# Tathagata Karmakar

Andrew N. Jordan ⧉ group

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## EXPERTISE

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

## EDUCATION

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| *Ongoing* | 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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| *2021–Ongoing* | Affiliated student researcher, Chapman University. |
| *Jul.–Sep. 2023* | Research Intern, PHI Lab, NTT Research, Inc., CA. |
| *2017* | Summer research assistant, CCA, Simons Foundation. |

## PUBLICATIONS

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

[2] Sethuraj K. R., **T. Karmakar**, A. N. Jordan and A. N. Vamivakas, and "Experimental realization of supergrowing fields", arXiv: 2309.00016 (2023).

[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**, S. Genel, and R. S. Somerville, "The relationship between galaxy and halo sizes in the Illustris and IllustrisTNG simulations", Monthly Notices of the Royal Astronomical Society, **520**, 1630 (2023).

[7] **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

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| *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.

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| *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.

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| *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.

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

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

## TALKS

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| *Oct. 2023* | *Supergrowing Optical Fields: Subwavelength Imaging and Experimental Synthesis* ⌉ , Chapman University. |
| *Aug. 2023* | *A discussion on quantum convolutional neural networks*, PHI Lab, NTT Research, Inc. |
| *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 SCHOOLS

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| *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).