2016 -2017

Annual Report

Saha Institute of Nuclear Physics
Kolkata

SAHA INSTITUTE OF NUCLEAR PHYSICS

ANNUAL REPORT

2016 – 2017

SINP

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Foreword

It is a great pleasure in bringing out the research and academic activities of the Institute carried out during the year 2016-17. As premier research institute catering to basic research and development in a wide variety of disciplines, Saha Institute of Nuclear Physics is now about to enter its 68th year of foundation.

Academic productivity of the Institute has remained steadily high over the last few years, with about 450 publications on an average. National and international collaborative works have contributed to about 60 high impact publications. While FRENA accelerator is about to be installed this year, an important development of SINP in collaboration with UCIL, Jaduguda has been in establishing an underground laboratory at 555 m level below the surface for dark matter and many other rare events search experiments. This is now the only working underground laboratory in India and second to the one at Kolar gold mine that is closed since 1992.

It is also noted with pride, the awards and honours bestowed on our faculty. Prof. Gautam Bhattacharyya was awarded the prestigious J.C. Bose National fellowship of DST-SERB. Dr. Biswarup Satpati has been awarded MRSI medal 2017, by the Material Research Society of India.

With a strong motivation to inspire more young minds to take up studies in basic sciences, our Institute has been conducting various types of outreach programs for school going children in and around Kolkata as well as in remote areas of West Bengal. The programs have gathered sufficient momentum with active participation from our young faculty and we look forward to intensifying our efforts in this direction.

SINP will be celebrating this year as the 125th birth anniversary of Prof. Meghnad Saha, our founder director. As a pioneer of modern physics in India, he opened new directions in the field of astrophysics with his theory of thermal ionisation and its application in the solar and stellar spectra, and was instrumental in laying the foundation for studies in nuclear physics. The initiation of National Institute of Science that went on to become the Indian National Science Academy and the formulation of the National Planning Committee are some of his great contributions to the Indian society. It is the appropriate time once again to draw lessons from the achievements of this great visionary as we become ready to face the challenges that are to come in these changing times. His scientific contributions will continue to inspire us and his social commitments will always be at our hearts.

Ajit Kumar Mohanty
Director

January 2018

Contents

Activities of the Institute
(April 2016 – March 2017)

Saha Institute of Nuclear Physics (SINP) is engaged in basic scientific research on four broad subject areas, namely, (a) Astroparticle physics and Cosmology, Theory (b) Applied Nuclear Physics, High Energy Nuclear & Particle Physics, Nuclear Physics and Plasma Physics, (c) Condensed Matter Physics, Surface Physics and Material Science (d) Biophysics and structural Genomics, Crystallography & Molecular Biology, Computational sciences and Chemical sciences.

The following table represents information on the number of Faculties, Research Fellows, Research Associates/Post Doctoral Fellows and number of Ph.D's awarded.

Division	Faculties	Research Fellows	R.A. / Post-Doc	Ramanujan Fellow	Ph. D. Awarded
Astroparticle Physics & Cosmology	6	6	1		7
Theory	13	13	5		4
Applied Nuclear Physics	7	7	1		2
High Energy Nuclear & Particle Physics	8	13	2	1	1
Nuclear Physics	6	15	1	1	1
Plasma Physics	2	8	1		4
Condensed Matter Physics	12	21	9		4
Surface Physics & Material Science	12	14	2		2
Biophysics & Structural Genomics	7	15	3		4
Crystallography & Molecular Biology	6	13	5		4
Chemical Science	8	10	3		5
Computational Science	2	2	1		1
Total	89**	137	34	2	39

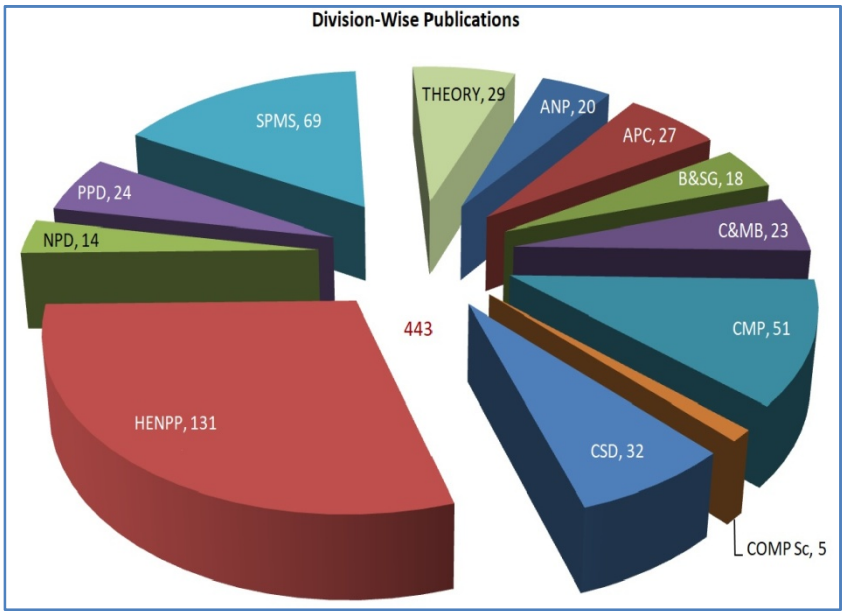
View at a glance of each Divisions in Tabular Form

**** Total 90 Faculties including Director**

Thirty one (31) Post M.Sc. students have been inducted into research and teaching program during the year 2016-17. Eleven (11) undergraduate associates and twenty four (24) summer students have been trained in the Institute. The students come from different parts of the country.

Important Achievements

Research Publications and PhD Awarded

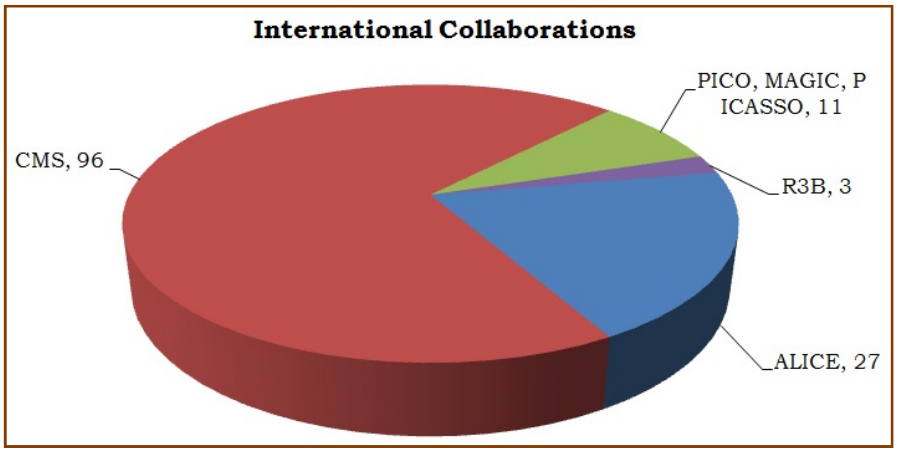


In this period about 39 theses have been awarded the Ph.D. degrees. Altogether 443 research publications have been credited during the period with 62 scientific articles published in high impact (I.F.≥ 6) journals like Nature, Science, ACS Catalysis, Nucleic Acids Research, Proceedings of The National Academy of Sciences of The United States of America, Chemistry of Materials, Physical Review Letters, ACS Applied Materials & Interfaces, Chemsuschem, Cancer Letters, Acta Biomaterialia, Chemical Engineering Journal and Journal of High Energy Physics, etc.

- **International Collaborations**

Besides, the institute is continuing several International Collaborations such as:

- ALICE and CMS experiments at CERN, PICASSO experiment at SNOLab.
- Experiments at Deutsches Elektronen-Synchrotron (DESY), Hamburg through the Indo-German Collaboration in synchrotron research.
- Successful operation of the Indian Beam Line at Photon Factory (KEK) at Tsukuba, Japan has been recognized as a flagship cooperative activity by the honorable Prime Minister of India. Publications through international collaborations are represented in the following graphical presentation.



Pie chart of the Number of publications through International Collaboration

Outreach Programme

The institute has organised several **outreach programmes** through the CARE unit (Centre for Advanced Research & Education) both inside and outside SINP and received overwhelming response from the participants.

A moment during Science Day Celebration at SINP, March 10, 2017

Award Giving Ceremony of Science Day Celebration Program: Award given by Prof Ajit Kumar Mohanty, Director, SINP and Prof Amitava Roy, Director, VECC

- ## Honours & Distinctions

Prof. Gautam Bhattacharyya

- **Prof. Gautam Bhattacharyya** has been awarded the prestigious **J.C. Bose National fellowship** (DST-SERB) in 2017.

Dr. Biswarup Satpati

- **Dr. Biswarup Satpati** has been awarded MRSI medal 2017, Material Research Society of India.

67th Annual Foundation Day Celebration
January 11, 2017

Tree plantation by Chieft Guest Dr. Mammen Chandey, Director, Tata Medical Centre, Kolkata in the presence of our Director, Registrar and staff of SINP.

67th Foundation Day Lecture delivered by Dr. Mammen Chandy, Director, TMC, Kolkata

Celebration of 70th Independence Day at SINP
August 15, 2016

Flag hoisting and saluting on Independence Day 2016

Special Events

61st DAE-BRNS Symposium on Nuclear Physics

December 4 – 9, 2016

Participants of 61st DAE-BRNS Symposium on Nuclear Physics 2016 at Saha Institute of Nuclear Physics, Kolkata. Over 458 scientists and students from from all over the country participated in this annual symposium organized by DAE, Govt. of India. The main symposium is preceded by a one-day Orientation Programme for the student participants with Nuclear Astrophysics as the theme of the programme.

Saha Theory Workshop 2017 of the Theory Division

January 16 – 20, 2017

Theory Division of Saha Institute of Nuclear Physics host its third "Saha Theory Workshop: Aspects of Early Universe Cosmology". Experts who are actively working in this field had participated and young members who are pursuing research in this area. The workshop focuses on several theoretical aspects of early universe cosmology, how present and forthcoming data can guide us to unravel the mystery of early Universe.

Care Seminar Lecture given by Mark McCanghrean on February 14, 2017

Under Graduate Associate 2016 – 2017

Summer Students 2016 – 2017

Research Highlights

1. Applied Nuclear Physics

Research carried out at the Applied Nuclear Physics Division during 2016-17 involves probing the atomic, nuclear and nanocrystalline systems using nuclear probes and techniques. Intermetallic alloys of technological importance and low-dimensional systems, such as nano-crystalline materials are also being studied to explore their properties. Our members are working on dark matter search experiment, cosmic muon based tomography and developing instruments, experimental techniques and simulation of various aspects for these applications involving interdisciplinary areas of Physics. Development, characterization and optimization of radiation detectors for next generation high energy physics experiments, model based simulation and cognitive science research to understand the details of visual perception are also being carried out in our laboratories.

Our members, in collaboration with Astroparticle Physics and Cosmology (APC) Division, are working on the development of an underground laboratory in India for dark matter search experiment using scintillation based detectors. The experiment evolved as active collaboration between SINP, BARC, NISER and UCIL (and also INO). First phase of the experiment is to establish the laboratory, measure the radiation background and devise methods of reducing the effects of radiation background. Parallel development of scintillation detectors, their characterization for operation at cryogenic temperatures and optimizing the pulse shape discrimination to distinguish between electron and nuclear recoil events is in progress. Significant work has been done on simulation of the radiation background at the laboratory site by considering penetrating cosmic rays and residual rock radioactivity. Simulation of the detector response to background neutrons and gamma rays is also in progress.

Experiments on Electromagnetically Induced Transparency (EIT) and Electromagnetically Induced Absorption (EIA) in room temperature Rb atoms were carried out at Laser Spectroscopy and Quantum Optics laboratory at SINP. We have performed spectroscopic studies on neutral Rubidium atoms using pump-probe spectroscopic techniques, and results are interpreted by assuming V- and Λ-type multi-level systems for ^{85}Rb and ^{87}Rb atoms in D2 and D1 transitions. The results can be used to render the medium opaque and transparent in a controlled way for optical switching applications. Laguerre-Gaussian (LG) beams (optical Vortex beam) were set up using external cavity diode lasers. Narrowing of the line shapes of hyperfine transitions were observed for higher orders of the LG beam in comparison to the Gaussian beam.

Using time-differential perturbed angular correlation (TDPAC) technique, studies of point defects, structural and magnetic phase transitions in metallic and inter-metallic systems, thin films and nano-crystalline materials are carried out. A four-detector TDPAC spectrometer with ultrafast BaF_2 or $LaBr_3$(Ce) detectors has been developed for the above purpose. Numerous technological applications of Ni-based Zr and Hf intermetallic alloys have prompted comprehensive studies in $ZrNi_3$ and $HfNi_3$ alloys by perturbed angular correlation (PAC) spectroscopy which were not studied earlier. The different phases produced in the samples have been identified by PAC and X-ray diffraction (XRD) measurements. Stoichiometry of the compounds was asserted by HRTEM analysis. Density functional theory (DFT) based calculations of electric field gradient (EFG) and asymmetry parameter (η) at ^{181}Ta probe nucleus allowed us to assign the observed EFG fractions at the lattice sites in the compounds.

Positron annihilation spectroscopy (PAS) was used for the studies of properties and processes related to defects in nanomaterials including metals, alloys, ferrites and semiconductors. An

interesting aspect of these studies has been to look for the effect of doping and surface modification by defects and other substitutional elements in a nanocrystalline system. Investigation on several polymeric samples are also carried out for characterization of free volume defects in them and estimating their concentration.

Our members have successfully implemented the nearly exact Boundary Element Method (neBEM) to solve for potential and flux field in a non-dissipative system governed by Laplace's equation. In an important break-through, we have been able to carry out analytic integration of Green's function (and derivative) for singularities uniformly distributed over typical rectangular and triangular elements through the use of symbolic mathematics. The solver has been applied to study the physical as well as weighting field configurations of a diverse group of detectors that includes a few wire chambers, TPC, RPC and several new generation micro-pattern gaseous detectors (MPGD) such as Micro-Wire, Micro MEGAS, THGEM etc. We are working onthe application-oriented field of cosmic ray muon tomography. Both experimental and numerical simulation tools are being used to explore various possibilities.

One of our members is working on computational neuroscience which is an interdisciplinary area involving computational science, cognitive science and various aspects of visual perception. Computational mechanism of filling in at the blind spot of the retina and its associated properties can be understood by taking into account the statistics of natural scene and the computational architecture (Hierarchical Predictive Coding) of the cortex, and demonstrated that several experimentally observed properties of filling-in at the blind-spot could be accommodated under the same computational framework. The findings, in this work, offer new insights into the role of natural scene statistics in our perception and suggest, what is possibly, the first systematic bridge linking anisotropy in three levels: natural environment, visual cortex, and perceptual filling-in at the blind spot.

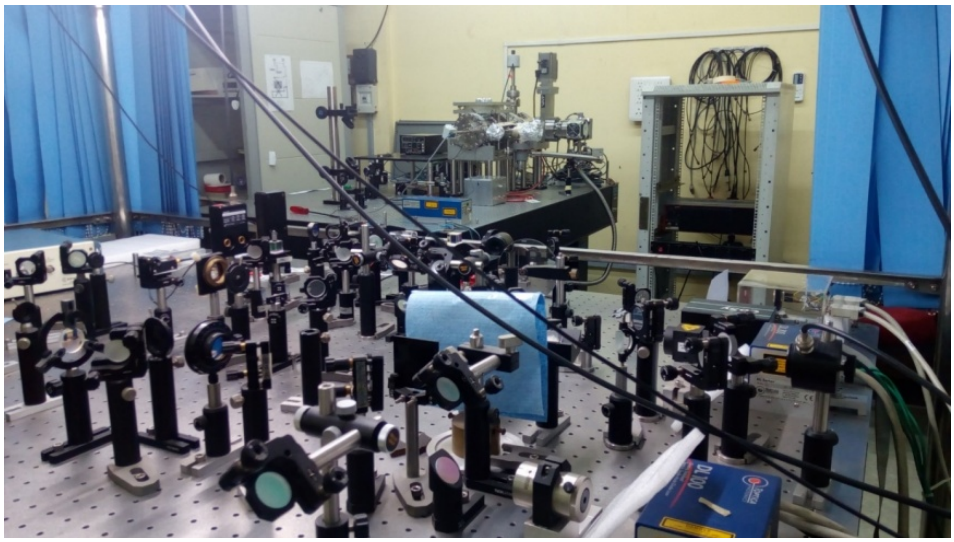


Fig. Laser Spectroscopy Laboratory in SINP studies electromagnetically induced phenomenon in neutral Rubidium atoms using external cavity diode lasers (ECDLs) operating at 780 nm.

1.1. Ph D Awarded

1. Hitesh V. Rahangdale [Satyajit Saha], Electron impact ionization study of high Z elements, Homi Bhabha National Institute, January 2017.
2. Meghna K. K. [Satyajit Saha], Performance of RPC detectors and study of muons with the Iron calorimeter detector at INO, Homi Bhabha National Institute, January 2017.

1.2. Lectures/Talks given in Conference/ Symposium/ Workshop/ Schools

Nayana Majumdar

1. Status of INO, International Workshop of Next Generation Nucleon Decay and Neutrino Detectors (NNN16), Beijing, China, November 3-5, 2016.

Supratik Mukhopadhyay

1. Ionization detectors in nuclear and astroparticle physics, 8th Vidyasagar-Satyendranath Bose National Workshop 2017 on Nuclear and Astrophysics: Two opposite ends of Dimension (NATD 2017), Vidyasagar University, Midnapore, West Bengal, India, January 17-19, 2017.
2. Detector Physics Simulation of Gaseous Ionization Detectors, Advanced Detectors for Nuclear, High Energy and Astroparticle Physics (ADNHEAP2017), Bose Institute, Kolkata, February 15-17, 2017.

P.M.G. Nambissan

1. Characterization of free volume defects in macromolecular systems through positron annihilation spectroscopy, International Conference on Macromolecules: Synthesis, Morphology, Processing, Structure, Properties and Applications (ICM-2016), Mahatma Gandhi University, Kottayam, Kerala, May 13-15, 2016.
2. Positron annihilation spectroscopic studies of multiferroic nanocrystalline bismuth ferrite doped with lanthanide ions, National Conference on Nanoscience, Nanotechnology and Advanced Materials (NCNNAM–2016), Birla Institute of Technology, Mesra, Ranchi, Jharkhand, September 26-27, 2016.
3. (i) Increasing the intensity of the consciousness of life through science and (ii) Nano is the word but Giga is the impact, INSPIRE Internship Science Camp, Sree Narayana College, Kannur, Kerala, December 25-30, 2016.
4. Positrons as nuclear spectroscopic probes for the studies of materials of astrophysical relevance, 8th Vidyasagar-Satyendranath Bose National Workshop 2017 on Nuclear and Astrophysics: Two opposite ends of Dimensions (NATD-2017), Vidyasagar University, Midnapur, West Bengal, January 17-19, 2017.
5. A metal oxide glass nanocomposite using its cationic vacancies as messengers of structural information in positron annihilation studies, 4th International Conference on Nanostructured Materials and Nanocomposites (ICNM-2017), Mahatma Gandhi University, Kottayam, Kerala, February 10-12, 2017.
6. Positron annihilation studies of a metal oxide nanocomposite system, One day Workshop on Recent Advances in Nuclear Technique Based Materials Science Research, UGC-DAE Consortium for Scientific Research, Kolkata Centre, Kolkata, February 27, 2017.
7. Defect spectroscopic studies of nanomaterials, National Seminar on Nanoscience and Nanotechnology (NSNN-2017), Haldia Institute of Technology, Haldia, West Bengal, March 17-18, 2017.
8. Defect characterization through electron-positron annihilation spectroscopy of rare-earth-ions-substituted $BiFeO_3$ multiferroic nanocrystallites, International Meeting on Highly Correlated Systems (IMHCS-2017), Mahatma Gandhi University, Kottayam, Kerala, March 24-26, 2017.

Sankar De

1. Intra-molecular scattering within dissociative diiodoacetylene authored by Sankar

De, P. Bhatt,C. P. Safvan, J. Matsumoto and H. Shiromaru, International Conference on Frontiers in Theoretical and Applied Physics (FTAPS 2017), American University of Sharjah, United Arab Emirates, February, 2017.

2. Probing ultrafast molecular dynamics with few-cycle infrared laser pulses and CEP control, Frontiers in Attosecond Science and Technology (FAST), Indian Institute of Science Education and Research (IISER), Mohali and Max Planck Society, Germany, March 2017.

2. Astroparticle Physics and Cosmology

The Astroparticle Physics & Cosmology (APC) Division carries out advanced research in the interface areas spanning High Energy Astrophysics, Cosmology, and Particle & Nuclear physics. During the year under review, members of the Division have carried out research on a variety of topics in Astroparticle Physics observational, experimental and theoretical. Some highlights are given below:

Dark matter direct search with PICASSO/PICO and various aspects of superheated liquid detector

Radiation linear energy transfer and drop size dependence of low frequency acoustic signal from tiny superheated droplets have been investigated experimentally at the SINP lab. The simulation of the response of superheated droplet detector to alpha particles has also been explored by incorporating the contamination both at the droplets and at the supporting matrix. Detection of bubble nucleation event has been carried out in superheated drop detector by using the pressure sensor. The design of the Camera Mount system for the next generation PICO-40L bubble chamber experiment has been done at SINP. The camera mount will be fitted with the viewing port of the chamber of the detector to view the bubble nucleation. Final sensitivity result from PICASSO dark matter search experiment has been published with the 32 detectors among which the two detectors were fabricated by the SINP group. We have also participated in the on-line shifts from SINP for the detector operation during actual physics run at SNOLab and in the data analysis program.

High Energy Gamma Ray Astronomy

The scientists of APC Division are involved in designing and building the calibration system for calibrating the camera of a prototype Large Size Telescope (LST) of Cerenkov Telescope Array (CTA) in close collaboration with Max Planck Institute for Physik, Munich and Tata Institute of Fundamental Research (TIFR), Mumbai. The calibration system has been assembled with help of engineers and technicians at SINP and TIFR and a graduate student from SINP. All tests to ascertain its performance have been completed. It is expected to be shipped to the observatory at La Palma, Canary Islands, Spain in autumn 2017 where the prototype LST is being constructed. Further field tests are envisaged in 2017.

The High Altitude Water Cerenkov (HAWC) detector array has recently released a catalog of very high energy gamma-ray sources above an energy threshold of ~ 10 TeV which have no clear counterparts in lower energies (either at > 10 GeV or > 300 GeV). The MAGIC telescopes and archival data from Fermi-LAT satellite detector were used to search for high energy and very high energy gamma ray emission from a selected list of promising candidate sources. No significant emission of gamma rays from any of the candidate sources was detected and hence differential flux upper limits were calculated for these sources. The combination of HAWC and MAGIC results together allow us to put strong constraints on the extensions of the sources.

A very detailed study of the long term light curve of the Flat Spectrum radio Quasar (FSRQ) PKS1510-089 in high energy gamma rays was done using the data taken by Large Area Telescope on board Fermi Gamma Ray Space Telescope (Fermi-LAT). Several flares of this highly variable source were identified and their temporal and spectral properties were studied in detail and compared with previous works on flares of PKS 1510-089. Five major flares and few sub-flares / sub-structures have been identified in our study. The fastest variability time is found to be 0.95 +_10 hr where the minimum size of the emission region is estimated to be 4.82 x 10^{15} cm. In most of the flares the spectral energy distributions are best fitted with Log-parabola distribution compared to simple Power law or Power law with

exponential cut-offs. This has strong physics implications regarding the nature of the high energy gamma-ray emission region

Neutron Stars

The magneto-elastic oscillations of magnetars were studied taking the effect of strong magnetic fields on the crustal composition, into account. Global magneto-elastic (GME) modes as well as modes confined to the crust (CME) only were investigated. Findings of model calculations were compared with frequencies of observed quasi-periodic oscillations in SGR 1806-20 and SGR1900+14. This comparison indicates that GME modes are essential to explain all the frequencies whereas CME modes can explain only the higher frequencies.

Furthermore, the influence of magnetic fields on the frame dragging effect of rotating neutron stars was investigated. It was found that the magnetic field has a non-negligible impact on the frame dragging.

