The Review Committee

for the science review of

Applied Nuclear Physics

High Energy Nuclear and Particle Physics

and

Nuclear Physics Divisions

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December 6-8, 2010

SAHA INSTITUTE OF NUCLEAR PHYSICS
I/AF Bidhannagar, Kolkata 700064, India.

APPLIED NUCLEAR PHYSICS DIVISION

APPLIED NUCLEAR PHYSICS DIVISION (ANPD):

Permanent members of the division:

Scientific		Technical		Adm / Auxiliary	
Sudeb Bhattacharya	Sr. Prof.	Amal Kumar Ghosal	SO	Nitish Chandra Sarkar	OIC.
Satyajit Saha	Prof.	Shaibal Saha	SO	Kuntal Sarkhel	Helper
Bichitra Nandi Ganguly	Prof.	Pradipta Kumar Das	SO	Prabir Das	Helper
Supratik Mukhopadhyay	Prof.	Haradhan Dhar	SA		
P.M.G. Nambissan	Prof.	Chandranath Marick	SA		
Mihir Baran Das	Scientist	Soma Roy	SA		
Chandi Charan Dey	Prof.	Dilip Kumar Sardar	Tech.		
Sandip Sarkar	Prof.				
Manoj Kumar Sharan	Prof.				
Nayana Majumdar	Prof.				

Ph. D. Students (2007 onwards):

Kuntal Ghosh, Shyamal Karmakar, Subhajit Karmakar, Debasmita Kanjilal, Ajanta Kundu, Purba Bhattacharya

Post Docs and visiting scientists (2007 onwards):

Nagendra Nath Mondal, Abhijit Samanta, Mala Das

Equipments and resources in the division:

1. Time Dependent Perturbed Angular Correlation (TDPAC) Spectrometer, consisting of four barium fluoride scintillation detectors for simultaneous acquisition of four spectra and equipped with sample temperature controller, adjustable between 193 ^{0}K and 1000 ^{0}K.
2. Lab made pulsed electron excitation set-up for atomic level life time measurement (being upgraded for pulsed laser excitation).
3. UV-VIS scanning monochromators with Peltier-cooled photomultipliers for single photon counting as well as two-photon coincidence measurements.
4. Variable energy (upto 110 kVp) desktop x-ray source with digital x-ray sensor.
5. Utrasonic array scanner (research grade).
6. Computer controlled 3D positioning system (25 micron precision).
7. Positron lifetime spectrometer with a prompt time resolution of 140 ps for Co-60 gamma rays.
8. Gamma-gamma coincidence set-up using HPGe detectors for Doppler broadening measurements.
9. Low temperature Leybold^{TM} refrigerator cryostat (300 ^{0}K to 20 ^{0}K).
10. Tensiometer with temperature controlled bath, Viscometer.
11. Cosmic muon test bench for characterizing resistive plate chamber (RPC) and other detectors, with large area plastic scintillators, indigenously made 4-component gas mixing system, related electronics and data acquisition system.
12. Blade server with seven computing blades (BL 460C based on Intel^{TM} Xeon E5506 & L5410 processors) and one storage blade (800 GB).
13. Four-component eight-channel gas mixing system and other accessories for work related to Micro-Pattern Gas Detectors (MPGD).
14. Small Time Projection Chamber.

APPLIED NUCLEAR PHYSICS DIVISION (ANPD):

Research Activities:

Using nuclear tools and techniques, the structure and dynamics of crystals, composites, nano-materials and soft condensed matter systems have been probed. Positron annihilation spectroscopic techniques have been employed to carry out studies on optical spectroscopy and photo chemistry of uranium in solution and liquid microemulsion system, studying the aggregation behaviour of the extractant, micelles/ reversed micelles, polymers etc. These studies are corroborated with complementary techniques such as light scattering, and photochemical methods. Study of positronium (Ps) pick-off annihilation in molecular substance including liquid systems, development of theoretical models, study of electron transfer reaction of Ps and spin conversion (electron spin exchange through paramagnetic ions) using inorganic solute ions in aqueous systems, and development of corresponding theoretical models are also carried out. Investigations of polymeric systems, multi porus materials, conducting polymers, radiation damage of polymers have also been done in the laboratory and the results are compared with gas absorption BET method. Study of some biologically important molecules, probing the biological importance of positron annihilation in medical diagnosis and usage of positron annihilation as a tool for surface studies have also been successfully conducted by the group. Positron annihilation spectroscopy was used for the studies of properties and processes related to defects in nano-materials including metals, alloys, ferrites and semiconductors. An interesting aspect of these studies has been to look for the effect of doping by other substitutional elements in a nanocrystalline system. Irradiation induced structural changes in metals, alloys and superconducting materials have been explored using the ion beams from the tandem Pelletron facility at TIFR, Mumbai and from the cyclotron at the Variable Energy Cyclotron Centre (VECC), Kolkata.

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 ultra fast BaF_2 detectors has been developed for the above purpose. Highlights of the research carried out in the TDPAC lab include chemical transformation of crystalline hafnium tetrafluoride and thin films of hafnium dioxide. Dehydration pathway of $HfF_4.3H_2O$ has been clearly established by this study. Thin films of HfO_2 produced by pulsed laser deposition at various partial oxygen pressures have been studied to determine the nuclear quadrupole interaction (NQI) and presence of any ferromagnetism in HfO_2 thin film. No indication of room-temperature ferromagnetism in HfO_2 thin film was found. This work has been carried out at Leipzig in collaboration with Prof. Dr. T. Butz of Leipzig University, Germany.

In the Atomic Physics and laser spectroscopy lab, design and development of the experimental setup for the measurement of lifetimes of excited atomic and molecular states using high frequency deflection technique with a delayed coincidence single photon counting arrangement and cascade-photon-coincidence technique was done. A large number of levels of some inert gases, both neutral and singly ionized, are investigated with the help of this apparatus. Some of the atomic levels investigated are: $2p^5nd$ (n=4,5) and $2p^5ns$ (n=5,6) configuration of NeI, $3p^44p$ and $3p^44d$ configuration of ArII, etc. A time resolved laser spectroscopy (TRLS) setup for radiative lifetime measurement using selective pulsed laser excitation and time resolved observation of the reemitted fluorescence is under development.

Using various types of charged particle, neutron, gamma ray and X-ray detectors studies in nuclear reactions and spectroscopy have been carried out. This includes exploration of nuclear structure of proton rich trans-lead, lanthanide and neutron rich nuclei near shell closure, using the large Clover detector array like Indian National Gamma Array (INGA). A facility for research in experimental Nuclear Astrophysics (FRENA) has been conceptualized for carrying out research work in experimental nuclear astro-physics around a low-energy (~300kV-3 MV) Tandetron accelerator. This has received funding by the Department of Atomic Energy and is presently in the stage of procurement and ancillary infrastructure build up.

Development of different types of gas based radiation detectors operating in ionization, proportional, avalanche and streamer modes; has been carried out. These detectors are used in various experiments involving gamma spectroscopy with charged particle tagging, exploring the nuclear dynamics of a few nucleon transfer reactions, fission and fusion reactions, and also for the detection of cosmic muons by RPC with an aim to develop indigenously built large area active detectors for a 50 kT iron calorimeter as planned for the India based

Neutrino Observatory (INO). Simulation work on avalanche propagation in wire grid based avalanche counters; simple phenomenological model based nuclear structure calculations to generate input to nuclear reaction codes are also carried out for interpretation of experimental findings.

Our members have successfully implemented the Boundary Element Method (BEM) to solve for potential and flux field in a non-dissipative system governed by Laplace's equation. The novelty of the solver lies with the formulation of the BEM following analytic integration of Green's function of the singularities uniformly distributed over a typical rectangular and/or triangular panel and its derivative. Owing to the analytic formulation, the solver can provide nominally exact results and thus has been termed as nearly exact BEM. 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. The neBEM has been optimized as a toolkit to be interfaced with an existing simulation software GARFIELD which performs a detailed simulation of the overall dynamics of a gaseous detector. This work has been performed as a part of RD51 collaboration launched by CERN to pursue a collective effort towards the development of MPGDs. Another solver, named Particle on Surface (PARSUR), for simulating the space charge evolution in gaseous detectors has been initiated using the fundamentals of neBEM formulation. The preliminary calculation for a simplistic model has produced promising results in comparison to the standard approach, namely particle-in-cell (PIC), used for simulating similar physical phenomena in several areas of science. Side by side, experimental efforts to study various physics issues in detector dynamics have been initiated with several developments taking place in a brief period of time. A set-up including gas handling system and test chamber has been completed. A time projection chamber (TPC) has also been procured for this purpose. The planning for the experiments is underway with the detectors.

We are also involved in the design of MANAS, a low noise ASIC readout chip for the ALICE relativistic heavy ion experiment at LHC in CERN. These chips are designed for the read out of Cathode Pad Chambers. About 100,000 MANAS chips are commissioned as front-end readout ASIC for the forward Muon Spectrometer of the ALICE experiment.

Work has also been initiated on the search for WIMPs as cold dark matter candidates. This has evolved from the in-house developmental work on superheated drop detector (SDD) for radiation detection and dosimetry. This is a collaborative work also involving members from the Astro-particle Physics and Cosmology division as part of PICASSO experiment stationed at the Sudbury Neutrino Observatory (SNOLAB), Canada. Recent activities include development of electret microphone based acoustic pulse detector to go with SDD for fast neutron spectroscopy, wide bandwidth acoustic pulse detection technique using commercially available MEMS based piezoelectric sensors, development of acquasonic gel-based SDD as an alternative to the current type of PICASSO SDD, exploration of gamma response using radioactive source, neutron gamma discrimination by pulse height analysis, and GEANT based simulation of the SDD response.

Studies on neutrinoless double beta decay using CdZnTe detectors have also been pursued. Major interest in this study is the exploration of the unconventional double positron decay mode which is relatively easy to detect without significant background contamination. In collaboration with IIT Kharagpur, members are involved in planning and setting up of double beta decay experiment. Initial study on contamination level of CdZnTe, procured from CEL, New Delhi, has been carried out.

In the computational aspects of simulation of vision, investigation of the center-surround model of low-level vision was carried out resulting in a proposed model. This model, which takes into account the recent physiological findings of retinal circuitry regarding “extra classical receptive field” and the presence of very narrow channels, is capable of retaining shading information, in the sense of *stochastic halftone process*, in the zero-crossing map. Contrary to the popular belief, this model, probably for the first time, suggest that several illusions like Simultaneous Brightness-Contrast, White Effect, Herman Grid, Todorovic Effect etc. could be explained by low-level computational model.

List of publications (2007 –date)

2010

1. *Experimental lifetimes of some levels belonging to the $4p^4 5p$ configuration of KrII using the cascade-photon-coincidence technique,* S. Karmakar and **M. B. Das**, *Euro. Phys. Jour D* **59** (2010) 361.

2. *Realistic three dimensional simulation on the performance of micromegas,* Purba Bhattacharya, **Supratik Mukhopadhyay, Nayana Majumdar, Sudeb Bhattacharya**, *Nucl. Instrum. Meth. in Phys. Res. A (in press) (2010) [doi: 10.1016/j.nima.2010.07.026].*

3. *Neutron-gamma discrimination by pulse analysis with superheated drop detector*; Mala Das, S. Seth, **S. Saha, S. Bhattacharya**, P. Bhattacharjee; *Nucl. Instrum. Meth. in Phys Res A (in press) (2010) [doi:10.1016/j.nima.2010.06.361].*

4. *High spin states and isomeric decays in doubly-odd ^{208}Fr,* D. Kanjilal, **S. Bhattacharya**, A.Goswami, R. Kshetri, R. Rout, **S. Saha**, R.K. Bhowmik, J. Gehlot, S. Muralithar, R.P. Singh, G. Jnaneswari, G. Mukherjee, B. Mukherjee, *Nucl. Phys. A* **842** *(2010) 1.*

5. *Study of timing properties of single gap high-resistive bakelite RPC,* S. Biswas, **S. Bhattacharya**, S. Bose, S. Chattopadhyay, **S. Saha**, Y.P. Viyogi, *Nucl. Instrum. Meth. in Phys. Res.* **A617** *(2010) 138.*

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6. *Some Physical Aspects of Positron Annihilation Tomography: a critical review*, **Bichitra Nandi Ganguly**, Nagendra Nath Mondal, Maitreyee Nandy, and Frank Roesch, *Journal of Radioanalytical and Nuclear Chemistry* **279** *(2009) 685.*

7. *Hydrogen bonded Supra Molecular Structure as studied by Positron Annihilation Spectroscopy*, **Bichitra Ganguly**, *Material Science Forum* **607** *(2009) 227.*

8. *Chemical transformation of crystalline hafnium tetrafluoride studied by perturbed angular correlation spectroscopy*, **C. C. Dey**, *Z. Naturforsch.* **64a** *(2009) 739.*

9. *3D field simulation in GEM-type structures***, N. Majumdar**, **S. Mukhopadhyay, S. Bhattacharya**, Journal of Instrumentation, **4** *(2009) P10013.*

10. *Electrostatics of Micromesh based Detectors*, **S. Mukhopadhyay, N. Majumdar, S. Bhattacharya,** Journal of Instrumentation, **4** *(2009) P11004.*

11. *3D electrostatic field simulation of a resistive plate chamber,* **N. Majumdar**, **S. Mukhopadhyay, S. Bhattacharya**, *Nucl. Instrum. Meth. in Phys Res* ***A*** **602** *(2009) 719.*

12. *Cluster dynamics in RPCs – A 3D electrostatic analysis,* **S. Mukhopadhyay, N. Majumdar, S. Bhattacharya**, *Nucl. Instrum. Meth. in Phys. Res.* ***A*** **602** *(2009) 731.*

13. *A study of three-dimensional edge and corner problems using the neBEM solver*, **Supratik Mukhopadhyay**, **Nayana Majumdar,** *Engineering Analysis with Boundary Elements* **33** *(2009) 105.*

14. *Mn doping in ZnO nanoparticles: effects investigated by positron lifetime and Doppler broadening studies*, B. Roy, B. Karmakar, M. Pal, and **P.M.G. Nambissan,** *Phys. Stat. Solidi C* **6** *(2009) 2572.*
15. *Positron annihilation studies of NiO nanoparticles prepared through two different chemical routes*, Soumen Das, Tandra Ghoshal and **P.M.G. Nambissan**, , *Phys. Stat. Solidi **C*** **6** *(2009) 2569.*

16. *Li^{3+} ion irradiated effects on polyamide nylon6,6 studied by positron annihilation lifetime and Doppler broadening spectroscopy*, Rajendra Prasad, Rajesh Kumar, **P.M.G. Nambissan**, Fouran Singh and S. Asad Ali, *Phys. Stat. Solidi **C*** **6** *(2009) 2442.*

17. *o-Ps lifetime, free volume and Doppler broadening spectroscopy (DBS) studies of 50 MeV Li^{3+} ion irradiated polysterene*, S. Asad Ali, Rajesh Kumar, **P.M.G. Nambissan**, Fouran Singh and Rajendra Prasad, *Phys. Stat. Solidi C* **6** *(2009) 2435.*

18. *Characterization of ion-implantation-induced defects in certain technologically important materials by positron annihilation*, **P.M.G. Nambissan**, *Defense Sci. Journal* **59** *(2009) 329.*

19. *Vacancy-type defects and their evolution under Mn substitution in single crystalline ZnO nanocones studied by positron annihilation*, Tandra Ghoshal, Soumitra Kar, Subhajit Biswas, S.K. De and **P.M.G. Nambissan**, *J. Phys. Chem. C* **113** *(2009) 3419.*

20. *Cadmium oxide octahedrons and nanowires on the micro-octahedrons: a simple solvothermal synthesis*, Tandra Ghoshal, Subhajit Biswas, **P.M.G. Nambissan**, Gautam Majumdar and S. K. De, *Crystal Growth and Design* **9** *(2009) 1287.*

21. *Development of linseed oil-free bakelite resistive plate chambers*, S. Biswas, **S. Bhattacharya**, S. Bose, S. Chattopadhyay, **S. Saha**, Y.P. Viyogi, *Nucl. Instrum. Meth. in Phys. Res.* **A604** *(2009) 310.*

22. *Determination of depth of an etch pit through studies of diffraction rings*, B Basu, S. Dey, A. Maulik, S. Raha, **S. Saha**, Swapan K. Saha, and D. Syam., *Radiation Measurements* **44** *(2009) 359.*

23. *Electric field distribution and simulation of avalanche formation due to the passage of heavy ions in a parallel grid avalanche counter*, D. Kanjilal and **S. Saha**, *Pramana* **72** *(2009) 833.*

24. *Performances of linseed oil-free bakelite RPC prototypes with cosmic ray muons*, S. Biswas, **S. Bhattacharya**, S. Bose, S. Chattopadhyay, **S. Saha, M. K. Sharan** and Y. P. Viyogi, *Nucl. Instrum. Meth. in Phys. Res.* **A 602** *(2009) 749.*

25. *High Voltage Power Supply for RPC detectors*, S. Bose, **S. Saha**, **S. Bhattacharya**, *Nucl. Instrum. Meth. in Phys. Res.* **A 602** *(2009) 842.*

26. *Control system for a four-component gas mixing unit*, S. Bose, S. Biswas, **S. Saha, M.K. Sharan**, **S. Bhattacharya**, *Nucl. Instrum. Meth. in Phys. Res.* **A 602** *(2009) 839.*

27. *INO prototype detector and data acquisition system*, Anita Behere, M. S. Bhatia, V.B. Chandratre, V.M. Datar, P. K. Mukhopadhyay, Satyajit Jena, Y.P. Viyogi, **Sudeb Bhattacharya**, **Satyajit Saha**, Sarika Bhide, S.D. Kalmani, N.K. Mondal, P. Nagraj, B.K. Nagesh, Shobha K. Rao, L.V. Reddy, M. Saraf, B. Satyanarayana, R.R. Shinde, S. S. Upadhya, P. Verma, Saikat Biswas, Subhasish Chattopadhyay, P.R. Sarma, *Nucl. Instrum. Meth. in Phys. Res.* **A 602** *(2009) 784.*

28. *Coherence resonance in a uni-junction transistor relaxation oscillator*, Md. Nurujjaman, P. S. Bhattacharya, A. N. Sekar Iyengar, and **Sandip Sarkar**, *Phys. Rev. E* **80** *(2009) 015201*.

29. *Physica Status de Solidi (PSS C6. No11. 2253-2600, 2009) Guest Editor***: Bichitra Nandi Ganguly.**

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30. *A perturbed angular correlation spectrometer for material science studies*, **C. C. Dey**, *Pramana*, **70** *(2008) 835.*

31. *Computation of 3D electrostatic weighting field in Resistive Plate Chambers*, **N. Majumdar**, **S. Mukhopadhyay, S. Bhattacharya**, *Nucl. Instrum. Meth. in Phys. Res. **A*** **595** *(2008) 346.*

32. *Factors affecting the precision of electrostatic computation of 3D MEMS structures*, **N. Majumdar, S. Mukhopadhyay**, *The African Physical Review*, Vol. 2, Special Issue, Part II (Materials): **0087** *(2008) 170.*

33. *Structural defects in Mn^{2+} incorporated ZnS nanoparticles as seen through positron annihilation measurements*, Subhajit Biswas, Soumitra Kar, Subhadra Chaudhuri and **P.M.G. Nambissan**, *J. Phys.: Condens. Matter* **20** *(2008) 235226.*

34. *Positron annihilation spectroscopic studies of solvothermally synthesized ZnO nanobipyramids and nanoparticles*, Tandra Ghoshal, Subhajit Biswas, Soumitra Kar, Subhadra Chaudhuri and **P.M.G. Nambissan,** *J. Chem. Phys.* **128** *(2008) 074702*. [Also published in *Virtual Journal of Nanoscale Science & Technology* **17 (8)**, *February 25, 2008*.]

35. *Positron lifetime studies of the dose dependence of nanohole free volumes in ion-irradiated conducting poly-(ethylene-oxide)-salt polymers*, Rajesh Kumar, Udayan De, **P.M.G. Nambissan**, M. Maitra, S. Asad Ali, T. R. Middya, S. Tarafdar, F. Singh, D.K. Awasthi and Rajendra Prasad. *Nucl. Instrum. Meth. Phys. Res.* B **266** *(2008) 1783*.

36. *Positron annihilation spectroscopy and specific heat study of neon ion irradiated MgB_2*, A. Talapatra, S. K. Bandyopadhyay, **P.M.G. Nambissan**, Pintu Sen, V. Ganesan, *Phys. Lett. **A*** **372** *(2008) 1521*.

37. *An active drop counting device using condenser microphone for superheated emulsion detector*, Mala Das, A. S. Arya, C. Marick, D. Kanjilal and **S. Saha**, *Rev. Sci. Instr.* **79** *(2008) 113301*.

38. *Charge response of polyethylene terepthalate polymers (PET) to light and heavy nuclei*, B Basu, S. Dey, B. Fischer, A. Maulik, S. Raha, **S. Saha**, S. K. Saha, D. Syam. *Radiation Measurements* **43** *(2008) S95*.

39. *Polyethylene terepthalate polymers at mountain altitude as cosmic ray heavy particle detector*, B Basu, S Biswas, S. Dey, A. Maulik, A Mazumder**,** S. Raha**, S. Saha**, S. K. Saha, D. Syam. *Radiation Measurements* **43** *(2008) S262*.

40. *A theory of "fuzzy" edge detection in the light of human visual system*, K. Ghosh, **S. Sarkar** and K. Bhaumik, *Journal of Intelligent Systems* **17** *(2008) 229*.

41. *A GEANT-based study of atmospheric neutrino oscillation parameters at INO,* Abhijit Samanta, **Sudeb Bhattacharya**, Ambar Ghosal, Kamales Kar, Debasish Majumdar, Amitava Raychaudhuri, *Int. J. Mod. Phys.* **A 23** *(2008) 233.*

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42. *Positronium interactions in liquids and porous substances*, **Bichitra Ganguly**, Debarshi Gangopadhyay, Dhanadeep Dutta, Sujib Chatterjee,Tapas Mukherjee and Binayak Dutta Roy, *Radiation Physics and Chemistry* **76(2)** *(2007) 263.*

43. *Behavior of hafnium fluoride octahedral complex in HF at low temperature studied by TDPAC*, **C. C. Dey**, *Hyperfine Interact.* **175** *(2007) 185*.

44. *Lifetime measurement of some excited states belonging to the $3p^4$ nd (n=4-6) configuration of Ar II*, S. Karmakar and **M. B. Das**, *Pramana* **69** *(2007) 477*.

45. *Simulation of 3D electrostatic configuration in gaseous detectors,* **N. Majumdar** and **S. Mukhopadhyay**, Journal of Instrumentation **2** *(2007) P09006.*

46. *Use of the neBEM solver to compute the 3D electrostatic properties of comb drives,* **S. Mukhopadhyay**, **N. Majumdar**, *The African Physical Review*, Vol. 1, Special Issue, Part I (Microfluidics): 0015 *(2007) 31*.

47. *Positron annihilation spectroscopic studies of the influence of heat treatment on defect evolution in hybrid MWCNT-polyacrylonitrile based carbon fibers,* K. Chakrabarti, **P.M.G. Nambissan**, C.D. Mukherjee, K.K. Bardhan, C. Kim and K.S. Yang, *Carbon* **45** *(2007) 2777.*

48. *Defect-related aspects of Mn-doped ZnS nanorods and morphological changes revealed from positron annihilation spectroscopy*, **P.M.G. Nambissan**, Subhajit Biswas, Soumitra Kar and Subhadra Chaudhuri, *Physica Status Solidi (c)* **4** *(2007) 3889.*

49. *Thermal evolution of boron irradiation induced defects in pre-doped Si revealed by positron annihilation experiments,* **P.M.G. Nambissan**, P.V. Bhagwat and M.B. Kurup, *J. Appl. Phys.* **101** *(2007) 113526.*

50. *Substitution-induced structural transformation in Mn-doped ZnS nanorods studied by positron annihilation spectroscopy*, Soumitra Kar, Subhajit Biswas, Subhadra Chaudhuri and **P.M.G. Nambissan**, *Nanotechnology* **18** *(2007) 225606.*

51. *Retinomorphic Image Processing,* K. Ghosh, K. Bhaumik and **S. Sarkar,** *Progress in Brain Research,* **168** *(2007) 175*.

52. *Understanding image structure from a new multi-scale representation of higher order derivative filters,* K. Ghosh, **S. Sarkar** and K. Bhaumik, *Image and Vision Computing*, **25** *(2007) 1228.*

53. *Positron lifetime studies and coincidence Doppler broadening spectroscopy of $Al_{94-x}Mg_6Sc_x$ (x = 0 to 0.6) alloy,* M.S. Kaiser, **P.M.G. Nambissan**, M.K. Banerjee, A. Sachdeva and P.K. Pujari, *J. Mater. Sci.* **42** *(2007) 2618.*

1. Name: SATYAJIT SAHA
Division/Section: Applied Nuclear Physics

Educational background:

Degree Awarded/Exam passed	Year	University/Institute
B Sc. (Physics Hons)	1980	Presidency College, Kolkata (Calcutta University)
M Sc (Physics)	1981	Science College, Kolkata (Calcutta University)
M S (Physics)	1984	University of Washington, Seattle, U S A
Ph D	1990	University of Washington, Seattle, U S A

2. Academic profile including earlier appointments and awards:

1. National Science Talent Search Scholarship 1976.
2. Teaching Assistant, Dept of Physics, UW, Seattle, USA, Jan 1983 to Dec 1984.
3. Research Assistant, Dept of Physics, UW, Seattle, USA, Jan 1985 to Jan 1990.
4. Visiting Fellow, Nuclear Reactions Group, TIFR, Mumbai, July 1990 to July 1993.
5. Lecturer, Dept of Physics, Bose Institute, Kolkata, August 1993 to November 1993.
6. Reader (SD), Nuclear Instrumentation and Spectroscopy Section, SINP, December 1993 to January 1998.
7. Associate Professor (E), NIS Division (presently N & AP Division), SINP, February 1998 to January 2003.
8. Professor (F), N & AP Division, SINP from February 2003.

3. Essential strength of research/development output:

- Research in nuclear reactions and spectroscopy using various types of charged particle, neutron, gamma ray and X-ray detectors, exploration of nuclear structure of proton rich nuclei like ^{208}Fr, ^{146}Tb and neutron rich nuclei like ^{34}P and ^{36}S vis a vis experiment with large Clover detector array like INGA;
- Development of different types of gas based radiation detectors, such as position sensitive multiwire proportional counter, parallel grid avalanche counter, Bragg curve and transverse ionization chamber, resistive plate chamber, liquid scintillator based neutron detector, etc. These detectors are used in various experiments involving gamma spectroscopy with charged particle tagging, exploring the nuclear dynamics of a few nucleon transfer reactions, fission and fusion reactions at beam energies available from the India based Pelletron accelerators, and also for the detection of cosmic muons by RPC with an aim to develop indigenously built large area active detectors for a 50 kT iron calorimeter as planned for the India based Neutrino Observatory.
- Simulation work on avalanche propagation in wire grid based avalanche counters; simple phenomenological model based nuclear structure calculations to generate input to nuclear reaction codes.
- Search for WIMPs as cold dark matter candidates. This is a collaborative work as part of PICASSO experiment stationed at the Sudbury Neutrino Observatory (SNOLAB), Canada. I am involved in the development of a wide bandwidth acoustic pulse detection technique using MEMS based piezoelectric sensors.

