Priyankar Banerjee

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p-banerjee

Research Interests

Quantum optics, Light-Matter Interaction, Cavity Optomechanics, Open Quantum Systems, Quantum information processing, Quantum many-body physics.

Education

2020 - 2022 **M.Sc. in Physics**, *Indian Institute of Technology*, Guwahati, India.
CGPA - 8.31/10

2017 - 2020 **B.Sc. (Honours) in Physics**, *Vidyasagar College*, University of Calcutta, India.
Percentage - 81.38% (Physics)

2015 - 2017 **Indian School Certificate**, *St. Jude's High School*, Kolkata, India.

2015 **Indian Council for Secondary Education**, *International Public School*, Kolkata, India.

Theses

Master Thesis

Title **Strong Mechanical Squeezing in a quadratically coupled Optomechanical MIM System**

Supervisor Dr. Amarendra Kumar Sarma

Description

• Explored a novel scheme to obtain mechanical squeezing in a quadratically coupled optomechanical system.

• Studied the squeezing in the position quadrature of the mechanical oscillator and optimize the ratio of the coupling side-bands to achieve maximum squeezing.

• Analyzed the system approximately and matched with the exact numerical solution, and then went on the study the robustness of the squeezing.

Status Submitted on 27^{th} April 2022. Manuscript in preparation. Thesis available **here**.)

Research Projects

July 2022 - Ongoing **Universal bounds on the fluctuations of a Stirling Engine**,
Advisor: Dr. Bijay Kumar Agarwalla (Indian Institute of Science Education and Research, Pune).

- Investigating the bounds on ratios of fluctuations in a Stirling engine modelled using a Brownian particle undergoing an overdamped motion in a harmonic trap.
- Exploring the bounds on ratios of fluctuations in a Stirling engine operating out-of-equilibrium by solving the Fokker-Planck Equation beyond the linear response regime.

Nov 2021 - Mar 2022 **Quantum state tomography of multiple spins in a BEC**,
Advisor: Dr. Tim Byrnes (New York University, Shanghai).

- Worked on developing an algorithm to reconstruct a coherent spin state in a BEC comprising of two spins (on Mathematica).
- Extracted the Euler angles of the unitary rotation of the spins using singular value decomposition.
- Explored the robustness of our protocol for partial depolarization of the pure states by introducing a specific form of decoherence.

May 2021 - Feb 2022 **Dynamics of Photon Squeezing in Two-Photon Dicke Model**,
Advisor: Dr. Aranya Bhuti Bhattacherjee (Birla Institute of Technology and Science, Pilani, Hyderabad Campus).

- Studied the mean-field dynamics of the Two-Photon Dicke Model.
- Explored the behaviour of squeezing time and strength near the superradiant phase and the unbounded region of the phase diagram under the Holstein-Primakoff approximation.
- Explored ways to enhance the quadrature squeezing of photons in the large spin limit and numerically matched the critical behaviour of squeezing near the unbounded region.

Mar 2021 - May 2021 **Vortex dynamics in 2-dimensional Bose-Einstein condensate**,
Advisor: Dr. Pankaj Kumar Mishra (Indian Institute of Technology, Guwahati).

- Surveyed literature on the dynamical behaviour of a rotating trapped BEC in 2-D by solving the Gross–Pitaevskii equation.
- Performed simulations to generate vortex lattices in a rotating BEC in an anisotropic trap for different angular frequencies and non-linearity factors (on Fortran).

Publications

Priyankar Banerjee, Deepti Sharma, and Aranya B. Bhattacherjee. Enhanced photon squeezing in two-photon dicke model. *Physics Letters A*, 446:128287, 2022. `https://doi.org/10.1016/j.physleta.2022.128287`.

Computational Proficiency

Programming Languages

Intermediate C, C++, JAVA, Fortran

Advanced: Python, Mathematica

Editors and IDEs

Intermediate JupyterLab

Advanced: LaTeX, MS Office

Operating Systems

Intermediate Microsoft Windows

Advanced: Linux

Achievements/Awards

- Ranked 1^{st} out of 75 students in the Department of Physics, Vidyasagar College, University of Calcutta.
- Scored 98.31 percentile in IIT-JAM Physics 2020 and secured an All India Rank 277 among 17000 applicants.
- Third for Poster Presentation on *Remote Sensing, an expert overview* at Vikram Sarabhai Space Exhibition at Bidhan Shishu Udyan, Kolkata.
- Gold Medal for an excellent result in Higher Secondary Examination by New Barrackpur Municipality, New Barrackpur, West Bengal.

Workshops/Schools/Seminars/Courses

April 2022 **IEEE workshop on Quantum Photonics**, *Organized by International Institute of Information Technology, Hyderabad, India*.

July 2021 **Short online course on INTRODUCTION TO QUANTUM OPTICS**, *Organized by Indian Institute of Science Education and Research (IISER) Tirupati, India.*.

July 2021 **International Summer Program (ISP) 2021**, *Organized by Osaka University*.

Dec 2020 **Workshop on Condensed Matter, High Energy, Astrophysics and Cosmology**, *Organized jointly by IIT Guwahati-Tokyo Institute of Technology*.

Dec 2020 **C. K. Majumdar Memorial Workshop in Physics**, *Organized by S. N. Bose National Centre for Basic Sciences, Kolkata, India*.

July 2018 **Basic Concepts of Quantum Statistics**, *One-day seminar organised by the University of Calcutta, India.* .

Relevant Coursework

- Mathematical Physics
- Solid State Physics
- Electrodynamics
- Statistical Mechanics
- Computer programming and numerical methods
- Atomic and Molecular Physics
- Quantum Optics
- Quantum Information and Quantum Computing

Languages

Bengali	Native	*Mother Tongue*
Hindi	Fluent	*Full Working Proficiency*
English	Fluent	*Full Working Proficiency*