Theoretical Research on Dark Matter

A new class of Dark Matter namely Feebly Interacting Dark Matter is explored in details. In this model, the Dark Matter is never in thermal equilibrium with the rest of the Universe's plasma and produced by the very feeble interaction of other particles. In contrast to more popular WIMP (Weakly Interacting Massive Particle) scenario, the FIMP Dark Matter approaches towards equilibrium whereas for the case of WIMP, the Dark Matter particles move away from equilibrium leading to decoupling. We propose a FIMP-WIMP model for dark matter and explore its phenomenology. It is revealed that while the Galactic centre (GC) gamma excess can be explained by considering annihilation of WIMP type Dark Matter at GC, the observation based self interaction bound of Dark Matter can be well explained by the FIMP component. Besides, we explore Axions as another possible candidate of Dark Matter.

Neutrino Physics and Astrophysics

(a) Neutrino Physics: Mass matrix phenomenology, Baryogenesis through Leptogenesis

Baryogenesis via leptogenesis is investigated in a specific model of light neutrino masses and mixing angles. The latter was proposed on the basis of an assumed complex-extended scaling property of the neutrino Majorana mass matrix M_ν, derived with a type-1 seesaw from a Dirac mass matrix m_D and a heavy singlet neutrino Majorana mass matrix M_R. One of its important features, highlighted here, is that there is a common source of the origin of a nonzero θ_{13} and the CP violating lepton asymmetry through the imaginary part of m_D. The model predicted CP violation to be maximal for the Dirac type and vanishing for the Majorana type. We assume strongly hierarchical mass eigenvalues for M_R. The leptonic CP asymmetry parameter $\epsilon^{\alpha}{}_1{}^L$ with lepton flavor α, originating from the decays of the lightest of the heavy neutrinos N_1(of mass M_1) at a temperature $T \sim M_1$, is what matters here with $\epsilon^{\alpha}{}_{2,3}$, originating from the decays of $N_{2,3}$, being washed out. The light leptonic and heavy neutrino number densities (normalized to the entropy density) are evolved via Boltzmann equations down to electroweak temperatures to yield a baryon asymmetry through sphaleronic transitions. The effect of flavored vs. unflavored leptogenesis in the three mass regimes (1) $M_1 < 10^9$ GeV, (2) 10^9 GeV $< M_1 < 10^{12}$ GeV and (3) $M_1 > 10^{12}$ GeV are numerically worked out for both a normal and an inverted mass ordering of the light neutrinos. Corresponding results on the baryon asymmetry of the universe are obtained, displayed and discussed.

(b) Supernova Neutrinos

Supernova neutrinos can excite nuclei above their neutron emission thresholds. Simultaneous detection of the neutrons in a Fe (dominantly sensitive to neutral current) and a Pb (dominantly sensitive to charged current) can allow us to probe the flavor composition of the supernova neutrinos.

2.1. Ph D Awarded

1. Apurba Kheto [Debades Bandyopadhyay], Isospin dependent entrainment in rotating superfluid neutron stars, HBNI, Mumbai, April 2016.
2. Mainak Chakraborty [Ambar Ghosal], A Study on Neutrino Masses, Mixing and Baryogenesis through Leptognesis in Some Electroweak models, University of Calcutta, Kolkata, June 2016.
3. Kamakshya Prasad Modak [Debasish Majumdar], Investigating Some Aspects of Dark Matter Indirect Detection Using Different Dark Matter Particle Physics Models, HBNI, Mumbai, August 2016.
4. Anirban Biswas [Debasish Majumdar], Exploring Some Models for Particle Dark Matter, University of Calcutta, September 2016.
5. Debabrata Adak [Debasish Majumdar], Studying Dark Energy from Theoretical and Observational Aspects of Late-time Cosmic Acceleration, University of Calcutta, November 2016.
6. Amit Dutta Banik, [Debasish Majumdar], Study of Different Dark Matter Models with Extended Higgs Sector, HBNI, Mumbai, November 2016.
7. Prasanta Char, [Debades Bandyopadhyay], Some studies on Core Collapse Supernovae and Neutron Stars, HBNI, Mumbai, January 2017.

2.2. Lectures/Talks given in Conference/ Symposium/ Workshop/ Schools

Debades Bandyopadhyay

1. Probing Exotic Fluid in Neutron Star Interior, One day seminar on the properties of nuclear fluid, VECC, Kolkata, December 29, 2016.
2. Neutron Stars: Masses and moments of inertia, Key Science Projcet (KSP) session, SKA 2016: Science for the SKA generation, Goa, November 7-11, 2016.
3. Neutron Stars: unique laboratories for fundamental physics at supranuclear densities, First Asia SKA Initiative on NS (ASIONS), Goa, November 4-5, 2016.
4. Masses, Radii and Moments of Inertia of Neutron Stars: Probing Neutron Star Interior, Introductory Workshop on Astrophysics and Cosmology, Aliah University, Kolkata, September 27-28, 2016.

Debasish Majumdar

1. Fermionic Dark Matter in a Dark Sector, PHENO1@IISERM, IISER, Mohali, April 6-9, 2016.
2. Invisible Sector: Neutrinos and Dark matter, Indo-US workshop, University of Hyderabad, Hyderabad, November 16-18, 2016.
3. Dark Matter, XXII DAE-BRNS High Energy Physics Symposium, University of Delhi, Delhi, December 12-16, 2016.

4. Aspects of Dark Matter, National Workshop on Recent Advances in Astrophysics and Cosmology, Department of Physics, University of North Bengal, Siliguri, March 17-18, 2017.

Mala Das

1. Direct detection of Dark Matter, 8th Vidyasagar Satyendranath Bose National Workshop 2017 on Nuclear and Astrophysics: Two opposite ends of Dimensions (NATD-2017), Vidyasagar University, Midnapore, January 18, 2017.

Pijushpani Bhattacharjee

1. Status of DINO, INO collaboration meeting, TIFR, Mumbai, October 25, 2016.
2. On the Trail of WIMPs: Detecting the Weakly Interacting Massive Particle Candidates of Dark Matter, National Conference on Frontiers of Physics, Burdwan University, Burdwan, West Bengal, March 30-31, 2017.

Pratik Majumdar

1. Origin of Cosmic Rays: A 100 Year Old Story, Recent trends in Condensed Matter and High Energy Physics (RCHP), IACS, Kolkata, January 30-February 1, 2017.
2. Exploring the Universe with High Energy Photons and Particles, DST-INSPIRE Camp, IISER, Pune, July 2016.
3. Guest Stars of the Universe, INSPIRE school students at JBNSTS, Kolkata, December 2016.

2.3. Teaching elsewhere

Debades Bandyopadhyay

1. Physics of neutron stars, NCRA-TIFR, Pune, March 23-29, 2017.

Debasish Majumdar

1. M.Sc. Course on Standard Model Interactions, St. Xavier's College, Kolkata, January - April, 2017.
2. Nuclear Astrophysics (3 Lectures), CNT Lectures, VECC, Kolkata, March 2017.

Pijushpani Bhattacharjee

1. Advances in High Energy Astrophysics & Astroparticle Physics, SINP Post-MSc. advanced course, January – March 2017.
2. Detecting the Weakly Interacting Massive Particle Candidates of Dark Matter, VECC, Kolkata, January 24, 2017.

3. Biophysics and Structural Genomics

Biophysics and Structural Genomics Division is focussed in interdisciplinary area of basic and clinical research involving Proteomics, Biomolecular spectroscopy, Chemical Biology and Synthetic & Structural Biology. The widely prevalent diseases of eastern India, HbE-thalassemia and leukemia are being studied as model for hematological disorders while Alzheimer's, Huntington's, and the Prion diseases are being investigated for gaining insights into neurodegenerative diseases. Differential proteomics studies have been performed using clinical samples of cerebrospinal fluid, blood and plasma. Classes of redox regulators and chaperone proteins have been found to be up-regulated in hemoglobinopathy and an interactome for haemoglobin has been identified in erythrocytes. Investigations in cellular signaling and its role in cell fate determination vis a vis regulation of metabolism were studied using comparative mitochondrial proteome. Our findings clearly underline that cellular signalling and differentiation, lead to the alteration of mitochondrial proteome which in turn affects the functioning of key metabolic pathways. Similar studies have also implicated deregulation in self renewal pathways in the process of metastasis in gastric and breast cancer. Biophysical studies on elasticity of nuclear membrane proteins Lamins have implicated their role not only in cardiovascular diseases but in cell differentiation as well. Currently, investigation on the role of lamins and intermediate filaments in DNA damage response, karyokinesis and carcinogenesis are underway. Epigenomics studies on function and dynamics of transcription factors have been initiated to interpret the epigenetic language in eukaryotic cells. We aim to understand the critical interactions between histone posttranslational modifications and the 'readers' which regulate important cellular pathways and their dysfunctions leading to disease such as breast cancer.

Neurodegenerative disorders like Alzheimer's, Huntington's and Prion Diseases are being pursued to study the roles of various micro RNAs in the disease process. The major focus of research in Alzheimer's has been the study of the downstream pathogenesis mediated through AICD and its adaptor network. AICD possesses conserved motifs that are known to interact with cytosolic adaptor proteins and these interactions in turn affect different signaling pathways. With Prion disease as a model system, we are trying to understand the significance of the ESCRT machinery and the endo-lysosomal pathway in Prion protein-mediated neurodegeneration. Our aim is to provide a molecular explanation for how the loss of function mutation of Mahogunin results in Prion disease like phenotype of spongiform neurodegeneration. In this regard, Ubiquitin-mediated regulation of the E3 ligase GP78 by MGRN1 in trans have been shown to affect mitochondrial homeostasis and positioning of spindle apparatus in development and disease.

Recently, we have initiated studies on a molecular systems level understanding of the combined effects of microgravity and space ionizing radiation (high energy particles) on human cells along with a metabolomics-guided system level elucidation of the effect of radiation exposure on living systems.

3.1. Ph D Awarded

1. Srijan Haldar [Subrata Banerjee], Biology of Megakaryocytes, University of Calcutta, May 2016.
2. Devika Srivastava [Oishee Chakrabarti], Mahogurin (MGRNI) mediated ubiquitination of α-tubulin and its regulation of cell division, University of Calcutta, July 2016.
3. Pritha Bhattacharjee [Kaushik Sengupta], Mechanistic elucidation of the Role of Lamin A in Dilated Cardiomyopathy, University of Calcutta, November 2016.

4. Avinanda Banerjee [Kaushik Sengupta], Effects of Lamin A mutations in Nuclear Morphology, Function and mechanics – a Plausible link with Dilated Cardiomyopathy, University of Calcutta, November 2016.

3.2. Lectures/Talks given in Conference/ Symposium/ Workshop/ Schools

Chandrima Das

1. Novel mechanisms of suppression of breast cancer metastasis by chromatin Readers/Effectors, 6th Meeting of the Asian Forum for Chromatin and Chromosome Biology, CCMB, Hyderabad, March, 2017.
2. Epigenetic Reader ZMYND8 is a novel regulator of tumorigenicity, 11th Asian Epigenomics Meeting, JNCASR, Bangalore, September, 2016.
3. Prolyl isomerization as a novel mode to regulate chromatin function, 6th Ramalingaswami Conclave, IISER, Pune, 2017.
4. HBx hijacks nuclear body protein Speckled 110 and promotes Hepatitis B Virus pathogenesis, 19th Transcription Assembly Meeting, Bose Institute in association with SINP and IICB, Kolkata, 2016.
5. Decoding the Epigenetic Landscape by the Histone Readers: Implications in Human Diseases, Special Colloquium, NCCS, Pune, 2017.

Sangram Bagh

1. Towards a Synthetic Biology Platform for Cellular Robotics and Space Bioengineering, International Biological Engineering Meeting (IBEM), JNU, Delhi, March 27, 2017.
2. Can We Program a Living Cell Like an Engineer Programs a Device?, SN Bose National Center for Basic Research, Kolkata, February 07, 2017.
3. Rewriting Cellular Programs for Cellular Robotics and Space Bioengineering, Synthetic Biology and Pathway Engineering Symposium, Anna University, Chennai, December 05, 2016.
4. Biological Cell: The Ultimate Programmable Soft Condensed Matter, Faculty Development Program for Physicists, St. Xavier's College, Kolkata, December 10, 2016.
5. Synthetic and Systems Biology for Reprogramming Cell and Space Bioengineering, National Symposium on Bioinformatics and Computational Systems Biology, HCU, Dharamshala, November 12-16, 2016.
6. Teaching Cell an Engineering Language, Transcriptional Assembly Meeting, Bose Institute, Kolkata, November 9, 2016.
7. Reprogramming Biology with an Engineering Language, Tata Institute of Fundamental Research, Hyderabad (TCIS-Hyderabad), August 29, 2016.

3.3. Teaching elsewhere

Chandrima Das

1. M.Sc. (3 Lectures) at Department of Biochemistry, Ballygunge Science College, November 2016.

Sangram Bagh

1. M.Sc course in Medical Biotechnology (8 Lectures), three departments including Department of Neuroscience, Department of Microbiology and Department of Genetics at Calcutta University, Kolkata, January-March 2017.

Pulak Ray

1. M.Tech. Course on Biomedical Instrumentation (12 Lectures), Electron Microscopy and Atomic Force Microscopy, University of Calcutta, March-June 2016.

3.4. Publications in Books/Monographs/Edited Volumes

Chandrima Das

1. Noncoding RNAs as chromatin scaffold of histone modification complexes in cancer' in Cancer and Non-coding RNAs, Translational Epigenetics Series, Volume eds: Jayprokas Chakrabarti and Sanga Mitra; Series ed: TrygveTollefsbol, (Elsevier). 2017 (In Press).

4. Chemical Sciences

Research in the Chemical Sciences Division is wide-ranging and interdisciplinary, and addresses fundamental aspects of science. Overarching goals of the research projects include understanding of the excited state dynamics of complex phenomena using ultra fast spectroscopy and single molecule imaging, finding new functions for old drugs: Non Steroidal Anti-inflammatory Drugs (NSAIDs), different areas in Nuclear Chemistry, Radiochemistry and Green Chemistry, developing nanotechnology and novel advanced materials for a myriad of applications, unraveling problems associated with devising new, alternative sources of energy, neutron spectrometry and interaction, nano particle dosimetry and radiation safety.

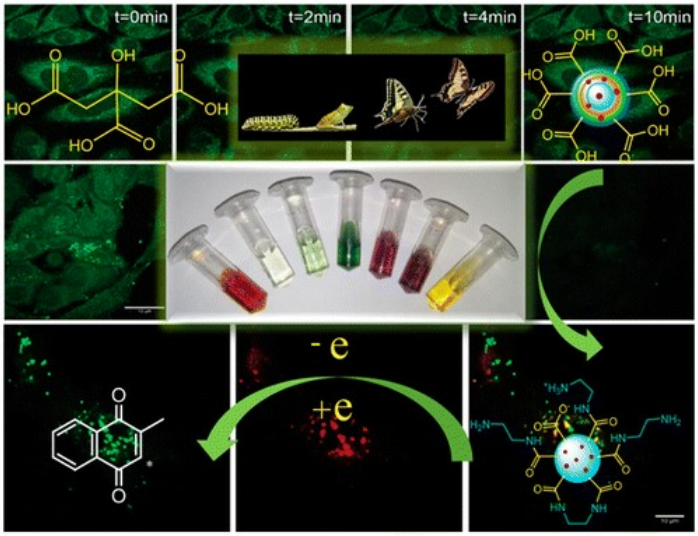


Fig. Schematic representation of the model metamorphosis of a butterfly; Synthetic root of Rr:CDs (red dots represent Ru).; White light images of seven intermediates of Ru(0.005):CDs in water, as obtained at different time intervals during pyrolysis of CA at 250 °C.

Time-resolved spectroscopy within femtosecond to nanosecond time regime is being used extensively to study excited state dynamics on electronic and spatial control over the formation of transient ion pairs during photo induced electron transfer and proton transfer with small organic molecules like proflavine–amine, lumichrome-amines, etc. Similarly the results from laser flash photolysis experiments corroborated with magnetic field highlight the inter-radical separation distance between acridine derivatives and serum albumin proteins undergoing photo induced electron transfer during binding. Moreover, steady-state and time-resolved spectroscopic studies supported by theoretical docking analyses on structure dependent hydrophobic and hydrophilic interactions of Schiff base complexes, comprising of different metal ions and ligands, with serum albumins as well as hen egg white lysozyme proteins emphasize the potentiality of less explored nickel complexes in drug–protein interactions. In recent years emphasis has been given on extension of the work using crystallography and STD NMR spectroscopy, synthesizing copper(II) and Nickel(II) Schiff base complexes which can act as efficient small perturbing agents for biomacromolecules by distinguishing the relation of the structures and functions of these complexes towards different model biomacromolecules and cell lines like HeLa and WI-38 and assessment of antibacterial efficacy of therapeutically important small molecules conjugated with gold nanoparticles. Very recently we have succeeded in synthesizing 'photo luminescent' carbon dots. As per our concern, this is a pioneering work, where the plausible molecular structure and the intrinsic mechanisms governing photoluminescence of carbon dots are explained by trapping seven visibly distinct coloured intermediates evolved during pyrolytic metamorphosis of citric acid (CA) with dopent Ru(III) as an indicator. The metamorphosis of Ru: carbon dots is monitored by characterizing each trapped intermediate using HR-TEM, DLS, XPS, XRD, ^{1}H-NMR, FT-IR, and steady-state and time-resolved UV-visible and fluorescence spectroscopy as well as magnetic field effect. The photo induced electron transfer ability of such carbon dots helps to develop their utility as quinone-sensor in live cells.

Copper complexes of Oxicam NSAIDs have been synthesized to study their biological applications. They form a new class of membrane anchors that require neither molecular recognition nor strength of interaction between interacting molecular partners, but still can

effectively increase membrane fusogenic efficacy over the bare drugs. This new class of membrane anchors is therefore a step ahead of traditional anchors that are based on two interacting molecular partners. DNA-binding with high base sequence specificity and apoptosis inducing properties have also been found for these complexes. Also, the copper complexes of traditional NSAIDs have been found to cause structural alterations upon interaction with chromatin/histone that makes them exert their effect at the epigenomic and genomic level.

Au-Polyaniline based conducting nano-composite has been utilized for bio-sensing of glucose, DNA and protein, using different electrochemical techniques and also for detecting the positional effect of single base mismatch in oligonucleotides. PEDOT-MnO_2 and graphene based materials have been used to fabricate super capacitors of high specific capacitance. A non-enzymatic electrochemical biosensor has been fabricated for cholesterol detection, having a distinct advantage over other conventional enzymatic processes. Chemically converted Graphene modified with β-CD, being hydrophilic, electro active and high surface area material, provides a platform for the electrochemical detection of cholesterol using Methylene Blue as redox indicator. Graphite nanoplatelet (GNP)/conducting polymer (poly(3,4-ethylenedioxythiophene)–poly(styrenesulfonate)) (PEDOT:PSS) composites were synthesized for their application as highly efficient electromagnetic interference (EMI) shielding material (SE) in the X-band frequency region.

A single molecule and ensemble spectroscopic study of dynamics of double stranded DNA and other DNA structural motifs were carried out. Effect of interaction of DNA with different nano particles as well as grapheme oxide was carried out using the above methods. The following results were obtained. i). *Conformational changes and complete unzipping of dsDNA by surface modified Gold Nanoparticles*. In this work the interaction of dsDNA with surface modified gold nano particles was studied. A collaborative effect of the nanoparticles resulted in structural changes e.g. compaction and strand separation depending on the size and hence the charge on the AuNPs. ii). *Bubble dynamics and DNA flexibility in presence of base pair mismatch*. Dynamics of the thermally induced DNA bubble formation shows spontaneously zipping- unzipping rate which follows multistate relaxation kinetics. The nature of bubble has been investigated using small DNA containing 23 nucleotides and having preferred nucleotide sequence nearly identical to that of the transcription initiation sequence. The selective introduction of base pair mismatch for creation of melting bubble affects the local base stacking, along with the base pairing. iii). *Chaotic Dynamics During the Restricted Branch Migration of IHF Bound Holliday Junctions due to Applied Force: A smFRET study.* The enhanced rigidity and reduced flexibility, that a Holiday junction experiences upon binding to a DNA binding/Bending Protein, IHF have been monitored. Using single molecule FRET technique, detection of the isomerization dynamics in presence of applied force becomes possible. *iv). Single molecule FRET Studies of Hybridization mechanism during the noncovalent adsorption and desorption of DNA on Graphene Oxide.* This provides the insight about the interaction of DNA with low dimensional material like 'Graphene Oxide' (GO) to give a detail hybridization mechanism during the adsorption and desorption of DNA on its surface.

Recently, different architectures of nanomaterials which include tunable gold nano-flowers, silver nano-wires, selenium nano-spheres, intercalated nano-prism, branched gold nano-crystals, and porous silver nano-materials have been developed. The main /results areas probed:

a) Standardization of nanotemplated growth technique for overgrowth anisotropic SERS active nanomaterials synthesis.

b) Controlled nanowire synthesis with aspect ratio ~1000 can replace carbon nanotube for their flexibility and giant conductivity.

c) Miniaturized electroanalytical instrument for cost effective blood profiling.

d) Synthesized bimetallic noble metal nanoparticle shows effective and selective killing of tuberculosis bacteria.

e) New generation mesoporous silica nanoparticle (MSN) for pH induced non-toxic drug delivery.

f) Newly synthesized hedgehog gold nanoparticle with high molecular weight non toxic polymer screening for long retention in blood vessel with ~5000K nanoscale thermalization.

g) Establishment of new field "Magnetic Field Enhanced Spin Dynamics".

The nuclear and radiochemistry group is engaged in various activities. For the first time non-destructive method have been designed to determine K content of ancient glass beads which eventually tells about the origin of glass bead. Contribution have made in Radio-Green Chemistry experiments. Ionic liquids and other green reagents have been used to separate no-carrier-added clinically important radionuclides like ^{61}Cu, ^{62}Zn, ^{97}Ru, ^{95,96}Tc, ^{111}In and ^{109}Cd. An effective separation of ^{163}Ho was designed from ^{163}Er which has implications in neutrino mass measurement. Another important program of nuclear and radiochemistry group is measurement of naturally occurring radioactive material in Sundarban and Punjab state in collaboration with University of Calcutta and Punjab University.

The decomposition of isolated carbonic acid (H_2CO_3) molecule into CO_2 and H_2O ($H_2CO_3 \rightarrow CO_2 + H_2O$) is prevented by a large activation barrier (>35 kcal/mol). Nevertheless, it is surprising that the detection of the H_2CO_3 molecule has not been possible yet in the Earth's atmosphere and hunt for the free H_2CO_3 molecule has become challenging not only in the Earth's atmosphere but also on Mars. In view of this fact, we first study the instability of H_2CO_3 molecule in presence of water (H_2O), formic acid (FA), acetic acid (AA) sulphuric acid (SA) and hydroperoxide radical (HOO), detected in the Earth's atmosphere. It is seen from this study the vapor phase of H_2CO_3 molecule is unstable in presence of H_2O, FA and AA. Moreover, we also study the energetic and kinetics of the OH radical-initiated H_2CO_3 degradation reaction ($H_2CO_3 + OH \rightarrow HCO_3 + H_2O$) to interpret the loss of the H_2CO_3 molecule in the Earth's atmosphere, as the OH radical is known as the atmospheric detergent. Importantly, it is seen from these two studies that, although the atmospheric concentration of the OH radical is substantially lower than the concentrations of the H_2O, FA, AA in the Earth's atmosphere, but nevertheless, the OH radical-initiated H_2CO_3 degradation reaction has significant impact, especially, towards the loss of H_2CO_3 molecule in the Earth's atmosphere. In contrary, although the catalytic efficiencies of SA, FA and AA upon the H_2CO_3 decomposition reaction are similar to each other and the concentrations of both the SA and OH radical in the Earth's atmosphere are more-or-less equal to each other, but nevertheless, the SA-assisted H_2CO_3 decomposition reaction cannot compete with the OH radical-initiated H_2CO_3 degradation reaction.

4.1. Ph D Awarded

1. Kallol Bera [Soumen Basak], Design and application of sensors for bioimaging and protein aggregation, University of Calcutta, April 2016.
2. Anupa Majumdar [Munna Sarkar], Effect of different physico-chemical properties of the drugs and the membranes on Non Steroidal Anti-Inflammatory Drugs induced membrane fusion. Jadavpur University, June 2016.
3. Banabithi Koley Seth [Samita Basu], Spectroscopic studies on structure dependent selective bindings of copper (II) and nickel (II) Schiff base complexes with macromolecules of biological relevane, Jadavpur University, September 2016.