4. Future research/development plan:

- Exploration of nuclear landscape through evaluation of nuclear structure of neutron deficient trans-lead and trans-uranium nuclei with very low yield; development and utilization of gas-based residue tagging detectors for the above purpose.
- Doppler-free laser spectroscopy, collision dynamics of cold atoms and exploration of interaction of cold atoms with ions.
- Exploring atmospheric neutrino oscillation with an aim to refine measurements of mass squared difference of neutrinos and related standard model parameters. This will be a collaborative work of the proposed India based Neutrino Observatory.
- Development of a suitable large volume aquasonic gel based superheated drop detector and associated technology including freon recovery, uniform sized superheated droplet production, customized electronics, data acquisition, etc. This work is also part of a collaboration between PICASSO dark matter search experiment and Centre for Astro Particle Physics of SINP.

5. List of important publications starting with recent publications.

1. High spin states and isomeric decays in doubly-odd ^{208}Fr, S. Saha in D. Kanjilal et al., Nucl. Phys. A, 842, 1 (2010).
2. Study of timing properties of single gap high-resistive bakelite RPC, S. Saha in S**.** Biswas et al, Nucl Instrum Meth in Phys Res A 617, 138 (2010).
3. Electric field distribution and simulation of avalanche formation due to the passage of heavy ions in a parallel grid avalanche counter, D. Kanjilal and S. Saha, Pramana 72, 833 (2009).
4. Performances of linseed oil-free bakelite RPC prototypes with cosmic ray muons, S. Saha in S. Biswas et al., Nucl Instrum Meth in Phys Res A 602, 749 (2009).
5. An active drop counting device using condenser microphone for superheated emulsion detector, S. Saha in Mala Das et al., Rev. Sci. Instr. 79, 113301 (2008).
6. Spin-parity measurements in the neutron-rich N ~ 20 ^{34}P and ^{36}S nuclei, S. Saha in Krishichayan et al, Eur. Phys. J. A **29**, 151 (2006).
7. Pre-equilibrium and equilibrium emission of neutrons in ^{114}Cd(α,*xn*) reactions, S. Saha in J. Pal et al, Phys. Rev. C 71, 034605 (2005).
8. High-spin states in the odd-odd nucleus ^{146}Tb, S. Saha in Krishichayan et al, Phys Rev C **70**, 044315 (2004).
9. Observation of unexpected orbiting behavior for ^{16}O + ^{89}Y and ^{16}O + ^{93}Nb reactions, S. Saha in A Ray et al, Phys Rev C, **68**, 051602(R) (2003).
10. Experimental investigation on the connection between nucleon transfer channels and near barrier fusion in ^{32}S + ^{64}Ni and ^{28}Si + ^{68}Zn systems, S Saha and Y K Agarwal, Nucl Phys A, 601, 251 (1996).
11. One- and two-proton transfer reactions in ^{32}S + ^{64}Ni and ^{28}Si + ^{68}Zn at near barrier energies, **S Saha**, Y K Agarwal and C V K Baba, Phys Rev C, 49, 2578 (1994).
12. A method to study heavy ion reactions using position sensitive and Bragg curve spectroscopy detectors, **S Saha**, Y K Agarwal, M D Deshpande and A Roy, Nucl. Instr. Meth. Phys. Res. A, 335, 165 (1993).

Name : **SUDEB BHATTACHARYA**
Present designation : Senior Professor
Department : Applied Nuclear Physics Division

Educational Qualification : Ph. D. (Science) from Calcutta University, Kolkata, India in 1982 after having completed M.Sc. in Physics with Nuclear Physics as special paper from Calcutta University.
Title of the thesis : **Nuclear Spectroscopy in the Technetium – Ruthenium region**

Details of Employment : Joined Saha Institute of Nuclear Physics as Research Scholar in 1974. Appointed in the permanent position as Scientist (SB) in July, 1983 in SINP. Reached the Senior Professor (H) grade in August 2006.

Essential strength of research / development output : I have been associated with projects related to nuclear structure studies using gamma- and charge-particle spectroscopy as the tools. In the field of nuclear structure studies my main objective has been to study, in details, the interplay of single particle and collective degrees of freedom manifested in the nuclear excitation spectra using both experimental and theoretical techniques. I was also associated in the sub-barrier fusion studies aimed to measure fusion and transfer cross-section of light heavy ions at these energies. I have been involved in the calculation of level properties of several odd-A and odd-odd nuclei in different mass regions using various phenomenological model. The necessary computer codes, for most of these calculations, were developed by me from a scratch. In these theoretical work my aim also has been to understand the potentialities as well as the limitations of different theoretical models. These codes are being used by other researchers in SINP and at other institutes**.** I have been also actively involved in various developmental works.

Present major activities & involvement at the Institutional / National level :

INGA : Setting up of Indian National Gamma Array (INGA). I participated in the planning, setting up of the array and execution of the projects from its inception at three major accelerator centres in India.
FRENA : Setting up of a dedicated facility for carrying out research work in experimental nuclear astro-physics around a low-energy (~300kV-3 MV) high current Tandetron accelerator at SINP.
INO : Setting up of a **I**ndia-based **N**eutrino **O**bservatory (**INO**). In the first phase the aim of the project is to build up an underground laboratory wherein a 50 KTon magnetized Iron calorimeter (ICAL) with Resistive Plate Chambers as the active detectors to study the oscillation properties of atmospheric neutrinos. I am participating in the planning, design, simulation and other issues related to the building up of this facility from its inception.
Work related to new generation of Gas Detectors (GEM / MPGD) and RD51 collaboration :
To carry out detailed three dimensional numerical simulation of detectors, classical and modern, (MPGD) used in nuclear experiments and medical imaging. Our contribution & participation has been accepted by the RD51 collaboration of CERN. This projects also envisages setting up of (i) experimental facilities for the measurement of the characteristics of such detectors and (ii) TPC-based rare event detection set-up .
Projects related to Astro-particle Physics : Participation in the activity towards a large scale WIMP Dark Matter search experiment using Superheated–heated Droplet Detectors (SDD) under CAPP and in collaboration with PICASSO group at SNOLAB, Sudbury, Canada.

Total number of publications in referred journals : 75

Selected list of publication

1. *Neutron-gamma discrimination by pulse analysis with superheated drop detector*; Mala Das, S. Seth, S. Saha, **S. Bhattacharya**, P. Bhattacharjee; NIMA(2010), [doi:10.1016/j.nima.2010.06.361]

2. Band crossing in shears band in ^{108}Cd ; Santosh Roy, Sukalyan Chattopadhyay, **S. Bhattacharya**, A. Goswami, Pradip Dutta, H.C. Jain, P.K. Joshi, R. K. Bhowmik, R. Kumar, S. Muralithar, R.P. Singh, P.V. Madhusudhana Rao; Phys. Rev. C 81, 054311 (2010).

3. Realistic Three Dimensional Simulation on the Performance of Micromegas; Purba Bhattacharya, Supratik Mukhopadhyay, Nayana Majumdar, **Sudeb Bhattacharya;** NIMA(2010) [doi:10.1016/j.nima.2010.07.026]

4. High spin states and isomeric decays in doubly-odd ^{208}Fr ; D. Kanjilal, **S. Bhattacharya**, A. Goswami, R. Kshetri, S. Saha, R.K. Bhowmik, J. Gehlot, S. Muralithar, R.P. Singh, G. Jnaneswari, G. Mukherjee, B. Mukherjee ; Accepted for publication in Nucl. Phys. A (2010)

5. Electrostatics of micromesh based detectors ; S. Mukhopadhyay, N. Majumdar and **S. Bhattacharya** ; JINST **4**, P11004 (2009)

6. Development of linseed oil-free bakelite resistive plate chambers ; S. Biswas, **S. Bhattacharya**, S. Bose, S. Chattopadhyay, S. Saha, Y.P. Viyogi ; Nucl. Inst. & Meth. **A604,** 310 (2009).

7. 3D Electrostatic Field Simulation of a Resistive Plate Chamber ; N. Majumdar, S. Mukhopadhyay, **S. Bhattacharya** ; Nucl. Inst. & Meth. **A595**, 346 (2008)

8. A GEANT-based study of atmospheric neutrino oscillation parameters at INO ; Abhijit Samanta, **Sudeb Bhattacharya**, Ambar Ghosal, Kamales Kar, Debasish Majumdar, Amitava Raychaudhuri ; Int. J. Mod. Phys. **A23**, 233 (2008)

9. India-based Neutrino Observatory – the present status; **Sudeb Bhattacharya** ; Progress in Particle and Nuclear Physics 57, 299 (2006)

10. First evidence of triaxial superdeformation in ^{161}Lu and ^{162}Lu ; P. Bringel, H. Hubel, H. Amro, M. Axiotis, D. Bazzacco, **S. Bhattacharya**, R. Bhowmik, J. Domscheit, G.B. Hagemann, D.R. Jensen, Th. Kroll, S. Lunardi, D.R. Napolai, A. Neusser, S.C. Pancholi, C.M. Petrache, G. Schonwasser, A.K. Singh and C. Ur ; Eur. Phys. J. **A16** (2003) 155

11. First triaxial superdeformed band in ^{170}Hf; A. Neusser, H. Hubel, G.B. Hagemann, **S. Bhattacharya**, P. Bringel, D. Curien, O. Dorvaux, J. Domscheit, F. Hannachi, D.R. Jensen, A. Lopez-Martens, E. Mergel, N. Nenoff and A.K. Singh : Eur. Phys. J. **A15** (2002) 439

12. Oblate bands in doubly odd-odd ^{134}La; U. Datta Pramanik, A. Mukherjee, M. Saha, A. Goswami, P. Basu, M.L. Chatterjee, B. Dasmahapatra, S. Sen and **S. Bhattacharya**; Nucl. Phys. **A637** (1998) 327.

13. High spin states in odd-odd ^{150}Eu nucleus ; J.M. Chatterjee, Somapriya Basu, U. Datta Pramanik, **S. Bhattacharya**, R..K. Chattopadhyay, S.S. Ghugre, G. Rodrigues, R.P. Singh and R.K. Bhowmik; J. Mod. Phys. Lett. **A12** (1997) 2791.

14. ^{7}Li+^{12}C and ^{7}Li+^{13}C fusion reactions at subbarrier energies; A. Mukherjee, U. Datta Pramanik, M. Saha Sarkar, A. Goswami, P. Basu, **S. Bhattacharya**, S. Sen, M.L. Chatterjee and B. Dasmahapatra, Nucl. Phys**. A596** (1996) 299

15. ^{128,130,132,134}La in axially symmetric rotor model; U. Datta Pramanik and **S. Bhattacharya**, Phys. Rev. **C52** (1995) 117.

16. Band structure in the N = 88 isotones ^{149}Pm, ^{151}Eu and ^{153}Tb; **S. Bhattacharya**, S. Sen and R. K. Guchhait, Phys. Rev. **C32** (1985) 1026.

17. Phenomenological anharmonic vibrator model for ground state bands of even even nuclei; **S. Bhattacharya** and S. Sen, Phys. Rev. **C30** (1984) 1014.

18. Anomalous M4 conversion coefficient in ^{125m}Te; P.Mukherjee, **S. Bhattacharya** et. al. , Phys. Rev. **C25** (1980) 2120.

19. Quasi-particle phonon coupling model for odd-A Ru isotopes **; S. Bhattacharya** and S. K. Basu , Phys. Rev. **C18** (1978) 2765.

20. In International conference ***: Probing deviation of tri-bimaximal mixing and reach of θ_{13} using neutrino factory at CERN and ICAL detector at INO***; Debasish Majumdar, Ambar Ghosal, **Sudeb Bhattacharya** and Kamales Kar ; Proc. NuFact07, at Okayama, Japan

NAME : BICHITRA NANDI GANGULY
EDUCATIONAL BACKGROUND : M.Sc. Ph. D.
ACADEMIC PROFILE :
1. Research Fellowship : SINP 1979-86
2. Ph.D Awarded : 1986
3. Research Associate : CNRS FRANCE 1986-87
4. CSIR Pool scientist : 1987-90
5 Lecturer SINP : JOINED SINP Sept 19, 1990.
6. Professor : 'G': 2007 contd… at present..

Essential strength of research/development output:

1. Initially worked on radiochemical separation techniques , using surfactant reagent as solvent extractant/liquid ion exchanger. Post doc experience in IPN Orsay France : Separation of heavy actinides using ion selective membrane under French Dubna collaboration simulating for Nobelium+2 ion separation.
2. Optical spectroscopy and photo chemistry of uranium in solution and liquid microemulsion system, studying aggregation behaviour of the extractant through various techniques like light scattering and positron annihilation technique.
3. Study of micelles/ reversed micelles, polymers etc. through positron annihilation and photochemical techniques (basically probing molecular association phenomena)
4. Study of positronium (Ps) pick –off annihilation in molecular substance including liquid systems, development of theoretical models, describing the phenomenology in collaboration with the theorists.
5. Studying Positronium (Ps) molecular complex formation in various solvents, dependence of temperature and pressure, study of electron transfer reaction of Ps and spin conversion (electron spin exchange through paramagnetic ions) using inorganic solute ions as impurity in aqueous systems.
6. Study of polymeric systems, conducting polymer, radiation damage of polymers, Osmotic membrane materials(porous systems).
7. Study of multi porous materials: pore structure important in technology : silica gel, zeolites etc. using positron annihilation as a tool and comparing with gas absorption BET method . Temperature dependent study of the pore surface materials with positronium annihilation.
8. Study of biologically important molecules, probing the biological importance of positron annihilation in medical diagnosis and usage of positron annihilation as a tool for surface studies.

9. International collaboration : ILTP Indo –Russia : Positron/Positronium studies in chemical science.1999-2003. with DST , Govt of India and Russian academy of Science. Worked as Project coordinator.

Also on a visit to Japan at KEK for about a week duration, worked in slow positron beam on a small aspect of the problem on mica surface layered structure.

10. Delivered invited talks : in positron/positron chemistry workshops in abroad several times; oral presentations in ICPA conference series.

11. Thesis Guidance : 3 students obtained Ph.D. in the domain of positron/ Positronium studies.

12. Organisation of International conference: On the basis of our work and our exhibits we were asked to put forth a proposal for *ICPA-15 conference* and it was held in SINP during January 2009, Total participants ~200, 27 countries participated.

International School on Positron Studies was also held. Jan 14-16 2009. total: 7 countries and 50 students including 20 foreign students participated.

Developmental work: Developed new laboratories for the study of positron and positronium chemistry . In fact started new work on chemical systems using positron as a probe in SINP since 1986.

Future research/development planed: **PROJECT ON PULSED SLOW POSITRON BEAM**

Slow positron beam is needed for surface / interface / depth related studies of a given nano structure material (thin materials of nano meter order) and pulsed positron beam would enable the investigators to study the lifetime of positron/positronium states in the substrate. Study of the ultra thin structure is expected to reveal much more fundamental aspects of natural phenomenology which can be practically utilized.

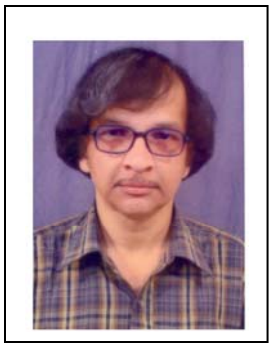
.**List of important publications starting with recent publications:** Total publication No 54 Those that given below are some of the important ones:

- Subtleties in Structural Aspects of Synthetic Zeolite Material: a comparative assay through PALS and BET methods.;*D. Dutta, S. Chatterjee, K.T. Pillai and B.N. Ganguly;J. Applied Physics ,98, 033509-16, (2005).*
- Effect of Temperature on Positronium Annihilation in Silica Gel.;*Dhanadeep Dutta, Bichitra Ganguly, Sujib Chatterjee, Tapas Mukherjee,;J. Phys. Chem. B. 109, 100092-95, (2005).*
- Microstructural Study of Silica Gel by Positron Annihilation: *Dhanadeep Dutta, Bichitra Nandi Ganguly, Debarshi Gangopadhyay, Tapas Mukherjee and Binayak Dutta-Ro;J. Phys. Chem. B 108, 8947-8952 (2004).*
- Insignia of positronium-molecular interaction in polyamide membrane material: *Dhanadeep Dutta, Amit Bhattacharya, Sujib Chatterjee and Bichitra Nandi Ganguly;Chem. Phys. Lett. 379,119-125 (2003).*
- Microstructural Study of Aromatic Polyamide Membrane: *Dhanadeep Dutta, Amit Bhattacharya and Bichitra Nandi Ganguly; J. Mem. Sci. 224, 127-135 (2003).*
- General Trends of Positronium Pick-off Annihilation in Molecular Substances: *Dhanadeep Dutta, Bichitra Nandi Ganguly, Debarshi Gangopadhyay, Tapas Mukherjee and Binayak Dutta-Roy;J. Phys. Condens. Matter 14, 7539 (2002).*
- Temperature, Pressure and Solvent Dependence of Positronium Reactivity towards Nitrobenzene *Debarshi Gangopadhyay, D. Sanyal, Bichitra Nandi Ganguly, Tapas Mukherjee, D. Banerjee, Binayak Dutta Roy and Rangalal Bhattacharya; J. Phys. Chem. A 105, 991-994 (2001).*
- Mechanism of Positronium-Nitrobenzene Complex Formation in Water :*Debarshi Gangopadhyay, Bichitra Ganguly, Tapas Mukherjee and Binayak Dutta RoyChemical Physics Letts, 344, 495 (2001).*
- Guest Molecules in Triton X-100 microemulsion; Studied by Positron Annihilation Technique and Absorption Spectroscopy, *Subir Kumar Das and B. Nandi Ganguly Colloids and Surfaces A Phy.chem Engg 168, 53 (2000).*
- Positronium Formation in Reverse Micellar Systems : *T. Mukherjee, S.K. Das, B. Nandi Ganguly, P. Sen and B. Dutta-Roy, Chem. Phys. Lett. 282, 64 (1998).*
- Positron Annihilation Study on γ-irradiated cellulose acetate matrix : *V.S. Subrahmanyam, S.K. Das, B. Nandi Ganguly, A. Bhattacharya and A. De Polymer 39, 1507 (1998).*
- Positronium Reactions in the Triton X-100-p-Nitro Phenol system :*Subir Kumar Das and B. Nandi Ganguly,Radiat Phys. Chem. 50, 355 (1997).*
- A Photochemical Study of Uranyl ion interaction with the Triton X-100 Micellar System :*Subir Kumar Das and B. Nandi Ganguly, Jr. Coll. & Interface Sci., 180, 377 (1996).*
- Study of Triton X-100-Surfactant-UO_2^{2+} Aqueous System by Positron Annihilation Technique :*Subir Kumar Das and B. Nandi Ganguly, Radiat. Phys. Chem. 47, 257 (1996).*
- Study of Transition Metal ion in Doped Mullite by Positron Annihilation Technique, *D. Sanyal, S.K. Patra, S.P. Choudhuri, B. Nandi Ganguly, U. De, D. Banerjee and R. Bhattacharya, J. Mater. Sci. 31, 3447 (1996).*
- Positronium Reactions in Uranyl ion-HDEHP Micro Emulsion Extraction Systems: *B. Nandi Ganguly, V.S. Subrahmanyam and P. Sen, Radiat. Phys. Chem. 38(2), 213 (1991).*
- Use of Reverse Micelles in Growing Monodispersive Catalytic Active Semiconductor Colloidal Particles for the Photocleavage of Water: A critical review: *B. Nandi Ganguly and S.N. Bhattacharyarya, Jour. Surface Sc. & Tech. 7, 151 (1991).*
- Spectroscopic Investigation of Uranium Complexation in the Reversed Micellar System of HDEHP/n-heptane/water, *B. (Nandi) GangulyJ. Photochem. Photobiol.,A: Chem. 51, 401 (1990).*
- Study of Aggregational Behaviour of Di(2-ethyl hexyl) Phosphoric acid in Heptane in the Presence of Water : *S.N. Bhattacharya and B. (Nandi) Ganguly, Jour. Colloid & Interface Sci., 118, 15 (1987).*

B. Ganguly

P.M.GOPALAKRISHNAN NAMBISSAN

(Abbreviated as P.M.G. Nambissan in published papers and other academic documents.)



B.Sc. in Physics with first class (86.50%) from Sree Narayana College, Cannanore (under University of Calicut) in 1984 with Mathematics and Chemistry as subsidiaries.

M.Sc. in Physics with first class & second rank (73.53%) from University of Calicut in 1986 with specialization in Nuclear Physics.

Post M.Sc. Associateship Diploma in Physics (75.73%) from Saha Institute of Nuclear Physics, Calcutta in 1987 with specialization in Nuclear Physics.

Ph.D. in Science (Physics) from University of Calcutta in 1991 for the thesis project ``Positron Annihilation and Scanning Electron Microscopy Studies on Alpha Irradiated Tantalum, Tungsten, Molybdenum and Aluminium Samples" done at Saha Institute of Nuclear Physics, Calcutta under guidance of Prof. Prasanta Sen.

1. Academic profile including earlier appointments, awards etc

Research Associate	(from 27.11.1991 to 12.08.1993)
Lecturer SC	(from 13.08.1993 to 31.07.1996)
Reader SD	(from 01.08.1996 to 31.07.1999)
Associate Professor E	(from 01.08.1999 to 31.07.2004)
Professor F	(from 01.08.2004 to 31.01.2008)
Professor G	(from 01.02.2008 onwards)

at **Saha Institute of Nuclear Physics, Kolkata.** I **a**lso served, on deputation from the institute, as **Course Director, Department of Nanoscience, Kannur University, Kerala** from 31.01.2009 to 30.01.2010.

2. Essential strength of research/development output

The areas of research in which I had been involved recently are the utilization of positron annihilation spectroscopy for the studies of properties and processes related to defects in nanomaterials including metals, alloys, ferrites and semiconductors. An interesting aspect that has attracted the attention of scientists working in this area is the effect of doping by other substitutional elements in a nanocrystalline system and look for the consequences. The defects play a significant role by way of aiding the doped atoms to follow their desired dynamics within the host. There are adverse effects too, like the decoration of the surfaces by the doped atoms. In all these cases, positron annihilation spectroscopy, by virtue of thermalized positrons diffusing out to the surfaces of nanoparticles prior to annihilation, is very significant. The information that can be gathered from such studies can help to understand these systems in greater depth and perspective.

3. Future research/development plan

1. Synthesis, characterization and measurements of positron lifetime and coincidence Doppler broadening in oxide semiconductor nanomaterials.
2. Optical absorption studies and estimation of band gap of these nanomaterials.
3. Kinematics of inert gas nanobubbles in high energy ion-irradiated solids.
4. Positron annihilation studies on certain alloys of importance in reactors.

4. List of important publications starting with recent publications

1. Characterization of ion-implantation-induced defects in certain technologically important materials by positron annihilation
   P.M.G. Nambissan
   Defense Sci. Journal **59** 329 (2009).
2. Vacancy-type defects and their evolution under Mn substitution in single crystalline ZnO nanocones studied by positron annihilation
   Tandra Ghoshal, Soumitra Kar, Subhajit Biswas, S.K. De and P.M.G. Nambissan.
   J. Phys. Chem. C **113** 3419 (2009).
3. Structural defects in Mn2+ incorporated ZnS nanoparticles as seen through positron annihilation measurements.
   Subhajit Biswas, Soumitra Kar, Subhadra Chaudhuri and P.M.G. Nambissan.
   J. Phys. : Condens. Matter **20** 235226 (2008).
4. Positron annihilation spectroscopic studies of solvothermally synthesized ZnO nanobipyramids and nanoparticles.
   Tandra Ghoshal, Subhajit Biswas, Soumitra Kar, Subhadra Chaudhuri and P.M.G. Nambissan.
   *J. Chem. Phys.***128** 074702 (2008) and *Virtual Journal of Nanoscale Science & Technology* **17** (8), February 25, 2008.
5. Thermal evolution of boron irradiation induced defects in pre-doped Si revealed by positron annihilation experiments.
   P.M.G. Nambissan, P.V. Bhagwat and M.B. Kurup
   J. Appl. Phys. **101** 113526 (2007).
6. Finite-size effects on band structure of CdS nanocrystallites studied by positron annihilation.
   Soumitra Kar, Subhajit Biswas, Subhadra Chaudhuri and P.M.G. Nambissan.
   Phys. Rev. B **72** 075338 (2005).
7. Positron annihilation lifetime changes across the structural phase transition in nanocrystalline Fe_2O_3.
   S. Chakrabarti, S. Chaudhuri and P.M.G. Nambissan.
   Phys. Rev. B **71** 064105 (2005).
8. Positron annihilation studies of some anomalous features of $NiFe_2O_4$ nanocrystals grown in SiO_2.
   S. Chakraverty, Subarna Mitra, K. Mandal, P.M.G. Nambissan and S. Chattopadhyay.
   Phys. Rev. B **71** 024115 (2005).

(Due to page limit, only eight important publications are listed.)

Name: Supratik Mukhopadhyay

Education:

Degree/Diploma	*University/Institute*	*Year*
B.Tech	IIT, Kharagpur	1984
Ph.D.	IIT, Kharagpur	1990

Academic Profile:

Post	*University/Institute*	*Period*
Senior Research Assistant	IIT, Kharagpur	1984 - 1986
Junior Scientific Officer	-do-	1986 - 1990
Scientist SC	Saha Institute of Nuclear Physics	1990 - 1994
Reader D	-do-	1994 - 1999
Asso Professor E	-do-	1999 - 2003
Professor F	-do-	2003 - 2008
Professor G	-do-	2008 – till date

Awards: Institute Silver Medal (first in Department of Aeronautical Engineering, IIT, Kharagpur)

Research/Development Output:

- ***Development of the nearly exact BEM (neBEM) formulation:*** The Poisson's equation governs a large class of non-dissipative Physics processes related to electromagnetics, gravitation, inviscid fluid flows etc. Boundary Element Method (BEM), based on the Boundary Integral Equations (BIE), is one of the more elegant approaches of the solving the Poisson's equation. The method involves the use of the Green's function or its normal derivative due to singularity distributed over the boundaries of a given system in order to satisfy Dirichlet / Neumann / Robin boundary conditions. As is expected with almost all approaches based on Green's functions, problems in the evaluation of the integral of the kernel or its derivative lead to mathematical and physical singularities while using conventional BEM. 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. Owing to the exact closed-form foundation expressions, the new method can provide nominally exact results and hence the name. Based on these expressions, a program library, namely Inverse Square Law Exact Solutions (ISLES), has been developed to compute the influences of singularities. The resulting neBEM solver based on the ISLES library has been found to achieve very high precision throughout the computational domain, including the critical near -field region, of arbitrary three-dimensional problems with multiple dielectrics, related to electrostatics.
- ***Solution of critical electrostatic problems:*** Electrostatic problems of seemingly harmless geometry have been known to be notoriously difficult to solve over the ages, both analytically and numerically. Using neBEM, we have numerically analyzed the electrostatics of plates, cubes, L-shaped conductors and configurations involving edges and corners. It has been possible to obtain accurate estimates of integral features such as the capacitance of a given conductor and detailed properties such as the charge density distribution at the edges/corners.
- ***Detailed analysis of gaseous detectors:*** Characteristics and performance of nuclear / particle detectors influences depend crucially on their electrostatic configuration. The neBEM solver has been applied extensively to study the physical as well as weighting field configurations of a diverse group of detectors that includes classical wire chambers and relatively new detectors such as RPC, MRPCs. Some of these devices are targeted towards large-scale experiments like INO, CBM at FAIR. In addition, neBEM has been used successfully to analyze the relatively more demanding new-generation micro-pattern gaseous detectors (MPGD) such as Micro-Wire, MicroMEGAS, THGEM etc. We have studied the effects of various geometrical parameters like shape, width, thickness, as well as the material of the structural components, on the electrostatic configuration. Similar studies have been performed to analyze the effects unavoidable features like spacers, edges, surface asperities of the materials used in those devices.
- ***A simulation framework for new-generation detectors:*** The neBEM solver has been recently modified and optimized as a toolkit in order to be interfaced with other high energy physics simulation software. One such integration is already operational with the GARFIELD code, extensively used to perform

detailed simulation of the overall dynamics of a gaseous detector. Presently, the GARFIELD + neBEM combination is being maintained at CERN as a common simulation framework for analyzing gaseous detector and being used by a number of users world-wide. This work is being pursued as a significant part of the RD51 international collaboration led by CERN to promote the development and application of MPGDs. This framework can now simulate many of the physical processes occurring within a state-of-the-art MPGD and estimate important experimental properties such as gain, induced signal etc.

