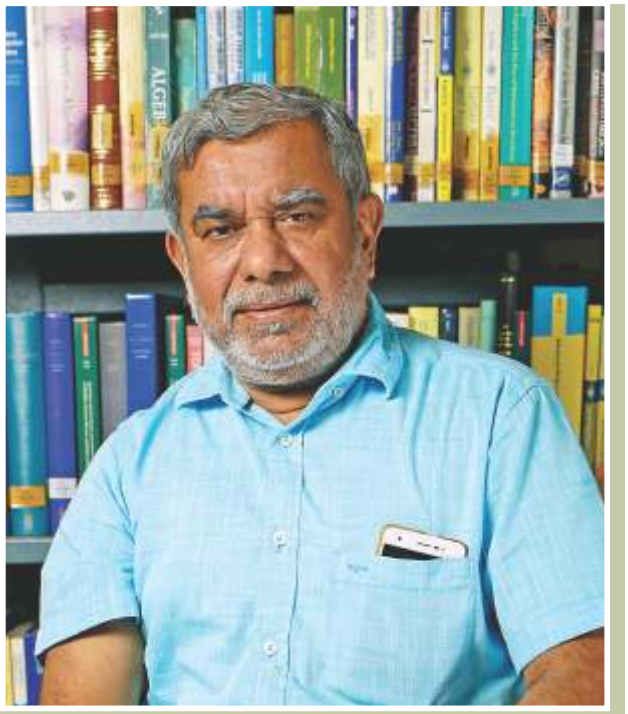

Rabin Banerjee

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Theoretical Sciences
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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Arpan Krishna Mitra; Canonical formulation of fluid dynamics; Awarded
2. Shirsendu Dey, Aspects of anomalous hydrodynamics, Thesis submitted (External candidate)

Teaching

1. 1st semester; Mathematical Physics; IPh.D; 5 students; Sunandan Gangopadhyay (Co-teacher)

Publications

a) In journals

1. **Rabin Banerjee**, *Demystification of nonrelativistic theories in curved background*, International Journal of Modern Physics D, 29, 2043015, 2020
2. **Rabin Banerjee** and Pradip Mukherjee, *Canonical formulation of a new action for a nonrelativistic particle coupled to gravity*, Physical Review D, 101, 126013, 2020
3. **Rabin Banerjee** and Bibhas Ranjan Majhi, *Fluctuation–dissipation relation from anomalous stress tensor and Hawking effect*, The European Physical Journal C, 80, 435, 2020
4. **Rabin Banerjee** and Pradip Mukherjee, *Canonical formulation for a non-relativistic spinning particle coupled to gravity*, Classical and Quantum Gravity, 37, 235004, 2020
5. **Rabin Banerjee**, Sk. Moinuddin, and Pradip Mukherjee, *New approach to the study of nonrelativistic bosonic string in flat spacetime*, Physical Review D, 103, 046020, 2021

Awards, Recognitions

1. Received Honorable Mention in the Annual Essay contest of the Gravity Research Foundation
2. Received mention in the top two percent (2%) of scientists, world-wide, in Nuclear and Particle Physics, in Stanford University's report
3. Awarded the CSIR emeritus scientist followed by the NASI senior scientist platinum jubilee fellowship

Outreach program organized / participated

1. Participated in the write-up of DST coffee table book

Areas of Research

Nonrelativistic theories in flat and curved backgrounds

I have continued and extended my studies on nonrelativistic theories, especially in a curved background. Also, I have looked at the fluctuation-dissipation theorem in the context of Hawking effect.

A new action for a nonrelativistic particle coupled to gravity was found using our approach of localizing Galilean symmetries, called Galilean gauge theory. Its equation of motion was found to satisfy the geodesic

equation involving the Newton-Cartan structures. The analysis was then extended for spinning particles where the geodesic equation is no longer satisfied. Several results could be interpreted as the nonrelativistic limit of the relativistic spinning particles coupled to gravity worked out earlier by Mathiesson-Papapetrou-Dixon. For both spinning and spinless examples a canonical Hamiltonian analysis was performed. The Schroedinger equation was derived which paved the way for a possible quantization of such theories.

A new approach to discuss the formulation of nonrelativistic bosonic string theories in flat background was developed. Using the constraints of the usual nonrelativistic bosonic string, an interpolating action was found. In one case it gave the Nambu-Goto form while in another, the Polyakov form was obtained.

It is known that the Hawking effect can be understood from the structure of anomalous stress tensors. We have used this correspondence to give an alternative interpretation or understanding of the fluctuation-dissipation theorem due to Kubo.

Plan of Future Work Including Project

As a continuation of my earlier research I plan to study the motion of nonrelativistic strings in a curved background. Incidentally some results have already been derived in the flat background and these have been recently published in Phys. Rev. D. For the curved case, I hope to use our technique of Galilean gauge theory, developed over the last few years, to get some new insights into the problem.

On a different note, recently there has been great interest in the study and application of symmetric higher rank tensor theories. In these theories the motion is restricted in the sense that the particles may be frozen or, alternatively, their motion is confined to a dimension less than from which they were initially defined. Such theories are called Fractonic gauge theories.

I have started working in this area and found certain preliminary results. I wish to extend and elaborate on these findings.