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RNDr. Ján Rybák, CSc.

Astronomical Institute of the Slovak Academy of Sciences

Tatranská Lomnica, 059 60 Vysoké Tatry, Slovakia

Respected Dr. Rybák,

I am writing to express my enthusiastic interest in the PhD position focused on the "Cycle of Solar Activity – Empirical Implications for the Solar Dynamo Modelling" at the Astronomical Institute of the Slovak Academy of Sciences. With a strong academic background in astrophysics, extensive research experience in analyzing astronomical datasets, and proficiency in programming and data analysis, I am eager to contribute to your research on the temporal evolution and hemispheric asymmetry of solar activity.

My academic journey has equipped me with a foundation in solar and astrophysical phenomena. I hold a Bachelor's degree in Science from Rajaram College, Kolhapur (CGPA: 8.0), where my thesis involved a comprehensive analysis of the supernova remnant CAS-A using SAOImage DS9, focusing on spectroscopic analysis and expansion rates. Further, at the Institute of Science, Mumbai (CGPA: 9.1), my thesis on AGN detection in the NGC 4725 galaxy utilized multi-wavelength analysis, improving my skills in handling complex astronomical datasets. These experiences have equipped me to undertake the analysis of long-term solar activity observations, including sunspots, photospheric magnetic fields, prominences, and green corona data, as outlined in your research focus.

My research experience aligns closely with the objectives of this position. As a Summer Research Student at the Green Bank Observatory (2023), I analyzed variations in the spin period of the pulsar PSR J0437-4715 using the ATNF Catalog, developing expertise in time-series analysis and periodicity detection—skills directly applicable to investigating periodicities in solar activity cycles. Additionally, my ongoing project on exoplanet candidate characterization using TESS data (2024–present) has strengthened my ability to process large datasets and apply statistical and machine learning techniques to uncover temporal patterns, which will be valuable for studying the time-latitude asymmetry of solar activity.

I bring advanced programming skills in Python, with proficiency in machine learning, deep learning, and digital image processing, as demonstrated in my upcoming publication, "Pulsar Detection from Imbalanced Datasets Using Hybrid 3-layer Model Without Artificial Class Balancing" (under review, *Astronomy and Computing*, 2025). These skills will support the numerical modeling of the solar dynamo and the analysis of extensive solar datasets. My familiarity with tools like TensorFlow and NumPy, combined with my experience in handling astronomical data, positions me to effectively contribute to your team's empirical and computational efforts.

My international research exposure, including a stint at the Instituto de Astrofísica e Ciências do Espaço in Portugal (2022) for the MOSFIRE Deep Evolution Field Survey, has fostered my ability to collaborate across diverse teams and adapt to new research environments. Furthermore, my participation in conferences such as the ASI Symposium (2024) and the PyHEP Workshop (2022) has kept me updated of cutting-edge methods in astrophysical data analysis, which I am eager to apply to your project.

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I am particularly drawn to this opportunity because of its focus on empirical implications for solar dynamo modeling, an area where my analytical skills and passion for understanding stellar processes converge. I am confident that my technical expertise, research experience, and dedication to advancing astrophysical knowledge make me a strong candidate for this position.

I would welcome the opportunity to discuss how my background and skills align with your research goals. Thank you for considering my application. I look forward to the possibility of contributing to the Astronomical Institute's esteemed legacy in solar research.

Sincerely,

Anup Karekar