Manjunath Bestha

Doctoral Candidate • Astronomical Instrumentation & Transmission Spectroscopy

Bhaskara Hostel, Indian Institute of Astrophysics (IIA), Bengaluru, India

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Education

Ph.D. — Astronomical Instrumentation 2022 – Aug 2026
Indian Institute of Astrophysics, Bengaluru & Calcutta University, Kolkata, India
Supervisor: Prof. Sivarani Thirupathi
Thesis: *Exoplanet Transmission Spectroscopy: Instrumentation and Observations*

M.Tech. — Astronomical Instrumentation 2019 – 2021
Indian Institute of Astrophysics, Bengaluru & Calcutta University, Kolkata, India
Project: Design of atmospheric dispersion corrector for TMT-HROS

B.Tech. — Mechanical Engineering 2013 – 2017
Jawaharlal Nehru Technological University, Anantapur, Andhra Pradesh, India

Research Interests

My research focuses on ground-based low- and high-resolution transmission spectroscopy of exoplanet atmospheres, with an emphasis on correcting stellar and instrumental systematics in observational data. I am also interested in the design and simulation of astronomical instrumentation, including ray-tracing–based instrument design and fiber positioners for multi-object spectroscopy.

Research Experience

- **Exoplanet Transmission Spectroscopy:** My Ph.D. thesis work involves conducting exoplanet transmission spectroscopy using both echelle high-resolution spectrographs and slit/slitless low-resolution spectrographs. I have 40+ complete night observation and hands-on experience with data reduction and analysis for high and low-resolution transmission spectra, having developed pipelines for this purpose.
- **Opto-Mechanical Design:** Also, As part of Ph.D. and master's thesis, I have been involved in the end-to-end optical design and analysis of an atmospheric dispersion corrector and the mechanical conceptual design of a fiber positioning system. Additionally, I've contributed to developing collision avoidance algorithms for positioners and on site atmospheric diperion measurement at indin astronomical observatory.

Skills

- High- and low-resolution spectroscopic data reduction, and differential photometric and spectrophotometric analysis (Python, PyRAF)
- Exoplanet transit modeling, including Rossiter–McLaughlin and centre-to-limb variation (RM/CLV) effects
- Time-series analysis and noise modeling (Gaussian Processes, SYSREM)
- Optical design and analysis using Zemax, and interfacing Zemax with Python to simulate observational data
- Conceptual mechanical design using SolidWorks
- Version control and code management using Git

Awards, Honors & Academic Distinctions

- **Early Career Researcher Award** at *International Conference on Space for Sustainability: Science, Technology, Education, and Policy* (S^2-STEP 2025) alongside the *6th Indian Planetary Science Conference* (IPSC 2025), Indian Institute of Technology (IIT) Roorkee, India (March 2025).
- **Best Poster Award** at the Astronomical Society of India meeting on Sun, Solar System, Exoplanets & Astrobiology, National Institute of Technology (NIT) Rourkela, India (February 2025).
- **Early Career Researcher Award** at the *International Conference on Planets, Exoplanets, and Habitability* (ICPEH 2024), Physical Research Laboratory (PRL), Ahmedabad, India (February 2024).
- **Senior Research Fellowship, Junior Research Fellowship, and Master's Fellowship** in Astronomical Instrumentation, awarded by the Indian Institute of Astrophysics (IIA) and Calcutta University (2019, 2021, 2023).
- **AMP-UP Program (Mentee)** — selected for the AMP-UP mentoring program and mentored by Dr. Sarah E. Moran.
- **Astro AI Program** — Center for Astrophysics | Harvard & Smithsonian; awarded conference registration fee and accommodation support (2024).
- **SPIE Student Conference Support** in Astronomical Instrumentation, Optics, and Photonics (2022, 2023, and 2025).
- **National-Level Qualifications**: CSIR-NET (Physical Sciences, 2018) and GATE (Physics, 2019).
- **Merit-Based Entrance Examinations**: COMED-K (2013) and AP-EAMCET (2013).
- **Rural Development Trust Scholarship Test (RDTST)** — awarded a six-year tuition and hostel fee waiver covering intermediate (10+2) and B.Tech education (2011–2017).

