Project Details

ROSES ID: NNH22ZDA001N-LWS
Selection Year: 2022
Program Element: Focused Science Topic

Topic: FST #1: Beyond F10.7: Quantifying Solar EUV Flux and its Impact on the Ionosphere - Thermosphere - Mesosphere System

Project Title:
Behind F10.7: Understanding The Physical Origin Of Solar F10.7 Index With Microwave Imaging Spectroscopy

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Summary:
Solar EUV flux is a dominant source of heating and ionization processes in the ionosphere-thermosphere-mesosphere (ITM) system but cannot be observed from the ground. Solar F10.7 index has been used as a proxy for EUV flux since then. Solar F10.7 index comprises a mix of contributions from mainly three emission processes: thermal emission from the upper chromosphere; ubiquitous thermal bremsstrahlung; and thermal gyroresonance from strong magnetic fields. While the first two emissions are closely related to solar EUV emission, the gyroresonance component in F10.7 index does not directly correlate with EUV flux. Moreover, gyroresonance contribution is dominated by the large active region, its partition in F10.7 could be significant when the solar is active. However, the relationship between them has not been well characterized so far. The reliability of using F10.7 as an EUV proxy is therefore limited. One solution is to image the Sun at 2.8 GHz routinely with sufficient angular resolution (_x000D_
Science Objectives:_x000D_
The overarching goal of the project is to gain a comprehensive understanding of the origin of solar F10.7 radio flux._x000D_
We will guide our investigations using the following specific science questions:_x000D_
1. What are the sources of solar F10.7 flux and how F10.7 is partitioned over different sources?_x000D_
2. How does solar F10.7 index and its partition evolve in different solar activity levels?_x000D_
3. What is the relationship between solar F10.7 index and EUV irradiance? _x000D_
_x000D_
Methodology:_x000D_
To achieve the science objectives above, we propose the following investigations:_x000D_
1) optimize EOVSA full-disk imaging procedure and create high fidelity images at multifrequency (1-18 GHz) from 2017. It will allow us to obtain the spatially resolved radio spectra of the Sun, perform spectral analysis to identify the emission mechanism(s) for different regions over the Sun and quantify the contributions of individual components. _x000D_
2) study in detail the time-dependent variations of spatially resolved F10.7 and its index partition in different regions. Explore how the gyroresonance component and its fraction in F10.7 index vary in active regions of different sizes, magnetic field strength, activity levels, etc. _x000D_
3) Calculate the prediction of bremsstrahlung emission with DEM (differential emission measures) results derived from EUV images of SDO/AIA. It will allow a quantitative comparison between the microwave observations and the bremsstrahlung prediction, in particular for the active region fluxes, whose discrepancy is largely due to gyroresonance contribution. We will explore the relation between gyroresonance emission and the physical properties of the active region towards a better estimation of the fraction of F10.7 flux contributed by gyroresonance._x000D_
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Relevance:_x000D_
Our proposal is highly relevant to the scope of FST#1, Beyond F10.7: Quantifying Solar EUV Flux and its Impact on the ITM", as this proposed research will advance our understanding of the physical origin of solar F10.7 index and consequently provide a modified F10.7, that is exclusively related to the coronal plasma responsible for EUV irradiance, as a better EUV proxy.

Publication References:

no references