

Siddhant Midha

Curriculum Vitae (brief)

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Research Interests

I am broadly interested in interdisciplinary research in quantum information processing. This spans quantum information theory, open quantum systems, condensed matter, quantum optics, and (quantum) machine learning. Moreover, I am keen on working with experimentally relevant theoretical problems.

Education

2020 - **Indian Institute of Technology Bombay** Pursuing a major in Electrical Engineering (with Present honors), along with a minor degree in Physics. GPA: 9.81/10.

Publications and Technical Writing

- Papers* (1) [S. Midha](#), K. Jana, B. Muralidharan; **Are Symmetry Protected Topological Phases Immune to Dephasing? – A topological electronics perspective** [[arXiv:2305.11149](#)] Accepted for publication at the *Journal of Physics D: Applied Physics*
- (2) M. Atallah, H. Velmurugan, R. Sharma, [S. Midha](#) et al. **Integer Factorization through Func-QAOA** [[arXiv:2309.15162](#)] Currently under review at *Quantum Information Processing*
- (4) A. Arora[†], [S. Midha](#)[†], A. Zyuzin, P. Hakonen, B. Muralidharan; **Steady-state dynamics and entanglement in quantum-dot Cooper pair splitters**, *Manuscript in progress*
- Reports* (1) **Exploring non-hermitian topological quantum phenomenon** [[Survey Paper](#), [Slides](#)]
- (2) **AC quantum transport: formalisms and applications** [[Survey Paper](#), [Slides](#)]
- (3) **Error correcting codes: the classical and the quantum** [[Report](#)]
- (4) **Phase transitions in open quantum systems** [[Report](#)]

Presentations and workshops

- Presentations* (1) [S. Midha](#), K. Jana, B. Muralidharan; **Are Symmetry Protected Topological Phases Immune to Dephasing?** Poster presentation at *Quantum Matter 2023, Madrid, Spain*. [[Abstract](#), [Poster](#)]
- (2) [S. Midha](#), M. Parashar, K. Saha; **Fourier and Bayesian Methods for Current Reconstructions: A Comparative Study** Poster presentation at *Quantum Sensing Gordon Research Seminar, Les Diablerets, Switzerland*.
- (3) [S. Midha](#)[†], A. Arora[†], B. Muralidharan; **A Journey through hybrid normal-quantum dot-superconducting systems** at the *Quantum Dynamics - Fundamentals and Realizations, MPI of Complex Systems, Dresden, Germany*. [[Poster](#)]
- (5) K. Agaram, [S. Midha](#), A. Müller, V. Garg; **Quantum State Preparation with Deep Reinforcement Learning**, poster at *Aalto SCI internship exhibition, Aalto University, Finland*
- Workshops* (1) **Perimeter Scholars International**: Selected for the PSI Summer School in Theoretical Physics.
- (2) Selected for the **Condensed Matter meets Quantum Information** meeting at the *International Centre for Theoretical sciences, Bengaluru, India*, and presented a poster.

[†] denotes equal contribution

Selected Research Experience

- 2022 - **Superconducting and topological quantum matter**. Guide: Prof. Bhaskaran Muralidharan, Present IIT Bombay. Worked on (i) dephasing in topological insulators, (ii) induced superconducting effect, and (iii) quantum dot-based Cooper pair splitters via the Keldysh Green's function approach.
- 2023 - **Phase transitions in monitored quantum systems**. Guide: Prof. Sai Vinjanampathy, IIT Present Bombay. Worked on trajectory and Master equation level dynamics in continuously measured Hamiltonian systems and random quantum circuits, and investigated the measurement induced phase transition and continuous time crystals.

- 2022 - **NV Centers: Bayesian Optimization and Quantum Simulation.** *Guide: Prof. Kasturi Saha, IIT Bombay.* Worked on (i) sequential Bayesian experiment design (ii) Bayesian reconstruction of 2D current densities in widefield NV imaging, and (iii) quantum simulations using NV centers.
- 2023 **Resonator design for MWO quantum transduction.** *Guide: Prof. Andreas Reiserer, TU Munich.* Worked on employing nanophotonic inverse design techniques for the design of silicon-on-insulator based optical resonator for quantum transduction.
- 2022 **Quantum generative learning.** *Guide: Prof. Vikas Garg, Aalto University.* Studied performance bounds on learning with quantum systems and information-theoretic lower bounds on machine learning for quantum systems.

Selected awards

- 2023 Awarded an **Undergraduate Research Award** at IIT Bombay
- 2023 Awarded the **Institute Academic Prize** for exemplary academic performance in the year 2022-23
- 2023 Sanctioned a **grant** of INR 170,000 ($\sim 1800\text{€}$) for presenting at conferences as an undergraduate
- 2023 Awarded the **DAAD-WISE** fellowship for pursuing summer research in Germany
- 2022 Awarded with **AP Grades** in MA106: Linear Algebra and EE214: Digital Circuits Lab courses
- 2022 Felicitated with the **Aalto Science Institute** research fellowship for pursuing research in Finland
- 2020 Achieved **All India Rank 150** in the JEE-Advanced Exam, out of over a million candidates
- 2020 Selected for the prestigious **Kishore Vaigyanik Protsahan Yojana** fellowship by Govt. of India

Teaching

Served as a teaching assistant (TA) in the following courses.

- 2021 MA 111: Calculus II. Instructors: *Prof. Saurav Bhaumik & Prof. Bata K. Das*
- 2021 MA 106: Linear Algebra. Instructors: *Prof. G.K. Srinivasan & Prof. K. Sivasubramanian*
- 2021 MA 108: Differential Equations I[†]. Instructors: *Prof. Santanu Dey & Prof. K. Sureshkumar*
- 2022 MA 205: Complex Analysis. Instructor: *Prof. Saikat Mazumdar*
- 2022 MA 109: Calculus I. Instructors: *Prof. Sanjoy Pusti & Prof. Madhusudan Manjunath*
- 2022 MA 111: Calculus II[†]. Instructors: *Prof. Preeti Raman & Prof. Niranjana Balachandran*
- 2023 PH 534: Quantum Information & Computing. Instructor: *Prof. Himadri Shekhar Dhar*

This included conducting weekly **live tutorial sessions** for **40+** students. I have been the head TA for (†), helped in invigilation duties, conducted help sessions, and made tutorial solutions using \LaTeX ([webpage](#)).

Mentorship

- 2023 **Institute Student Mentor** to a batch of *twelve* freshmen to guide them personally and academically throughout the first year at IIT Bombay.
- 2023 **Department Academic Mentor** to *eight* sophomores to support them through the rigorous second year in Electrical Engineering at IIT Bombay.
- 2023 **Machine learning for quantum error correction** (*Winter in Data Science*): Mentoring a project exploring the use of ML methods in QEC, as decoders as well as for finding codespaces.
- 2022 **Learning with quantum computers** (*Winter in Data Science*): Mentored two projects in quantum machine learning and classical and quantum reinforcement learning ([Repository](#))
- 2022 **Quantum machine learning** (*Seasons of Code*): Co-mentored *eight* students studying the fundamentals of QC and QML, and implementing research papers in QML ([Repository](#))
- 2022 **Machine learning** (*Summer of Science*): Guided *four* students with suitable resources and material to build a theoretical understanding of the basics of machine learning.

Computer Skills

- Languages Python, \LaTeX , Matlab, C++
- Libraries QuTiP, Qiskit, PennyLane, QuSpin, Stim, PyClifford, MEEP, PyTorch, TensorFlow