Adhil Abdulla M A

abdullaadhil92@gmail.com | adhilabdulla@alumni.iitm.ac.in

Kozhikode, 673017

Kerala, India

Education

Indian Institute of Technology Madras, Chennai, India *July 2025*

M.Sc. Physics, *CGPA: 8.57/10*

Kannur University, Kerala, India *May 2023*

B.Sc. Physics, *First Class with Distinction*

Research/Work Experience

- **IC&SR, IIT Madras** *Aug 2025 - Ongoing*

  Position: Project Associate

  Supervisors: Prof. Vaibhav Madhok and Prof. Pranay Patil, IIT Madras

  – Currently engaged in two ongoing projects:
  – Project 1: Understanding Entanglement in Complex Quantum States using Stochastic Series Expansion.
  – Project 2: Gate Invariants and Information Scrambling, extension of Master's project.

- **Master's Thesis** *Aug 2024 - May 2025*

  Title: Measurement Induced Phase Transitions and Information Scrambling in Many-Body Systems

  Supervisor: Prof. Vaibhav Madhok, IIT Madras View Thesis

  – Investigated how bipartite gate invariants- entangling power (e_p) and gate typicality (g_t)- govern entanglement dynamics, operator spreading, and quantum chaos in many-body systems built from two-qubit unitaries.
  – Analyzed scrambling behavior using out-of-time-ordered correlators (OTOCs) to show that increasing g_t enhances inter-subsystem scrambling and suppresses intra-subsystem correlations, even at fixed e_p.
  – Explored measurement-induced phase transitions (MIPTs) in hybrid circuits with probabilistic unitaries and random projective measurements; extracted critical measurement rates and scaling exponents via finite-size scaling analysis.
  – Focused on families of gates including the CNOT–DCNOT line (with fixed e_p) while varying g_t, revealing how gate typicality controls the sharpness and onset of the MIPT.
  – Performed extensive numerical simulations using **Qiskit** and **QuTiP**, leveraging **HPC clusters** to study large ensembles and compute entanglement entropy and OTOCs.

Short-Term Projects

- **Numerical Analysis of the 1-D Schrödinger Equation** *April 2023*

  B.Sc. Project, Under Prof. Suresh T.P, Govt. Brennen College View Report

  – Used SciLab to develop a program that numerically solves the 1D Time-independent Schrödinger Equation for arbitrary potentials; computed energy eigenvalues and generated plots of the corresponding probability density functions.

- **Chaos in the Standard Map** *May 2025*

  Mini-Project View Report

  – Performed detailed numerical studies of the standard map to examine the transition from integrable to chaotic behavior in nonlinear dynamical systems.

– Investigated how varying the chaoticity parameter influences phase space structure, revealing the onset and development of chaos.

- **A Study of Measurement-Induced Phase Transitions** *May 2025*
  Mini-Project View Report

  – Studied Measurement-Induced Phase Transitions (MIPTs) in hybrid quantum circuits, where competition between unitary dynamics and projective measurements leads to a transition between volume-law and area-law entangled phases.
  – Reviewed recent analytical work on measurement-only circuits and random circuits.

Skills

- **Numerical Methods**: Stochastic Series Expansion (SSE), Quantum and Classical Monte Carlo
- **Programming Languages**: C++, Python, Julia
- **Libraries**: Qiskit, QuTiP, Numpy, Scipy, Pandas, Scikit-Learn, Matplotlib
- **Tools and Frameworks**: High-Performance Computing Environment (HPC), Unix/Linux Terminal, Jupyter Notebook, Visual Studio Code, SSH
- **Documentation**: LaTeX, Word
- **Languages**: English, Malayalam, Hindi, Urdu

Key Courses

- **Dynamical Systems** (from Nonlinear Dynamics by S. Strogatz)
- **Quantum Error Correction** (from Preskill Notes)
- **Quantum Information and Computation** (from Nielsen and Chuang)
- **Detailed Transcripts**: M.Sc. Physics, B.Sc. Physics

Scholastic Achievements

- Secured a position among top 2.34% of over 12,000 candidates in the **IIT-JAM** Physics exam with **All India Rank 289**. View Scorecard *2023*
- Qualified the **TIFR-GS** Entrance Examination for Admission to Integrated PhD in Physics. *2023*