Study of electron acceleration using a hard X-ray two-ribbon flare

Satoshi Masuda[1]; Satoshi Inoue[2]

[1] STEL, Nagoya Univ; [2] STEL, Nagoya Univ.

In H-alpha, so-called two-ribbon structure is observed during solar flares, especially long duration events. At that time, in the solar corona, an arcade structure (a group of loops connecting the two-ribbon) is often observed with soft X-ray and EUV imagers. These features are consistent with a standard magnetic reconnection model. In hard X-rays above 30 keV, however, such a two-ribbon structure is not observed even in an arcade-type flare. Instead of that, usually a pair of compact footpoint sources is observed. Asai et al. (2002) analyzed one of such events. Comparing the hard X-ray intensity and magnetic field strength along the two ribbons, they concluded that the difference of source structure between H-alpha and hard X-rays was due to the poor dynamic range of the hard X-ray telescope (HXT) on board Yohkoh. Among more than 3,000 flares observed with Yohkoh/HXT, only one event showed a two-ribbon structure in hard X-rays. We analyzed this unique event, which occurred on 14 July 2000, in order to obtain some hints for understanding acceleration mechanism of electrons in solar flares and to check the standard magnetic reconnection model. Comparing the hard X-ray images taken with Yohkoh/HXT and the magnetic field data taken SOHO/MDI, we investigated the spatial relationship along each ribbon between magnetic field strength and hard X-ray intensity, which is directly related to the efficiency of acceleration and the amount of accelerated electrons. The general tendency of their distribution patterns is similar, but there is no clear one-to-one correspondence. The hard X-ray intensity distribution along each ribbon is more uniform than that expected from the distribution of magnetic filed strength through standard magnetic reconnection models. To understand this result correctly, the magnetic connectivity between the two ribbons might have to be considered. For the simplest case, we assume that the brightest region in hard X-rays along each ribbons are magnetically connected, and the magnetic field lines in other regions are parallel to it. This assumption is very simple, but not very far from the real situation. Because the hard X-ray time profiles of the two brightest regions are very similar, and the EUV loops observed with TRACE are consistent of the magnetic field configuration assumed here. After considering this magnetic connectivity, the hard X-ray intensity and the magnetic field strength show much higher correlation. However, it is not enough to explain the reason why only this flare shows a two-ribbon structure.