Parth Bhargava

+65 9121 7298 | Singapore | bhargava.parth07@gmail.com
https://github.com/Vis-42 | https://vis-42.github.io/ | linkedin.com/in/parth-bhargava-6819b124a/

EDUCATION

National University of Singapore *Aug 2024 – May 2028*

Bachelor of Science in Physics (Honors, Distinction) **GPA: 4.43**

SUMMARY

Year 2 physics student building toward research in complex systems and nonlinear dynamics. Experience in experimental physics (Hall effect, X-ray diffraction, magnetic moment measurements) with emphasis on uncertainty analysis and methodological limitations. Developing computational modeling skills in Python and Julia. Seeking research opportunities combining theoretical rigor with computational and experimental approaches.

COURSEWORK

Labwork:

- Measured **carrier type**, **density**, and **mobility** in n-type and p-type germanium via **Hall effect**; cross-validated mobility through independent **magnetoresistance analysis** ($R^2 > 0.99$); characterized **temperature-dependent transition** from extrinsic to intrinsic conduction at 106°C
- Determined **lattice constants** via **X-ray diffraction** using **Bragg's law**; achieved **sub-2% accuracy** for LiF and **0.24% deviation** for KBr identification through structural fingerprinting; extracted **Planck's constant** from bremsstrahlung cutoff analysis
- Calibrated **Helmholtz field constant** through five independent experimental methods with **3.3% uncertainty**; validated all **electromagnetic torque scaling laws** ($R^2 > 0.997$); determined unknown loop geometries via **magnetic moment measurements**; corrected mathematical model using **quadratic fitting** ($T \propto d^2$ vs linear)
- Characterized **electron spin resonance** in paramagnetic systems; extracted **g-factors** from frequency-field relationships with excellent linearity ($R^2 = 0.9995$); analyzed **Zeeman splitting** and resonance conditions
- Measured **Gaussian beam propagation** and **spatial intensity profiles**; determined **beam waist** and **Rayleigh range** with **sub-1% agreement** to theoretical predictions; characterized **beam quality factor**; validated **Gaussian beam optics** model ($R^2 > 0.998$)

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