Ujjwal Kumar Upadhyay

Senior Research Fellow, Joint Astronomy Programme
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Research Profile

I am a PhD student working in the field of theoretical and statistical cosmology under the joint supervision of Dr. Tarun Deep Saini and Prof. Shiv K. Sethi at the Indian Institute of Science (IISc) Bangalore. My thesis is primarily focused on developing statistical methods for cosmological inference with particular emphasis on incorporating the effect of peculiar motion into the analysis. I am also interested in understanding cosmological tensions and their resolution within the framework of scalar-tensor theories of gravity/dark energy.

Education

2021 – Present — **PhD** [Candidate] **in Cosmology**
Indian Institute of Science, Bangalore, India
Thesis: *Investigating the impact of peculiar motion of galaxies on cosmological inference from SNIa data* (tentative)
Supervisors: Dr. Tarun Deep Saini & Prof. Shiv K. Sethi

2017 – 2019 — **MSc, Masters Degree in Physics**
Banaras Hindu University, Varanasi, India
Specialization: Spectroscopy
Thesis: *Phase Space Visualization of Quantum States*
Supervisor: Dr. Devendra Kumar Mishra

2014 – 2017 — **BSc, Bachelors Degree in Physics**
St. Xavier College, Ranchi, India
Subjects: Physics, Mathematics & Computer Science with `C/C++`

Publications

[1] Brijesh Kanodia, **Ujjwal Upadhyay**, Yashi Tiwari, *Revisiting Cosmic Distance Duality with Megamasers and DESI DR2: Model Independent Constraints on Early–Late Calibration*, [arXiv:2507.11518]

[2] **Ujjwal Upadhyay**, Tarun Deep Saini and Shiv K. Sethi, *Accounting for motion of supernova host galaxy in statistical inference from SNIa data*, [arXiv:2502.09258]

[3] Yashi Tiwari, **Ujjwal Upadhyay**, Rajeev Kumar Jain, *Exploring cosmological imprints of phantom crossing with dynamical dark energy in Horndeski gravity*, PhysRevD.111.043530, [arXiv:2412.00931]

Computational Experience

Boltzmann Codes: `class, hi_class`
Experience with Boltzmann codes to study scalar field models of dark matter and dark energy.

Statistical Codes: `Cobaya, Monte Python`
Skilled in Bayesian analysis of cosmological models, with experience in Cobaya and Monte Python codes for statistical inference.

High Performance Computing
Experience with high-performance computing clusters for MCMC analysis.

Statistics & Machine Learning
Bayesian Inference, Model Selection, Non-linear Regression with Errors-in-variables, Gaussian Process Regression, Symbolic Regression, Genetic Algorithm.

Programming Languages
Skilled in C/C++ and Python.

Operating Systems
Proficient in Linux, macOS, and Windows environments.

Other Software & Tools
Proficient in Mathematica, GetDist, and Latex.

Mentoring & Teaching Experience

Co-supervised, a first-year PhD student on a project titled 'Cosmological Parameter Estimation Using Bayesian Statistics and Markov Chain Monte Carlo Techniques', conducted as part of *Astronomical Techniques* course, from January - April, 2025.

Teaching Assistant, for the course 'General Relativity and Cosmology' with Dr. Sanved Kolekar, from January 2024 - April 2024 at IISc, Bangalore.

Teaching Assistant, for the course 'Fundamentals of Astrophysics' with Prof. Nirupam Roy, from August 2023 - December 2023 at IISc, Bangalore.

Academic Duties & Outreach

Referee Task
Referee for *Physical Review D*.

Organizational Tasks

2024 – Present : Organizer of the Cosmology Journal Club at IISc.
2024 – Student volunteer in 42^{nd} meeting of Astronomical Society of India, held at IISc.

IISc Open Day

2025 – Public talk on 'Decoding the Cosmos: How the Universe Evolves'.
2024 – Poster presentation on 'The Standard Model of Cosmology'.
2023 – Public talk on 'Multi-messenger Astronomy'.

Awards & Achievements

Best Teaching Assistant Award 2024 for the course Fundamentals of Astrophysics, Indian Institute of Science, Bangalore.

All India Rank 28 in the Graduate Aptitude Test for Engineering (GATE) for Physics, 2021.

All India Rank 48 in Council for Scientific and Industrial Research (CSIR) – Lectureship for Physics, 2021.

State Topper in the National Graduate Physics Examination (NGPE), 2017.

Conference and Seminars

[07/2025] – **Oral Presentation** in Cosmic Connections: Bridging the Early and Late Universe at the Institute of Mathematical Sciences, Chennai, India.

[06/2025] – **Oral Presentation** in Cosmology from Home 2025 (Online).

[04/2025] – **Poster Presentation** in Radiocoscon'2025 at the Internation Center for Theoretical Sciences, Bangalore, India.

[01/2025] – **Oral Presentation** in PDA Student Seminar at the Indian Institute of Science, Bangalore.

[12/2024] – **Oral Presentation** in the 2nd Neighbourhood Cosmology Meeting at the Indian Institute of Science, Bangalore.

[11/2024] – **Oral Presentation** in In-house Symposium at the Indian Institute of Science, Bangalore.

[11/2024] – **Poster Presentation** at Kashiwa-no-ha Dark Matter and Cosmology Symposium, Kavli IPMU, Tokyo, University.

[10/2024] – **Poster Presentation** at 27th International Conference on Particle Physics and Cosmology, COSMO'24, YITP, Kyoto University, Japan.

[08/2024] – **Poster Presentation** in Frontiers of Particle Physics Conference, Centre of High Energy Physics, IISc.

[04/2024] – **Oral Presentation** in In-house Symposium at the Raman Research Institute, Bangalore, India.

[02/2024] – **Poster presentation** in 42nd Annual Meeting of Astronomical Society of India (ASI), IISc, Bangalore.

[12/2023] – **Oral presentation** in 10th International Conference on Gravitation and Cos-

mology (ICGC) at Indian Institute of Technology (IIT), Guwahati, India.

[12/2023] – **Poster presentation** in 21-cm Cosmology Workshop at NISER, Bhubaneshwar, India.

[04/2023] – **Attended** a school on the Less Travelled Path to the Dark Universe, held at the International Center for Theoretical Sciences (ICTS), Bangalore, India.

References

Dr. Tarun Deep Saini
Assistant Professor, Department of Physics,
Indian Institute of Science, Bangalore, India.
Email: tarun@iisc.ac.in

Prof. Shiv K. Sethi
Professor, Astronomy & Astrophysics Group,
Raman Research Institute, Bangalore, India.
Email: shiv_sethi@yahoo.com

Prof. Rajeev Kumar Jain
Associate Professor, Department of Physics,
Indian Institute of Science, Bangalore, India.
Email: rkjain@iisc.ac.in

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