4. Neha Rai [Sanghamitra Raha and Munna Sarkar], Identification of cellular signalling network which induces cancer cell death in response to certain drugs and natural products, University of Calcutta, November 2016.
5. Nidhi Agnihotri [Amitabha De], Graphane/conducting polymer based nanocomposites: application in energy storage and sensors, University of Calcutta, March 2017.

4.2. Lectures/Talks given in Conference/ Symposium/ Workshop/ Schools

Dulal Senapati

1. Nanosciene: The Idiosyncratic Thinking, Tiny Machine and the Missing Link in Jagadis Bose National Science Talent Search, Government of West Bengal, Kolkata, September 2016.
2. Beauty of Anisotropic Plasmonic Nanomaterials: Fundamentals and Multidirectional Applications, Discussion Meeting on Synchrotron Techniques in Material Research, Sponsored by Nanomission, DST; Dooars, West Bengal, February 2017.
3. Beauty of Anisotropic Plasmonic Nanomaterials: Fundamentals and Multidirectional Applications, in the Special Winter School in Chemical Science and Technology at UGC-HRDC section, Sponsored by UGC-HRD; Academic Staff College, Calcutta University, February 2017.
4. Nanosciene and Nanotechnology: Fundamentals and Applications, Jagadis Bose National Science Talent Search, Government of West Bengal, Kolkata, March 2017.

Samita Basu

1. Photochemistry at Interface, DST INSPIRE Science Camp in collaboration with Department of Science and Technology, INSPIRE INTERNSHIP component of INSPIRE Program, JBNSTS, Kolkata, March 27, 2017.
2. Laser flash photolysis and magnetic field effect on photoinduced electron transfer reactions, National Seminar on Recent Trends in Chemistry Research, Department of Chemistry, Siksha-Bhavana (Institute of Science), Visva-Bharati, Santiniketan, West Bengal, March 26, 2017.
3. Periodic Table: A Periodic Classification of Elements, Science Workshop, JBNSTS, supported by Department of Higher Education, Government of West Bengal, Kolkata, February 21, 2017.
4. Photoinduced reactions in organized assemblies, Academic Staff College, Calcutta University, February 10, 2017.
5. Basics of Spectrophotometry and Spectrofluorimetry, Ph.D. Course Work, Department of Biochemistry, Ballygunge Science College, Kolkata, February 09, 2017.
6. Electron Transfer and Magnetic Field Effect, National Symposium on Advances in Chemical Sciences (NSACS-2017), Department of Chemistry Assam University, Shilchar, Assam, January 12, 2017.
7. Photochemical Reactions in Heterogeneous Media, National Seminar on Recent Advances in Chemical Science and Application, Vidyasagar College, Kolkata, January 6, 2017.

8. Photochemistry at Interface, DST INSPIRE Science Camps, JBNSTS, Kolkata, December 23, 2016.
9. Application of Light in Chemistry: Molecular Photonics, DST INSPIRE Science Camps, JBNSTS, October 25, 2016.
10. Spectroscopy as an elegant tool for investigating interactions of small molecules with biological macromolecules, National seminar on Recent Trends in Chemical Research, Department of Chemistry at Sarojini Naidu College for Women, Kolkata, September 29, 2016.
11. Spectroscopic exploration of drug–protein interactions, Colloquium, Department of Life Sciences, Presidency University, Kolkata, September 21, 2016.
12. LASER: Basic Principles and Applications, DST-JBNSTS INSPIRE Science Camp, JBNSTS, Kolkata, August 12, 2016.
13. Chemistry through interface probed by fluorescence, Workshop, JBNSTS, Kolkata, June 8-11, 2016.
14. LASER and its applications in light-induced reactions, DST-JBNSTS INSPIRE Science Camp, JBNSTS, Kolkata, May 18, 2016.
15. Photoinduced electron transfer corroborated by magnetic field effect, Colloquium, Department of Chemistry, Presidency University, Kolkata, April 12, 2016.

Susanta Lahiri

1. Third School on Trace Analysis, Mizoram University, Radiotracer Technique, March 28, 2017.
2. Amity Institute of Nuclear Science & Technology, Radium to Radium: A hundred years cycle, New Delhi, March 09, 2017.
3. Bhabha Atomic Research Centre, Radiochemistry Division, CERN-MEDICIS: an unique facility dedicated to human welfare, February 27, 2017.
4. Radium to radium: 100 years cycle, Eruption of Radionuclides in Imaging and Therapy, Nuclear Medicine Physicist Association of India, Kolkata, February 25-26, 2017.
5. Green Chemistry to mitigate environmental hazards, UGC Interdisciplinary Refresher Course on Environmental Hazard and Disaster Management, University of Calcutta, Kolkata, February 20, 2017.
6. Green synthesis of nano-particles by in situ radiation, National Conference on Nanoscience, Nanotechnology and Advanced Materials (NCNNAM- 2016), Birla Institute of Technology Mesra, September 26-27, 2016.
7. Converter Target Chemistry : A new challenge to the Radioanalytical Chemistry – and its relevance with MEDICIS programme, Workshop on Radiochem Aspects of MEDICIS, CERN, Switzerland, September 23, 2016.
8. Radium to Radium- Hundred Years Cycle, DST-INSPIRE Science Camp 2016, NIT Sikkim, June 30, 2016.
9. The Periodic Table, DST-INSPIRE Science Camp 2016, NIT Sikkim, June 30, 2016.
10. Separation of lead and bismuth from proton irradiated lead-bismuth eutectic by differential precipitation, 99th Canadian Chemistry Conference and Exhibition, Halifax, Canada, June 05-09, 2016.
11. Revisiting NORM measurement, 99th Canadian Chemistry Conference and Exhibition, Halifax, Canada, June 05-09, 2016.

12. Ride on Time Machine, User interaction workshop on Accelerator Mass Spectrometry dating, IUAC, New Delhi, April 21-23, 2016.
13. Converter Target Chemistry – A New Challenge to the Radioanalytical Chemistry, First International Conference on Radioanalytical and Nuclear Chemistry (RANC-2016), Budapest, Hungary, April 10–15, 2016.

4.3. Teaching elsewhere

Samita Basu

1. Spectroscopy, M.Sc Course in Inorganic Chemistry Special, Calcutta University, March-April, 2017.
2. Photochemistry, M.Sc Course in General and Physical Chemistry special, Bidhannagar College, West Bengal State University, West Bengal, September-October, 2016 & March-April, 2017.

Maitreyee Nandy

1. Radiation Safety, Pre-Ph.D course work, Department of Biophysics & Molecular Biology, University of Calcutta, December 30, 2016.
2. Radiation Physics, Post M. Sc. Course in Biophysical Sciences, Saha Institute of Nuclear Physics, Kolkata, Session 2016-2017.
3. Advanced Particle Detectors, Post M. Sc. Course in Experimental Physics, Saha Institute of Nuclear Physics, Kolkata, Session 2016-2017.
4. Radioactivity -- M. Sc., Biophysics & Molecular Biology & Bioinformatics, University of Calcutta, 3rd semester, 2016-2017.
5. Radioisotopes and Nuclear Medicine, M. Tech. course in Biomedical Instrumentation, Department of Applied Optics and Photonics, University of Calcutta, 3rd semester, 2016-2017.

5. Computational Science

Infrastructure Development and Maintenance by the Division:

The project involves migration of all the services (HTTP, SMTP, IMAPS, SSH, FTP, LDAP, DNS, Webmail etc.) and data to the new hardware and further enhancement to that. The solution also included the scope of DC and DR (Disaster Recovery) architecture, so that in case of a declared Disaster Scenario of the regular Data Center the DR setup can give critical service continuity to the users. As SINP does not have a campus at a geographically separate location, a location within our campus with electrical isolation was chosen to house the DR infrastructure. Storage (SAN) at both location and data replication between the two sites was planned. Like before we planned to use Redhat HA Cluster Suite to handle High Availability between two nodes. The nodes can be in Active/Active or Active/Passive mode. There were provisions in the scope to also have a virtual system in place (using RHEV suite) and run some applications in that. The virtual infrastructure may grow in future to support Desktop and Server Virtualization Services to cater the need of other departments.

However, mainly due to the vast nature of the project, many customizations and other factors it took quite a while to have the migrated system in production. Eventually we have moved to a more of a Virtual environment with RHEV, with RedHat Enterprize Virtualization Manager to control the guest machines. Now there are more than 10 such hosts in the virtual environment running services like, WWW, Webmail, Mailstore, Mail Gateways, Name Servers, Gatekeeper (inward SSH access to SINP LAN), LDAP, IMAP/POP, Proxy, UFS etc. Virtualization benefits in better utilization of hardware resources, reduce Data Centre (DC) footprint, provides environment for testing, custom provisioning of hardware, reduce hardware vendor lock-in, extend the life of older applications. Recently we have moved to an open source solution for virtualization called oVirt.

The infrastructure continues to serve as a heart for email, web and other Internet services from 2013. However the DR infrastructure were fully utilized in 2016 with DR (Disaster Recover) System deployment followed by a DC-DR Drill. The DC-DR drill is actually a two part drill. The first part being migration of services from DC (#237) to DR(#3401) infrastructure. This involves switching off the primary site completely and run all the production services from DR site. A role reversal happens for all the connected LUNs of the SAN (Storage Area Network) pairs, the SAN of DR starts working as primary storage and stores all the production data. After few days of observation and running the production system on DR infrastructure a reverse drill i.e. DR-DC Drill was conducted and storage and services were brought back to the DC infrastructure.

After the successful completion of the weeklong (21st to 26th July, 2016) DC-DR Drill, Dr. Sekhar Basu, Chairman AEC, along with a team of distinguished members and our Director inaugurated/visited the newly implemented DR Site. A poster session was also organised at the venue. We plan to place the DR infrastructure in future at Belgachia Campus of SINP.

Research Activities of the Division

We have developed a software to generate accurate model of a base pair using the six relative orientation parameters, Buckle, Open, Propeller, Stagger, Shear and Stretch, as suggested by IUPAC-IUB. This software can generate three-dimensional coordinates of double helical fragment also with such unusual base pairs. We have carried out extensive quantum chemical studies using Density Functional Theory with Dispersion correction on stacking interaction between successive base pairs in those double helical fragments. The structures predicted to have strongest stacking energy are seen to be quite similar to experimental structures for Watson-Crick base pair containing stretches. Thus we hope we can extend this method of stacking energy analysis to double helices containing non Watson-Crick base pairs as well.

We have done extensive molecular dynamics simulation studies to understand different features of DNA and RNA, such as melting behavior of polymeric DNA, molecular recognition of DNA sequences by protein through conformational selection mechanism, relative stabilities of telomeric DNA of different topology types and dynamics of loop residues in miRNA like fragments. We have done density functional theory based quantum chemical calculations to study stacking between Watson-Crick and non Watson-Crick base pairs and effect of positive charge on stability of unusual base pairing.

5.1. Ph.D. awarded

1. Angana Ray [Dhananjay Bhattacharyya], Computational Studies on Biologically Important Macromolecules, University of Calcutta, 2016.

5.2. Lectures/Talks given in Conference/ Symposium/ Workshop/ Schools:

Dhananjay Bhattacharyya

1. Understanding Structural Features of miRNA from Analogous Structural Fragments in RNA Database: Molecular Dynamics Simulation Studies, 8th RNA Group Meeting, CCMB, Hyderabad, January 8-10, 2016.
2. Electronic properties of edges of nano materials, National Workshop on Computational Nanotechnology: Modeling and Applications with Matlab (CNMAM 2016), College of Engineering & Management, Kolaghat, August 21-22, 2016.

5.3. Miscellany

Dhananjay Bhattacharyya

1. Designed, written and delivered lecture for eight course materials for E-PG Pathsala, an MHRD project under National Mission on Education through ICT (NMEICT) on Quantum Biophysics. Students can listen and view the video and read the e-text on Internet.

6. Condensed Matter Physics

3D Dirac/Weyl semimetals: We have grown high quality single crystals of 3D topological materials such as Cd_3As_2, $ZrTe_5$ and ZrSiS using different techniques and studied their transport and magnetic properties [Phys. Rev. B 94, 165139 (2016);Sci. Rept. 7, 40327 (2017)]. The Fermi surface geometry of these systems is analyzed using Shubnikovde Haas and de Haasvan Alphen oscillations. We observe remarkably large charge carrier mobility and magnetoresistance in these materials; potential for fast electronic device and magnetic field sensor applications. By measuring resistivity under electric field parallel to magnetic field configuration, we observe negative magnetoresistance in $ZrTe_5$ and ZrSiS due to Adler-Bell-Jackiw anomaly as predicted by the relativistic theory of charged chiral fermions induced by external gauge fields with non-trivial topology. According to ISI web of science, our work on ZrSiS [PNAS 114, 2468 (2017)] has received enough citations to place it in the top 0.1% of papers in the academic field of Physics.

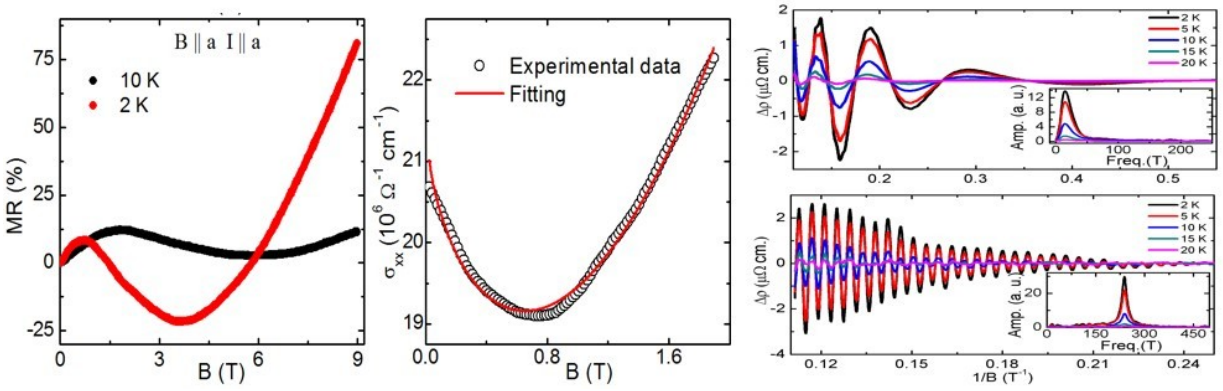


Fig. Longitudinal magnetoresistance (Adler-Bell-Jackiw chiral anomaly) with both current and magnetic field alongcrystallographic axis a of ZrSiS Dirac system (left panel) and the theoretical fit (middle panel).Shubnikov–de Haas effect in ZrSiS single crystal and its fast Fourier transform for two different frequencies (right panel)

Intermetallic compounds: Novel ternary intermetallic compounds of R_2NiSi_3 (R = Gd, Er) type have been recently synthesised. The magnetic ground state of the compounds found to exhibit frustrated glassy magnetic components coexisting with spatially limited long-range antiferromagnetic state, as revealed by dc & ac magnetization, heat capacity, and neutron diffraction studies. The compounds exhibit large magnetocaloric effect with, $-\Delta S_M$ ~18.4 J/kg-K and RCP~525 J/kg in Gd_2NiSi_3 and $-\Delta S_M$ ~22.6 J/kg-K and RCP~540 J/kg in Er_2NiSi_3 for 70 kOe magnetic field change. A correlation between large RCP and magnetic frustration is discussed for developing new magnetic refrigerant materials [Phys. Rev. B 94, 104414 (2016)]. Another interesting finding is the observation of zero thermal expansion behaviour in $Ho_2Fe_{16}Cr$, over a wide range of temperature (13330 K). Magnetovolume effect has been argued to be responsible for that kind of anomalous thermal expansion [RSC Adv. 6, 94809 (2016)].

In intermetallic compounds $RECo_2Si_2$ (RE = rare earth), when cobalt are partially substituted by another transition metal, namely vanadium, due to complex magnetic interactions, multiple magnetic transitions are observed [JMMM 401 998 (2016)].

Rare-earth and transition metal oxides: We have shown disorder as well as particle size induced giant enhancement of the magnetoresistive properties in several manganite materials [RSC Adv. 7, 16575, (2017), J. Appl. Phys. 121, 103904 (2017), JMMM 403, 36 (2016)]. We also synthesized fascinating nano-tubes of Gadolinium oxide (Gd_2O_3) using controlled template assisted electrochemical deposition technique. Tube of diameter 200nm, wall thickness 20nm, are constituted of nano-clusters of diameter 7.5nm. It shows anisotropic,

large magnetocaloric effect at cryogenic temperature JMMM 417, 182 (2016), Physica E 80, 149 (2016).

Battery performance and basic physics: Established correlation between battery performance and basic physics of battery material (such as $LiCo_yMn_{2-y}O_4$). The critical doping y ~ 0.16 results in breakdown of cooperative-distortion network, enhancing lithiation and delithiation of battery, thereby minimizing electrochemical capacity fading. [Appl. Phys. Lett. 110, 143901 (2017)].

Supersolidity in natural and artificial systems: Exploring supersolidity in naturally occurring and artificially designed systems is an area of immense interest. The cooperation of the super- fluid and charge-density-wave (CDW) orders is studied in a two-dimensional BoseHolstein (BH) model where hard-core-bosons (HCBs) are coupled locally to optical phonons. In the parameter regimes of strong HCB-phonon coupling and nonadiabaticity, a novel mechanism for latticesupersolidity is found. At densities not far from half filling and in the parameter regime where the double-hopping terms are non-negligible (negligible) compared to the nearest-neighbor hopping, checkerboard-supersolidity (phase separation) is realized [Annals of Physics 375, 322 (2016)].

Localization effect in Graphene: I have been working recently on interplay of disorder and interactions to explore many-body localisation which is an exotic phase of matter as it challenges basic foundations of quantum statistical physics. We demonstrated recently that localisation does survive in presence of interactions even in system which has single particle mobility edges. We also studied localization in context of graphene and showed that even in this 2D system there are single particle mobility edges. I am also interested in transport in strongly correlated systems. Recently, we have shown in a system of hard core bosons that the normal phase of the superfluid, which undergoes a Kosterlitz-Thouless transition in 2D is ballistic having finite Drude weight [Phys. Rev. B 94, 134508 (2016);Phys. Rev. B 93, 235426 (2016)].

Diffusion of hard-core particles: Studied diffusion of hard-core particles on a one-dimensional periodic lattice subjected to a constraint that the separation between any two consecutive particles does not increase beyond a fixed value n + 1; an initial separation larger than n + 1 can however decrease. These models undergo an absorbing state phase transition when the conserved particle density of the system falls below a critical threshold $\rho c = 1/(n + 1)$ [Phys. Rev. E 94, 062141 (2016)].

Exclusion processes in closed systems: It has been shown that closed asymmetric exclusion systems with weak particle nonconservation can lead to nontrivial steady states that are generically nonuniform. Further by using a similar lattice-gas type agent-based model for opinion dynamics, we have shown that diffusion of the agents plays a significant role in formation of consensus. General scaling behaviour and macroscopic profiles are obtained. These studies are expected to be relevant in a number of areas including intra-cellular transport in biology and traffic management in a city, and physical approaches to social dynamics [Phys. Rev. E 95, 012113 (2017); Reports in Advances of Physical Sciences 1 (01), 1740008 (2017)].

6.1. Ph D Awarded

1. Moumita Nandi [Prabhat Mandal], Study of structural, magnetic and thermal properties of some low-dimensional spin chain compounds, University of Calcutta, 2016.
2. S Kundu [Prabhat Mandal], Investigation of the physical prooerties of DNA and other nano-bio systems, Univeersity of Calcutta, March 2017.
3. Susmita Dhara [Bilwadal Bandyopadhyay], Preparation, characterization and study of magnetic properties of Co_xCu_(1-x) (x ~ 0.01-0.7) granular alloys, Homi Bhabha National Institute, March 2017.
4. Rajeswari Roychowdhury [Bilwadal Bandyopadhyay], Effect of substitution at the transition metal site on the magnetic properties of rare earth ternary silicides, Homi Bhabha National Institute, March 17, 2017.

6.2. Lectures/Talks given in Conference/ Symposium/ Workshop/ Schools

Chandan Mazumdar

1. Griffiths phase in a frustrated antiferromagnetic intermetallic compound $GdFe_{0.17}Sn_2$, International Conference on Magnetic Materials and Applications (ICMAGMA - 2017), Defence Metallurgical Research Laboratory (DMRL), Hyderabad and the Magnetics Society of India (MSI), Hyderabad, February 1-3, 2017.

P.K. Mohanty

1. Sandpile models and Percolation, one day Seminar on D Dhar's retirement, TIFR, Mumbai, November 17, 2016.
2. Universality in self-organized criticality, Discussion meeting on 60 years of percolation phenomena, SNBNCBS, Kolkata, January 24, 2017.
3. Biological networks –disease and complexcity in the Low dimensional Quantum Systems, HRI, Allahabad, February 15-16, 2017.

Prabhat Mandal

1. Magneto-transport properties of 3D Dirac semimetal Cd_3As_2, National Workshop on Condensed Matter Physics, IIT Kharagpur, February 03 - 05, 2017.
2. Structural, magnetic, thermal, electrical properties Nb-doped $EuTiO_3$ single crystal, Indo-French Workshop on Pressure Effects on Strongly Correlated Materials, Bharathidasan University, Tiruchirappalli, January 9-12, 2017.
3. ZrSiS: A new robust Dirac semimetal with unusual transport properties, Recent Trends in Condensed Matter Physics: Experiment and Theory, IACS, Kolkata, March 3-4, 2017.
4. Breakdown of Wiedemann and Franz Law in Dirac semimetal Cd_3As_2, 9th India-Singapore Joint Symposium, National University of Singapore, February 24-26, 2016.
5. Magnetotransport properties of some Dirac Semimetals, University of Potsdam, Berlin, Germany, November 2016.

Sudhakar Yarlagadda

1. Oxide devices – the best replacement for semiconductor devices?, International meeting on Highly Correlated Systems (IMHCS-2017), at Mahatma Gandhi Univiversity, Kerala, March 24-26, 2017.

6.3. Miscellany

Barnana Pal

1 Best poster award by Ultrasonic Society of India in the 21st National Symposium on Ultrasonics, November 08-10, 2016 for her paper "Incidence of ultrasonic wave through Newtonian and non-Newtonian fluids".

7. Crystallography and Molecular Biology

Main focus of Crystallography and Molecular Biology Division is study of the structure and conformation of proteins involved in various cellular regulatory processes. Studies relating the structure and dynamics of biological macromolecules to function are essential part of modern biophysics in order to unravel the mechanism of action of proteins at the molecular level. Our research is strongly focused on understanding the mechanistic insights of various classes of proteins such as membrane skeletal proteins; cell-cycle regulatory proteins; signaling and heat shock proteins; cysteine proteases and inhibitors; proteins involved in unique sugar metabolism; and integral membrane proteins. Using well-established expertise of recombinant DNA technology, X-ray crystallography and structure-guided protein engineering, we attempt to understand the mechanism of proteolytic activity of cysteine proteases, alter the function of cysteine proteases (like imparting hemoglobinase activity), design and generate specific protein inhibitors from serpin family against falcipain2 from *Plasmodium falciparum*, a drug target for the malaria parasite. Structural and functional aspects of *Vibrio cholera* proteins involved in many processes such as c-di-GMP mediated biofilm formation, transcription termination and activation (Rho-specific), small heat shock proteins (HSP31, HSP15, DnaK etc.) mediated protein folding and protein phosphorylation / dephosphorylation involved in metabolic activity and signal transduction will be studied in great detail.

Several unique sugar metabolizing proteins have been identified in *Leishmania donavani*, a protozoan parasite that causes Leishmaniases, which are potential drug targets. Structural characterizations have been initiated with the proteins UDP-Glc 4 ′-epimerase, UDP-galactopyranose mutase and Galactose Mutarotase. Works are in progress to elucidate the functional interaction of DNA repair protein (Ku) with the cell cycle modifier polo-like kinase 1 (Plk1). Further, structural and thermodynamic insights related to the interaction of cyclophilin, a peptidyl-prolyl cis-trans isomerase, with a transmembrane protein CD147 would be examined since this interaction has been implicated in inflammation, cancer and cardiac disorders. We would use the newly installed Next Generation Sequencer (NGS) to elucidate any differential relationship of involvement of Ku with the origin-uses in a spatio-temporal manner. Another line of research would focus on the altered drug resistance in *Leishmania* strains against available drugs. NGS would effectively be used to identify proteins/pathways involved in drug resistance.

