EUV lines observed by EIS/Hinode in a solar prominence

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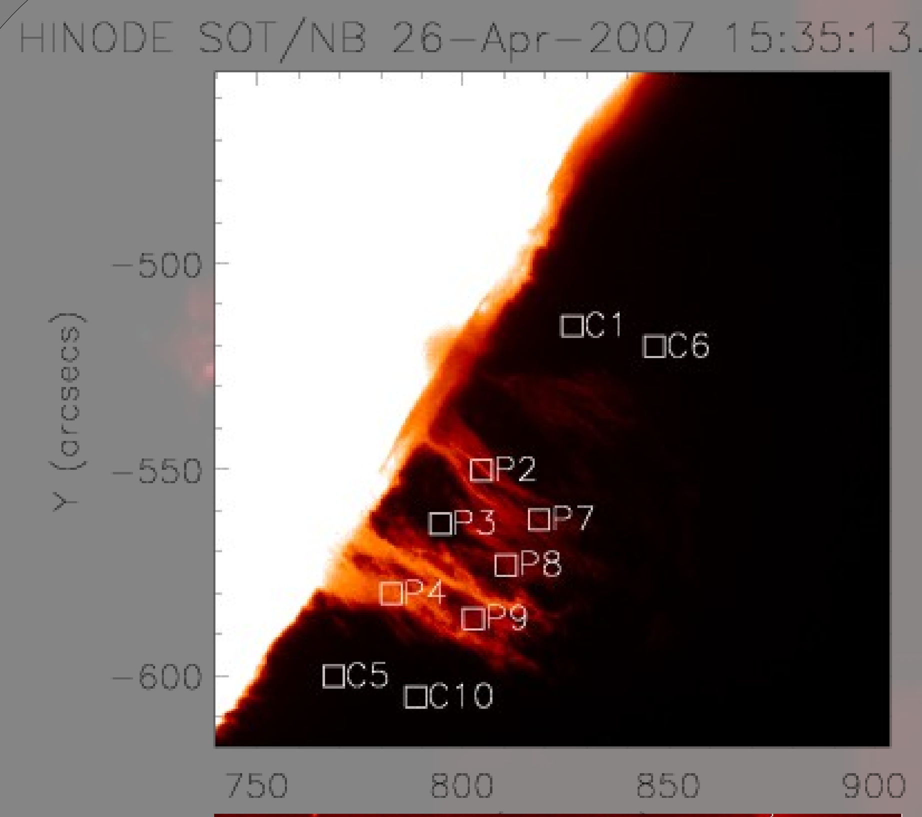
