Project Details

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Topic: Jets in the Solar Atmosphere and their Effects in the Heliosphere

Project Title:
High-Spatial and High-Spectral Resolution Study of Small-Scale Jets

PI Name: Haimin Wang
PI Email: haimin@flare.njit.edu
Affiliation: New Jersey Institute of Technology
Project Member(s):
- Tritschler, Alexandra ; Collaborator; Association of Universities for Research in Astronomy
- Liu, Chang ; Co-I; NJIT
- Deng, Na ; Co-I; New Jersey Institute of Technology
- Reardon, Kevin P; Collaborator; National Solar Observatory
- Denker, Carsten ; Co-I/Co-PI (non-US organization only); Astrophysikalisches Institut Potsdam

Summary:
Small-scale dynamics in the solar chromosphere are believed to play an important role in the energy balance and structuring of the corona as well as the mass transport in the solar wind. In particular, jets, in a variety of forms, may be responsible for providing the upward flux of energy and momentum necessary for the observed heating and flows. The recently discovered type II spicules are of special importance due to their high speed, rapid heating, and large vertical extent. The jet-like structures may also have their on-disk counterpart in the large upward velocities identified in the blue wings of chromospheric spectra, termed Halpha upflow events (UFE) in earlier publications by the PI, or by more recent authors Rapid Blueshifted Excursions (RBE). These small-scale jets share some common properties with the microflare associated jets in active regions, the most prominent of which has the magnetic reconnection as the driving mechanism.

It is now possible to obtain the unprecedented data from Hinode and the Solar Dynamic Observatory (SDO) simultaneously with high-resolution imaging spectroscopic data from medium to large-aperture ground-based telescopes equipped with adaptive optics. This makes it an opportune moment to quantitatively analyze small-scale chromospheric and coronal jets along with the corresponding magnetic field evolution in the photosphere. Imaging spectropolarimetric observations are immediately available from NSO/SP using the Interferometric BIdimensional Spectrometer (IBIS). Within the time frame between one and two years, the New Solar Telescope (NST) at Big Bear and the GREGOR solar telescope at Tenerife will finish their commissioning and allow us to study, for the first time, physical processes at a spatial resolution below 0.1 arcsec. The scientific objectives of this study include:

1. Through imaging spectroscopy with IBIS at NSO/SP (and NST and the GREGOR Fabry-Perot Interferometer in later years), we will study the properties such as velocity, temperature, statistical spatial distribution, and occurrence frequency of small-scale ejections and associated heating. This will be enhanced by high spectral resolution spectrograph observations with GERMAN VTT. The response of the corona will be investigated using Hinode EUV Imaging Spectrometer (EIS) and SDO Atmospheric Imaging Assembly (AIA) data.

2. Using high-resolution, high-cadence magnetograms (initially from IBIS, the Hinode SOT/SP, and SDO/HMI, and then subsequently from BBSO/NST and GREGOR), the photospheric magnetic structures associated with jets will be investigated. In particular, the chromospheric response to magnetic reconnection on small scales will be characterized.

3. In order to gain a better physical understanding of the quiet Sun jets, especially the properties of their accelerated electrons which are not directly observable, we will study the electron energy distribution of microflares in active regions using hard X-ray spectroscopic data obtained with RHESSI and investigate the physical interpretation of the association between some microflares and type III radio bursts, the signature of jets through the outer corona. As microflare associated jets may be larger version of quiet Sun jets, this will allow us to analyze their heating in the atmosphere and acceleration through corona.

The proposed research responds to the topic of "Jets in the Solar Atmosphere and their Effects in the Heliosphere". We will contribute to the focused team effort by providing and analyzing high-quality imaging spectropolarimetric data of small-scale jets and associated dynamics obtained with the state-of-the-art instruments. This will help to address some fundamental question in LWS science goal such as source of plasma to the corona and solar wind. Our team has profound expertise in analyzing multi-wavelengths and spectropolarimetric data as proposed in this study.

Publication References:

Summary: no summary

Reference: Wang, Haimin; Liu, Chang; (2012), Circular Ribbon Flares and Homologous Jets, The Astrophysical Journal, Volume 760, Issue 2, article id. 101, 9 pp, doi: 10.1088/0004-637X/760/2/101