Erythroid spectrin is a major constituent of Red Blood Cells (RBC) and plays a vital role in maintaining the cytoskeletal structure and flexibility of the erythrocyte. Cloning, expression and purifications of spectrin domains such as the ankyrin binding domain, self-associating domain, SH3 domains etc have been initiated to explore their protein-protein interactions, chaperone activity and membrane binding potential. We are starting a new research area on characterizing the structural dynamics of membrane proteins. Importantly, ~30% of human genome codes for membrane proteins and ~60% of available drugs target membrane proteins. Structural dynamics of potassium and magnesium ion channels have been just initiated to decipher lipid-dependent voltage gating mechanisms.

7.1. Ph D Awarded

1. Rakhi Paul [Udayaditya Sen), Stucture-Function Relationship of Sugar Kinases from Vibrio cholerae O395, Homi Bhaba National Institute, May 2016.
2. Neha Rai [Sanghamitra Raha & Munna Sarkar], Identification of cellular signalling network which induces cancer cell death in response to certain drugs and natural products, University of Calcutta, November 2016.
3. Soumita Mukherjee [Partha Saha], Role of post-translational modifications on cell cycle progression of eukaryotes, University of Calcutta, November 2016.

4. Debashree Das [Abhijit Chakrabarti], Membrane and spectrin interactions of heme and hemoproteins, March 2017.

7.2. Lectures/Talks given in Conference/ Symposium/ Workshop/ Schools

Abhijit Chakrabarti

1. Erythrocyte & Platelet Proteomics in Haematological Diseases, Indo-US Bilateral Worshop cum Symposium on Frontiers in Functional Proteomics and Translational Research in Food & Health, National Institute of Plant Genome Research, New Delhi, December 12-13, 2016.
2. Platelet Proteomics in Blood Disorders, International Conference on Functional & Interaction Proteomics : Application in Food & Health, 3rd meeting of Asia Oceania Agricultural Proteomics Organization and 8th Annual Meeting of Proteomic Society, India, PSI, AOAPO and National Institute of Plant Genome Research, New Delhi, December 14-17, 2016.
3. Redox Regulators in Hemoglobin Diseases, 15th Annual Meeting of Society for Free Radical Research – India (SFRR) along with a one-day workshop on Radiation and Redox Processes in Health and a conference entitled Basic and Applied Aspects of Health Management Using Radiation, Antioxidants and Nutraceuticals, Mumbai, January 9-12, 2017.
4. Membrane Asymmetry, Protein Aggregation, Spectrin and Disease, Discussion Meeting on Material Research & Synchrotron Techniques, Nanomission of DST, Dooars Forest, Chalsa Sinclair Resort, North Bengal, February 1 – 5, 2017.
5. Status of Membrane Asymmetry in Disease: Role of Spectrin, 11th International Symposium on Biochemical Roles of Eukaryotic Cell Surface Macromolecules (11th ISCSM), IISER-Mohali, Chandigarh, February 24– 28, 2017.
6. Redox Regulators in Hemoglobin Diseases, National Symposium on Plant Biotechnology: Current Perspectives on Medicinal and Crop Plants & 38th Annual Meeting of Plant Tissue Culture Association (India), CSIR-IICB, Kolkata, March 3 – 5, 2017.
7. Membrane asymmetry: role of skeletal proteins, BioScience Group, Molecular Biology Division, Bhabha Atomic Research Centre, Mumbai, July 5, 2016.
8. Clinical proteomics in haematological diseases, Birla Institute of Technology and Science (BITS), Hyderabad, August 29, 2016.

7.3. Teaching elsewhere

Abhijit Chakrabarti

1. On Proteomics, Refresher Course in Challenges and options in Life Science Research in the developing world today for College and University Teachers, Human Resource Development Centre/Academic Staff College, Department of Zoology, University of Calcutta, Kolkata, January 9, 2017.
2. Protein, Proteins, Proteomics (2 Lectures), Science Academy Workshop on Modern Chemistry & Biology in Birati College, Kolkata, March 4 & 6, 2017.

7.4. Publications in Books/Monographs/Edited Volumes

Rahul Banerjee

1. Indian Philosophy & Meditation: Perspectives in Consciousness Routledge, Oxon & New York (2017). Rahul Banerjee & Amita Chatterjee. ISBN 978-1-138-30897-8.

8. High Energy Nuclear and Particle Physics

ALICE Collaboration activities

The Saha groups of ALICE are one of the cofounder laboratories of the Muon Spectrometer and collaborating since 1997. In past years, the Saha members have achieved major milestones such as detector hardware fabrication, designing of MANAS (ASIC readout chip), active participation in ALICE data collection, analysis of large volume data, publication of ALICE results in major national and international conferences and journals. The groups is focused to share the knowledge gained in the frontier of science experiment such as ALICE with the school, college, university students through various seminars and public. A short summary of the major hardware and analysis activities are summarized below.

Saha hardware performance and maintenance

The indigenously built large area cathode pad chamber by Saha group comprises with 2.2 lakh readout channels which have been fully fabricated commissioned and installed by the Saha members of ALICE. Since Muon Spectrometer is a tracking detector, the stable data collection with Indian made detector is critical for the physics prospects of the Spectrometer. Each year LHC exceeds its previous record in terms of luminosity and stable beam delivery. This imposes the detector operation challenging due to the high particle flux. The successful operation of the Indian made Muon detector marked a record due to the stable performance in high luminosity (10^{29} $cm^{-2}s^{-1}$) during the pPb and Pbp data collection in 2016.

Nevertheless, it is to be mentioned that the successful operation requires critical and delicate maintenance work of the detector which are carried out by the special team of technical, engineer and scientific members of the group.

MANAS

The first stage of detector signal is processed by the ASIC chip named MANAS designed in Saha. Since the readout scheme of Muon Spectrometer and Photon Multiplicity Detector of ALICE are similar, the Saha team has delivered 88 thousands to two detector collaborations. An excellent performance of MANAS chip has been observed in LHC operation during Run I and II in high radiation background environment. The recent successful pPb data collection is an added confirmation of the stable operation of the chip in high luminosity environment.

Detector operation

The detector operation in complex setup like ALICE is a challenging task since ALICE hosts 18 different detection technologies. The Saha group of ALICE is also recognized for its leadership role during critical data collection periods such as pPb and high luminosity pp runs. The group took challenging responsibility of System Run Coordinator for Muon Spectrometer and ALICE Run Coordinator for ALICE setup in 2016 and 2017, respectively

Data analysis

The high luminosity pPb runs allow to collect a large statistics for the study of the bound and open heavy flavour mesons of charm and beauty quarks. The suppression (or no suppression) quark-antiquark pair in pPb collisions provides and important information for saturation/shadowing parameter used to understand the quark gluon plasma created during the first epoch of Big-Bang. The number of J/psi, psi(2S), Upsilon(1S) and Upsilon(2S) as measured by the Muon Spectrometer and analyzed by Saha team is shown in the plot below [Fig (1) and (2)]. The anomalous psi(2S) suppression have been reported for the backward rapidity by the Saha group for p-Pb collisions at 8.16 TeV. The analysis note have been

submitted for psi(2S) analysis after the completion of the analysis where Saha Institute took leading role.

The Saha team is involved in the analysis of Pb-Pb data of 2015 for the measurement of nuclear modification factor of Upsilon(1S) and (2S) at 5 TeV collsions. The paper draft is prepared in present academic year and ready for collaboration review for publication.

The double differential measurement of J/psi production in Pb-Pb 2015 provide a new insight to the study of recombination effect. The Saha group has initiated this analysis and currently in advanced stage.

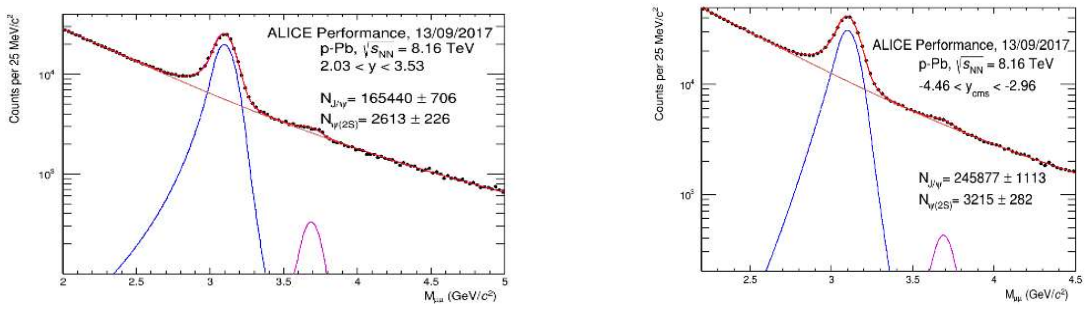


Fig. The J/psi and psi(2S) production in p-Pb collisions at forward (left) and backward (right) rapidities.

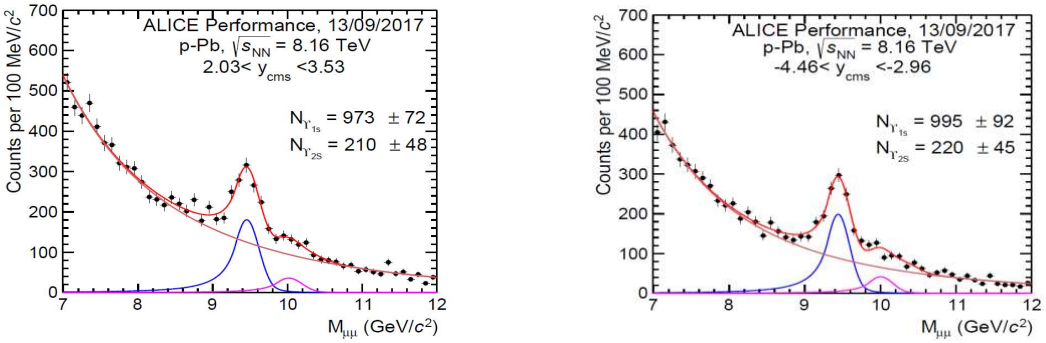


Fig. The Upsilon(1S) and (2S) production in p-Pb collisions at forward (left) and backward (right) rapidities.

The photo production of J/psi in ultra-peripheral Pb-Pb collisions allows to study the electromagnetic production cross-section of charmonium state at relativistic energies. In recent times this has drawn attention of the high energy physics community since it provides access to the electromagnetic production effect without contribution of the hadronic interaction. This measurement is carried out by the Saha group in collaboration with a Ph.D student from Aligarh Muslim University (AMU).

In proton-proton collisions where medium formation is not expected has started to show some peculiar properties which were initially observed only in Pb-Pb collisions such long range correlation. The Saha group is involved in the study of J/psi production in pp collisions at 2.76 TeV and 5. TeV in collaboration with AMU student, which demonstrated that the production of charmonium increases linearly with charge particle multiplicity. This is understood to be originated due to multi-parton interactions in the high energy pp collisions.

The Saha group is also involved to analyze the pp 13 TeV data for the study of heavy flavor decay mouns from various sources.

ALICE Upgrade: Muon Forward Tracker (MFT)

The next ALICE upgrade includes the fabrication of silicon pixel detector in the forward rapidity known as Muon Forward Tracker. This will enhance the signal resolution due to the accurate identification of the collision vertex in the z-direction of the beam. A critical component of the detector in high luminosity environment is the reduction of the heat with proper cooling method. The SINP team is involved with the planning and fabrication of the cooling mechanism for MFT.

ALICE Upgrade: Readout Upgrade for Muon Spectrometer

The LHC luminosity will be increased further after LS2 and current readout of Muon Spectrometer cannot record at such high rate. Therefore, a new design have been proposed for the second station of Muon Spectrometer by the Saha group. The new readout PCB conceptual design has been reviewed and approved by the ALICE collaboration. This will be a multilayer PCB for continuous readout and finalization of detail design is in progress.

QGP Phenomenology

This activity is being pursued for the last 17 years with present emphasis on the properties of hadrons in non-zero magnetic field at finite temperature. The highlights of these studies in recent times are:

a) Spectral properties of rho and pi mesons in magnetic field at non-zero temperature.

b) Study of rho-omega mixing in vacuum in magnetic field.

c) QCD collective oscillations in hot magnetized plasma.

The other studies include the production ratio of Y(3S) to Y(1S) and Y(2S) to Y(1S) via pp collisions at the LHC energies is an important preliminary to the research on QGP. Such effects has been studied for forward rapidities along with J/psi(1S), Psi(2S)(charmonia) and compared with experimental results of ALICE and LHCb to understand both the hot and cold nuclear matter produced at LHC energies.

CMS Collaboration activities

The CMS group of SINP started in 2011 with 5 faculty members and 4 students. Some of the members have been involved in CMS for a much longer period contributing significantly to the design and construction of the CMS expeiment. Since the beginning of data taking, the group has had major responsibilities in tracker operations, Hadron calorimeter (HCAL) calibration and overall Data Quality Monitoring (DQM). In physics analysis, the group's major involvement has been in new particle searches including the Higgs boson. At the time of the Higgs discovery, the group was involved in search for Higgs in the high mass region. The group's work in physics and detector development has resulted in 16 physics papers, about 15 public physics results and 10 detctor related notes. So far, 9 students have graduated from the group. At present, the group with 6 faculty members and 10 students has major involvements in several important channels of Higgs Physics, physics of jets and in searches for dark matter and extra dimensions. The group has ongoing responsibilities for the Run II data taking, in detector performance and calibration studies of the hadron calorimeter, tracker validation, bad channel calibration, and tracking performance studies. The group has commitments for several important upgrades of the CMS detector for the High Luminosity LHC opetations. SINP members have held positions of responsibilities, in detector development, operations and Physics analyses, within the collaboration.

Physics Studies and Computing

Analyses

The SINP-CMS group has been involved in serveral important LHC physics analyses, namely: (1) SM Higgs boson studies in the γγ decay mode, e.g differential cross-section measurement, and in the 4-lepton decay mode (4e, 4μ, 2e2μ). (2) SM Higgs boson searches in the associated production mode with a W, where the Higgs boson decays into a pair of τ leptons and the W decays to an electron or a muon; (3) di-Higgs production at the LHC energies; (4) search for dark matter and extra-dimensions; (5) inclusive jet production at different energies and event shape studies; (6) Feasibility study to trigger on $B_S \rightarrow \varphi\varphi \rightarrow 4$ kaons events at Level 1 using the proposed CMS PhaseII tracker.

The SINP team played a central role in two important publications of CMS in 2016 from dark matter searches and excited lepton searches from 2012 data. Students from SINP were leading analyzers and served as analysis contact persons within the collaboration. The bound on dark matter nucleon scattering cross-section obatined from our monophoton analysis appears in the global plot of dark matter-nucleon scattering cross-section upper bound. The SINP members have also contributed towards rediscovery and first mass measurements of the Higgs boson using the Run II data.

Computing

The SINP-CMS cluster became fully operational in 2013, with the successful hosting of the Asian CMS Data Analysis (CMSDAS) school. The cluster served significantly for the PhaseII Tracker related simulation studies. In 2016 SINP has become a part of the LHCone network supported under the National Knowledge Network (NKN). A new divisional computing center has also been developed during the last year.

Run II Detector Performance related activities

The group has long-term responsibilities on current tracker and HCAL operations and calibration. The group is responsible for the validation of the present tracker detector; tracker bad channel calibration and tracking performance studies. The group have contributing substantially to the calibration of the hadron calorimeter making use of different approaches to do relative and absolute calibration of the calorimeter. In addition, strategies to trigger on isolated particles are pursued.

Hadron Calorimeter Upgrade

The backend electronics of HCAL has been upgraded during the long shutdown period 1 (LS1) of LHC. The group made substantial contribution in two broad areas: 1) microTCA based readout cards for HF and 2) Optical Splitters for barrel and end-cap HB/HE detectors.

A total of 54 μHTR cards were fabricated within LS1. All the required cards have been built in the industries in Bangalore and tested at SINP before being shipped to CERN. These cards required some power mezzanine cards and they have been tested at SINP. All the cards were successfully installed and commissioned for RunII data taking in 2015 and have been working successfully ever since.

Optical splitters for LS1 upgrade were crucial for the working of trigger with CMS HCAL back-end electronics. Students and post-doc have played a major role in designing and testing for 3 years, to meet our partial commitment towards LS1 upgrade. Eventually, 206 such units have been shipped to CERN and installed and integrated with the detector.

Phase II Upgrade

A number of sub-detectors of the CMS detector will be upgraded fully before the HL-LHC phase starts. The timeline for upgrade is 2020-23 and R&D activities are in full swing.

The CMS tracker detector will be replaced entirely in order to operate at the High Luminosity LHC. The proposed tracker design allows us to reconstruct tracks with sufficient resolution at Level 1 phase of the trigger system. The tracks reconstructed at Level 1 trigger is crucial to reduce and keep event rate at an acceptable limit. We have contributed towards the Associative Memory (AM) based L1 track trigger simulation studies. We have also made major contribution to the study of performance of the proposed L1 track trigger by looking at the improvement in electron rate. This study is already a part of the PhaseII tracker Technical Proposal (TP). We have also studied whether rare processes like $B_s \rightarrow \varphi\varphi \rightarrow 4$ kaons can be triggered using the PhaseII tracker and the results have been included in the Tracker Technical Design report (TDR). The group members have contributed significantly to the PhaseII tracker module-test software development and Data Quality Monitoring (DQM) tool used in laboratory and Tracker Beam tests. The group is also responsible for the development of the digitizer software for the proposed new tracker. Presently, the group is setting up a module test facility in the institute.

The CMS-GEM activities have been going on since several years with a view to upgrade the tracking and triggering capabilities of the CMS muon system in the high rapidity region. The upgrade is also important to cope up with the HL-LHC scenario.

An infrastructure is being set up which will be used to carry out several quality control steps related to the final production of GE1/1. In addition, the same infrastructure is expected to be used for detector R&D for GE2/1 and ME0 upgrades. It may be noted that a large fraction of the components for this R&D will be based on products made within the country.

We hope to use the same laboratory for studies related to muon tomography, which can be considered as a spin-off having societal applications.

Both ECAL and HCAL endcap calorimeters will be replaced with a new detector, known as HGCal that will utilize highly granular silicon pads for both ECAL and the front part of the HCAL. The group has been involved in simulation studies, beam test data analysis and in setting up a test facility locally in the institute.

8.1. Ph D Awarded

1. Atanu Modak [Subir Sarkar and Suchandra Dutta], Search for the Standard Model Higgs boson decaying to a Tau lepton pair in proton-proton collisions using the CMS detector at the LHC, University of Calcutta, March 2017.

8.2. Lectures/Talks given in Conference/ Symposium/ Workshop/ Schools

Debasish Das

1. Quarkonia results from LHC at the CNT workshop on Quarkonia production and suppression in High Energy Heavy Ion Collisions, University of Calcutta, Salt Lake Campus, February 14, 2017.

Tinku Sinha

1. Looking forward towards next decade for ALICE Muons, DAE-DST Special Task Force Meeting at BARC, Mumbai, September 3, 2016.

9. Nuclear Physics

The members have been successfully continuing their activities in Accelerator based Nuclear Physics (In-Beam gamma spectroscopy and Reaction studies) using National and International Accelerator Facilities. They have been invited to present their work in several School, Conferences and Symposia during this tenure.

The divison is involved in experiment done in international RIB facilities at GSI, Germany.

This group is a constituent member of the Indian National Gamma Array (INGA) collaboration since its inception. During this time-period, apart from collaborating with other National Institutes to utilize and maintain this INGA array, our group has actively participated in the submission of the upgrade proposal of INGA to DST.

Achievements from National Accelerator Based Work

The members have contributed significantly in understanding the shears mechanism and development of collectivity in nuclei in A~140 region. High-spin states in the dipole structure of ^{141}Sm have been investigated using the fusion-evaporation using the Indian National Gamma Array. Comparisons between the experimental characteristic and the semi-classical shears mechanism with the principal axis cranking model calculation has shown that one of the dipole band may be interpreted as a magnetic rotational band.

Threshold behavior of interaction potential, fusion barrier distribution and channel coupling have experimentally investigated for the weakly bound stable projectiles and targets in medium mass and heavy nuclei. Fusion cross-sections, at above and below the Coulomb barrier, with stable projectile have been studied to understand the effect of breakup or breakup-like processes with medium-mass target in comparison with a projectile which has a lower breakup threshold.

Breakup effects on α spectroscopic factor of light nuclei have been investigated. The study of astrophysically important reaction using weakly bound projectiles and breakup induced alpha transfer process for some bound states have been pursued.

Shell model studies of neutron-rich nuclei near ^{132}Sn done by divisional members have been successful in explaining data from National and International groups. Members have collaborated with other national institutes to study shape coexistence in rare-earth nuclei.

The high-spin states in ^{153}Ho have been studied using Indian National Gamma Array (INGA) setup. From the comparison of experimental and theoretical results, it is found that there are definite indications of shape coexistence in this nucleus. The experimental and calculated lifetimes of several isomers have been compared to follow the coexistence and evolution of shape with increasing spin.

Achievements from International Accelerator Based Work

Experiments proposed by member of this group have been performed at international accelerator facilities using RIB in collaboration with many institutes of repute from different countries. One of remarkable achievements is observation of disappearance of magic numbers in the neutron rich nuclei. Measurement to probe neutron-skin of exotic nuclei has been undertaken which is important for improving nuclear equation of state important for understanding neutron-star properties.

First results are reported on the ground state configurations of the neutron-rich ^{29,30}Na isotopes, obtained via Coulomb dissociation (CD) at energies of 400–430 MeV/nucleon using the FRS-ALADIN-LAND setup at GSI, Darmstadt.

Achievements from In-house Developmental work

- The group has been consistently involved in developmental activities in in-house labs.
- Performance of axial field ionization chamber with Xenon gas has been tested.
- An old sum spectrometer consisting of six large NaI(Tl) detectors has been rejuvenated and set up with a CAEN 5780 digitizer, characterized and then utilized to suppress room background.

This year Saha Institute has hosted the 61st DAE-BRNS Symposium on Nuclear Physics during 4-9th December 2016. Nuclear Physics Division has been involved in the organization of the Symposium in a major way. The academic and organizational aspect of the Symposium has been highly appreciated by more than 500 participants coming from all parts of India and even abroad.

9.1. Ph D Awarded

1. Subhendu Rajbanshi [A. Goswami], Generation of angular momentum in weakly deformed nuclei in mass ~ 140 regions, University of Calcutta, October 2016.

9.2. Lectures/Talks given in Conference/ Symposium/ Workshop/ Schools

Anjali Mukherjee

1. Large back angle quasi-elastic scattering for weakly bound systems at near-barrier energies, DAE-BRNS Symposium on Nuclear Physics, SINP, Kolkata, December 5-9, 2016.
2. Study of Quasi-elastic scattering at back angles for weakly bound systems at near-barrier energies, International conference FUSION 17, Hobart, Australia, February 20-24, 2017.
3. Nuclear Astrophysics, Colloquium lecture at Dum Dum Motijheel College, March 2017.

M. Saha Sarkar

1. Nuclear Physics: From Triviality to Eternity, National Workshop on Nuclear and Astrophysics: Two opposite ends of Dimensions (NATD-2017), Vidyasagar University, Midnapore, January 17-19, 2017.
2. Studies in Nuclear Structure relevant to Astrophysics: experimental efforts, 61st DAE-BRNS National Symposium on Nuclear Physics, Bhabha Atomic Research Center (BARC), Mumbai [funded by Board of Research in Nuclear Physics (BRNS)], Kolkata, December 4-9, 2016.
3. Nuclear structure near exotic doubly closed Sn isotopes, Nuclear structure and inputs for possible experiments with upcoming high resolution gamma ray array at FAIR facility SPIN-2016 (2 Lectures), Department of Physics, University of Calicut, supported by Bose Institute Indo-FAIR Co-ordination Centre (BI-IFCC), Calicut, November 5-19, 2016.
4. Why and How Study Nuclear Physics?, National Conference on Nuclear and Accelerator Physics (NCNAP-2016), Centre for Applied Physics, Central University of Jharkhand, Brambe, Ranchi, October 4-6, 2016.

