

## **The flare on December 13, 2006 and the standard solar flare model**

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**Abstract.** The solar flare on December 13, 2006 was well observed by Hinode, other satellites and ground based telescopes. In this work, these observations are used to test the applicability of the standard solar flare model. This flare contains: a prominence eruption prior to the flare, two flare ribbons and increase of separation in time, soft X-ray arcade of loops and a cusp, and microwave non-thermal bursts and a gradual soft X-ray increase. Each of these phenomena supports the standard solar flare model. However, temporal development of these phenomena and their mutual and spatial relations show that they do not necessarily support the model.

Soft X-ray images taken by XRT/Hinode in the early phase of the event show sheared bright loops oriented nearly parallel to the polarity inversion line. Optical images (Ca H line) taken by SOT-FG/Hinode around the same time show bright flare ribbons which coincide with the outer boundary of the X-ray loops. Sheared soft X-ray loop brightening in the early phase of the event means that magnetic reconnection above the polarity inversion line is not needed for soft X-ray brightening or plasma heating. In the later phase of the event, soft X-ray images show that footpoints of the arcade coincide with the optical ribbons. This supports the standard model.

Microwave (spatially integrated) fluxes measured by Nobeyama Radio Polarimeters show impulsive bursts during the early phase of the event and soft X-ray fluxes measured by GOES satellite show gradual increase. The soft X-ray fluxes and the time-integrated microwave fluxes show similar temporal variations. This relation is called Neupert effect and causal relation between non-thermal and thermal plasmas has been discussed. However, microwave images taken by Nobeyama Radioheliograph at 17 and 34 GHz show that the microwave source is confined in a single loop, while soft X-ray images taken by XRT show sheared, in the early phase, and then arcade of loops distributed along the polarity inversion line. Hence non-thermal energy deposit and thermal plasma production are not causally related. We cannot find any enhancement of soft X-ray emission around the footpoints of the microwave loop.

This event tells us that simultaneous and multi-wavelength observations are inevitable to understand real solar flares.