- ***Electrostatic analysis of MEMS and nano-devices:*** Several electrostatic problems related to the effect of three dimensionality, fringe field effect, capacitance, charge density distribution for different micro-electromechanical systems (MEMS) and nano-devices have been studied in detail. Despite the large length scale variations in these devices, neBEM has been found to provide extremely precise estimates.
- ***Model for space charge or spatial distribution of other properties:*** A new model has been proposed to simulate the effect of space charge, or other spatially distributed properties. In the new model, instead of approximating the effect of spatially distributed charges by a point charge, a surface distribution is used. This model, namely, Particles on Surface (PARSUR), is also based on the same fundamentals of neBEM formulation. The preliminary calculation for a simplistic model has produced promising results.
- ***Experimental efforts to study detector physics:*** Experimental efforts to study various physics issues in detector dynamics have been initiated with several developments taking place in a brief period of time. A set-up including gas handling system and test chamber has been almost completed. A TPC device has also been procured for this purpose. The planning for the experiments is underway with the detectors being designed and to be supplied by collaborators from Saclay, France.

Future Research/Development Plan:

- ***Extensive improvement and application of neBEM for simulating multi-physics multi-scale problems:*** The immense potential of neBEM to analyze a wide range of problems related to science and technology is obvious. We plan to improve neBEM significantly and use it to study problems related to gas and solid-state radiation detectors, nano-sciences, bio-physics, impedance tomography, non-destructive testing etc.
- ***Detailed study of detector physics:*** A detailed study of the physical processes occurring in MPGDs has been planned. Measurements are being planned of basic properties like electric field, ion drift, gain. We plan to set up the following facilities in order to pursue the above goal:
  a) Development of a laser setup for controlled event generation.
  b) Development of a set-up for measuring electric field using the scintillation signal from gaseous medium with appropriate readout arrangements.
- ***Optimization study for future experiments:*** Major physics issues such as ion backflow, aging, sparking etc need to be understood and, if possible, resolved in order to optimize these state-of-the-art detectors. Future experiments, such as the INO, CBM, ILC, sLHC and rare event detection like double beta decay depend critically on our ability to characterize gas and solid-state detectors. We plan to orient our experimental and numerical efforts to some of these experiments. In addition, we hope to help researchers in other laboratories to optimize detectors being planned / used in their programmes.
- ***Application of radiation detectors:*** Possibilities of radiation hazard detection, earthquake prediction, fire / smoke detection, geophysical and archaeological monitoring etc using radiation detectors will be explored.

List of Important Publications:

1 **S.Mukhopadhyay**, N.Majumdar, . *A Study of Three Dimensional Edge and Corner Problems using the neBEM Solver,* **Engineering Analysis with Boundary Elements** 33 (2009) 105 - 119

2 **S. Mukhopadhyay**, N. Majumdar and S. Bhattacharya, *Cluster dynamics in RPCs - A 3D electrostatic analysis,* **Nuclear Instruments and Methods in Physics Research A 602,** 731-734 (2009)

3. **S. Mukhopadhyay**, N. Majumdar, *Computation of 3D MEMS electrostatics using a nearly exact BEM solver,* **Engineering Analysis with Boundary Elements,** Vol.30, Issue 8, pp687-696 (2006)

4. **S.Mukhopadhyay**, N.Majumdar, S.Bhattacharya, *Electrostatics of micromesh based detectors*, **Journal of Instrumentation, 4**, P 11004, 2009

5. N. Majumdar, **S. Mukhopadhyay,** *Simulation of 3D electrostatic configuration in gaseous detectors* **Journal of Instrumentation,** Vol, 2 P09006, September 14, 2007

Name: Dr. Mihir Baran Das

Educational Background: M. Sc. (Physics), PhD (Sc)

Academic Profile including earlier appoitments, awards etc:
Present Position: Scientist 'G'
Earlier Appoitments: Scientist 'SB' in SINP in 1987, Scientist 'SC' in 1990,
Scientist 'SD' in 1994, Scientist 'SE' in 1999,
Scientist 'SF' in 2004

Academic Award & Honours: Recipient of Resident Research Associateship award of the National Research Council (NRC) of USA in 1997.

Essential Strength of research/development output:

I was actively involved in the design and development of the experimental setups for the measurement of lifetimes of excited atomic and molecular states using high frequency deflection technique with a delayed coincidence single photon counting arrangement and cascade-photon-coincidence technique. With the help of these apparatus we have measured lifetimes of a large number of levels of some noble gases, both neutral and singly ionized. . A large number of levels of some inert gases, both neutral and singly ionized, are investigated with the help of these apparatus as shown below.

i) Levels belonging to the $2p^5nd$ (n=4,5) and $2p^5ns$ (n=5,6) configuration of NeI.

ii) Levels belonging to the $2p^44s$, $2p^43p$ and $2p^43d$ configuration of NeII.

iii) Levels belonging to the $3p^5ns$ (n=6-8), $3p^5np$ (n=5-7), and $3p^5nd$ (n=4-7) configuration of ArI.

iv) Levels belonging to the $3p^44p$ and $3p^44d$ configuration of ArII.

v) Levels belonging to the $4p^5ns$ (n=7-9), $4p^5np$ (n=6,7) and $4p^5nd$ (n=4-6) configuration of KrI.

vi) Levels belonging to the $4p^45d$ and $4p^46s$ configuration of KrII.

vii) Levels belonging to the $5p^5nd$ (n=6-9), $5p^5nf$ (n=4-7) and $5p^5ns$ (n=8-9) configuration of XeI.

viii) Levels belonging to the $5p^4 6d$ and $5p^4 7s$ configuration of XeII.

Lifetimes of forty atomic and ionic states have been measured for the first time by us.

A time resolved laser spectroscopy (TRLS) setup is under development for radiative lifetime measurement using selective pulsed laser excitation and time resolved observation of the reemitted fluorescence . The excitation source is a pulsed tunable dye laser pumped by a fixed frequency Nd-Yag laser. A hollow cathode discharge ion source has been designed and fabricated for use in time resolved spectroscopic measurement. A collision chamber has also been designed and constructed.

Future research /development plan:

Radiative lifetime measurement by time resolved laser spectroscopy (TRLS) and elemental analysis with the help of laser induced breakdown spectroscopy (LIBS) setup. LIBS utilizes a high powered pulsed laser to generate a plasma plume on the surface of a target and as a result the sample material breaks down into excited ionic and atomic species. The spectral emission due to subsequent relaxation of the constituent excited species is collected and analyzed by a broadband spectrometer and gated detector. Each chemical element has a unique spectral signature that can be discriminated from the obtained spectra and thus the multielemental composition of the sample can be determuned.

List of important publications:

M.B.Das and S. Karmakar – Experimental lifetimes of some levels belonging to the $4p^4$ 5p configuration of KrII using the cascade –photon coincidence technique- accepted for publication in EPJ **D.**

S. Karmakar and M.B.Das – Lifetime measurement of some excited states belonging to the $3p^4$ nd (n=4-6) configuration of ArII–Pramana 69, 477 (2007).

M.B.Das, D.Mitra and S. Karmakar- Lifetime measurement of some excited states of neutral Neon-Phys. Script. **71**, 599, (2005).

I. Kanik, P.V. Johnson, M.B.Das, M.A.Khakoo and S.S. Tayal- Electron impact studies on atomic oxygen, I:Differential and integral cross section; Experiment and Theory- J.Phys. **B34**, 2647, (2001).

M.B.Das, and R.Bhattacharya- An apparatus for the measurements of lifetime of the excited states of atoms and molecules- Ind. J. Phys., **65B2**, 150, (1991).

M.B.Das and R. Bhattacharya- Lifetime measurement of some levels belonging to the $3p^4$ 4p configuration of ArII- Z.Phys. **D14**, 25, (1989).

M.B.Das, S.Bose and R.Bhattacharya- Production of high energy pulsed electron beam of nanosecond duration- J. Phys. E; Sci. Instrum. **19,** 454, (1986).

M.B.Das, S.Bose and R.Bhattacharya – Single photon response of Photomultiplier Tubes- Nucl. Instr. & Meth. **A242**, 156, (1985).

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Education:

B.Sc. (Physics)	Kolkata University	1983
M.Sc. (Physics)	Madras University	1987
Post M.Sc.	Saha Institute of Nuclear Physics	1988
Ph.D. (Science)	Jadavpure University	1998

Academic Profile:

Post doctoral	Saha Institute of Nuclear Physics	1998
Reader 'D'	-do-	2000
Associate Professor 'E'	-do-	2003
Professor 'F'	-do-	2007

Awards:

Best paper S. Sarkar, K. Ghosh and K. Bhaumik, "Generation of interpolation kernels based on a combination of Gaussians of different scales," National Conference on Image Processing with Focus on Medical Applications, Bangalore, India, March 23-25, 2005.

Research Interest:

Computational Vision, Silicon Brain, Neuromorphic VLSI

Cognitive science considers mental processes as 'computations' defined over representations. Visual perception, in this framework, is defined as the process which transforms the intensity pattern formed on the retina, which are raw data of vision, into integral representations. The task of 'computational vision' is to investigate the theoretical aspects of visual perception and to explore the biological and artificial implementations. This computational paradigm, therefore, needs an interdisciplinary approach where knowledge of biological vision can help in choosing feasible approaches to the problems of vision and the knowledge of machine vision can serve as a test bed for the computational models of vision. Visual perception, in information processing terms, is generally studied in three distinct levels. Computational theory of vision, in the top level, characterises mapping from one kind of information to another; algorithms for mapping, in the middle level, determines input output dependencies and implementational details, at the lowest level, takes care of physical realizations of the algorithms.

In line with the paradigm proposed by Marr and Poggio, we started our journey with the investigation of center-surround model of low-level vision. Our proposed model, which takes into account the recent physiological findings of retinal circuitry regarding "extra classical receptive field" and the presence of very narrow channels, is capable of retaining shading information, in the sense of "stochastic halftone process", in the zero-crossing map. Our model has also been able to reproduce many illusions which were previously believed to be the result of higher level perception. Contrary to the popular belief, this model, probably for the first time, suggest that several illusions like Simultaneous Brightness-Contrast, White Effect, Herman Grid, Todorovic Effect etc. could be explained with low-level computational model. With this model we could demonstrate, through simulation, the enhancement of visual perception through "Stochastic Resonance" observed experimentally by others. In a very recent study, we have shown that our proposed model could also be used to simulate "Contrast Sensitivity

Curve" through "Stochastic Resonance". In a related work we have derived a criterion for designing an efficient interpolator with the help of center-surround receptive field modeled with Gaussians. This idea can be a possible explanation of our continuous vision in spite of the existence of Blind Spot.

Important Developments:

Design of MANAS, a Low Noise Readout Chip for Muon Spectrometer in ALICE, CERN:

MANAS (**M***ultiplexed* **ANA***log* **S***ignal-processor*) is a front-end readout ASIC chip for the forward Muon-Spectrometer of ALICE in LHC. It is a mixed-analog-digital chip with 16 input channels, one multiplexed output channel and fabricated in 1.2μm CMOS N-well process. **MANAS** *is an extremely low-noise (1000e-) charge amplifier with a sensitivity of 3.5 mv/fC with a input dynamic range of 500 fC*. It is specifically designed for the readout of Cathode Pad Chambers (CPC) in Dimuon Spectrometer of ALICE, CERN. All the collaborating countries working in Muon Spectrometer is using **MANAS** for the CPC readout.

Future Research Plan:

I will continue to work in the field of "Computational Vision" with special emphasis on "noise enhanced information processing" through "Stochastic Resonance". I will also initiate works on "Silicon Brain" which is essentially simulating functionalities of brain on Neuromorphic Analog VLSI Hardware. I would also like to venture into the investigation of low SNR nanoscale devices because we might need to capitalise the knowledge of "noise enhanced information processing" for proper operation of these devices.

Important Publications:

Book Chapters:

1. K. Ghosh, K. Bhaumik and S. Sarkar, "Retinomorphic Image Processing," *Progress in Brain Research,* 168, 175, Editors: R. Banerjee and B.K. Chakrabarti, Elsevier, 2008, ISSN 0079-6123.
2. Kuntal Ghosh, Sandip Sarkar and Kamales Bhaumik, Vision-Systems: Segmentation and Pattern Recognition, Editors: Goro Obinata and Ashish Dutta, I-Tech Education and Publishing, Viena, Austria, 2007, ISBN 978-3-902613-05-9, 353.

Papers:

1. A Kundu and S Sarkar, "Can Centre Surround Model Explain the Enhancement of Visual Perception through Stochastic Resonance?," International Conference on Communication, Computers and Devices, Kharagpure, INDIA December 10-12, 2010 (Communicated).
2. S Sarkar, K Ghosh and K Bhaumik, "Stochastic Resonance in the Perceptual Interpretation...," 3rd Indian International Conference on Artificial Intelligence, Pune, India, December, 17-19, 2123-2139, 2007, ISBN: 978-0-9727412-2-4.
3. K. Ghosh, S. Sarkar and K. Bhaumik, "Understanding image structure from a new multi-scale representation of higher order derivative filters," Image and Vision Computing, 25, 1228, 2007.
4. K. Ghosh, S. Sarkar and K. Bhaumik, "A possible explanation of the low-level brightness-contrast illusions in the light of an extended classical receptive field model of retinal ganglion cells," Biological Cybernetics, 94, 89-96, 2006.
5. K. Ghosh, S. Sarkar and K. Bhaumik, "Proposing new methods in low-level vision from the Mach band illusion in retrospect," Pattern Recognition, 39, 726-730, 2006.
6. K. Ghosh, S. Sarkar and K. Bhaumik, "A Possible Mechanism of Zero-crossing detection using the concept of extended classical receptive field of retinal ganglion cells," Biological Cybernetics, 93, 1-5, 2005.
7. S. Sarkar, K. Ghosh and K. Bhaumik, "Generation of interpolation kernels based on a combination of Gaussians of different scales," National Conference on Image Processing with Focus on Medical Applications, Bangalore, India, March 23-25, 2005.

1. Name, Passport sized photograph and educational background

Name – Dr. Chandi Charan Dey

Educational background:

M. Sc. (Phys.) – Burdwan University, West Bengal

Ph. D. – March 1995, Jadavpur University

2. Academic profile including earlier appointments, awards etc.

Post Doctoral Fellow – From April 1995 to Aug. 1997, Saha Institute of Nuclear Physics
Lecturer SC – From August 1997 to January 2000, Saha Institute of Nuclear Physics
Reader D – From February 2000 to January 2004, Saha Institute of Nuclear Physics
Associate Professor E – From Feb. 2004 to Jan. 2007, Saha Institute of Nuclear Physics
Professor F – From February 2007 to till date, Saha Institute of Nuclear Physics

Visiting positions abroad

Göttingen University, Germany – From October 2000 to December 2000
Pennsylvania State University, USA (Post Doc. Fellow) – From Oct. 2001 to Sept. 2002
HISKP, University of Bonn, Germany – From August 1, 2004 to August 31, 2004
University of Leipzig, Germany – From August 2005 to November 2005
University of Leipzig, Germany – From March 26, 2007 to May 25, 2007

3. Essential strength of research/development output

My main research interest is on the applications of time-differential perturbed angular correlation (TDPAC) technique in Material Science. The TDPAC is a nuclear technique based on the interaction of electromagnetic moments (electric quadrupole or magnetic dipole) of a specific nuclear level with the electric field gradient or the magnetic field generated at the nuclear level by the surrounding environment of the nucleus.

With an aim to apply this nuclear technique in materials for studies of i) point defects ii) structural and magnetic phase transitions in metallic and inter-metallic systems iii) thin film and v) nano-crystalline materials, a four detector TDPAC spectrometer with ultra fast BaF_2 detectors has been developed. This spectrometer can acquire four spectra (two at 180° and two at 90°) simultaneously and thus making it suitable for the above mentioned studies where a large coincidence data are required. The present set up is equipped with a provision for measurements at different temperatures of the samples in the range 77K to 900K. A further development of the TDPAC spectrometer for measurements at higher temperatures (up to1300K) and in inert atmosphere is currently going on. Two studies that have been carried out recently using TDPAC are following-

Chemical transformation of crystalline hafnium tetrafluoride:

In this work, chemical transformation of $HfF_4.3H_2O$ crystal has been studied. The crystalline compound was produced by dissolving a piece of active hafnium metal (activated to ^{181}Hf by thermal neutron in the reactor at Mumbai) in HF and evaporating

the resulting solution (hafnium hexafluoride complex in HF). From our TDPAC studies, it has been found that the compound $HfF_4.3H_2O$ dehydrates directly to anhydrous HfF_4 without producing monohydrate as an intermediate and do not support the earlier idea that two water molecules of $HfF_4.3H_2O$ are loosely bound. (Ref. given in section 5)

Thin films of hafnium dioxide studied by TDPAC:

Here, thin films of HfO_2 produced by pulsed laser deposition at various partial oxygen pressures have been studied to determine the nuclear quadrupole interaction (NQI) and presence of any ferromagnetism in HfO_2 thin film. The samples were neutron activated and measured at room temperature as received as well as after annealing in air. All spectra exhibited two to three inequivalent lattice sites, even after annealing, and did not have the same endpoint. At 0.3 mbar oxygen partial pressure and annealing for 5 hours at 1073K the majority (88%) of the sites exhibited NQI parameters as reported for the bulk monoclinic phase (ω_Q = 125 Mrad/s, η = 0.34). At partial oxygen pressures between 0.0003 and 0.03 mbar the corresponding NQI frequencies were always lower compared to the bulk value, they increased but remained lower even after prolonged annealing. There was no indication of room-temperature ferromagnetism in HfO_2 thin film. This work has been carried out at Leipzig in collaboration with Prof. Dr. T. Butz of Leipzig University, Germany (to be published).

4. Future research/development plan

I would like to conduct research on the applications of TDPAC technique in Material Science studies viz. i) defect studies of materials, ii) structural and magnetic phase transitions in materials, iii) thin film oxide studies and iv) studies on macromolecular motion using the TDPAC spectrometer that has been developed in our laboratory at SINP.

5. List of important publications:

1. Chemical transformation of crystalline hafnium tetrafluoride studied by perturbed angular correlation spectroscopy- C. C. Dey, Z. Naturforsch. **64a**, 739 (2009)

2. A perturbed angular correlation spectrometer for material science studies – C. C. Dey, Pramana 70, 835 (2008)

3. Behavior of hafnium fluoride octahedral complex in HF at low temperature studied by TDPAC – C. C. Dey, Hyperfine Interact. 175, 185 (2007)

4. Atomic "after effects" following ^{181}Hf β^- decay – C. C. Dey, Hyperfine Interact. 155, 27 (2004)

5. Evidence of "penetration effects" for the 94 keV K-allowed unhindered transition in ^{169}Tm – C. C. Dey, B. K. Sinha and S. K. Basu, Phys. Rev. C 55, 1197 (1997)

6. Multipole mixing ratios of the 198 and 177 keV gamma ray transitions in ^{169}Tm – C. C. Dey and B. K. Sinha, Phys. Rev. C49, 533 (1994)

7. Differential angular correlation of the 1408-122 keV cascade and the g factor of the 122 keV 2^+ level of ^{152}Sm – C. C. Dey, N. R. Das, B. K. Sinha and R. Bhattacharya, Can. J. Phys. 70, 268(1992)

8. Measurements of subnanosecond nuclear lifetimes – C. C. Dey, B. K. Sinha and R. Bhattacharya, Phys. Rev. C44, 2213 (1991)

Name: Nayana Majumdar

Education:

Degree/Diploma	*University/Institute*	*Year*
B.Sc	Visva Bharati	1988
M. Sc	Visva Bharati	1990
Post M.Sc.	Saha Institute of Nuclear Physics	1991
Ph.D.	Calcutta University	1998

Academic Profile:

Post	*University/Institute*	*Period*
Post-doctoral	Saha Institute of Nuclear Physics	1998 - 2000
Reader D	-do-	2000 - 2006
Associate Professor E	-do-	2006 - 2008
Professor F	-do-	2008 -

Awards:
'Young Scientist' Award, 84th. Indian Science Congress, 1997

Research/Development Output:

- ***Development of a novel formulation in BEM:*** The potential and flux field in a non-dissipative system governed by Poisson's equation are obtained by a few numerical techniques of which Boundary Element Method (BEM) is one. The method involves solution of the potential from the singularity distribution over the boundaries of a given system following Green's function technique while the singularities can be obtained by satisfying the boundary conditions (of Dirichlet/Neumann/Robin type) in similar manner. In a novel approach following analytic integration of Green's function of the singularity uniformly distributed over a typical rectangular and/or triangular panel and its derivative, the difficulties related to the mathematical and physical singularities in BEM could be removed. Owing to the analytic formulation, the new method can provide nominally exact results and thus has been christened as nearly exact Boundary Element Method (neBEM). A solver based on this new formulation has proved the efficacy of the approach in determining the potential and flux field very precisely in various branches of physics. A program library, namely Inverse Square Law Exact Solutions (ISLES), has been developed to incorporate the closed form expressions to be used to generate the influences of the singularities. The neBEM solver making use of the ISLES library generates and manipulates the influence matrix for finding out the surface singularities and finally the potential and the flux field in a system.
- ***Design analysis and optimization of gaseous detectors:*** The neBEM solver has found significant application in R&D of the nuclear/particle gaseous detectors used for tracking and imaging purposes. Electrostatic configuration of these detectors influences their performance significantly and thus requires a thorough simulation in order to optimize their design addressing issues like gain, cross-talk, sparking and finally interpret their responses. 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 classical wire chambers and chambers like Resistive Plate Chamber (RPC), Multi-gap RPC and some of the new-generation Micro-Pattern Gaseous Detectors (MPGD), namely Micro-Wire, MicroMEGAS, THGEM. Some of these devices have been designed to be used in large-scale experiments like INO, CBM. The detectors have been studied for the effects that various geometrical parameters like shape, width, thickness as well as the material of the structural components produce on the electrostatic configuration. The same has been performed for artifacts like spacers, edges, surface asperities of the materials used in those devices.
- ***Development of analysis framework of new-generation detectors:*** The neBEM has been further optimized as a toolkit to be interfaced with an existing simulation software GARFIELD which performs a detailed simulation of the overall dynamics of a gaseous detector. Presently, the GARFIELD with the neBEM acting as the module for field simulation is being maintained at CERN as a common software framework for detector physics studies. This work has been performed as a part of RD51 collaboration launched by CERN to pursue a collective effort towards the development of MPGDs. This framework

can now provide a complete analysis on the dynamics of any complicated state-of-art geometry.

- ***Electrostatic analysis of MEMS and nano-devices:*** Electrostatic configuration of devices from other branches of science and technology has also been simulated using the neBEM solver. These include a few MEMS and nano-structures which are usually found to be difficult to study with other numerical methods due to large variation in their length scales. Several electrostatic problems related to the effect of three dimensionality and fringe field, capacitance, charge density distribution for different configurations have been studied in detail.
- ***Analysis of electrostatic problems:*** Several electrostatic problems notoriously difficult to solve numerically are the devices with singularities of various orders including plates, cubes and L-shaped conductors containing edges and corners. Using the neBEM, it has been possible to obtain accurate estimates of integral features such as the capacitance of a given conductor, charge density distribution at the edges/corners.
- ***Formulation of space charge evolution:*** A solver, namely Particle on Surface (PARSUR), for simulating the space charge evolution in gaseous detectors has been initiated using the fundamentals of neBEM. The preliminary calculation for a simple model has produced promising results in comparison to the standard approach, particle-in-cell (PIC), used for simulating similar physical phenomena in other areas.
- ***Experimental efforts to study detector physics:*** Experimental efforts to study various physics issues in detector dynamics have been initiated with several developments. A set-up including gas handling system and test chamber has been almost completed. A TPC device with gaseous detector readout has been procured for this purpose which is being readied for testing. The planning of the experiments is underway with some of the detectors being designed and fabricated here and a few to be supplied by the collaborators from Saclay, France.

Future Research/Development Plan:

- ***Study of detector physics:*** A detailed experimental and numerical study of the physical processes occurring in MPGDs has been planned. The basic aspects like electric field, ion drift, gain, in these detectors are planned to be measured. In this regard, the following developmental work will be carried out in near future.
  a) Development of a laser setup for precisely located event generation.
  b) Development of a set-up for measuring electric field using the scintillation signal from gaseous medium with appropriate readout arrangements.
- ***Optimization study for upcoming experiments:*** The problems like ion backflow, aging, sparking, are to be addressed for the optimization of these detectors for the upcoming colliders like ILC, sLHC and rare event detection like double beta decay. Some of these aspects are relevant to optimize RPCs for INO.
- ***Application of neBEM:*** The formulation of neBEM allows a large class of problems in various areas to be investigated. Solid state detectors, nano-devices, impedance tomography, may be some of these topics which will be explored.
- ***Exploration on the possible applications of MPGDs:*** The application of the MPGDs in various issues like earthquake and fire/smoke and radiation hazard detection, monitoring related to geological and archeological subjects will be explored.

List of Important Publications:

1. **N. Majumdar**, S. Mukhopadhyay, S. Bhattacharya, **Journal of Instrumentation 4 P10013 (2009)**, *"3D field simulation in GEM-type structures"*
2. **N. Majumdar**, S. Mukhopadhyay, S. Bhattacharya, **Nuclear Instruments and Methods in Physics Research A 602, 719 – 722 (2009)**, *"3D electrostatic field simulation of a resistive plate chamber"*
3. S. Mukhopadhyay, **N. Majumdar**, **Engineering Analysis with Boundary Elements 33, 105 - 119 (2009)**, "*A study of three-dimensional edge and corner problems using the neBEM solver*"
4. **N. Majumdar**, S. Mukhopadhyay, S. Bhattacharya, **Nuclear Instruments and Methods in Physics Research A 595, 346 - 352 (2008)**, *"Computation of 3D electrostatic weighting field in Resistive Plate Chambers"*
5. **N. Majumdar** and S. Mukhopadhyay, **Journal of Instrumentation 2 P09006 (2007)**, *"Simulation of 3D electrostatic configuration in gaseous detectors"*
6. **N. Majumdar**, S. Mukhopadhyay, **Nuclear Instruments and Methods in Physics Research A 566, 489-494 (2006)**, *"Simulation of three-dimensional electrostatic field configuration in wire chambers: A novel approach"*
7. S. Mukhopadhyay, **N. Majumdar**, **IEEE/ACM Transactions on Nuclear Science, Vol. 53, 539-543 (2006)**, *"Effect of finite dimensions of gas detectors on electric field configuration"*
8. S. Mukhopadhyay, **N. Majumdar**, **Engineering Analysis with Boundary Elements, Vol. 30, 687-696 (2006)**, *"Computation of 3D MEMS electrostatics using a nearly exact BEM solver"*

Manoj Kumar Sharan

1.Educational Background:

Degree	*Year*	*Institution*	*Subject(s)*	*Performance*
B.Sc (Hons.)	1985	Ranchi University	Physics (Hons.) Maths, Geology	First Class (70%)
M.Sc	1987	Pune Univesity	Physics	First Class (75%)
Ph.D	1993	Mumbai University (TIFR)	Physics	-

2.Academic assignments:

Sl. #	Position held	Univ./Inst.	Period	
			From	To
1	Research Associate	SUNY(Stony Brook), New York	3/1994	3/1996
2	CSIR Research Associate	NSC, New Delhi	07/1996	01/1998

3. Scientific contribution :

I have been involved in setting up, testing and doing experiments in the field of nuclear and high energy physics. I have done accelerator based experiments at VECC, Kolkata, Pelletron at NSC and Mumbai and SUNY (Stony Brook)to study the dynamics of early stages of reactions by studying high energy gamma-rays.. In last few years, I have been mainly involved in setting up systems used for high energy physics – MAP and INO project.