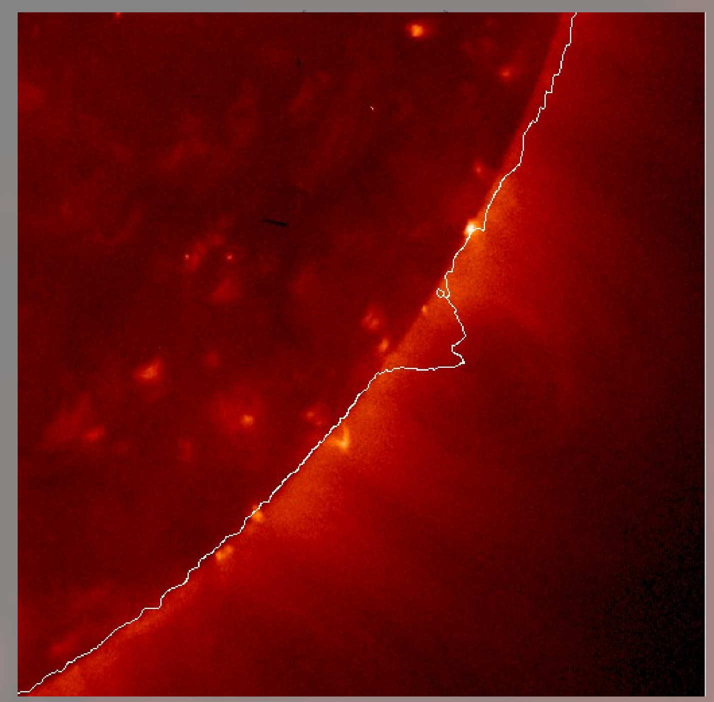
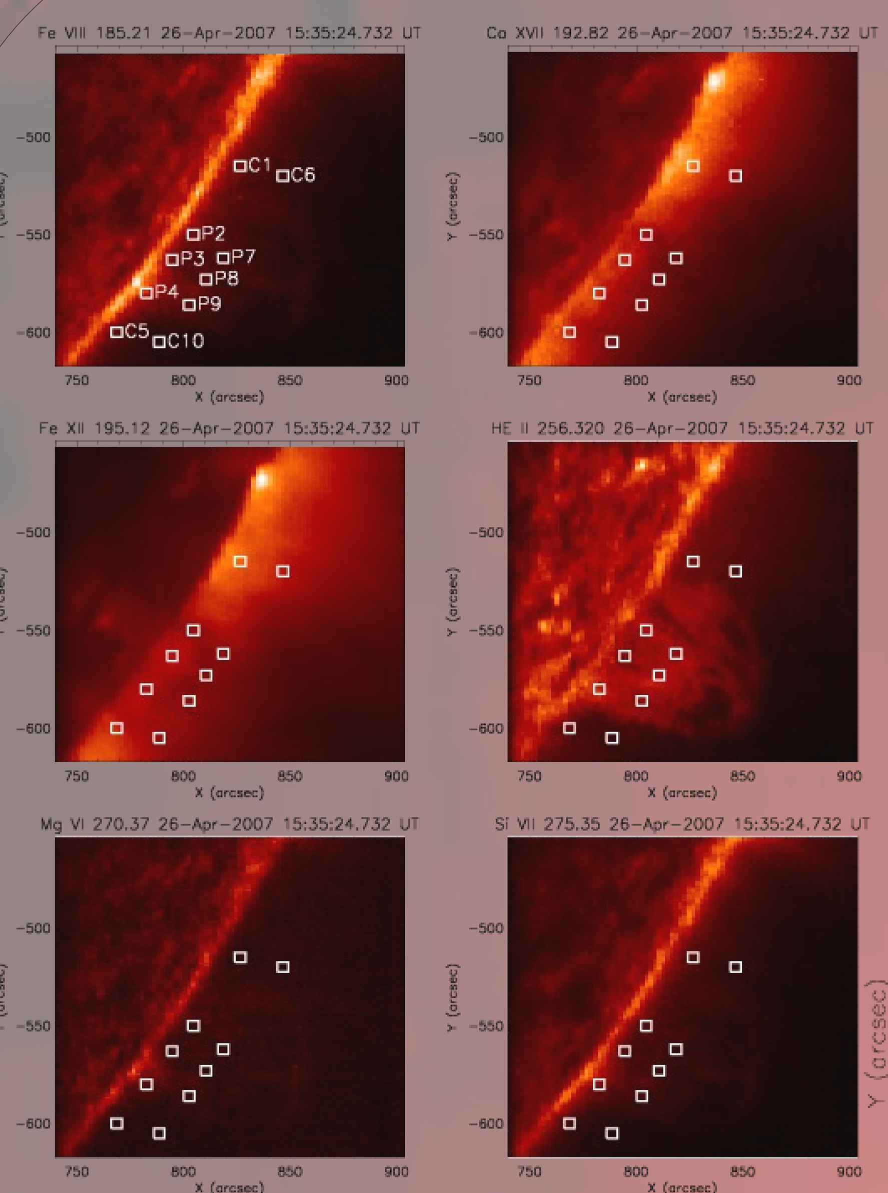
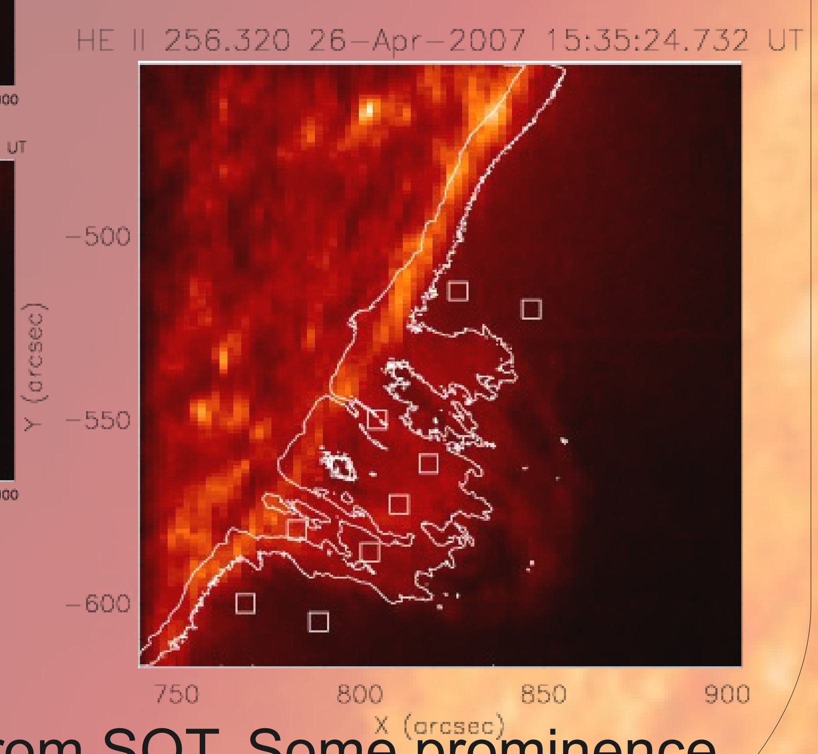




