Space Science Seminar
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10:30 a.m.
Virtual via Teams

Probing the Sun with Imaging Spectrographs

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With contributions from the COSIE, ESIS, MOXSI, and COOL-AID teams

Host: Dr. Alphonse Sterling

EUV and X-ray images of the Sun have revolutionized our understanding of our closest star. With them, we can probe the morphology and temperature structure of the solar atmosphere and see how they evolve as a function of space and time. However, image data cannot be used to determine line-of-sight velocities, abundances, or densities. This information is required to calculate the energy budget of eruptive events, provide boundary conditions for global solar models, and explore fundamental processes occurring in the solar atmosphere. For those diagnostics, we require spectroscopy. Because the structures on the Sun are extended sources, most modern-day spectrometers observe the Sun through long narrow slits. Two-dimensional, spectrally pure solar images with velocity, abundance, and density information are built up by stepping the slit over regions of interest. This implies that two-dimensional information is highly limited by cadence and the temporal evolution and spatial structure of these parameters can never be truly separated. Both spatial and spectral information can be obtained in a single snapshot with slitless spectrometers, which were often used in the 1950-1970s, but were abandoned due to the difficulty of unfolding the overlapping spatial and spectral information.

Thanks to advances in computer processing speeds and machine learning algorithms, there have been several techniques developed to complete the spatial/spectral unfolding, unlocking the full capability of slitless spectrometers for solar observations. In this talk, I will review several slitless spectrometers that have either flown or been proposed in the last five years. These instruments roughly fall into two categories – ones designed to measure the density, temperature, and/or abundances and only observe the dispersed solar spectra in a single direction, and ones designed to measure velocity, so must observe the dispersed solar spectra in multiple directions. I will also review some of the inversion techniques associated with these instruments. The goal of this talk is to give a broad overview of the capability of such instruments and demonstrate their usefulness in the next decade of solar observatories and beyond.

https://solarscience.msfc.nasa.gov/colloquia/