Radio and hard X-ray evidence of chromospheric evaporation

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Chromospheric evaporation



electron-beam driven evaporation: the chromopsheric materials after the electron beam heating show higher temperature, higher pressure, which drives the mass upflow along the loops.

Hα Ribbon

g









Ha ribbon & width





2004 Dec. 1 solar flare

- M1.1 class
- 07:00 ---- 07:20 ----07:41 UT
- N06E20 (disk event)



1. Seen on radio dynamics

high frequency cutoff and positively drifting(e.g. Aschwanden & Benz 1995)

2. Seen by EUV and Ha

I. EUV red-shift on the edge of ribbons (e.g. Czaykowska et al. 1999)

II. broad Ha width on the edge of ribbons(e.g.Li & Ding 2004)

3. Seen by HXR

I. HXR footpoint sources tend to rise up and finally merge together (limb event, e.g. Liu et al. 2006)

II. HXR footpoints move close and finally merge together (disk event, e.g. Ning et al. 2009)

2004 Dec. 1 solar flare

- 1.higher frequency cutoff
- 2.negatively drifting

3. drifting structures from positive to negative



Then, we analyze the HXR images to try to find the evidence of chromospheric evaporation.

2004 Dec. 1 solar flare



HXR (at 10-15 keV) shows the double footpoints movment closer and finally mergence into a single source with the same position of the SXR loop-top source (at 6-10 keV).

Projection correction



Assumption: semi-circular loop Evaporation speed: (S)347 km/s & (N)175 km/s

Summary

- 2004. Dec. 1 solar flare:
- **1. Radio dynamic spectra:**
 - higher frequency cutoff & negatively drifting
- 2. HXR emission:

double footpoints movement close & finally mergence into a single source at the same position as the looptop source.

The chromospheric evaporation can well explain such radio and HXR observations. (Ning et al. 2009) Thanks