I was involved in setting up of VME base Data acquisition system which was further set up for testing the MANAS electronics.. In INO project, I have been involved in the setting up of a gas mixing system. The system is currently being used for testing and settting up RPC(resistive plate chamber) detectors.

One aspect of the INO project is the study of neutrinoless double beta-decays in some nuclei which could give information about neutrino mass and tell whether neutrinos are their own anti-particles or not. In collaboration with IIT Kharagpur, we are involved in planning and feasibility study of positron double beta decay experiments. We are currently setting up a CdZnTe detector for such studies along with a PC based DAQ for taking data and comparing it with simulations.. Such a setup would be also helpful in estimating background at the INO site.

4. Future Research/Development Plan:

I intend to participate and contribute to PANDA program which is one of the major project of the FAIR facility at Darmstadt. It is proposed that in such studies interactions between antiprotons and fixed target protons will be carried out in the momentum range of 1.5Gev/c -15 GeV/c. The PANDA program involves various measurements with high yield of anti-proton induced reactions which addresses fundamental questions of QCD.From the experimental side, the Indian collaboration (BARC, IIT Mumbai, TIFR, SINP) intends to participate in the building of luminosity monitor detectors and research of silicon PMTs. Towards this goal, we have setup the Pandaroot simulation and we are planning to do the simulation for detector geometry that will be used for luminosity monitor. Further, I will get involved in the setting up and testing of Si PMT's. These will be major components for other high energy physics experiments as well.

5 List of important Publications :

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1. *Control system for a four component gas mixing uni,*, S. Bose, S. Biswas, S. Saha, M.K.Sharan, S. Bhattacharya, *Nucl. Inst. & Methods, **A602**, 839*
2. *Positron double beta decay in CdZnTe materials*, , M.K.Sharan, Published in Neutrinoless Double Beta Deay 115, (2008)(Editors VKB Kota & U Sarkar), Narosa Publishing House, New Delhi
3. *Ultradipole Photon Production in 40 and 50 MeV α-Nucleus Collisions*, M.K.Sharan, Y.K.Agarwal, C.V.K.Baba, D.R.Chakrabarty, V.M.Datar, *Phys.Rev. **C48**, 2845 (1993)*

HIGH ENERGY NUCLEAR AND PARTICLE PHYSICS DIVISION

HIGH ENERGY NUCLEAR AND PARTICLE PHYSICS DIVISION:

Permanent members of the Division:

Scientific		Technical		Adm/Auxiliary	
Sunanda Banerjee	Sr. Prof.	Lipy Das Bose	SA	Sanjib Mondal	Upper Div Clerk
Pratap Bhattacharya	Prof.	Dipankar Das	SA	Rakesh Kumar Ram	Helper
Sukalyan Chattopadhyay	Prof.				
Pradip Kumar Roy	Prof.				
Abhee K. Dutt-Mazumder	Prof.				
Tinku Sinha	Scientist				

Ph. D. Students (2007 onwards):
Pradip Dutta, Danish Azmi, Sanjoy Pal, Indranil Das, Santosh Roy, Subhrajyoti Biswas, Kaushik Pal, Lusaka Bhaatacharya, Sreemoyee Sarkar, Palash Khan, Mohotsob Mondal

Post docs. And visiting scientists (2007 onwards):
Supriya Das, Debasish Das, Danish Azmi, Kaushal Das

Equipment and Resources in the Division:

1. Facilities for Gas Detector Fabrication.
2. Detector (gas and scintillation) testing facilities
3. Cosmic Muon Trigger Bench
4. VME DAQ for ASIC readout testing
5. One Itanium Server for phenomenological calculations.

Research Activities:

The research activities in High Energy Nuclear Physics used to involve the experimental and theoretical studies of matter produced in Ultra-relativistic High Ion Collisions and nuclear structure studies at high spin. There is a plan to extend these activities in the field of experimental particle physics and detector R & D activities.

In the domain of experimental high energy, Saha Institute has played a key role in ALICE Collaboration at Large Hadron Collider, CERN. Currently, the 1.1 Million readout channels of the Muon Spectrometer of ALICE are being successfully readout for p-p collisions using the MANAS chip which has been developed by Saha Institute. In addition, the 2nd Tracking Station of the spectrometer which has been commissioned by SINP in February, 2008 and is fully functional since then. During 2010, which is the first year of LHC operation, SINP is responsible for the run coordination of the Muon Spectrometer of ALICE. Thus, currently SINP is playing a significant role on collection, quality monitoring and analysis of the data. SINP team has also successfully commissioned the High Level Trigger for Muon Spectrometer in May, 2010.

On the theoretical side, the photon spectra in anisotropic quark-gluon-plasma (QGP) have been calculated and compared with the experimental data measured at RHIC, BNL. We have also have explored the possibility of para-ferro phase transition in dense quark system which may be realized at

the core of neutron stars. We have also calculated a charge symmetry violating potential due to rho-omega and pi-eta mixing for asymmetric nuclear matter.

The nuclear structure studies are being pursued at the two Pelletron Accelerator Centres at Delhi (IUAC) and Mumbai (BARC-TIFR) using the Indian National Gamma Array (INGA). The primary object of these studies has been to understand the various excitation modes through which the high angular momentum states are formed. In our group, we have been working in mass-100 region and have studied the properties of ^{103,104,108,109,110}Ag and ^{105,106,108,109,110}Cd. This systematic study has revealed both interplay and competition between collective rotation and Shears mechanism in this mass region.

The activities planned for experimental particle physics is to participate in the CMS experiment also at the Large Hadron Collider, CERN. The phase I of the experiment has started taking data since December 2009 and the various detector components are getting commissioned. The new recruits of the institute have been involved in these activities for the past several years and they will form a core group taking part in the software, computing, analysis activities as well as in the future upgrade program of the detector. There is also a plan to start a generic detector R & D activity focussing on future needs in nuclear and high energy physics experiments.

List of publications (2007 –date)

2010

1. Midrapidity antiproton-to-proton ratio in pp collisions at $\sqrt{s}$ = 0.9 and 7 TeV measured by the ALICE experiment, **ALICE Collaboration** , Phys. Rev. Lett. (in press).

2. Two-pion Bose-Einstein correlations in pp collisions at sqrt(s)=900 GeV, **ALICE Collaboration,** *Phys. Rev D (in press).*

3. *Jet conversion photons from an anisotropic Quark-Gluon-Plasma*, Lusaka Bhattacharya and **Pradip Roy,** *J. Phys. G (in press).*

4. Photons from jet - plasma interaction in relativistic heavy ion collisions, Lusaka Bhattacharya and **Pradip Roy,** Euro. Phys. C (in press).

5. First proton–proton collisions at the LHC as observed with the ALICE detector: measurement of the charged-particle pseudorapidity density at $\sqrt{s}$*=900* GeV, **ALICE Collaboration,** Euro Phys. J. C, **1-2**, 111 (2010).

6. *pi-eta mixing and charge symmetry violating NN potential in matter*, S. Biswas, **P. Roy** and **A. K. Dutt-Mazumder,** *Phys. Rev* ***C81****,* 064002 (2010).

7. *Symmetric and anti-symmetric Landau parameters and magnetic properties of dense quark matter***,** K. Pal, **A. K. Dutt-Mazumder,** *Phys. Rev.* ***C81,*** 054906 (2010).

8. *Rapidity distribution of photons from an anisotropic quark gluon plasma*, Lusaka Bhattacharya and **Pradip Roy,** *Phys. Rev.* ***C81,*** 054904 (2010).

9. *Band crossing in a shears band of ^{108}Cd***,** Santosh Roy, Pradip Datta, S. Pal, **S. Chattopadhyay,** S. Bhattacharya, A. Goswami, H. C. Jain, P. K. Joshi, R. K. Bhowmik, R. Kumar, S. Muralithar, R. P. Singh, N. Madhavan, and P. V. Madhusudhana Rao, *Phys. Rev.* **C81,** 054311 (2010).

10. *Matter induced charge symmetry violating NN potential***,** S. Biswas**, P. Roy** and **A. K. Dutt-Mazuimder,** *Phys. Rev* **C81,** 041006 (2010).

11. *Observation of a VHE cosmic-ray flare-signal with the L3+C muon spectrometer*, **L3 Collaboration**, *Astroparticle Physics* **33** (2010) 24.

12. *Commissioning of the CMS experiment and the cosmic run at four tesla*, **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03001.

13. *Performance of the CMS Level-1 trigger during commissioning with cosmic ray muons and LHC beams*, **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03002.

14. *Performance of the CMS drift-tube chamber local trigger with cosmic rays*, **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03003.

15. *Fine synchronization of the CMS muon drift-tube local trigger using cosmic rays*, **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03004.

16. *Commissioning of the CMS High-Level Trigger with cosmic rays*, **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03005.

17. *CMS data processing workflows during an extended cosmic ray run*, **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03006.

18. *Commissioning and performance of the CMS pixel tracker with cosmic ray muons*, **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03007.

19. *Commissioning and performance of the CMS silicon strip tracker with cosmic ray muons*, **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03008.

20. *Alignment of the CMS silicon tracker during commissioning with cosmic rays*, **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03009.

21. *Performance and operation of the CMS electromagnetic calorimeter*, **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03010.

22. *Measurement of the muon stopping power in lead tungstate*, **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03007.

23. *Time reconstruction and performance of the CMS electromagnetic calorimeter*, **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03011.

24. *Performance of the CMS hadron calorimeter with cosmic ray muons and LHC beam data*, **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03012.

25. *Performance of CMS hadron calorimeter timing and synchronization using test beam, cosmic ray, and LHC beam data*, **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03013.

26. *Identification and filtering of uncharacteristic noise in the CMS hadron calorimeter,* **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03014.

27. *Performance of the CMS drift tube chambers with cosmic rays,* **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03015.

28. *Calibration of the CMS drift tube chambers and measurement of the drift velocity with cosmic rays,* **CMS Collaboration**, *Journal of Instrumentation,* **5** (2010) T03016.

29. *Performance study of the CMS barrel resistive plate chambers with cosmic rays,* **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03017.

30. *Performance of the CMS cathode strip chambers with cosmic rays,* **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03018.

31. *Aligning the CMS muon chambers with the muon alignment system during an extended cosmic ray run,* **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03019.

32. *Alignment of the CMS muon system with cosmic-ray and beam-halo muons,* **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03020.

33. *Precise mapping of the magnetic field in the CMS barrel yoke using cosmic rays,* **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03021.

34. *Performance of CMS muon reconstruction in cosmic-ray events*, **CMS Collaboration**, *Journal of Instrumentation* **5** (2010) T03022.

2009

35. *Spin susceptibility of degenerate quark matter,* K. Pal and **A. K. Dutt-Mazumder,** *Phys. Rev* **C80,** 054911 (2009).

36. *Ground state energy of spin polarized quark matter with correlation,* K. Pal, S. Biswas and **A. K. Dutt-Mazumder,** *Phys. Rev.* **C80,** 024903 (2009).

37. *Measuring the isotropization time of quark gluon plasma from direct photons at energies available at the BNL Relativistic Heaviy Ion Collider (RHIC),* Lusaka Bhattacharya and **Pradip Roy,** *Phys. Rev.* **C79,** 054910 (2009).

38. *Spin dependent Fermi Liquid parameters and properties of polarized quark matter,* K. Pal, S. Biswas and **A. K. Dutt-Mazumder,** *Phys. Rev.* **C79,** 015205 (2009).

39. *The CMS barrel calorimeter response to particle beams from 2 to 350 GeV/c,* **USCMS Collaboration and ECAL/HCAL Collaboration,** *European Physics Journal* **C60** (2009) 359.

2008

40. *Abrupt change of rotation axis in ^{109}Ag,* P.Datta**,** S. Roy, S. Pal, **S. Chattopadhyay**, S. Bhattacharya, A. Goswami, M. Saha. Sarkar, J. A. Sheikh, Y. Sun, P. V. Madhusudhana Rao, R. K. Bhowmik, R. Kumar, N. Madhavan, S. Muralithar, R. P. Singh, H. C. Jain, P. K. Joshi, Amita, *Phys. Rev.* **C78,** 021306 (2008) (R).

41. *Photons from anisotropic quark gluon plasma,* Lusaka Bhattacharya and **Pradip Roy,** *Phys. Rev.* **C78,** 064904 (2008).

42. Effects of the Dirac sea on pion propagation in asymmetric nuclear matter, S. Biswas and A. K. Dutt-Mazumder, Phys. Rev. **C77,** 045201 (2008).

43. The ALICE muon spectrometer and related Physics, S. Bose, **S. Chattopadhyay**, I. Das, S. Pal, P. Roy & T. Sinha, J. Phys. Nucl. & Part. **G35**, 104145 (2008).

44. *Matter induced charge symmetry breaking and pion form factor in nuclear medium,* **P. Roy**, **A. K. Dutt-Mazumder,** S. Sarkar, J. Alam, *J. Phys. Nucl. & part.* **G35**, 065106 (2008).

45. *Real Time Global Tests of the ALICE High Level Trigger Data Transport Framework,* B. Becker, **S. Chattopadhyay**, C. Cicalo J. Cleymans, G. de Vaux, R.W. Fearick, V. Lindenstruth, M. Richter, D. Rorich, F. Staley, T.M. Steinbeck, A. Szostak, H. Tilsner, R. Weis, Z.Z. Vilakazi, *IEEE Transactions on Nuclear Science, **55,*** issue 2, 703 (2008).

46. *Design, performance and calibration of the CMS forward calorimeter wedges*, **CMS HCALGroup**, *European Physics Journal* **C53** (2008) 139.

47. *Design, performance, and calibration of CMS hadron-barrel calorimeter wedges*, **CMS HCAL Group**, European Physics Journal **C55** (2008) 159.

48. *Study of hadronic event shape in flavour tagged events in e^+e^- annihilation at $\sqrt{s}$ = 197 GeV*, **L3 Collaboration**, *PMC Physics* **A2** (2008) 6.

49. *Design, performance, and calibration of the CMS Hadron outer calorimeter,* **CMS HCAL Group**, *European Physics Journal* **C57** (2008) 653.

50. *The CMS experiment at the CERN LHC,* **CMS Collaboration**, *Journal of Instrumentation* **3** (2008) S08004.

2007

51. *Thermal Radiation from Au + Au Collisions at $\sqrt{s}$ = 200 GeV/A Energy.* J. Alam, J. K. Nayak, **P. Roy**, **A. K. Dutt-Mazumder**, B. Sinha, *J. Phys. Nucl. & part* **G34,** 871 (2007).

52. *Collisional energy loss and the suppression of high p(T) hadrons,* J. Alam, **A. K. Dutt-Mazumder**, **P. Roy,** *Nucl. Phys. **A785,*** 245 (2007).

53. *Study of the charmed baryonic decays $B^{-0} \to \Sigma_c^{++} p^- \pi^-$ and $B^{-0} \to \Sigma_c^{0} p^- \pi^+$*, **Belle Collaboration**, *Physical Review* **D75** (2007) R011101.

54. *Observation of time-dependent CP violation in $B^0 \rightarrow \eta' K^0$ decays and improved measurements of CP asymmetries in $B^0 \rightarrow \varphi K^0$, $B^0 \rightarrow K_s^0 K_s^0 K_s^0$ and $B^0 \rightarrow J/\psi\ K^0$ decays,* **Belle Collaboration**, *Physical Review Letters* **98** (2007) 031802.

55. *Measurement of inclusive D_s, D^0 and J/ψ rates and determination of the $B_s^* \bar{B}_s^*$ production fraction in $b\bar{b}$ events at the Y(5S) resonance,* **Belle Collaboration**, *Physical Review Letters* **98** (2007) 052001.

56. *Puzzles of excited charm meson masses,* B. Ananthanarayan, **Sunanda Banerjee**, K. Shivaraj, A. Upadhyay, *Physics Letters* **B651** (2007) 124.

57. *CMS technical design report, volume II: Physics performance*, **CMS Collaboration,** *Journal of Physics* **G34** (2007) 995.

Name: Sunanda Banerjee (DOB: 20.07.1952)

Educational Background:

B.Sc, (1971) from Presidency College; D.I.C. (1976) from Imperial College; Ph.D. (1976) from London University; Post-Doc at Imperial College (1975-77).

Academic Profile Including Earlier Appointments:

Sunanda joined TIFR as a visiting fellow in January 1978 and was associated with TIFR till December, 2007 and has gone through the ranks of Fellow (78-85), Fellow-SD (85-87), Reader (87-91), Associate Professor (91-97), Professor G & H (97-06), Senior Professor I (06-07). He was a guest scientist at KfK, Karlsruhe, Germany (81-82), paid associate at CERN for 3 periods (86-88, 95-96, 03-04). He worked as an instructor in the World Laboratory (88-90) and as an application scientist at Fermilab (07-10) before joining SINP as a Senior Professor.

Academic Honours:

- Young Associtae of Indian Academy of Science, India (1985-1988)
- Fellow of Indian Academy of Science, Bangalore, India (2002)
- Fellow of Indian National Science Academy, New Delhi, India (2005)

Research Activities:

1. Member of the CMS experiment at CERN since 1994. Worked on the radiation damage of crystals, design of the hadron calorimeter and participated in the construction of the outer hadron calorimeter. Coordinated the offline software work with emphasis on detector geometry and simulation from the early work with CMSIM to the more advanced simulation work with Geant4 using the OSCAR and CMSSW framework.
2. Led the TIFR group in the Belle experiment at the asymmetric e^+e^- collider at KEK-b during 2002-2006. Worked on the Crystal Clear collaboration to study properties of scintillating crystals during 1992-1996. Also worked in the two R&D projects RD44 and RD45 to evaluate object oriented programming for simulation and persistency during 1996-2001. Working currently in the Geant4 collaboration for the hadronic physics models.
3. Worked in the e^+e^- collider experiment L3 at LEP, CERN from 1983-2004. Worked on WA83 experiment at the omega spectrometer at CERN to look for direct soft photon production in hadronic collisions. Worked on three hybrid spectrometer experiments with rapid cycling bubble chamber at CERN (NA23) and the little European bubble chamber at CERN (NA27) and at FNAL (E743). Worked on the e^+e^- experiment using the CELLO detector at PETRA, DESY, Hamburg. Worked on a variety of bubble chamber experiments with hadron and neutrino beams at the Rutherford laboratory (K^+d experiment at 2-3 GeV/c – thesis experiment) and at CERN (antiproton-proton at 12 GeV/c; narrow band ν experiments from SPS, K^-p at 110 GeV/c, K^+d at 70 GeV/c, etc).
4. Have extensive experience in Computer Software related to High Energy Physics. For example set up online geometry for manual measuring machines at Imperial College, worked on the

simulation, data base and reconstruction programs for L3 experiment, worked in the development of the simulation toolkits Geant3 and Geant4, etc.

Future Research/Development Plans:

Develop a group to actively take in a frontline experiment in high energy physics. The first step will be to participate in the CMS experiment. In addition to take responsibilities of some key areas in offline software and computing, emphasis will be given to data analysis in tests of the Standard Model and searches of new physics, notably the Higgs boson and Supersymmetry. Also try to utilize the exisiting expertise in SINP to participate in heavy ion program and some generic detector R & D plans in view of future detectors for upgrade program of the LHC.

List of a few Selected Publications:

Sunanda has more than 470 publications in refereed international journals. A few of them have citations exceeding 1000. Here is a list of 11 selected publications:

1. "Geant4 – a Simulation Toolkit", Nuclear Instruments and Methods **A506** (2003) 250
2. "Z^o Parameters and m_{top} from LEP 1990 Data.", International Journal of Modern Physics A7 (1992) 1853.
3. L3 Collaboration, "Determination of α_s from Hadronic Event Shapes Measured on the Z^o Resonance", Physics. Letters B284 (1992) 471.
4. L3 Collaboration: "A Determination of the Properties of the Neutral Intermediate Vector Boson Z^o", Physics Letters B231 (1989) 509.
5. EHS LEBC Collaboration , "Charm Hadron Properties in 400 GeV/c pp Interactions", Zeitschrift für Physik C40 (1988) 321.
6. EHS RCBC Collaboration , "A Study of Λ Production in Target Fragmentation Region from pp Interactions at 360 GeV/c in the Triple Regge Framework", Zeitschrift für Physik C29 (1985) 339.
7. CELLO Collaboration: "The Influence of Fragmentation Models on the Determination of the Strong Coupling Constant in e^+e^- Annihilation into Hadrons", Nuclear Physics B218 (1983) 269.
8. CELLO Collaboration: "Topology of Hadronic e^+e^- Annihilation Events at 22 and 34 GeV CM Energy", Physics Letters B110 (1982) 329.
9. Bombay-CERN-Crakow-Innsbruck-London-Vienna-Warsaw Collaboration: "Inclusive φ Production in K^-p Interactions at 110 GeV/c and Search for Structure in $\varphi\pi^-$", Zeitschrift für Physik C31 (1986) 401.
10. Aachen-Bonn-CERN-London-Oxford-Saclay Collaboration: "Analysis of Nucleon Structure Functions in CERN Bubble Chamber Neutrino Experiments", Nuclear Physics B142 (1978) 1.
11. Brussels-CERN-Imperial College-Mons-Orsay Collaboration: "Evidence for a Narrow Peak in $K^o\,\pi^+\pi^-\pi^\pm$ at 2.6 GeV in 12 GeV/c antiproton-proton Interactions", Physics Letters B66 (1977) 185.

Thesis Advisor and Student Supervisor:

- Seven students for Ph.D.: Suvadeep Bose, Seema Sharma, Pratima Jindal, Garima Gokhroo, Swagato Banerjee, Satyaki Bhattacharya, Subir Sarkar
- 8-10 summer students at TIFR, Mumbai (1983-2000), 4 students at the World Laboratory

Career Profile : Sukalyan Chattopadhyay

Academic Qualification

Ph.D. **:** Ph.D work was carried out at Tata Institute of Fundamental Research and Ph.D degree awarded by University of Bombay (1994).

Thesis title: **"Investigation of Nuclear structure Studies at High Spins in mass-80 region**"

M.Sc. **:** 1988, in **Physics** (1^{st} Class), Joint M.Sc Program of TIFR and University of Poona

B.Sc **:** 1986, in **Physics Honors** (1^{st} Class), University of Calcutta.

Academic Profile:

A. High Energy Nuclear Physics

- Responsible for the first large scale production (1,10,000 in number) of ASIC (named MANAS) in India for an International Collaboration.
- Responsible for the production, installation, commissioning and Data Collection of 2^{nd} Muon Tracking Station of Muon Spectrometer.
- Responsible for the Run Co-ordination of the ALICE Muon Spectrometer in 2010, the First year of operation of LHC.
- Member of ALICE-Muon Spectrometer Management Board.

B. Low Energy Nuclear Physics

- Identification of high spin states of ^{84}Y for the first time.
- First observation of Co-existence of Principal and Tilted axis rotation.
- Identification of Antimagnetic rotation in $^{108}Cd.$
- First Observation of an abrupt change of rotational axis was observed in ^{108}Ag.

C. Ph.D. Guidance

1. **Dr. Pradip Datta:** Degree awarded in 2008.
2. **Dr. Danish Azmi:** Co-guide with Prof. Irfan. Degree awarded in 2008.
3. **Dr. Sanjoy Pal:** Degree awarded in 2009.
4. **Mr. Indranil Das:** Will be submitting in thesis in 2010.
5. **Mr. Santosh Roy:** Will be submitting in thesis in 2010.
6. **Mr. Polash Khan:** In his first year of thesis work.

D. Awards/Distinctions

1. Received TIFR Scholarship from 1986-'88 during post-graduation studies on basis of a written test and interview held at National level.
2. Identified as *potential young scientist in nuclear physics* by the Department of Science and Technology, Government of India in 1990.
3. Received the *best thesis award* of the Indian Physics Association for the year 1993. Life member of IPA.
4. Member of ALICE Collaboration Board.
5. Project Leader, ALICE Dimuon High Level Trigger.
6. Team Leader of the Indian Collaboration to ALICE Muon Spectrometer at LHC, CERN.

Future Research Plans

A. High Energy Nuclear Physics

- Measurement of production cross-sections of heavy-quark resonances at LHC energies.
- Measurement of event-by-event fluctuations at LHC energies.
- Measurement of the ratio of thermal photons to lepton pairs at LHC energies
- Search for Tri-critical point for Nuclear Matter at FAIR.

B. Low Energy Nuclear Physics

- Systematic study of Antimagnetic Rotation in Cadmium Isotopes.
- Study of interplay of Principal and Tilted Axis Rotation in Silver Isotopes.
- Nuclear Structure studies of neutron-rich Isotopes in mass-100 region through fission-induced and transfer-induced reactions.

Future Development Plan

- Development of new Physics Triggers using ALICE-HLT Framework
- On-line Data Visualization and Analysis based on GPUs.
- Development of Thick-GEM Detector with support from Indian industries.
- Development of Muon Radiography for detecting high-Z materials.

Important Publications in last Three years

1. *Midrapidity antiproton-to-proton ratio in pp collisions at $\sqrt{s}$ = 0.9 and 7 TeV measured by the ALICE experiment,*
ALICE Collaboration , Phys. Rev. Lett. (in press).

2. *Two-pion Bose-Einstein correlations in pp collisions at sqrt(s)=900 GeV*
ALICE Collaboration, Phys. Rev D (in press).

3. *Band crossing in a shears band of ^{108}Cd*
Santosh Roy, Pradip Datta, S. Pal, **S. Chattopadhyay,** et. al
Phys. Rev. C. 81 (2010), 054311.

4. *First proton–proton collisions at the LHC as observed with the ALICE detector: measurement of the charged-particle pseudorapidity density at $\sqrt{s}$=900 GeV*
ALICE Collaboration
Euro Phys. Journal C, 1-2, 111 (2010).

5. *Abrupt change of rotation axis in ^{109}Ag*
P.Datta**,** S. Roy, S. Pal, **S. Chattopadhyay**, et al
Phys. Rev. C. 78 (2008), 021306(R).

6. *The ALICE muon spectrometer and related Physics.*
S. Bose, **S. Chattopadhyay**, I. Das, S. Pal, P. Roy & T. Sinha.
Jour. Phys. G: Nucl. Part. Phys. 35 (2008), 104145.