Hα observation from Hinode/SOT of the west-limb prominence on 26 April 2007 at 15:35UT (top) and Hinode/XRT showing the prominence cavity (bottom). The boxes on the SOT image indicate the positions around the prominence where the EIS line profiles are studied. A contour of the Hα limb including the prominence observed with the spectroheliograph of Meudon indicates the location of the prominence at the bottom of the cavity in the XRT image.



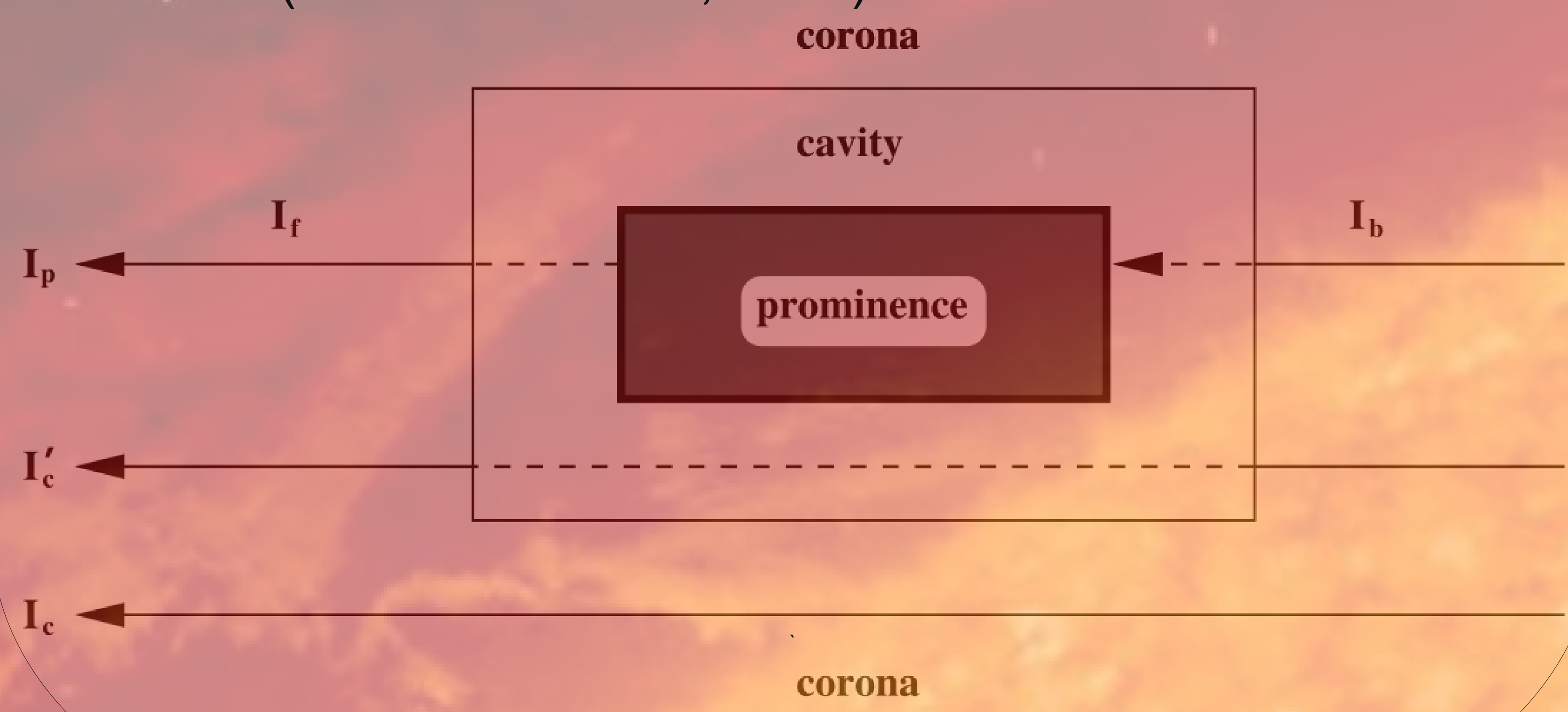
Raster images obtained with fil_rast_s2 on April 26, 2007 between 14:46UT and 16:29UT. The white boxes on each raster indicate the positions around the prominence where line profiles are averaged.



