Paras Sharma
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EDUCATION

Stony Brook University, New York, USA — Aug 2023 – Present
M.A. in Physics & Astronomy

Indian Institute of Technology, Delhi, India — July 2019 – May 2023
Bachelor of Technology in Engineering Physics — **CGPA: 9.382/10**
- *Department Rank 1*, among the 2023 Class of Engineering Physics, IITD.
- *Institute Merit Award*, was among the *Top 7%* in the Institute for *five semesters*.

Navyug Convent School, Delhi, India — Apr. 2017 – Mar. 2019
Senior High School Education — **Percentage: 90.4%**

ACHIEVEMENTS AND HONORS

Institute Silver Medal, IIT Delhi, awarded for having highest GPA in the Physics Department.   2023

Mitacs GRI Scholar, was awarded Scholarship for Summer Internship at Univ. Of Toronto, Canada.   2022

Summer Undergraduate Research Award, awarded by Industrial R&D Unit (IRD)-IIT Delhi.   2021

Mudit Sharma Memorial Scholarship Recipient, for having the highest GPA in the Department.   2021

B-83 Scholarship Recipient, awarded by the 1983 alumni of IITD for Academic Excellence.   2021

IIT-JEE 2019, was among the **Top 0.2%** students out of *1.2 million* students across India.   2019

RESEARCH EXPERIENCE

Understanding the Galactic Dynamics with Pattern Speed estimation — Aug. 2023 – Present
Supervisor: Prof. Jin Koda, Department of Physics & Astronomy, Stony Brook University
- Using N-body hydrodynamic simulation data to analyze the pattern speed variation in a Milky-Way-like galaxy.
- Quantifying the validity of pattern speed estimation techniques such as the Tremaine-Weinberg method to probe the pattern speed in the context of real observational data of a barred spiral galaxy.
- Understanding the spatial variation of the pattern speed within the galaxy by employing various modifications to the original Tremaine-Weinberg method.

Estimating Galactic Magnetic Field using Mg-II absorbers and background Quasars — Aug. 2022 – Present
Supervisors: Prof. Suprit Singh, Department of Physics, IIT Delhi
        Dr. Sunil Malik, Institute of Physics and Astronomy, Universität Potsdam
- Mapping the Quasars from NVSS RM catalog of 37K quasars to those of 750K quasars from SDSS DR16.
- Probing the line of sight magnetic fields in high-redshift galaxies using excess extragalactic contribution to residual rotation measure (RRM) for quasar sightlines with and without intervening Mg II absorbers.
- Using RRM to explore the evolution of magnetic fields of galaxies over a redshift range of $0.38 \leq z \leq 2.3$.
- Radial profile of the RM leading to insights into the morphology of Galaxies and their halos.

Exploring the Neutral ISM using spectra of atomic Hydrogen — May 2022 – Aug. 2022
Supervisors: Prof. Peter G. Martin, Canadian Institute for Theoretical Astrophysics, Univ. of Toronto
        Dr. Antoine Marchal, Canadian Institute for Theoretical Astrophysics, Univ. of Toronto
- Analyzed the multiphase structure of an intermediate latitude HI field among the GHIGLS 21-cm line surveys using the ROHSA multi-Gaussian decomposition code.
- Analyzed the archival HI spectral data for assessment of the distribution of the gas among the thermal phases and their physical properties, and insights into the dynamical origin of the phase transition.
- Compared the results of gaussian decomposition to other tracers of the ISM, such as the thermal emission by dust grains seen by the Herschel and molecular gas traced by CO emissions, which provided insights into the evolution of the constituents of the ISM toward denser conditions.

Simulations of Quantum Key Distribution using BBM-92 Protocol May 2021 – Aug. 2021

Supervisor: Prof. Bhaskar Kanseri, Department of Physics, IIT Delhi

- Literature review of Quantum Key Distribution and error correction algorithms for QKD.
- Implementation of **post-processing algorithms** to develop software repository for QKD post-processing on github.
- Error correction of sifted keys using algorithms such as **Cascade, Winnow & LDPC**.
- Tested post-processing software against experimental data extracted from the implementation of BBM-92 protocol.

COMPETITIVE RESEARCH

International Theoretical Physics Olympiad — Rank 12 out of 150+ teams worldwide Jan. 2021

- Involved solving rigorous theoretical physics problems within a time constraint of 24 hours.

The University Physics Competition — Silver Medal (Rank 12 out of 244 teams worldwide) Nov. 2020

- Using Ion Thrusters to determine the most optimal trajectory for a satellite from Earth's LEO to Saturn's orbit.
- Co-authored "Ion Thrusters to Saturn" from calculations to analysis within a time constraint of 48 hours. Certificate.

TECHNICAL SKILLS

Computational Tools:

- Extensively used Python and it's scientific libraries for various astronomy and simulations based projects.
- Recently, I've started using Julia, due to it's fast performance compared to python in scientific research.
- Basic experience in using C++ and C# for computer graphics and simulations.
- Used symbolic computation from Wolfram Mathematica a lot for quick calculations.
- ROHSA multi-Gaussian decomposition code, an optimization tool for inverse problem solving.
- Versatile in using the OS environments of Windows, MacOS and Linux.

Other Tools: Github, Overleaf, LaTeX, Markdown, MS Office.

Languages: Hindi (*Native Speaker*), English (*C1-level Proficiency*).

TEACHING EXPERIENCE

Undergraduate Teaching Assistant | *PYL121: Mathematical Physics*. Fall 2022

- Only student in the department selected as an Undergraduate TA.
- Conducted weekly doubt sessions, Graded Answer scripts and Prepared Assignments.

Institute Academic Mentor | *PYL101: Electromagnetic Waves & Quantum Mechanics*. Fall 2020

- Conducted weekly doubt sessions for First-year students.

RELEVANT COURSEWORK

Graduate Astronomy: Stars*, Observational techniques in Astronomy*.

Graduate Physics: General Relativity & Cosmology, Field Theory & Quantum Electrodynamics, Quantum Information & Computation, Computational Optical Imaging, Non-Linear Dynamics and Chaos, Statistical Mechanics*.

Undergraduate Physics: Statistical Physics, Computational Physics, Particle Accelerators, Applied Quantum Mechanics, Electrodynamics, Classical Mechanics and Relativity, Optics and Photonics, Mathematical Physics, Solid State Physics.

Lab Courses: Semiconductor Physics Lab, Applied Optics Lab, Introductory Electrical Lab, Introductory Chemistry Lab.

* Ongoing Courses – Fall 2023

Outreach

Extragalactic Astronomy Talk: I presented my work on Magnetic field estimation using radio observations of background quasars in an event organized by "Physics and Astronomy Club" at IIT Delhi. Advertisement.

Science Communication: Produced educational videos on physics and science. Youtube Channel.

Former Collaborator, Gramoly: At Gramoly, I organized online boot-camps and a lecture-series on "Basics Of Tensors and Differential Geometry" for interested high school and college students, which can be found here.

Extra-Curriculars

Former Production Head, IITD OnAir: Designing and editing media for IITD OnAir.

Former Member, Robotics Club IITD: Used Arduino to design a Rugby playing robot for ABU Robocon 2020.

Youth Parliament Winner (Delhi Region): Won the 28th National Youth Parliament (Delhi Region) competition in 2015 with a team of 50+ students during Junior High School. Certificate.