

# Shivaprasad Umesh Hulyal

## Curriculum Vitae

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### Education

2019–2023 **Bachelor of Technology (B.Tech)**, Indian Institute of Technology (IIT) Madras, Chennai.  
CGPA : 9.25/10.00, Engineering Physics

### Research Experience

- August 2022– **Dual unitary gates and quantum circuits** *Prof. Arul Lakshminarayan,*  
Department of Physics, IIT Madras.
- Present
  - Studying the complexity of many-body nonintegrable quantum chaotic systems using Dual-Unitary Circuits
  - Calculation of the dynamical correlation function of single-particle operators on a quantum lattice
  - Implementing the class of dual-unitary circuits in many-body physics, which are difficult to solve classically on a real quantum computer to show quantum speed up
  - Exploring the above class of circuits on IBMQ and using entanglement growth to show quantum advantage
- June 2022 – **High frequency superconducting qubits design** *Prof. Rainer Dumke,*  
August 2022 Centre for Quantum Technologies, Nanyang Technological University (NTU), Singapore, Online.
- Studied challenges of Two-level System (TLS) defects in transmon qubits in developing high-frequency superconducting circuits for near-term applications
  - Explored surface participation ratio, dielectric losses and their effects on the relaxation time ( $T_1$ ) of qubits.
- May 2022 – **Ultrafast electro-optical signal processing in quantum communication** *Prof. Roberto Morandotti,*  
July 2022 Institut national de la recherche scientifique (INRS), Montreal, Canada, In-person.
- Worked on increasing the efficiency of coupling of light from single mode lensed fiber to an integrated waveguide on a photonic chip
  - Characterised the microrings for frequency comb generation and improved the stability of the setup
  - Generated and processed data for Quantum Random Number Generator (QRNG) experiment using single photon source
- September 2021 – **Simulating quantum black holes using matrix models** *Prof. Ayan Mukhopadhyay,*  
May 2022 Department of Physics, IIT Madras.
- Built a matrix model to simulate black hole physics
  - Simulated and studied how a typical black hole microstate behaves in real time
  - Developed a Mathematica package for future works that are based BFSS matrix theory
- May 2021 – **Quantum Error Correction using Cellular Automaton Decoders** *Prof. Pradeep Kiran Sarvepalli,*  
October 2021 Department of Electrical Engineering, IIT Madras.
- Studied Quantum Error Correcting Code using topological Cellular Automaton Decoders and only local update rules and their near-term applications
  - Simulated nearest neighbor interaction and update rules and obtained their threshold error rates
- Dec 2020 – **Programming of Quadrupole mass analyzer** *Prof. G Aravind,*  
March 2021 Department of Physics, IIT Madras.
- Programmed a Quadrupole Mass Spectrometer (QMS) for analyzing Interstellar Medium Ions using Iontrap
  - Designed the LabVIEW interface for measurements and correlation parameters and understood the various interconnections between the hardware FPGAs and software

### Patents

- Enhanced Linear Induction Motor (LIM) with a modified end-teeth design**  
Nikhil Yelamarthy, Parth Shah, **Shivaprasad Hulyal**, Kishan Thakkar, Dr. Satyanaryanan Chakravarthy (Patent Application No: 202241024672, Filed 27th April 2022)

### Presentations

- Shivaprasad Hulyal**, Vishnu Jejjala, Tanay Kibe, Ayan Mukhopadhyay and Rishi Raj. Simulating quantum black holes with matrices. Poster presented at Young Research Fellows Event; August 2022; Chennai [Poster]

## Projects

- November 2021 - January 2022 **Solving NP-Hard integer problems on a Quantum Computer.**
- Demonstrated and solved the Quadratic Knapsack Problem (QKP) using Graver Augmented Multiseed algorithm (GAMA) and Quantum Annealing
  - Showed that it could match the commercially available solvers in accuracy without a rapid increase in time as the density of the graph increases. [\[Final Paper\]](#)
- February 2022 - May 2022 **High threshold universal quantum computation on the surface code.**
- Surveyed literature on high-threshold Quantum Error correcting Surface code
  - Studied the practical regime with only nearest-neighbor coupled lattice of qubits using stabilizer formalism to achieve low error rates. [\[Thesis Paper\]](#)