Observing Experience

- 20+ nights — Hanle Faint Object Spectrograph and Camera (HFOSC, HCT, Ladakh)
- 15+ nights — Hanle Echelle Spectrograph (HESP, HCT, Ladakh)
- 8+ nights — Vainu Bappu Observatory (Echelle and OMR)
- Distributed peer-reviewed 30+ VLT and Gemini proposals

List of Publications

1. **A New Broadband Atmospheric Dispersion Corrector for HROS-TMT**
   Manjunath Bestha., Sivarani, T., Wehbe, B., Hasan, A., Chandra, B. P., Divakar, D. K., Unni, A., Menon, P., Surya, A., Saraf, P.
   RASTI (2025) — https://academic.oup.com/rasti/article/doi/10.1093/rasti/rzaf057/8327618

2. **An Initial Assessment of the Hanle Echelle Spectrograph for Exoplanet Atmosphere Studies**
   Manjunath Bestha., Unni, A., Sivarani, T., Menon, S., Parvathy, M., Surya, A., Saraf, P., Divakar, D., Manickavasaham, L.
   SPIE (2025) — https://doi.org/10.1117/12.3064331

3. **A Multi-Object Approach for Studying Exoplanet Atmospheres Using High-Resolution Spectrographs**
   Manjunath Bestha., Athira Unni, T. Sivarani, Dhanush S. R., Lokesh Manickavasaham, Parvathy M., Devika K. Divakar, Arun Surya
   SPIE (2025) — https://doi.org/10.1117/12.3064406

4. **Atmospheric Dispersion Measurement at Hanle Site**
   Manjunath Bestha., Sivarani, T., Unni, A., Parvathy, M., Divakar, D.
   SPRINGER (2025) — https://doi.org/10.48550/arXiv.2509.17300

5. **A Multi-Functional Fiber Positioning System for Extremely Large Telescopes**
   Manjunath Bestha., Sivarani, T., Surya, A., Yadav, S., Unni, A., Parvathy, M., Divakar, D., Sriram, S., Prakash, A., Hasan, A.
   SPIE (2024) — https://doi.org/10.1117/12.3019098

6. **Atmospheric Dispersion Corrector for a Multi-Object Spectroscopic Mode of HROS-TMT**
   Manjunath Bestha., Hasan, A., Divakar, D., Surya, A., Sivarani, T., Sriram, S., Prakash, A., Parvathy, M., Yadav, S.
   SPIE (2023) — https://doi.org/10.1117/12.2677192

7. **An Observational Study of Systematics Affecting Low-Resolution Multi-Object Transmission Spectroscopy**
   Manjunath Bestha., Unni, A., Sivarani, T., Surya, A., Parvathy, M., Divakar, D.
   (Manuscript in preparation)

8. **Probing the Atmosphere of KELT-9 b with High-Resolution Spectroscopy from a 2-m Himalayan Chandra Telescope**
   Manjunath Bestha., Unni, A., Sivarani, T., Surya, A., Parvathy, M., Divakar, D.
   (Manuscript in preparation)

9. **Addressing Wavelength-Correlated Systematics in Exoplanet Transmission Spectroscopy: A 2D Gaussian Process Approach**
   Manickavasaham, L., **Manjunath Bestha.**, Sivarani, T., Surya, A., Unni, A.
   arXiv:2510.20423 — `https://doi.org/10.48550/arXiv.2510.20423`

10. **High-Resolution Echelle Spectroscopy for Solar System Planets: A Planet-as-Point-Source Analogy**
    Parvathy Menon, Sivarani T., Sriram S.,**Manjunath Bestha.**, Devika K. Divakar, S. P. Rajaguru, Arun Surya
    arXiv:2510.20559 — `https://doi.org/10.48550/arXiv.2510.20559`

11. **Doppler Shifted Transient Sodium Detection by KECK/HIRES**
    Unni, A., Oza, A. V., Hoeijmakers, H. J., Seidel, J. V., Sivarani, T., Schmidt, C. A., Kesseli, A. Y., de Kleer, K., Baker, A. D., Gebek, A., Meyer zu Westram, M., Fisher, C., Sallum, S., **Manjunath Bestha.**, Bello-Arufe, A.
    arXiv:2504.03974 — `https://doi.org/10.48550/arXiv.2504.03974`

12. **Slitless Spectroscopy Simulations of Milky Way Dwarf Satellite Galaxies Using TMT-WFOS**
    Devika K. Divakar, Thirupathi Sivarani, Ramya Sethuram, Jason Fucik, Chuck Steidel, **Manjunath Bestha.**, Prasanna Deshmukh
    Proc. SPIE 13099, Ground-based and Airborne Instrumentation for Astronomy XI, 130992C (2024) — `https://doi.org/10.1117/12.3019070`

