

# KARTIK TIWARI

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## EDUCATION

- (Ongoing) Doctor of Philosophy: Thesis 'On Asymptotic Symmetries of Spacetime' | **University of Bonn** (Bonn, Germany)
- (Ongoing) Visiting Doctoral Student: Philosophy of Physics | **University of Oxford** (Oxford, UK) Trinity Term 2026
- Masters in Astrophysics: Grade 1.4 (top-division, 'very good') | **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

**Doctoral Research Visit (Trinity Term 2026), University of Oxford**      **Advisors - Prof. Dennis Lehmkuhl, Prof. Samuel Fletcher**  
*Summer 2026 - Ongoing*

- Testing the cosmological de-idealizations of cornerstone results in GR established originally for asymptotically flat spacetimes
- Performing a joint historical-philosophical comparison of two mathematical frameworks for studying 'spacetime at infinity'

**Masters Thesis with Large Scale Structure Group, University of Bonn**      **Examiners - Prof. Cristiano Porciani, Prof. Peter Schneider**  
*Winter 2024 - Winter 2025*

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

**Center of Gravity Project, University of Bonn**      **Advisors - Prof. Dennis Lehmkuhl, Dr. Erik Curiel**  
*Winter 2023 - Winter 2025*

- Clarified the role that torsion and non-metricity plays in Metric Affine Gauge Theory and Geometric-Trinity formalisms
- Assisted in archival organization to trace historical development of Petrov-Pirani-Penrose classification of vacuum spacetimes

**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
- Demonstrated that imposing quintessence compatibility in the  $w_0 w_a$ -parameter space reduces tension between DESI and  $\Lambda$ CDM

**Department of Physics, Ashoka University [Bachelors Thesis Research]**      **Examiner - Prof. Dipankar Bhattacharya**  
*Summer 2022 to Summer 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

**Indian Space Research Organization - Space Applications Center and IIT, Indore**      **Advisor - Prof. Hari Hablani**  
*Summer 2020*

- Simulated interference errors for Indian navigation satellite cluster and compared against data collected by project collaborator
- Drafted majority of the research paper that yielded a publication and a Best Paper Award at SpacSec International Conference

## PUBLICATIONS AND CONFERENCE TALKS

- Tiwari, K., Nassar, M., Elkhatab, M. Y., Porciani, C., Bertacca, D. (in preparation), *Higher Order Multipoles of Finger-of-the-Observer Effect*, to appear in *Astronomy and Astrophysics*
- Tiwari, K. (in preparation), *Conflicting Perspectives on Geometrizing Spacetimes*, to appear in *Foundations of Physics*
- Tiwari, K. (2026), *From Cosmic Dipoles to the Cosmological Principle*, History and Philosophy of Cosmology, Athens (Greece)
- Trimarelli, C., Tiwari, K. (in preparation), *Data Analysis for Anomalous Threshold Reactions*, to appear in *Proceedings of Science*, from the workshop "Searching for Quantum Gravity in the Sky," Bad Honnef, 2025
- Tiwari, K. (2025), *Conflicting Perspectives on Geometrizing Spacetime*, Spacetime Matters Workshop, Utrecht (Netherlands)
- Tiwari, K. (2024), *Lensing in White Hole Analogs*, Quantum Field Theory in Curved Spacetimes Workshop III, Lisbon (Portugal)
- Tiwari, K., Bhattacharya, D. (2024), *Modeling Polarization Pulse Profiles* (based on **undergraduate thesis**), XVII Bonn Neutron Star Workshop, Max Planck Institute for Radio Astronomy, Bonn (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)

## ADDITIONAL PROJECT REPORTS

- **Investigating the Influence of Priors on DESI's Evolving Dark Energy Claim (Poster)** (2025), Advisor - Cristiano Porciani
- Fishbone-Moncrief Simulation for EinsteinToolkit Gallery (2023), Advisor - Roland Haas (performed during ICERM-NRCSS22 Hackathon)
- **comp-physics-tools: Repository of Scientific Computing Tools for Physics Problems** (2023), Advisors - N/A
- **A Learner's Map of Numerical Relativity**, (Published in *Ashoka Physics Journal* 2023)
- **White Hole Analogs in Circular Hydraulic Jumps** (2022), Advisor - Pramoda Kumar

## 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, Cobaya, EinsteinToolkit, athena++, PLUTO, GADGET, MESA, TensorFlow Keras
- **Visualization Tools and Libraries:** SAOds9, VisIT, ParaView, HDF5, FITS

## HONORS AND AWARDS

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- 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

## ADDITIONAL RESEARCH INTERESTS

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### Independent Numerical Relativity Project

Advisor - **Prof. Miguel Alcubierre**

Summer 2021

- 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

### Wolfram Physics Project

Advisors - **Dr. Stephen Wolfram, James Boyd**

Monsoon 2021

- Constructed a *Novel Framework for Consistency and Completeness Using Multiway Sub-graph Isomorphism* for Formal Systems
- 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

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- Primary Instructor, *Special Topics in Natural Philosophy* (University of Bonn, Summer 2026)
- Teaching Assistant for **Prof. Norbert Langer**, *Stars and Stellar Evolution* (University of Bonn, Summer 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)

## WINTER AND SUMMER SCHOOLS

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- *Theoretical Aspects of Astroparticle Physics, Cosmology and Gravitation*, Galileo Galilei Institute (INFN), Florence, Italy, 2026
- *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

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### 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
- Planned and facilitated the creation of student led summer research groups on campus and 'Internship Diaries' program

## AFFILIATIONS

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

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

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

**Elected Committee Member** Computational Physics Group, Institute of Physics, United Kingdom (2020-2021)