HYDRODYNAMIC MODELING OF FLARES WELL-OBSERVED BY YOHKOH/SXT

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By comparing X-ray image sequences collected by Yohkoh/SXT and the hydrodynamic calculations made with the Palermo-Harvard code (Peres et al. 1982) we aim at physical insight of soft X-ray solar flares.

SXT flare images, with their simultaneous high spatial and temporal resolution, are very informative, but their physical content is not obvious, since the brightness distribution results from a non linear folding of the emission from a highly structured plasma through the instrument filters. In order to have a deeper interpretation of SXT data, our approach is to fold the results of our hydrodynamic model, providing the evolution of density, temperature and velocity along the loop, with the instrument spectral response in its various filters, to synthesize loop images as they would be detected by SXT, and therefore compare them directly to real images. The power and validity of this approach has already been shown in Peres & Reale (1993) and Reale & Peres (1995).

Here we try to model a specific event occurred in January 13, 1992 at 17:30 UT, selected as appropriate for modeling because it is a limb flare inside a semicircular loop, with very clear and steady geometry, and observed in detail by Yohkoh/SXT. This flare has been already analyzed by Masuda et al. (1994) and Doschek et al. (1995). In our study, we first derive relevant loop characteristics and parameters from the observation: the loop semilength is $\approx 2\ 10^9$ cm and the peak flare temperature ≈ 15 MK. For a first set of simulations, we have assumed a single flaring loop whose

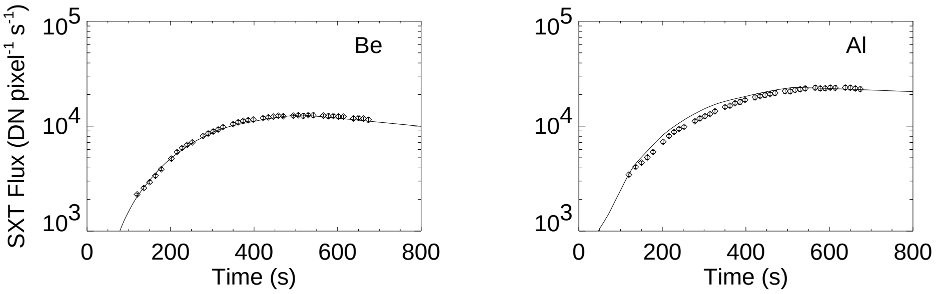

Figure 1. Model flare light curves in two SXT bands (cf. labels and text) obtained with the Palermo-Harvard model (solid line) and observed data (points). In the model we assume a flare heating constant for 300 s and then decaying with an e-folding time $\tau = 800$ s. The heating is deposited at the loop apex, with a characteristic gaussian width of 5 10^8 cm and maximum intensity of 2.2 erg cm^{-3} s^{-1}.

geometry does not change during the evolution, and a transient heating, located either at the apex or at the footpoints of the loop.

We compare the model results to the data in various SXT bands on two progressively higher levels of detail: i) the whole loop light curve; ii) the evolution of the loop brightness morphology during the flare. One of the first simulations has given a good fit to the light curves observed with the two hardest SXT filters (Al 12 μm and Be 119 μm), under the assumption of transient flare heating deposited at the loop apex (Fig.1). An equivalently good fit could not be obtained with a heating at the loop footpoints, proving that the light curves provide a diagnostics of the heating (Peres et al. 1987).

Fitting the brightness evolution in the images is a more difficult task. The observation shows us that the loop initially has very bright footpoints in both bands, and, after about 100 sec, the apex becomes steadily the brightest loop region. While the model can reproduce the initial brightening of the loop footpoints, a possible signature of the so-called *chromospheric evaporation*, such a long-lasting steady brightening at the loop apex is harder to simulate. Therefore, the interpretation of all the details of the emission during this flare requires further analysis and modeling.

References

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