



Partha Guha

Professor
Theoretical Sciences
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Professor Partha Guha's research interests are centered around integrable systems, integrability in curved and noncommutative spaces, nonlinear vibrations and delay differential equations, geometric thermodynamics and contact geometry, applications of cosymplectic and locally conformal symplectic geometry.

Supervision of Research / Students

Ph.D. Students

1. Sumanto Chanda
2. Ankan Pandey

Post Doctoral Research Scientists

1. Kumar Abhinav

Publications in journals

1. S. Chanda, G.W. Gibbons, **P. Guha**; *Jacobi-Maupertuis-Eisenhart metric and geodesic flows*; Journal of Mathematical Physics; 2017; **58**; 032503.

2. A. Ghose Choudhury and **P. Guha**; *An analytic technique for the solutions of nonlinear oscillators with damping using the Abel Equation*; Discontinuity, Nonlinearity and Complexity; 2017; **6**(1); 65-74.
3. A. Ghose-Choudhury, **Partha Guha**, Andronikos Paliathanasis, P. G. L. Leach; *Noetherian symmetries of noncentral forces with drag term*; International Journal of Geometric Methods in Modern Physics; 2017; **14**(2); 1750018.
4. O. Esen, A. Ghose Choudhury and **P. Guha**; *Bi-Hamiltonian Structures of 3D Chaotic Dynamical Systems*; International Journal of Bifurcation and Chaos; 2016; **26**(13); 1650215.
5. K. Abhinav and **P. Guha**; *Quasi-Integrability in Supersymmetric Sine-Gordon Models*; Euro Physics Letters; 2016; **116**(1); 10004.
6. S. Chanda, **P. Guha** and R. Roychowdhury; *Schwarzschild instanton in emergent gravity*; International Journal Geometric Methods in Modern Physics; 2017; **14**(1); 1750006.
7. S. Chanda, **P. Guha** and R. Roychowdhury; *Taub-NUT as Bertrand spacetime with magnetic fields*; Journal of Geometry and Symmetry in Physics; 2016; **41**; 33.
8. **P. Guha**, E. Harikumar and N.S. Zuhair; *Regularization of Kepler Problem in k -spacetime*; Journal of Mathematical Physics; 2016; **57**; 112501.

Lectures Delivered

1. Invited speaker at Discussion meeting on Geophysical Fluid Dynamics; International Center for Theoretical Sciences, Bangalore; 21-23 July 2016.
2. Poster presentation at XXV International Fall Workshop on Geometry and Physics; IEM-CSIC, Madrid; August 29-September 2, 2016.
3. Talk given at Department of Theoretical Physics; University of Zaragoza, Spain; 13 September, 2016.
4. Lectures given at the 5th SERC school on Nonlinear Dynamics is being held in PSG College of Technology, Coimbatore, Tamil Nadu (1-21 December 2016).

Awards / Recognitions

1. Grant obtained from Brazil, FAFESP, Sao Paulo Research Foundation, for a project on Nonlinear dynamics and gravity.

Conference / Symposia / Workshops / Seminars etc. organized

1. Organized an activity on Dynamics of complex systems jointly with Professor Amit Apte; May 23- July 23, 2016.
2. Co-convenor of the C. K. Majumdar Memorial Workshop, June 2016.

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

National

1. Anindya Ghose Choudhury (Surendranath College, CU, Sl. No.2, 3, 4)
2. E. Harikumar (faculty, HCU, Sl. No.8)
3. M.Zuhair (student, HCU, Sl. No.8)

International

1. Ogul Esen (Gabze Technology, Turkey, Sl. No. 4)
2. Gary Gibbons (Cambridge, England, Sl. No.1)
3. Peter Leach (Kwazulu Natal, South Africa, Sl. No.3)
4. A. Palaithanasis (Valdivia, Chile, Sl. No.3)
5. Raju Roychowdhury (USP, Brazil, Sl. No.6, 7)

Member of Editorial Board

1. Advances in Mathematical Physics
2. International Journal of Physics and Mathematical Sciences

Significant research output / development during last one yearGeneral research areas and problems worked on

Integrable systems, contact and metriplectic geometry, nonlinear dynamics and geometrical mechanics.

Interesting results obtained

Jacobi-metric has been mainly formulated only for autonomous systems, because for the autonomous systems the Hamiltonians are conserved quantity. However, such convenience is denied in the case of time-dependent systems. Under such circumstances, the Eisenhart-Duval lift proved to be a useful tool, by providing a dummy variable along an extra dimension, and thus, a conserved quantity.

This gives us a momentum equation from which we can define a metric for the unit momentum sphere, and thus, the Jacobi metric for time-dependent systems.

We have studied the regularization of kappa-deformed Kepler problem. We used an extension of Moser method to regularize Kepler problem in kappa-spacetime. The mapping of geodesic motion on a sphere to the Kepler problem in deformed-spacetime have dependence on the deformation parameter 'a'. We have studied the generalization of the Ligon-Schaaf map to the kappa-deformed case and it

is established that the procedure of regularization can be carried out in a straightforward manner, as in the commutative situation. The key idea in our regularization is that we consider coordinates of kappa-deformed phase space in terms of functions of usual variables in Minkowski phase space.

We have studied Poisson structures of dynamical systems with three degrees of freedom which are known for their chaotic properties and all these flows admit bi-Hamiltonian structures depending on the values of their parameters.

We have carried forward the programme of analysis of curl forces initiated by Berry and Shukla. This is largely an unexplored area of nonlinear mechanics, though efforts at linearisation of planar systems subject to nonisotropic central forces

We have shown that the first integrals derived by Berry and Shukla are the Noetherian first integrals resulting from the symmetries of the Emden-Fowler equation.

Proposed research activities for the coming year

The non-standard Lagrangians are deformations of simpler standard Lagrangians for Lienard system.

We wish to exhibit its connection with contact Hamiltonian mechanics and thermostat problem. We wish to explore geometry of thermodynamics using contact mechanics, GENERIC or metriplectic structure and information geometry.

Exploring the Hamiltonian geometry of non-autonomous three dimensional dynamical systems using nambu cosymplectic geometry and nambu metriplectic geometry.

We wish to do qualitative analysis of quadratically and higher-order damped oscillators with non-linear restoring force. In particular, we wish obtain Hamiltonian structure and analytical form of the energy functions and other qualitative features.

We wish to carry out the inverse problem of dynamics in noncommutative kappa spacetime and we want to continue our mechanics on curved space-time.