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# Generation of energetic protons and $\gamma$-ray line emission during solar flares

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Solar flares are associated with a strong enhancement of the emission of electromagnetic waves over a broad spectrum from the radio over the visible up to the hard X- and $\gamma$-ray range, indicating the generation of energetic electrons during flares. In addition, the occurrence of the $\gamma$-ray line emission during flares shows that protons are also accelerated at the flare. RHESSI imaging observations reveal that the enhanced hard X- and $\gamma$-ray line emission occur at the same time but their sources are spatially separated of about 20". That indicates that the electrons and protons are simultaneously accelerated but at different places in the corona. It is intended to explain that the energetic electrons and protons are generated at different location in the corona during flares. In the framework of the reconnection scenario of solar flares, jets of hot plasma shoot away from the reconnection region due to the relaxation of the new magnetic field configuration. If the jet velocity exceeds the local Alfvén speed, a standing shock wave, so-called termination shock (TS), can be established in the flare region. Such TS is able to accelerate both electrons and protons via the shock-drift acceleration (SDA). A fully relativistic study of SDA at the TS confirms that this mechanism is able to accelerate protons up to few tens of GeV under flaring conditions in the solar corona. This model implies different locations for electron and proton acceleration at the TS. That can explain the separation of the hard X- and $\gamma$-ray sources as really seen by RHESSI imaging observations. Such an agreement between the model and the observations supports the idea that the TS is the source of energetic particles as originally proposed by Tsuneta & Naito (1998).