

# Cover Letter

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I am writing to express my strong interest in the PhD position focused on the analysis of long-term solar activity and its modeling through the solar dynamo. With an academic background rooted in theoretical and astroparticle physics and hands-on experience in data analysis and scientific computing, I am enthusiastic about the opportunity to contribute to this project exploring the hemispheric asymmetries and temporal evolution of solar activity.

My master's studies in Physics provided me with a solid foundation in key subjects such as Theoretical Physics, Subnuclear Physics, and Multimessenger Astrophysics. These courses deepened my understanding of complex physical systems and enhanced my ability to approach astrophysical phenomena from both empirical and theoretical standpoints. My scientific curiosity was particularly engaged by topics involving the dynamic interplay of magnetic fields and symmetry in natural systems—elements central to this PhD project. My participation in a specialized course on Statistical Methods in Particle Physics further strengthened my computational expertise. This course covered topics such as hypothesis testing, likelihood estimation, and Monte Carlo simulations—tools that are invaluable in handling large datasets and extracting meaningful patterns, as required in long-term observational studies of solar activity. I also carried out a course project on CP violation in kaon decays, where I analyzed the NA48 experiment's findings and reviewed their implications for fundamental symmetries in particle physics.

As part of my master's thesis in high-energy astroparticle physics, I worked on simulation and analysis for the Southern Wide-field Gamma-ray Observatory (SWGO), focusing on investigating prospective sensitivity performance of SWGO. This research required extensive data processing, modeling, and statistical evaluation. Through this work, I significantly developed my programming and data analysis skills, particularly in Python, using libraries such as NumPy, SciPy, and Matplotlib. I presented the results of this thesis at the 10th SWGO Collaboration Meeting in Mexico, gaining valuable experience in scientific communication and international collaboration.

I am particularly drawn to this PhD project's goals of examining time-latitude asymmetries in solar activity and exploring possible periodicities over several solar cycles. These challenges align closely with my background in both theoretical modeling and data-driven research. The project's connection to solar dynamo theory offers an exciting opportunity to bridge observational analysis with physical modeling—a scientific approach that reflects my academic and research trajectory.

I am eager to work in a collaborative research environment where I can continue to grow as a physicist, deepen my programming and modeling skills, and contribute meaningfully to the understanding of solar activity. I believe my interdisciplinary background, combined with strong motivation and a capacity for independent and team-based work, make me well-suited for this position.

Thank you very much for considering my application. I look forward to the opportunity to contribute to your team's research and to further develop my skills in this stimulating scientific domain.

Warm regards,

Muhammad Muneeb Bin Shoaib

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