

Bhavesh Rajpoot

Curriculum Vitae

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Education

M.Sc. in Physics (Astrophysics) **03/2022 - Present**
Universität Heidelberg, Heidelberg, Germany

- GPA: 1.6/1.0 (current) • Credits: 106/120 ECTS
- Thesis: *Spatially resolving star-formation in galaxies at Cosmic Noon with JWST NIRISS*
- Advisers: Dr. Leindert Boogaard & Dr. Fabian Walter

B.Sc. in Physics **07/2017 - 11/2020**

Fergusson College (Autonomous), Pune, Maharashtra, India
Affiliated to Savitribai Phule Pune University, India

- Major: Physics • Minors: Mathematics, Chemistry
- CGPA: (i) 8.29/10.0 (Overall) (ii) 9.38/10.0 (Major - Final Year)
- Thesis: *Effects of Coronal Mass Ejections on Earth's Thermosphere*
- Advisers: Dr. Raka V. Dabhade, Dr. Pratibha B. Mane

Research

Major Projects:

Experience

Max Planck Institute for Astronomy, Heidelberg, Germany

- **Spatially resolving star-formation in galaxies at Cosmic Noon with JWST NIRISS** **05/2023 - Present**

Master Thesis Student, Advisers: Dr. Leindert Boogaard & Dr. Fabian Walter

- Making spatially resolved H α and H β maps from JWST's NIRISS slitless spectroscopy data on Hubble Ultra Deep Field acquired from the MIRI GTO Program and the NGDEEP survey using Grizli python package.
- Using these maps to trace the inside-out growth, redshift evolution in the stellar mass surface density and dust attenuation in star-forming galaxies at $0.5 \leq z \leq 2.5$ and comparing these results with previous studies done using HST and the TNG-50 cosmological simulations.
- *Results are planned to be published by the end of the project in July 2024.*

- **Testing the Flat-field Calibration Unit for ELT's MICADO in Near-IR** **08/2022 - 08/2023**

Research Assistant, Advisers: Dr. Robert J. Harris & Dr. Jörg-Uwe Pott

- Evaluated the prototype design of the Flat-field and wavelength Calibration Unit (FCU) for ELT's Multi-AO Imaging Camera for Deep Observations (MICADO) in JHK bands for criterion required for calibrations. Gained extensive experience in operating two scientific-grade Near-IR cameras and other instruments to test the FCU.
- Simulated Global Uniformity pattern for various designs, configurations, and failure modes, comparing them with test results to constrain defects and factors impacting calibration quality.
- Summarised results in a detailed technical report for the MICADO team and, based on the test results, prepared a testing plan for the final FCU hardware. The results, along with key challenges faced during testing, were presented in the NYRIA workshop 2023 and will be presented at the SPIE meeting 2024.

Villanova University, Villanova, United States

- **Bayesian Analysis of Eclipsing Binaries using PHOEBE** 09/2020 - 10/2021
Undergraduate Research Assistant, Adviser: Dr. Kyle E. Conroy
 - Tested inverse problem solver suite of the *PHOEBE* eclipsing binary (EB) code with photometric time-series data from Kepler and TESS and compared its efficiency and accuracy to reproduce the published results done previously using other model fitting codes such as *jktebop*, *ellc*.
 - Tested the then in-development features of the code and provided feedback on model caveats through statistical analysis of discrepancies in the fitted parameters given by various physical models such as *ellc*, *jktebop*, & *PHOEBE* to help in the development of the solver suite. Gained extensive experience in Python programming, model optimization and Bayesian sampling.
 - Gave talks on the project and later mentored a small group of students during *Krittika Summer Projects 2.0* to use PHOEBE and solve inverse problems.

Minor Projects:

- **Königstuhl Observatory Opto-mechatronics Laboratory (KOOL)** 05/2023 - Present
Research Assistant, Advisers: Pascal Jaufmann, MSc & Dr. Jörg-Uwe Pott
Max Planck Institute for Astronomy, Heidelberg & Universität Stuttgart, Stuttgart, Germany
- **Leveraging Physics-Informed Machine Learning to estimate memberships of Open Clusters** 11/2022 - 02/2023
Research Assistant, Adviser: Apl. Prof. Andreas Just
University of Heidelberg, Heidelberg, Germany
- **Modernization of the 70cm telescope at LSW** 08/2022 - 09/2023
Research Assistant, Advisers: Prof. Jochen Heidt & Dr. Julian Stürmer
University of Heidelberg, Heidelberg, Germany
- **Morphological Analysis of CEERS' MIRI pointings in comparison to 3D-HST's AEGIS field** 08/2022 - 05/2023
Research Assistant, Advisers: Dr. Leindert Boogaard & Dr. Fabian Walter
Max Planck Institute for Astronomy, Heidelberg, Germany