5. Nuclear Physics: From Triviality to Eternity, Rammohan College, Kolkata, September 22, 2016.
6. Study of isomers near doubly closed $_{208}$Pb with N<126, Workshop on isomer studies at the focal plane of HYRA, September 19, 2016.
7. Angular distribution, correlation, and DCO ratio, Experimental methods in gamma-ray spectroscopy (3 Lectures), Inter University Accelerator Centre, New Delhi, April 25-29, 2016.

9.3. Teaching elsewhere

Anjali Mukherjee

1. M.Sc. on Nuclear Physics (12 Lectures), West Bengal State University, Barasat, January – March 2017.

Chinmay Basu

1. M.Sc. Advanced Course in Nuclear Reactions & Nuclear Astrophysics (25 Lectures), Rajabazar Science College, University of Kolkata, January-March 2017.

9.4. Miscellany

Anjali Mukherjee

1. Member of the International Advisory Committee for the FUSION 17 conference, held at Hobart, Australia.

10. Plasma Physics

Research activities in the plasma physics division encompass a variety of theoretical and experimental topics in the field of linear and nonlinear wave propagation. Theoretical studies using Lagrange fluid description for various types of waves in unmagnetized and magnetized plasmas have been carried out to understand wave breaking phenomena due to phase-mixing processes. In a relativistic scenario, wave breaking limit of a cold electrostatic wave in an electron-positron-ion plasma has been derived and its dependence on various mass ratios obtained. Such studies have relevance to particle acceleration and heating in astrophysical environments and laboratory experiments. Investigations on stationary solutions of Bursian and non-neutral plasma diodes and their stability characteristics in presence of external magnetic fields reveal interesting results that are relevant in the design of fast electron switches. Studies are also being pursued to understand the formation of different types of nonlinear coherent structures such as solitons, double layers and vortices in classical as well as quantum plasmas. Dynamics of charged particles in chaotic magnetic fields is being explored to understand diffusion and energization aspects.

Strongly coupled dusty plasma having a viscoelastic nature supports propagation of longitudinal acoustic and transverse shear modes. Linear and nonlinear coupling between these modes as well as excitation of various instabilities driven by velocity shear, non-Newtonian characteristics and density dependent viscosity have been investigated. Simulation studies using pseudo-spectral analysis are being carried out to study the formation and evolution of vortices as well as interaction between co and counter propagating mono polar Gaussian vortices in a strongly coupled collisional dusty plasma.

Experimental activities are being carried out in the MaPLE (Magnetized Plasma Linear Experiment) device, double Layer experimental device (DLX), glow discharge plasma and the currentless toroidal device.

MaPLE device has been designed to study waves and instabilities in a controlled parameter regime. In the regime where both hot and cold flowing electron species are present, excitation of electron acoustic wave has been observed in the low wave number regime. Excitation of electron acoustic mode is an unconventional phenomena in laboratory plasmas and an understanding behind the excitation mechanism has been obtained using a kinetic model. In order to enhance the density in the MaPLE device that is currently produced by electron cyclotron resonance discharge a quiescent filamentary source has been developed, fabricated, tested and integrated with the machine. This will facilitate study of magnetic electron drift mode.

Double layer experimental device enables studies in radio-frequency produced plasma in presence of diverging magnetic fields. Self-excited drift waves with frequency greater than ion cyclotron frequency have been observed in an argon plasma and termed upper drift modes to distinguish them from conventional low frequency drift modes. In helium plasma, two drift modes coexisting over a wide range of axial and radial locations have been observed and accorded to smaller values of ion Larmor radius of helium compared to argon.

Nonlinear dynamic experiments are being carried out in DC glow discharge plasmas having cylindrical and toroidal configurations revealing a variety of nonlinear phenomena.

Application of dipolar magnetic field using bar magnet has lead to excitation of canard orbit and mixed mode oscillations when the system is in excitable state and period doubling bifurcation when the system is in oscillatory state. In a currentless toroidal assembly, floating potential fluctuations associated with anodic fireballs have been found to exhibit different kinds of oscillations depending on the vertical magnetic field applied. Different

statistical and spectral methods have been used to explore the complex dynamics of the plasma.

10.1. Ph D Awarded

1. Sudip Garai [M.S. Janaki and Nikhil Chakrabarti], Velocity shear driven phenomena in strongly copupled dusty plasma, HOMI Bhabha National Institute, April 2016.
2. Anwesa Sarkar [Nikhil Chakrabarti], Nonlinear waves in relativistic and nonrelativistic plasma, Homi Bhabha National Institute, May 2016.
3. Abhik Mukherjee [Prof. Anjan Kundu and M.S. Janaki], Study of nonlinear waves in oceanic and other physical systems, Homi Bhabha Nationl Institute, June 2016.
4. Sourav Pramanik [Nikhil Chakrabarti], Nonlinear particle dynamics of plasma diodes in presence of external magnetic field, Homi Bhabha National Institute, January 2017.

10.2. Lectures/Talks given in Conference/ Symposium/ Workshop/ Schools

Nikhil Chakrabarti

1. Oscillations in the view point of students and researchers, National conference on Recent Developments in Mathematics and its Applications, Ramkrishana Mission Vidyamandira, Belur Math, September 26-27, 2016.
2. Plasma research: from beginners perspective, National conference on Plasma Physics and Nonlinear dynamics – 2017 (NCPPND-17), JIS University, Agarpara, Kolkata, March 23-24, 2017.
3. DST-SERB school organized by Institute of Advanced Study in Science and Technology (IASST) (8 Lectures), November 9-12, 2016.

10.3. Teaching Elsewhere

M. S. Janaki

1. DST-SERB school organized by Institute of Advanced Study in Science and Technology (IASST) (4 Lectures), November 9-12, 2016.
2. Short term course entitled 'Nonlinear dynamics, chaos and application' at Department of Physics (2 Lectures), NIT Durgapur, July 14, 2016.

11. Surface Physics and Material Science

In order to achieve superior device performances, it is absolutely necessary to explore the properties of new materials within multifunctional platforms in the nanometer length scale (~1-100 nm), where the surface and the interface essentially dictates the functions. Keeping this view in mind, research activities of the Surface Physics & Material Science (SPMS) Division mainly encompass the growth of low-dimensional metallic, semiconducting and organic materials via physical and chemical routes followed by their extensive characterizations with state-of-the-art techniques/tools for achieving tunable mechanical / electrical / magnetic / optical properties relevant in the forefront research areas of micro-nano science & technology. Synthesis of the condensed and soft materials in the form of ultra-thin layer and nanometer sized particles with different morphology are implemented by sophisticated growth techniques, like, molecular beam epitaxy (MBE), metal oxide vapour phase epitaxy (MOVPE), cluster ion deposition, sputtering, ion implantation, Langmuir-Blodgett (LB) techniques along with other conventional growth techniques, like, spin coating and wet chemical methods. The state-of-the-art characterization techniques, such as a 300 kV transmission electron microscope (TEM) attached with electron energy loss spectroscopy (EELS) and energy dispersive x-ray spectroscopy (EDX), high resolution scanning electron microscope (SEM) augmented with cathode luminescence (CL) optical detection system, versatile x-ray diffraction (VXRD) system, X-ray photoelectron spectroscopy (XPS) systems along with angle resolved detection capability, ultra high vacuum based scanning tunnelling microscope (STM) and ambient scanning probe microscopes (SPMs) are utilized for structural, compositional, optical, tribological and surface/interface analysis in routine manner. In short, the faculty members of SPMS division, with their diversified fields of expertise, have been working on systems where surface/interface plays a crucial role in dictating its properties relevant to applications, such as, MOS-based electronic devices, magnetic devices, photonic devices, sensors for detecting hazardous gas and human blood glucose monitoring, bio-imaging, solar cells, to name a few. Many faculty members of the division have also been using advanced synchrotron facilities in India and abroad for a further detailed understanding of these materials, apart from developing an SINP beam line at the INDUS II synchrotron at RRCAT, Indore.

That an atomically sharp interface (revealed by cross-sectional TEM) plays a crucial role in determining the quality of the cutting-edge new materials having possible applications in next generation electronic, spintronic and quantum computation devices, has recently been demonstrated in a high-temperature ferromagnetic topological insulator utilizing our TEM facility through an international collaborative work. Our TEM work has been instrumental in the discovery of a super dense nonmagnetic fcc phase of cobalt and demonstrating the growth of nanoscale nickel monosilicide, a desired material for the future complementary metal oxide semiconductor (CMOS) technology.

Formation of 2D-networked structures of disk-like islands for ultrathin Langmuir-Schaefer (LS) films of thiol-coated Au-nanoparticles (DT-AuNPs) on H-passivated Si substrates is evidenced for the first time, directly from a broad peak in grazing incidence small angle X-ray scattering (GISAXS) data and also from atomic force microscopy (AFM) images [*RSC Adv.* 2016, 6, 12326]. The structural information of the LS films, obtained at different surface pressure, helps to infer the growth of Langmuir monolayers of DT-AuNPs, which is very important in understanding the self-assembly process of nanoparticles at the air-water interface and in controlling the growth of 2D-networked nanostructures in large areas.

The crystallization process ZrO_2 thin-film is identified and found that 1-D crystal growth took place initially that spreads laterally with temperature and time without increasing their numbers. The growth of Zr-Silicate and silicide is also investigated using differential scanning calorimetry. The substrate dependent performance of the high-k dielectric film is also investigated. Charge storage properties of InP quantum dots in GaAs metal-oxide-

semiconductor based nonvolatile flash memory devices is also investigated. A nanoparticle (NP)-based non-volatile memory devices with HfO_2 as tunnel and barrier layers are fabricated and characterized.

We work with nano dimensional organic semiconducting (OSc) thin films prepared on various substrates in ultra high vacuum chamber. Structure and electronic properties of these films are studied. OTFT devices are prepared and the field effect mobility of the devices is measured. We use various spectroscopic and microscopic techniques for our experiments such as XPS/UPS, NEXAFS, PRES (synchrotron based techniques), AFM etc. We also perform density functional theory calculations using StoBe and VASP software. The objective of our study is to understand interfacial's properties that are required for the development high mobility organic semiconductor devices.

We study the structures in different phases and their incorporation into the membrane depending on the temperature-surface pressure phase diagram of the mixed lipids. Self organization mechanism in supramolecular materials in presence of foreign species is also very crucial in developing new functional devices based on these self assembled materials. We have also demonstrated that these supramolecular nanofibers are very promising candidates for various applications such as solar cells, sensors, FETs, etc.

In our recent works on the dynamics in soft matter, i.e., the two-dimensional nanoscale pattern dynamics at air-water interface, we investigated the role of the nanoparticle–monolayer and monolayer–monolayer lipophilic attraction in influencing morphology and dynamics of AuNP cluster patterns in fatty acid monolayers. The corresponding pattern morphology, observed with a Brewster Angle Microscope (BAM) essentially reveals three stages in pattern evolution. On the otherhand, coalescence of myristic acid droplets on water surface is found to exhibit anomalous behaviour such as simultaneous increase of mean droplet size and droplet number with time at low surface pressure.

We have shown that the 3D micro-snowflake structured α-Fe_2O_3 synthesized by simple hydrothermal decomposition of $K_3[Fe(CN)_6]$ without using any surfactant can be used for highly selective, sensitive and stable amperometric sensing of H_2O_2 and N_2H_4 in presence of common coexisting electroactive interferes. As an ideal enzyme less sensing material, the sample has good stability and selectivity against common coexisting interferes. We also report non-equilibrium dynamics and giant spontaneous exchange bias obtained in zero field cooled mode for $Ni_{46}Mn_{43}In_{11}$ alloy. The dc magnetic measurements indicate a super spin glass type magnetic ground state in the system.

We have started work on epitaxial growth of $(Al_{1-y}Ga_y)_xIn_{1-x}P/(Al_{1-y'}Ga_{y'})_xIn_{1-x}P/GaAs$ QW structures. Initial low temperature photoluminescence measurements show peaks correspond to the QW emission. While working on the growth of AlxGa1-xAs epitaxial layers in the QW structures, we have observed natural superlattice ordering in the material, which is not reported on (100) GaAs grown by this technique. This growth behaviour is further studied by growth of thick $Al_xGa_{1-x}As$ layer with different composition and their thermal stability using different x-ray techniques, TEM microscopy and photoluminescence. Effect of the superlattice on emission properties of the QW is also being studied in detail.

We have performed extensive studies of the antiferromagnetic NiO single crystals and ultrathin films using XPS, ARPES, LEED, LEEM, XMLD-PEEM methods and have been the subject of many publications. Electronic band structures of low-dimensional layered materials such as single crystal Graphite, MoS_2, $MoSe_2$ etc. have also been extensively investigated. Epitaxial Cr, V and Mn monolayers, and multilayers, as well as their oxides such as V_2O_3, MnO, Mn_3O_4 etc, have been studied in respect of their surface magnetism and electronic structures. Further systems studied includes ultrathin films and overlayers of CoO, MgO, Cu_2O, metallic Sn and SnO etc.

The time evolution of the spontaneous oxidation of the prepared film in air at room temperature (RT) was studied. A compositional analysis of the film was carried out in an ultra-high vacuum (UHV) deposition chamber using an in situ XPS system. The morphological aspects of the deposited film were studied with a high resolution scanning electron microscope (SEM) and an atomic force microscope (AFM). We report the spontaneous production of highly pure (95%) and technologically appealing nano-crystalline Cu_2O within 300 seconds of air exposure. The crystalline structure was probed using high resolution TEM (HRTEM) and the optical properties were studied using a cathodoluminescence (CL) device attached to a SEM.

Examination of radiative localized surface plasmon resonance (LSPR) modes of individual polyhedral nanoparticles (NPs) with high index facets, such as trisoctahedral (TOH) shaped or concave nanocube (CNC) shaped gold (Au) nanocrystals (NCs) using cathode luminescence (CL) across the visible spectral range show interesting results. Pronounced enhancement is observed in the Raman scattering on Rhodamine 6G (R6G)-covered TOH Au NPs aggregates on a Si substrate whereas for CNC shaped Au NPs, we report the existence of edge quadrupolar mode as well as substrate-mediated hybridized corner quadrupolar and octupolar modes.

11.1. Ph D Awarded

1. Ishani Roy [Satyajit Hazra], Structural ordering in semiconducting organic molecules or polymers, University of Calcutta, June 2016

2. Tanmay Ghosh [Biswarup Satpati], Studies of Structural and Optical Properties of Low Dimensional Structures Using Transmission Electron Microscopy and Associated Techniques, University of Calcutta, June 2016.

11.2. Lectures/Talks given in Conference/ Symposium/ Workshop/ Schools

Biswarup Satpati

1. Transmission Electron Microscopy of Composite Materials, TEQIP II Sponsored One Day Seminar on Recent trend in composite material held at Mechanical Engineering Department, Jadavpur University, Kolkata, August 18, 2016.
2. MRSI Medal Lecture on Heteroepitaxy in chemically grown silver nanodendrites on germanium and mapping its surface plasmon associated photon emission, Victor Menezes Convention Centre, IIT, Mumbai, February 15, 2017.
3. Insight into the World of Nanomaterials: Microscopy and Spectroscopy with Electrons, UGC-SAP (DRS III) sponsored National Seminar on Advances in Materials Science, Department of Physics, Gauhati University, March 24-25, 2017.

Mrinmoy K. Mukhopadhyay

1. Beauty of Anisotropic Plasmonic Nanomaterials: Fundamentals and Multidirectional Applications, Discussion Meeting on Synchrotron Techniques in Material Research, Sponsored by Nanomission, DST; Dooars, West Bengal: February 2- 5, 2017.

Satyaranjan Bhattacharyya

1. Morphologies of the softlanded size-selected Cu nanoclusters over different substrates, Workshop on Nanoclusters Synthesis, Characterization and Applications, Okinawa Institute of Science and Technology (OIST), Japan, May 16-19, 2016.

Manabendra Mukherjee

1. Recent developments in the field of Nanomaterials, Dolphin (PG) Institute of Biomedical and Natural Sciences, Dehradun, April 4, 2016.
2. A systematic study of synthesis and self assembly of silver triblock copolymer nanoparticles, Physics Department of HNB Garhwal University, Srinagar, Uttarakhand, April 8, 2016.
3. Near Edge X-ray Absorption Fine Structure Spectroscopy (NEXAFS) and a few case studies, Center for Condensed Matter Sciences, National Taiwan University, Taipei, Taiwan, June 30, 2016.
4. Effect of solvent-polymer interaction in swelling dynamics of ultra-thin polyacrylamide films, 6th Conference on Neutron Scattering (CNS-2016), BARC, Bombay, November 23, 2016.
5. An overview of synchrotron and related research, at Dolphin (PG) institute of Biomedical and Natural Sciences, Dehradun, December 6, 2016.
6. Near Edge X-ray Absorption Fine Structure Spectroscopy (NEXAFS) and a few case studies, at National Conference on Electron Spectroscopy, Toshali Sands, Puri, December 23, 2016.

12. Theory

Particle Physics Phenomenology

Flavor-changing decays of the top quark have been predicted to be small in the Standard Model. The experimental limits on these processes are much higher. We have set up theoretical framework in which experimentally accessible results can be expected in models of new physics. We have discussed two models of supersymmetry, one with conserved R-parity, and the other in which R-parity is mildly violated. We show that in the latter case there is a distinct possibility of detecting the rare decay of top quark decaying to a charm quark and a Z boson at the LHC.

We have also worked on intergenerational symmetries and tried to explain fermion masses and mixings.

The SM at the LHC is being scrutinized at an unprecedented level of precision. It is only natural to have the competing BSM scenarios match the same order of accuracy in QCD as the SM observables.

At the LHC, first step towards a precision phenomenological study of the production of spin-2, coupling non-universally to the SM particles would be to compute form factors to the production of a singlet, on-shell spin-2 state via the quark-antiquark and gluon-gluon production channels, to the same order of accuracy as the SM background. A priori, it is not clear how the UV and IR structure would look like when spin-2 couples to particles of the SM with non-universal couplings, this is investigated up to the three loop level in QCD.

We have performed the very first calculation involving a massive spin-2particle at NNLO level in QCD for the production of a pair of leptons at hadron colliders. We have included all the relevant sub-processes that can contribute to the invariant mass distribution of the di-leptons. The methodology of reverse unitarity and IBP identities are systematically employed to achieve it.

The two-loop QCD correction to massive spin-2 graviton decaying to quark +antiquark + gluon is presented considering a generic universal spin-2coupling to the SM through the conserved energy-momentum tensor. The motivation are to (a) probe the structure of quantum field theory in the presence of a spin-2 field, to check the universality of IR pole structure in QCD and (b) present one of the important ingredients for full two-loop QCD correction for real graviton production in association with a jet.

Using the pseudo-scalar Higgs boson form factors that have recently become available up to three loops and the third order soft function from the real radiations, a complete N3LO threshold correction to the production of a pseudo-scalar Higgs boson at the LHC has been obtained. Using our approach, we have also computed the process dependent coefficient that appears in the threshold resumed cross section, which will be useful for resumed predictions at N3LL in QCD. Using threshold corrected N3LO results; we have presented a detailed phenomenological study of the pseudo-scalar Higgs boson production at the LHC for various center of mass energies as a function of its mass.

Non-perturbative studies of Quantum Field Theories

The standard Wilson lattice gauge theory with compact gauge fields is explicitly gauge-invariant at all stages of the calculation and does not require gauge fixing. This works perfectly well for vector-like gauge theories. However, for proposals of chiral gauge theories on the lattice, gauge invariance is lost because lattice fermions do necessarily break chiral symmetry, and as a result the redundant longitudinal gauge degrees of freedom end up coupling with physical degrees of freedom, and render the theories unsuitable. Gauge-fixing

has been suggested as a possible remedy to control the couplings of the redundant degrees of freedom.

However, gauge-fixing at the non-perturbative level of compact gauge fields is a non-trivial business because of a rigorous no-go theorem by Neuberger which says that the partition function of a BRST-invariant theory of compact gauge fields is identically zero, apparently because of cancelling contributions from Gribov copies.

Here at SINP, we are pursuing particular proposals of non-perturbative gauge fixing both for Abelian and non-Abelian compact gauge theories.

For the Abelian case, a higher derivative gauge fixing term, breaking gauge and BRST invariance, is added to the Wilson term along with a counter-term to recover gauge symmetry. A new universality class is found at a continuous phase transition between a broken symmetry phase with regular order and another broken symmetry phase with spatially modulated order that has a vector condensate. Approaching this transition from the regularly ordered phase recovers the gauge symmetry and thereby decoupling the longitudinal gauge degrees of freedom. Contribution of the SINP group has been to determine the phase diagram beyond weak couplings and establish the availability of the new universality class to all gauge couplings through computation of various observables. Investigation of the Abelian gauge-fixing on the lattice has been completed in the past year.

The non-Abelian gauge fixing involves extension of the BRST called equi-variant BRST (eBRST) to evade the Neuberger's theorem. This is basically application of gauge fixing to the coset while a subgroup is kept gauge-invariant, and necessarily involves four-ghost term in the action. We have developed, from scratch, a code for generating gauge configurations with this eBRST action. The work is still in progress.

In pure QCD with free boundary conditions, work was also done to determine the lowest glue ball spectrum.

Gravity and Cosmology

An alternate model of gravity including torsion is being investigated. The main feature of this new model is it reduces to Einstein's theory at long distances and becomes a Yang-Mills' theory at short distances. However, no exact solution beyond the trivial ones (with non-vanishing torsion) has been found in which these features are exhibited. A report on this is yet to come out.

The number of observable e-foldings during inflation is sensitive to the post-inflationary history of the Universe. The generic presence of light scalar fields in theories motivated by supersymmetry or String theory leads to a late-time period of matter domination which lowers the required number of e-foldings, and in turn, the exact predictions of inflationary model. This issue has been explored in a concrete set-up of Kahler moduli inflation in String theory. The initial displacement of volume modulus has been calculated explicitly, and the generic expectation from supergravity theory was confirmed that the initial displacement is of the order of Planck mass. The constraints from reheating has also been analysed for this model in a subsequent work. In separate projects, the issue of attractor models in non-minimal f(R) gravity, and the supergravity contributions to inflation in models with non-minimal coupling to gravity have been analysed.

Strings

It has been shown earlier by us that, like BPS Dp branes, bulk gravity gets decoupled from the brane even for the non-susy Dp branes of type II string theories indicating a possible extension of AdS/CFT correspondence for the non-supersymmetric case. The detailed

decoupling limit and the throat geometry of the non-susy D3 brane when the charge associated with the brane is very large have been worked out. This leads to the gravity dual of a non-supersymmetric QCD-like gauge theory with running coupling constant having confinement property. Also starting from an anisotropic non-susy D2 brane solution of type IIA string theory an anisotropic space-like D2 brane solution has been constructed by the standard trick of double Wick rotation. It is shown that upon compactification on six dimensional hyperbolic space of time dependent volume of this SD2 brane solution leads to accelerating cosmologies on the resultant four dimensional universe. On the other hand, at early times this four dimensional space, under certain situations, leads to four dimensional Kasner-like cosmology. Unlike in the standard four dimensional Kasner cosmology here all three Kasner exponents could be positive definite, leading to expansions in all three directions.

New examples of Lifshitz type vacua in 10D massive typeIIA supergravity are constructed. These Lifshitz geometries arise when `massive' closed strings are excited in D2-D8 brane system. Upon compactification to four dimensions they produce 4-dimensional Lifshitz solutions (with dynamical exponent of time being 2) like in the Einstein-Proca model of Son et. al. We also studied M5 action in six dimensions using Yang-Mills fields and adjoint scalars with the help ofauxiliary vector field and new axion field. The 6D covariant action is well defined for 'instantonic' string solitons.

In addition, the following issues were explored and addressed: a) Building on earlier works that describe a certain steady-state configuration, the causal structure of an emergent geometry, which emerges from the dynamics of open strings, was explored within the context of gauge-string duality. The similarity of causal structures emerging from dynamical gravity and this particular kinematic space-time was elaborated on. b) Motivated by earlier works within holography, a preliminary study of candidate infrared fixed points were carried out in a system of arbitrary number of adjoint and fundamental degrees of freedom, in a strongly coupled large N gauge theory. A large class of exact solutions were obtained, which are non-perturbative in terms of the ratio of the number of fundamentals and the number of adjoints.

