

# KARTIK TIWARI

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## EDUCATION

- (Ongoing) Masters in Astrophysics | **University of Bonn (BCGS Scholarship)** (Bonn, Germany) 2025
- Postgraduate Diploma in Advanced Studies and Research: GPA 3.86/4.00 (*Magna cum Laude*) | **Ashoka University** 2023
- B.Sc. Physics (Hons) with Philosophy Minor: GPA 3.85/4.00 (*Magna cum Laude*) | **Ashoka University** (Delhi, India) 2022

## RESEARCH EXPERIENCE

### Masters Thesis with Large Scale Structure Group, University of Bonn

Advisor - **Prof. Cristiano Porciani**

Winter 2024 - Ongoing

- Developing methods to extract novel statistical information from relativistic distortions in large-scale structure (using **LIGER**)
- Refining a technique to measure our peculiar velocity by writing **scripts based on fast estimators on power-spectra multipoles**

### Summer Internship with Large Scale Structure Group, University of Bonn

Advisor - **Prof. Cristiano Porciani**

Summer 2023

- Replicated DESI's sampling pipeline to test the robustness of evolving dark energy claims under varying Bayesian priors
- Identified how quintessence compatibility in  $w_0w_a$ -parameter space can reduce tensions between DESI posterior and  $\Lambda$ CDM

### Center of Gravity Project, University of Bonn

Advisor(s) - **Prof. Dennis Lehmkuhl, Dr. Erik Curiel**

Winter 2023 - Ongoing

- Using Ehler's Frame Theory to compare the use of torsion and non-metricity across incompatible metric affine spacetime theories
- Assisting in archival organization to trace historical development of Petrov-Pirani-Penrose classification of vacuum spacetimes

### Department of Physics, Ashoka University [*Bachelors Thesis Research*]

Advisor - **Prof. Dipankar Bhattacharya**

Summer 2022 to Spring 2023

- Developed a **gravitational lensing and polarization transport program** to model pulse profile dependencies in neutron stars
- Extensions for radiative transfer calculations in Neutron Star atmospheres and including birefringence effects currently in progress

### Hands-on Numerical Relativity Project

Advisor - **Prof. Miguel Alcubierre**

Summer 20212

- Worked on a minimal NR code to simulate Schwarzschild spacetime by solving conformally decomposed ADM-York equations
- Studied canonical formulation of GR, gauge choices for foliating spacetime and advanced numerical techniques

### Indian Space Research Organization - Space Applications Center and IIT, Indore

Advisor - **Prof. Hari Hablani**

Summer 2020

- Developed simulations of Multipath Error for NavIC frequencies and compared against data collected by project collaborator
- Drafted majority of the research paper that yielded a publication and a Best Paper Award in at SpacSec International Conference

## PUBLICATIONS AND CONFERENCE TALKS

- Tiwari, K. (2025), **Spacetime Theories Beyond Curvature: Two Incompatible Approaches to Torsion Gravity**, Annual Meeting of German Physical Society, Bonn (Germany)
- Tiwari, K. (2024), **Lensing in White Hole Analogs**, Quantum Field Theory in Curved Spacetimes Workshop III, Lisbon (Portugal)
- Tiwari, K., Bhattacharya, D. (2024), **Modelling Polarization Pulse Profiles**, XVII Bonn Neutron Star Workshop, Max Planck Institute for Radio Astronomy, Bonn (Germany)
- Tiwari, K. (2024), **Godel, Penrose and Paraconsistency**, Annual Meeting of German Physical Society, Berlin (Germany)
- Tiwari, K., Althaf, A., Hablani, H. (2022) **Short-Delay Multipath Errors in NavIC Satellite Signals for a Stationary Receiver**, Communications in Computer and Information Science, Springer (ISSN: 1865-0929)
- Tiwari, K., Althaf, A., Hablani, H. (2021) **Short-Delay Multipath Error in NavIC Satellite Signals**, Conference Proceedings of IAF's 72nd International Astronautical Congress, Dubai (UAE)

## TECHNICAL PROFICIENCY

- **Languages:** Python, Julia, C/C++, MATLAB, Wolfram Language, HTML, CSS, JavaScript
- **HPC Tools and Libraries:** Bash, CUDA, MPI, OpenMP, enroot, Docker, git
- **Modelling Tools and Libraries:** LIGER, EinsteinToolkit, athena++, PLUTO, GADGET, MESA, TensorFlow Keras
- **Visualization Tools and Libraries:** SAOds9, VisIT, ParaView, HDF5, FITS

## SELECT PROJECTS AND REPORTS

- **Investigating the Influence of Priors on DESI's Evolving Dark Energy Claim (Poster)**, Advisor - Cristiano Porciani
- **On Neutron Star Pulsars and Polarization** (year-long capstone thesis), Advisor - Dipankar Bhattacharya
- Fishbone-Moncrief Simulation for EinsteinToolkit Gallery, Advisor - Roland Haas (performed during ICERM-NRCSS22 Hackathon)
- **comp-physics-tools: Repository of Scientific Computing Tools for Physics Problems** Advisors - N/A
- **A Learner's Map of Numerical Relativity**, (Published in *Ashoka Physics Journal* 2023)
- **White Hole Analogs in Circular Hydraulic Jumps** Advisor - Pramoda Kumar
- **Novel Framework for Consistency and Completeness Using Multiway Isomorphism** Advisor(s) - S. Wolfram, J. Boyd, N. Murzin
- **Quantum Mechanics on Python: Investigating Fun(ky) Phenomena** Advisor - Bikram Phookun