7. *Real Time Global Tests of the ALICE High Level Trigger Data Transport Framework*
B. Becker, **S. Chattopadhyay**, et. al
IEEE Transactions on Nuclear Science, vol. 55, issue 2, pp. 703-709 (2008)

Career Profile : Pradip Kumar Roy

Academic Qualification

Ph.D. **:** Ph.D work was carried out at Variable energy Cyclotron Centre and Ph.D degree awarded by Jadavpur University (1998).

Thesis title: "Signatures of Quark Gluon Plasma"

M.Sc. **:** 1990, in **Physics** (1st Class), Jadavpur University, Kolkata

B.Sc **:** 1988, in **Physics Honors** (1st Class 2nd), Jadavpur University

Academic Profile:

A. High Energy Nuclear Physics

- Responsible for test beam data analysis for the 2nd Muon Tracking Station of Muon Spectrometer.
- Responsible for the implementation of the mapping of the 2nd station
- Fabrication of cathode pad chamber of dimuon arm in ALICE
- Testing of read-out chip MANAS

B. QGP Phenomenology

- Evaluation of electromagnetic probes of the QGP.
- Role of in-medium effects on different observables from relativistic heavy ion collisions.
- Meson mixing and charge symmetry violating nucleon-nucleon potential.
- Energy loss (jet quenching) and high transverse momentum hadron spectra.
- Photon production from anisotropic quark gluon plasma

C. Ph.D. Guidance

1. Ms. Lusaka Bhattacharya

Her Ph. D work is almost complete.

2. Mr. Mahatsab Mandal

He is in his first year of post M.sc. review work.

D. Awards/Distinctions

1. Received National scholarship.

Future Research Plan

High Energy Nuclear Physics

- Measurement of production cross-sections of heavy-quark resonances at ultra-relativistic heavy ion collision.
- In-medium properties of hadrons in warm and dense matter corresponding to CBM experiment.
- Damping rate of photons (gluons) in anisotropic QGP
- Radiative energy loss in anisotropic QGP
- Electromagnetic probes in anisotropic QGP using running strong coupling .
- Off-shell effects in electromagnetic probes from jet-plasma interaction in anisotropic QGP
- Foundation of Quantum Mechanics in regard to quantum computation

Future Development Plan

- **Development of ALICE and EUINDIA GRID.**
- **Installation of High Performance Computing Cluster**

Important Publications in High Energy Nuclear Physics

1. **Jet conversions photons from an anisotropic quark gluon plasma, L. Bhattacharya and P. Roy, J. Phys. G37, 105010 (2010)**
2. **Photons from jet-plasma interaction in relativistic heavy ion collisions, L. Bhattacharya and P. Roy, Euro. Phys. Journal C in press**
3. **Rapidity distribution of photons from an anisotropic quark gluon plasma, L. Bhattacharya and P. Roy, Phys. Rev. C81, 054904 (2010)**
4. **pi-eta mixing and charge symmetry and charge symmetry violating NN potential in matter, S. Biswas, P. Roy, and A. K. Dutt-mazumder, Phys. Rev. C81, 064002 (2010)**
5. **Matter-induced charge symmetry violating potential , S. Biswas, P. Roy, and A. K. Dutt-mazumder, Phys. Rev. C81, 014006 (2010).**
6. **Midrapidity antiproton to proton ration in pp collisions at sqrt(s) =0.9 and & TeV measured bi ALICE experiment, ALICE collaboration, Phys. Rev. Lett. 105, 072002 (2010)**
7. **First propon-proton collisions at the LHC as observed by the ALICE detector: measurement of the charged particle pseudo rapidity density at sqrt(s)=900 GeV, ALICE collaboration, Euro. Phys. J. C1-2, 111 (2010)**
8. **Charged particle multiplicity measurement in proton-proton collisions at sqrt(s)=0.9 and 2.36 TeV with ALICE at LHC, ALICE Collaboration, Euro. Phys. J. C68, 89 (2010)**
9. **Measuring the isotropization time of quark gluon plasma from direct photons at energies available at the BNL RHIC, L. Bhattacharya and P. Roy, Phys. Rev. C 79 , 054901 (2009)**
10. **Photons from anisotropic quark gluon plasma, L. Bhattacharya and P. Roy, Phys. Rev. C 78 , 064904 (2008)**
11. **rho-omega mixing and spin independent charge symmetry violating potential, S. Biswas, P. Roy, and A. K. Dutt-mazumder, Phys. Rev. C81, 045207 (2008)**
12. **Matter induced charge symmetry breaking and pion form factor in nuclear medium, P. Roy, A. K. Dutt-Mazumder, S. Sarkar, and J. Alam, J. Phys. G35, 065106 (2008)**
13. **Quenching of light hadrons at RHIC in a collisional energy loss scenario, P. Roy, J. Alam, and A. K. Dutt-Mazumder, J. Phys. G35, 104047 (2008)**
14. **Collisonal energy loss and the suppression of high pT hadrons, J. Alam, P. Roy, and A. K. Dutt-Mazumder, Nucl. Phys. A785, 245 (2007)**
15. **Energy loss and dynamical evolution of high pT hadrons, P. Roy, J. Alam, and A. K. Dutt-Mazumder, Phys. Rev. C73, 044911 (2006)**
16. **Stopping Power of QCD Plasma, A. K. Dutt-Mazumder, J. Alam, P. Roy, and B. Sinha, Phys. Rev. D71, 094016 (2005)**

Career Profile : Abhee Kanti Dutt-Mazumder

Academic Qualification

Ph.D. Work was carried out at the Saha Institute of Nuclear Physics. Degree awarded by the University of Calcutta (1998).

Thesis title: Vector Mesons in Nuclear Matter

M.Sc. University of Calcutta, 1992

P. Msc (diploma): Saha Institute of Nuclear Physics, 1993

Present Occupation: Professor, Saha Institute of Nuclear Physics

Positions Held: Research Associate (2004, till March 15th, 2004) VECC, India
Research Associate (2001-2003) TRIUMF, Canada
Post Doctoral Research Fellow (1998-2001), McGill University, Canada

Academic Profile (Research Areas):

A. Hadronic Physics

- Mass modification of hadrons in nuclear medium.
- In-medium spectral functions of hadrons at finite temperature and density
- Matter induced symmetry breaking processes and mixing phenomenon.
- QCD sum rule approach to study vector meson properties at finite density

B. QGP Phenomenology

- Calculation of partonic energy loss and momentum space diffusion constants in Quark Gluon Plasma
- Energy loss (jet quenching) and high transverse momentum hadron spectra relevant for RHIC and LHC.
- Drag and diffusion coefficients of quarks in dense and hot medium relevant for Compressed Baryonic Matter experiments (CBM).

C. Ph.D. Guidance

1. Subhrajyoti Biswas
(Writing thesis)
2. Kausik Pal
(Writing thesis**)**
. **3. Sreemoyee Sarkar** (Currently working)

D**. Post Msc. Review Supervisor**

1. Kausik Pal (2006)
2. Sreemoyee Sarkar (2009)
3. Pratik Mohanto (2010)

D. Teaching Experience

- **Post MSc (SINP) 2010 Statistical Mechanics**
- **SERC Main School 2006 (High Energy) Thermal Field Theory**
- **S.N. Bose National Centre for Basic Sciences, Advance Quantum Mechanics**
- **McGill University (2000), Path Integral Approach in Quantum Mechanics**
- **VECC, (1997) Kolkata Finite temperature field theory (Lecture Series)**.
- **Post Msc (1996) SINP, Angular Momentum Algebra (Lecture Series)**

Future Focus:

- Physics of dense quark matter.
- Foundation of Quantum Mechanics in regard to quantum computation

Recent Publications

1. **Energy and momentum relaxation of heavy fermion in dense and warm plasma, S. Sarkar and A. K. Dutt-Mazumder Phys. Rev D82, 056003 (2010).**
2. **Symmetric and anti-symmetric Landau parameters and magnetic properties of dense quark matter.K. Pal, A. K. Dutt- Mazumder, Phys.Rev.C 81, 054906 (2010)**.
3. **pi-eta mixing and charge symmetry and charge symmetry violating NN potential in matter, S. Biswas, P. Roy, and A. K. Dutt-mazumder, Phys. Rev. C81, 064002 (2010)**
4. **Matter-induced charge symmetry violating potential , S. Biswas, P. Roy, and A. K. Dutt-mazumder, Phys. Rev. C81, 014006 (2010).**
5. **Midrapidity antiproton to proton ration in pp collisions at sqrt(s) =0.9 and & TeV measured bi ALICE experiment, ALICE collaboration, Phys. Rev. Lett. 105, 072002 (2010)**
6. **First propon-proton collisions at the LHC as observed by the ALICE detector: measurement of the charged particle pseudo rapidity density at sqrt(s)=900 GeV, ALICE collaboration, Euro. Phys. J. C1-2, 111 (2010)**
7. **Charged particle multiplicity measurement in proton-proton collisions at sqrt(s)=0.9 and 2.36 TeV with ALICE at LHC, ALICE Collaboration, Euro. Phys. J. C68, 89 (2010)**
8. **Spin susceptibility of degenerate quark matter, K. Pal and A.K. Dutt-Mazumder Phys. Rev C 80 (2009) 054911.**
9. **Spin dependent Fermi Liquid Parameters and properties of polarized quark matter, K. Pal, S. Biswas and A. K. Dutt-Mazumder, Phys. Rev C 79 (2009) 015205.**
10. **Isospin mode splitting and mixing in asymmetric nuclear matter, S. Biswas and A.K. Dutt-Mazumder, Phys. Rev C 74 (2006)065205.**
11. **rho-omega mixing and spin independent charge symmetry violating potential, S. Biswas, P. Roy, and A. K. Dutt-mazumder, Phys. Rev. C81, 045207 (2008)**
12. **Matter induced charge symmetry breaking and pion form factor in nuclear medium, P. Roy, A. K. Dutt-Mazumder, S. Sarkar, and J. Alam, J. Phys. G35, 065106 (2008)**
13. **Quenching of light hadrons at RHIC in a collisional energy loss scenario, P. Roy, J. Alam, and A. K. Dutt-Mazumder, J. Phys. G35, 104047 (2008)**
14. **Collisonal energy loss and the suppression of high pT hadrons, J. Alam, P. Roy, and A. K. Dutt-Mazumder, Nucl. Phys. A785, 245 (2007)**
15. **Energy loss and dynamical evolution of high pT hadrons, P. Roy, J. Alam, and A. K. Dutt-Mazumder, Phys. Rev. C73, 044911 (2006)**
16. **Stopping Power of QCD Plasma, A. K. Dutt-Mazumder, J. Alam, P. Roy, and B. Sinha, Phys. Rev. D71, 094016 (2005)**

Experimental Nuclear and particle physics

Dr. Tinku Sinha

PhD., S.I.N.P (Jadavpur University), Kolkata

M.Sc., Physics (Visva Bharati University), West Bengal

B.Sc., Physics (Bethune College, Calcutta University), Kolkata

Title of PhD topic:
"A Study of clustering effect of ^{6}Li in light ion induced reaction"

Academic profile

Scientist E 2007-onwards.
Scientist D 2005-2007.
Senior Research Associate at SINP, 2002-2004.
CNRS Post-Doc at IPN Orsay, France 2001-2002.
CSIR Research Associate at SINP, 1997-2000.
DAE fellowship for Post-MSc and PhD at SINP, 1990-1996.

Essential strength of research/development output

I. Experimental High Energy Physics

II. a) Developmental work on large area wire chambers

b) Developmental work on new generation micro pattern gas detectors

c) Developmental work on PCB related electronics readout boards

III. Simulation work on ROOT platform to analyze ALICE experimental Data

IV. Experimental Nuclear Physics, nuclear reactions

Future research/development plan

- The characteristic study and comparison of micro pattern gas detector whose template has been fabricated by HFL, Hyderabad and the existing THGEM detector obtained from CERN. This detector may be used for studying heavy particles in nuclear reaction at low gas pressure down to sub-Torr values.
- Simulation work on ROOT platform to perform QGP study using Hijing and Pythia event generators.
- Participation in ALICE p-p and Pb-Pb experiment as a member of DIMUON spectrometer (2nd Station) group.
- Analysis of the existing data for nuclear reactions using FRESCO code.

List of important publications

1. Charged-particle multiplicity measurement in proton-proton collisions at sqrt(s) = 7 TeV with ALICE at LHC.
   e-Print: **arXiv:1004.3514,** ALICE Collaboration (K. Aamodt *et al.*), Apr 2010.

2. Charged-particle multiplicity measurement in proton-proton collisions at sqrt(s) = 0.9 and 2.36 TeV with ALICE at LHC.
   e-Print: **arXiv:1004. 3034,** ALICE Collaboration (K. Aamodt et al.), Apr 2010.

3. First proton–proton collisions at the LHC as observed with the ALICE detector: measurement of the charged-particle pseudorapidity density at √s=900 GeV
   Eur.Phys.J.C65:111-125, 2010, ALICE Collaboration.

4. The ALICE experiment at the CERN LHC**.**
   JINST 3:S08002, 2008., ALICE Collaboration (K. Aamodt *et al.*).

5. Investigation of the ALICE muon forward spectrometer performances for upsilon measurement.
   Eur.Phys.J.C49:143-148, 2007, ALICE Collaboration.

6. ALICE: Physics Performance Report, Volume II
   J.Phys.G32:1295-2040, 2006, ALICE Collaboration.

7. Anomalous increase in width of fission fragment mass distribution as a probe for onset of quasi fission reactions in deformed target-projectile system at near and sub- barrier energies
   T. K. Ghosh, S. Pal, **T. Sinha,** S. Chattopadhyay, P. Bhattacharya, D. C. Biswas and K. S. Golda.
   Phys. Rev. C 70 (2004) 011604 (R).

8. The tracking system of the ALICE dimuon spectrometer
   Basciu, S.; Arba, M.; Atanassov, I.; Cicalo, C.; De Falco, A.; Floris, M.; La Delfa, L.; Marras, D.; Masoni, A.; Puddu, G.; Serci, S.; Siddi, E.; Tuven, M.; Usai, G.; Boudjemline, M.; Carduner, H.; Charrier, D.; Cussonneau, J.P.; Dialinas, M.; Finck, C.; Fresneau, S.; Lautridou, P.; Luquin, L.; Pichot, P.; Thers, D.; Baldisseri, A.; Borel, H.; Dumonteil, E.; Gosset, J.; Jourde, D.; Lugol, J.C.; Orsini, F.; Penichot, Y.; Robert, J.P.; Staley, F.; Comets, M.P.; Courtat, P.; Diarra, C.; Espagnon, B.; Guez, D.; Le Bornec, Y.; MacCormick, M.; Martin, J.M.; Rousseau, S.;**Sinha,T**.;Willis,N.;Nikulin,V.
   Nuclear Science Symposium Conference Record, 2003 IEEE Volume 1, Issue, 19-25 Oct. 2003 Page(s): 660-664.

9. Coupling effect of resonant and discretized nonresonant continuum states in ^{4}He +^{6}Li scattering at 10 MeV/A
   T. Sinha, Rituparna Kanungo, C. Samanta, Sudip Ghosh, P. Basu, and H. Rebel.
   Z. Physik A 355, 397 (1996).

10. Double-folding model potential for ^{6}Li scattering with ^{4}He : Absence of anomalous reduction factor
    T. Sinha, Subinit Roy, and C. Samanta.
    Phys. Rev. C 48, 785 (1993).

NUCLEAR PHYSICS DIVISION

NUCLEAR PHYSICS DIVISION (NPD):

Permanent members of the division:

Scientific		Technical		Adm / Auxiliary	
Chhanda Samanta	Sr. Prof.	Sujib Chatterjee	SO.	Jeevan Shaw	Sr. Asst.
Polash Banerjee	Prof.	Ajoy Kumar Mitra	SO.	Dulal Chandra Ghosal	Helper
Padmanava Basu	Prof.	Jonaki Panja	SO.	Siladitya Chakraborty	Helper
Subinit Roy	Prof.	Kaushik Chatterjee	SO.		
Maitreyee Saha Sarkar	Prof.	Rita Ghosh	SA.		
Asimananda Goswami	Prof.	Dilip Sil	SA.		
Ushasi Datta Pramanik	Prof.	Pradip Barua	Tech.		
Chinmay Basu	Prof.	Sankar Prasad Singh	Tech.		
Anjali Mukherjee	Prof.				

Ph. D. Students (2007 onwards):

Mukesh Kumar Pradhan, Santosh Chakraborty, Dhrubajyoti Gupta

Post Docs and visiting scientists (2007 onwards):

Indrani Ray, Sucheta Adhikari, Sudatta Ray, Mandira Sinha

Equipments and resources in the division:

1. CLOVER detectors with BGO anti-Compton shields – (5) (4 are contributed to the Indian National Gamma Array for use at the different Accelerator Centres)
2. Target Laboratory with a facility for preparing thin targets by evaporation technique using electron gun; rolling machine for rolling thin foils.
3. Vacuum Systems (Dry Turbo pumping system, rotary + Diffusion system, Dry Turbo molecular pump and associated gadgets for HPGe annealing, etc.)
4. HPGe Detectors (25% efficiency): 4 nos; LEPS Planar Detector with 80 mm^2 active area: 1 no. COMPOSITE LEPS (Planar Detector with active area ~ 4 x 80 mm^2) : 1 no.
5. Ultra-thin (8 μm thick) window Si(Li) with active area: ~ 30 mm^2; Si(Li) Detector (25 μm thick, active area – 12 mm^2) – (1); Small volume LEPS – (1)
6. 16-channel strip Si-strip Detector (area 50x50 mm^2, 300 μm thick) – (2); Resistive Position-sensitive Detector (3); CsI(Tl) Detector (25x25x40 mm^3) – (8); CsI(Tl) Detector (10 dia.x10 mm thick) – (10); E and ΔE Si surface barrier detectors of different thicknesses.
7. Deep-freezer, Lyophilizer (freeze dryer), Vacuum oven, etc.
8. Mass Analyzer for gas-flow system.
9. DELL WORKSTATION for theoretical calculations, PC-based MCA, CAMAC-based multiparameter data-acquisition system.

NUCLEAR PHYSICS DIVISION (NPD):

Research Activities:

The present research activities of the Nuclear Physics Division broadly include study of nuclear structures and nuclear reactions from spectroscopic data using the different Accelerator Centers in India and a few abroad. In addition, the members of the Division are actively involved in the setting up of a Facility for Research in Experimental Nuclear Astrophysics (FRENA) at the Saha Institute of Nuclear Physics. The other major activities are: theoretical research, developmental activities and EDXRF spectrometry.

The highlights of Accelerator based research in Nuclear structure are identification of magnetic rotation bands in ^{83}Rb, ^{111}In and ^{143}Sm, first observation of band termination in ^{111}Sn based on lifetime studies, indication of the onset of collectivity in ^{30}P, study of the yrast band in ^{155}Tm up to high spins, study of transition rates in mirror nuclei ^{35}Ar and ^{35}C. Recently, experiments were performed at GSI, Darmstadt to understand the failure of magic number (N~20) through Coulomb breakup using the LAND-FRS setup and at NSCL, Michigan State University to study the lifetime of excited state of ^{16}C isotope through gamma ray spectroscopy. Both off-line and on-line studies of fission fragments are also being planned.

In Nuclear Reaction studies, measurements (fusion cross-sections and elastic and alpha angular distributions) were made with loosely bound projectiles ^{6,7}Li on different targets like ^{24}Mg, ^{28}Si, ^{159}Tb and ^{64}Ni at sub, near and above-barrier energies leading to an improved understanding of fusion mechanism vis-à-vis breakup/total/incomplete fusion components, anomaly of enhancement & suppression and effect of the breakup reaction pathways on the energy dependence of the effective interaction. Besides, measurements were carried out for the heavy systems ^{10,11}B+^{209}Bi, using pulsed beams from the Pelletron facility at the Australian National University. Alpha cluster states were studied from resonance breakup of ^{18}O from ^{12}C target (at E(^{18}O) = 94.5 MeV) into α and ^{14}C particles. Several new states between 11-18 MeV were observed and new spin parity for the 11.59 MeV cluster state was proposed.

Highlights of theoretical studies include analysis of ^{16}O breakup data at intermediate energies from a heavy target to extract the reduced alpha width and ANC of ^{16}O states, study of ^{16}O breakup from a light target to deduce its alpha spectroscopic factors, a generalized mass formula was developed for non-strange, strange and multi-strange nuclei and predicted the binding energies of pure hyperonic systems, shell model study of neutron rich nuclei near ^{132}Sn in order to generate an appropriate empirical interaction and study the evolution of collectivity in this exotic mass domain.

The developmental work includes the development of (a) Planar charged particle array, (b) gas scintillation proportional counter, (c) set up for fission gamma-ray spectroscopy and (d) high energy gamma-ray detector array. A Multi gap Multi-strip Resistive Plate Chamber (MMRPC**)** detector was developed at the SINP and the performance of the detector was studied using both cosmic background and γ- ray source at the laboratory. The detector has been recently tested using pulsed electron beam at Germany. This MMRPC can be used as an active part of Neutron detector of R3B, FAIR facility at Darmstadt.

Radio-isotope induced off-line studies of environmental samples are also carried out. A EDXRF spectrometer with the newly procured Super Si(Li) detector having ultra thin Be-window has been setup and optimized for detection from K to Pb and different samples e.g. Municipal Solid Wastes (MSW),

Soils, Vegetables grown on MSW, Air Particulate Matter are analyzed and absolute quantification done using the AXIL/QXAS Code system.

The Nuclear Physics Division has undertaken to set up a Facility for Research in experimental Nuclear Astrophysics (FRENA). This will constitute a major field of research in the future. FRENA is a national project and will be a unique facility in the country. The facility is centered on a 3 MV Tandetron (Tandem accelerator) that will provide low energy beams of light and heavy-ions with a very large current. Highest proton beam currents will be about 500 μA. The machine will also deliver pulsed beams of light ions (H, He and D). The facility is expected to be operational within the next 3-4 years. The department has also initiated several related activities that include (i) collaboration with JINA, University of Notre Dame, (ii) preparation of thin targets by implantation, (iii) theoretical reaction network calculations and (iv) development of a windowless gas-target set up and a sophisticated detector system.

It is envisaged that a Recoil Mass Analyzer and provisions for studies of neutron-induced reactions will be augmented to the facility during the next phase of development.

List of publications (2007 –date)

2010

1. *Comment on "High spin structure of the neutron-rich nuclei ^{137}I and $^{139}Cs"*, S. Sarkar and **M. Saha Sarkar**, *Phys. Rev.* ***C 81,*** *(2010) 039803.*

2. *New shell closure for neutron-rich Sn isotopes,* S. Sarkar and **M. Saha Sarkar**, *Phys. Rev.* ***C 81****, (2010) 064328.*

3. *Sub- and above-barrier fusion of loosely bound ^{6}Li with ^{28}Si,* Mandira Sinha, H.Majumdar, **P.Basu, Subinit Roy**, R.Bhattacharya, M.Biswas, M.K.Pradhan, R.Palit, I.Majumdar and S.Kailas, *Eur. Phys. J.* ***A44****, (2010) 403.*

4. *Charged and neutral hyperonic effects on the driplines,* P. Roy Chowdhury, **C. Samanta** and D.N. Basu, *Rom. Rep. Phys.* ***62*** *(2010) 65.*

5. *Hypernuclear Spectroscopy at JLab Hall C,* O. Hashimoto, A. Chiba, D.Doi, Y. Fujii, T. Gogami, H. Kanda, M. Kaneta, D. Kawama, K. Maeda, T.Maruta, A.Matsumura, S. Nagao, S. N. Nakamura, A. Shichijo, H. Tamura, N. Taniya, T. Yamamoto, K. Yokota, S.Kato,Y. Sato, T. Takahashi, H. Noumi, T. Motobae, E. Hiyama , I. Albayrak,, O. Atesg, C. Cheng, M. Christy, C. Keppel,M. Kohl, Y. Li, A. Liyanage, L. Tang T. Walton, Z. Ye, L.Yuan, L. Zhu, P. Baturin, W. Boeglin, S. Dhamija, P. Markowitz, B. Raue, J. Reinhold, Ed. V. Hungerford, R. Ent, H. Fenker, D. Gaskell, T. Horn, M. Jones, G. Smith, W. Vulcan, S. A. Wood, C. Johnston, N. Simicevic, S. Wells, **C. Samanta**, B.Hu, J. Shen, W. Wang, X. Zhang, Y. Zhang,J. Feng, Y. Fu, J. Zhou, S. Zhou, . Jiang, H. Lu, Yan, Y. Ye, L. Gan, A. Ahmidouch, S. Danagoulia, A. Gasparian, M. Elaasar, F. R. Wesselmann, A. Asaturyan, A. Margarya, A. Mkrtchya, H. Mkrtchyan, V. Tadevosyan, D. Androic, M. Furic, T. Petkovic, T. Seva, G. Niculescu, I. Niculescu, V. M. Rodriguez, E. Cisbani, F. Cusannou, F. Garibaldi,G. M. Uuciuoli, R. De Leo, and S. Maronne, P. Achenback, J. Pochodzala, *Nucl. Phys.* ***A 835*** *(2010) 121.*

6. *Generalised mass formula for non-strange, strange and multiply-strange nuclear systems,* **C. Samanta**, *Jour. Phys.* ***G 37*** *(2010) 075104.*

7. *Influence of projectile breakup on complete fusion,* **A. Mukherjee** and M. K. Pradhan, *Pramana **75**, (2010) 99.*

8. *Target dependence in the study of collective modes in stable and exotic Ni nuclei*, T. Le Bleis, D. Rossi, A. Klimkiewicz, P. Adrich, K. Boretzky, F. Aksouh, H. Alvarez-Pol, T. Aumann, J. Benlliure, M. Boehmer, E. Casarejos, M. Chartier, A. Chatillon, D. Cortina-Gil, **U. Datta Pramanik,** H. Emling, O. Ershova, Fernandez-Dominguez, H. Geissel, M. Gorska, M. Heil, H. Johansson, A. R. Junghans, O. Kiselev, J. V. Kratz, N. Kurz, M. Labiche, R. Lemmon, Y. Litvinov, K. Mahata, P. Maierbeck, T. Nilsson, C. Nociforo, R. Palit, S. Paschalis, R. Plag, R. Reifarth, H. Simon, K. Sümmerer, A. Wagner, W. Walus, H. Weick and M. Winkler, *J. Phys. G. Nucl. & Part. **202** (2010) 01203.*

2009

9. *Observation of enhanced orbital electron capture nuclear decay rate in a compact medium,* A. Ray, P. Das, S. K. Saha, **A. Goswami**, A. De, Phys. Lett. **B 679**, (2009) 106.

