Annual Report for the year (2010-2011)

Physics & Applied Mathematics Unit (PAMU)

1. Teaching and Training :

Apart from research activities in Physics & Applied Mathematics, Faculty Members of the Unit are engaged in teaching various courses like B. Stat (Hons.), M. Tech. (CS), M. Tech (QROR), ISEC and other courses. They guide and assist research students (towards the Ph.D. programme) and Research Associates to enable them to complete their projects.

1.2 Ph.D./D.Sc. Degrees :

I.

a) Name of the research fellow : **Suvadip Paul**
b) Title of the dissertation :
"Dispersion phenomena in laminar and turbulent flows"
c) Name of the University / Institute : **University of Jadavpur**
d) Name and affiliation of the Supervisor (s) : **Dr. B. S. Mazumder**
Physics & Applied
Mathematics Unit
Indian Statistical Institute

II.

a) Name of the research fellow : **Arpita Ghosh**
b) Title of the dissertation :
"Study of cavity quantum electrodynamics in both fock space and interacting fock space"
c) Name of the University / Institute : **University of Jadavpur**
d) Name and affiliation of the Supervisor (s) : **Dr. P. K. Das**
Physics & Applied
Mathematics Unit
Indian Statistical Institute

III.

a) Name of the research fellow : **Tapas Kumar Jana**
b) Title of the dissertation :
"Application of symmetry principles to some problems of quantum mechanics"
c) Name of the University / Institute : **Jadavpur University**
d) Name and affiliation of the Supervisor (s) : **Dr. P. Roy**
Physics & Applied
Mathematics Unit
Indian Statistical Institute

2. CONVOCATION : N. A.

3. RESEARCH AND OTHER SCIENTIFIC ACTIVITIES

PHYSICS

1. *Astro Optics :*

Analysis of PAHs extinction efficiencies to prepare an analytic framework for study of inter Stellar Extinction data corresponding to Galaxies like the Milky way, SMC, LMC was carried out. This work is covered under an ISRO project. **(A. K. Roy)**

2. *Bayesian Approach to Data Analysis in Astronomy:*

New Bayesian methodology as developed by Bhattacharya et al in BIRU; ISI has been applied to a large data set from SDSS quasar catalogue to study the recent unsolved cosmological issues. Attempts have been made to study the relation between the apparent magnitude and the redshift based on this new methodology. This sheds new light on the validity of Hubble law for high redshift. The cluster analysis is under investigation for this kind of quasar data. This is in collaboration with Dr. Souvarh Bhattacharya and Mr. Sabyasachi Mukhopadhyay of BIRU, ISI.
(**Sisir Roy**)

3. *Classical Optics (Scattering)* :

Analytic modeling of small particle size-distributional PHASE function has been done to extend our earlier single particle formula. The results are expected to be of practical use in the study of scattering of light from soft, tenuous media collaborator. **(A. K. Roy)**

4. *Cosmology :*

New models of cosmological inflation have been proposed in the framework of background super-gravity. This involves construction of the inflation potential from super-gravity and analysis of the typical energy scale of inflation, which resonates well with present estimates from cosmology and standard model of particle physics. Further, a careful investigation of cosmological perturbations have been performed, which leads to exploring observational aspects related to Cosmic Microwave Background (CMB) radiation. It has been demonstrated that this semi-analytical treatment reduces complications related to numerical computation to some extent and may even result in increased accuracy level for studying the features of different phenomena related to CMB angular power spectrum, which can be useful in precision cosmology to confront with the existing and upcoming observational data.

On the other hand, the generalized particle dynamics, proposed earlier, have been employed to model dark energy, which accounts for the late acceleration of the universe. An effective dark energy equation of state, exhibiting a phantom like behavior, is generated. The results have been confronted with present day cosmological data coming from high redshift Supernovae.