Teaching

- Experience** *Tutor*, MVAstro1.2: Astro-Lab I & II 09/2022 - 03/2024
Königstuhl State Observatory (LSW), Universität Heidelberg, Heidelberg, Germany
- Taught MSc and PhD students how to operate a 0.7m class telescope for taking astronomical observations during the Astro-Lab. Student count: 100+. Time commitment: 20hrs/week.
- Teaching Assistant* 12/2020 - 03/2021
Curiosity Space India, Pune, India
- Taught introductory astronomy courses to high school students. Student count: 80. Time commitment: 30hrs/week.

Work

- Experience** *Student Assistant* 03/2022 - 03/2023
House of Astronomy, Max Plank Institute for Astronomy, Heidelberg, Germany
4 hrs/week
- Assistant to 4 public outreach projects with the task of media collection for the *glossary*, creating a member video for the IAU meeting, serving as a reviewer for the IAU Astrophotography competition and compiling lecture notes into a book.

Support Astronomer

10/2021 - 01/2022

Varahmihir Astronomical Observatory, MPCST, Ujjain, M.P., India

40 hrs/week

- Renovated a 0.5m class telescope system and upgraded it with remote observing functionality. Performed monthly site and instrument characterisation studies, variable star studies and assisted guest observers with observations and technical assistance.

Summer Intern

05/2019 – 08/2019

Science Popularisation Centre of IUCAA, Pune, Maharashtra, India

40hrs/week

- Taught high-school level astronomy to 15 summer school students and also compiled various DIY experiments related to the Moon for the IAU's 100th-anniversary celebration.

Skills

Technical:

- **Languages:** Python (functional and object-oriented), L^AT_EX, Bash
- **Scientific Python:** NumPy, AstroPy, SciPy, Photutils, PyMC3, Scikit-Learn, PyTorch
- **Data Management:** Pandas, Topcat, Microsoft Excel, ADQL/SQL, Plotly, Matplotlib
- **Software Engineering Skills:** Versioning (Git), Debugging, Code profiling and refactoring, Pipeline automation, GPU-based Parallelisation, Code publishing
- **Astronomical Data Analysis:** Data reduction (JWST pipeline), Aperture photometry, Light and radial velocity curve retrieval, MCMC fitting and Gaussian Process regression, Neural Networks and Random Forests classification

Observations:

- Observing on sub-1m telescopes: 25 nights on LSW's 70cm, 28 nights on Varahmihir Astronomical Observatory's 70cm telescope
- **Softwares:** MaxIm DL 5 Pro Suite, Cartes du Ciel, The SkyX Pro Observatory Control, TPoint Pointing analysis, CCDSoft, SAOImage DS9, IRAF

Awards & Scholarships

- *Tuition Fee Waiver based on Special Talent* (€ 6k) **04/2022**
Universität Heidelberg, Germany
- *Honorary Fellowship* **11/2021**
Varahmihir Astronomical Observatory, MPCST, Bhopal, IN
- *All India Rank 3 out of 3000* **11/2020**
National Entrance Exam for M.Sc. Physics, Savitribai Phule Pune University, Pune, IN
- *Top 30 Under 30 Young Achievers* **06/2019**
Astronomy Influencer, *Hindustan Times: 2nd Anniversary Issue*, Pune, IN
- *International Ambassador Award for Excellent Encouragement* **06/2019**
International Astronomy and Astrophysics Competition, Pune, IN

Astronomy Schools & Workshop Attended

NYRIA Workshop

13 - 17/11/2023

Laboratoire d'Astrophysique de Marseille, Marseille, France

- Presented a talk on the results of the "Testing the FCU for ELT's MICADO in NIR" project.

IMPRS Summer School on Galaxy Evolution with JWST

4 - 8/09/2023

Max Planck Institut für Astronomie, Heidelberg, Germany

- Gained hands-on experience in reducing and analysing photometric and spectroscopic data of galaxies spanning from the local to the high-z universe from various JWST instruments.

