TITLE: Complementing the EU imager (EUI) in the detection of MHD waves in coronal loops

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MHD waves in coronal loops, which were previously only predicted by theory have now actually been detected with instruments such as TRACE and SUMER on-board SOHO. These observations have given the solar comunity an important and novel tool to measure fundamental parameters in the magnetically embedded solar corona. Furthermore, the theory of waves and oscillations is now being refined to such a stage that it will even be able to predict how a coronal loops will oscillate depending on magnetic field and plasma density variatrions along a loop. There are new models available which describe oscillating loops with realistic curvature and twisted magnetic fields. All this exciting new theory can only be fully exploited if one has the instruments capable of measuring the theoretically predicted effects. It is crucial that the EUS and EUI are *used together* while observing an oscillating loop so that we can fully exploit this exciting new opportunity. E.g. if EUS detects the Doppler shifts of a standing slow wave along a loop, it is crucial that the EUI can give us an accurate measurement of the loop's length and curvature. Only using this combined information of a spectrograph and an imager we can then calculate accurately the density stratification and possibly other parameters along that loop. It would therefore be imperative that the EUI and EUS have the capability of observing *in similar EUV wavelengths*.
Further, EUS will also be capable of detecting transverse fast kink waves on the limb in loops which may appear motionless to the EUI. Complementary to this, EUS could also detect vertically polarised fast kink waves in loops near the disc centre which again might appear stationary to the EUI.
It is imperative for the development of coronal seismology that we can measure the frequencies and/or amplitude profiles of higher order modes in loop oscillations as these contain otherwise un-extractable information about the magnetic and plasma density fine structure. This means that we need the time resolution to be at the order of a second or similar.

EUS instrument requirements

1. Emission line requirements

Band 1 for observing fast waves (as seen by TRACE) and Band 7b for observing slow waves (as seen by SUMER).

2. Spectral resolution requirements

Profile needs to be resolved in order to study line widths.

3. **Spatial coverage**

1-5x50-80Mm

4. **Time resolution (incl. count rates)**

Of the order of second

5. **Requirements for other instruments**

Co-aligned EUI, possible ground-based (optical) H_alpha for magnetic field construction or a direct vector-magnetograph

6. **Other requirements**

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**

Such observations can shed light on the direct leakage of waves from lower solar regions into the Transition Region, corona or even into solar wind.

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

The proposed project would be able to determine important coronal loop equilibrium parameters through observation of MHD waves. The fine plasma density and magnetic field structure along loops could be revealed for the first time. This knowledge is crucial in determining the true nature of the coronal heating mechanisms.

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

N/A