10. *Alpha decay chains from Superheavy nuclei*, **C. Samanta,** *Prog. in Part. & Nucl. Phys. **62** (2009) 344.*

11. *Isospin dependent properties of asymmetric nuclear matter,* P. Roy Chowdhury, D.N. Basu, **C. Samanta,** *Phys. Rev. **C. 80** (2009) 011305(R).*

12. *Isobaric incompressibility of isospin asymmetric nuclear matter, D. N. Basu, P. Roy Chowdhury*, **C. Samanta,** *Phys. Rev. **C 80** (2009) 057304.*

13. *The study of the reduced a-width and ANC of ^{16}O states through its sequential breakup,* Sucheta Adhikari and **Chinmay Basu,** *Phys. Lett. **B 682**, (2009) 216.*

14. *The study of α + ^{14}C cluster states of ^{18}O through the resonant breakup reaction $^{12}C(^{18}O, ^{14}C\ \alpha)$ at $E(^{18}O)$ = 94.5 MeV,* S. Adhikari, **C. Basu,** B. R. Behera, S. Ray, A. K. Mitra, Suresh Kumar, A. Chatterjee, *Int. Jour. Mod. Phys. **E Vol. 18**, No.9 (2009) 1917.*

15. *Properties of the ^{7}He ground state from ^{8}He neutron knockout*, Yu.Aksyutina, H.T.Johansson, T. Aumann, K. Boretzky, M. J. G.Borge, A. Chatillon, L. V. Chulkov, D. Cortina-Gil, **U. Datta Pramanik**, H. Emling, C. Forssen, H. O. U. Fynbo, H. Geissel, G. Ickert, B. Jonson, R. Kulessa, C. Langer, M. Lantz, T. LeBleis, A. O. Lindahl, K.Mahata, M. Meister, G. Munzenberg, T. Nilsson, G. Nyman, R. Palit, S. Paschalis, W. Prokopowicz, R. Reifarth, A. Richter, K. Riisager, G. Schrieder, K. Summerer, O. Tengblad, H. Weick, M. V. Zhukov, *Phys. Lett. **B 679,** (2009)191.*

16. *Collective Dipole Excitations in Neutron-Rich Nuclei from ^{132}Sn Mass Region, the Nuclear Symmetry Energy and Neutron Skins***,** A. Klimkiewicz, N. Paar, P. Adrich, M. Fallot, K. Boretzky, T. Aumann, D. Cortina-Gil, **U. Datta Pramanik**, Th. W. Elze, H. Emling, H. Geissel, M. Hellstrom, K. L. Jones, J. V. Kratz, R. Kulessa, C. Nociforo, R. Palit, H. Simon, G. Surowka, K. Summerer, D. Vretenar, W. Walus, *Acta Phys. Pol. **B40**, (2009) 589.*

17. *Seven-quasiparticle bands in ^{139}Ce*, S. Chanda, T. Bhattacharjee, S. Bhattacharyya, **A. Mukherjee**, S.K. Basu, I. Ragnarsson, R.K. Bhowmik, S. Muralithar, R.P. Singh, S.S. Ghugre, **U. Datta Pramanik,** *Phys.Rev. **C 79**, (2009) 05433.*

18. *Suppression of complete fusion due to breakup in the reactions $^{10,11}B+^{209}Bi$,* L. R. Gasques, D. J. Hinde, M. Dasgupta, **A. Mukherjee,** R.G. Thomas, *Phys. Rev. **C 79** (2009) 034605*.

19. *Band structures in near spherical ^{138}Ce,* T. Bhattacharjee, S. Chanda, S. Bhattacharyya, S.K. Basu, R.K. Bhowmik, J.J. Das, **U. Datta Pramanik,** S.S. Ghugre, N. Madhavan, **A. Mukherjee,** G. Mukherjee, S. Muralithar, R. P. Singh, *Nucl.Phys. **A825**, (2009) 16*.

2008

20. *Experimental study of the 2p-2h band in ^{111}Sn,* S. Ganguly, **P. Banerjee,** I. Ray, R. Kshetri, R. Raut, S. Bhattacharya, **M. Saha Sarkar, A.Goswami** and S.K.Basu, *Phys. Rev. **C 78**, (2008) 037301*.

21. *Structure of even-even A = 138 isobars and the yrast spectra of semi-magic Sn isotopes above the ^{132}Sn core,* S. Sarkar and **M. Saha Sarkar,** *Phys. Rev. **C 78,** (2008) 024308*.

22. *Fusion cross sections for $^{6,7}Li$ + ^{24}Mg reactions at energies below and above the barrier,* M. Ray, **A. Mukherjee**, M. K. Pradhan, Ritesh Kshetri, **M. Saha Sarkar**, R. Palit, I. Majumdar, P. K. Joshi, H. C. Jain, and B. Dasmahapatra, *Phys. Rev. **C 78**, (2008) 064617.*

23. *The study of threshold behaviour of effective potential for ^{6}Li + $^{58,64}Ni$ systems,* M. Biswas, **Subinit Roy**, M. Sinha, M.K. Pradhan, **A. Mukherjee**, P. Basu, H. Majumdar, A. Shrivastava, K. Ramachandran**,** *Nucl. Phys. **A802** (2008) 67.*

24. *Spectroscopic factors for alpha decay in the N_pN_n scheme,* Madhubrata Bhattacharya, **Subinit Roy**, G.Gangopadhyay, *Phys. Lett. **B665** (2008) 182.*

25. *Sub-barrier fusion excitation for the system ^{7}Li + ^{28}Si,* Mandira Sinha, H.Majumdar, **P. Basu, Subinit Roy,** R.Bhattacharya, M.Biswas, M.K. Pradhan, S.Kailas, *Phys. Rev. **C78** (2008) 027601.*

26. *Gamow-Teller strengths in ^{24}Na using the ^{24}Mg (t, ^{3}He) reaction at 115 MeV/u,* M. E. Howard, R.G.T. Zegers, Sam M. Austin, D. Bazin, B.A. Brown, A.L. Cole, B. Davids, M. Famiano, Y. Fujita, A. Gade, D. Galaviz Redondo, G.W. Hitt, M. Matos, S.D. Reitzner, **C. Samanta,** L.J. Schradin, Y. Shimbara, E.E. Smith, and C. Simenel, *Phys. Rev. **C 78** (2008) 047302.*

27. *Nuclear equation of state at high baryonic density and compact star constraints*, D.N. Basu, P. Roy Chowdhury and **C. Samanta,** *Nucl. Phys. **A 811** (2008) 140.*

28. *Lambda hyperonic effect on the normal driplines,* **C. Samanta,** P. Roy Chowdhury and D. N. Basu**,** *Jour. Phys. **G 35** (2008) 065101.*

29. *Search for long lived heaviest nuclei beyond the valley of stability,* P. Roy Chowdhury, **C. Samanta** and D. N. Basu**,** *Phy. Rev. **C 77** (2008) 044603.*

30. *Nuclear lifetimes for alpha radioactivity of elements with 100 < Z < 130*, P. Roy Chowdhury, **C. Samanta** and D. N. Basu, *Nucl. Data and At. Data Tables **94** (2008) 781*.

31. *Fusion cross sections for $^{6,7}Li$+^{24}Mg reactions at energies below and above the barrier*, M. Ray, **A. Mukherjee**, M.K. Pradhan, R.K. Kshetri, **M.S. Sarkar**, R. Palit, I. Majumdar, P.K. Joshi, H.C. Jain, B. Dasmahapatra, *Phys. Rev. **C 78** (2008) 064617.*

32. *Multi-quasiparticle bands in ^{137}Ce,* T. Bhattacharjee, S. Chanda, **A. Mukherjee,** S. Bhattacharyya, S.K. Basu, S.S. Ghugre, **U.D. Pramanik**, R.P. Singh, S. Muralithar, N. Madhavan, J.J. Das, R.K. Bhowmik, *Phys. Rev. **C 78** (2008) 024304.*

2007

33. *Study of yrast band of ^{155}Tm,* R. Raut, S.Bhowal, S. Ganguly, R. Kshetri, **P. Banerjee,** S. Bhattacharya, R.K. Bhowmik, G. Gangopadhyay, A. Mukherjee, S. Muralithar, **M. Saha Sarkar,** R.P. Singh, **A. Goswami,** *Nucl. Phys. **A 794**, (2007) 1.*

34. *High spin structure of ^{35}Cl and the sd-fp shell gap,* Ritesh Kshetri, **M. Saha Sarkar,** Indrani Ray, **P. Banerjee,** S. Sarkar, R. Raut, **A. Goswami,** J.M. Chatterjee, S.Chattopadhyay, **U. Datta Pramanik**, **A. Mukherjee**, C.C. Dey, S. Bhattacharya, B. Dasmahapatra, Samit Bhowal, G. Gangopadhyay, P. Datta, H.C. Jain, R.K. Bhowmik, S. Muralithar, R.P. Singh, R. Kumar**,** *Nucl. Phys. **A 781**, 277 (2007).*

35. *Study of intruder band in ^{112}Sn,* S. Ganguly, **P. Banerjee,** I. Ray, R. Kshetri, R. Raut, S. Bhattacharya, **M. Saha Sarkar, A. Goswami,** S. Mukhopadhyay, **A. Mukherjee,** G. Mukherjee, S.K. Basu, *Nucl. Phys. **A 789,** (2007)1.*

36. *Indication of the onset of collectivity in ^{30}P,* I. Ray, M.R. Basu, R. Kshetri, **M.S. Sarkar,** S. Sarkar, **P. Banerjee**, S. Chattopadhyay, C.C. Dey, **A. Goswami,** J.M. Chatterjee, **A. Mukherjee**, S. Bhattacharya, B. Dasmahapatra, P. Datta, H.C. Jain, R.K. Bhowmik, S.Muralithar, R.P.Singh, *Phys. Rev. **C 76,** (2007) 034315.*

37. *First observation of excited states in the ^{138}I nucleus,* T. Rzaca-Urban, K. Pagowska, W. Urban, A. Złomaniec, J. Genevey, J. A. Pinston, G. S. Simpson, **M. Saha Sarkar,** S. Sarkar, H. Faust, A. Scherillo, I. Tsekhanovich, R. Orlandi, J. L. Durell, A. G. Smith, and I. Ahmad, *Phys. Rev. **C 75** (2007) 054319.*

38. *First observation of medium-spin excitations in the ^{138}Cs nucleus*, T. Rzaca-Urban, W. Urban, **M. Saha Sarkar**, S. Sarkar, J.L. Durell, A.G. Smith, B.J. Varley, and I. Ahmad, *Euro. Phys. Jour. **A 32** (2007) 5 (Letter).*

39. *High-spin structure and Band Termination in ^{103}Cd,* A. Chakraborty, Krishichayan, S. Mukhopadhyay, S. Ray, S.N. Chintalapudi, S.S. Ghugre, N.S. Pattabiraman, A.K. Sinha, S. Sarkar, U. Garg, S. Zhu, **M. Saha Sarkar,** *Phys. Rev. **C 76,** (2007) 044327.*

40. *EDXRF analysis of municipal solid waste using ^{109}Cd source*, D. Gupta, J.M. Chatterjee, R. Ghosh, A.K. Mitra, **S. Roy,** M. Sarkar, *App. Rad. & Isot. **65** (2007) 512.*

41. *Elemental uptake in radish grown near a Municipal Solid Waste dumping site by EDXRF method*, D. Gupta, J.M. Chatterjee, R. Ghosh, A.K. Mitra, **S. Roy** and M. Sarkar, ***J.** of Radioanalytical and Nucl. Chem., **274** (2007) 389.*

42. *Experimental investigation of fusion of $^{7}Li+^{28}Si$ above the Coulomb barrier*, Mandira Sinha, H. Majumdar, R. Bhattacharya, **P. Basu, Subinit Roy,** M. Biswas, P.K. Joshi, R. Palit, I. Majumdar, H.C. Jain, S. Kailas, *Phys. Rev. **C76** (2007) 027603.*

43. *Quantum tunneling in 277112 and its alpha-decay chain*, **C. Samanta,** D. N. Basu, P. Roy Chowdhury, *Jour. Phys. Soc. Japan **76** (2007) 124201.*

44. *Alpha Decay chains from element 113*, P. Roy Chowdhury, D. N. Basu and **C. Samanta,** *Phy. Rev. **C 75** (2007) 047306.*

45. *Predictions of Alpha Decay Half lives of Heavy and Superheavy Elements*, **C. Samanta,** P. Roy Chowdhury and D. N. Basu, *Nucl. Phys. **A 789** (2007) 142.*

46. *She decays near the magic island*, **C. Samanta,** *Rom. Rep. Phys. **59** (2007) 491.*

47. *Reaction mechanisms in $^{16}O+^{40}Ca$ at an incident energy of $E(^{16}O)$ = 86 MeV through inclusive measurements of α and proton spectra*, **Chinmay Basu,** S. Adhikari, S.K. Ghosh, S. Roy, S. Ray, B. R. Behera, and S. K. Datta, Phys. Rev. **C 76** (2007) 034609.

48. *New challenges in understanding heavy ion fusion*, M. Dasgupta, D.J. Hinde, **A. Mukherjee,** J.O. Newton, *Nucl. Phys. **A 787,** (2007) 144c.*

49. *Characterization of fragment emission in ^{20}Ne(7-10 MeV/nucleon) + ^{12}C reactions*, A. Dey, C. Bhattacharya, S. Bhattacharya, S. Kundu, K. Banerjee, S. Mukhopadhyay, D. Gupta, T. Bhattacharjee, S.R. Banerjee, S. Bhattacharyya, T.K. Rana, S.K. Basu, R. Saha, K. Krishan, **A. Mukherjee,** D. Bandopadhyay, C. Beck, *Phys. Rev. **C 76** (2007) 034608.*

50. *Sub-Barrier Coulomb Excitation of ^{110}Sn and Its Implications for the ^{100}Sn Shell Closure*, J. Cederkall, A. Ekstrom, C. Fahlander, A.M. Hurst, M. Hjorth-Jensen, F. Ames, Banu, P.A. Butler, T. Davinson, **U. Datta Pramanik,** J. Eberth, S. Franchoo, G. Georgiev, M. Gorska, D. Habs, M. Huyse, O. Ivanov, J. Iwanicki, O. Kester, U. Koster, B.A. Marsh, O. Niedermaier, T. Nilsson, P. Reiter, H. Scheit, D. Schwalm, T. Sieber, G. Sletten, I. Stefanescu, J. Van de Walle, P. Van Duppen, N. Warren, D. Weisshaar, F.Wenander, *Phys. Rev. Lett. **98** (2007) 172501.*

51. *Indirect measurement of radiative capture cross sections relevant in astrophysical scenarios*, **U.D. Pramanik**, *Prog. Part. Nucl. Phys. **59** (2007) 183.*

Information for Faculty Review

1. (a). Name: Professor Polash Banerjee
   (b). Educational background: Ph.D. (Physics); University of Calcutta; 1989.

2. (a). Joined Saha Institute of Nuclear Physics as Scientist 'B' in 1984
   (b). Last promotion from Professor 'F' to Professor 'G' in 2007
   (c). No academic assignment prior to joining Saha Institute of Nuclear Physics

3. Essential strength of research/development output:

I have been working on the study of nuclear structure in nuclei in the A = 80, 110 and 120 mass regions through in-beam gamma-ray spectroscopy using the different Accelerator facilities in the country and the Indian National Gamma Array. These experimental projects have yielded significant new information about exciting structural features in several nuclei in these mass regions. These are summarized below:

(i) Established the presence of prolate and oblate deformed bands in ^{77}Br. Lifetime studies established for the first time a large quadrupole deformation of β_2=0.35 for the positive-parity yrast band in ^{77}Br.

(ii) An excited ΔI=1 three quasi-particle band in ^{83}Rb was interpreted as arising from magnetic rotation from a study of the behaviour of the B(M1) rates with angular momentum. Shape co-existence (prolate at low spin and oblate after the neutron alignment) was observed in the $\pi g_{9/2}$ yrast band in the same nucleus from a comparison of the experimental results and particle-rotor model calculations.

(iii) Lifetime studies, reported for the first time in ^{111}Sn, indicate that collectivity decreases progressively with spin for the ΔI=2 band populated up to a spin of $63/2^-$. The dynamic moment of inertia of the states also decrease continuously up to the highest observed frequencies. These results and the predictions of TRS calculations show that the states undergo a gradual shape-change from collective prolate at low spin to non-collective oblate at large angular momentum where the band terminates.

(iv) Shears bands have been identified in ^{111}In, studied recently at the IUAC, New Delhi. Weakly-deformed high-*K* bands involving the coupling of a $g_{9/2}$ proton hole to neutrons in the in the $h_{11/2}$ orbital are being investigated. Results will be communicated shortly.

(v) Reaction Network calculations have been carried out for the reactions that occur in the *pp*-chain in the sun. The reaction ^{3}He(α, γ)^{7}Be is critical to the understanding of the abundance of ^{7}Li and the flux of the high energy neutrinos from the sun. Network calculations show that the present 12% discrepancy in the experimental S-factor leads in a 30% uncertainty in the abundance of ^{7}Li produced in the sun. The calculations are being extended to other astrophysical scenarios.

I have collaborated with various other Groups on spectroscopic studies in the A=40 and 140 mass regions.

4. Future research/development plan

(i) I am co-coordinating the overall activities related to the setting up of FRENA (Facility for Research in Experimental Nuclear Astrophysics) at the Salt Lake Campus of the Institute. The facility will center around a 3 MV high current Tandem accelerator. The architectural designs and the radiation safety clearances are being processed. A windowless gas target facility will be set in the Laboratory for use in experiments once FRENA becomes operational. Gas targets are essential in many experiments in Nuclear Astrophysics as it (a) permits to get rid of impurities present in solid targets that hamper most low-cross-section measurements (b) allows adjustment of target thickness by varying gas pressure and (c) ensures uniformity in target thickness. The set up is now being configured.

(ii) A proposal has been submitted for experiments at the TIFR Pelletron using the Indian National Gamma Array (comprising of clover detectors) for the study of neutron rich $^{82-84}$Se and $^{84-87}$Kr and other medium-mass isotopes from fission-fragment spectroscopy. New areas of *N-Z* plane inaccessible by heavy-ion fusion reactions can be studied from such experiments. Most of these nuclei have been studied fro spontaneous fission and only very low excitation-energy states are reported in the literature. The proposed experiments will help in understanding the evolution of nuclear structure in new mass regions away from the line of stability, especially the changes in magic numbers and single-particle order.

5. List of recent publications (Work done under my supervision)

[1]. Experimental study of the 2p-2h band in ^{111}Sn; S. Ganguly, P. Banerjee, I. Ray, R. Kshetri, R. Raut, S. Bhattacharya, M. Saha-Sarkar, A. Goswami and S. K. Basu; PHYSICAL REVIEW C **78**, 037301 (2008).

[2]. Study of Intruder band in ^{112}Sn; S. Ganguly, P. Banerjee, I. Ray, R. Kshetri, R. Raut, S. Bhattacharya, M. Saha-Sarkar, A. Goswami, S. Mukhopadhyay, A. Mukherjee, G. Mukherjee and S.K. Basu, Nucl. Phys. **A789**(2007)1.

[3]. Band structure in ^{83}Rb from lifetime measurements; S. Ganguly, P. Banerjee, I. Ray, R. Kshetri, S. Bhattacharya, M. Saha-Sarkar, A. Goswami, S. Muralithar, R.P. Singh, R. Kumar and R.K. Bhowmik, Nucl. Phys. **A 768** (2006) 43.

[4]. . Co-existence of prolate and oblate bands with similar proton configurations in ^{121,123,125}I; Hariprakash Sharma and P. Banerjee, Phys. Rev. **C64** (2001) 064310.

[5]. Band structure of ^{79}Br; I. Ray, P. Banerjee, S. Bhattacharya, M. Saha-Sarkar, B. Sethi, J.M. Chatterjee, S. Chattopadhyay, A. Goswami, S. Muralithar, R.P. Singh and R.K. Bhowmik, Nucl. Phys. **A646** (1999) 141.

[6]. Evidence for shape co-existence in ^{77}Br; I. Ray, P. Banerjee, S. Bhattacharya, A. Goswami, S. Muralithar, R.P. Singh and R.K. Bhowmik, Nucl. Phys. **A694** (2001) 411.

[7]. Structure of positive-parity yrast band in ^{80}Br; I. Ray, P. Banerjee, S. Bhattacharya, M. Saha-Sarkar, S. Muralithar, R.P. Singh and R.K. Bhowmik, Nucl. Phys. **A678** (2000) 258.

[8]. Experimental evidence for co-existing structures in ^{125}I; Hariprakash Sharma, B. Sethi, P. Banerjee, R.K. Bhandari and Jahan Singh, Phys. Rev. **C63** (2000) 014313

CHHANDA SAMANTA, Senior Professor

ACADEMIC QUALIFICATIONS:

Ph.D., June 1981, University of Maryland, U.S.A., (Experimental Nuclear Physics)
M.Sc., August 1971, University of Calcutta, INDIA, (Nuclear Physics Special)
B.Sc., August 1969, University of Calcutta, INDIA, (Honours in Physics)

PROFESSIONAL POSITIONS HELD:

1. Saha Institute of Nuclear Physics, INDIA (’07-), Senior Professor “H”
2. Saha Institute of Nuclear Physics, INDIA (’03-‘06), Professor “G”
3. Saha Institute of Nuclear Physics, INDIA (’96-‘03), Professor “F”
4. Saha Institute of Nuclear Physics, INDIA (‘91-‘96), Associate Professor
5. Saha Institute of Nuclear Physics, INDIA (‘86-‘91), Reader
6. Saha Institute of Nuclear Physics, INDIA (‘83-‘86), Lecturer
7. Saha Institute of Nuclear Physics, INDIA (‘82-‘83), Post Doctoral Fellow
8. University of Maryland, College park, USA ('78-'81), Research Assistant
9. Goddard Space Flight Centre, NASA, USA ('76-'78), Research Assistant
10. University of Maryland, College park, USA ('75-'76), Teaching Assistant
11. University of Utah, Salt lake city, USA ('73-'74), Teaching Assistant

PROFESSIONAL AWARDS / DISTINCTION AND OTHER HONOURS:

1. Yamada Science Foundation award, Japan (1998)
2. Homi Bhabha National Institute, BARC, Mumbai, Affiliate Faculty
3. University Of Richmond, VA, USA, Visiting Professor
4. Virginia Commonwealth University, VA, USA, Visiting/Affiliate Professor
5. RCNP, Osaka University, JAPAN, ‘Center of Excellence’ Professor
6. University of Maryland, College Park, USA, Visiting Scientist
7. Institut fur Kernphysik, Karlsruhe, GERMANY, Visiting Scientist

HIGHLIGHTS OF SCIENTIFIC CONTRIBUTIONS:

- A generalized mass formula is developed for non-strange, strange and muti-strange hypernuclei. Obtained following results:
  (a) Masses of unknown hypernuclei containing Lambda0(uds), Sigma +(uus), Sigma0 (uds), Sigma-(dds), Cascade-(dss), Cascade0(uss) and Theta+(uudds-) hyperon(s),
  (b) A wide range of bound nuclear systems without any neutron and proton (pure hyperonic system),
  (c) Neutron- and proton-driplines for Lambda, Cascade and Theta hypernuclei

(d) Some exotic hypernuclei beyond the normal neutron and proton driplines,
(e) Lambda and Cascade hyperon-drip lines of different elements.

- Experimental investigations on hypernuclei are being carried out in collaboration with Japan, USA and Russia at JPARC/KEK, Japan and JLAB, USA.
- Alpha-decay half lives of 1700 Superheavy elements ($100 \leq Z \leq 130$) are predicted. Half lives of a few long-lived Superheavy nuclei have been suggested.
- Half lives of several spherical proton emitters are predicted.
- Bethe-Weizsäcker mass formula was extended for light nuclei. Some new shell closures (including N=6) as well as disappearance of some known magicity were predicted.
- ^{6}Li target breakup reactions were studied at VECC, Calcutta and a critical momentum transfer was pointed out for a change of reaction mechanism.
- Reaction mechanism of the ^{6,7}Li projectile breakup reactions were studied at BARC / TIFR Pelletron facility, Forschungszentrum, Karlsruhe, Germany, and at RCNP, Osaka University, Japan.
- Experimental investigations with several radioactive ion beams were carried out in collaboration with NSCL, USA and, RIKEN, Japan. Explored exotic nuclear structures through one- and two-nucleon removal reactions.

FUTURE RESEARCH & DEVELOPMENTAL PLAN

- Both theoretical and experimental investigations on properties of strange and multi-strange hypernuclei will be carried out. A computer code is being developed.
- Commonalities between nuclear and atomic clusters will be investigated using Density Functional Theory.

LIST OF IMPORTANT PUBLICATIONS

1.**C. Samanta,** Jour. Phys. G37, 075104, (2010)
2.P. Roy Chowdhury**, C. Samanta** and D.N. Basu, Rom. Rep. Phys. 62, 65 (2010)
3.**C. Samanta,** Prog. in Part. & Nucl. Phys.62, 344 (2009)
4.P. Roy Chowdhury, D.N. Basu, **C. Samanta,** Phys. Rev. C80, 011305(Rapid) (2009)
5.D. N. Basu, P. Roy Chowdhury, **C. Samanta**, Phys. Rev. C80, 057304 (2009)
6.**C. Samanta**, P. Roy Chowdhury, D. N. Basu, Jour. Phys. G35, 065101 (2008)
7.P. Roy Chowdhury, **C. Samanta**, D. N. Basu, Phys. Rev. C77, 044603 (2008)
8.D.N. Basu, P. Roy Chowdhury and **C. Samanta**, Nucl. Phys. A811, 140 (2008)
9.P. Roy Chowdhury, **C. Samanta** and D. N. Basu, ADNDT 94, 781 (2008)
10. **C. Samanta**, D. N. Basu, P. Roy Chowdhury, Jour. Phys. Soc. Jap.76,124201(2007)
11. P. Roy Chowdhury, D. N. Basu and **C. Samanta**, Phy. Rev. C75, 047306 (2007)
12. **C. Samanta**, P. Roy Chowdhury and D. N. Basu, Nucl. Phys. A 789, 142 (2007)
13. **C. Samanta**, Rom. Rep. Phys.59, 491 (2007)
14. **C. Samanta**, P. Roy Chowdhury, D. N. Basu, Jour. Phys. G.32, 363 (2006)
15. D. N. Basu, P. Roy Chowdhury, and **C. Samanta**, Phys. Rev. C72, 051601(R) (2005)
16. P. Roy Chowdhury, **C. Samanta**, D. N. Basu, Mod. Phys. Lett. A21,1605 (2005)
17. **C. Samanta** and S. Adhikari, Phys. Rev. C 65 , 037301 (2002)
18. R. Kanungo, M. Chiba, N. Iwasa, S. Nishimura, A. Ozawa, **C. Samanta**, T. Suda, T. Suzuki, Y. Yamaguchi, T. Zheng, I. Tanihata, Phys. Rev. Lett. 88,142502 (2002)
19. **C. Samanta**, R. Kanungo, S. Mukherjee, D.N.Basu, Phys. Letters. B 352, 197 (1995)
20. **C. Samanta**, T. Sinha, S. Ghosh, S.Ray, S. R. Banerjee, Phys. Rev. C50, 1226 (1994)

Name: Padmanava Basu

Designation: Professor G

Academic Qualifications: M.Sc., Ph.D (Physics)

Essential strength of research/development output

The highlights of my contributions can be broadly classified into two categories: (a) nuclear reaction mechanism studies and (b) developmental & project related work. In (a), we have undergone extensive studies on fusion mechanism at sub, near and above barrier energies. Fusion cross-section for the ^{6,7}Li+^{28}Si system has been measured for the first time from below barrier to sufficiently above-barrier energies (6-26 MeV). Multiple experiments at different accelerator centres and also utilising different techniques viz., characteristic γ-ray method and the evaporation α measurement method were undertaken. Results are consistent with the one-dimensional Barrier Penetration Model (1D BPM) predictions up to twice the Coulomb barrier, but they overestimate the data by about 15–20% at higher energies. For the near and below barrier energies (6-11.5 MeV), the results indicate substantive enhancement for which two plausible scenarios are conjectured: Incomplete fusion (ICF) or neutron transfer. Probed the role of loosely bound stable (^{6,7}Li) & unstable (^{7}Be) projectiles and its effect on fusion. Our results have improved the understanding of fusion mechanism vis-à-vis breakup/total fusion components, anomaly of enhancement & suppression, etc. Second, we have probed the role of target spin & deformation in heavy ion induced fission at near barrier energies. We have studied two systems viz., ^{14}N+^{232}Th and ^{11}B+^{235}U, both of which lead to the same Compound Nucleus ^{246}Bk. The motivations of the study are (i) entrance channel effects, (ii) influence of target spin, etc. In developmental work (b), I was associated in the design, fabrication and commissioning of large area position sensitive multiwire proportional counters (MWPC), PPAC's, cylindrical proportional counters (used in the ΔE mode). Long-term sustenance of filled gas counters has also been studied in detail. Part of the development of the MEGHNAD 4π charged particle array was done in our laboratory. I am also actively involved in the setting up of the facility for research in experimental nuclear astrophysics (FRENA) which centres centres around the 3MV low energy high current accelerator.

