahadevan

Dr. Priya Mahadevan has been awarded the NASI-SCOPUS young scientist award for physics for the year 2010. This is awarded by Elsevier. Applicants were evaluated in two stages based on key criteria such as publication output, citations and other metrics based on Scopus data, as well as research quality and impact by forty-eight panelists. The primary focus of her



group has been understanding materials using a combination of first principle and model Hamiltonian methods. Her group has made important contributions in understanding magnetism in materials, charge and orbital ordering in strongly correlated systems. This has been published in almost 70 international peer reviewed papers which includes 9 Physical Review Letters, 28 Physical Review Bs and 4 Applied Physics Letters.

Prof. Tanusri Saha-Dasgupta Elected the fellow of National Academy of Sciences, India (NASI)

Prof. Tanusri Saha-Dasgupta received her PhD in the year 1995 from Calcutta University. Her field of research is computational material science and theoretical condensed matter physics. Her expertise lies in electronic structure of bulk and nano-materials, strongly correlated electron system and disordered alloys. She is a receipt of Swarnajayanti fellowship, a fellow of Indian

Academy of sciences and National Academy of Sciences, India. She is also head of the Max-Planck-India partnergroup. She has been involved in several international collaborations including Indo-US, Indo-EU, Indo-Sweden and Indo-German. Over the years, she has published more than 100 papers.



Patent on detection and estimation of Au³⁺ present in very low concentrations in aqueous solutions

Rajib K. Mitra

A patent has been granted to the Centre which involves detection of gold ions (Au³⁺) in aqueous solutions present in very low concentrations with the help of a very simple spectroscopic technique, which exploits the unique property of this noble metal ion to quench the fluorescence of proteins, which contain tryptophan residues. With human serum albumin (HSA) used as the protein with a minimum concentration of 10 μM of the protein in water, gold ion can be detected in the range of 2.5 to 500 μM with most effectively in the range of 2.5 to 200 μM . The detection ability can be improved by using proteins with higher number of tryptophan residues, e.g. when α -chymotrypsine (α -CHT), which contains five tryptophan residues, is employed with a minimum concentration of 500 nM, gold ions can be detected in the range of 100 nM to 10 μM with most effectively in the range of 100 nM to 2 μM . This method is also useful for quantitative estimation of gold ions (based on Stern-Volmer relation) and with 10 μM HSA, gold ion concentration can be estimated with an accuracy of 0.15 μM in the range of 2.5 to 40 μM . With 500 nM α -CHT the estimation can be made in the concentration region of 100 to 1000 nM with an accuracy of 15 nM.

Reference : S. K. Pal et al. "A method of detection for gold ion (Au³⁺) present in low concentrations in aqueous solutions", Indian Pat. No. 246804 (date of filing: 10.12.2007, patent granted on 16.3.2011)

Installation of Transmission Electron Microscope (TEM) with Field Emission Gun (FEG) source

Barnali Ghosh (Saha) & Kaustuv Das

The high resolution TEM machine (model : Tecnai G2 F20 Super Twin) with 200KV FEG source, the first in Eastern India, has been successfully installed and working satisfactorily at our Centre. The inauguration of the machine was done by our Director Prof. A. K. Raychaudhuri on 1st April, 2011. The machine can give High resolution Bright/Dark field images. The instrument resolution $\sim 0.2\text{nm}$. The Scanning Tunneling Microscope (STEM) and EDAX facility is also there.

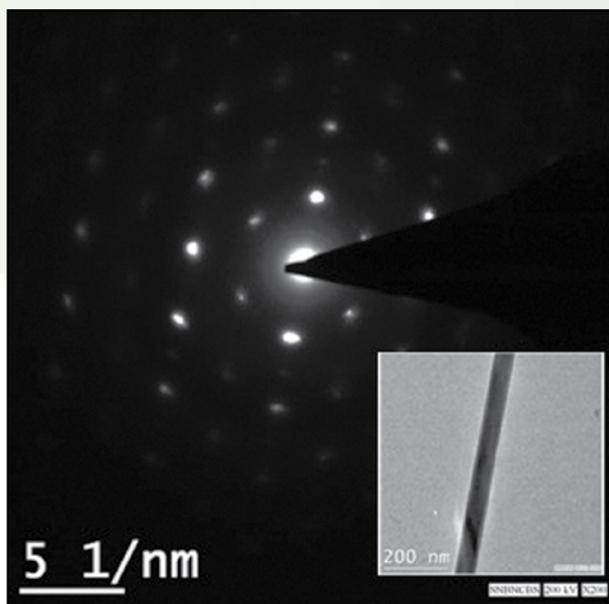


Illuminating a new impact of non-commutative quantum mechanics by Prof. F. G. Scholtz

Indrakshi Raychowdhury

During his visit to our centre, Professor Frederik G Scholtz (National Institute for Theoretical Physics, Stellenbosch, South Africa) presented a wonderful seminar on 15th Feb. 2011 on non-commutative quantum mechanics (NCQM) which he has been working on for quite a long time. In this talk he discussed the general formalism of incorporating in NCQM spatially extended objects which play a crucial role in the understanding of several non-perturbative phenomena of particle physics.

