Biswajit Chakraborty

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After his schooling from Shillong, Professor Biswajit Chakraborty did his B.Sc. and M.Sc. from Delhi University and eventually completed his Ph.D. from Institute of Mathematical Sciences, affiliated to Madras University in 1992. After a few years of Post Doctoral experience in IIT, Kanpur, HRI, Allahabad and SNBNCBS, he was finally absorbed in the faculty in SNBNCBS in 1997. Currently, he is a professor in SNBNCBS.

Supervision of Research / Students

Ph.D. Students

1. Yendrenbam Chaoba Devi, submitted her thesis on "Study in Noncommutative geometry inspired Physics" on Dec'2016 in Calcutta University.
2. Aritra N. Bose, Mr. Partha Nandi, Mr. Sayan Paul and Mr. Jaydeb Das are currently working on different aspects of Noncommutative Geometry. Besides, Mr. Debabrata Ghorai, who is also being co-supervised by Dr. Sunandan Gangopadhyay of IISER, Kolkata, is currently working on holographic superconductors-inspired by AdS-CFT correspondence.

Projects of M.Sc./ M.Tech./ B.Tech./ Post B.Sc. students

1. I have supervised the summer projects of Kaushlendra Kumar of IPhD batch, IISER, Kolkata and that of Atul Rathore of IPHD batch , SNBNCBS.

Post Doctoral Research Scientists

1. Ravi Kanth Verma worked on some aspects of Zitterbewegung in kappa-Minkowski type of Noncommutative spaces.

Teaching activities at the Centre

I have taught the following Courses in last two semesters under IPhD & PhD Curriculum of the Centre.

1. Advanced Quantum Mechanics & Applications (PHY 303) in Fall Semester 2016 jointly with Professor Archan S Majumdar.
2. Quantum Physics [Application] (PHY 604) in Spring Semester 2017.

Independent publications of students

1. Debabrata Ghorai, Sunandan Gangopadhyay; *Noncommutative effects of spacetime on holographic superconductors;* Phys.Lett. B; 2016; **758;** 106.
2. Debabrata Ghorai, Sunandan Gangopadhyay; *Holographic free energy and thermodynamic geometry;* Eur. Phys. J. C; 2016; **76;** 702.

Membership of Committees

External Committee

Member, Board of Research Studies, Physics Department, West Bengal State University, Barasat, West Bengal.

Internal Committee

1. CAC; 2. Admission Committee; 3. FSC; 4. CWEP.

Significant research output / development during last one year

General research areas and problems worked on

Noncommutative Geometry inspired Physics, Noncommutative Quantum Mechanics and Noncommutative Quantum Field Theory.

We continued with th computation of finite Connes distance on Noncommutative spaces like Moyal Plane and Fuzzy sphere. Besides we formulated Noncommutative Quantum Mechanics with space-time Noncommutativity.

Interesting results obtained

1. We have formulated an appropriate Schrodinger equation, where time is also an operator satisfying space-time noncommutativity. We start with a time re-parametrization invariant form of the action, where time and its conjugate variables are both counted as phase space variables. For this we make use of the Hilbert-Schmidt operatorial formulation of quantum mechanics, devised earlier by us. Our earlier application did not involve time operator; it was taken to be a c-number evolution parameter, as

in the case of usual commutative Quantum mechanics. But here the situation is drastically different and one needs to identify ``sub-Hilbert space", so to say, from the original Hilbert space, where the inner product for the former case can be thought of an induced one from the latter case, in the sense that the former involves integration over only spatial coordinates, in contrast to the former one, where integration over both spatial and temporal coordinates occur, when an appropriate coherent state basis is used (for Moyal type of noncommutativity). Although the energy spectrum of most of the bound state problems are not affected, the wave functions themselves undergo deformation and displays the distinctive features of parity violation. Finally in the presence of time-dependent potential we find a deformation, stemming from noncommutativity, in the transition probability, where the rate of transition probability is enhanced i.e. a deformed Fermi's Golden rule.

2. The computation of spectral distance in doubled Moyal plane is taken up, for the important role played by its counterpart in Almost-Commutative spaces like the models proposed by Chamseddine et. al. and Connes et.al. In the formulation of Standard model in Particle Physics. In this sense, the doubled Moyal plane is a natural toy model having an intrinsic space time noncommutativity and may be of relevance for quantum gravity scale. We compute, using our Dirac eigen spinor basis formulation, various distances here, like (i) transverse (the distance between a state in the Moyal plane and its "clone" in the other Moyal Plane), (ii) longitudinal (the distance between a pair of states in the same Moyal plane and finally (iii) the hypotenuse distance. We find remarkably that the Pythagoras theorem is satisfied here, provided certain quantization rule is satisfied by a dimensionless variable constructed out of Moyal space noncommutativity and inter-Moyal plane separation.

Proposed research activities for the coming year

1. We plan to take up the similar studies in kappa-Minkowski spaces and extension.
2. We plan to extend our formulation of the computation spectral distance from Riemannian to Pseudo-Riemannian spaces, where the metric is of Lorentzian signature.