The constraint structure of the recently proposed Horava gravity regarding the existence of extra mode has been considered. It has been shown that in weak gravity the problem is absent. Furthermore a scheme has been provided for gauge invariant extension of Horava gravity.
(S. Pal, S. Ghosh & B. Basu)

6. *Foundations of Quantum Mechanics & Theory of Measurements:*

A framework has been developed where partial reduction of wave pocket is considered depending on certain conditions. The connection with weak measurements as proposed and developed by Aharanov et al is under investigation. **(S. Roy)**

7. *High and Ultrahigh Energy Physics:*

The Large Hadron Collider (LHC) started its actual experiments since November 2009. But, to date, no significant results arousing new wonder(s) were reported. On the contrary, the

experimental reports emanated from the RHIC-BNL-TEVATRON, SPS, and ISR etc. are much more meaningful, and at the same time, more reliable after repeated confirmation with very high statistics experiments. As a result, our attention over the last one-year was, in the main, focused by the model-based analyses - both intensive and extensive - of the vast amount of very important data on the rapidity spectra of the various particles produced in both particle-particle and particle-nucleus and nuclear collisions. This objective is now fulfilled by nearly completing the assigned task from the viewpoint of a newly built-up model by us. Besides, the behaviour of the p_T – spectra in Cu-Cu interactions at very high (RHIC) energies was studied in detail in the light of an established non-standard approach. Furthermore, the characteristics of 'soft' particle production in very heavy nucleus – nucleus collisions at extremely high energies were exhaustively studied and discussed in a substantial work of great merit. The chain of works highlights the importance of some useful alternative approaches. **(S. Bhattacharyya)**

8. Planck Scale Physics and Cellular Network Theory:

Cellular Network Theory has been proposed to understand the space-time at Plank Scale. Kind of self-similar processes are supposed to be involved in the emergence of space-time around. With the help of agent-based simulations we are able to produce continuum space-time starting from discrete structure. The result has been published in a research monograph jointly with Prof. Ralph Abraham. **(S. Roy)**

9*. Plasma Physics:*

Large amplitude dust ion acoustic solitary waves and double layers in complex plasma with non-isothermal electrons have been studied and critical values of some plasma parameters, beyond which solitary solutions would cease to exist, are obtained. **(R. Roychoudhury)**

10*. Quantum Control, Interacting Fock Space and Boson Fock Space*

In continuation of our development of studies in interacting Fock space we observed that starting with the interaction of interacting field and a two level atom the atom-interacting field system acquires a space parameter dependent Berry phase after the phase parameter slowly changes and ultimately returns to its initial form.

In fact, geometric phase will be applied to implement the fault-tolerant quantum gates which shows its importance in physical application.

We are also in the process of generating W state with the help of designing QED baths connected in parallel with the help of state space representation in stochastic field of the optical QED by developing quantum feedback QED control system.

The Doppler effect is one of the dominant broadening mechanisms in thermal vapour spectroscopy. For two-photon transitions one would naively expect the Doppler effect to cause a residual broadening, proportional to wave-vector difference. In coherent population trapping (CPT) which is a two-photon narrow-band phenomenon, such broadening was not observed experimentally. This has been commonly attributed to frequent velocity-changing collision, known to narrow Doppler-broadened one-photon absorption lines (Dicke narrowing). We would like to study such a narrowing mechanism for CPT resonances. **(P. K. Das)**

11*. Quantum Information Theory:*

Recently a new principle, namely 'information causality principle' has been discovered and this is stronger than no-signaling principle. This new principle exactly reproduces the Trielson's bound for optimal violation of Bell's inequality in quantum mechanics. In the context of information causality condition, the Hardy's non-locality has been studied and compared to all the

corresponding results under no signaling condition and those in quantum mechanics. Simulation of quantum correlation by signaling correlation with binary input and binary output has been studied and a complementary relation between local randomness and communication has been found. The result for simulation has also been extended to more general spin measurement. Local Hidden Variable theory has been provided for measurements of un-sharp spin observable on a singlet state with some restrictions on the un-sharp parameters.

Recent investigations have revealed that there exist quantum correlations other than entanglement. One such is the quantum discord, which basically quantifies the total non-classical correlations in a quantum state. The geometric measure of entangle meant and quantum discord have been calculated analytically for arbitrary superposition of two N-qubit GHZ state. Quantum discord for the W state was also conjectured. **(G. Kar & P. Parashar)**

12*. Quantum Mechanics:*

A new class of polynomials, called the exceptional orthogonal polynomials (EOP), has been studied in details and various properties of these polynomials have been found out. Also information entropies and different measures of uncertainty associated with the models (whose solutions are given in terms of EOP) have been studied. Using quantum mechanical techniques some results related to option pricing have also been obtained.

Entropic origin of gravity, as suggested by Verlinde, is a new area of intense research. It has also been extended to quantum regime through Heisenberg Uncertainty Principle. We have considered effects of Generalized Uncertainty Principle in the context of holographic gravity.

