MHD simulation of solar flare by applying analytical energetic fast electron model

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In order to study the evaporation of chromospheric plasma and the formation of hard X-ray (HXR) sources in solar flare events, we coupled an analytic energetic electron model with the multi-dimensional MHD simulation code MPI-AMRVAC. The transport of fast electrons accelerated in the flare looptop is governed by the test particle beam approach reported in Emslie et al. (1978), now used along individual field lines. Anomalous resistivity, thermal conduction, radiative losses and gravity are included in the MHD model. The reconnection process self-consistently leads to formation of a flare loop system and the evaporation of chromospheric plasma is naturally recovered. The non-thermal HXR emission is synthesized from the local fast electron spectra and local plasma density, and thermal bremsstrahlung soft X-ray (SXR) emission is synthesized based on local plasma density and temperature. We found that thermal conduction is an efficient way to trigger evaporation flows. We also found that the generation of a looptop HXR source is a result of fast electron trapping, as evidenced by the pitch angle evolution. By comparing the SXR flux and HXR flux, we found that a possible reason for the “Neupert effect” is that the increase of non-thermal and thermal energy follows the same tendency.