## Scholastic Achievements

- Awarded **MITACS Globalink Research Internship** 2022 to perform a fully funded research internship with a Canadian supervisor and was awarded \$15,000 to pursue graduate studies in Canada.
- Awarded the prestigious IITM **Young Research Fellowship** 2021 to work on a research project under the guidance of an IITM Faculty in Physics Dept. throughout the year.
- Runner Up: The 2021 **Tayur Prize from Carnegie Mellon University's Quantum Computing Research Group** for solving practical problems on Quantum Annealers.
- Nominated for **KVPY** Fellowship 2018 by the Department of Science and Technology, Government of India. **(All India Rank 447)** Top 0.2% among 150 thousand applicants.
- Achieved Advanced Joint Entrance Examination 2019 **All India Rank: 2360 among 1.5 million**  
It is one of the most selective engineering entrance exams in the world, with an acceptance rate of less than 1% into the prestigious Indian Institute of Technology (IITs)
- Awarded CBSE Merit Certificate for being among the top **0.1%** successful candidates in CBSE Higher Secondary Physics Board Exam.
- **National Talent Search Examination** - Successfully cleared **NTSE** stage – I in 2017, organized by the Government of India. In the top 500 students in the state of Tamil Nadu.

## Skills

- **Programming Languages:** Python, C++
- **Softwares:** COMSOL Multiphysics, Ansys, LabVIEW, Mathematica, MATLAB, Verilog, Spice, Qiskit
- **Documentation:**  $\text{\LaTeX}$
- Certified **Machine Learning** and **Deep Learning Scientist** from Stanford University Online by Prof. Andrew Ng. The certificate can be found [here](#).
- **Languages known:** English, Hindi, Sanskrit, Tamil, Kannada, Telugu, German (Level A1)

## Relevant Course Work

- |   |                                      |
|---|--------------------------------------|
| ○ Quantum Photonics Devices & Technology                      | ○ Electromagnetics & Applications    |
| ○ Computational Physics                                       | ○ Quantum Integer Programming        |
| ○ Quantum Computation & Quantum Information                   | ○ Statistical Physics & Applications |
| ○ Quantum Mechanics   | ○ Classical Dynamics                 |
| ○ Digital Signal Processing                                   | ○ Analog Systems & Lab               |
| ○ Experimental techniques for quantum computation & metrology | ○ Superconductivity & Applications   |

## Co-Curricular Activities

- June 2019 – May 2020 **National Social Service Chennai, India.**  
Volunteered to inspire, encourage and develop self-confidence among government school students. Tutored Physics and Mathematics free of cost to aspiring students from economically deprived backgrounds. Bridged the gap that poor students faced to study because of a lack of teachers and infrastructure and helped them crack competitive exams to secure education and scholarships in colleges.
- June 2021 – Present **Science Communicator Physics Department, IIT Madras.**  
Organize weekly hour-long sessions to discuss & explain recent and intriguing scientific research results such as those of Nobel Prize winners to students so as to encourage students to take up reading research papers and brainstorm new ideas from them.
- Oct 2020 – July 2021 **Centre for Innovation, IIT Madras Team Avishkar Hyperloop,**  
Project Member of Propulsion System.  
Designed and conducted time-dependent simulations using COMSOL Multiphysics for the Linear Induction Motor by which the Hyperloop is powered for the [European Hyperloop Week](#) competition 2021. We won the most scalable Hyperloop Design Award and were among the top 5 nominees for various subsystem designs among 20 other international teams. My subsystem won the best propulsion system award among all the international teams. We were [featured](#) in many newspapers and journals across India.