- [Motivating a Formalism for Phenomenologically Distinct Present](#) Advisor - Thomas 'Raja' Rosanhagen
- [Tolman-Ehrenfest Effect in Reissner-Nordström Geometries](#) Advisor - Vikram Vyas
- [Black-Hole Behavior in CMBR Bath: An Exploration using Thermodynamics](#) Advisor - Vikram Vyas
- [Least Squares Estimation through QR Factorization using Givens Rotation](#) Advisor - Hari Hablani

## ADDITIONAL RESEARCH INTERESTS

### Hydrodynamics Lab - Ashoka University

Advisor - [Prof. Pramoda Kumar](#)

Spring 2022

- Experimentally and analytically probed the relationship between gravity waves and Schwarzschild geometry in Hydraulic Jumps
- Analyzed the feasibility of measuring lensing effects in circular hydraulic jumps for analog geodesic computations

### Wolfram Physics Project

Advisor(s) - [Dr. Stephen Wolfram](#), [James Boyd](#)

Monsoon 2021

- Constructed a novel Completeness-Consistency framework for Axiom Systems using Subgraph Isomorphisms of Multiway Graphs
- Investigated correspondence between Gauge Choices in ADM formulation and foliation functions of Causal Graphs

### Shape Dynamics Research Collaboration

Advisor - [Dr. Julian Barbour](#)

Monsoon 2021

- Performed numerical experiments related to complexity, central configurations and best-matching in Shape Dynamical contexts
- Studied alternate symmetry choices for GR and Dirac's constraint algebra in geometrodynamical formulation of Shape Space

## TEACHING EXPERIENCE

- Teaching Assistant for [Prof. Norbert Langer](#), *Stars and Stellar Evolution* (University of Bonn, Spring 2025)
- Teaching Assistant for [Prof. Andrina Nicola](#), *Statistical Methods in Cosmology and Astrophysics* (University of Bonn, Winter 2024)
- Teaching Assistant for [Prof. Dipankar Bhattacharya](#), *Observing the Cosmos* (Ashoka University, Spring 2023)
- Teaching Assistant for [Prof. Sushmita Saha](#), *Lab 2: Classical Mechanics and Electromagnetism* (Ashoka University, Monsoon 2022)
- Teaching Assistant for [Prof. Somak Raychaudhury](#), *Measuring the Universe* (AshokaX, Summer 2022)
- Teaching Assistant for [Prof. Somak Raychaudhury](#), *Future of the Universe* (AshokaX, Winter 2021)

## HONORS AND AWARDS

- Bonn-Cologne Graduate Scholarship, University of Bonn 2023, to study astrophysics at Bonn-Cologne Graduate School
- First Prize, St. Stephen's College (Delhi University) 2023, Meera Memorial Paper Presentation Competition
- Academic Excellence Award, Ashoka University 2022, for 'excellence in Physics Major Programme'
- All-Round Philosophical Excellence, Department of Philosophy, Ashoka University 2022
- Featured Contributor, Research Project selected as a 'Staff Pick' by Wolfram Community
- Best Paper Award, *SpacSec International Conference on Cyber Warfare, Security and Space Research*, December 2021
- Dean's List (all semesters), Ashoka University, for 'a superior level of academic performance'
- 1974 Batch Outstanding Student Scholarship, St Paul School 2017, in recognition of exceptional leadership
- Gold Medalist, Aryabhat Astronomy Quiz, for years 2015, 2016 and 2017

## WINTER AND SUMMER SCHOOLS

- [CosmoVerse Workshop](#) (on Cosmic Tensions and Fundamental Physics), Naples, Italy, 2025
- [Searching for Quantum Gravity in the Sky](#), Physikzentrum, Bad Honnef, Germany, 2025
- Zwicky Transient Facility Summer School, [ZTF \(Caltech\)](#) and [University of Minnesota](#), 2023
- Magnetohydrodynamics and HPC Workshop, [Indian Institute of Science \(IISc\)](#), 2023
- Numerical Relativity Community Summer School, [ICERM](#), [Brown University](#), 2022
- Wolfram Winter School, [Wolfram Physics Project](#) Batch of 2022

## POSITIONS OF RESPONSIBILITIES

### Ashoka Research and Development Office

University Office

Student Research Coordinator

2022

- Responsible for effective collection and organization of all data on student research from Physics, Philosophy and CS departments
- Contributed towards the launch of Ashoka's first Research Magazine which showcased university's annual research output

### Ashoka Physics Society

Student Organization

President (interim Astronomy Head)

2020-2021

- Designed a 3-Day workshop on Integrated Space Mission Design and programmed interactive teaching aids on jupyter notebooks
- Envisioned and facilitated the creation of student led summer research groups on campus and 'Internship Diaries' program

## AFFILIATIONS

**Working Group Member** German Physical Society (2023-now)

**Student Member** Astronomical Society of India (2022-2023)

**Elected Student Representative** Physics Department, Ashoka University (2022-2023)

**Research Affiliate** Wolfram Physics Project, Wolfram Institute (2022-2023)