The path integral formulation as well as the constants of motion were shown to demonstrate that there were hints of extended objects already in a nonlocal unconstrained description of NCQM. In the classical picture itself the energy of a theory was shown to have corrections proportional to the non-commutative parameter in either local or nonlocal form. The local formulation coincides exactly with the theory of two oppositely charged particles with harmonic potential among themselves and moving in a strong magnetic field. Prof. Scholtz extended this description to extend quantum level. The fact that the local quantum description gives additional information about the structure of quantum states were explicitly shown through the examples of free particle and harmonic oscillator at the cost of introducing an additional degree of freedom. The nonlocal description is nontrivial where the additional structure were shown to be encoded in higher order derivatives.



Installation of a new XRD machine

P. K. Mukhopadhyay

A new Rigaku MiniFlex II compact transportable benchtop powder X-Ray Diffraction machine is newly installed for regular quantitative and qualitative phase identification of various materials. Instead of conventional 1-D gas detector, this machine has solid state line detector. This makes it an order of magnitude faster than the older machine. It was formally open for general user community by SN Bose Director on 11/3/2011.

Doctoral Degree award

Abhishek Pandey, Date of Degree Award : 21.02.2011, from West Bengal University of Technology. Title of Thesis : "MAGNETIC TRANSPORT AND ELECTRONIC PROPERTIES OF INTER-METALLIC PEROVSKITE COMPOUNDS".

The Effects of Grain Size and Grain Growth on the Chemical Evolution of Cold Dense Clouds

Kinsuk Acharyya

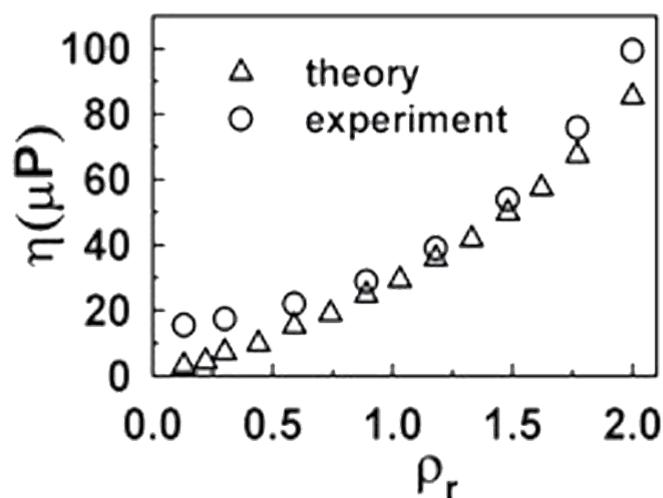
We investigated the formation of molecules during the chemical evolution of a cold dense interstellar cloud using a gas-grain numerical code in order to study the effects of grain-size distribution and grain growth on molecular abundances. Three initial size distributions have been used, based on earlier models. To incorporate different granular sizes, we divided the distribution of sizes utilized into five logarithmically equally-spaced ranges, integrated over each range to find its total granular number density, and assigned that number density to an average size in that range. We utilized rate coefficients for surface reactions, accretion, and desorption as functions of grain size. We then followed the chemical evolution of the surface populations of the five average-sized grains along with the gas phase chemistry. We find that the total effective granular surface area of a distribution is an important parameter in the determination of surface abundances, with and without grain growth. The effect on gas-phase abundances can also be sizable. Grain growth with time increases the rate of depletion of molecules, such as CO, produced in the gas phase. Use of a size distribution for grains in gas-grain models does not improve the agreement of calculated and observed abundances, in the gas or on grains, as compared with models containing “classical” grains of a fixed radius of 0.1 μm . This result helps to verify the quality of the classical grain approximation for cold cloud models. Further, it provides an important basis for future gas-grain models.

