# Tathagata Karmakar

K. B. Whaley group

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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

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| *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

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| *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

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| *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

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| *Feb. 2025* | IPAM Winter School: Quantum Error Suppression, Mitigation, 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

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| *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).