Future research & developmental plans:

- To undertake experiments with explicit particle-particle coincidence to resolve the impasse regarding incomplete fusion (ICF) and/or transfer followed by fusion in loosely bound projectile induced fusion e.g. ^{6,7}Li+^{28}Si or similar systems.

- Commissioning of the facility for research in Experimental Nuclear Astrophysics (FRENA) and also to finalize the proposal of a recoil separator.
- Develop a transmission type windowless gas target system. It will be used for the study of reactions of astrophysical importance, characterized by very small cross sections.
- To plan for suitable experiments in the astrophysical scenario using our facility FRENA

Selected Publications

Mandira Sinha, H. Majumdar, **P. Basu**, Subinit Roy, R. Bhattacharya, M. Biswas, M.K. Pradhan, R. Palit, I. Mazumdar, and S. Kailas; Sub- and above-barrier fusion of loosely bound ^{6}Li with ^{28}Si; Eur. Phys. J. A **44**, (2010) 403

M. Biswas, Subinit Roy, M. Sinha, M. K. Pradhan, A. Mukherjee, **P. Basu**, H. Majumdar, K. Ramachandran, A. Shrivastava; The study of threshold behaviour of effective potential for ^{6}Li + ^{58,64}Ni sytems; Nucl. Phys. A 802 (2008) 67

M.Sinha, H.Majumdar, R.Bhattacharya, **P.Basu**, S.Roy, M.Biswas, R.Palit, I.Mazumdar, P.K.Joshi, H.C.Jain, S.Kailas; Experimental investigation of fusion of ^{7}Li+^{28}Si above the Coulomb barrier; Phys.Rev**.** C 76, 027603 (2007)

A. Mukherjee, Subinit Roy, M. K. Pradhan, M. Saha Sarkar, **P. Basu**, B. Dasmahapatra et al; Influence of projectile α- breakup threshold on complete fusion; Phys. Lett. B636 (2006) 91

K. Kalita, S. Verma, R. Singh, J. J. Das, A. Jhingan, N. Madhavan, S. Nath, T. Varughese, P. Sugathan, V. V. Parkar, K. Mahata, K. Ramachandran, A. Shrivastava, A. Chatterjee, S. Kailas, S. Barua, **P. Basu**, H. Majumdar, M. Sinha, R. Bhattacharya, and A. K. Sinha; Elastic scattering and fusion cross-sections for ^{7}Be, ^{7}Li + ^{27}Al systems; Phys. Rev. C73 (2006) 024609

S. Adhikari, C. Basu, C. Samanta, S. Brahmachari, B. P. Das, **P. Basu**; I Performance of an axial gas ionization chamber; IEEE Trans. Nucl. Sci. 53(2006)2270

Bivash R. Behera, M. Satpathy, S. Jena, S. Kailas, R. G. Thomas, K. Mahata, A. Chatterjee, Subinit Roy, **P. Basu**, M. K. Sharan, S. K. Datta; Fission fragment angular distributions for the systems ^{14}N + ^{232}Th and ^{11}B + ^{235}U, at near and sub-barrier energies; Phys. Rev. C69 (2004) 064603

Bivash R. Behera, M. Satpathy, S. Kailas, A. Chatterjee, K. Mahata, **P. Basu**, Subinit Roy, S. K. Datta; Role of entrance channel properties in heavy-ion induced fission fragment angular distribution studies; Nucl. Phys. A, 734C (2003) 249

H. Majumdar, C. Basu, **P. Basu**, S. Roy, K. Mahata, S. Santra, A. Chatterjee, S. Kailas; Effect of higher order couplings in the barrier distribution of ^{12}C + ^{142}Nd extracted from quasi-elastic excitation functions; Phys. Rev. **C68**(2003)017602

Chinmay Basu, B. P. Das, Subinit Roy, **P. Basu**, H. Majumdar, M. L. Chatterjee; Performance of a position sensitive low-pressure wire chamber (LPWC) having position readout from a separate sense wire plane: a critical analysis; Nucl. Instr. & Meth. Phys. Res. **A484** (2002) 407

Name: **SUBINIT ROY**

Division: **Nuclear Physics Division**

Educational Background : **M.Sc., Ph.D.(Sc.)**

Academic Profile:

1. Research Associate	SINP, Kolkata	1993-1994
2. Visiting Fellow	TIFR, Mumbai	March-September,1994
3. Lecturer C	SINP, Kolkata	1994-1997
4. Reader D	SINP, Kolkata	1997-2001
5. Associate Professor E	SINP, Kolkata	2001-2005
6. Professor F	SINP, Kolkata	2005-2008
7. Professor G	SINP, Kolkata	2008-

Essential Strength of Research/Development Output:

The low energy nuclear reactions research is, in the present days, focused on understanding the breakup mechanisms of weakly bound nuclei, stable as well as unstable, and their impact on nuclear reaction dynamics. A rich variety of reaction pathways arise as a consequence of the breakup of these nuclei with a few body, cluster structure. Our research activity primarily involves the experimental investigation of the influence of these reaction pathways on the effective interactions controlling the collision of these projectiles on targets of different masses and on the process of fusion of these nuclei at energies around the Coulomb barrier. Identification of the reaction pathways through exclusive measurements constitutes an important part of the activity.

In addition, study of environmental samples using the Energy Dispersive X-Ray Fluorescence technique, identification of sample matrices using the coherent and incoherent X-ray scattering are the other aspects of my research activity. Setting up the offline spectrometer and its optimization for absolute quantification constitute the important part of this research project.

Future Research/Development Plan:

- Keeping in mind the upcoming FRENA (Facility for Research in Experimental Nuclear Astrophysics), as a member of Nuclear Physics Division the primary motivation of my future plan will be to ensure the successful installation and operation of the low energy, high current accelerator. To provide a suitable detection facility at FRENA, a strip detector telescope array to perform low cross section measurements will be developed. This type of detector with large solid angle coverage will be essential for deep sub-barrier measurements using the light ion beams from the FRENA accelerator.
- To conduct systematic investigations of breakup and breakup-like processes of loosely bound projectiles through particle-particle and particle-gamma coincidence measurements to obtain complete quantitative understanding of the processes and their influence on fusion reaction.

List of Important Publications: (Last 5 years)

1. Sub- and above-barrier fusion of loosely bound ^{6}Li with ^{28}Si

Mandira Sinha, H.Majumdar, P.Basu, *Subinit Roy*, R.Bhattacharya, M.Biswas, M.K.Pradhan, R.Palit, I.Majumdar and S.Kailas; Eur. Phys. J. A44, 403 (2010)

2. The study of threshold behaviour of effective potential for ^{6}Li + ^{58,64}Ni systems
M. Biswas, *Subinit Roy*, M.Sinha, M.K.Pradhan, A.Mukherjee, P.Basu, H.Majumdar, A.Shrivastava, K.Ramachandran , *Nucl. Phys*. **A802** 67(2008)

3. Spectroscopic factors for alpha decay in the N_pN_n scheme
Madhubrata Bhattacharya, *Subinit Roy*, G.Gangopadhyay , *Phys. Lett.* **B665** 182 (2008)

4. Sub-barrier fusion excitation for the system ^{7}Li + ^{28}Si
Mandira Sinha, H.Majumdar, P.Basu, *Subinit Roy*, R.Bhattacharya, M.Biswas, M.K.Pradhan, S.Kailas, *Phys. Rev.* **C78** 027601 (2008)

5. EDXRF analysis of municipal solid waste using ^{109}Cd source
D.Gupta, J.M.Chatterjee, R.Ghosh, A.K.Mitra, S.Roy, M.Sarkar *Applied Radiation and Isotopes* **65** 512(2007)

6. Elemental uptake in radish grown near a Municipal Solid Waste dumping site by EDXRF method; D.Gupta, J.M.Chatterjee, R.Ghosh, A.K.Mitra, S.Roy and M.Sarkar *Jounal of Radioanalytical and Nuclear Chemistry*, **274** 389(2007)

7. Experimental investigation of fusion of ^{7}Li+^{28}Si above the Coulomb barrier
Mandira Sinha, H.Majumdar, R.Bhattacharya, P.Basu, *Subinit Roy*, M.Biswas, P.K.Joshi, R.Palit, I.Majumdar, H.C.Jain, S.Kailas, *Phys. Rev.* **C76,** 027603(2007)

8. Characterisation of a Compton suppressed Clover detector for high energy γ-rays (≤11MeV); M.Saha Sarkar, Ritesh Kshetri, Rajarshi Raut, A.Mukherjee, Mandira Sinha, Maitreyi Roy,A.Goswami, *Subinit Roy*, P.Basu,H.Majumdar, S.Bhattacharya, B.Dasmahapatra , *Nucl. Instr. and Meth.* **A556**, 266(2006)

9. Influence of alpha breakup threshold on complete fusion
A.Mukherjee, *Subinit Roy*, M.K.Pradhan, M.Saha Sarkar, P.Basu, B.Dasmahapatra, T.Bhattacharya, S.Bhattacharya, S.K.Basu, A.Chatterjee, V.Tripathy and S.Kailas , *Phys. Lett.* **B636**, 91(2006)

10. Relativistic Mean Field study of neutron-rich even-even C and Be isotopes
G.Gangopadhyay and *Subinit Roy*, J.Phys. **G**: Nucl. Part. Phys. **31**, 1111(2005)

- ***Name:*** **MAITREYEE SAHA SARKAR**
- ***Present Position:*** Professor G
- ***Date of Birth:*** 14.09.1960
- *Ph.D.* 1994, Calcutta University.
- *Studied at Holy Child Institute, Presidency College and Calcutta University (Ranked 7th (2nd among girl students) in Madhyamik, 6th in B. Sc. Physics Honours, 2nd in M. Sc. in Pure Physics)*
- *Recipient of National Scholarship, UGC NET qualified.*

Sl. #	Position held	Univ/Inst.	From
1.	Research Associate	SINP	Sept. 1994
2.	Lecturer 'SC'	SINP	19.4.1996
3.	Reader 'SD'	SINP	February 1998
4.	Associate Prof. 'E'	SINP	August 2001
5.	Prof. 'F	SINP	August 2005
6.	Prof. 'G'	SINP	August 2008

Essential strength of research/development output

- I always aim to get a comprehensive understanding of nuclear structure from my experimental and theoretical studies.
- Characterisations of different types of state-of the art composite semiconductor gamma detectors, which are essential tools of my experimental endeavours, are also of interest to me. Characterisation of Clover detectors done by us has been useful in the gamma spectroscopic studies nationally and internationally using large detector arrays.
- Our experimental studies of nuclei in A~40 have generated some impact in the understanding of the role of intruders and the sd-fp shell gap. Theoretical interpretation of our data using Shell model has also lead to further studies for nuclei in this mass region.
- The most important aspect of our theoretical work is the development of an improved empirical shell model Hamiltonian using the most recent experimental information for the ^{132}Sn region, having excellent predictive power for very neutron rich nuclei above ^{132}Sn. This work has been appreciated internationally. We have collaborated with international groups of experimentalists for interpretation of their data. Very recently we have predicted some unexpected behaviour of semi-magic nuclei and a new shell closure for neutron rich Sn isotope at N=90, which might have interesting consequences for the r - process nucleosynthesis. Along with this theoretical work, I have started setting up an experimental set up in my laboratory to study neutron rich fission fragments.

Future research/development plan

- Preparation and characterisation of implanted targets for use in experiments of Nuclear Astrophysics in the Low energy accelerator facility at Notre Dame University, USA and with the upcoming Facility for Research in experimental Nuclear Astrophysics (FRENA) facility.
- Characterisation of segmented low energy semiconductor planar detectors and to get more acquainted with the International collaborations on tracking detectors.
- Study of evolution of *sd-fp* shell gap in nuclei around A~40. Results from our experimental work will be coupled with the earlier observations for neutron rich isotopes in the island of inversion to have a comprehensive view regarding the changes in $sd - fp$ shell gap. . The role of intruders in the observed large mirror energy differences should be investigated by studying systematic data for different mirror pairs in this mass region to have a deeper understanding of the isospin symmetry-breaking phenomenon.
- Extension of shell model studies to nuclei below ^{132}Sn core and in A~150 and 208 regions.
- Attempts are being taken to propose experiments in international facilities to test our theoretical predictions for neutron rich Sn isotopes, especially the new shell closure at N=90.

Teaching, Research Guidance, Administrative responsibilities

- I am a regular teacher in our Post M.Sc course. I have taught Nuclear Structure in Presidency College M.Sc. Part II course during the time period 2002-2009. I am also working as a member of Teaching Committee.
- My Student Dr. Ritesh Kshetri has been awarded Ph.D degree in April 2009. He is presently working as a Post Doc Fellow in TRIUMF, Canada. Ms. Moumita Basu Roy is working under my supervision since September

2004 on Part time basis. Mr. Abhijit Bisoi, a CSIR Fellow, has joined my group in 2009. He is now completing his Post M.Sc course work.

- I have supervised project work of quite a few undergraduate and Postgraduate students in the last few years.
- Have worked as referee for several International and National Journals.
- Working as a member of DST, India appointed committee for Women Scientist's Scheme-A.
- Have been working actively for Implementation of FRENA since its inception.
- Visited several International laboratories like National Superconducting Cyclotron Laboratory, Michigan State University, USA; University of Notre Dame, USA; GANIL, Caen, France; ILL, Grenoble, France; GSI, Darmstadt, Germany; CERN, Geneva, Switzerland and delivered seminars on our theoretical and experimental work. I have initiated collaboration between Joint Institute for Nuclear Astrophysics, Notre Dame University, USA and FRENA, SINP.

List of important publications starting with recent publications

1. *New magic number for neutron-rich Sn isotopes*, S. Sarkar and **M. SAHA SARKAR**. http://arxiv.org/abs/0910.2119 v1 (12 Oct 2009), v2 (16 April 2010), Accepted for publication in ***Phys. Rev C***, 15 June 2010.

2. *Comment on "High spin structure of the neutron-rich nuclei ^{137}I and ^{139}Cs"*, S. Sarkar and **M. SAHA SARKAR**, ***Phys. Rev. C*** 81, 039803 (2010).

3. *Structure of even-even A = 138 isobars and the yrast spectra of semi-magic Sn isotopes above the ^{132}Sn core*, S. Sarkar and **M. SAHA SARKAR**, ***Phys. Rev. C*** 78, 024308 (2008).

4. *Indication of the onset of collectivity in ^{30}P*, Indrani Ray, Moumita Roy Basu, Ritesh Kshetri, **M. SAHA SARKAR**, S. Sarkar, P. Banerjee, S. Chattopadhyay, C.C. Dey, A. Goswami, J. M. Chatterjee, A. Mukherjee, S. Bhattacharya, B. Dasmahapatra, P. Datta, H.C. Jain, R. K. Bhowmik, S. Muralithar, R. P. Singh, ***Phys. Rev. C*** 76, 034315 (2007).

5. *First observation of medium-spin excitations in the ^{138}Cs nucleus*, T. Rzaca-Urban, W. Urban, **M. SAHA SARKAR**, S. Sarkar, J.L. Durell, A.G. Smith, B.J. Varley, and I. Ahmad, ***Euro. Phys. Jour. A*** 32 (2007) 5 **(Letter).**

6. *First observation of excited states in the ^{138}I nucleus*, T. Rzaca-Urban, K. Pagowska, W. Urban, A. Złomaniec, J. Genevey, J. A. Pinston, G. S. Simpson, **M. SAHA SARKAR**, S. Sarkar, H. Faust, A. Scherillo, I. Tsekhanovich, R. Orlandi, J. L. Durell, A. G. Smith, and I. Ahmand, ***Phys. Rev. C*** 75 (2007) 054319.

7. *High spin structure of ^{35}Cl and the sd–fp shell gap*, Ritesh Kshetri, **M. SAHA SARKAR**, Indrani Ray, P. Banerjee, S. Sarkar, Rajarshi Raut, A. Goswami, J. M. Chatterjee, S. Chattopadhyay, U. Datta Pramanik, A. Mukherjee, C. C. Dey, S. Bhattacharya, B. Dasmahapatra, Samit Bhowal, G. Gangopadhyay, P. Datta, H.C. Jain, R. K. Bhowmik, S. Muralithar, R. P. Singh, R. Kumar, ***Nucl. Phys. A*** 781 (2007) 277

8. *Evolution of collectivity in neutron-rich nuclei of ^{132}Sn region*, R. Kshetri, **M. SAHA SARKAR** and S. Sarkar, ***Phys. Rev. C*** 74 (2006) 034314.

9. *New information on the T=47 s isomer in the ^{136}I nucleus*, W. Urban, **M. SAHA SARKAR**, S. Sarkar, T. Rzaca-Urban, J.L. Durell, A.G. Smith, J.A. Genevey, J.A. Pinston, G.S. Simpson, I. Ahmad, ***Euro. Phys. Jour. A*** 27 (2006) 257 **(Letter).**

10. *Characterisation of a Compton Suppressed Clover Detector for high energy gamma rays (≤ 11 MeV)*, **M. SAHA SARKAR**, Ritesh Kshetri, Rajarshi Raut, A. Mukherjee, Mandira Sinha, Maitreyi Ray, A. Goswami, S. Ray, P. Basu, H. Majumder, S. Bhattacharya,and B. Dasmahapatra, ***Nucl. Instr. & Meth. A***556 (2006) 266.

11. *Shell Model Calculations with Modified Empirical Hamiltonian in ^{132}Sn region*, Sukhendusekhar Sarkar and **M. SAHA SARKAR**, ***Euro. Phys. Jour. A*** 21 (2004) 61.

12. *In search of collectivity in $^{95,97}Mo$ nuclei*, J. M. Chatterjee, **M. SAHA SARKAR**, S. Bhattacharya, S. Sarkar, R. P. Singh, S. Murulithar, and R. K. Bhowmik , ***Phys. Rev. C*** 69, (2004) 044303.

13. *Characteristics of a Compton Suppressed Clover Detector up to 5 MeV*, **M. SAHA SARKAR**, P. Datta, I. Ray, C.C. Dey, S. Chattopadhyay, A. Goswami, P. Banerjee, R.P. Singh, P.K. Joshi, S.D. Paul , S. Bhattacharya, R. Bhowmik , J.M. Chatterjee, H.C. Jain , S. Sen and B. Dasmahapatra, ***Nucl. Instr. & Meth. A***491 (2002) 113.

14. *Shell model study of neutron - rich nuclei near ^{132}Sn*, Sukhendusekhar Sarkar, **M. SAHA SARKAR**, ***Phys. Rev. C*** 64 (2001) 014312.

15. *Structure of ^{96}Mo at high spin*, J.M. Chatterjee, **M. SAHA SARKAR**, S. Bhattacharya, P. Banerjee, S. Sarkar, R.P. Singh, S. Muralithar and R.K. Bhowmik, ***Nucl. Phys. A***. 678 (2000) 367.

16. *Structure of neutron-rich nuclei around A~100*, **M. SAHA SARKAR**, ***Pramana*** 53 (1999) 431.

17. *Particle Rotor Model Calculations of Superdeformed Bands in A= 150 and 190 regions*, **M. SAHA SARKAR**, ***Phys. Rev. C*** 60 (1999) 064309.

1. **Name** Asimananda Goswami
2. **Present position** Professor `G'
3. **Division** Nuclear Physics Division
4. **Academic qualification** PhD

5. <u>Essential strength of research/development output</u>:

Research output:

The main research work is centered on the study of magnetic rotation phenomena responsible for the generation of angular momentum for weakly deformed nuclei in the mass region ~130-140. With the availability of moderately large array of new generation Compton suppressed Clover detectors in our country, such as INGA (Indian National Gamma Array), the nuclei in this domain were studied using in beam gamma spectroscopy. Out of the nuclei studied ^{143}Sm, ^{141}Nd and ^{138}Ce indeed show a Magnetic Rotational character. Apart from the study of Magnetic Rotation phenomenon in this mass region, the structures of several other nuclei were investigated in order to study the complex interplay of single particle and collective degrees of freedom which give rise to various types of excitation spectra.

In addition to the above, I have also actively participated / collaborated in the following projects:

1. Spectroscopy of trans- lead and trans- uranium nuclei.
2. High spin behavior of neutron rich nuclei in mass 100 region

Development output:

The Indian national gamma Array (INGA) collaboration has been set up by the nuclear physics community of the country, belonging to National Institutes and the Universities some year ago with a view to realize a high efficiency and high resolving power gamma array, based on the latest state of the art technology in detector and pulse processing, for pursuing research of contemporary interest in the field of nuclear structure and dynamics With the available resources in the country four successful INGA campaigns took place, the first one at BARC-TIFR Pelletron Accelerator in 2001, the second one at IUAC Pelletron in 2002-2003 using eight clover detectors and other available ancillary devices, such as Charge Particle Detector Array (CPDA) and Heavy Ion Reaction Analyzer (HIRA), the third one at VECC, Kolkata during the period 2004-2006. During 2008 the INGA array was installed at IUAC, New Delhi. A total of 24 clover detector was set up in the array. In all these campaigns I am actively put forward my effort for the installation of the array in the four centers.

6. <u>Future research/development plan</u>:

Development plan:

The Nuclear physics community of the Institute is going to installed a dedicated experimental set up for studying low energy Nuclear Astrophysics, using very high current Accelerator (FRENA- Facility for Research in Experimental Nuclear Astrophysics). I was actively involved in the detailed planning of the infrastructure development related to the FRENA machine such as radiation safety calculations, designing of beam hall and associated laboratories etc.

Research plan:

In the upcoming INGA campaign at TIFR, we proposed an experiment to study the level structure of ^{142,141}Sm. The motivation of the present experiment is to search for Magnetic and Anti magnetic rotational bands and to study the effect of participating proton quasiparticle and the crossing of each other similar to the band crossing observed in the normal rotational band with a systematic study of MR band in A=139, 141 and 143 nucleus with Z=62.

7. <u>List of important publication starting with the recent publication (2008-2010)</u>:

Energy levels in ^{141}Nd from fusion evaporation study
Samit Bhowal, R.Raut, P.Singh, Chirasree Lahiri, M.Kumar Raju, **A.Goswami**, S.Bhattacharya, G.Mukherjee, T. Bhattacharya, A.K.Singh, S.Bhattarchya, R.K. Bhowmik, S.Muralithar, R.P.Singh, N.Madhavan and G.Gangopadhyay.
To be communicated to J.Phys.G

Systematics of antimagnetic rotation in even-even Cd isotopes
Santosh Roy, S.Chattopadhyay, Pradip Datta, S. Pal, S. Bhattacharya, R. K. Bhowmik, **A. Goswami**, H. C. Jain, R. Kumar, S. Muralithar, D. Negi, R. Palit, R. P. Singh
Communicated to Phys. Rev. Lett.

Band crossing involving a 'pure' shears band in A ~130 region
T. Bhattacharjee, S. Chanda, S. Bhattacharyya, G. Mukherjee, S. K. Basu, S. Ray,S. S. Ghugre, R. K. Bhowmik, R. Chakrabarty, A. Chatterjee, L. S. Danu, J. J. Das **A. Goswami**, R. Kumar, S. Muralithar, D. Pandit, R. Raut, R. P. Singh and A. Shrivastava
Communicated to Phys. Rev. Lett.

Alignment and change of shape: signatures in the yrast sequences in A~50 mass region
S. Mukhopadhyay, A. K. Sinha, Krishichayan, A. Chakraborty, N. S. Pattabiraman, R. Chakrabarti, S. Ray, S. S. Ghugre, S. N. Roy, P. V. Madhusudhana Rao, U. Garg, G. Kiran Kumar, S. Ganguly, R. Raut, P. Banerjee, **A. Goswami**, M. B. Chatterjee, A. Dhal, L. Chaturvedi, A. Deo, S. B. Patel, Rakesh Kumar and S. K. Basu.
Submitted to Phys. Rev.C

Band crossing in a shears band of ^{108}Cd
S.Roy, P.Dutta, S.Pal, S.Chattopadhyay, S.Bhattacharya, **A.Goswami**, H.C.Jain, P.K.Joshi, R.K.Bhowmik, R.Kumar, S.Muralithar, R.P.Singh, N.Madhavan, P.V.Madhusudan Rao.
Phys. Rev.C 81, 054311 (2010)

High spin states and isomer decay in doubly odd ^{208}Fr
D.Kanjilal, S.Bhattacharya**, A.Goswami**, R.Kshetri, R.Raut, S.Saha, R.K.Bhowmik, J.Gehlot, S.Muralithar, R.P.Singh, G.Jnaneswari, G.Mukherjee, B.Mukherjee**.**
Nucl. Phys.A 842, 1 (2010)

Observation of enhanced orbital electron capture nuclear decay rate in a compact medium.
A.Ray, P.Das, S.K.Saha, **A.Goswami**, A.De
Phys. Lett.B 679, 106 (2009)

Experimental study of the 2p-2h band in ^{111}Sn
S.Ganguly, P.Banerjee, I.Ray, R.Kshetri, R.Raut, S.Bhattacharya, M.SahaSarkar, **A.Goswami** and S.K.Basu.
Phys. Rev.C 78, 037301 (2008)

Abrupt change of rotation axis in ^{109}Ag
P. Datta, S.Roy, S.Pal, S. Chattopadhyay, S. Bhattacharya, **A. Goswami**, M. Saha. Sarkar, J.A.Sheikh, Y.Sun , P. V. Madhusudhana Rao, R. K. Bhowmik, R. Kumar, N. Madhavan, S. Muralithar, R. P. Singh, H.C. Jain, P. K. Joshi and Amita
Phys. Rev. C 78, 021306(R), (2008)

Prof. Ushasi Datta Pramanik

1.Educational background:

Ph.D (Sc.), July, 1998, Calcutta University (SINP, Kolkata)
Title: 'Study of deformed odd-odd nuclei'

2.Assignments:

Professor-'F', SINP, Kolkata (Feb., 2008- onwards)
Assoc. Professor-'E', SINP, Kolkata (Aug,2005-Feb, 2008)
Visiting scientist , GSI, Darmstadt, Germany (2004-2006)
Visiting scientist, CSNSM, Orsay, France (2003)
Reader-'D', SINP, Kolkata (June,2002-Aug, 2005)
Post Doctoral Fellow, GSI, Darmstadt, Germany (June,1999-June2002)
Visiting research Fellow, INFN, Italy (Nov-Dec, 1998, April-May,1999)

Awards/Fellowships:

Foundation day award for research, Saha Institute Of Nuclear Physics, Kolkata (2010)
Alexander Von Humboldt Fellowship, Germany (2004-2006, 2008-2009)
CNRS Fellowship, Orsay, France, (2003)
DFG-BMBF, Fellowship, Germany (June,1999-June,2002)
International INFN fellowship, Catania, Legnaro, Italy (1999-2001)
DAE Fellowship (1990-1998), National Scholarship (1983), National Merit certificate (1981)

3.Essential strength of research/development Output:

More than eighteen years of research experience in experimental nuclear physics, gathered significant expertise in accelerator based experiments utilizing wide range of techniques and detector systems to explore static and dynamical properties of nuclei. Particularly deep involvement was in understanding properties of exotic nuclei under various extreme condition around the limits of its existence. The implication of these properties in various other field of science such as astrophysics, Energy generation, etc also have been explored.. Several experiments were performed at various international accelerator facilities in Germany, France, Italy, India, Netherlands, Switzerland, USA etc. using both stable and unstable nuclear beam with energy from a few MeV to several tens of GeV. Some of these novel experiments, data were taken in least mode of very large number of parameters (more than thousands) using sophisticated multi-detector arrays for detecting γ-rays, high energy neutrons, charge particles and mass separators. Few experiments were performed as a spokesperson or co-spokesperson of large international collaboration. These research work have been published in more than seventy-one papers in high impact international journals. Received invitation to deliver invited lecture (more than 25 times in last ten years) on above mentioned research work in various internationally prestigious conference, workshop and school. Some of the outstanding contributions in this field are mentioned below.

