Dynamic events in the solar atmosphere

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There is a 'zoo' of transient, dynamic events which occur in the solar atmosphere (including blinkers, explosive events, spicules, active region transient brightenings etc). The basic processes that produce the events can lead to the understanding of coronal heating and solar wind acceleration of the Sun and also other stars.

In most cases, the classification of the different events has been made using the characteristics of the event in observations of one wavelength from one instrument. This has lead many to think that some of these events may be the same thing just identified differently.

This builds on work done with SOHO (Harrison, 1997; Madjarska & Doyle, 2002; Wilhelm, 2000; Berghmans & Clette, 1999) and extensions planned for Solar-B.

Solar Orbiter is the only future mission that will provide the high resolution spectroscopic data at a variety of temperatures necessary to determine whether different event types are the same. The out of the ecliptic view will enable the thorough study of these fundamental processes in the polar regions for the first time. Also the proximity of Solar Orbiter to the Sun will give us unprecedented spatial resolution of these small scale events.

EUS instrument requirements

1. Emission line requirements

A range of strong emission lines at a variety of temperatures (10 000K - >2MK) through the solar atmosphere is required. A pair of density sensitive lines in the chromosphere, transition region and corona are also needed. The choice of emission lines will evolve as the study continues, therefore the wavelength bands need to contain a variety of strong emission lines that can be used. It would be good to plug the temperature coverage gaps that occur in current instrumentation.

2. Spectral resolution requirements

Both line shifts and line widths must be resolved. Line shifts on the order of km/s must be resolvable. Many of the phenomena named above are identified from characteristic features in the line profiles of the events. It is essential to be able to accurately identify events and their plasma properties from the spectral information.

3. Spatial coverage

Regions containing a few supergranule cells must be covered e.g. 40" at 1 AU, 200" at 0.2 AU.

4. Time resolution (incl. count rates)

Raster of the size stated above must be covered in up to a couple of minutes.

5. Requirements for other instruments

Magnetograms are necessary to relate dynamic events to magnetic fragments and their evolution in the quiet Sun.

6. Other requirements

To observe a number of events useful for comparison, a number of hours of observations are required (minimum few hours).

The pointing of our observations could be on disc or at the limb. The co-rotation of the spacecraft with the Sun could be useful for studies which are trying to compare phenomena that occur on the limb and on the disk.

The combination of co-spatial ground based limb observations with on disc observations from Solar Orbiter would also be useful. Solar feature tracking is required.

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

The links between events observed at different heights in the solar atmosphere would be determined. By determining the characteristics of these events in the atmosphere, we can compare plasma parameters observed at the spacecraft, e.g time scales of transient events, temperatures and densities.

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

The energetics and dynamics of small scale transient events would be studied, across a range of unprecedented latitudes.

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

Studies of fundamental processes on small scales in the polar regions may usefully link in to studies of the solar cycle and the dynamo.