Wave vs. mass flow in coronal loops revisited

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Quasi-periodic propagating intensity disturbance are observed on high cadence (15-30 s) EUV coronal images (SOHO/EIT; TRACE) along quasi-open active region loops. In most of the cases the spectroscopic information is missed, leading to the ambiguity of interpretation in terms of mass flows or propagating compressional waves (Robbrecht et al., A&A 370, 2001). To solve this ambiguity would be of primary importance in understanding the nature of these waves and loops and their possible role in the coronal heating.
The intensity fluctuations observed are often quite faint with respect to the background coronal emission. We think that one of the problems is the lack of sufficient spatial resolution, which leads to observe a superposition effect of intensity fluctuations over several unresolved strands composing the loop.
A coordinate study with EUS, EUI will be essential for a proper constraint of the problem. The high spatial resolution of Solar Orbiter will allow the identification and study of intensity fluctuations over the fine structure of loops. The spectroscopic information through the detection of Doppler shift, in combination with imaging data, will allow untangling wave propagation from mass flow (Eriksen & Maltby, ApJ 148, 1967). Besides it will also reduce the uncertainties introduced by the projection effects. At present mostly only one component of the propagation speed is reported for these waves (mostly only the plane of sky speed). This introduces a large uncertainty on the speed estimation. The fact that the estimated speeds are all close to or below the coronal sound speed, was one of the main reasons to interpret the disturbances in terms of slow MHD waves.

EUS instrument requirements

1. Emission line requirements

Strong coronal lines are required. Transition regions lines would also be useful to study the wave propagation through the solar atmosphere. Bands 5 and 7b are the most suitable because include strong first and second order lines. Band 1 can replace band 7b. This would be suitable for density diagnostic in corona.

2. Spectral resolution requirements

A resolution to detect shift of few km/s would be required. High resolution is also needed to deblend first and second order lines. Many coronal lines are ob served at the second order on band 5.

3. Spatial coverage

The slit field of view should possibly cover a full loop length. It would be also important to have access to small and fast rasters to be able to cover a portion of active region, a footpoint of a loop system.

4. Time resolution (incl. count rates)

The high cadence is a priority. The observation can be restricted to few intense lines to reduce the time resolution.

5. Requirements for other instruments

The coordination with EUI images Fe X/XI 174 (1.5 MK) would be essential in order to have a content raster which covers the full observed active region. In addition we may have access to spectroscopic and imaging information at similar temperatures by using the same line observed on band 1 or Mg X in band 5.

6. Other requirements

Relation to Solar Orbiter science goals

1. Determine the properties, dynamics and interactions of plasma, fields and particles in the near-Sun heliosphere

N/A

2. Investigate the links between the solar surface, corona and inner heliosphere

N/A

3. Explore, at all latitudes, the energetics, dynamics and fine-scale structure of the Sun's magnetized atmosphere

A more systematic study on waves propagating in corona would give hints on their role in coronal heating. The study of their propagation and damping through the fine coronal scale will give access a diagnostic of the coronal plasma.

4. Probe the solar dynamo by observing the Sun's high-latitude field, flows and seismic waves

N/A