- ESO ORP Instrumentation School** on IFU Spectroscopy **17 - 26/05/2023**
 INAF-Osservatorio Astronomico di Brera, Merate, Milan, Italy
- Did a Phase A study, with a group of 5 participants, on designing an integral field unit spectroscope with a science case of dedicated studies on globular clusters, including the ability to find intermediate-mass black holes in their centres.
- Astro Hack Week workshop** **17 - 21/10/2022**
 Max Planck Institut für Astronomie, Heidelberg, Germany
- Worked on comparing various density laws for open clusters as the hack project in a group of 5 participants, [be-open repo](#).
- Code/Astro Workshop** **21 - 25/06/2021**
 California Institute of Technology, Pasadena, United States - (remote)
- Gained hands-on experience with software engineering and developed TCalc: Telescope Calculator python package. Zenodo. <http://doi.org/10.5281/zenodo.5035311>
- Scientific Computing in Astronomy** **17/04/2020 - 03/05/2020**
 Indian Institute of Technology, Bombay, India - (remote)
- Daily tutorials on major topics along with astrophysics-oriented assignments.
 - Served as a pre-selection round for the *Binaries: Study and Analysis* project.
- Radio Astronomy Winter School** **14 - 24/12/2018**
 National Centre for Radio Astrophysics - TIFR, and
 Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune, India
- Operated 3m & 4m class radio telescopes along with the Spectracyber module to observe galactic HI emission-line sources for estimating their brightness temperature and redshift.

Talks & Posters

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- Illumination Tests of MICADO FCU **14/11/2023**
NYRIA Workshop, Laboratoire d'Astrophysique de Marseille, Marseille, FR
- Astro Podcast: Exploring the Universe **08/10/2021 - 16/12/2021**
Knowform LLP, Pune, IN
- Pursuing Astronomy and Astrophysics in India **25/04/2021**
Vedantu Olympiad School | Vedantu, IN
- The Physics of Eclipsing Binaries **24/09/2020**
Equinox Astrophysics Program, Naxxatra Club, Bengaluru, IN
- Introduction to Observational Astronomy & Astrophysics **21/09/2020**
Equinox Astrophysics Program, Naxxatra Club, Bengaluru, IN
- Eclipsing Binaries: Our Winking Buddies **03/08/2020**
Science Club, College of Engineering, Pune, IN
- Effects of Coronal Mass Ejections on Earth's Thermosphere **12/06/2020**
Astro Club, Fergusson College, Pune, IN
- Effects of Coronal Mass Ejections on Earth's Thermosphere [Poster] **01/2021**
*National E-Symposium on "Cloud and Precipitation Processes"
 Indian Institute of Tropical Meteorology, Pune, IN*

Outreach &

Volunteering **Krittika Astronomy Club, Indian Institute of Technology, Bombay, IN - (Remote)**

- Mentor* **07/2021 - 10/2021**
- Mentored the "Eclipsing Binaries" group at the Krittika Summer Projects 2.0.
 - Responsible for exposing and guiding mentees to learn the physics of eclipsing binaries and

to analyze the time-dependent variation in the photometric data from TESS to estimate the absolute parameters of component stars using dedicated physical eclipsing binaries models and Bayesian techniques.

Astro Club, Fergusson College, Pune, IN

Peer Advisor

06/2019 - 06/2020

- Advised junior students with elective selection, project hunting, career guidance, CV and statement of purpose drafting.

Coordinator & Organiser

08/2018 - 03/2020

- Organized sessions on observational astronomy, star parties and meteor shower observations, & communal solar eclipse watching.
- Organized and coordinated Frontiers in Physics XII - XIII, a 2/3-day National Student Seminar Series aimed to provide research exposure to undergraduate students.

Founder, Public Outreach Department

07/2018 - 12/2019

- Organised guest lectures of various researchers in astrophysics and established a website, social media accounts and brand logo for the club.

Volunteer

07/2017 - 07/2019

- Gave talks on 'Basics of Observational Astronomy' [10/12/2019] and 'Introduction to Asteroid Hunting' [06/07/2019].
- Designed and presented posters on the topic 'Our Future in the Universe' at club's 2018 Annual Poster Exhibition, 'Unravelling the Cosmos'. [09/2018]
- Volunteered for National Science Day celebrations at IUCAA, Pune, India and presented exhibits to an average of +8k people, at 0:18 min. [02/2019 & 02/2018]
- Renovated a vintage 90mm Refractor telescope with equatorial pier mount.

Others

- Languages: English (Fluent); Hindi and Punjabi (Native)
- Hobbies: Cooking & Baking, Astrophotography, Trekking, Cycling, Badminton