Soumyadeep Sarma

Undergraduate · Department of Physics

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Education

Indian Institute of Science (Abbr. IISc) *Bangalore, India*

Integrated Bachelors + Masters in Physics *Nov. 2021 - Jul. 2026 (expected)*

- Current Cumulative GPA: **9.7/10**; Physics + CS GPA: **9.9/10**
- Additional Minor in **Quantum Technologies**; Minor GPA: **9.9/10**

Highlighted Research Projects

Analyzing k-mers on $k \times L$ strips *ICTS, Bangalore*

Deepak Dhar *May 2023 - Dec. 2023*

- Numerically studied zeroes of grand partition functions of k-mers on $k \times L$ lattice systems for $k = 2, 3$. Formulated novel transfer matrix methods, and optimised matrices by using symmetries of the configurations.
- Analytically study partition functions of the given setup using the recursive transfer matrix and phase jumps across branch cuts.
- Computed critical exponents at the end-points of branches of zeroes for trimers, comparing them with the ones postulated by Fisher.
- **Solo-author publication in JPhyA: Math and Theor.**

Benchmarking Floquet Kondo model using quantum simulations *MPI Stuttgart*

Elio König (UW Madison), Jukka Väyrynen (Purdue) *May 2024 - Dec. 2024*

- Simulated a Floquet Kondo model using quantum circuits in Qiskit.
- Numerically found oscillations in impurity magnetization in finite-sized chains. Analyzed entanglement between impurity and other fermionic sites and heating behaviour.
- Analytical calculations using bosonization and Emery-Kivelson transformation to support data.
- **First-author publication in PRB**

Semidefinite Programming for understanding Lindblad Equation limitations *ICTS Bangalore*

Devashish Tupkary (IQC Waterloo), Manas Kulkarni *Aug. 2024 - Apr. 2025*

- Used semidefinite programming (SDP) to test the feasibility of constructing QMEs that satisfy physical consistency requirements and accurate steady-state properties.
- Established rigorous no-go results for XXZ and XX spin chains, demonstrating that for most non-equilibrium and strongly coupled regimes, it is fundamentally impossible for a Markovian QME to satisfy local conservation laws while correctly reproducing the leading-order populations and coherences of the non-equilibrium steady state (NESS).
- Provided new measures of non-Markovianity for our framework optimized by SDP.
- Derived an analytical lower bound on the trace distance between the exact zeroth-order NESS and that of any locally-conserving Lindbladian QME.
- **Manuscript in preparation**

Magic properties of finite-temperature eigenstates in quantum chaotic Hamiltonians *Caltech, Pasadena CA*

Dariel Mok, Tobias Haug *Mar. 2025 - Present*

- Introduced the Scrooge ensemble, constructed from Haar-random states distorted by a thermal operator, and numerically demonstrated that its magic (filtered stabilizer entropy) accurately matches that of finite-temperature eigenstates in quantum chaotic systems.
- Derived analytical formulae for the magic of the Scrooge ensemble for inverse temperatures β, using Weingarten calculus, in strong agreement with numerical data.
- **Manuscript in preparation**

Publications

S. Sarma, J. Väyrynen, E. König, Design and Benchmarks for Emulating Kondo Dynamics on a Quantum Chip. Physical

Review B Vol. 111, 235142 (2025).

S. Sarma, A numerical study of the zeroes of the grand partition function of hard needles of length k on strips of width k. Journal of Physics A: Mathematical and Theoretical, 58, 165001 (2025).

Joseph, A., **Sarma, S.** et al. Bug-eecha 2.0: An Educational Game for CS1 Students and Instructors, COMPUTE '23: Proceedings of the 16th Annual ACM India Compute Conference (2023)

(In preparation) **S. Sarma**, M. Kulkarni, A. Purkayastha, D. Tupkary, Semidefinite Programming for understanding limitations of Lindblad Equations.

(In preparation) **S. Sarma**, D. Mok, T. Haug, Magic properties of finite-temperature eigenstates in quantum chaotic Hamiltonians.

Skills

Standardized Tests: TOEFL: 114 of 120; R: 30, L: 30, S: 27, W: 27

Computational: Exact Diagonalization, Monte Carlo, Tensor Networks.
Languages: Python, C++, LaTeX, Mathematica, MATLAB.
Packages: QuTiP, Qiskit, NumPy, SciPy, MatPlotLib, PyTorch.

