

Parth Bhargava

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EDUCATION

National University of Singapore

Bachelor of Science in Physics (Honors, Distinction)

Aug 2024 – May 2028

GPA: 4.43

COURSEWORK

Labwork:

- Measured **carrier mobility** and type in semiconductors via **Hall effect**; cross-validated through **magnetoresistance analysis** ($R^2 > 0.99$); identified **intrinsic transition temperature** at 106°C
- Determined **lattice constants** via **X-ray diffraction** with sub-2% accuracy; applied **structural fingerprinting** to identify unknown crystal phases (KBr); validated **Kramers theory** for bremsstrahlung cutoff
- Calibrated **Helmholtz field configuration**; validated **five independent scaling laws** ($R^2 > 0.997$); quantified uncertainty to **3.3%**; corrected diameter dependence ($T \propto d^2$ vs $T \propto d$)
- Characterized **electron spin resonance** in paramagnetic systems; extracted **g-factors** and analyzed **hyperfine interactions**
- Analyzed **laser light propagation** through optical media; measured **diffraction patterns** and beam characteristics

Theory & Computation:

- Mechanics:** Lagrangian and Hamiltonian formulations, coupled ODEs, variational principles, phase space dynamics
- Electromagnetism:** Maxwell's equations, boundary-value problems, vector calculus, gauge theory
- Quantum Mechanics:** Schrödinger equation, operator methods, eigenvalue problems, perturbation theory
- Mathematical Methods:** Linear algebra, ODEs/PDEs, Fourier analysis, complex analysis, special functions
- Computation:** Python, Julia, C++; numerical methods (finite differences, Runge-Kutta), data analysis, visualization
- Experimental Methods:** Statistical analysis, uncertainty propagation, calibration, regression, error budgets

PROJECTS

Quantum Wavepacket Visualization

Jan 2025 – Mar 2025

Developed interactive visualizations of quantum phenomena in Python

- 3D simulation** of quantum wavepacket traversing potential barrier using finite difference methods
- Quantum harmonic oscillator** dynamics; visualization of energy eigenstates and time evolution

ACHIEVEMENTS

- BITSAT: 321/390**, strong proficiency in Physics, Chemistry, and Mathematics
- JEE Mains: 99.14 percentile** (Top 1% of 2 million candidates)
- JEE Advanced Rank: 9112**, exceptional problem-solving abilities
- Awarded **Silver Medal** in International Aerospace Olympiad 2024
- IISER Aptitude Test Rank: 357**

INTERESTS

- Complex Systems & Nonlinear Dynamics:** Emergence, collective behavior, chaos theory, and how simple rules generate complex patterns across scales
- Network Science & Information Theory:** Information flow, network structures, graph theory, and connections between abstract mathematics and physical systems
- Computational Modeling:** Simulation, geometric intuition, and bridging theoretical frameworks with numerical methods