Reference: Acharyya, K., George E. Hassel, G. E., Herbst, E. 2011, *ApJ*, 732, 73

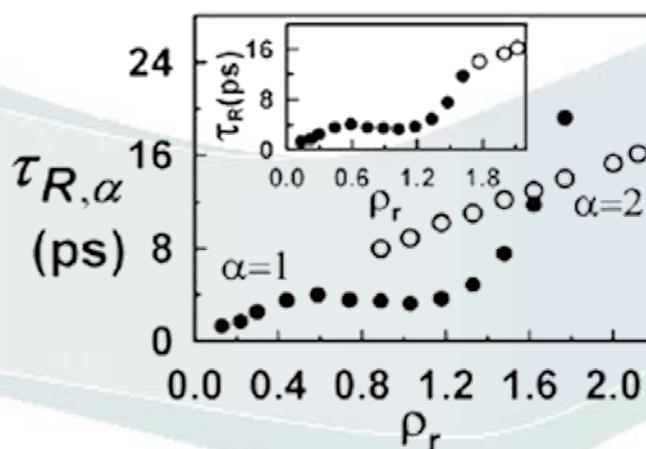
Dipolar solute rotation in a supercritical polar fluid

Amit Das

Fluorescence anisotropy measurements reveal a non-monotonic density dependence for average rotation time of a polar solute coumarin 153 (C153) in supercritical (SC) fluoroform (CHF₃)¹. The conventional Stokes-Einstein-Debye (SED) model, relating the rotation time to the solvent viscosity, fails to explain the observed density dependence, because the experimental viscosity increases monotonously with density for a fluid, in general. Here, the density dependent rotation time is calculated by incorporating the wave vector dependent viscosity of the solvent and the solute-solvent interaction. A molecular hydrodynamic description, verified by molecular dynamics simulation is used for the wave vector dependent



viscosity which brings the solvent static structure factor directly into the picture. A justification for the applicability of the present prescription is provided by reproducing the experimental viscosity of SC CHF₃ (left panel of the figure).



Solute-solvent interaction has been included via the torque acting on the rotating solute. Incorporation of wave vector dependent viscosity gives qualitative description of the observed density dependence which is further improved upon inclusion of solute-solvent interaction, leading to a semi-quantitative agreement² with the experimental data. In the right panel of the figure, the calculated rotation times are shown for the compressibility modes ($\alpha=1$) and the nearest neighbour modes ($\alpha=2$) of the static structure factor of the SC fluid. Recently, we have extended this formalism for a polar liquid solvent focussing on the modification of the total friction due to the solute-solvent dipolar interaction, to point out different regimes where the electrostatic contributions are significant. Our calculated rotation times for C153 in several polar ambient liquids agree well with the experimental data.

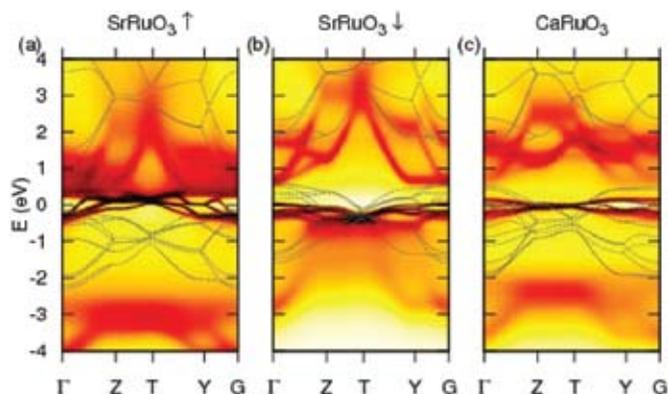
References :

1. N. Kometani et al, *J. Phys. Chem. A*, 108, 9479 (2004). 2. A. Das, R. Biswas, J. Chakrabarti, *J. Phys. Chem. A*, 115, 973 (2011).

A LDA+DMFT study of Ru-based perovskites, SrRuO₃ and CaRuO₃

T. Saha-Dasgupta

The correlated electron systems of transition metal (TM) oxides has been a source of constant attention to researchers. A pertinent question in this context has been how the electron-electron correlation behaves as one moves down the periodic table from 3d to 4d to 5d TM oxides. In this context, we carried



out local density approximation coupled with dynamical mean field theory (LDA+DMFT) study of 4d TM-based perovskite ruthenates, SrRuO₃ and CaRuO₃, compounds which have been discussed in great detail in recent literature. Our calculations could reproduce the observed mass enhancements, the magnetic properties and were found to be in reasonable agreement with the measured photoemission spectra. Our calculations produced rather different coherence temperatures between SrRuO₃ and CaRuO₃, providing a possible explanation for the observed differences between SrRuO₃ and CaRuO₃. We also present k-resolved spectra for the sake of comparison with future angle-resolved photoemission experiments. The figure shows intensity plot of the k-resolved spectral function A(k, ω) calculated by LDA+DMFT. The LDA band structure, shown with dots, has been superimposed for comparison.