Quite recently, the prospect of realizing complex PT symmetric potentials within the framework of optics has been suggested. These optical PT symmetric potentials can lead to behaviors, which are impossible in standard quantum mechanical systems. For example, it has been shown that there exists more than one exceptional (critical) point for a particular PT symmetric optical potential.

The effect of position dependent mass profiles on dynamical breaking of N – fold supersymmetry in several type B and type X_2 models whose wave functions are given in terms of exceptional orthogonal polynomials, has been investigated. It was found that some physically relevant mass profiles can change the pattern of dynamical N-fold supersymmetry breaking in trigonometric, hyperbolic, and exponential potentials of both type B and type X_2. The latter results open the possibility of detecting experimentally the breaking of N-fold as well as ordinary supersymmetry at a realistic energy scale.

Non-isopectrality of the generalized Swanson Hamiltonian and Harmonic Oscillators has been studied in a position dependent mass frame when the mass function takes some particular functional forms. **(P. Roy, S. Ghosh, B. Roy, R. Roychoudhury)**

13. Quantum Tunneling for Dissipative System:

The stability of the solutions of Schrodinger Langevin equation has been studied using the concepts of non-linear dynamics. The tunneling time has been estimated for dissipative system based on quantum Langevin approach. This is in collaboration with Mr. S. Bhattacharya of PAMU and Dr. S. Dutta. Charuchandra College, Kolkata. **(Sisir Roy)**

14*. Theoretical Condensed Matter Physics:*

The zero temperature phase transition, known as ‘Quantum phase transition’ (QPT) has attracted a lot of attention recently. The dynamics of quantum phase transition induced by a quench in different one-dimensional spin system has been studied. The dynamical mechanism of Kibble

Zurek has been followed to show the role and importance of geometric phase in the study of quantum critical phenomena. The entanglement properties of these systems in the vicinity of the critical points have also been investigated. **(B. Basu & P. Bandyopadhyay)**

FLUID MECHANICS & APPLIED MATHEMATICS

15. Transport of contaminants in rivers and its possible application to biological fluid dynamics.

The stream-wise dispersion of tracer materials released in an oscillatory flow through an annular pipe with reversible and irreversible reactions has been studied analytically using a method of homogenization. Numerical simulations have also been performed to investigate the dispersion of passive contaminants released in time-dependent flows through conduits in presence of boundary absorption at the wall, which causes a depletion of contaminant in the flow. The contributions have great relevance due to its application for dispersion of tracers in cardiovascular system and environmental fluid mechanics. **(B. S. Mazumder)**

16. *Integral Equations:*

Numerical solution of weakly singular integral equations using Bernstein polynomials as basis. Evaluation of singular integrals using Daubechics wavelets and use is numerical solution of singular integral equations. **(B. N. Mandal)**

17. *Water Waves:*

The water wave problems involve transmission of water waves through apertures in a pair of thin vertical barriers, construction of wave free potentials, Cauchy-Poisson problem in sloping beach, generation of waves due to disturbances on the bed of a beach sloping at an arbitrary angle, source potential due to higher order boundary conditions. **(B. N. Mandal)**

INTERDISCIPLINARY RESEARCH

18. Fluvial Mechanics Laboratory (FML):

A) *Turbulence characteristics associated with bedforms* :

Turbulent flow over bedforms structures and understanding its impact on sediment movement has been studied**.** The novelty of this work is the collection of velocity data over successive fixed asymmetric dunes in an experimental channel and investigation of the evolution and development of turbulent boundary layer over successive dunes. Moreover, one pioneering result had been achieved that *'*secondary points of separation' at the bifurcation points of shear layer over a series of dunes were discovered, the well known primary points being at the crest of dunes. The secondary points of separation vanish when surface waves are superimposed. The superposition of surface waves on the unidirectional flow leads to increase in the apparent bottom roughness, which causes resistance to flow as well.

B) *Flow visualization and image processing* **:**

To understand the sand grain sorting process at the riverbed, High-Speed Motion Scope Camera (1000fps) available at the ISI laboratory has been used to record the motion-picture photography of the particle movement of different sizes at near-bed turbulence. The imaging technique was used to characterize the particle motion, displacement and angle of orientation and their trajectories, and their interactions with the rough boundary. The important

phenomenon observed in this study is that the fluctuations of angle of orientation of any particle follow statistically the Gaussian distribution, which may be closely related to fluctuating shear stress.

