Rabin Banerjee

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Theoretical Sciences
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Professor Rabin Banerjee did his masters from IIT Kharagpur and Ph.D from Saha Institute of Nuclear Physics (Calcutta University). He joined S.N.Bose Centre as a research associate in 1988 and stayed here since then.

Supervision of Research / Students

Ph.D. Students

1. Arpita Mitra, Nonrelativistic diffeomorphism symmetry and its applications, Completed (Thesis to be submitted in July 2017).
2. Shirsendu Dey (external), Some aspects of anomalous hydrodynamics, Completed (Thesis to be submitted in July 2017).
3. Arpan Krishna Mitra, Fluid dynamics as Field theory, Ongoing.

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

1. Poulami Mondal (IIT KGP), PT symmetric quantum theory, Completed.

Teaching activities at the Centre

1. Second semester (Jan. - Apr. 2017), Quantum mechanics II, IPHD, 9 students, Soumendu Dutta

Publications in Journals

1. **Rabin Banerjee,** Bibhas Ranjan Majhi and Saurav Samanta; *Thermogeometric phase transition in a unified framework;* Phys. Letters B, 2017, **767**, 25.
2. **Rabin Banerjee** and Pradip Mukherjee; *Torsional Newton-Cartan geometry from Galilean gauge theory;* Class. Quant. Grav.; 2016, **33,** 225013.

Lectures Delivered

1. Nonrelativistic diffeomorphism invariance and its applications, Ben Gurion University, Israel, March 2017 (invited lecture)
2. Gauging nonrelativistic diffeomorphism invariance and applications, ISI, Kolkata, March 2017 (colloquium)

Collaborations including publications (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

National

1. Sl. No. 1 and 2

Significant research output / development during last one year

General research areas and problems worked on

Nonrelativistic diffeomorphism symmetry and its applications in field theory, condensed matter systems and gravity.

Newton Cartan geometry, with or without torsion, from Galilean gauge theory.

Shift symmetric galileon field theory in curved background and its cosmological implications.

Noncommutative fluid dynamics.

Interesting results obtained

We have found new results in the context of Newton Cartan geometry which is the mathematical foundation of Newton's gravity. Specifically, torsional Newton Cartan geometry could be formulated in a consistent manner. An explicit expression for the contorsion tensor was derived for the first time. An exact parallel with the general relativistic result was shown.

Recently, galileon field theories are in vogue. A problem is that they cannot be consistently defined in a curved background because they lose their original shift symmetry. Using our techniques developed in formulating Galilean gauge theory, we have solved this problem.

Fluid dynamics in noncommutative space was developed. It was shown that while the continuity equation remained form invariant, the Euler equation received a correction. This noncommutativity was shown to have a direct connection with the Moyal product used to define a noncommutative algebra.

Proposed research activities for the coming year

We wish to use our results for noncommutative fluid dynamics in the context of cosmology. Specifically, the role of the modified Euler equation is expected to yield nontrivial consequences.

Renewed interest has surfaced in discussing knotted solutions in electrodynamics and their mapping with fluid dynamics. We wish to investigate these issues in the context of noncommutative spacetime.