New spectroscopic tool for exotic nuclei: It was shown for the first time that γ-ray spectroscopy after Coulomb breakup of intermediate energy exotic nuclei is an excellent spectroscopic experimental tool to probe quantum numbers of valence nucleon of nuclei close to drip line (ref 11). Many contradictory results (ref.10) on properties of exotic nuclei has been solved (ref.9) using the above mentioned spectroscopic tool. This new tool open up a broad horizon to understand extra-ordinary features observed in exotic nuclei. Recently as a spokesperson in a large international collaboration another experiment (GSI-s306) has been performed to understand failure of magic number.

Indirect measurement of capture cross-section for nuclear synthesis process: First successful indirect measurement of capture cross-section of neutron-rich nuclei, relevant to astrophysical process was performed (Ref.7) though Coulomb breakup which opens up a new direction for nuclear astrophysics using RIB facility .

PIGMY resonance, symmetry energy, and Neutron skin and neuron star: New types of excitation mode of exotic nuclei (PIGMY) were experimentally observed through kinematical complete measurement using RIB facility at GSI, Germany (Ref. 8, 13). Measurement of these excitation modes gave an access to symmetry energy which can be utilized for equation of state to understand Neutron star (ref. 7).

Spectroscopy of Unbound nuclei: The structure of some very exotic nuclei beyond drip line has been studied through knockout reaction of exotic nuclei using RIB facility at Germany [ref.3]. and France which may bring information in understanding existence of nuclei.

Probing shapes of nuclei: Several experiments were performed in both national laboratory and international laboratories using in beam γ-ray spectroscopy to probe shapes of nuclei (ref.14,6) to understand nuclear behavior in static and dynamic mode.

Gamma-ray astronomy: γ-ray spectrums obtained from satellite based detectors were analyzed to understand cosmic background related events.

Cosmic/natural background study: At SINP laboratory, a cosmic/natural background related study is going on using scintillator detectors, semiconductor detectors and recently indigenously developed detector (MMRPC).

Detector development: Developed a special laboratory at SINP, Kolkata for developing ultra fast radiation detector [Multi gap multi strip resistive plate chamber (MMRPC)] [XI-plan project]. **In this laboratory, for the first time in India , technologically challenging , low cost, multi purpose detector with timing resolution better than 100 ps with efficiency 99% is developed recently [ref.1].** The planning, designing, and fabrication of the detector have been performed at SINP, Kolkata using local facilities**. The performance of the detector** studied extensively using both cosmic background and γ- ray source at SINP laboratory as well as pulse electron beam at Germany. This developed MMRPC can be used as an active part of Neutron detector of **R3B, FAIR facility at Darmstadt [ref.1].** This detector can also have numerous applications in the field medical imaging, cosmology etc.

4.Future research/development plan: Plan to develop international competitive laboratory to study cosmic background or rare events related to cosmological background using indigenously developed detector as well as commercial developed detectors. In this respect some further technologically challenging detector development can be carried out.

In addition to that, research activity related to nuclear physics and nuclear astrophysics using both national and international accelerator facilities will be continued to explore novel phenomena in exotic nuclei around the drip-line and its implication in various cosmological events.

5.List of important publications: Seventy-one (71) publications in the int. jour., H-index -14

1. Development of multi strip multigap resistive plate chamber for R3B, FAIR, to be published in **NIMA**, 2010
2. Channel coupling effects on the fusion excitation functions for ^{28}Si+$^{90, 94}$Zr in sub- and near-barrier regions, **PRC** 81, 044610 (2010)
3. Properties of the ^{7}He ground state from ^{8}He neutron knockout', **PLB** 679, 191 (2009)
4. Lithium isotopes beyond the drip line, **PLB** 666, 430 (2008)
5. Indirect measurement of radiative capture cross sections relevant in astrophysical scenarios, **Prog.Part.Nucl.Phys**. 59, 183 (2007) (Review)
6. Sub-Barrier Coulomb Excitation of ^{110}Sn and Its Implications for the ^{100}Sn Shell Closure '**PRL** 98, 172501 (2007),

*7. Nuclear symmetry energy and neutron skins derived from pygmy dipole resonances **PRC** 76, 051603 (2007),

*8. Evidence for Pygmy and Giant Dipole Resonances in ^{130}Sn and ^{132}Sn, **PRL** 95, 132501 (2005), ***(This article was appeared in PRC focus)***

9. Coulomb breakup of ^{23}O**, PLB** 605, 79 (2005)
10. Shell Structure of the Near-Drip line Nucleus ^{23}O, **PRL**93, 062501 (2004),

*11.Coulomb breakup of the neutron-rich isotopes ^{15}C and ^{17}C, **.PLB** 551, 63 (2003) ***Hottest article in PLB journal (top 20 papers) in year 2003***

12. Experimental Evidence for the 8B Ground State Configuration , **PLB**529, 36 (2002),

13. Photoneutron Cross Sections for Unstable Neutron-Rich Oxygen Isotopes, **PRL 86, 5442 (2001) ,

14. Rotational Bands in the Doubly Odd ^{138}Pm, NPA632, 307 (1998)

** ***Cited more than hundred times,*** * ***Cited more than fifty times according to ISI web science***

1. Name: Chinmay Basu
Educational background:
B.Sc-Physics (H), University of Calutta, 1989
M.Sc (Pure Physics), University of Calcutta, 1991
P. MSc (Physics), SINP, 1992-93
NET, Qualified Joint CSIR-UGC Fellowship, Dec 1992
Ph.D (Theoretical Nuclear Physics) University of Calcutta/
Saha Institute of Nuclear Physics, 1999

2. Academic profile:
Senior Research Fellow -I (SINP), 1.10.1992 to 30.09.1995
Senior Research Fellow-II (SINP), 1.10.1995 to 31.10.2000
Research Associate (SINP), 1.11.2001 to 11.4.2002
Reader D (SINP) 12.4.2002 to 31.1. 2006
Associate Professor E 1.2.2006 to 31.7.2008
Professor F 1.8.2008 till date

3. Essential strength of research/development output:

My PhD dissertation, entitled "Cluster Emissions in Nuclear Reactions through Non-equilibrium processes" was concerned with the investigation of pre-equilibrium cluster emissions in nucleon and heavy ion induced reactions. A formalism was developed from first principles that took into account the cluster formation probability inside an excited nucleus as well as its pre-emission energy and momentum distributions. The observed energy spectra and angular distributions were satisfactorily explained without empirical or adjustable parameters. In parallel to my thesis work, I carried out extensive research on the development of radiation gas detectors in general and a low pressure position sensitive multi-wire proportional counter in particular. This detector was indigenously fabricated in SINP using the workshop facility and its properties were studied in detail. During my PhD period, I also participated in a few accelerator based experiments related to nuclear fission studies.

Subsequently, I carried out experimental studies on various low energy nuclear reactions such as compound nuclear reactions, quasi-elastic reactions and fusion reactions using Pelletron facilities in New Delhi (IUAC) and Mumbai,(TIFR-BARC) In particular the entrance channel dependence of compound nuclear energy spectra was studied by populating ^{56}Ni compound nucleus through symmetric (^{28}Si+^{28}Si, ^{28}Si+^{27}Al) and asymmetric (^{16}O+^{40}Ca) channels. Besides these systems ^{6,7}L+^{6,7}Li reactions have been also studied extensively as reaction mechanisms for these nuclei are analogous to radioactive nuclei. I theoretically investigated the spectroscopic factor for the two proton radioactivity process in proton rich nuclei ^{45}Fe and ^{48}Ni and studied magic numbers from the deuteron separation energies. On the development side an axial gas ionization chamber was indigenously developed and tested successfully. This detector is presently operating and can be used for in beam experiments.

In recent times, I have studied the alpha cluster states of ^{18}O nucleus using resonant particle spectroscopy. In this method, the nuclei whose cluster states are to be measured are excited to these states that subsequently decay into its components through a breakup process. The fragments are detected in coincidence to construct the excitation energy spectra. We observed some higher energy cluster levels and proposed new spin parity for a state from our angular correlation study. The heavy cluster configurations of ^{18}O have been also studied using inclusive measurement of heavy fragments at low incident energies. Model analysis shows that source of such fragments can only result from projectile fragmentation process. This is a preliminary indication for a possible heavy cluster configuration in ^{18}O. Using available ^{16}O resonance breakup data at intermediate energies we have for the first time proposed a breakup method to deduce the alpha spectroscopic properties of ^{16}O. These properties have immense astrophysical importance in relation to the R matrix calculation of the important ^{12}C(α,γ) reaction at astrophysical energies.

4. Future research/development plan:

My interests in near future will be oriented to nuclear astrophysics studies. We have already performed some calculations using the indirect method with breakup reactions as a means to derive the spectroscopic properties of a nucleus. Experiments utilizing this method would require beams at intermediate energies. Since we have already gained experience in resonant particle spectroscopy we can utilize this method at higher energies to obtain the desired angular distribution data. Such experiments are feasible with the upcoming Superconducting Cyclotron at VECC. In view of doing some experiments with already available facilities we have submitted a proposal at the IUAC to extract the ANC of ^{16}O using alpha transfer reactions at above barrier energies. As transfer methods are sensitive to nuclear potential fresh experiments at different energies with extracted optical potential at that energy is required. The proposal has been accepted and beam time has been sanctioned. This work is expected to provide us the experience in the various aspects of nuclear astrophysics. The experiments at IUAC can be extended to sub-barrier energies using the upcoming FRENA (Facility for Research in Low Energy Astrophysics) machine. At sub-barrier energies it has been already shown that the nuclear potential contribution is replaced by only Coulomb potential and this makes the extracted spectroscopic properties (ANC) independent of potential parameters. We are presently trying to write an R-matrix code appropriate for calculations of capture cross-sect ions. I am also developing a gas scintillation proportional counter that has wide range of applications in astronomy and physics. The detector fabrication and its laboratory setup have been completed. The vacuum components, working gas (Xenon), VUV photomultiplier and some electronics have been procured. An important part of this detector is purification of the gas that should be maintained at a very high level with a continuous flow. At present we are planning this gas flow setup that will be installed once the various components such as the getter purifiers, the bellow pumps etc. are procured. We are also thinking of procuring a compact arrangement so that we can concentrate more on the optimization of the various parameters of the detector.

5. List of important publications:

i) "The study of reduced α-width and ANC of ^{16}O states through its sequential breakup" **Phys. Lett. B** 682 (2009) 216, Sucheta Adhikari and Chinmay Basu

ii) "The study of α+^{14}C cluster states of ^{18}O through the resonant breakup reaction ^{12}C(^{18}O, ^{14}Cα) at E(^{18}O) = 94.5 MeV" **Int. Jour. Mod. Phys. E** 18 No.9 (2009) 1917, S. Adhikari, C. Basu, B. R. Behera, S. Ray, A. K. Mitra, Suresh Kumar, A. Chatterjee

iii) "Reaction mechanisms in ^{16}O+^{40}C at an incident energy of E(^{16}O) =86 MeV through inclusive measurements of α and proton spectra" **Phys. Rev. C** 76, No.3 (2007) 034609, Chinmay Basu et al

iv) "Performance of an axial gas ionization detector", **IEEE Trans. Nucl. Sci.** 53, Issue 4, (2006) 2270, S. Adhikari, C. Basu, C. Samanta, S.S. Brahmachari, B.P. Das and, P. Basu

v) "Magic numbers from new systematics", **Int. J. Mod. Phys. E** 15, No.3 (2006) 747, Chinmay Basu

vi) "Spectroscopic factors for two-proton radioactive nuclei", **Pramana – Jour. of Phys.** Vol. 63, No. 5 (2004) 1047, Chinmay Basu

vii) "Performance of a position-sensitive low-pressure multiwire proportional counter (LPMWPC) having position readout from a separate sense wire plane: a critical analysis", **Nucl. Instr. & Meth. in Phys Res A** 484 (2002) 407, Chinmay Basu et al

viii) "Target-projectile symmetry effect on fast light-particle emissions", **Phys. Lett. B** 484 (2000) 218, Chinmay Basu and Sudip Ghosh

ix) "Closed-form evaluation of pre-equilibrium light-cluster emission in heavy ion reactions", **Phys. Lett. B** 425 (1998) 227, Chinmay Basu and Sudip Ghosh

x) "Pre-equilibrium cluster angular distribution in heavy ion reactions", **Jour. Phys. G** 25 (1999) 2123 Chinmay Basu and Sudip Ghosh

xi) "Pre-emission cluster energies in pre equilibrium nuclear reactions", **Phys. Rev. C** 56 (1997) 3248 Chinmay Basu and Sudip Ghosh

1. **Name:** Prof. Anjali Mukherjee
2. **Educational background:** M.Sc , Ph.D.
3. **Ph.D.(Year & Name of University):** Thesis submitted: 19.11.97
Degree awarded: 1.08.98
University of Calcutta

4. **Academic awards:**

i) Amongst the top 9 candidates in the CSIR-UGC NET (National Eligibility Test) examination for junior research fellowship, 1990

ii) Among the best three presentations in the Young Physicist's Colloquium of the Indian Physical Society, 1998

iii) Best thesis presentation award of The Indian Physics Association, 1998

5. **Academic assignments (Post Doctoral / Teaching etc.) prior to joining SINP in a permanent position**

Sl. #	Position held	Univ./Inst.	Period	
			From	To
1.	Research Associate	SINP, Kolkata	Aug. 1998	Nov. 1999
2.	Postdoctoral Fellow	Australian National University, Australia	Nov. 1999	Sep. 2002
3.	Postdoctoral Fellow	VECC, Kolkata	Sep. 2002	Feb. 2004

6. **Date of joining SINP (in a permanent position): 23.02.04**

7. **Present position held: Prof. 'F'**

8. **Promotions obtained in chronological order:**

Sl. #	Designation change		Year of
	From	To	Promotion
1.	Reader 'D'	Asso. Prof. 'E'	Feb. 2007
2.	Asso. Prof. 'E'	Prof. 'F'	August 2009

9. **Ph.D. Student: Mr. M.K. Pradhan (ongoing)**

10. **List of 5 (five) important invited talks delivered in Conference/Workshop/schools**

i) **"Recent results on Fusion measurements" at the** *National Theme Workshop on Nuclear Reaction Mechanism (NTWNRM-2010), Chandigarh, 2010*

ii) **"*FRENA*" at the** *National Theme Workshop on Nuclear Reaction Mechanism (NTWNRM-2010), Chandigarh, 2010*

iii) **"Influence of projectile breakup on complete fusion" at the** *International DAE-BRNS Symposium on Nuclear Physics (ISNP2009), Mumbai, 2009*

iv) "A facility for research in experimental nuclear astrophysics (FRENA)" at the *Expanding Horizons in Nuclear Physics, Mumbai, 2009*

v) **"Role of breakup/transfer on the fusion process" at the** *DAE-BRNS Symposium on Nuclear Physics, Mumbai, 2003*

11. **Essential strength of research/development output:**

My current field of research interest is primarily investigation of near-barrier heavy-ion fusion mechanism, especially with weakly bound nuclei. Proper theoretical calculations still do not exist that can predict the complete and incomplete fusion cross sections, and hence understand the dynamics of the fusion process of weakly bound nuclei. We hope our experimental investigations in this field will pave the way, at least to a certain extent, to obtaining a quantitative theoretical explanation of the effect of breakup of weakly bound nuclei on fusion. With the recent advent of the radioactive ion beams at different laboratories around the world, this field has received a strong fillip because understanding the fusion mechanism with halo nuclei has become very important. This is very significant for understanding the reactions of astrophysical interest and also for the production of superheavy nuclei. A thorough understanding of the topic requires measurements both with unstable and weakly bound stable nuclei. Considering the present status of the subject, I feel that our works have been very important contributions to the field and this is evidenced by several citations made by other workers in this topic.

12. Future research/development plan:

i) Fusion measurements with radioactive beams available from laboratories outside India

ii) Study of reactions of astrophysical interest

iii) Working on the upcoming project FRENA

iv) Development of a ΔE-E gas detector, having a single window at the entry point. This will be useful for detecting very low energy evaporation residues. Once made, this detector will also be of immense use for studying reactions in astrophysical energy domain.

13. Important publications:

i) Suppression of complete fusion due to breakup in the reactions $^{10,11}B+^{209}Bi$
L. R. Gasques, D. J. Hinde, M. Dasgupta, **A. Mukherjee**, R.G. Thomas
Phys. Rev. C 79 (2009) 034605

ii) Fusion cross sections for $^{6,7}Li+^{24}Mg$ reactions at energies below and above the barrier
M. Ray, **A. Mukherjee**, M.K. Pradhan, R.K. Kshetri, M.S. Sarkar, R. Palit, I. Majumdar, P.K. Joshi, H.C. Jain, B. Dasmahapatra
Phys. Rev. C 78 (2008) 064617

iii) Failure of a Woods-Saxon nuclear potential to simultaneously reproduce precise fusion and elastic scattering measurements
A. Mukherjee, D.J. Hinde, M. Dasgupta, K. Hagino, J.O. Newton, R.D. Butt
Phys. Rev. C75, 044608 (2007)

iv) Influence of projectile α-breakup threshold on complete fusion
A. Mukherjee, S.Roy, M.K.Pradhan, M.S.Sarkar, P.Basu, B.Dasmahapatra, T.Bhattacharya, S.Bhattacharya, S.K.Basu, A.Chatterjee, V.Tripathi, S.Kailas
Phys. Lett. B 636 (2006) 91

v) Fusion cross sections for $^{7}Li+^{16}O$ at energies above barrier
M. Ray, **A. Mukherjee**, M. Saha Sarkar, A. Goswami, S. Roy, S. Saha, R. Bhattacharya, B.R. Behera, S.K. Datta, B. Dasmahapatra
Phys. Rev. C 68 (2003) 067601

vi) Severe inhibition of fusion by quasifission in reactions forming ^{220}Th
D.J. Hinde, M. Dasgupta, **A. Mukherjee**
Phys. Rev. Lett. 89 (2002) 282701

vii) Dominance of collective over proton transfer couplings in the fusion of ^{32}S and ^{34}S with ^{89}Y
A. Mukherjee, M. Dasgupta, D.J. Hinde, K. Hagino, J.R. Leigh, J.C. Mein, C.R. Morton, J.O. Newton, H. Timmers
Phys. Rev. C66 (2002) 034607

viii) Absence of fusion suppression due to breakup in the $^{12}C+^{7}Li$ reaction
A. Mukherjee, M. Dasgupta, D.J. Hinde, H. Timmers, R.D. Butt, P.R.S. Gomes
Phys. Lett. 526B (2002) 295

ix) Breakup vs. fusion inhibition of Li-induced reactions at low energies
A. Mukherjee, B. Dasmahapatra
Phys. Rev. C63 (2001) 017604

x) Investigation of $^{6}Li+^{16}O$ and $^{7}Li+^{16}O$ reactions at low energies
A. Mukherjee, U. Datta Pramanik, S. Chattopadhyay, M. Saha Sarkar, A. Goswami, P. Basu, S. Bhattacharya, M.L. Chatterjee, B. Dasmahapatra
Nucl. Phys. A645 (1999) 13

xi) Fusion cross-sections for $^{6}Li+^{12}C$ and $^{6}Li+^{13}C$ reactions at low energies
A. Mukherjee, U. Datta Pramanik, S. Chattopadhyay, M. Saha Sarkar, A. Goswami, P. Basu, S. Bhattacharya, M.L. Chatterjee, B. Dasmahapatra
Nucl. Phys. A635 (1998) 305; Erratum Nucl. Phys. A640 (1998) 509

xii) Fusion cross-sections for $^{7}Li + ^{11}B$ and $^{9}Be+^{9}Be$ at low energies
A. Mukherjee, B. Dasmahapatra
Nucl. Phys. A614 (1997) 238; Erratum Nucl. Phys. A640 (1998) 508

xiii) $^{7}Li+^{12}C$ and $^{7}Li+^{13}C$ fusion reactions at subbarrier energies
A. Mukherjee, U. Datta Pramanik, M. Saha Sarkar, A. Goswami, P. Basu, S. Bhattacharya, S. Sen, M.L. Chatterjee, B. Dasmahapatra
Nucl. Phys. A596 (1996) 299

1. Name:

Maitreyee Nandy
Professor
Chemical Sciences Division
Saha Institute of Nuclear Physics

Educational Background:
B.Sc. (Physics Honours) University of Calcutta (1986)
M.Sc. (Physics) University of Calcutta (1989) (Session 1986-88)
Post M.Sc. (Radiological Physics) Saha Institute of Nuclear Physics (1989-'90)
Ph.D. (Science) University of Calcutta (2000)

2. Academic Profile:

Earlier employment data:
Physicist, Cancer Centre Welfare Home & Research Institute , February 1991-April 1992
Visiting Scientist:

a) Laboratori Nazionali di Frascati (INFN), Frascati, Italy: December 9, 2001 to March 8, 2002
b) Laboratori Nazionali di Frascati (INFN), Frascati, Italy: January 2, 2003 to February 15, 2003.
c) High Energy Accelerator Research Organisation, Tsukuba, Ibaraki, Japan; February 18, 2003 and April 20, 2003:

Awards:
National Merit Scholarship, Madhyamik Pariksha, awarded by West Bengal Board of Secondary Education, Ministry of Education, Govt. of West Bengal.

Ph.D. work:
Studies on Preequilibrium Emissions in Nuclear Reactions

3. Essential strength of research/development output

Theoretical estimations and experimental measurements of radiation environment have been carried out in proton and heavy ion accelerators spanning the energy range from a few MeV to 1 GeV in terms of double differential yield of neutrons and photons and radioactivity induced by the primary beam and secondary radiation.
Study in this area involving proton projectiles with energy up to about 1 GeV finds important application for facility design and radiological safety analysis for upcoming Accelerator Driven Subcritical Systems (ADSS). The measured neutron data for heavy ion projectiles reflects the total ambient dose equivalent and organ dose to humans and radiation damage caused to instruments in these facilities in any accidental condition.
The empirical formalisms developed for low to intermediate energy proton and light ion induced reactions helps to asses the radiation environment in such facilities. The energy differential neutron yield distributions at different angles give insight into nuclear reaction mechanisms when compared with theoretically computed results.

4. Future research/development plan

- Theoretical study and experimental measurement of neutron and photon energy-angle, dose distributions and transport in ADSS facilities
- Radiation environment, safety and reaction mechanism studies for low energy positive ion accelerators

5. List of important publications:

1. Maitreyee Nandy, P. K. Sarkar, N. Nakao, T. Shibata, "Measurement and theoretical estimation of induced activity in ^{nat}In by high energy neutrons" *PRAMANA – Journal of Physics* Volume 73, Number 4 / 669-683 October, (2009)
2. Sunil C, A A Shanbhag, M Nandy, M Maiti, T. Bandyopadhyay, Sarkar P K, "Direction Distribution of Ambient Neutron Dose Equivalent from 20 MeV Protons Incident on Thick Be and Cu Targets", *Radiation Protection Dosimetry* **136**: 67-73; doi:10.1093/rpd/ncp146. (2009)
3. Sunil C, Maitreyee Nandy, P. K. Sarkar, Measurement and analysis of energy and angular distributions of thick target neutron yield for 110 MeV ^{19}F on Al, *Physical Review C* **78**, 064607(1-10) (2008)
4. Sunil C, Nandy M, Bandyopadhyay T, Maiti M, Shanbhag A A, Sarkar P K, "Neutron dose equivalent from 100 MeV ^{19}F projectiles on thick Cu target", *Radiation Measurement 43, 1278-1284 (2008)*
5. Maitreyee Nandy and P. K. Sarkar, "Estimation of induced activity in thick lead-bismuth and iron alloy targets by 30 MeV protons", *Nuclear Instruments and Methods in Physics Research A*, **583** 248-255, (2007)
6. Maitreyee Nandy, C. Sunil, Moumita Maiti and P.K. Sarkar, "Estimation of angular distribution of neutron dose using time of flight for ^{19}F+Al system at 110 MeV" *Nuclear Instruments and Methods in Physics Research A*, **576**, 380-388, (2007).
7. C. Sunil, Maiti M., Nandy M., Sarkar P.K., "Thick Target Neutron Dose Evaluation For ^{19}F+Al System", *Radiation Protection Dosimetry* (Oxford Journals) **123** pp.277-282 (2007).
8. M. Maity, Maitreyee Nandy, S.N.Roy and P.K.Sarkar, "Systematics and empirical expressions for neutron emission from thick targets in α-induced reactions", *Physical Review C* **71**, 034601(2005).
9. D.Dhar, S.N.Roy, Maitreyee Nandy and P.K.Sarkar, "Analysis of neutron emission spectra for 30-50 MeV alpha-particle induced reactions in thick targets", *Physical Review C* **67**, 064611 (1-5) (2003).
10. Maitreyee Nandy, Tapas Bandyopadhyay, P.K. Sarkar, "Measurement and analysis of neutron spectra from a thick Ta target bombarded by 7.2A MeV ^{16}O ions", *Physical Review C* **63**, 034610 (1-6) (2001).
11. P. K. Sarkar and Maitreyee Nandy, "Concepts in computation of preequilibrium nucleon emission from heavy ion reactions", *Physical Review E* **61**, (6) 7161-7168 (2000).
12. Maitreyee Nandy, Sudip Ghosh and P. K. Sarkar, "Angular distribution of Preequilibrium Neutron Emissions from Heavy Ion Reactions", *Physical ReviewC* **60**, 044607(1-10) (1999).
13. N. Chakravarty, P. K. Sarkar, Maitreyee Nandy and Sudip Ghosh, "Excitation Function Measurement and Reaction Mechanism Analysis for Alpha-induced Reactions on 197-Au" *Journal of Physics G* **24**, p.151-166, (1998).
14. Sudip Ghosh, Maitreyee Nandy, P. K. Sarkar, N. Chakravarty, "Neutron Skin Effect in Preequilibrium Nucleon Emissions", *Physical Review C* **49**, 1059-1065 (1994).