EIS raster in the 256 Å window with Hα contours from SOT. Some prominence plasma is visible in He II but not in Hα.

Absorption and emissivity blocking

When the LOS passes through the cavity, the intensity of coronal radiation is lowered. In the case of a LOS passing through the prominence, coronal EUV lines with λ<912 Å are absorbed by H and He resonance continua in a cool prominence. There is a depression of the coronal brightness due to the cavity plus lack of coronal emission in the prominence volume and the absorption of background radiation (see Heinzel et al, 2008).



The blend at 256 Å

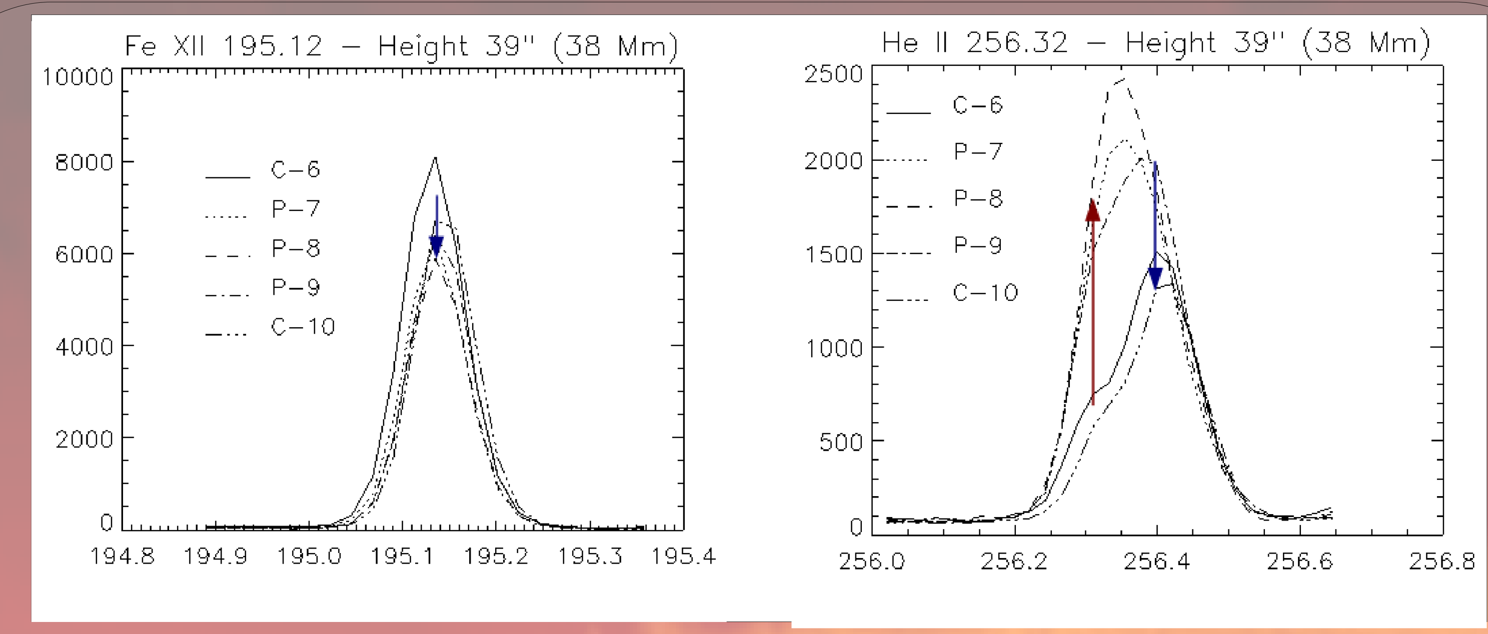
The optically thick He II line at 256 Å is blended with at least three coronal lines in the red wing (Si X, Fe XII, and Fe XIII). To disentangle this blend in the prominence we need to take account of the absorption and emissivity blocking as described above. We devise four scenarios:

