Prominence plasma diagnostic with EIS/Hinode

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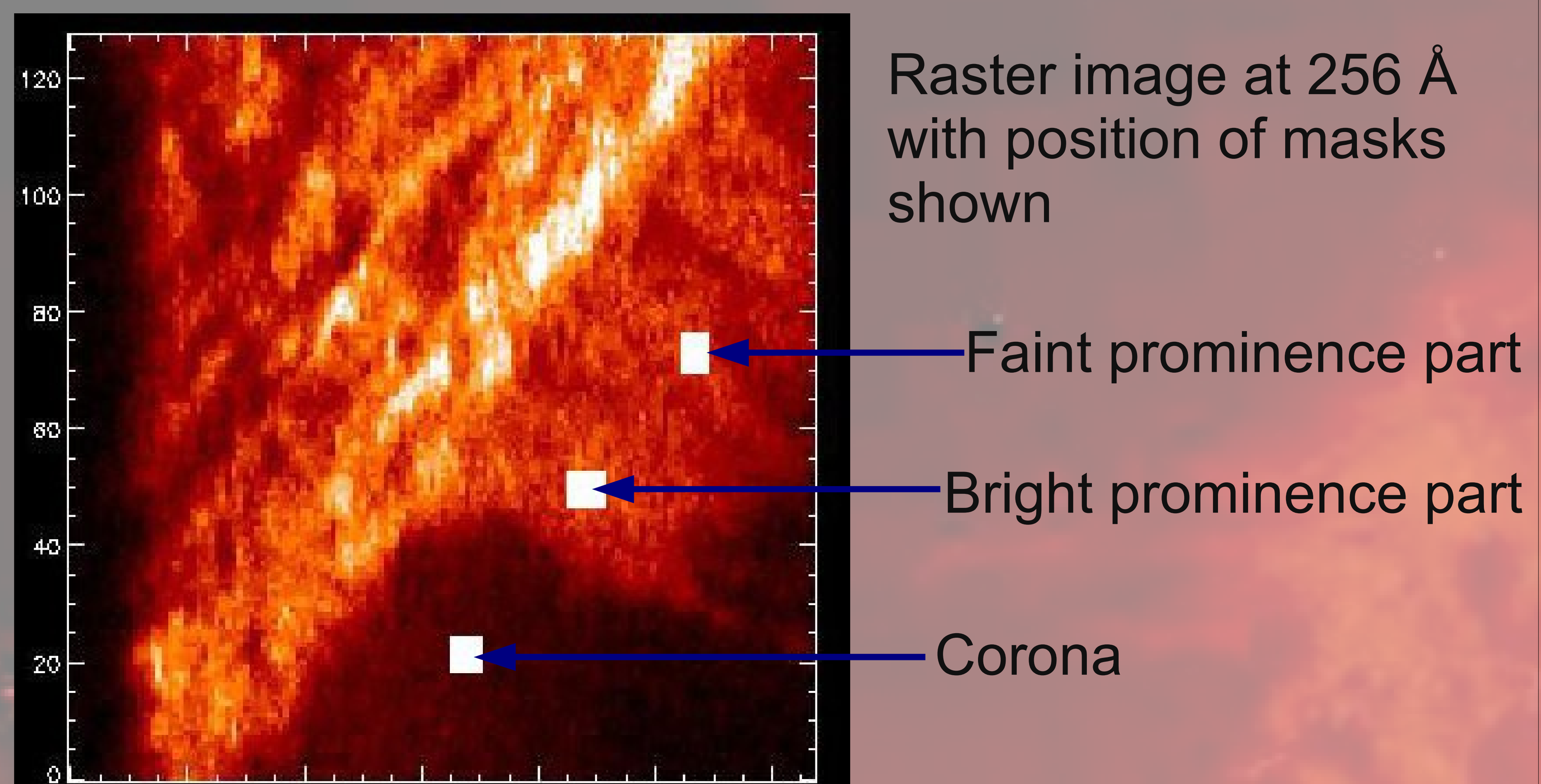
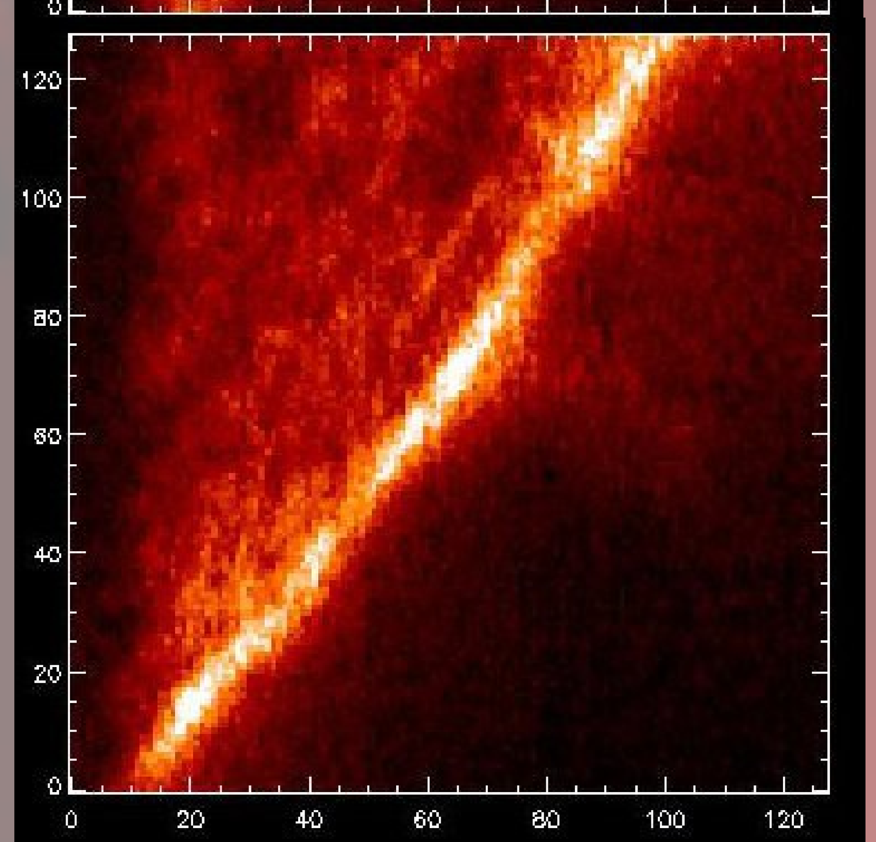
Data from the 26th April 2007 taken with the EIS spectrometer aboard HINODE was used to carry out an investigation of the plasma parameters of a solar prominence. In this data set, the whole spectrum detected by the 2 EIS CCDs is returned. It used the 1" slit and 25s exposure times. A quiet sun region, two prominence regions and a coronal region were selected for investigation.
The data was prepared using eis_prep. Calibrations for the twin CCD misalignment, and for the tilt and orbital errors were also corrected for. The prominence is well visible in several cool lines (e.g., He II 256 and Fe VIII 185.21, below).