C) *Turbulent Flow over obstacle marks:*

Local scouring around an obstruction in the river bed is a result of the interaction between the local flow field inducted by the obstruction and the river bed. An immovable obstruction, such as, a pipeline placed at the sand bed, restricts the area of flow in a stream channel. Water piles up against the upstream edge of the obstruction, causing an increase in velocity around the sides, accompanied by the development of vortices. Scour marks may develop, and the scoured-out material may be deposited downstream as a sand bar. The obstacle marks named as current crescent preserved in geological record are traditionally used as an indicator of palaeo-current direction. The formations of obstacle marks are available in cross-bedded sediments depending on the orientation and plunge of the long axes of the pebbles.

(B. S. Mazumder)

19. Information Processing in the Brain:

The information processing in the brain has been studied within the framework of dynamic probabilistic geometric framework. Fisher measure has been shown to be the appropriate measure for this kind of information processing. Noise plays a significant role in brain function. We have studied the cancellation of noise in cognition based on the principle of least time. This is collaboration with Prof. Rodalfo Llinas USA and Prof. Daniel Bennequin, France.

(Sisir Roy)

20*. Systems and Control Theory:*

Numerical methods have been developed to design controller for input-output decoupling of descriptor variable system. Stability of the closed-loop system has also been ensured. Matrix second-order systems arise frequently in the formulation of dynamic systems in classical mechanics, robotics, aerodynamics and many others. Obviously, future area of work would be to design observer/controller for Matrix second-order system. (**S. Gangopadhyay**)

INTERNALLY / EXTERNALLY FUNDED PROJECTS

4.1 Internally funded plan projects

ONGOING PROJECTS

Sl. No.	Name of the Project	Principal Investigator	Unit(s) involved
General Project			
1.	Experimental investigations on the genesis of obstacle marks and their implications for the generation of current crescents	**B. S. Mazumder**	PAMU

4.2 Externally funded projects

ONGOING PROJECTS

Sl. No.	Name of the Project	Principal Investigator(s)	Unit(s) involved	Funded by
1.	Influence of bedforms on turbulent characteristics and its implications to sedimentology : an experimental study	**B. S. Mazumder**	PAMU	Department of Science and Technology
2.	Particle-fluid interactions at turbulent boundary layer flow over smooth/rough surface using Image processing technique	**B. S. Mazumder**	PAMU	Council of Scientific and Industrial Research
3.	Digital imaging technique for investigations of particle-fluid interactions due to turbulent flow	**Anindita Bhattacharya**	PAMU	Department of Science and Technology
4.	NASI senior scientist platinum jubilee fellowship	**B. N. Mandal**	PAMU	National Academy of Sciences India (NASI)
Completed Project				
1.	Image processing technique to study the particle behavior in the near wall region of turbulent open channel flow	**B. S. Mazumder**	PAMU	Council of Scientific and Industrial Research

5. CONFERENCES, SYMPOSIA, WORKSHOPS, LECTURES & SEMINARS

Workshop :

I. "*Micro-Seminar on Nonlinear Phenomena*", **:** April 21, 2010**,** ISI, Kolkata (One day Seminar)**.**

II. *"National Workshop on Modelling Biological Systems" Organized by ISI & NEHU, Shillong ,* October 25 – 29, 2010**,** NEHU, Shillong.

III. *"INDO-US Bilateral Workshop 2010" Organized by ISI & USA,* **:** November 1 – 3, 2010**,** ISI, Kolkata.

Lectures and Seminars

Ghosh, Sibasish, Institute of Mathematical Sciences, Chennai (5.5. 2010) : i) *Dynamics of open quantum systems-I;* (12.5.2010) : ii) *Dynamics of open quantum systems-II.*

Balasubramanian, Ganesh, State University of Virginia (31.5. 2010) : *Understanding transport phenomena at the naroscale using mocular dynamics.*

Dutta, Prasun, Department of Physics & Meterology, IIT, Kharagpur (4.6. 2010) : *Turbulence in the interstellar medium of galaxies.*

Daripa, Prabir, Department of Mathematics, Texas A & M University, College Station, USA (29.7.2010) : *Thin film problems in fluid mechanics.*

Das, Shantanu, Reactor Control Division, BARC, Mumbai (03.12.2010) : *Application of fractional calculus.*

Sasaki, Ryu, Institute of Theoretical Physics, University of Kyoto, Japan, (10.12.2010) : *Discrete quantum mechanics and exceptional orthogonal polynomials.*

Lahti, Pekka, Department of Physics & Astronomy, University of Turku, Finland, (14.12.2010) : *Measuring together complementary quadrature observable in quantum mechanics.*

Tollaksen, Jeff, Center for Quantum Studies, Chapman University, USA, (11.01.2011) : *Weak measurements and time-symmetry in quantum mechanics*.

