Tathagata Karmakar

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EXPERTISE

Quantum optics, open quantum systems, quantum optimal control, continuous measurements, machine learning approaches in physics, superresolution imaging, quantum thermal machines.

EDUCATION

2024	Ph.D., Physics and Astronomy, University of Rochester.
2020	M.A., Physics and Astronomy, University of Rochester.
2018	BS, Physics CPI: 9.9/10, IIT Kanpur.

PROFESSIONAL APPOINTMENTS

2024–Ongoing	Postdoctoral scholar, University of California, Berkeley.
2021–2024	Affiliated student researcher, Chapman University.
Jul.–Sep. 2023	Research Intern, PHI Lab, NTT Research, Inc., CA.
2017	Summer research assistant, CCA, Simons Foundation.

SELECTED PUBLICATIONS

[1] Sethuraj K. R., **T. Karmakar**, S. A. Wadood, A. N. Jordan and A. N. Vamivakas, and "Experimental realization of supergrowing fields", Phys. Rev. Research **6**, L032043 (2024).

[2] **T. Karmakar**, É. Jussiau, S. K. Manikandan, and A. N. Jordan, "Cyclic superconducting refrigerators using guided fluxon propagation", Phys. Rev. Research **6**, 013085 (2024).

[3] **T. Karmakar**, A. Chakraborty, A. N. Vamivakas and A. N. Jordan, "Supergrowth and sub-wavelength object imaging", Opt. Exp. **31**, 37174-37185 (2023).

[4] **T. Karmakar** and A. N. Jordan, "Beyond Superoscillation: General Theory of Approximation with Bandlimited Functions", J. Phys. A: Math. Theor., **56** 495204 (2023).

[5] **T. Karmakar**, P. Lewalle, and A. N. Jordan, "Stochastic path-integral analysis of the continuously monitored quantum harmonic oscillator", PRX Quantum **3**, 010327 (2022).

[6] **T. Karmakar** and T. Sarkar, "Distinguishing Between Kerr and Rotating JNW Space-Times via Frame Dragging and Tidal Effects", General Relativity and Gravitation **50**, 85 (2018).

RESEARCH EXPERIENCE

2023–Ongoing **Quantum optimal control**

Generalized Pontryagin maximum principle to find optimal control for continuously monitored continuous variable quantum systems.

Solved for optimal control protocols for state preparation under continuous measurements numerically.

2023–Ongoing **ML based Model reduction in nonlinear optics, NTT Research, Inc.**

Built a physics-informed neural operator based learning architecture that approximates the unitary propagator for quantum harmonic oscillators, capable of solving for the dynamics of 256 separate initial conditions simultaneously.

2022-2023 **Superoscillations and supergrowth [2–4]**

Developed an algorithm to generate functions with arbitrary superoscillation/supergrowth by choosing the values of only the first two coefficients in a series expansion.

Developed an algorithm to reconstruct objects that are an order of magnitude smaller than the illuminating wavelength.

Collaborated on the experimental realization of supergrowing optical fields.

2021-2022 **Fluxon refrigerator [1]**

Devised a refrigeration scheme utilizing the flow of magnetic field vortices along a magnetic field gradient in a type-II superconducting device.

2020-2021 **Stochastic path integral [5]**

Formulated a stochastic action principle-based description of the optimal evolution of continuously monitored harmonic oscillators.

TALKS

Mar. 2024 *Supergrowing Optical Fields: Subwavelength Imaging and Generation,* APS March Meeting.

Oct. 2023 *Supergrowing Optical Fields: Subwavelength Imaging and Experimental Synthesis* , Chapman University.

Mar. 2023 *Cyclic superconducting quantum refrigerators using guided fluxon propagation*, APS March Meeting.

Jun. 2022 *Stochastic path integral analysis of a harmonic oscillator* , Quantum Thermodynamics Conference.

Mar. 2022 *Tomography of a Continuously Monitored Qubit*, APS March Meeting.

Sep. 2021 *Stochastic path integral analysis of a harmonic oscillator undergoing simultaneous continuous position and momentum measurements* , IQS, Chapman University.

Mar. 2021 *Stochastic Path Integral Analysis of the Continuously Monitored Simple Harmonic Oscillator*, APS March Meeting.

Jan. 2021 *Optical Field Quadrature Measurements: Introduction to Homodyne and Heterodyne Detections*, with Dr. Philippe Lewalle, University of Rochester.

PROGRAMMING EXPERIENCE

Python (5+yrs, PyTorch, JAX), Mathematica (5+ yrs), QuTiP, Fortran, C.

AWARDS AND FELLOWSHIPS

2020	Okubo Prize, Department of Physics and Astronomy, UR.
2018-2020	Robert L. and Mary L. Sproull fellow, UR.
2017	S. N. Bose Scholar (WSF, DST Govt. of India, IUSSTF).
2016	Academic Excellence Award (dean's office, IIT Kanpur).
2015	Academic Excellence Award (dean's office, IIT Kanpur).
2014-2018	KVPY fellow, DST, Govt. of India.

SUMMER/WINTER SCHOOLS

Feb. 2025	IPAM Winter School: Quantum Error Suppression, Mediation, and Correction, UCLA.
Jun. 2023	Quantum Connections, Stockholm, Sweden.
Jun. 2022	Solstice of Foundations, ETH Zürich.
Aug. 2021	Quantum Thermodynamics (online), ETH Zürich.

TEACHING EXPERIENCE

Jan.–Apr. 2019	Teaching assistant, 20th Century Physics.
Aug.–Nov. 2018	Teaching assistant, Gravitation and General Relativity.

PEER-REVIEWER/REFEREE

Optics Express, Phys. Rev. A, Annals of Physics, npj Quantum Information, Applied Physics Letters.

SELECTED COURSEWORK

Quantum optics I and II (UR), Computational Physics (IITK).