Model 1: From the total integrated intensity at the prominence position we subtract the full coronal He II, assuming that it is due to an instrumental scattering of the strong disk radiation. Then we also subtract all coronal blends properly attenuated.

Model 2: Same as Model 1, but we add back one half of Si X blend, assuming that roughly one half (the radiation from behind the prominence) was fully absorbed by the prominence He II line opacity.

Model 3: Same as Model 1, but we subtract only one half of attenuation of the coronal He II component. Here we assume that it is of truly coronal origin and thus one half of it is fully absorbed by the prominence He II line opacity.

Model 4: As Model 3, but we add back one half of Si x blend, assuming that roughly one half was fully absorbed by the prominence He II line opacity.



Selected line profiles at various positions (shown by boxes in the raster on the left). Upward and downward arrows indicate respectively an increase in line emission, or the effect of absorption and emissivity blocking due to the prominence.

Integrated Intensity / Box	P-7	P-8	P-9	C-6	C-10
Total emission	323	353	328	224	191
He II				50	40
coronal blends	135	125	138	174	151
Si x 256.37	92	85	94		
1/2 (Si x 256.37)	46	42	47		
Si x 261.04					
Fe XII 195.12	520	482	534	681	575
He II (model 1)	143	183	145		
He II (model 2)	189	225	192		
He II (model 3)	165	205	167		
He II (model 4)	211	247	214		

Integrated intensities for the He II 256 Å line and the blending lines in different regions of the corona (C) and the prominence (P).

The combined information from XRT and EUV observations in coronal and transition region lines gives us the amount of attenuation to compute the He II line intensity according to our four models. By using simple 1D models of prominences including a prominence-to-corona transition region, we are able to reproduce the range of inferred integrated intensities of the He II 256 Å line, yielding a preliminary estimate for the central temperature of 8700 K, central pressure of 0.33 dyn cm^{-2}, and column mass of 2.5×10^{-4} g cm^{-2}.

Conclusions

Off-limb raster images from EIS must be looked at carefully in order to separate the contributions of the different lines blended with the nominal line. We have analysed the blend of the He II 256 Å line and obtained a reasonable estimate of the He II line integrated intensities in several prominence locations. These are consistent with results of non-LTE modelling (Labrosse & Gouttebroze 2004). There is an important contribution of resonant scattering of the incident radiation in the formation of the He II 256 Å line (similar to the case of the He II 304 Å line - Labrosse et al. 2008).

References

Heinzel, P., et al. 2008, ApJ, 686, 1383
Labrosse, N. & Gouttebroze, P. 2004, ApJ, 617, 614
Labrosse, N., et al. 2008, Annales Geophysicae, 26, 2961