Ref: E. Jakobi, S. Kanungo, S. Sarkar, S. Schmitt, and T. Saha-Dasgupta, *Phys. Rev. B Rapid Commn.* 83, 041103 (2011)

Thesis Summary

Studies of magnetic and transport properties of disordered systems

Mitali Banarjee

We use standard magnetization and electronic properties as tools to study various disordered systems, namely random substitutional Ni-rich Ni-Fe-V, Ni-Fe-Mo, and Ni-Fe-W

alloys, Co-rich Ni-Cr pseudo-binary amorphous alloys, self-assembled Ni-nanocrystallites, and Ni-Fe-Mo alloy thin films. We focus our study of magnetization to see the effect of 4d (Mo) and 5d (W) substitution in Ni-rich Ni-Fe permalloys. Mo and W substitution are done at the expense of Fe and we find that with Fe dilution the alloys show distinctive spin dynamics signatures associated with strongly coupled cluster spins. We have also studied their electronic transport properties as well as those of the amorphous alloys and Ni-nanocrystals. We have successfully separated contributions from the various electronic scattering processes in all the above disorder-driven systems. Finally we have studied a set of pulsed LASER deposited thin films of Ni-Fe-Mo alloys to see the effect of size reduction on their magnetic properties. We have used various techniques for structural characterization, like X-ray diffraction, X-ray reflectivity, Rutherford backscattering, Atomic force microscopy, and Scanning electron microscopy. We do find structural disorders in these thin films and interpret the magnetic data accordingly. We conclude that these disordered thin films have distinctly different magnetic properties than those of their bulk counterparts.

News and Views

It pays to have a good h-index : It is good for scientific health

A. K. Raychaudhuri

In last couple of months the pages of Current Science is busy with a debate on the necessity of h-index as an indicator of performance in science. For some taking part in the debate, it is detrimental to scientific health and yet for some others, has a worthy value although with limitations. I have a view that though it is not the only metric or one of the parameters to quantify something that cannot be quantified strictly, yet it is a good guide line for really check whether you have played too many “dot balls” in your career. It is clear that if your professional career is some what more than a decade long after your PhD and you have not reached h-index of double digits you may take a serious look into your work plans and choice of problems that you are working on. After two decades in science, it is most desirable that the h-index crosses 20 or even better 25. h-index may not be worth “anything” but the facts show that it is an indicator of “something”. Nearly 84% of the Nobel Prize winners have h-index greater than 30. Of course it is also true that an h-index greater then 30 will not guarantee a Nobel Prize. Definitely there are many other factors. Whatever our views are, we have reached an era of “quantification” and escaping h-index will be a difficult if not an undesirable proposition. After all it pays to have a good h-index.

भ्रष्टाचार और हमारा देश

राजेश कु. नियोगी

आज अगर कोई मुद्दा हम भारतवासियों को सबसे ज्यादा डरा रहा है और सोचने के लिए मजबूर कर दिया वो है “भ्रष्टाचार”। यह “आचार” बहुत ही आम हो गया है। आए दिन एक एक कर के नए घोटालों का सामने आना इसी आचार का नतीजा है। ये घोटाले कोई छोटे मोटे नहीं होते, इनका आकार बहुत ही विकराल होता है। इसमें जो पैसा और संसाधन की बर्बादी होती है उसे सुन के पाँव तले ज़मीन खिसक जाए। एक आँकड़े के अनुसार हमारे देश का पैसा जो विदेशी बैंको में रखा है काले घन के रूप में वह इतना ज्यादा है की हमारे देश के सारे गाँव देश की राजधानी से पक्के सड़को से सीधा जोड़ सकते है।

हमारे मेहनत से कमाए हुए पैसे जिसे हम सरकार को देते है कर के रूप में, कुछ भ्रष्ट लोग अपने स्वार्थ के लिए उसे चट कर जाते है। आज भारत विश्व के मानचित्र में एक आर्थिक शक्ति के रूप में उभरा है। कुछ साल पहले जो मंदी देखी गई थी विश्व की अर्थ व्यवस्था पर, उसका प्रभाव हमारे देश पर उतना देखने को नहीं मिला। मगर इस तरह के घोटाले अगर चलते रहे तो वो दिन दूर नहीं जब हम आर्थिक रूप से अपंग हो जायेंगे।