Rauch, Helmut, Vienna University of Technology, Austria, (11.01.2011) : *Basic features of quantum physics studied with neutrons.*

Sarkar, Sujit, i) Poornaprajna Institute of Scientific Research, Bangalore, (12.01.2011) : *Non-universal tunneling resistance at the quantum critical point of a mesoscopic SQUIDs arra;* (21.03.2011) : ii) *Perfect entanglement transport in quantum spin chain.*

Sarkar, Swarnendu, Department of Physics & Astrophysics, Delhi University, (10.03.2011) : *Holographic BCS instability at finite baryon densities.*

6. PUBLICATIONS OF THE INSTITUTE : N. A.

7. SCIENTIFIC PAPERS PUBLICATIONS

7.1 Books Published :

1) Mandal, B. N. and Chakrabarti, A. : Applied Singular Integral Equations, *Science Publishers / CRC Press, USA,* pages 264, 2011.

2) Abraham, R. and Roy, S. : Demystifying the Akasa; Consciousness and Quantum Vacuum, *Publishers Epigraph, N. Y*. 2010.

3) Mazumder, B. S. and Bhowmik, N. G. (editors) : *Ecological Health of River-2010 (IUSSTF)*, pages 1-300.

7.2 Papers Published in Journals :

1) Basu, B. Bandyopadhyay, P. and Majumdar, Priyadarshi : Density of defects and the scaling law of the entanglement entropy in quantum phase transition of one-dimensional spin systems induced by a quench, *Phys. Rev. A* **83**, 032312 2011.

2) Basu, B. and Bandyopadhyay, P.: The geometric phase and the dynamics of quantum phase transition induced by a linear quench, *J. Phys. A : Math. Theor*. **43**, 354023 (10 pp) 2010.

3) Bhattacharya, S. and Mandal, B. N. : Numerical solution of an integral equation arising in the problem of cruciform crack. *International Journal of Applied Mathematics & Mechanics*, **6**, 70-77 2010.

4) Choudhary, S. K., Ghosh, S., Kar, G., Kunkri, S., Rahaman, R. and Roy, A. : Hardy's non-locality and generalized non-local theory, *Quantum Information and Computation*, **10**, 0859-0871 2010.

5) Choudhary, S. K., Ghosh, S., Kar, G. and Rahaman, R. : Comment on Gisin's theorem for arbitrary dimensional multipartite states, *Physical Review Lett*. **105,** 218901 2010.

6) Das, D. and Mandal, B. N. : Construction of wave free potentials in the linearised theory of water waves, *Journal of Marine Science and Application*, **9**, 347-354 2010.

7) Das, D. and Mandal, B. N. : Construction of wave free potentials in the linearised theory of water waves in uniform finite depth water, *Review Bulletin of Calcutta Mathematical Society*, **18**, 171-182 2010.

8) Das, D. and Mandal, B. N. : Wave radiation by a sphere submerged in a two-layer ocean with an ice-cover, *Applied Ocean Research*, **32**, 358-366 2010.

9) Das, P. K. : Dynamics of cavity QED in stochastic field in interacting Fock space. Form physics to control theory : an emergent view, *World Scientific Series on Nonlinear Science, Series B*, **15**, 45-50 2010.

10) Das Ghosh, A. C., Sau, G., Biswas, S. K. and Bhattacharyya, S. : On production of soft particles in Au + Au and Pb + Pb Collisions at high energies, *Fizika B*, 19 **(4),** 2010.

11) De, S., Mandal, B. N. and Chakrabarti, A. : Use of Abel integral equations in water wave scattering by two surface-piercing barriers, *Wave Motion*, **47**, 279-288 2010.

12) Dutta, D. and Roy, P. : Conditionally exactly solvable potentials and exceptional orthogonal polynomials Journal of Mathematical Physics, **52**, 032104 2011.

