ANANTHA KRISHNAN

@ readatanantha@gmail.com   ⓖ Portfolio   🌐 Hi I am Anantha   🆔 0009-0005-4897-8459   in ananthakrishnan

Project Associate at **Indian Institute of Science Education and Research Thiruvananthapuram**
Integrated BS-MS dual degree Physics graduate and **2023 Chanakya Research Fellow**

EDUCATION

Thesis: Quantum Causal Networks with Ranked LHV-Neural Network Oracles : advised jointly by Prof. Anil Shaji and Dr. Debashis Saha

📅 Jul 2024   📍 IISER TVM, Kerala, India

- Developed a new model for distinguishing local distributions for separable network states with rank-k. Expanding the work to all quantum causal structures and reframing GNN and its resources.
- Was awarded the Chanakya Fellowship (I-HUB QTF) under the Department of Science and Technology, Govt. of India

Minor Thesis: Superadditivity of Coherent Information in Noisy Quantum Channels: advised by Dr. Nagaiah Chamakuri

📅 Jan 2022 – Apr 2022   📍 IISER TVM, Kerala, India

- using Restricted Boltzmann Machines identified Quantum states demonstrating Superadditivity of coherent information, applying GAs and PSOs (Evolutionary algorithms) over gradient descent for global optimisation.

Research Course: Quantum Complexity Theory

- From lectures of Scott Aaronson on Quantum Complexity Theory from MIT OpenCourseWare and predominantly his delightful book "Quantum Computing since Democritus"

RESEARCH EXPERIENCE

Project Associate: Is Genuine Network Nonlocality exclusive to Pure States : soon to be published

📅 Ongoing   📍 IISER TVM, Kerala, India

- We uncover that genuine network nonlocality in the triangle scenario is exclusive to pure states. And that the RGB4 distribution exhibits extreme noise sensitivity, unlike standard Bell scenarios.
- This work was presented in 24th QCMC conference in IIT Madras, Chennai.

Project collaboration: Foundations of Quantum Mechanics from Bell's Theorem to Random no. verification & Multipartite Quantum Causal Structures: advised by Dr. Manik Banik

📅 Aug 2020 – Dec 2020   📍 IISER TVM, Kerala, India

- Presented the case of the Bohr Einstein Debate to its consequence in Random no. generation & the Bell experiment to Multipartite Causal Networks and Genuine network Nonlocality.

Research Project: Quantum Circuits, Algorithms, and Computing

- Experienced with designing Quantum Circuits, Quantum Machine Learning Algorithms (qNNs, qGANs, qSVM/Qiskit). Tensor Network Circuits such as MPS and Tree Tensor Quantum Circuit.
- Experienced with Pennylane, Qiskit, tensorflow quantum, etc.

Research Internship: Semi Definite Programming and POPs

- Experienced with using SDP, SOS approach for POPs. cvxp package for SDP, NCSOStools and NCAlgebra for Non-commutative polynomial optimization.

Research Internship: Variational principles for finding quantum bound states

📅 Aug 2019 – Dec 2019   📍 IISER TVM, Kerala, India

RESEARCH INTERESTS

Quantum Information, Learning Algorithms focusing on learning Complex Systems.
- My research interests questions how foundations of quantum correlations coupled with learning theory can bring about better quantum technology for understanding complex systems.
Sci-Comm. and Philosophy of Science

AWARDS

Integrated BS-MS Dual Degree in Physical Sciences with Data Science Minor
IISER Thiruvananthapuram

📅 Jul 2018 – Jul 2023

CGPA - 8.34/10

Chanakya Research fellow
I-HUB Quantum Technology Foundation

📅 July 2023 – Dec 2023

Project Associate - I
IISER Thiruvananthapuram

📅 Feb 2024 – Feb 2025

TOEFL iBT Score - 101

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Chanakya PG Fellowship I-HUB QTF

Qiskit Quantum Excellence Award

MASTERY

Python · MatLab · Mathematica · R
HPC · Conda · MPI · Parallel Computing

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Qiskit · QuTip · tensorflow and keras
Pennylane · SDP · Tensor Networks/MPS

COURSEWORK

- Courses on Classical, Statistical, and Quantum Mechanics, courses on Condensed matter physics, Electrodynamics with Special and General theories of relativity, Atomic and molecular physics, and High energy physics.
- Advanced courses on Quantum Information Theory, Quantum Foundations, Quantum Field Theory, and Quantum Many-Body Theories.
- Courses on Computational Techniques and Programming languages, Introduction to Machine Learning, Probability and Statistics, Advanced Mathematical methods, and Data and Statistical Models in Astronomy.

