

# Tathagata Karmakar

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

## INTERESTS

Open quantum systems, continuous measurements, machine learning approaches in physics, superresolution imaging, quantum thermal machines.

## 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] Sethuraj K. R., **T. Karmakar**, A. N. Jordan and A. N. Vamivakas, and “Experimental realization of supergrowing fields”, arXiv: 2309.00016 (2023).
- [2] **T. Karmakar**, A. Chakraborty, A. N. Vamivakas and A. N. Jordan, “Supergrowth and sub-wavelength object imaging”, Opt. Exp. **31**, 37174-37185 (2023).
- [3] **T. Karmakar** and A. N. Jordan, “Beyond Superoscillation: General Theory of Approximation with Bandlimited Functions”, J. Phys. A: Math. Theor., **56** 495204 (2023).
- [4] **T. Karmakar**, É. Jussiau, S. K. Manikandan, and A. N. Jordan, “Cyclic superconducting quantum refrigerators using guided fluxon propagation”, arXiv: 2212.00277 (2022).
- [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, NTT Research, Inc.**  
Built a neural operator based learning architecture that can solve for the dynamics of 256 quantum harmonic oscillators simultaneously.

*2022–2023*          **Superoscillations and supergrowth [1–3]**

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 [4]**

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.

## 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.

## PROGRAMMING EXPERIENCE

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

## **SUMMER SCHOOLS**

*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**

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

## **SELECTED COURSEWORK**

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