# Shuhul Mujoo

Discovering the Universe, Inventing the Future

California Institute of Technology

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LinkedIn

## Education

- **Caltech Undergraduate Sophomore (2nd year) majoring in Applied Physics (GPA 4.2)**
  - Courses: Quantum Mechanics, Statistical Mechanics, Waves, Differential Equations, Multivariable Calculus, Linear Algebra, Complex Analysis, Introductory Mechanics, E&M, Special Relativity, Semiconductor Devices, Photonics, Caltech Physics League

## Employment

- **Research Intern at Leiden University** (Aug - Sep 2024)
  - Worked on Superconducting Nanowire Single Photon Detectors (SNSPD's), Completed project on 3-omega Method for Measuring Thermal Conductivity of Supercooled Nanowires
  - Learned superconducting physics: BCS Theory, Coherence Length, London penetration depth, DC Josephson and Meissner Effects, Type I & II Superconductors, Ginzburg-Landau theory
  - Deposited 10 μm gold wire on $SiO_2$ substrate, spin coated bilayer of PMMA, E-Beam lithography, then evaporation deposition and developing, finally wire bonding to test in cryostat
  - Created op amp subtractor circuit, removed noise with Lock-in amplifier, simulated circuit in LTSpice, used LABView, pyVISA, and pyMeasure for automation
- **Quantum Engineering Intern at Rigetti Computing** (Jun - Aug 2024)
  - Coded circuit simulation software to calculate Hamiltonian specs and qubit frequencies, ported Julia code to Python (test driven development), created tensor operation and eigensolver code
  - Learned superconducting quantum computing: Josephson Junctions, Transmons, Cooper pair boxes, Quasiparticles, $T_c$, $E_J/E_C$ ratio, readout resonators, chip fabrication
- **Research Intern at Search For Extraterrestrial Intelligence Institute** (Feb - Jun 2023)
  - Completed project and final presentation on Gas Temperature Prediction For Accretion Disks
  - Coded in Fortran and Python, cleaned data and fixed exponent overflows, created/trained neural network with dozens of iterations, 94% accuracy, analyzed weights of network, collected runtime results, extensive use of packages: numpy, scikit learn, tensorflow, matplotlib, joblib
- **Research Intern at NASA California Space Consortium** (Jun - Aug 2022)
  - Designed and constructed an Arduino powered prototype fire detection robot with distance & smoke sensors, 3D printed, and soldered, machined aluminum parts with CNC, bandsaw, drill press, mentored others through Computer Aided Design (Fusion 360), and Arduino/C++
- **Robotics Intern at Dusty Robotics** (Jul - Aug 2021)
  - Assembled printer robots from start to finish, drove robots around sites to print construction markings on floor, wrote unit test cases and debugged navigation issues, documented a tutorial for new hires and indexed parts inventory, designed battery mount for next gen of robots

## Publications

- **HGI-SLAM: Loop Closure With Human and Geometric Importance Features**
  - Published paper on Simultaneous Localization and Mapping Loop Closure to arXiv & submitted to IEEE International Conference on Robotics and Automation 2023
  - Created novel method with better precision\recall than state of the art, implemented and tested the algorithms in the paper as an independent researcher using a custom robot
- **Quantum Computing for Self-Driving Cars and Pedestrian Detection**
  - Created a Quantum K-Nearest Neighbors (Q-KNN) implementation to classify objects and pedestrians for self-driving cars to improve safety
  - Improved performance compared to the classical approach and designed a wireless networking framework based on quantum teleportation

## Awards

- **USA Physics Olympiad Silver Medalist**, American Invitational Mathematics Examination Qualifier, National Merit Scholarship Winner, FTC Robotics Competition World Finalist, National French Contest Silver Medalist, Coaches Award Water Polo

## Activities

- **Division III Men's Water Polo** (2023 - present)
    - Play as an attacker (right/left wing) on the Caltech Men's Water Polo team
- **Founder and President of Quantum Computing Club (QCC)** (2022 - 2023)
    - Instructor of EVHS QCC, created lesson plans, lectures, and mentored 6 officers, created feedback forms and a website, organized meetings and finance, outreached to UC Davis Quantum Club, increased membership to 25
- **Founder and Captain of FTC Robotics Team Terrabats 14525** (2017 - 2023)
    - Designed robot using CNC machined and 3D printed parts, created CAD designs, lead programmer, implemented convolutional neural network using Tensorflow Lite, created splines and performed inverse kinematic analysis, created feedforward PID motor controllers
    - Team achieved 1st in California, and became a world finalist
- **MIT Beaver Works Summer Institute (BWSI) Quantum Computing** (2020 - 2021)
    - Learned and implemented QC Algorithms: Shor's, Deutsch-Jozsa, Grover's, and quantum teleportation, mastered QC languages: Q# and Qiskit, completed final team project, quantum KNN algorithm, made of internal subroutines such as quantum phase estimation
- **Student Ambassador Inspirit AI Program Taught by Stanford & MIT alumni** (2019 - 2021)
    - Published blog, 2 projects on object detection (YOLO Deep Learning Architecture) & audio processing (FFT and filtering), promoted AI in my school and community

## Skills

- **Java, Python, C++**, C, Fortran, Julia, Q#, Qiskit, Arduino, JavaScript
- **Fusion 360, Android Studio, LTSpice**, GitHub, Linux, Layout Editor, Adobe Photoshop, LABView
- **Electron Beam Lithography, Lock-in Amplifier**, Operational Amplifier, 3D Printing, CNC, Drill Press
- **English, Kashmiri**, French, Hindi

## Community

- **Robotics Instructor at Afterschool Programs and Community Libraries** (2017 - 2023)
    - Conducted multiple camps and sessions for EV3 and First Lego League Robotics at local elementary and middle schools, mentored 100+ new students, and founded two teams
- **Mentoring and Tutoring Middle and High School Students** (2019 - 2023)
    - Science olympiad and math olympiad mentor for middle schools, the Tech Challenge and Odyssey of the Mind mentor for community teams, robotics camps and workshops
    - SchoolHouse World Tutor: physics and math tutoring with positive feedback given

## Traits

- **Curious, Hardworking, Passionate,** Persevering, Motivated, Selfless, Honest, Helpful, Thoughtful