SKILLS & EXPERTISE

Machine Learning & Programming

- Machine Learning Algorithms - Neural Networks, SVMs, Random Forest.
- Languages - Python, JS, C.
- Statistical analysis & Optimisation - Gradient descent, Metaheuristic algorithms (PSO, GA), Bayesian optimisation.

Learning Quantum Foundations/ML for Quantum

- Tailoring machine learning algorithms to model Quantum Causal Structures or Quantum Noisy Channels to study correlations and properties such as Superadditivity of coherent information.
- Bell Inequalities and Causal probability relationships.
- Neural Network Architecture - Restricted Bolztmann NN ansatz.
- Local hidden variable neural network models, PINNs.

Resources for Quantum Advantage & Quantum Complexity theory

- Contextuality for MBQC, Magic States for Universal Computation.
- Complexity Measurements for Measuring the Quantum Advantage in Quantum Algorithms

Quantum Computing for Complex Systems

- QML algorithms modelling non-linear systems for classification, EEG, finance. VQE and Tensor Network Circuits for Complex Systems.
- Qiskit, Pennylane, tensorflow quantum, Cirq.
- Quantum Machine Learning: qNNs, qCNNs.

Scientific Computing and Optimisation

- Scientific packages & techniques - TensorFlow, MatLab, Mathematica, R.
- QuTip Quantum Channels and Density States
- Perturbation theory, Variational methods, Adiabatic Approximation, DFT, Path Integral Formulation, Quantum MonteCarlo Methods

Other Software skills

Adobe | Scientific Illustration: Blender (Design team)

Origin Pro | Data Visualisation | Web Dev: NodeJS

WORKSHOPS & CONFERENCES

- Presented my work at the **24th International Conference on Quantum Communication, Measurement and Computing (QCMC24)** at IIT Madras, Chennai.
- Been selected for the **International conference on Foundations of Quantum Mechanics (QM100)** on occasion of a century of Quantum Mechanics at IISER Kolkata
- Presented my work on **Quantum Network Nonlocality using Machine learning** at the Frontier Symposium Physics 2024 in IISER Thiruvananthapuram.
- **Qiskit Global Summer School (QGSS) 2021, 2022, 2023** on **Quantum Machine Learning, Quantum Simulation and Algorithms, and Theory to Implementation**.
- Participated in Hackathon - **Datathon IndoML** 2023
- **Brain, Computation, and Learning (BCL)** 2023 workshop at IISc, Bangalore.
- Attended the Summer school on **Quantum Information and Quantum Technology (QIQT)** 2021
- Participated in 2021 **Build a Detector Workshop** organized by the **NewtonBhabha** and **LIGO India** partnership
- Attended the **Intel one API HPC Free Training & Workshop** at IISER Thiruvananthapuram
- Attended the **International Workshop on HPC in Science and Engineering 2021** at IISER TVM

PUBLICATIONS & MANUSCRIPTS

Master Thesis: "Exploring Triangle Nonlocality using Machine Learning"

📅 May 3rd 2023   📍 IISER TVM, Kerala, India
PDF

Is Genuine Network Nonlocality exclusive to Pure States

📍 IISER TVM, Kerala, India
Manuscript PDF

24th International QCMC Conference

📍 IIT Madras, Chennai, India
Poster PDF

Minor Thesis: "Superadditivity of Coherent Information in Noisy Quantum Channels"

📅 July 20th 2022   📍 IISER TVM, Kerala, India
PDF

COMMUNICATION & TEAMWORK

- Clear and concise **scientific writing**.
- Active member of the **Journal Club**
- Co-organized the **23rd NCAMP conference school** in **IISER TVM**
- Experience working in **research teams** or **collaborative projects** like with **NCAMP-23** and **Cloud Cuckoo Land, India**.
- **Mentored** undergraduate students and junior researchers at IISER TVM.
- **Ishya** & **IICM Cultural Fest** design volunteer and participant.
- **Humanities Collective** member.
- Continual learning and participation in workshops, conferences, and training programs.

REFEREES

Prof. Anil Shaji

@ IISER Thiruvananthapuram

✉ shaji@iisertvm.ac.in

Website +91 (0)471 - 2778080

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Dr. Debashis Saha

@ IISER Thiruvananthapuram

✉ saha@iisertvm.ac.in

Website +91 (0)471 - 2778326

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Dr. Nagaiah Chamakuri

@ IISER Thiruvananthapuram

✉ nagaiah.chamakuri@iisertvm.ac.in

Website +91 (0)471 - 2778326