Raster image at 256 Å with position of masks shown



Raster image at 185 Å

Analysis

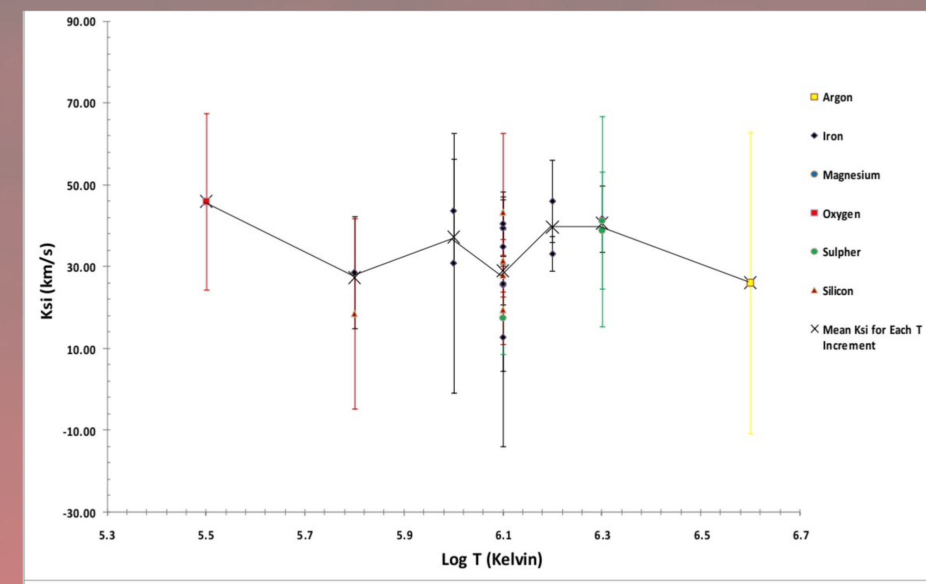
Most lines were automatically fitted with gaussian profiles for line identification. Then a manual fitting procedure was used to remove as many blends as possible. We also used line pair fixed ratio to constrain some of the fit parameters (Young et al. 2007).

