Personal Scientific Contributions of
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in PhD Dissertation

"Solar Transients From The Sun to Earth: Coronal Bright Fronts, Radio Bursts, and Energetic Protons"

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My interdisciplinary thesis advances our understanding of solar transients by investigating the early dynamics of Coronal Bright Fronts (CBFs), diagnosing solar type III radio bursts, and forecasting Solar Energetic Proton (SEP) fluxes. By integrating these studies, I have revealed the relationships among these phenomena and their implications for space weather forecasting and hazard mitigation.

In the first study, I analyzed 26 CBFs using the Solar Particle Radiation Environment Analysis and Forecasting–Acceleration and Scattering Transport framework and data from the Atmospheric Imaging Assembly (AIA) and the Large Angle and Spectrometric Coronagraph instruments. This analysis unveiled the temporal evolution, plasma properties, and compressional characteristics of CBFs.

For the second study, I utilized the Low-Frequency Array (LOFAR) and Parker Solar Probe (PSP) to characterize 9 type III radio bursts in the LOFAR-PSP combined dynamic spectrum automatically and 16 in the LOFAR spectrum alone. Utilizing Potential Field Source Surface (PFSS) and magnetohydrodynamic (MHD) models, I gained insights into plasma conditions and magnetic fields, advancing our understanding of type III radio bursts triggered by accelerated electrons associated with CBFs and solar flares.

In the third study, I developed forecasting models based on the Bi-directional Long Short-Term Memory (BiLSTM) neural network using OMNIWeb data from 1976 to 2019 to predict SEP integral fluxes, emphasizing the hazardous influence of energetic particles on Earth and technology.

Additionally, I collaborated on works regarding the acceleration and transport of SEPs from the Sun to the Earth, testing Wavetrack—a flexible, object-oriented Python library designed for general solar feature detection and tracking, and reconstructing the 3D structure of geo-effective Coronal Mass Ejections (CMEs) and examining correlations with Interplanetary CME and interplanetary Parameters.

This collective work provides a unified framework, highlighting the interconnected nature of solar transients and their impact on space weather.