QCD at Finite Temperature and Density

A captivating nature of non-central heavy ion collisions indicates that a very strong anisotropic magnetic field is generated in the direction perpendicular to the reaction plane, due to the relative motion of the ions themselves. The initial magnitude of this magnetic field can be very high at RHIC and LHC energies at the time of the collision and then it decreases very fast. The presence of an external anisotropic field in the medium subsequently requires modification of the present theoretical tools that can be applied appropriately to investigate various properties of QGP. We have been involved in developing theoretical tools appropriate for a hot magnetised QCD medium. Also involved in studying non-perturbative aspects of hot QCD medium with effective models.

Nuclear Theory

The strong and model independent correlations of neutron star radii with the linear combination of the slope of the nuclear matter incompressibility coefficient and slope of the nuclear symmetry energy coefficient are reported for the first time. Such correlations are found to be more or less independent of the neutron star mass over a wide range. This correlation is traced back to be linked to the empirical relation existing between the star radius and the pressure at a nucleonic density between one and two times saturation density.

Mathematical Physics

An su(m)-invariant Haldane-Shastry like quantum spin chain with long-range interaction and open boundary condition has been studied. It is shown that this spin chain is integrable for some suitable choice of the lattice sites depending on the roots of the Jacobi polynomial. The ground state wave function of such integrable spin model can be obtained from the chiral correlator of the c=m-1 free boson boundary conformal field theory. The partition function of this spin chain is computed by using the freezing trick. Moreover, a complete description for the spectrum of this spin chain is given in terms of Haldane's motifs and a related classical vertex model.

We analyzed the fermionic quasinormal modes of the BTZ black hole in the presence of space-time noncommutativity. Our analysis exploits a duality between a spinless and spinning BTZ black hole, the spin being proportional to the non commutative deformation parameter. Using theAdS/CFT correspondence we show that the horizon temperatures obtained from the dual CFT pick up non-commutative contributions. We demonstrate the equivalence between the quasinormal and non-quasinormal modes for the non-commutative fermionic probes, which provides further evidence of holography in the noncommutative setting. Finally we present an analysisof the emission of Dirac fermions and the corresponding tunnelling amplitude within this non-commutative framework.

We analyzed the effects of noncommutativity in conformal quantum mechanics (CQM) using the \kappa-deformed space-time as a prototype. Upto the first order in the deformation parameter, the symmetry structure of the CQMalgebra is preserved but the coupling in a canonical model of the CQM gets deformed. We show that the boundary conditions that ensure a unitary time evolution in the non-commutative CQM can break the scale invariance, leading to a quantum mechanical scaling anomaly. We calculate the scaling dimensions of the two and three point functions in the non-commutative CQM which are shown to be deformed. The AdS_2/CFT_1 duality for the CQM suggests that the corresponding correlation functions in the holographic duals are modified. In addition, the Breitenlohner-Freedman bound also picks up a non-commutative correction. The strongly attractive regime of a canonical model of the CQM exhibit quantum instability. We show that the non commutativity softens this singular behaviour and its implications for the corresponding holographic duals are discussed.

We showed that the realizations of noncommutative coordinates that are linear in the Lorentz generators form a closed Lie algebra under certain conditions. The star product and the co-product for the momentum generators are obtained for these Lie algebras and the corresponding twist satisfies the co-cycle and normalization conditions. We also obtain the twisted flip operator and the \mathcal R-matrix that define the statistics of particles or quantum fields propagating in the se-non commutative space times. The Lie algebra obtained in this work contains a special case which has been used in the literature to put bounds on noncommutative parameters from the experimental limits on Pauli forbidden transitions. The general covariant framework presented here is suitable for analyzing the properties of particles or quantum fields at the Planck scale.

We showed that the N-particle Sutherland model with inverse-square and harmonic interactions exhibit orthogonality catastrophe. For a fixed value of the harmonic coupling, the overlap of the N-body ground state wave functions with two different values of the inverse-square inter action term goes to zero in the thermodynamic limit. When the two values of the inverse-square coupling differ by an infinitesimal amount, the wave function overlap shows an exponential suppression. This is qualitatively different from the usual power law suppression observed in the Anderson's orthogonality catastrophe. We also obtain an analytic expression for the wave function overlaps for arbitrary set of couplings, whose properties are analyzed numerically. The quasi-particles constituting the ground state wave functions of the Sutherland model are known to obey fractional exclusion statistics. Our

analysis indicates that the orthogonality catastrophe may be valid in systems with more general kinds of statistics than just the fermionic type.

Recently unusual properties of water in single-walled carbon nanotubes (CNT) with diameters ranging from 1.05 nm to 1.52 nm were observed. It was found that water in the CNT remains in an ice-like phase even when the temperature ranges between 105 - 151 C and 87 - 117 C for CNTs with diameters 1.05 nm and 1.06 nm respectively. Apart from the high freezing points, the solid-liquid phase transition temperature was found to be strongly sensitive to the CNT diameter. In this paper we show that water in such CNT's can admit coherent nano-scale structures provided certain conditions are met. The formation of such coherent structures allows for high values of solid-liquid phase transition temperatures that are in qualitative agreement with the empirical data. The model also predicts that the phase transition temperature scales inversely with the square of the effective radius available for the water flow within the CNT. This is consistent with the observed sensitive dependence of the solid-liquid phase transition temperature on the CNT diameter.

12.1. Ph D Awarded

1. Atanu Kumar [Amit Ghosh], Evolution of cosmological perturbation through bounce in covariant perturbations theory and tests of linearity, Homi Bhabha National Institute, August 2016.
2. Arindam Mazumdar [Palash Baran Pal], Effect of preheating on cosmic microwave background, University of Calcutta, February 2017.
3. Chowdhury Aminul Islam [Munshi Golam Mustafa], Study of hot and dense nuclear matter in effective QCD Model, Homi Bhabha National Centre, February 2017.
4. Avirup Ghosh [Amit Ghosh], Thermodynamics of horizons: some aspects of semi-classical approaches, Homi Bhabha National Institute, March 2017.

12.2. Lectures/Talks given in Conference/ Symposium/ Workshop/ Schools

Arnab Kundu

1. Indian Association for the Cultivation of Science, SYK Model Black Hole Physics, Kolkata, February 2017.
2. Fundamental Flavours, Veneziano Limit and Holography, Harish Chandra Research Institute, Allahabad, November-December 2016.
3. Attaching Strings to Holography: A Study in Quantum Field Theories, Strings Attached, Indian Institute of Technology, Kanpur, February 2017.
4. Many Bodies Meet Massive Bodies: A Holographic Perspective, Recent trends in Condensed Matter and High Energy Physics, IACS, Kolkata, January - February 2017.
5. Fundamental Matters (Veneziano Limit and Holography), Indian Strings Meeting 2016 (International), IISER Pune, December 2016.
6. Gauge-String Duality and Strongly Coupled Systems, String Theory: The Present and the Future, Ramakrishna Mission Vidyamandira, September 2016.
7. Which way will the train go?, DST INSPIRE Internship Camp 2016, Visva-Bharati, Santiniketan, September 2016.

8. Fundamental Flavours, Veneziano Limit and Holography: a Continuing Story and Open Problems, HRI, November-December 2016.
9. Gauge-String Duality with Flavours: Musings with Dirac-Born-Infeld Action, University of Amsterdam, Amsterdam, September 2016.
10. Three dimensional super Yang-Mills with compressible matter, IIT Bombay, Bombay, April 2016.
11. Three dimensional super Yang-Mills with compressible matter, Quantum Spacetime Seminar Series, TIFR, Mumbai, April 2016.
12. Three dimensional super Yang-Mills with compressible matter, CHEP, IISc, April 2016.

Gautam Bhattacharyya

The hierarchy problem and physics beyond the standard model

1. Conference 'Pheno1@IISERM', Chandigarh, April 2016.
2. National Symposium on Physics (SYMPHY 2016), IIT Bombay, April 2016.
3. Indo-French network (INFRE-HEPNET) kick-off meeting, IISc, Bangalore, May 2016
4. Physics Department, IIT Guwahati, May 2016.
5. LAPTh, Annecy, France, July 2016.
6. India-CMS Workshop, SINP, Kolkata, August 2016.
7. Department of Physics, University of Valencia, Spain, September 2016.
8. Colloquium at ICTS, Bangalore, October 2016.
9. Physics Department, Delhi University, November 2016.
10. Plenary talk in XXII DAE-BRNS High Energy Physics Symposium, University of Delhi, December 2016.
11. School of Physics, NISER, Bhubaneswar, February 2017.

An Overview of Electroweak Precision Tests

1. Pedagogic Lecture for students in Sangam @ HRI 2016, HRI, Allahabad, February 2016.
2. Physics Department, Univ of Calcutta, February 2016.

Gauge-Higgs Unification

1. Looking for BSM physics, IISc, Bangalore, December 2016.

Fine-tuning in composite Higgs models

1. International Conference from Strings to LHC-IV, Chalsa, West Bengal, March 2017.
2. Scuola Normale Superiore, Pisa, Italy, June 2017.
3. INFN and Univ. Federico, Napoli, Italy, June 2017.
4. University of Rome, La Sapienza, Rome, Italy, June 2017.

Harvendra Singh

1. Entanglement thermodynamic laws and perturbative corrections for Dp branes, ICTP, Trieste, November 22, 2016.
2. Entanglement thermodynamic laws and perturbative corrections for Dp branes, INFN Sezione di Padova, Italy, December 06, 2016.

3. Entanglement thermodynamic laws and perturbative corrections in AdS, ASC, LMU, Munich, Germany, December 02, 2016.

Koushik Dutta

1. Inflation Models in Supergravity, Strings 2 LHC IV (3 Lectures), Chalsa, March 2017.
2. Moduli Vacuum Mis-alignment and Precise Predictions in String Inflation, Ladders of the Universe, Mainz Institute of Theoretical Physics, Germany, June 2016.
3. Moduli Domination and Precise Prediction in Inflation, PHENO01@IISERM, Mohali, April 2016.
4. Ramanujan Conclave Meeting, SN Bose Centre, December 2016.

Munshi G. Mustafa

1. Heavy quark production and propagation in heavy-ion collisions, FAIR Physics – Compressed Baryonic Matter at FAIR, Sikkim-Manipal Institute of Technology, Mongpo, Sikkim, June 21-24, 2016.

Palash Baran Pal

1. Unification of forces, Science Camp, Physics Department, Jadavpur University, March 14, 2017.
2. Neutrinos and astrophysics, CNT Lectures on Special Topics in Nuclear Astrophysics (4 lectures of 1.5 hours each), Variable Energy Cyclotron Centre, Calcutta, March 06–09, 2017.
3. Neutrinos and cosmology, Orientation session of the DAE Nuclear Physics Symposium, Saha Institute of Nuclear Physics, December 04, 2016.
4. Unification of forces, Current trends in modern physics, Department of Physical Sciences, IISER Kolkata, November 5, 2016.
5. Neutrinoless double beta decay and neutrino mass, NDBD workshop (4 lectures of 75 minutes each), IIT Ropar and Tata Institute of Fundamental Research, IIT Ropar, October 17–21, 2016
6. Symmetry and the PMNS matrix, First workshop on beyond standard model physics, IISER Mohali, April 06–09, 2016.
7. Unification of forces, Frontiers of modern physics, Department of Physics, Jogamaya Devi College, Kolkata, November 21, 2016.
8. Unification of forces, Science Colloquium, IIT Ropar, October 21, 2016.
9. Three horizons of scientific terminologies for Indian languages – Colloquium, Homi Bhabha Centre for Scientific Education, Mumbai, June 16, 2016.
10. Statistical Mechanics (2 lectures of 75 minutes each), NIUS (National Initiative on Undergraduate Science) Physics Camp, Homi Bhabha Centre for Scientific Education, Mumbai, June 14-15, 2016.

Prakash Mathews

1. Quantum Chromodynamics, School-cum-workshop on Collider Physics: Events, Analysis and QCD (3 Lectures), Indian Institute of Technology, Guwahati, March 27-31, 2017.

12.3. Teaching elsewhere

Munshi G. Mustafa

1. Electromagnetic Theory-II; Integrated MSc course in Bose Institute, Kolkata, February-May 2017.

12.4. Miscellany

Munshi G. Mustafa

1. A talk on "My Association with Prof. Dinesh K. Srivastava" on his 64th Birthday, VECC, Kolkata, June 30, 2016.

Palash Baran Pal

1. Curriculum revision, "Curriculum revision" organized by the Electrical Engineering Department, Jadavpur University, March 22, 2017.
2. Protecting mother tongues, "Protecting the mother tongue", organized by Sahitya Akademi, New Delhi, February 21, 2017.
3. Bangla horoph (Bengali script), "The cultural heritage of Bengal", organized by Narasinha Dutt College, Howrah, February 17, 2017.
4. Developing Bangtex, or Latex in Bengali, "Technology and the Bengali language", organized by Sarsuna College and the Linguistics Department of Jadavpur University, held at Jadavpur University, November 25, 2016.
5. Wave-particle duality and the birth of Quantum Mechanics, Physics Department, Raja Peary Mohan College, Uttarparha, February 25, 2017.
6. বাংলায় বিজ্ঞান চর্চা (Study of science in Bengali), "P. C. Ray Memorial Lecture" organized by the Breakthrough Science Society, January 15, 2017.
7. ক্যালেণ্ডারের রহস্য (The mystery of calendars), "Public Lecture" organized by the New Garia Housing Society, January 8, 2017.
8. The history and mystery of calendars, "Public Lecture" at IIT Ropar, October 20, 2016.
9. The history and mystery of calendars, "Humbolt Club", Kolkata, June 10, 2016.
10. মহাকর্ষের ঢেউ (Gravitational waves), "Young Scientists Forum", held at the Senate Hall of Calcutta University, June 4, 2016.
11. Waves and particles, "In-service course for Physics teachers for CBSE Schools", held at Kendriya Vidyalaya, Cossipore, May 24, 2016.
12. The history and mystery of calendars, Institute of Engineering and Management, Kolkata, April 19, 2016.

13. Facilities

13.1. Centre for Advanced Research & Education

One Year Pre-PhD Training Program

CARE coordinated SINP's participation in JEST, another nationwide written test conducted by several DAE institutions together, through Prof. M G Mustafa, the JEST coordinator of SINP. The written tests are followed by interviews conducted in SINP. The tests and interviews are conducted in two major areas – Physics and Biophysical Sciences. In 2016-17, 31 students were selected.

They are now going through the mandatory one-year pre-PhD course work. CARE coordinates the one-year course work following the HBNI guidelines through the Post-M.Sc. coordinators. It coordinates the formation of doctoral committee for each student as per HBNI guideline and reviews each PhD students' annual progress and renewals of fellowships following the recommendation of doctoral committees. CARE office acts as the office of Dean, students' welfare, HBNI, SINP.

Undergraduate Associateship Program & Summer Students' program

In 2016-17, 13 undergraduate associates were trained in various labs of the Institute – the program is coordinated by Prof. Krishna Menon. In 2016-17 summer, 32 summer students were trained in various labs of the Institute – this program is coordinated by Prof. Nikhil Chakrabarti.

Institute Colloquiums, Distinguished Visitors

CARE organized **32** Institute colloquiums through colloquium coordinators, Prof. Y Sudhakar, Prof. Pratik Majumdar and Prof. Dulal Senapati.

Organizing Schools/Workshops (after getting the required approval of DAE)

- 8-th CARE School on Genomics & Proteomics for Clinicians in April 2016 in SINP.
- Partial support in organizing the Saha Theory workshop in cosmology and astrophysics at SINP during January 16-20, 2017.
- A meeting of LIGO and SINP scientists on November 9, 2016.
- Jointly organize 34th Young Physicist colloquium 2016 with Indian Physical Society during August 18-19, 2016 at SINP.
- CARE Seminar delivered by Dr. Chama Mukherjee on 07.01.17 on Gender sensitive issues at workplace.The seminar was jointly organized by CARE and Women Cell of SINP.
- CARE Seminar given by Mark McCanghrean of British Council on 14.2.17

Outreach Programs of Care

- 19-th National Science Exhibition during August 10–14, 2016, at Surer Math, DumDum, Kolkata, organized by the Central Calcutta Science & Culture Organization for Youth.
- 21-st Sundarban Kristi Mela o Lokosanskriti Utsav during 20-29 December 2016 at Sundarban, S 24 Parganas.

In house outreach programme organized by CARE on 08.11.2016

Science Day

CARE celebrated the Science Day on March 10, 2017. A day-long science outreach program was organized. About 500 students from local schools attended. Talks were delivered, followed by visits to several labs of the Institute. An interactive session was organized to address queries raised by the students. The day ended with a Science Quiz competition conducted by the SINP research fellows. Prizes were given to the winning schools by the Director.

Meghnad Saha Archive

CARE maintained and preserved the Prof. M.N. Saha Archive – a unique collection of numerous letters, documents, writings, personal items and memoirs of Prof. Saha and his colleagues. From time to time visitors from India and abroad, who are working on the history of Indian science, visit the archive. With permissions of our Director, CARE office hands over copies of these documents to scholars who are working on the subject.

Publication

Partial support in publishing a journal called Science and Culture, published by the Council of Indian Science News Association, Kolkata. Full financial support in developing the website of SINP and coordinating, preparing and publishing the annual report of SINP. CARE office also prints all posters requested by SINP students and faculties for participating in conference/workshops.

13.1.1. The Post-M Sc Associateship Course 2016 – 2017

Theoretical Physics

1. Anwesha Chattopadhyay
2. Aranya Bhattacharya
3. Avik Paul
4. Bishnu Awon (has not completed)
5. Bithika Karmakar
6. Supriyo Ghosh

Experimental Physics

1. Amrita Datta
2. Ashok Kumar Mondal
3. Dipak Mazumdar
4. Gourab Saha
5. Md Samsul Islam

6. Pintu Barman
7. Piyasi Biswas
8. Prithwijita Ray
9. Rajkumar Santra
10. Ram Sewak
11. Sathi Sharma
12. Sayan Ghosh
13. Smruti Ranjan Mohanty
14. Sunita Sahoo
15. Tanmay Maiti
16. Vishal Kumar

Biophysical Sciences

1. Anindita Das
2. Anushka Chakravorty
3. Biswendu Biswas
4. Deepro Bonnerjee
5. Gargi Biswas
6. Priyadarshani Suchismita Sethy
7. Rajkamal Srivastava
8. Satyaki Chatterjee
9. Subhoja Chakraborty

Theoretical & Experimental Physics courses

Compulsory Courses in the First Trimester (Aug – Nov 2016)

1) Quantum Mechanics (Subinit Roy, Satyajit Saha)
2) Statistical Mechanics (Abhik Basu)
3) Advanced quantum Mechanics (Amit Ghosh)
4) Advanced Statistical Mechanics (Pradeep Mohanty)
5) Quantum Field Theory I (Asit K De)
6) Computational and Numerical Methods including C++ programming: Supratik Mukhopadhyay, Nayana Majumdar, Sandip Sarkar, Debasish Das
7) Short Experiments in Research Laboratories (Satyajit Hazra and Indranil Das, Co-ordinators)
8) Research Methodology: a) Numerical Methods and Alogorithms b) Research Ethics c) Attending seminar/colloquium (Arti Garg, Kalpataru Pradhan, Debades Bandyopadhyay and Bijay Agrawal, Krishnakumar S R Menon, Biswajit Karmakar)

Advanced Courses (optional) in Second Trimester (Dec 2016 – Mar 2017)

1) Quantum Field Theory-II (Asit K De)

2) Particle Physics (Palash B Pal)

3) Advanced Condensed Matter-I (Arti Garg & Kalpataru Pradhan)

4) Astro-Particle Physics-I (Debashis Majumdar)

5) Geometry and Gravity (Amit Ghosh)

6) Advances in High Energy and Astroparticle Physics**: (**Pijushpani Bhattacharjee, Naba Kumar Mondal)

7) Advanced tools for High Energy Physics and related detectors: (Subir Sarkar and Satyaki Bhattacharya)

8) Advanced Nuclear Physics I (Nuclear Structure and advanced nuclear radiation detectors & techniques): Maitreyee Saha Sarkar and Haridas Pai

9) Advanced Nuclear Physics II (Nuclear Reactions): Chinmay Basu

10) Materials Science / Nanoscience / Physics of Surfaces and Interfaces: Sangam Banerjee

11) Some Topics on Detection and Measurement of Radiation: Debasish Das, Co-ordinator

Review works (Theoretical & Experimental physics) for 2015 – 16 batch

1. Avik Banerjee, Higgs as pseudo Nambu-Goldstone Boson (Gautam Bhattacharyya, Theory)
2. Aritra Das, Collective oscillations in isotropic and anisotropic quark gluon plasma (Pradip K Roy, HENPP)
3. Augniva Ray, Conformal Bootstrap: a classic Idea and a modern Revival (Arnab Kundu, Theory)
4. Samanwaya Mukherjee, Two component dark matter model (Debasish Majumdar, AP&C)
5. Madhurima Pandey, Singlet scalar feebly interacting massive particle dark matter (Debasish Majumdar, AP&C)
6. Sajad Ahmad Bhat, Equation of state of neutron star matter (Debades Bandyopadhyay, AP&C)
7. Sourav Chakraborty, Metal-Insulator transition in binary disorder model (Kalpataru Pradhan, CMP)
8. Udit Narayan Chowdhury, Galilean Conformal Field Theories (Rudranil Basu, Theory)
9. Pintu Barman:- Growth process of size-selected metal nanoclusters and fabrication of soft-landed films (Satyaranjan Bhattacharyya, SPMSD)
10. Ashok Kumar Mondal:- Determination of the ANC of ^{16}O states using $^{12}C(^{6}Li,d)^{16}O$ angular distribution data at sub-Coulomb energies (Chinmay Basu, NPD)
11. Piyasi Biswas:- Study of Quasi-elastic scattering for the system ^{7}Li + ^{159}Tb at around barrier energies (Anjali Mukherjee, NPD)
12. Sajad Ali:- Search for unobserved transitions and assignment of Multipolarity of different transitions: Investigation of level structures of ^{142}Eu (Asimananda Goswami, NPD)
13. Abhishek Rakshit:- Electron Energy Loss Spectroscopy of Magnetic Materials (Biswarup Satpati, SPMSD)

14. Jhuma Ghosh:- Charmonium Production as a function of rapidity and transverse momentum in pp and PbPb collisions (Sukalyan Chattopadhyay, HENPPD)
15. Wadut Shaikh:- Production yields of bottomonium states in pp and Pb-Pb collisions at LHC energies (Sukalyan Chattopadhyay, HENPPD)
16. Prasant Kumar Rout:- Particle Tracking In The Context Of CMS Experiment (Supratik Mukhopadhyay, ANPD)
17. Subhankar Roy:- Magnetothermal transports of 3D Dirac semimetal Cd3As2 (Prabhat Mandal,CMPD)
18. Moumita Das:- Giant magnetocaloric effect of rare earth orthoferrite GdFeO3 (Prabhat Mandal,CMPD)
19. Apurba Dutta:- Preparation and Characterization of MnPt Thin Film (Indranil Das, CMPD)
20. Snehal Mandal:- Deposition of thin film using magnetron sputtering and characterization using X-ray (Indranil Das, CMPD)
21. Arpita Das:- Slow Light in atomic medium & design of magneto-optical trap (Sankar De, ANPD)
22. Sridhar Tripathy:- Basic and Advanced aspects of Muon Tomgraphy (Nayana Majumdar, ANPD)
23. Bibhuti Bhusan Jena:- Antiferromagnetic/Antiferromagnetic coupling (Krishnakumar S R Menon, SPMSD)
24. Debabrata Bhowmik:- (Satyaki Bhattacharya, HENPPD)

Avik Banerjee in PMSC (Physics) was the recipient of: Best performance award in PMSc (Physics) and Prof. A. P. Patra Memorial Prize in PMSc (Physics) for the session 2015-2016.

