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Long Duration Thermal Hard X-ray Sources Observed in Two Eruptive Flares

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Abstract. We present observations of two eruptive flares on 17 of December 2006 (C1.9) and 19 of May 2007 (B9.7) which had good coverage with both *Hinode* and RHESSI. In these flares we see a long lived, gradual thermal hard X-ray source of low emission measure and, relative to the loops observed with GOES and XRT, high temperature. The lack of a non-thermal hard X-ray component and impulsive behaviour is inconsistent with electron beam driven chromospheric evaporation.

1. Introduction

Both flares were eruptive events which share characteristics of the well known Yohkoh event observed in February, 1992 by Tsuneta et al. (1992) and exhibit many of the characteristics of the standard CSHKP flare model. While the 19 May event occurred on disk and thus clearly in a weak field region, the 17 December event occurred at the limb. Examination of earlier MDI magnetograms suggests this event also occurred in the weaker magnetic field in the periphery of the active region. This comparatively weak field could account for the thermal appearance of the hard X-ray spectrum, presumably due to the related low reconnection rate.

2. Observations

The 17 December event had an associated CME while the 19 May event had, in addition, an associated filament eruption observed in Hα. The RHESSI source was observed, in each case, above the cooler loops seen by EIS and co-located with the cusp of the XRT loops. In the 17 December flare we see a gradual increase in height of the XRT loops as well as a gradual rise in the RHESSI source location suggesting the height of the reconnection region is rising throughout the flare (see Fig. 1). As the loops increase in height in XRT a void appears at lower altitudes, co-located with the loops observed with EIS, suggesting the loops are cooling from X-ray temperatures to where they are seen in EUV. It is likely this is also the case for 19 May but the geometry prevents us from determining this. In both cases we see Doppler motions and non-thermal broadening in the EIS spectra. The RHESSI lightcurves show little or no impulsive be-

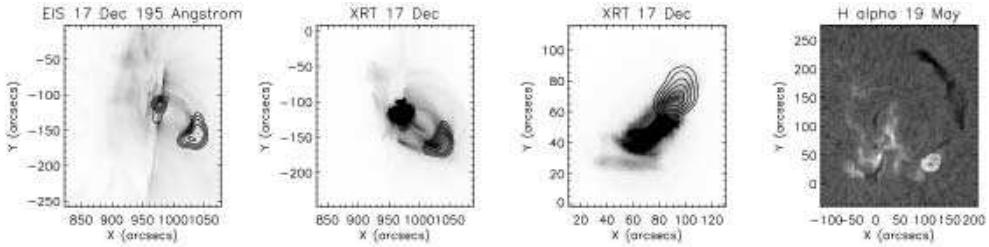

Figure 1. The left-most figure shows the 17th of December EIS 195 Å loops with the RHESSI source above. The next figure shows the XRT loops with the RHESSI source in the cusp. The middle right figure shows the 19th of May XRT loops with the RHESSI source in the cusp and the far right shows the position of the RHESSI source compared to the location of the pre-eruption filament.

haviour consistent with a thermal hard X-ray source. Spectral fitting confirms this giving temperatures of 18-20 MK for the 19 May flare and 14-16 MK for the 17 December event. The emission measures observed with RHESSI are low: 10^{46} cm^{-3} for 19 May and 10^{47} cm^{-3} for 17 December.

3. Conclusions

In two eruptive flares on 17 December 2006 and the 19 May 2007 we observe a thermal source in the hard X-ray regime. The source is located at the cusp of the soft X-ray looptops and there is no visible non-thermal or impulsive emission. As the hard X-ray source and thermal loops rise we see the loops below cooling and the observed flows are consistent with this. The lack of impulsive behaviour suggests that the X-ray emission is not consistent with electron beam driven chromospheric evaporation. Thus the thermal hard X-ray emission in particular may be connected to the termination shock of the reconnection outflow as this region rises post eruption.

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References

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