Photosphere - Chromosphere - Transition Region Linkage

Werner Curdt[1],

[1]Institute for Solar System Research

Contact: [curdt@mps.mpg.de]

Many authors report a meso-granulation of the solar network in photospheric to chromospheric layers (e.g., Koutschmy 86, Leitzinger 05). An investigation of this meso-structure and its relation to the photospheric magnetic field as well as to the chromospheric network and transition region could help to understand the photosphere-chromosphere-TR linkage. In order to see the partitioning and fine structure of a supergranular cell in the lower to upper chromosphere (both in Doppler and in intensity) and its linkage to the photosperic magnetic field, we need hires vector magnetograms and spectra in cool chromospheric lines. Another requirement is a good co-alignment of both, which should be as good as the resolution, i.e. down to 1 pixel. The recombination continuum of Si I at ~1180Å is by far the coolest emission seen by EUS in the band 7b (if we leave out the emission of molecular hydrogen). Atmospheric models give it a temperature of 4700 K. Rasters in this continuum are ideally suited for co-alignment purposes between the EUS, EUI, VIM and ground based observations. It has been demonstrated that Ca II K images look so similar to 1180-Å rasters that a 1-pixel co-alignment uncertainty is easily achieved (Curdt et al. 1999, Teriaca et al. 2004). An example is shown in Fig.1; although the wavelength is not exactly the same, we can expect a similar result. An accurate co-alignment is indispensable for all studies, which try to connect the photospheric (magnetic), chromospheric and transition-region manifestation of any small-scale phenomena like bright points, explosive events, jets, etc.. In this sense, this is a generic science case, which can be used by any other hires observation! Rasters in the recombination continuum of hydrogen, which is formed at 6700 K, have a much more fuzzy structure and are not useful for co-alignment purposes.

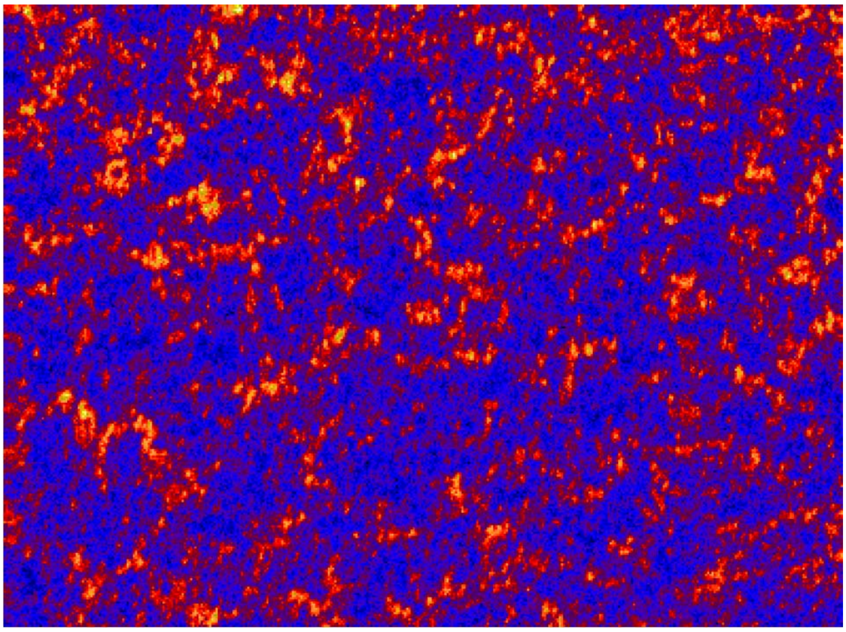

Fig. 1 Example of a raster scan in continuum emission at 1430 Å. The QS emission, which emerges near temperature minimum forms an image, which is full of fine structures and details and which almost looks like an Ca II K image: one can even see the chain of Ca-grains forming the network boundary.

EUS instrument requirements

1. **Emission line requirements**

Need a section of Si I or C I recombination continuum, free of emission lines. This can only be provided by spectral band 7b. Here we also find strong emission lines of Si II, Si III, and N V, needed for the study.

2. **Spectral resolution requirements**

continuum: N/A
Si II, Si III, N V: need at least 5 km/s resolution

3. **Spatial coverage**

A supergranular cell, to be able to see differences between network and internetwork (i.e. 200 x 200 arsec at perihelion).

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

Need good time resolution, since we are looking at small structures. An exposure time of 3s will result in a 10 minute raster, which should be ok and in compliance with the telemetry rate.

5. **Requirements for other instruments**

Need VIM filtergrams and vector-magnetograms to see the photospheric context. Need also EUI hires Ly-alpha images to see the large-scale chromospheric context.

6. **Other requirements**

n/a

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**

We will be able the study the PS to TR link in great detail.

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

We will, in particular, be able to study the role of the magnetic field dominating this link.

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

n/a