Bio-physical Sciences courses

Compulsory Courses in the First Trimester (Aug – Nov 2016)

1. Biochemistry and Cell Biology (BCB) (40 lectures by Abhijit Chakrabarti, Oishee Chakrabarti, Subrata Banerjee, Chandrima Das, Kaushik Sengupta and Partha Saha)
2. Chemical Biology and Biophysics (CBB) (40 lectures by Montu Hazra, Padmaja Mishra and Sangram Bagh).
3. Spectroscopy and Nanoscience (SPN) (20 lectures by Samita Basu and Dulal Senapati)
4. Computer Programming & Bioinformatics (CPB) (40 lectures by Gautam Garai and Dhananjay Bhattacharyya)
5. Macromolecular Structure (MMS) (40 lectures by Rahul Banerjee, Dhananjay Bhattacharyya, Udayaditya Sen, Sampa Biswas, H Raghuraman, Kaushik Sengupta)
6. Radiochemistry & Radiation Physics (RRP) (20 lectures by Susanta Lahiri and Maitreyee Nandi)

Research Methodology (Compulsory)

i. Biochemical and Molecular Biology Techniques (BMBT) (by Debashis Mukhopadhyay, Partha Saha)

ii. Spectroscopy, Imaging and Crystallography Techniques (SICT) (by Padmaja Mishra, Montu Hazra, Dulal Senapati, Kaushik Sengupta and H Raghuraman)

iii. Good Laboratory Practices, Radiological safety (Radiation Protection Standards, Principles of Monitoring and Protection), Ethics of scientific research, writing of scientific articles and project proposals.

iv. Research colloquium: During the first two weeks of the course work, presentation on scientific research work carried out in the laboratories where students have opportunity to join for their doctoral work will be made by the respective faculty. Purpose of the colloquiums is to provide an overview of research activities at the Institute in the relevant subject area to the new students.

Advanced Courses (December 2016 – July 2017)

Each course consists of 20 lecture hours. Each student has to opt for 4 courses in total

1. Topics in Cell Biology - I (Kaushik Sengupta, Oishee Chakrabarti and Partha Saha)
2. Topics in Cell Biology – II (Chandrima Das and Subrata Banerjee)
3. Membrane Biophysics and Structural Dynamics of Membrane Proteins (H. Raghuraman)
4. Chromatography and Mass Spectrometry (Soumen Kanti Manna)
5. Synthetic Biology: 21st Century Biological Engineering (Sangram Bagh)
6. Macromolecular Crystallography (Udayaditya Sen and Sampa Biswas)
7. Advanced Spectroscopy and imaging (Samita Basu, Padmaja Mishra and Montu Hazra)
8. Drug Discovery: Modern Day Approach (Munna Sarkar)

9. Multi Scale Modeling (Dhananjay Bhattacharyya)
10. C programming language and its application in Bioinformatics (Gautam Garai)

Review/Project work (December 2016 – July 2017)

Each student has to do a literature review and laboratory work on a particular research topic under the supervision of a faculty in addition to their advance courses.

Review works (Biophysical sciences) for 2015 – 16 batch

1. Dibyashree Chowdhury, TDCR (Triple to Double Coincidence Ratio) - an excellent tool for low level analysis (Susanta Lahiri)
2. 2.Kathakali Sarkar, Synthetic gene circuits in therapeutics: Towards the making of biochemical digital decoder in Escherichia coli (Sangram Bagh)
3. Kaushik Chanda, Targeting RTK Signaling Pathways in Neurodegeneration (Debashis Mukhopadhyay)
4. Payel Mondal, Regulation of gene expression by transcription factor 19 (TCF19) in association with tumour suppressor proteins during glucose metabolism (Chandrima Das)
5. Rajdeep Das, Dynamics of ER-Mitochondrial junctions (Oishee Chakrabarti)
6. Samrat Basak, DNA-Protein interactions and beyond: A single molecule Biophysical approach (Padmaja P. Mishra)
7. Sandip Kumar De, Synthesis of different shaped gold nanoparticles and their electrocatalytic study in different redox reactions and as a SERS substrate to detect fungicides/pesticides (Dulal Senapati)
8. Satyabrata Maiti, Hybrid coarse grain analysis and simulation of nucleic acid double helices (Dhananjay Bhattacharyya)
9. Sauvik Sarkar, Cross talk between membrane lipids and the skeletal proteins (Abhijit Chakrabarti)
10. Sayak Mukhopadhyay, Synthetic genetic devices for space missions (Sangram Bagh)
11. Sweta Singh, Immune evasion by Human Herpes Viruses (Subrata Banerjee)
12. Suparna Saha, Neuromyelitis Optica (Debashis Mukhopadhyay)
13. Tanushree Chakraborty, Organelle-specific changes in metabolome associated with cancer (Soumen Manna)
14. Tulika Chakraborty, Structure of the transcription factor vpsR implicated in biofilm formation and its regulation by the second messenger c-di-GMP in Vibrio cholera (Udayaditya Sen).

13.2. Library

Library is the hub for every educational sector. In research and development organisation, library is the resource centre for information, knowledge management and dissemination of information and knowledge. The SINP Library is also one of the major information resource centres within Eastern India in the field of Physical and Biophysical Sciences. It is our privilege to support the institutes march towards its vision- to be the pioneer research institute in India. Through our well equipped and digitised library, the members of our

institution and the other members associated with our research and development program are being benefited and this will assist towards scientific development of our institute and our country at large. The Library not only acquires, organizes and disseminates knowledge; it has put its foot ahead towards policies and procedures, systems and services. The details of our library are given below.

13.2.1. Collections

Library has a huge collection of books, e-books and non-book materials. The details are given below:

- **Technical Books Accessioned:** 31980 (62 added in this year)
- **Non-Technical Books Accessioned:** E4315 (94 added in this year)
- **E- Books available:** 2929
- **Bound volumes of Journals Accessioned:** P51974
- **Current subscribed Journals:** 220 (Foreign)
- **Total no. of Online Journals including current subscription:** 3012 (Volume added from 2004 – 2012 of 8 Nature titles in this year)
- **Number of CD/DVD Rom Accessioned:** C1205 (total 26 CD added)
- **Theses accessioned:** T315 (26 added in this year)

13.2.2. Membership

In addition to our 609 institute members (faculties, research fellows and non academic), library has the privilege to serve more than six hundred (605) external users coming from different scientific and educational institutes of Eastern India. The external users includes; Calcutta University, Jadavpur University, Viswa Bharati, IACS, IICB, ISI, Bengal Engineering and Science University, WBUT, CMERI, Guwahati University, North-Eastern Hill University, Patna University etc. apart from numerous Under-Graduate/Post-Graduate colleges and project students.

13.2.3. Library Services

1. Borrowing of books and other documents.
2. Prints and Xerox of documents request by our students and faculties.
3. Prints all posters requested by our students and faculties for participating in conference/workshops.
4. Inter Library Loan request by our students and faculties.
5. Online access to more than three thousand journals.

13.2.4. Publications in Books/Monographs/Edited Volumes

Manlunching

1. Manlunching 2017, 'Information Needs of Bioinformatics Researchers' in Shri Ram, (ed), *Library and Information Services for Bioinformatics Education and Research*, pp.34-44. IGI Global Publisher, Hershey, PA.

Publications in Journals

Samit De

1. De, Samit (2016). Comparative research trends among five research institute, Kolkata. *International Journal of Information Dissemination and Technology*, 6(3), pp.216-233.

Publication in Conference proceedings

1. De, Samit (2016), A Study of Scientific Co-operation among SAARC Nations, *Proceedings of TIFR-BOSLA National Conference on Future Librarianship Innovation for Excellence*, pp.332-339.
2. De, Samit (2017), A Comparative Research Performance Study among Some R&D Institutes under Department of Atomic Energy, *Proceedings of National Conference on Library Innovations for Excellence (LIFE 2017).*

13.3. Crisis Management Section

Safety Awareness Programme conducted by Crisis Management Committee

Crisis Management Section under the supervision of Crisis Management Committee looks after the safety aspects of different activities carried out. This includes regular surveillance of fire safety, radiation safety and safety against biological hazards. Staff members are advised about safety against chemical hazard, electrical and mechanical accidents.

Safety Awareness Programme

The Committee has organized a Safety Awareness Programme on November 11, 2016, at Saha Institute of Nuclear Physics. The technical program comprised of five lectures on Electrical, Radiation, Fire Safety and Occupational health hazard. Demonstration of handling electrical and fire safety equipment and of handling accidents was carried out.

A Two day Fire Safety Awareness Programme was organized by the Crisis Management Committee on March 16-17, 2017. The programme was conducted by West Bengal Fire & Emergency Services Department. Handling of different types of fire, emergency measures to be taken, several fire accidents in the state were discussed. A mock fire drill was conducted with some participating members.

14. Miscellany

14.1. Cosmetics Committee

Swatch Bharat Mission conducted by Cosmetics Committee

14.2. Women Cell

The Women Cell and CARE jointly organized a seminar on "Gender Sensitization: Issues at workplace". The lecture was deliverd by Dr. Chama Mukherjee, Advocate of the Calcutta High Court on November 18, 2016.

Director, SINP felicitating Dr. Chama Mukherjee

In the seminar, Dr. Mukherjee explains the growing need of spreading awareness on the "Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013". Staffs of SINP, irrespective of their gender, had attended the seminar.

15. Administration

15.1. Governing Council

Chairman:

Dr Sekhar Basu

Chairman, Atomic Energy Commission &
Secretary to the Government of India
Department of Atomic Energy

Members:

Shri Ajay Sule
Joint Secretary (R&D)
Government of India
Department of Atomic Energy

Joint Secretary (Finance)
Government of India
Department of Atomic Energy

Prof Sudhakar Panda
Director, Institute of Physics
Bhubaneswar

Prof Mustansir Barma
TIFR Centre for
Interdisciplinary Science
Hyderabad

Prof Amitava Raychaudhuri
Palit Professor of Physics
University of Calcutta

Prof NR Das
University of Calcutta

Prof Dilip Kumar Maity
University of Calcutta

Principal Secretary
Higher Education Department
Government of West Bengal

Prof Ajit Kumar Mohanty
Director
Saha Institute of Nuclear Physics
Kolkata

15.2. Members of the Institute [As on March 31, 2017]

Prof. Ajit Kumar Mohanty: Director

DIRECTOR'S OFFICE

1. Sri Jeevan Shaw: A.A.O.(D.O.)
2. Sri Subhasish Ghoshal: Superintendent
3. Sri Manoj Biswas: Lower Division Clerk
4. Sri Ramesh Hari: Helper 'D'
5. Sri Subodh Kr. Pradhan: Bearer-I

REGISTRAR'S OFFICE

1. Sri Anirban Banerjee: Registrar
2. Smt. Chandana Basu: A.A.O.
3. Sri Bimlesh Kr. Tripathi: Senior Hindi Translator
4. Shri Bibekbijay Bandyopadhyay: Superintendent
5. Sri Abhijit Betal: Scientific Assistant-E
6. Sri Rudal Prasad Ram: Technician 'F'
7. Sri Gobinda Ch. Das: Helper 'D' (Sweeper)

Academic Departments and Divisions

ASTROPARTICLE PHYSICS & COSMOLOGY (APC)

1. Prof. Debades Bandyopadhyay: Sr. Professor 'H+ & HOD
2. Prof. Pijushpani Bhattacharjee Sr. Professor 'H+'
3. Prof. Debasish Majumdar: Professor 'G'
4. Prof. Ambar Ghosal: Professor 'G'
5. Prof. Mala Das: Associate Professor 'F'
6. Prof. Pratik Majumder: Associate Professor 'E'
7. Shri Nilanjan Biswas: Scientific Assistant 'C'
8. Sri Bijay Kr. Das: Superintendent

THEORY DIVISION

1. Prof. Palash Baran Pal: Sr. Professor 'H+'
2. Prof. Gautam Bhattacharyya: Sr. Professor 'H+'
3. Prof. Shibaji Roy: Sr. Professor 'H+'
4. Prof. Munshi Golam Mustafa: Sr. Professor 'H+'
5. Prof. Kumar Sankar Gupta: Sr. Professor 'H+'
6. Prof. Asit Kr. De: Sr. Professor 'H' & HOD
7. Prof. Bijay Kr. Agrawal: Sr. Professor 'H'
8. Prof. Bireswar Basu Mallick: Sr. Professor 'H'
9. Prof. Prakash Mathews Professor 'G'
10. Prof. Amit Ghosh: Professor 'G'
11. Prof. Harvendra Singh: Professor 'G'
12. Prof. Koushik Dutta: Associate Professor 'E'
13. Prof. Arnab Kundu: Associate Professor 'E'
14. Smt. Sangita Pande: Scientific Assistant 'C'
15. Sri Prodyut Kr. Mitra: Technician 'G'
16. Sri Sudarshan Hazra: Technician 'B'
17. Sm. Dola Mallick: A.A.O.
18. Sri Arun Kr. Bose: Caretaker

PLASMA PHYSICS DIVISION

1. Prof. Mylavarapu Sita Janaki: Sr. Professor 'H' & HOD
2. Prof. Nikhil Chakraborty: Professor 'G'
3. Sri Shantanu Chowdhury: Engineer 'G'
4. Sri Subhasis Basu: Scientific Officer 'D'
5. Sri Monobir Chattopadhyay: Scientific Officer 'D'
6. Sri Dipankar Das: Technician 'F'
7. Sri Ashok Kr. Ram: Helper 'C'

SURFACE PHYSICS AND MATERIAL SCIENCE DIVISION

1. Prof. Alokmay Datta: Sr. Professor 'H+'
2. Prof. S. R. Bhattacharyya: Sr. Professor 'H' & HOD
3. Prof. Sangam Banerjee: Professor 'G'
4. Prof. Manabendra Mukherjee: Professor 'G'
5. Prof. Tapas Kr. Chini: Professor 'G'
6. Prof. Satyajit Hazra: Professor 'G'
7. Prof. Krishnakumar S.R. Menon: Professor 'G'
8. Prof. Supratic Chakraborty: Associate Professor 'F'
9. Prof. Madhusudan Roy: Associate Professor 'F'
10. Prof. Satyaban Bhunia: Professor 'F'
11. Dr. Biswarup Satpati: Scientist 'F'
12. Prof. Mrinmay Kr. Mukhopadhyay: Associate Professor 'E'
13. Sri Avijit Das: Scientific Officer 'D'
14. Sri Subir Roy: Scientific Officer 'D'
15. Sri Susanta Banerjee: Scientific Officer 'D'
16. Sri Souvik Banerjee: Scientific Assistant-D
17. Sri Goutam Sarkar: Scientific Assistant-D
18. Shri Debraj Dey: Scientific Assistant 'C'
19. Sri Ramkrishna Deb Das: Scientific Assistant 'B'
20. Sri Mukul Ch. Das: A.A.O.
21. Sri Syama Prasad Mallik: Technician 'G'
22. Sri Provash Halder: Helper 'E'
23. Sri Gobardhan Jana: Helper 'C'

APPLIED ELECTRONICS SECTION (AES)

1. Sri Abhijit Sanyal: Engineer 'G', HOD
2. Sri Dwijendra Das: Scientific Assistant-D
3. Sri Singh Bahadur Thapa: Helper 'C'

APPLIED NUCLEAR PHYSICS DIVISION

1. Prof. Satyajit Saha: Sr. Professor 'H+' & HOD
2. Prof. Supratik Mukhopadhyay: Sr. Professor 'H'
3. Prof. P. M. G. Nambissan: Sr. Professor 'H'
4. Prof. Chandi Charan Dey: Professor 'G'
5. Prof. (Sm.) Nayana Majumdar: Professor 'G'
6. Prof. Sandip Sarkar: Professor 'G'
7. Prof. Sankar De: Associate Professor 'E'
8. Sri Pradipta Kumar Das: Scientific Officer 'D'
9. Sri Shaibal Saha: Scientific Officer 'D'
10. Sri Haradhan Dhar: Scientific Assistant-F
11. Sri Chandra Nath Marik: Scientific Assistant-D
12. Smt. Soma Roy: Scientific Assistant-D
13. Smt. Suparna Das: Superintendent
14. Sri Dilip Kr. Sardar: Technician 'D'
15. Sri Kuntal Sarkhel: Helper 'C'
16. Sri Prabir Das: Helper 'C

NUCLEAR PHYSICS DIVISION

1. Prof. Maitreyee Saha Sarkar: Sr. Professor 'H' & HOD
2. Prof. Ashimananda Goswami: Sr. Professor 'H'
3. Prof. Subinit Roy: Sr. Professor 'H'
4. Prof. (Smt.) Anjali Mukherjee : Professor 'G'
5. Prof. Ushasi Datta: Professor 'G'
6. Prof. Chinmay Basu: Professor 'F'
7. Sri Sujib Ch. Chattopadhyay: Scientific Officer 'D'
8. Sri Kaushik Chatterjee: Scientific Officer 'D'
9. Smt. Jonaki Panja: Scientific Officer 'D'
10. Sri Ajoy Kr. Mitra: Scientific Officer 'D'
11. Smt. Tultul Dutta: Superintendent
12. Sri Pradip Barua: Technician 'D'
13. Sri Shankar Prasad Singh: Technician 'D'
14. Sri Siladitya Chakraborty: Helper 'C'

HIGH ENERGY NUCLEAR AND PARTICLE PHYSICS DIVISION

1. Prof. Sukalyan Chattopadhyay: "Sr. Professor 'H+' & HOD & Chairman, Housing Allotment Committee"
2. Prof. Pradip Kr. Roy: Professor 'G'
3. Prof. Manoj K. Sharan: Professor 'G'
4. Prof. Satyaki Bhattacharya: Professor 'G'
5. Dr. (Smt.) Tinku Sinha: Scientist 'F'
6. Prof. Subir Sarkar: Associate Professor 'F'
7. Prof. Suchandra Dutta: Associate Professor 'F'
8. Prof. Debasish Das: Associate Professor 'E'
9. Sri Arindam Das: Engineer 'D'
10. Sri Dipankar Das: Scientific Assistant-D
11. Smt. Lipy Das Bose: Scientific Assistant-D
12. Sri Sanjib Kr. Mondal: Superintendent
13. Sri Rakesh Kr. Ram: Helper 'C'
14. Sri Sudam Bagdi: Helper 'C'

CONDENSED MATTER PHYSICS DIVISION

1. Prof. Bikas Kanta Chakrabarti: Sr. Professor 'I'
2. Prof. Sudhakar Yarlagadda: Sr. Professor 'H' & HOD
3. Prof. Prabhat Kr. Mandal: Sr. Professor 'H'
4. Prof. Indranil Das: Sr. Professor 'H'
5. Prof. Asok Poddar: Professor 'G'
6. Prof. Bilwadal Bandyopadhyay: Professor 'G'
7. Prof. Chandan Mazumdar: Professor 'G'
8. Prof. Pradeep Kr. Mohanty: Professor 'G'
9. Prof. Abhik Basu: Professor 'G'
10. Prof. Barnana Pal: Professor 'F'
11. Prof. Arti Garg: Associate Professor 'F'
12. Prof. Biswajit Karmakar: Associate Professor 'E'
13. Prof. Kalpataru Pradhan: Associate Professor 'E'
14. Smt. Sankari Chakrabarti: Scientific Assistant-D
15. Sri Arindam Chakraborti: Scientific Assistant-D
16. Smt. Papia Mondal: Scientific Assistant-D
17. Sri Dhrubajyoti Seth: Scientific Assistant-D
18. Sri Kausik Das: Scientific Assistant-D
19. Sri Nilkamal Barai: Scientific Assistant 'B'
20. Sri Tapan Kr. Sarkar: Superintendent
21. Sri Arun Kumar Paul: Technician 'J'
22. Sri Anish Karmahapatra: Technician 'G'
23. Sri Prabir Das: Technician 'C'
24. Sri Jhantu Mallick: Helper 'C'
25. Shri Rajeshwar Dubey: Helper 'A'

CRYSTALLOGRAPHY & MOLECULAR BIOLOGY DIVISION

1. Prof. Abhijit Chakrabarti: Sr. Professor 'H+' & HOD
2. Prof. Rahul Banerjee: Professor 'G'
3. Prof. Sampa Biswas: Professor 'G'
4. Prof. Partha Saha: Professor 'G'
5. Prof. Udayaditya Sen: Professor 'G'
6. Prof. H.Raghuraman: Associate Professor 'E'
7. Sri Utpal Basu: Scientific Officer 'C'
8. Sri Abhijit Bhattacharya: Scientific Assistant-E
9. Sri Bikram Nath: Scientific Assistant-D
10. Sri Sushanta Debnath: Scientific Assistant-D
11. Sri Saikat Mukherjee: Scientific Assistant-D
12. Sri Ashis Kumar Dutta: Scientific Assistant-D
13. Smt. Durga Hazra: Superintendent
14. Sri Samir Kr. Majumdar: Technician 'D'
15. Sri Sakal Dev Ram: Helper 'C'
16. Sri Bipin Bose: Helper 'C'

BIOPHYSICS AND STRUCTURAL GENOMICS DIVISION

1. Prof. Subrata Banerjee: Sr. Professor 'H' & HOD
2. Prof. Debashis Mukhopadhyay: Professor 'G'
3. Prof. (Smt.) Oishee Chakrabarti: Associate Professor 'F'
4. Prof. Kaushik Sengupta: Associate Professor 'F'
5. Prof. Chandrima Das: Associate Professor 'E'
6. Prof. Soumen Kanti Manna: Associate Professor 'E'
7. Prof. Sangram Bagh: Associate Professor 'E'

8. Sri Arijit Pal: Scientific Assistant-E
9. Smt. Mahuya Dutta: Lower Division Clerk
10. Sri Nirmal Das: Technician 'C'
11. Sri Raju Dutta: Technician 'C'
12. Sri Sanjay Shaw: Helper 'C'
13. Sri Shyamal Ch. Digar: Helper 'C'
14. Shri Madhu Sudan Samal: Asstt. Halwai-cum-Cook

CHEMICAL SCIENCES DIVISION

1. Prof. Samita Basu: Sr. Professor 'H+' & HOD
2. Prof. Susanta Lahiri: Sr. Professor 'H+'
3. Prof. Amitabha De: Sr. Professor 'H'
4. Prof. Maitreyee Nandy: Professor 'G'
5. Prof. Munna Sarkar: Professor 'G'
6. Prof. Padmaja Prasad Mishra: Associate Professor 'E'
7. Prof. Montu K. Hazra: Associate Professor 'E'
8. Prof. Dulal Senapati: Associate Professor 'E'
9. Sri Ajay Das: Scientific Assistant-F
10. Smt. Chitra Raha: Scientific Assistant-E
11. Sri Avijit Shome: Scientific Assistant-D
12. Sri Subir Bandyopadhyay: Superintendent
13. Sri Bablu Ram: Technician 'F'
14. Sri Deepak Kr. Ram: Technician 'B'
15. Sri Jitendra Nath Roy: Technician 'B'

COMPUTATIONAL SCIENCES DIVISION

1. Prof. Dhananjay Bhattacharyya: Sr. Professor 'H' & HOD
2. Dr. Gautam Garai: Scientist 'G'
3. Sri Deeptish Dey: Engineer 'F'
4. Sri Gautam Datta: Scientific Assistant-F
5. Sri Sumit Basu: Scientific Assistant-D
6. Sri Subhendu Biswas: Scientific Assistant-B
7. Sri Nanda Lal Sanpui: Technician 'D'
8. Sri Soumya Majumdar: Technician 'D'

Central Facilities

CENTRE FOR ADVANCED RESEARCH & EDUCATION

1. Prof. Amit Ghosh: Professor 'G' & Head
2. Sri Suchintya Kumar Gupta: Officer-In-Charge
3. Sri Amit Kumar Saha: Scientific Officer 'D'
4. Sri Sushanta Chakraborty: Scientific Assistant-F
5. Sri Jayant Kr. Mukherjee: Scientific Assistant-D
6. Sri Pradip Das: Scientific Assistant-C
7. Sri Sudarshan Mondal: Superintendent
8. Sri Nirmal Ch. Biswas: Technician 'B'
9. Sri Sanjib Kr. Roy: Helper 'C'

ELECTRON MICROSCOPE

1. Sri Pulak Kumar Roy: Engineer 'G' & Head
2. Sri Ajoy Chakrabarty: Scientific Assistant-E
3. Sri M.Mahendar: Scientific Assistant 'B'

