

# Tathagata Karmakar

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<https://tathagata-karmakar.github.io/>

## EXPERTISE

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

## EDUCATION

*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

*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

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

Built a 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 a continuously monitored harmonic oscillator.

**TALKS**

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

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

## SUMMER SCHOOLS

<i>Jun. 2023</i>	Quantum Connections, Stockholm, Sweden.
<i>Jun. 2022</i>	Solstice of Foundations, ETH Zürich.
<i>Aug. 2021</i>	Quantum Thermodynamics (online), ETH Zürich.

## TEACHING EXPERIENCE

<i>Jan.–Apr. 2019</i>	Teaching assistant, 20th Century Physics.
<i>Aug.–Nov. 2018</i>	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).