13) Ghosh, S. and Mignemi, Salvators : Quantum mechanics in de sitter space, *Int. J. Theor*. *Phys.* **50**, 1803-1808 2011.

14) Guptaroy, P., Sau, G., Biswas, S. K. and Bhattacharyya, S. : Understanding the characteristics of multiple production of light hadrons in Cu + Cu interactions at various RHIC, energies : a model-based analysis, *IL Nuovo Cimento B,* **125(9)**, 1071-1097 2010.

15) Gogoi, Runmoni, Roychoudhury, R. and Khan, M. R. : Arbitrary amplitude .. kappa distributed electron plasma. *Indian Journal of Pure and Applied Physics*, **49**, 173-179 2011.

16) Jana, T. K. and Roy, P. : Supersymmetry in option pricing, *Physica* **A390**. 2350-2355 2011.

17) Kar, G., Gazi, Rajjak MD., Banik, M., Das, S., Rai, A. and Kunkri, S. : A complementary relation between classical bits and randomness is local part in simulating singlet state, *J. Phys. A : Math. Theor*. **44**, 152002 2011.

18) Midya, B., Dube, P. and Roychoudhury, R. : Non-isospectrality of the generalized swanson hamiltonian and harmonic oscillator. *J. Phys. A : Math. Theor*. **44**, 062001 (FTC) 2011.

19) Midya, B., Roy, B. and Roychoudhury, R. : A note on the PT invariant periodic potential V (x) = 4 $\cos^2$ (x) + 4i V_0 sin (2x), *Physics Letters A* **374,** 2605-2607 2010.

20) Maity, P. and Mandal, B. N. : Wave scattering by a thin vertical barrier submerged beneath an ice-cover, *Applied Ocean Research*, **32**, 367-373 2010.

21) Mazumder, B. S., Maity, H. and Chadda, T. : Turbulent flow field over fluvial obstacle marks generated in a laboratory flume, *Int. Journal of Sediment Research*, **26,** (1). 1-16 2011.

22) Nath, D. and Das, P. K. : Interaction of three level atom with a single mode field in a two photon resonant cavity, *International Journal of Modern Physics B*, **25,** *No*. 3, 1-15 2011.

23) Ojha, S. P. and Mazumder, B. S. : Turbulence characteristics of flow over a series of 2-D bedforms in the presence of surface waves, *Journal of Geophysical Research-Earth Surface (AGU),* **115**, F04016-F04030 2010.

24) Parashar, P and Rana, S. : Entanglement and discord of the superposition of GHZ states, *Phys. Rev. A* **83,** 032301 2011.

25) Paul, S. and Mazumder, B. S. : Effects of nonlinear chemical reactions on the transport coefficients associated with the unsteady flow through a tube, *Int. Journal of Heat and Mass Transfer*, **54**, 75-85 2011.

26) Pal, B. K., Roy, B. and Basu, B. : Quantum dot with spin-orbit interaction in noncommutative phase space and analog Landau levels, *Phys. Lett. A* **374**, 4369-4374 2010.

27) Pandey, R. K. and Mandal, B. N. : Numerical solution of a system of generalized Abel integral equations using Bernstein polynomials, *J. Advanced Research in Scientific Computing,* **2**, 44-53 2010.

28) Sjoqvist, E., Rahaman, R., Basu, U. and Basu, B. : Berry phase and fidelity susceptibility of the three-qubit Lipkin-Meshkov-Glick ground state, *J. Phys. A* : *Math. Theor*. **43**, 354026 (15 pp) 2010.

29) Sinha, A., Dutta, D. and Roy, P. : Study of classical mechanical systems with complex potentials, *Phys. Lett*. A, **375**, 452-457 2011.

30) Sau, G., Biswas, S. K., Ghosh, Das A. C., Bhattacharya, A. and Bhattacharyya, S. : On the nature of the rapidity-spectra at RHIC and some other energies, *IL Nuovo Cimento B,* **125(7)**, 833-849 2010.

31) Sau, G., Guptaroy, P., Ghosh, Das A. C. and Bhattacharyya, S. : Rapidity spectra of heavy baryons in nuclear collisions at various energies : a systematic approach, *IL Nuovo Cimento B,* **125(11)**, 1379-1393 2010.

