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

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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 2x10^{12} erg/s/cm^2 for 25 keV (9x10^{12} erg/s/cm^2 for 10 keV). This corresponds to a giant electron beam density within the hard X-ray source of 0.3x10^{10} cm^{-3} above 25 keV (5x10^{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.