LIBRARY

1. Prof. Mylavarapu Sita Janaki: Chairperson
2. Sri Abhijit Kumar Malakar: Scientific Assistant-F
3. Sri Samit De: Scientific Assistant-F
4. Shri Mahesh Hembram: : Scientific Assistant 'C'
5. Dr. Manlunching: Scientific Assistant 'C'
6. Sri Manoj Karmakar: Technician 'D'
7. Sri Kishori Lal Ram: Technician 'D'
8. Sri Siblal Hari: Helper 'E' (Sweeper)
9. Sri Kartick Ch. Panigrahi: Helper 'C'

WORKSHOP

1. Prof. Sukalyan Chattopadhyay: Sr. Professor 'H+' & Chairman
2. Dr. Jisnu Basu: Engineer 'G' & Officer-In-Charge
3. Sri Ramen Jana: Technician 'H'
4. Sri Sadananda Dutta: Technician 'H'
5. Sri Sudipta Barman: Scientific Assistant 'E' (Fitter)
6. Sri Narayan Chandra Dey: Scientific Assistant-D (CNC Operator)
7. Sri Debasish Sen: Technician 'G'
8. Sri Supriya Mondal: Technician 'G'
9. Sri Biplab Kr. Dey: Technician 'G'
10. Sri Partha Sarathi Karmakar: Technician 'G' (Turner)
11. Sri Tarun Tapan Biswas: Technician 'G' (Fitter)
12. Sri Ramkrishna Roy: Technician 'G' (Machinist)
13. Sri Bhairab Ch. Nath: Technician 'F' (Mil. Fitter)
14. Sri Sunil Das: Technician 'F' (Mil. Fitter)
15. Sri Durlav Tudu: Technician 'F' (Turner)
16. Sri Subrata Baidya: Technician 'F' (Machinist)
17. Sri Sadip Patra: Technician 'F' (Welder)
18. Sri Himadri Chakraborty: Technician 'F' (Machinist)
19. Sri Subal Ch. Bindi: Technician 'D'
20. Shri C. Palanivel: Technician 'D' (Glass Blower)
21. Sri Adhir Sarkar: Technician 'D'
22. Sri Santosh Kr. Barman: Caretaker
23. Sri Deb Prasad Sardar: Caretaker
24. Sri Gopal Das: Helper 'C'

BUILDING MAINTENANCE (ELECTRICAL)

1. Sri Rajkumar Sengupta: Chairman, BM(Elec) Committee
2. Sri Soumendra Pal: Engineer 'D', Engineer -in-Charge
3. Sri Swapan Kr. Mandal: Scientific Assistant-E
4. Sri Somenath Ghosh: Scientific Assistant-E
5. Sri Kali Kanto Dey: Technician 'H'
6. Sri Madhusudan Kaity: Technician 'G'
7. Sri Asok Kr. Majumdar: Technician 'G'
8. Sri Gautam Kr. Sabui: Technician 'D'
9. Sri Pratap Dhanuk: Technician 'D'
10. Sri Dilip Kr. Chakraborty: Technician 'D'
11. Shri Jai Prakash Tiwari: Technician 'D'
12. Sri Jagannath Mondal: Technician 'D'
13. Sri Mahendra M. Khapekar: Technician 'F'
14. Sri Pintu Sahoo: Technician 'B'
15. Sri Bijay Ram: Helper 'D'
16. Sri Sankar Adhikari: Helper 'C'

BUILDING MAINTENANCE (CIVIL)

1. Sri Rajkumar Sengupta: "Engineer 'F' & Chairman,
2. BM(Civil) Committee"
3. Sri Siddhartha Saha: Engineer 'D'
4. Sri Arup Polley: Technician 'H'
5. Sri Nil Kanta Sinha: Scientific Assistant-E
6. Sri Gobinda Pal: Scientific Assistant-D
7. Shri Sujoy Halder: Scientific Assistant 'C'
8. Sri Subir Modak: Superintendent
9. Sri Sisir Kumar Mondal: Technician 'G' (Structural Draftsman)
10. Sri Sunil Murmu: Technician 'D'
11. Sri Samir Kr. Chakraborty: Caretaker
12. Sri Shyamal Kr. Bose: Helper 'E'

Administrative Departments

ESTABLISHMENT

1. Sri Suchintya Kumar Gupta: Establishment Officer
2. Shri Biplab Kumar Ray: A.A.O.(E-I)
3. Sri Biswajit Dutta: Accountant
4. Shri Subhendu Naskar: Lower Division Clerk
5. Smt. Paramita Pal: Lower Division Clerk
6. Shri Manoj Lakra: Lower Division Clerk
7. Mr. Rizwan Ahmed: Lower Division Clerk
8. Sri Subhash Ch. Gayen: Technician 'C'
9. Sri Nabin Kumar Halder: Technician 'C'

DESPATCH

1. Smt. Chandana Mitra: A.A.O.
2. Sri Tarak Nath Bhattacharya: Technician 'C'
3. Sri Gouri Sankar Singh: Driver - V
4. Shri Ramesh Singh: Helper 'C'

ACCOUNTS

1. Sri Niladri Sanyal: Dy. Controller of Accounts
2. Shri Ved Prakash Mishra: Accounts Officer
3. Sri Swarup Kr. Bose: A.O.(Accounts)
4. Sri Goutam Ghosh: Superintendent
5. Sri Avijit Saha: Superintendent
6. Sri Gobinda Ch. Roy: Upper Division Clerk
7. Shri Nand Kishor Gond: Lower Division Clerk
8. Shri Pourjok Majumder: Lower Division Clerk
9. Sri Mahadeb Das: Caretaker
10. Sri Biswanath Paul: Caretaker
11. Shri Sandip Hembrom: Helper 'B'
12. Sri Barun Kr. Barua: Bearer-II

ACCOUNTS (BUDGET & AUDIT)

1. Sri Somnath Sarkar: A.A.O.
2. Sri Pradip Dutta Sharma: Lower Division Clerk

ACCOUNTS (CASH)

1. Shri Raghunath Naskar: Superintendent
2. Smt. Seethalakshmi Rath: Superintendent
3. Sri Sanat Kumar Kotal: Technician 'C'

ACCOUNTS (SALARY)

1. Sri Debasish Das: A.A.O.
2. Sm. Nirupama Halder: Superintendent
3. Smt. Monika Bhattacharya: Lower Division Clerk
4. Shri Aditya Dhara: Lower Division Clerk

ACCOUNTS (PF)

1. Sri Goutam Mandal: Superintendent

ACCOUNTS (PF & PENSION)

1. Accounts (PF & Pension): Sri Ranjit Dutta
2. Accounts (PF & Pension): Sri Kalyan Paul Roy

PURCHASE

1. Smt. Seema Bhattacharyya: A.O.-III & Off.-In-Charge of Purchase Cell
2. Smt. Jhuma Rajak: Helper 'B'

Purchaser (Domestic)

1. Sri Gautam Das: Superintendent
2. Sri Ajoy Kumar Biswas: Superintendent, In-Charge Purchase (D)
3. Sri Asim Haldar: Superintendent
4. Ms. Rekha Ram: Upper Division Clerk
5. Sri Soumyajit Karmakar: Lower Division Clerk
6. Sri Ashoke Kr. Roy: Technician 'B'
7. Sri Asit Ranjan Deb: A.O.
8. Sri Ranjit Roy: Superintendent
9. Mr. James Wilson Kerketta: Lower Division Clerk
10. Sri Gour Hari Das: Caretaker

Purchase (Foreign Cell)

1. Sri Asit Ranjan Deb: A.O.
2. Sri Ranjit Roy: Superintendent
3. Mr. James Wilson Kerketta: Lower Division Clerk
4. Sri Gour Hari Das: Caretaker

STORES

1. Sri Shyamal Ch. Biswas: Superintendent
2. Sri Asish Ram: Helper 'C'

MEDICAL UNIT

1. Prof. Munshi Golam Mustafa: Chairperson, MAC
2. Dr. Sanghamitra Nag: Part Time Medical Officer
3. Dr. Pranab Kumar Mukherjee: Part Time Medical Officer
4. Sri Dipak Kr. Das: A.A.O.
5. Sri Sankar Nath Dewan: Sr. Superintendent
6. Sri Subhasish Sanyal: Superintendent
7. Smt. Chandana Nayak: Lower Division Clerk
8. Shri Avishek Pal: Lower Division Clerk
9. Shri Gopal Banik: Lower Division Clerk
10. Shri Pintu Ram: Helper 'C

GUEST HOUSE & HOSTEL

1. Prof. Sukalyan Chattopadhyay: Prof.-in-Charge, Guest House & Hostel, SINP Housing Com.(MSA-II)
2. Prof. Pradip Kr. Roy: Prof.-In-Charge, Guest House & Hostel, Salt Lake Campus (MSA-I)
3. Sri Somenath Das: Helper 'C'
4. Sri Suresh Ch. Das: Asstt. Halwai-cum-Cook
5. Sri Sakti Pada Bisui: Asstt. Halwai-cum-Cook

CANTEEN

1. Prof. Debashis Mukhopadhyay: Chairperson, Canteen Committee
2. Sri Asok Kumar Roy: Asstt. Manager-cum-Storekeeper
3. Sri Prabhat Maity: Halwai-cum-cook
4. Sri Kartick Ch. Maity: Asstt. Halwai-cum-Cook
5. Sri Sujan Ch. Mistri: Asstt. Halwai-cum-Cook
6. Shri Pradip Ram: Asstt. Halwai-cum-Cook
7. Sri Shankar Andia: Asstt. Halwai-cum-Cook
8. Sri Sailen Halder: Bearer-II
9. Sri Nemai Ch. Das: Bearer-II
10. Sri Amar Das: Bearer-II
11. Sri Sunil Ram : Bearer-II
12. Sri Santosh Hari: Helper 'C' (Sweeper)
13. Sri Kala Chand Hela: Helper 'C' (Sweeper)

TELEPHONE

1. Prof. (Smt.) Samita Basu: Prof. & In-Charge
2. Smt. Sunanda Chakraborty: Technician 'G'
3. Smt. Bithi Biswas: Technician 'G'
4. Smt. Pampa Bhattacharjee: Technician 'F'

SECURITY

1. Sri Supriya Gangopadhyay: Sr.Security Officer
2. Sri Ratan Kr. Bose: Security Officer
3. Sri Tapas Kr. Dalal: Security Officer
4. Sri Swaraj Nath Sarkar: Security Officer
5. Sri Ashok Kr. Singh: Security Officer
6. Sri Ganesh Prasad Sharma: Security Supervisor 'B'
7. Sri Tarak Chandra Nath: Security Supervisor 'B'
8. Sri Gobinda Chakraborty: A.A.O.
9. Sri Balli Rana: Technician 'C'
10. Sri Dukha Krishna Reddy: Technician 'B'
11. Sri Subrata Kr. Chowdhury: Technician 'B'
12. Sri Joyram Murmu: Helper 'E' (Watchman)
13. Sri Madhusudan Bhakta: Caretaker
14. Sri Sudhangsu Sekhar Mondal: Helper 'E' (Watchman)
15. Sri Mongol Oraon: Helper 'D' (Watchman)
16. Sri Sibu Oraon: Helper 'D' (Watchman)
17. Sri Tapan Kr. Singha: Helper 'D' (Watchman)
18. Md. Manayar Hasan Mondal: Technician 'B'
19. Sri Ranjit Kr. Roy: Helper 'D' (Watchman)
20. Sri Arun Kumar Dutta: Helper 'B' (Watchman)
21. Sri Pran Gopal Das: Helper 'C' (Watchman)
22. Sri Gopal Chandra Saren: Helper 'D' (Watchman)

CRISIS MANAGEMENT COMMITTEE

1. Sri Umesh Kumar Gond: Scientific Assistant 'B'

COSMETIC

1. Sri Sakhi Chand Hari: Caretaker
2. Smt. Anjali Hari: Helper 'D' (Sweeper)
3. Sri Ashok Mallick: Helper 'C'
4. Smt. Suro Mahato: Helper 'C'
5. Sri Amit Hari: Helper 'C'
6. Smt. Radha Debi Ram: Helper 'B'

GARDENER

1. Sri Sushil Kr. De: Caretaker
2. Sri Santosh Kr. Sarkar: Caretaker
3. Sri Swapan Kr. Mondal: Caretaker
4. Sk. Mostakin: Helper 'C'

TRANSPORT

1. Sri Shantanu Chowdhury: Chairman, Transport Committee
2. Sri Kaushik Chatterjee: Officer-in-Charge, Transport Sec.
3. Sri Dharmendra Prasad: Scientific Assistant-D
4. Sri Aloke Kr. Sarkar: Transport Supervisor
5. Sri Swapan Kumar Mondal: Technician 'H'
6. Sri Trinath Maharana: Technician 'G'(Vehi.Mech.)
7. Sri Surai Mandi: Technician 'D' (Vehi.Mech.)
8. Sri Kanai Lal Malakar: Technician 'D'
9. Sri Madhusudan Mondal: Driver - IV
10. Sri Gopal Ch. Ghosh: Driver - V
11. Sri Prabir Kr. Mistri: Driver - V
12. Sri Kartick Ch. Pal: Driver - V
13. Sri Prabir Biswas: Driver - III
14. Sri Uttam Kr. Roy: Driver - III
15. Sri Asit Kr. Mahapatra: Technician 'C'
16. Sri Mongol Ch. Mondal: Caretaker
17. Sri Shankar Ram: Helper: 'C'

List of Retirement: April 2016 - March 2017

1. Sri Asok Kr. Das / BM(C) 3.4.6
2. Sri Tapan Kr. Pyne / CMP 3.5.6
3. Sri Sanjoy Chakraborty / Adm 3.7.6
4. Sri Dulal Chatterjee / Adm 3.8.6
5. Prof. (Smt.) Bichitra Ganguly / ANP 3.8.6
6. Prof. Partha Sarathi Mitra / Theory 3.9.6
7. Smt. Rita Ghosh / NPD 3..6
8. Prof. A. Harindranath / Theory 3..6
9. Sri Dilip Ram / BM (E) 3..6
10. Sri Alok Mitra / Adm 3..7
11. Sri Debashis Bandyopadhyay / AES 3..7
12. Prof. R. Ranganathan / CMP 8..7
13. Sri Sakhi Chand Hari / BM(C) 3.3.7

LIST OF DEMISE: April 2016 – March 2017

1. Sri Sekhar Bhattacharya / B&SG "Demise on 14.8.2016"
2. Prof. Anjan Kundu / Theory "Demise on 31.12.2016"

Obituary

Our colleague **Prof. Anjan Kundu** has passed away on 31st December 2016. A mathematical physicist who specialized in classical and quantum integrable systems, he is well known for the Kundu, Kundu–Eckhaus and Radhakrishnan–Kundu–Lakshmanan equations. Prof. Kundu worked with integrable nonlinear systems with a tremendous zeal ranging from a new quantum algebra, new integrable higher dimensional nonlinear Schrodinger equation, new braided Yang-Baxter equation, new integrable models in presence of defects, the list of "new" is very long... all of which have innovative applications to physical contexts. Even during the days of critical illness, he worked with an intense desire to invent even more. His last work accepted for publication on January 3, 2017 is an epitome of his passion " to contribute theoretical ideas that can address the control of devastating events like tsunami.

Prof. Kundu was elected to fellowship of the Indian National Science Academy (2014) and the Indian Academy of Sciences, Bangalore (2015). He was acting as a member of the editorial board of the Proceedings of the Royal Society of London since 2012.

We, the members of Saha Institute of Nuclear Physics are deeply saddened by his demise.

***

Sekhar Bhattacharyya worked for 33 long years in SINP before passing away on 14th August 2016, after a brief illness, just about a month before his superannuation. He was one of the most popular and smart scientific workers of the Institute. Sekhar was well known and loved by all. He could speak three languages English, Hindi and Bengali fluently and was a champion cricket player. His demise has been most untimely and unfortunate, however, like a true cricketer, missing the century only by one run, without completing his tenure at SINP.

15.3. Audited Accounts

15.3.1. Balance Sheet

SAHA INSTITUTE OF NUCLEAR PHYSICS

Balance Sheet as at 31st March, 2017

CAPITAL FUND & LIABILITIES	Schedule	2016-17	2015-16
CORPUS / CAPITAL FUND	1	387790058.56	184352025.63
RESERVE & SURPLUS	2		
EARMARKED FUNDS / ENDOWMENT FUNDS	3	5917372.00	6909446.00
SECURED LOANS & BORROWINGS	4		
UNSECURED LOANS & BORROWINGS	5		
DEFFERED CREDIT LIABILITIES	6		
CURRENT LIABILITIES AND PROVISIONS	7	2963681313.12	2475322021.59
TOTAL		3357388743.68	2666583493.22
ASSETS			
FIXED ASSETS			
Gross Block	8	4178299888.84	4107123110.91
Less : Accumulated Depreciation	8	2502123858.55	2319377171.23
		1676176030.29	1787745939.68
INVESTMENTS- FROM EARMARKED/ ENDOWMENT FUNDS	9		
INVESTMENTS- OTHERS	10	593000.00	3510000.00
CURRENT ASSETS, LOANS & ADVANCES	11	1055684023.07	875327553.54
EXCESS OF EXPENDITURE OVER INCOME		624935690.31	
TOTAL		3357388743.68	2666583493.22
SIGNIFICANT ACCOUNTING POLICES	24		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

The Schedules referred to above form part of these Accounts

(V. P. Mishra)
Accounts Officer

(N. Sanyal)
Dy. Controller of Accounts

(Anirban Banerjee)
Registrar

(Ajit Kumar Mohanty)
Director

In terms of our attached Report of even date
For K. Sharma & Co
Chartered Accountants
FRN 302045E

(K. Sharma)
Partner
Membership No. 005313
1/B, Old Post Office Street, Room No.8, (First Floor),
Kolkata - 700 001
Dated :-05th September, 2017

K. SHARMA & CO. KOLKATA-1 CHARTERED ACCOUNTANTS

15.3.2. Income & Expenditure Account

SAHA INSTITUTE OF NUCLEAR PHYSICS

Income & Expenditure Account for the year ended 31st March, 2017

	Schedule	2016-17	2015-16
INCOME : -			
Income from Sales/Services	12	377600.00	642897.00
Grants	13	1005597579.37	883584669.27
Fees / Subscriptions	14		
Income from Investments	15		
Income from Royalty, Publication	16		
Interest Earned	17	5811907.00	3758762.12
Other Income	18	5460529.32	4586786.83
Increase / Decrease in stock of finished goods and works-in-progress	19		
Excess of Expenditure over Income transferred to Balance Sheet		624935690.31	708452967.77
		1642183306.00	1601026082.99
EXPENDITURE : -			
Establishment Expenses	20	1193448756.00	1164789486.60
Other Administrative Expenses	21	265676308.59	233272243.29
Expenditure on Grants, Subsidies	22		
Interest	23	19774.10	28630.00
Depreciation	8	183038467.31	202935723.10
		1642183306.00	1601026082.99

The Schedules referred to above form part of these Accounts

(V. P. Mishra)
Accounts Officer

(N. Sanyal)
Dy. Controller of Accounts

(Anirban Banerjee)
Registrar

(Ajit Kumar Mohanty)
Director

In terms of our attached Report of even date
For K. Sharma & Co
Chartered Accountants
FRN 302045E

(K. K. Sharma)
Partner
Membership No. 005313
1/B, Old Post Office Street, Room No.8, (First Floor),
Kolkata - 700 001
Dated :-05th September, 2017

K. SHARMA & CO. KOLKATA-1 CHARTERED ACCOUNTANTS

SAHA INSTITUTE OF NUCLEAR PHYSICS

Receipts & Payments Account for the year ended 31st March, 2017

Receipts	2015-16	2016-17	Payments	2015-16	2016-17
Opening Balance b/f :-					
Cash in hand	54,196.00	16,82,322.00	Establishment Expenses	64,63,64,724.60	68,19,74,527.00
Current Account Balances	93,31,16,961.18	49,31,23,982.18	Administrative Expenses	22,97,08,845.29	26,30,15,206.59
			Bank Charges	28,630.00	19,774.10
Grant-in-aid received from DAE :-			Assets	7,79,74,871.23	7,11,76,777.93
Recurring	80,00,00,000.00	88,51,08,000.00	Expenses paid for ongoing projects of other agencies	70,37,87,800.38	4,21,04,617.17
Non-Recurring	35,00,00,000.00	30,00,00,000.00	HBA & Other Advances paid	11,28,190.00	9,35,807.00
Grant received from other agencies			Margin Money deposit	3,57,93,800.00	23,62,54,172.00
for on going projects	3,16,59,775.88	2,78,62,450.81	Other Deposit	1,01,78,000.00	6,65,08,000.00
HBA & Other Advance recovery	32,46,616.00	35,29,679.00	Advances paid	2,29,33,658.00	2,25,95,171.73
Realisation of Margin Money Deposit	5,07,49,300.00	10,33,84,216.00	Last Year's provision paid	42,45,658.00	39,70,346.00
Realisation from other Deposit	1,77,50,458.00	29,17,000.00	Last Year's current liabilities paid		
Realisation of other advances	2,26,93,172.00	2,06,18,629.73	Pension Fund Payments		
Interest Received	37,58,762.12	58,11,907.00	Closing Balance c/f :-		
Income Receipts	52,29,683.50	58,38,129.32	Cash in hand	16,82,322.00	90.00
Liabilities (Deposits)	86,91,557.00	1,35,63,445.00	Current Account Balances	49,31,23,982.18	47,48,85,271.52
Pension Fund Receipts					
	2,22,69,50,481.68	1,86,34,39,761.04		2,22,69,50,481.68	1,86,34,39,761.04

(V. P. Mishra)
Accounts Officer

(N. Sanyal)
Dy. Controller of Accounts

(Anirban Banerjee)
Registrar

(Ajit Kumar Mohanty)
Director

In terms of our attached Report of even date
For K. Sharma & Co
Chartered Accountants
FRN 302045E

(K. K. Sharma)
Partner
Membership No. 005313
1/B, Old Post Office Street, Room No.8, (First Floor),
Kolkata - 700 001
Dated :-05th September, 2017

K. SHARMA & CO. ★ CHARTERED ACCOUNTANTS ★ KOLKATA-1

List of Publications – Without Collaboration

(April 2016 – March 2017)

1. *Adhikari, S.*; *Basu, C.*; Sugathan, P.; et al. (*Mitra, A. K.*). 'Breakup effects on alpha spectroscopic factors of O-16', JOURNAL OF PHYSICS G-NUCLEAR AND PARTICLE PHYSICS 44 (2017) Art No: 015102
2. Adhikary, Biswajit; *Chakraborty, Mainak; Ghosal, Ambar*. 'Flavored leptogenesis with quasidegenerate neutrinos in a broken cyclic symmetric model', PHYSICAL REVIEW D 93 (2016) Art No: 113001
3. *Adhya, Souvik Priyam; Mandal, Mahatsab*; Biswas, Subhrajyoti; *Roy, Pradip K.* 'Pionic dispersion relations in the presence of a weak magnetic field', PHYSICAL REVIEW D 93 (2016) Art No: 074033
4. Ahmed, Taushif; Banerjee, Pulak; Dhani, Prasanna K.; et al. (*Mathews, Prakash).* 'Three loop form factors of a massive spin-2 particle with nonuniversal coupling', PHYSICAL REVIEW D 95 (2017) Art No: 034035
5. Ahmed, Taushif; Banerjee, Pulak; Dhani, Prasanna K.; et al. (*Mathews, Prakash*). 'NNLO QCD corrections to the Drell-Yan cross section in models of TeV-scale gravity', EUROPEAN PHYSICAL JOURNAL C 77 (2017) Art No: 22
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7. Ahmed, Taushif; Bonvini, Marco; Kumar, M. C.; *Mathews, Prakash*; et al. 'Pseudo-scalar Higgs boson production at $N^3LO_A+N^3LL'$', EUROPEAN PHYSICAL JOURNAL C 76 (2016) Art No: 663
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12. Bagchi, Arjun; *Basu, Rudranil*; Kakkar, Ashish; et al. Galilean Yang-Mills theory, JOURNAL OF HIGH ENERGY PHYSICS 4 (2016) Art No: 051
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14. Bandopadhyay, Manikankana; Sarkar, Neelakshi; (Datta, Sibnarayan; et al. (*Das, Chandrima*). 'Hepatitis B virus X protein mediated suppression of miRNA-122 expression enhances hepatoblastoma cell proliferation through cyclin G1-p53 axis', INFECTIOUS AGENTS AND CANCER 11(2016) Art No: 40

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