
Publications

- Harsh Vardhan Upadhyay, **Sanket Kumar Tripathy**, Ting Rei Tan, Baladitya Suri, and Athreya Shankar.
Scalable high-dimensional multipartite entanglement with trapped ions.
Quantum Science and Technology, **9**(3), 035013 (2024).
<https://doi.org/10.1088/2058-9565/adac06>

Research Projects Undertaken

- **Quantum Emitter Localization Using Second-Order Photon Correlation in the Diffraction-Limited Regime**
Advisor: Prof. Simeon Bogdanov, University of Illinois Urbana-Champaign (2024–2025)
Designed and simulated a novel emitter localization framework based on the spatial structure of $g^{(2)}(t)$ correlation data, operating within and beyond the Rayleigh limit. Combined quantum statistical optics with differentiable ML optimization to extract sub-wavelength spatial features from sparse photon streams, paving the way for non-classical super-resolution strategies in practical quantum imaging and tracking.
- **AFM-Based Characterization of Nanodiamonds**
Advisor: Prof. Simeon Bogdanov, University of Illinois Urbana-Champaign (2024–2025)
Gained hands-on lab experience with nanoscale scanning and force spectroscopy using atomic force microscopy (AFM). Characterized and mapped nanodiamond surfaces and their embedded NV centers to aid in quantum photonic material development.
- **Effect of Chaos on Gate Fidelity in Transmon Architectures**
Advisor: Prof. Baladitya Suri, Indian Institute of Science (2021–2023)
Explored dynamical chaos transitions in superconducting qubit arrays using spectral statistics and entanglement growth indicators. Evaluated their impact on gate implementation fidelity by analyzing deviations from ideal unitaries in noisy, many-body transmon systems. Work integrates condensed matter chaos with quantum information stability.
- **Simulation of Non-Markovian Dynamics of Open Quantum Systems**
Advisor: Prof. C. M. Chandrasekhar, Indian Institute of Science (2023)
Characterized master equations and their operational equivalence with non-unitary Kraus representations to simulate decoherence in open quantum systems. Investigated memory effects via completely positive trace-preserving (CPTP) maps and applied quantum process divisibility conditions to identify non-Markovian regimes.
- **Quantum Assisted Entropy Estimators**
Advisor: Prof. Vinod Sharma, IISc (2021–2023)
Devised multiple quantum algorithms using quantum kernels and the Durr-Hoyer scheme for entropy estimation. Further, established the regimes in which they are effective by their performance and scaling of computational resources.

Additional Work Experience

- Co-founded **Coeuss** (US-based startup) in 2024 and worked in a consultative role with domain experts on AI and quantum R&D initiatives. Contributed to early-stage strategy, quantum-AI integration concepts, and SAP-compatible framework design for enterprise optimization.
- Co-founded a startup in 2022 to develop integrated photonic chips for ML training/inference and a hardware–software co-design stack. Collaborated with industry experts, reached TRL-3, filed for a patent, and built an early prototype before discontinuation.
- Secured **3rd position**, in Siemens Healthineers ITTCP (Innovation Think Tank Certification Program) to develop **prototypes** and **business models** for innovative solutions to challenges faced by hospitals and pandemic response systems. Among 220 participants from India and China.

Technical Skills

Programming Languages	C, C++, Python
Software Packages	QuTiP, Qiskit, PennyLane, PyTorch, Mathematica, Lumerical

Teaching Experience

- Teaching Assistant, University of Illinois Urbana-Champaign *2023–2025*
Supported undergraduate physics instruction, grading, and discussion sessions while conducting research. Assisted in both theoretical and experimental coursework over four semesters.

Education and Relevant Coursework

- **Ph.D. Coursework and Research**, University of Illinois Urbana-Champaign *2023–2025*
Conducted independent research in quantum emitter localization and AFM-based nanodiamond characterization. Program enrollment concluded prior to degree completion.
- **Master of Science (Research)**, Indian Institute of Science, Bangalore *2022–2023*
Focused on quantum computation, photonics, and information theory. Completed thesis research on quantum chaos and entropy estimation.
- **Bachelor of Science (Research)**, Indian Institute of Science, Bangalore *2018–2022*
Completed foundational and advanced coursework in quantum mechanics, statistical physics, and mathematical methods.
- **Select Graduate-Level Coursework:** QFT I/II, Discrete Photonics, Quantum Computation, Advanced Quantum Computing, Quantum Information Theory, Topics in AI, Advanced Mathematical Methods of Physics (AMMOP)

Academic Achievements

- Secured an **All India Rank of 289** in **JEE Mains**, 2018 among 1.5 million candidates *2018*
- Secured an **All India Rank of 841** in **JEE Advanced**, 2018 among 230,000 candidates *2018*
- Secured the **KVPY** fellowship (DST, Govt. of India) with an **All India Rank of 200** *2018*
- Secured the **KVPY** fellowship (DST, Govt. of India) with an **All India Rank of 351** *2017*