Tathagata Karmakar

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Education

Year	Degree	Institute	Score
2018–present	Ph.D.	University of Rochester	N.A.
2014–18	BS	Indian Institute of Technology, Kanpur	9.9/10

Research Interests

Quantum measurements, quantum trajectories, path integral formulations, tomography, quantum gates, quantum thermodynamics, general relativity, black holes.

Academic Positions

- Graduate student, University of Rochester (Fall 2018–present).
- Summer research assistant at the Center for Computational Astrophysics (CCA), Simons Foundation, New York City (May – July, 2017).

Academic Achievements

- Robert L. and Mary L. Sproull fellow, University of Rochester, 2018–20.
- S.N. Bose scholar (by Winstep forward, SERB DST Govt. of India and IUSSTF), 2017.
- Academic Excellence Award for outstanding performance in academic years 2014–15 and 2015–16 (dean's office, IIT Kanpur).
- KVPY (Kishore Vaigyanik Protsahan Yojana, fellowship funded by Department of Science and Technology, Government of India) fellow 2014–18.

Publications

- Tathagata Karmakar, Philippe Lewalle, and Andrew N. Jordan. Stochastic Path Integral Analysis of the Continuously Monitored Quantum Harmonic Oscillator. *arXiv:2103.06111 [quant-ph]*, March 2021. arXiv: 2103.06111.
- Tathagata Karmakar and Tapobrata Sarkar. Distinguishing Between Kerr and Rotating JNW Space-Times via Frame Dragging and Tidal Effects. *General Relativity and Gravitation*, 50(7):85, June 2018.

Talks

- *Stochastic Path Integral Analysis of the Continuously Monitored Simple Harmonic Oscillator*, APS March Meeting 2021.
- *Simultaneous Weak-Continuous Position and Momentum measurements of a Harmonic Oscillator*, Graduate Student Research Meeting, University of Rochester, February 13, 2021.
- *Optical Field Quadrature Measurements: Introduction to Homodyne and Heterodyne Detections*, with Dr. Philippe Lewalle, University of Rochester, January 18, 2021.

Research Experience

- **Superconductivity and fluxons (April 2021 – Ongoing)**
  With Prof. Andrew Jordan, University of Rochester.
  - Working on superconductivity and fluxon properties.
- **Qubit tomography (April 2021 – Ongoing)**
  With Prof. Andrew Jordan, University of Rochester.
  - Working on tomography of a continuously monitored qubit.
- **Stochastic path integral analysis of the continuously monitored simple harmonic oscillator (January 2020 – March 2021)**
  With Dr. Philippe Lewalle and Prof. Andrew Jordan, University of Rochester.
  - Found the stochastic evolution equations for the position and momentum expectation values of a harmonic oscillator in a general Gaussian state undergoing simultaneous position and momentum measurements.
  - Constructed an analytic proof for fact that the deterministic evolution of the covariance matrix elements lead to their steady states, regardless of the initial state.
  - Constructed a path integral description of the quantum trajectories of the oscillator based on the Chantasri-Dressel-Jordan formalism, and found the stochastic Hamiltonian and action of the system.
  - Analytically solved for optimal paths and the probability density of final states, and confirmed our results using numerical simulations.
- **Illustris and IllustrisTNG data analysis: a look at galaxy scaling relations (May 2017 – 2020)**
  With Dr. Shy Genel and Prof. Rachel Somerville, CCA.
  - Studied the radii ratio of galaxies and their host dark matter halos (from Illustris and IllustrisTNG simulations) as a function of stellar mass, halo mass and redshift.
  - Compared simulation data with observations from Galaxy And Mass Assembly Survey.
  - Analyzed size differences between low and high star forming galaxies.
- **Calculation of tidal disruption limit of stars near a rotating naked singularity (May 2016 – Mar 2017)**
  With Prof. Tapobrata Sarkar, IIT Kanpur.
  - Found the general expression of coordinate transformations from Boyer–Lindquist to Fermi normal coordinates in rotating Janis-Newman-Winicour (JNW) metric.
  - Constructed the necessary equations to be solved in rotating JNW metric.
  - Found the expression for the tidal potential faced by a star orbiting in an equatorial circular orbit.
  - Calculated Roche limits in the rotating naked singularity background, and compared them with the corresponding results in Kerr metric.
- **Introduction to the use of computational tools in high energy physics (May 2015 – July 2015)**
  Under supervision of Dr. Ravindra Kumar Verma and Prof. Pankaj Jain, IIT Kanpur.
  - Studied quantum scattering, Feynman diagrams, Fermi's golden rule for transition rates.
  - Learned ROOT (data analysis framework developed by CERN), used MCFM (Monte Carlo for FeMtobarn processes) to calculate cross sections for various collision processes at particle colliders.

- Fixed MCFM which had been generating buggy .C files.
- Calculated cross section of collision of two protons (first creating W^+ boson which decays into ν_e and e^+).

Project report: www.pas.rochester.edu/~tathagata/HEP_Summer_2015_Report.pdf

Course Projects

- **Reproduction of magnetic field of the Sun using python (March 2017 – April 2017)**
  With Aniket Maiti, under supervision of Prof. Mahendra Kr. Verma, IIT Kanpur.
  Reproduced the structure of toroidal and polar components of magnetic field of the Sun using spherical harmonics.
  Project report: www.pas.rochester.edu/~tathagata/PHY473_Report.pdf

Teaching Experience

University of Rochester

- Teaching assistant, 20th Century Physics (PHY 143, Spring 2019).
- Teaching assistant, Gravitation & General Relativity (AST 231, Fall 2018).

Programming Languages and Softwares

Python, Mathematica, Octave, Fortran, C, ROOT.

Selected Coursework

University of Rochester:

Quantum optics I and II
Condensed matter physics I and II
Plasma physics
Stellar astrophysics

Coursera:

Machine learning by Andrew Ng

Indian Institute of Technology, Kanpur:

Astrophysics
Advanced general relativity and black holes
Fluid mechanics and rate processes
Numerical analysis
Partial differential equations
Statistical physics
Graph theory
Optics
Nuclear and particle physics