CME Onset Studies

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The CME onset process is still a mystery despite numerous studies using multi-instrument/wavelength datasets and sophisticated models. High spatial and temporal resolution spectroscopic observations of CME source regions will provide a unique insight into the processes that lead to a CME eruption. This study is an extension of JOP 67 work which focuses heavily on the analysis of coronal dimming and the comparison with CME events.

Ideally, for this type of study, a coronagraph and a spectrometer well spaced at an angle to each other would be required.

Solar Orbiter will open up a few new avenues, e.g.

- Viewing a coronal dimming out of the Sun-Earth line with a spectrometer will give a better view of the source region. Current dimming observations with a spectrometer are restricted to regions on the limb.
- A view out of the ecliptic will give a global view of CMEs. Being able to view the whole of the streamer belts would be very useful for dimming studies.

EUS instrument requirements

1. Emission line requirements

Emission lines covering a range of temperatures from the chromosphere, through the transition region and into the corona are required. The maximum temperature should be greater than 2 MK. Coronal density sensitive lines are also required. The lines required would be similar to those in CDS JOP 67 but we require extra temperature coverage around the existing CDS lines.

2. Spectral resolution requirements

Need to be able to resolve line shifts and line widths to determine Doppler and non-thermal velocities.

3. Spatial coverage

At 1 AU, regions larger than 4”x4” will need to be covered. Mosaics of rasters to cover the field of view could be used.

4. Time resolution (incl. count rates)

Rasters of 4”x4” (at 1 AU) need to be produced in less than 10 minutes.

5. Requirements for other instruments

Data from 2 further instruments are essential for this study:

- Magnetograms, from an instrument on the same satellite.
- Coronagraph observations from the same, as well as a different platform

6. Other requirements

This study requires long periods of observations – the observing scheme can be made fairly generic to be used for other studies as well.

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

Understanding the CME onset process will enable us to predict the occurrence of events that will be seen in the in-situ instruments.

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

Investigating the CME onset process will involve the underlying magnetic driver, the resulting influence in the corona, and then the effect on the heliosphere. Links between the observations at the surface, in the atmosphere and to what is detected at the spacecraft will be possible.

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

The dynamics of the CME source region in the lead up to the mass ejection would be studied. Solar Orbiter will provide unique opportunities for observing CMEs at all latitudes and out of ecliptic.

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

N/A