इन बड़े बड़े घोटालो पर नकेल कसने में सरकार और दुसरे नेता विफल रहे है। आम आदमी को लगने लगा है की पानी अब सर के ऊपर से जाने वाली है और धैर्य का बाँध टूटने वाला है। सभी के अन्दर से एक आवाज़ आने लगी की “अब बस बहुत हुआ”, और एक विद्रोह भाव उठने लगा इस व्यवस्था के खिलाफ।

मगर किसी अकेले आम आदमी की आवाज़ इस व्यवस्था के कानो में जू तक नहीं रेंगने देगी। तब एक ऐसे मार्ग दर्शक की जरूरत महसूस होने लगी जो हमें रास्ता दिखा सके और इस भ्रष्टा तंत्र के खिलाफ एक जुट होकर लड़ने (आहिंसक) में मदद कर सके। जिस तरह बापू जी ने

हमें अंग्रेजी तंत्र से मुक्त किया था, अहिंसा के पथ पर ऐसे कठिन समय में हमें गांधीवादी, समाज सेवक, पूर्व सैनिक और देश के लिए अपना सब कुछ लुटा चुके “अन्ना हजारे”, जी का साथ मिला। जिन्होंने इस भ्रष्ट तंत्र मे लड़ने की कसम खाई है। उन्होंने आम आदमी को एक नागरिक मंच प्रदान किया जो किसी प्रकार कोई राजनीतिक उद्देश्य से दूर था, इसलिए की हम लोगो का इन राजनेताओ से भरोसा उठ चुका है। ये लोग सिर्फ सत्ता और ताकत के पिपासु है। उन्हें आम आदमी की भलाई की कोई चिंता नहीं है। हम लोगों को एहसास होने लगा की हमें ही अपना हाथ जगन्नाथ बनाना पड़ेगा इस लड़ाई में। अन्ना हजारे का एक ही उद्देश्य है की एक ऐसे “जन लोकपाल” बिल को तैयार करे जो भ्रष्टाचारियों को पकड़े और कठिन सजा का प्रावधान हो ऐसे लोगो के लिए। उनके अनशन को ऐसा जन समर्थन मिला जिसे देखकर सरकार भी चकित रह गई। ये विरोध पूरी तरह से आम नागरिकों का था जिसमे युवा वर्ग सबसे ज्यादा बढ़ चढ़ कर हिस्सा लिया। इन लोगों ने भ्रष्टाचार के खिलाफ विगुल बजा दिया। सरकार अब राजी हो गयी है इस बिल को फिर से तैयार किया जाए, एक कमेटी के द्वारा जिसमे आधी हिस्सेदारी आम जनता के द्वारा चुने गए नागरिक प्रतिनिधी होंगे और बाकी संसद सदस्य/मंत्री होंगे।

ये भारत के इतिहास में पहला मौका है जब एक कानून को तैयार किया जायेगा जिसमे आम नागरिक शामिल होंगे जबकि हमारे संविधान के अनुसार सारे कानून जनता द्वारा निर्वाचित संसद सदस्य द्वारा पास किया जा सकता है। इस जन आन्दोलन के द्वारा यह अवसर हमें अन्ना जी और उनके साथियों ने प्रदान किया है की हम इसे और आगे ले जाए और समाज के बुराइयाँ मिटाते चले। हम सब लोगो को जाती, धर्म आंचलिक भावनाओं से ऊपर उठ के, इस लड़ाई में शामिल हो ता कि भ्रष्टाचार के चंगुल से हम अपने भारत माता को मुक्ति दिला सके ताकि भारत को फिर से सोने की चिड़िया बनाने का सपना साकार हो सके।



“The Blunt Memory”
Photography by Snehasis Das Chakraborty

Jungle Cat (*Felis Chaus*)

Prasenjit Singha Deo

A resident species of our country. Also found in many different areas of the world. However, very difficult to see or photograph. Distinctive features are the large ears with a notch at the sides. Long thick tail with a black tip and a few faint circles in the tail. Larger than domestic cats. All jungle cats have this particular color unlike domestic cats that have varying color and markings. Like other cats, it is mostly nocturnal. It can live in the outskirts of villages and cities as well as in jungles. It often preys on domestic livestock like chickens, pigeons etc for which they are often poisoned. However, the species is very versatile and doing very well. Photographs in the wild are very rare and I was very lucky to snap this one in Narendrapur area.



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