ABHISHEK PATEL

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ACADEMIC QUALIFICATION

Indian Institute of Technology (IIT) Delhi, New Delhi, India — August 2022 — May 2024
Master of Science in Physics — Cumulative GPA: 8.39/10.00

Banaras Hindu University, Varanasi, Uttar Pradesh, India — July 2019 — May 2022
Bachelor of Science: Physics(Hons.), Chemistry, Mathematics — Cumulative GPA: 8.65/10.00

RESEARCH INTERESTS

Condensed Matter Physics and Quantum photonics

- Low-dimensional systems: Quantum-materials, Nano-materials, and Plasmonics for sensing, imaging, and communication applications.
- Experiments based on detailed theoretical treatment of scientific problems.

RESEARCH EXPERIENCE

Growth and patterning of ultra-thin NbN layers for SNSPD development. *IIT Bombay* **India** *01/2025 - Continue*
Research Project, Supervised by **Prof. Kantimay Das Gupta**

- Researching the growth optimization and electron beam patterning of ultra-thin NbN layers for Superconducting Nanowire Single Photon Detectors.
- Developing and characterizing ultra-thin NbN superconducting layers (5–10 nm thick) on substrates such as Si, sapphire, and AlN/sapphire, employing advanced techniques like sputtering and plasma-assisted molecular beam epitaxy (PAMBE).
- Investigating critical temperature properties and fabricated nanoscale geometries suitable for single-photon detection, focusing on integrating predictable kinetic inductance for high-performance quantum detection devices.

Quantum Entangled Fractional Topology and Curvatures. *HRI,India* **India** *10/2024 - 12/2024*
Visiting Student, Supervised by **Prof. Sayan Chaudhury**

- Fractional Topology in Quantum Systems: Contributed to the theoretical understanding of fractional topology in spin-1/2 systems, introducing stable half-integer Chern numbers in entangled quantum systems.
- Topological Lattice Models: Analyzed the correspondence between spin-1/2 systems and bilayer lattice models (Two Haldane layers AA and BB stacking), elucidating the role of Z2 symmetry in fractional topology and nodal ring semimetals which is robust in the adiabatic limit.

Exploring Density Functional Theory and application in 2D material. *IIT BHU* **India** *07/2024 - 10/2024*
Research Internship supervised by Prof. Ashish Kumar Mishra

- Developing computational models to predict and enhance SERS signals.
- Convergence and structural optimisation of (Ag+R6G), (MoS2+Dopamine), and (WSe2+Dopamine) using SCF and relax, vc-relax calculation.
- Calculating band structure, state density and quantitative charge transfer analysis using the Bader tool.

Tuning Surface Plasmon Resonance on Bimetallic Nano-Dimensional Thin Film. *IIT Delhi* **India** *05/2023 - 06/2024*
Master's project at Nano-s-tech lab supervised by Prof.Pankaj Srivastava *and Prof. Santanu Ghosh*

- Deposition of gold and silver films onto glass substrates of varying thicknesses using thermal evaporation techniques and various vacuum systems.
- Thermal annealing was performed using a microprocessor-controlled furnace at different temperatures to modulate the morphology and tune the Surface Plasmon Resonance (SPR).
- Advanced characterization techniques, such as Atomic Force Microscopy (AFM), X-ray diffraction (XRD), UV-visible spectroscopy, and Raman Spectroscopy, are essential for in-depth analysis.
- Explored potential applications in Surface Enhanced Raman Spectroscopy(SERS) of Rhodamine 6G molecule and molecular sensing.

Intra-cavity Q-Switch for Lasers: Working Principles and Characteristics *IITD* **India** *07/2023 - 11/2023*
Optical Electronics Term Paper Project supervised by Prof.M R Shenoy

- Analyzed the working principles of intra-cavity Q-switch systems and characteristics of laser output with Q-switching.
- Compared Electro-optic and Acousto-optic devices.

Obstacle Avoiding Robot *IITD* **India** *07/2022 - 11/2022*

Mini project supervised by Prof.Bodhatiya Santra

- Implemented a Microcontroller on Arduino by developing a controller program in an Arduino-UNO environment
- The design of the obstacle avoidance robot required the integration of sensors like ultrasonic sensors and Bluetooth sensors according to their task. Also, I have used four DC motors to navigate the robot

TECHNICAL SKILLS

- **Programming Language: C** (*Basic*), **bash**(**Linux**)(*Intermediate*), **Python** [numpy(*Intermediate*), Scipy(*Intermediate*), Qiskit(*Intermediate*)] , **Java**(*Intermediate*), **FORTRAN**(*Basic*)
- **Software: VASP, Guassian, Quantum expresso, MATLAB, Origin, Gwyddion**, Arduino.

PROFESSIONAL PRESENTATION

Kubo Formalism *Indian Institute of Technology Delhi* *April 2024*
- Proof of Kubo Formula and theoretical proof of quantisation of conductivity.

Qunatum Spin Hall Effect *Indian Institute of Technology Delhi* *April 2024*
- Two copies of Haldane's Model, spin up and spin down (Kane mele Model)

ADVANCE COURSES

- **Computational technique in solid-state material (Grade- 9/10)** – Density Functional Theory (Using FHI- aims Software)
- **Physics of Semiconductor Devices (Grade- 10/10)**
- **Topology in Condensed matter physics**
- **Nanostructured Materials**
- **Optical Electronics**

TEACHING EXPERIENCE

PHYSICS AND ADVANCED PHYSICS Subject Expert *Chegg.com* *May 2021- Present*
- Selected by qualifying for an Online Subject Test of Physics and based on academic record.
- Involved in solving queries asked by students from all over the world in the concerned subject and is bound to provide quality answers to continue working as a subject expert

WORKSHOPS

1. Hands-On Workshop on CFD using Ansys *IIT Delhi* *Dec 2022*
- Introduction to Computational Fluid Dynamics Ansys fluency.
- Hands-on flow through the duct and High-Performance computing in Ansys CFD.

2. Advanced technique in stimulated emission depletion microscopy *IIT Delhi* *Oct 2022*
- Introduction basics of Stimulated Emission Depletion Microscopy (STED)
- Sample preparation and imaging using STED and Data Analysis

3. Introduction to Linux and use of the Central High-Performance Computing Facility *IIT Delhi* *Jan 2023*

4. One-day Workshop on MEMS, NEMS, and Microfluidics *IIT Delhi* *Feb 2023*

5. Two-day workshop on Atomic Force Microscopy (AFM) *IIT Delhi* *March 2023*

6. Quantum and nonlinear optics-Optic and photonic centre *IIT Delhi* *Dec 2023*

SCHOLASTIC ACHIEVEMENT

- **S**ecured **All India Rank 675** in Graduate Aptitude Test in Engineering **(GATE-2024)** Physics among the 20258 aspirants across the country
- **S**ecured **AIR 390** in prestigious joint admission for Maser **(IIT JAM-2022)** Physics among the 12700 aspirants across the country
- **S**ecured **AIR 256** in **JEST-2022**, is a screening test for admission to PhD and Int. PhD program of different participating top institutes