Tathagata Karmakar

K. B. Whaley ↗ group

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SUMMARY

Quantum information theorist specializing in quantum control protocols for state preparation, dissipative stabilization, and measurement-driven quantum algorithms for solving classical optimization problems. Experienced in bridging foundational theory with practical applications in quantum computation and quantum optics.

EXPERTISE

Quantum optimal control, quantum measurements, open quantum systems, measurement-driven quantum computation.

EDUCATION

2024	Ph.D., 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.

INDUSTRY COLLABORATION

Internship (2023)

ML-based Model reduction in nonlinear optics, NTT Research, Inc:
Built a physics-informed neural operator-based learning architecture that is capable of solving for the dynamics of harmonic oscillators with 256 separate initial conditions simultaneously.

SELECTED PUBLICATIONS

Quantum control and feedback

[1] Y. Zhang, A. Sarlette, P. Lewalle, **T. Karmakar**, and K. B. Whaley, "Optimal schedule of multi-channel quantum Zeno dragging with application to solving the k-SAT problem ", arXiv: 2507.16128 (2025).

[2] **T. Karmakar**, P. Lewalle, Y. Zhang, and K. B. Whaley, "Noise-Canceling Quantum Feedback: non-Hermitian Dynamics with Applications to State Preparation and Magic State Distillation", arXiv: 2507.05611 (2025).

[3] **T. Karmakar** and A. N. Jordan, "CDJ-Pontryagin Optimal Control for General Continuously Monitored Quantum Systems", arXiv: 2504.08173 (2025).

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

Thermodynamics and optics

[5] 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).

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

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

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

RESEARCH EXPERIENCE

2024–Ongoing **Measurement driven k-SAT solver [1]:**
Built optimal control protocols for solving k-SAT with measurement-driven quantum computation.

2024–2025 **Noise-canceling feedback [2]:**
Designed feedback protocols to generate deterministic dynamics in continuously monitored systems.

Applied noise-canceling feedback for 5-to-1 magic state distillation based on $[[5, 1, 3]]$ code.

Developed feedback protocols that lead to a 300-400% boost in successful distillation probabilities.

2023–2025 **Quantum optimal control [3]:**
Generalized Pontryagin maximum principle to find the optimal control for general continuously monitored systems.

Solved for optimal control for oscillator state preparation problems, such as binomial codeword preparation, parametric cooling, and cat state to cat state transformation.

Designed optimal control protocols that lead to a 40-190% increase in the trajectory success rates.

2020-2021 **Stochastic path integral [4]:**
Formulated a stochastic action principle-based description of the optimal evolution of continuously monitored harmonic oscillators.

TALKS

Jun. 2025 *Noise-Canceling Feedback for Continuously Monitored Systems*, CQS-12, Rochester, NY.

Mar. 2025 *Noise-Canceling Feedback for Continuously Monitored Systems*, APS Global Summit, Los Angeles, CA.

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

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

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

Jun. 2022	*Stochastic path integral analysis of a harmonic oscillator* , Quantum Thermodynamics Conference, Online.
Mar. 2022	*Tomography of a Continuously Monitored Qubit*, APS March Meeting, Online.
Sep. 2021	*Stochastic path integral analysis of a harmonic oscillator undergoing simultaneous continuous position and momentum measurements* , Chapman University, Orange, CA.
Mar. 2021	*Stochastic Path Integral Analysis of the Continuously Monitored Simple Harmonic Oscillator*, APS March meeting, Online.
Jan. 2021	*Optical Field Quadrature Measurements: Introduction to Homodyne and Heterodyne Detections*, with Dr. Philippe Lewalle, University of Rochester, Online.

PROGRAMMING EXPERIENCE

- Python (PyTorch, numpy, JAX, QuTiP, mpi4py), experience with HPC clusters, Mathematica.
- Simulation of open and monitored quantum systems with stochastic differential equations.

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, Mitigation, and Correction, UCLA, Los Angeles, CA.
Jun. 2023	Quantum Connections, Stockholm, Sweden.
Jun. 2022	Solstice of Foundations, ETH Zürich, Zürich, Switzerland.
Jun. 2022	Quantum Thermodynamics, ETH Zürich, Online.

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.