ADVIK GUPTA

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EDUCATION

Indian Institute of Technology (BHU), Varanasi *Dec 2021 – Present*
B.Tech + M.Tech in Engineering Physics ***9.49/10***
(Honors in Astrophysics) *Dept. Rank 1*

RESEARCH INTERNSHIPS

Quantifying Selection Effects in Galactic Surveys *May 2024 - Aug 2024*
Supervisor: Prof. Luca Casagrande, Research School of Astronomy & Astrophysics, ANU, Australia [ ]

- Developed a code to calculate the probability of observing a star given its age, distance, and metallicity.
- Simulated the Milky Way galaxy using the `GALAXIA` code. Subsequently, sampled stellar populations in terms of age, [Fe/H] and distance.
- Using sampled distributions and probability calculation code, we simulate the synthetic PDF for age and [Fe/H], effectively modeling a section of the sky as observed in surveys. Currently, the code is optimized for *GALAH* and *GAIA* surveys.
- I developed this framework into a computational pipeline named `OPACOS` (available on my GitHub).

Degenerate RGB Stars as Probes for Constraining Core Overshoot During Main Sequence *May 2025 – Jul 2025*
Supervisor: Prof. Sébastien Deheuvels, IRAP (Institut de Recherche en Astrophysique et Planétologie), Toulouse, France (Remote)

- Identified a degenerate RBG branch for the *Kepler* field.
- Tested the input physics and the initial parameter to model the branch using MESA.
- Conducted simulations with `MESA` to reproduce the observed degenerate branch by modeling the *Kepler* Synthetic data and the observed degenerate branch, using varying step overshoots.
- Constrained the core overshooting parameter $\alpha_{\rm OV}$ to lie between 0.15 and 0.2 for red giants of mass 1.6–1.8 $M_\odot$ using asteroseismic modeling.

PROJECTS

Measuring Helium Abundance in Subgiant Stars using Asteroseismology *May 2023 - Dec 2024*
Honors Project under Prof. Kuldeep Verma, Department of Physics, IIT (BHU), India

- Developed a comprehensive theoretical understanding of the pressure-, gravity- and mixed-mode pulsations of stars, along with acoustic glitches and their signatures in the oscillation frequencies.
- Using glitches, we extract information about stellar interiors, also constrain helium abundance in main-sequence and subgiant stars. It is done using the GlitchPy and BASTA packages.
- Utilized latest oscillation frequencies from the Hertzsprung SONG Telescope to model G5 Subgiant μ Herculis. Performed glitch analysis on the oscillation frequencies.
- Modeled G5 Subgiant μ Herculis using GARSTEC (Stellar evolution code) and BASTA (Bayesian Fitting Tool), achieving more accurate inferred parameters compared to prior studies on the target subgiant.

Implementation of Epsilon Difference Calculation in *PLATO* MSAP5-16 *Feb 2025 - Present*
Project under Prof. Kuldeep Verma, Department of Physics, IIT (BHU), India

- I verified the compatibility of the Epsilon differences calculation code of `BASTA` with the `GlitchPy` code which calculate glitches and ratios.
- I modified the `GlitchPy` code to include the calculation of Epsilon differences.
- Following the code architecture of the initial version of MSAP-16 sub-module, I reduced the GlitchPy code to the current MSAP-16 sub-module.
- The code is now ready to be deployed and is with the *PLATO* team now.

Conferences & Posters

Detailed asteroseismic modeling and precise inferences of the physical properties of the benchmark subgiant μ Herculis *Feb 2025*
43rd Annual Meeting of the Astronomical Society of India (ASI)

Glitch analysis and asteroseismic modeling of subgiant μ Herculis: confirming and interpreting the Γ_1 peak as the helium glitch *Jul 2025*
9th TESS/16th Kepler Asteroseismic Science Consortium Workshop (Virtual Participation)

Skills

- **Language:** Python, C, IDL, MATLAB
- **Computational Tools:** `MESA`, `BASTA`, `GARSTEC`, `GALAXIA`, `ALextin`, `batman`, `GlitchPy`
- **Soft Skills:** Critical thinking, Problem Solving, Teamwork, Content Writing

Achievements & Honors

- Cleared the first round of the NSSC Case Study which is an astronomy based competition event organized by IIT Kharagpur.
- Secured a rank among the top 0.25 % of 1 million plus students in Joint Entrance examination (JEE) .
- **ANU FRT scholar:** Recipient of the 2024 ANU Future Research Talent (FRT) Award and scholarship to carry out research in the summer of 2024.
- **DAAD-WISE scholar:** Awarded by the German Academic Exchange Service (DAAD) to carry out research in Germany in the summer of 2024.

Relevant Coursework

- Solar and Space Plasma Physics
- Mathematical Methods
- Practices of Engineering Physics
- Fourier Optics
- Magnetohydrodynamics
- Introduction to Astronomy & Astrophysics
- Computational Physics
- Relativistic Electrodynamics
- Classical Mechanics
- Simulation Methods in Statistical Physics

Position of Responsibility

Co-Convenor *April 2024*
Yuri's Night, Astronomy Club, IIT (BHU) Varanasi
- Conducted the Astronomy Festival at IIT BHU, featuring multiple astronomy-based events and hackathons.
- Managed and hosted workshops and guest talks, inviting renowned scientists.

Senior Core Team Member *July 2023 - Present*
Research Community, IIT (BHU) Varanasi
- Made research opportunity information available and assisted other students in their research path.
- To provide support and aid in the coordination and seamless execution of club events, including activities such as guest lectures and more.

Senior Core Team Member *Sept. 2022 - Present*
Astronomy Club, IIT (BHU) Varanasi
- Wrote many posts about latest events in astronomy and space science exploration, also about astronomical events.
- Assisted and managed different events of our club like induction, observatory session.

Extracurricular

- Competed with my band as a drummer at Inter IIT cultural meet 2023 hosted by IIT Kharagpur.
- **Rock School London**: Successfully completed and passed the formal graded assessment for Drums, achieving qualification up to grade 3 through the Rock School London (RSL) examinations. Additionally, obtained a Level 1 Award in Popular Music Performance.
- **OKINWAN SHORIN-RYUKARATE DO INTERNATIONAL:** Association of Middle East & South Asia – Approved by All India Karate Federation, World Karate Federation, Recognized by Govt of India, Department of Youth Affairs $ Sports, Indian Olympic Association Awarded Green Belt in Karate.