Dynamic features in the solar atmosphere

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The solar atmosphere contains a wide variety of transient features. To explore these features requires simultaneous spectral and imaging data. With SUMER and TRACE data we see transient features which show a factor of two enhancement in N V 1238, coupled with a factor of two decrease in O V 629 (despite the fact that these lines have over-lapping formation temperatures) visible over 3-4 arcsec along the SUMER slit. In some instances one of these lines may show a secondary component with a flow of ~75 km s^{-1}, yet the other line shows only a small additional broadening of the line. We believe that these events are not unique but that their detection depends on the availability of simultaneous high spectral resolution and imaging data of comparable spatial and temporal resolution.

The type of sequence proposed below has the potential of exploring the full range of small-scale transient features from the quiet Sun regions to highly active regions of the solar atmosphere, seen either as plasma jets (explosive events or bi-directional jets and flows) or as sporadic radiative events (blinkers, spicules and macro-spicules). We aim to answer several questions:
(a) is there any connection between these features?
(b) do they provide the plasma supply for the ubiquitous fast solar wind?
(b) what is their effect on heating the solar corona?

EUS instrument requirements

1. Emission line requirements

For this project, Bands 7a and 7b are of prime importance, e.g. we have C III 977, O V 629 (2^{nd} order), N V 1238 and O VI 1032 and the coronal line Mg X 625 giving an excellent coverage of the mid TR and the corona. The SUMER data clearly shows that a mis-interpretation can result if one line is observed, hence the requirement for 2 or more TR lines. Furthermore, the C III 977/1176 ratio will allow an estimate of the electron density.

A secondary choice is Bands 7b and 6. The Band 6 includes the O V 760 lines, which are suitable for density diagnostics (Doyle & Madjarska, 2003, A&A, 407L, 29). These lines are, however, quite weak, and can be used in only higher intensity events.

2. Spectral resolution requirements

The line profile needs to be resolved in order to study line-shifts.

3. Spatial coverage

These features seem to be 2000 – 3000 km, however in order to be sure of detecting events we need coverage along the slit of at least 20 times longer.

4. Time coverage

We require a time resolution better than 20 sec, using a sit-and-stare mode.

5. Requirements for other instruments

Simultaneous imaging at similar temperatures and spatial and temporal resolution is essential, plus magnetograms.

6. Other requirements

N/A

Relation to Solar Orbiter science goals

Indicate how your science fits in with the four Orbiter science goals. Simply type "N/A" if it's not applicable to a science goal.

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

Many transient features (flows, jets, explosive events and blinkers) are probably related but their appearance may depend on the geometry of the shock collision and the physical parameters of the medium, which can lead to magnetic reconnection at higher temperatures or wave leakage of MHD waves from the lower atmosphere.

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

In order to explore the dynamics and fine-scale structure of the TR requires the study of several spectral lines simultaneously, plus imaging data. Such data will then allow us to model the energy flow through the atmosphere.

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

N/A