Density diagnostics

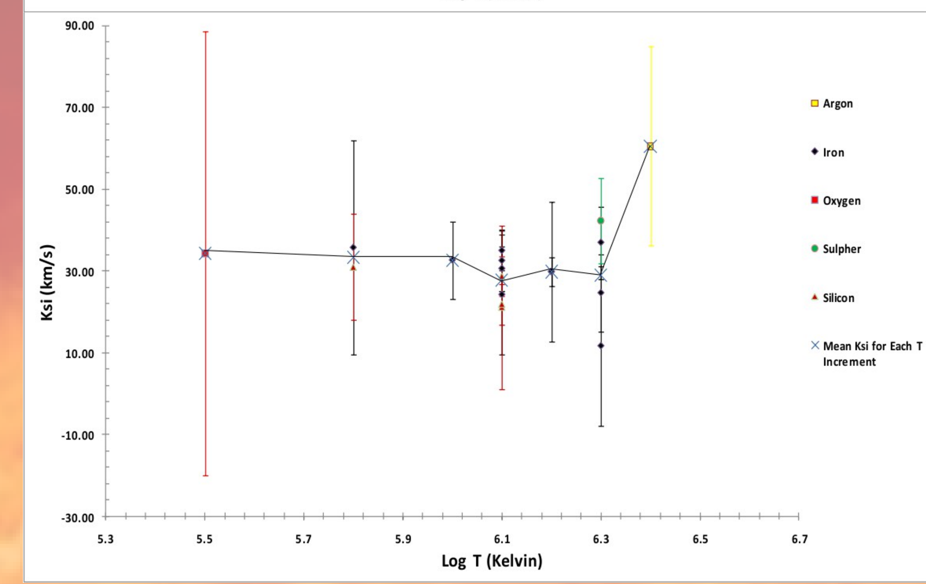
CHIANTI 6.0.1 (Dere et al. 2009) was used to infer electron densities from line intensity ratios. Among the cool lines (with log T[K] < 6), the Mg VII 280.75/278.39 line ratio would be the best suited for prominence plasma density diagnostics. Unfortunately, the signal-to-noise ratio above the limb is rather low in the Mg VII 280 line. Using this ratio we find densities of log ne[cm^{-3}] = 8.8 in the bright prominence part, and 8.5 on the disk. Using the Si X 258.37/261.04 line ratio, the coronal density was found to be around log ne[cm^{-3}] = 8.4, in agreement with measurements by, e.g., Landi & Young (2010).

Non-thermal line widths

The level of non-thermal broadening is useful to know since it is thought to be linked to the unresolved fine structure of the prominence (see e.g. Labrosse et al 2010 and references therein). Assuming that most spectral lines in our data are broadened by the instrumental profile (taken from Brown et al 2008 to be 0.054 Å for the short wavelength range and 0.057 Å for the long wavelength range) and by thermal and non-thermal processes, we estimated the non-thermal velocities in the prominence region. We obtained values of 20-40 km s^{-1}, but no discernible trend was found.



Non-thermal velocities in the bright prominence region



Non-thermal velocities in the corona

Conclusions

As can be seen from the full spectrum displayed below, we have a lot of data to look at! The plasma parameters inferred from this first analysis confirm that EIS is well suited to study the prominence-to-corona transition region and the surroundings of the prominence, and will help us to further constrain models of energy balance. A DEM analysis will be made (see also poster by Gunar et al on issues with DEM determination in prominences).

Acknowledgements
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References

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Labrosse, N., et al. 2010, SSRv, 151, 243-332
Landi, E., & Young, P., 2010, ApJ, 714, 636-643
Young, P., et al. 2007, PASJ, 59, 857-864