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High resolution imaging of solar flare footpoints in white light and hard X-rays

Sam Krucker

Space Sciences Lab, UC Berkeley

Hugh Hudson

Space Sciences Lab, UC Berkeley

R.P. Lin

Space Sciences Lab, UC Berkeley

Abstract. We test the standard thick target beam scenario of solar flares using high resolution G-band (430 nm) observations (0.2 arcsec FWHM) taken by HINODE/SOT and hard X-ray observations (2.3 arcsec FWHM) from the Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI) of the December 6, 2006 GOES X9 flare. At both wavelengths, several co-spatial footpoint sources are seen on the flare ribbons that show similar relative intensities. This excellent correlation suggests that the suprathermal electrons producing the hard X-ray emission are also the source of energy for the white light emission, excluding energetic protons as a possible source. If both emissions indeed come from the same location, the higher resolution G-band observations suggest that the individual hard X-ray sources are unresolved. Using the footpoint area from the G-band images, the energy deposition rate by the hard X-ray producing electron beam in cold thick target approximation become enormous with values of $2\text{x}10^{12}$ erg/s/cm^2 for 25 keV ($9\text{x}10^{12}$ erg/s/cm^2 for 10 keV). This corresponds to a giant electron beam density within the hard X-ray source of $0.3\text{x}10^{10}$ cm^{-3} above 25 keV ($5\text{x}10^{10}$ cm^{-3} above 10 keV). These estimates pose serious questions for the thick-target beam interpretation. We will discuss alternative scenarios, including the idea of a purely non-thermal electron distribution as the source of the hard X-ray emission.