Fellowships & Invitations

Short term reseach stay — *A*STAR, Singapore*
Dr. Kishor Bharti, Dr. Dax Enshan Koh — *Jan. 2025 - Feb. 2025*
Invited for 2 months to study transversal non-Clifford gates and methods to bypass Eastin-Knill theorem.

Long Term Visiting Students Programme (LTVSP) — *ICTS Bangalore*
Dr. Manas Kulkarni — *Aug. 2024 - Apr. 2025*
9 month fellowship to study bath optimization in quantum master equations.

Working Internships in Science and Engineering — *MPI Stuttgart*
Prof. Elio König — *May 2024 - July 2024*
12-week fellowship by German Academic Exchange Service (DAAD) to research on quantum computing.

National Initiative for Undergraduate Students (NIUS) — *HBCSE, TIFR Mumbai*
Prof. Deepak Dhar — *May. 2022 - Aug. 2022*
Summer fellowship where I studied k-mers on lattice models in Statistical Mechanics.

KVPY Fellowship — *IISc Bangalore*
Department of Science and Technology, India — *2021 - 2026*
Provides stipend to those who clear the KVPY exam, for pursuing undergraduate studies in the basic sciences.

NTSE Scholarship — *DAV Intl. School*
National Council of Educational Research and Training (NCERT) — *2019 - 2021*
Provides stipend to high school students who clear the NTSE exam.

Teaching & Mentoring

Grader and Moderator — *Remote*
EuPhO and IPhO — *2021-2023*
Graded international olympiad papers, updated grading rubrics and participated in moderation.

Student Facilitator (Teaching Assistant) — *HBCSE, TIFR Mumbai*
International Olympiad on Physics - Orientation cum Selection Camp (India) — *2023*
Conducted tutorials/recitations, graded examinations and gave feedback.

TA for QT202: Introduction to Quantum measurement *IISc Bangalore*
INSTRUCTOR: **BALADITYA SURI** *Spring 2024*
Conduct weekly tutorial sessions on assignment solutions and/or aspects of quantum measurement theory.

Exams & Contests

2023 **Contest:** Captain of the Indian team selected for PLANCKS'23 held in Italy
2022-2023 **Contest:** Won bronze medal from India in Physics Cup for 2 consecutive years
2022 **Contest:** As part of a 4-man team from IISc, won world rank 2 in OPhO Invitationals.
2021 **Exam:** Secured all India rank 627 in JEE Advanced, among 170 thousand test takers.
2019 **Exam:** Secured all India rank 138 in KVPY Fellowship examination

Workshops & Seminars

TQC: Theory of Quantum Computation, Communication and Cryptography *15 - 19 Sept. 2025*
INDIAN INSTITUTE OF SCIENCE (IISC) *Volunteer and participant*
Attended and volunteered for TQC 2025

Many-body entanglement in Quantum computing *17th Feb. 2025*
INTERNATIONAL CENTRE FOR THEORETICAL SCIENCES (ICTS) *Online participant*
Attended the ICTS seminar given by Prof. Aram Harrow

Quantum Many-Body Physics in the Age of Quantum Information *25 - 29 Nov. 2024*
INTERNATIONAL CENTRE FOR THEORETICAL SCIENCES (ICTS) *On-spot registrant*
Attended the Infosys-ICTS Chandrasekhar Lectures given by Prof. Joel Moore.

Topological Gap Opening without Symmetry Breaking *11 Jul. 2024*
MPI FKF, STUTTGART *Informal Attendee*

Extracurriculars

Physics Club: Leader of UG physics club in 2023. Organized several talks, activities and lecture series.
Music: Convener of IISc's music club for 2023. Cleared Grade 7 Trinity keyboard with distinction.
Sports: Won multiple gold and silver medals in Swimming and Ultimate Frisbee in intra-IISc events
Web Dev: In charge of the website for college's annual fest. Integrated various event pages.
NGO: Took part in IISc's Notebook drive initiative to help teach underprivileged children.

References

Prof. Subroto Mukerjee
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Prof. Elio König
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Prof. Manas Kulkarni
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