Strand-like Structure and Characteristic Spectral Signatures of Transversely Oscillating Flux Tubes in the Solar Corona

Antolin, Patrick (1), patrick.antolin@nao.ac.jp; T. Van Doorsselaere (2); T. Yokoyama (3); T. Okamoto (4); B. De Pontieu (5); and H. Uitenbroek (6).
(1) National Astronomical Observatory of Japan, Japan
(2) Centre for mathematical Plasma Astrophysics, KU Leuven, Belgium
(3) Department of Earth and Planetary Sciences, University of Tokyo, Japan
(4) Institute of Space and Astronautical Science (ISAS) / Japan Aerospace Exploration Agency (JAXA), Sagamihara, Kanagawa, Japan
(5) Lockheed-Martin Solar and Astrophysics Laboratory, Palo Alto, CA, USA
(6) National Solar Observatory, Sunspot, NM, USA

High resolution observations of the solar corona in EUV lines, or in chromospheric lines through prominence or coronal rain observations, indicate strand-like structure and ubiquitous low-amplitude transverse motions. Furthermore, recent observations of a prominence with IRIS and Hinode report a tendency for non-thermal line broadening to increase with height and specific out-of-phase behaviour between transverse motions and Doppler shifts. Based on a 3D MHD numerical model and appropriate radiative transfer, we suggest an explanation for the observed features. Our model is based on previous numerical work showing that transverse MHD oscillations can lead to Kelvin-Helmholtz instabilities that deform the cross-sectional area of loops. We show that the instability can occur for low wave amplitudes for long and thin coronal or prominence loops, matching those presently observed in the corona. The vortices generated from the instability are velocity sheared regions with enhanced emissivity hosting current sheets. Strands result as a complex combination of the vortices, the line-of-sight angle and optical thickness. While the transverse displacement of the loop axis damps quickly, the vortices and azimuthal flows retain the main dynamics clearly in Doppler shifts and line broadening, especially at the edges of loops. The instability extracts the energy from the boundary layer in which resonant absorption takes place, and converts it into heat through ohmic and viscous dissipation in the current sheets and vortices.