7.3 <u>Papers Published in Conference Proceedings</u> :

1) Das, S., Ghosh, S., Holten van Jan-Willem and Pal, S. : Generalized particle model : a possible source for dark energy, *J. Phys. Conf. Ser*. 222 012022 *doi* : 10.1088/1742-6596/222/012022.

2) Bhattacharya, S., Dutta, S. and Roy, S. : Schrodinger langevin equation and ion transport at nano-scale, *Frontiers of Nonlinear Physics Proceedings (Russia)*,116-117 2010.

7.4 Papers Published in Books :

1) Gangopadhyay, Kausik and Basu, B.: Income and expenditure distribution : A Comparative Analysis, Economics of Order-driven Markets, Abergel, F., Chakraborti, B. K., Chakraborti, A. and Mitra, M. (eds.) *New Economic Windows, Springer* 2011.

8. Visiting Scientists :

Chakrabarti, A.
Department of Mathematics, Indian Institute of Sciences, Bangalore, June 21 – July 2, 2010.

Bhowmik, N. G.
Illinois State Water Survey, University of Illinois at Urbana-Champaign, USA, October 22 – Novermber 15, 2010.

Demissie Mike
Director, Illinois State Water Survey, University of Illinois at Urbana-Champaign, USA, October 31 – Novermber 6, 2010.

Lahti, Pekka
Department of Physics, University of Turku, Finland, December 12 – 15, 2010.

Graf, W. H.
A. L. Ecole Polytechnique Federale, Laboratoire D'Hydraulique, Lausanne, Switzerland, December 22, 2010.

Rahaman, Ramij
University of Bergen, Norway, January 17 – February 7, 2011

Sarkar, Sujit
Poornaprajna Institute of Scientific Research, Bangalore, January 11 – 14, 2011

Purkait, Barendra
Geological Survey of India, Kolkata, February 01 – March 31, 2011

Paul, Suvadip
Tripura, February 01 – March 31, 2011

Sarkar, Swarnendu
Department of Physics & Astrophysics, Delhi University, March 09 – 11, 2011

9. Honours and Awards

i) *Name of the scientist* : **Dr. Supratik Pal**
ii) *Nature of Recognition* : Alexander Von Humboldt Fellowship
iii) *Recognition given by* : Alexander Von Humboldt Foundation, Germany
iv) *For which recognition earned*: Research (2010-2011).

10.1 Editorship

1) Mazumder, B. S. and Bhowmik, N. G. (editors) : *Ecological Health of River-2010 (IUSSTF)*.

2) Mandal, B. N., (Editor-in-chief) : *OPSEARCH Springer*.

3) Mandal, B. N., Member of the Board of Editor : *International Journal of Mathematics and Mathematical Sciences, Hindwai, USA.*

10.2 Scientific Assignments / Academic Visits Abroad

Ghosh, S.
University of Metz, France, 1 September – 5 November 2010; National Institute for Theoretical Physics in Matieland, South Africa, 15 February 2011 to 3 March 2011.

Pal, S.
University of Bonn, Germany, 7 September 2010 – 6 September 2011.

Das, P. K.
Chungbuk National University, Cheongiu, Korea, January 7 – 13, 2011.

Mazumder, B. S.
Islamic University of Technology, Bangladesh, December 17 – 21, 2010.

Roy, Sisir
Member of Steering Committee of the International Workshop on "Data Analysis in Astronomy" at Erice, Italy, April 15 – 22, 2011.

10.3 Scientific Assignments / Academic Visits in India

Ghosh, S.
Academic collaboration in Department of Physics, Institute of Mathematical Sciences, Chennai, April 30 to May 16, 2010.

Kar, Guruprasad
Academic collaboration in Institute of Mathematical Sciences, Chennai, 22 November 2010 to 2 December 2010.

Roy, Sisir
Invited by Government of Sikkim regarding Education Policy, Gangtok, December 19-24, 2010.

Roy, Sisir
Invited talk at National Workshop on Modeling Biological Systems, NEHU, Shillong Oct. 25-29, 2010.

Roy, Kr. Ashim
Accademic collaboration in IUCAA, Pune, February 14 – 26, 2011.

Pal, Supratik
Invited talk at Indian Institute of Technology, Kharagpur, July 20 – 22, 2010; Harish-Chandra Research Institute, Allahabad, December 14 – 18, 2010.

Mazumder, B. S.
Invited talk at Indian Statistical Institute, Delhi, February 7 – 8, 2011.