Conference Presentations

- Presented a poster titled “Atmospheric Dispersion Measurement at Hanle Site” at STEP & IPSC 2025, IIT, Roorke, India| Mar 2025
- Presented a poster titled “Simulation of Multi-Object High Resolution Transmission Spectroscopy” at ASI 2025, NIT, Rourkela, India| Feb 2025
- "A Multi-functional Fiber Positioning System for Extremely Large Telescopes" — a poster of my work — was presented by the co-author at the SPIE Astronomical Instrumentation Conference, held in Yokohama, Japan| June 2024.
- Virtually presented a talk titled “Slit and Slitless Low-Resolution Transmission Spectroscopy using 2m Himalayan Chandra Telescope” at 30th Young Scientists Conference, Kyiv, Ukraine| Apr 2024

- Presented a poster titled “Transmission spectroscopy using 2m Himalayan Chandra Telescope” at International Conference on Planets, Exoplanets and Habitability, PRL, Ahmadabad, India| Feb 2024
- Presented a talk titled “High and low-resolution transmission spectroscopy using 2m Himalayan Chandra Telescope” at the 42nd meeting of the Astronomical Society of India, IISc, Bengaluru, India| Jan 2024
- Presented a talk titled “Opto-mechanical design of multi-object spectroscopic mode of high-resolution spectrograph of the thirty-meter telescope” at the Modern Engineering Trends In Astronomy, RRI, Bengaluru| Nov 2023 /
- Presented a poster titled “Feasibility of transmission spectroscopy using Hanle echelle spectrograph” at the STRANGE NEW WORLDS: The Exploration of Exoplanets Conference, IISER, Pune, India| Aug 2023
- "Atmospheric Dispersion Corrector for a Multi-object Spectroscopic Mode of HROS-TMT" — a poster of my work — was presented by the co-author at the SPIE Optics and Photonics Conference, held in Santiago, USA, in July 2023.
- Presented a poster titled “Optical design of atmospheric dispersion corrector for TMT-HROS” at the 41st meeting of the Astronomical Society of India, IIT, Indore, India| Mar 2023
- Presented a poster titled “Optical design of atmospheric dispersion corrector for TMT-HROS” at the Indo-French CEFIPRA Astronomy Meeting (IFCAM)-III, IIA, Bengaluru, India| Jan 2023

Workshops

- Remotely participated in the Sagan Exoplanet Summer Hybrid Workshop Characterizing Exoplanet Atmospheres: The Next Twenty Years | July 2024
- Remotely attended the Two-HORSes conference organized by Maxplank Institute, Germany | July 2024
- Remotely participated in the AstroAI workshop organized by Harvard University, USA | June 2024
- Participated in the workshop “ UV-Optical-IR Astronomy in India: Prospects of the next decade” during the 42nd meeting of the Astronomical Society of India (ASI), Indian Institute of Science (IISC), Bangalore, India | February 2024
- Participated in the workshop “Machine Learning in Astronomy” during the 41st meeting of the Astronomical Society of India (ASI), Indian Institute of Technology (IIT), Indore, India | March 2023
- Remotely participated in the Sagan Exoplanet Summer Hybrid Workshop Characterizing Exoplanet Atmospheres: The Next Twenty Years | July 2023

- Participated in the workshop "Exoplanets: A Short Course on Planets Orbiting Stars Other Than the Sun" organized by the Pune Knowledge Cluster (PKC), India | February 2023

Internships

- Kodaikanal Solar Observatory, Kodaikanal, Tamil Nadu — Jan 2022
- Vainu Bappu Observatory, Kavalur, Tamil Nadu — Aug 2021
- Remotely Attended Optics Lab, Indian Institute of Astrophysics, Karnataka — Sep 2020
- Diesel Loco Shed, Indian Railways, Guntakal, Andhra Pradesh — Feb 2017

Outreach Activities

- Actively participated in the IIA Job Shadowing Program and served as a mentor to three students (by Jan 2026).
- Served as a co-mentor to three internship students (by Jan 2026).
- Served as a mentor at the AISA camp school in the Hebbal community (2021).
- Served as the Student Representative of Bhaskara (a hostel for 60 PhD students) for nine months (July 2024 – March 2025).
- Participated in comet observations as part of IIA's public outreach programs.
- Served as a student representative for SCOPE–IIA (Outreach) and represented IIA at the India International Science Festival, Goa (2021), and the International Cultural Jamboree, Mudbidri (2022).
- Contributed articles to IIA's *Doot* magazine and *EdurVed* magazine.