ENERGY RELEASE AND PLASMA ENERGIZATION IN MAGNETIC RECONNECTION OUTFLOW REGIONS DURING THE PRE-IMPULSIVE PHASE OF A SOLAR FLARE

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One of the intriguing aspects of solar flares is how efficiently they energize electrons. The energization is believed to happen as a result of magnetic reconnection in the corona. One of the most direct observational signatures of energized electrons is found at X-ray wavelengths. However, due to the relatively low coronal density and low dynamic range of current instruments, the emission of these electrons from the acceleration site itself is difficult to observe. Here we present observations of electron energization in magnetic reconnection outflows during the pre-impulsive phase of a solar flare during which two X-ray sources, one above the presumed reconnection region and one below, were observed. Imaging spectroscopy X-ray observations from RHESSI are combined with EUV images from SDO/AIA and forward-fitted simultaneously to determine the mean electron distribution function as a function of time over an energy range from 0.1 keV up to several tens of keV. The measured electron distribution spectrum is consistent with a kappa-distribution with $\kappa = 3.5 - 5.5$. The spectral evolution suggests that electrons are accelerated to progressively higher energies in the source above the reconnection region, while in the source below, the spectral evolution suggests density increase due to evaporation and heating. The main mechanisms by which energy is transported away from the source regions are conduction and free-streaming electrons. The latter dominates by more than one order of magnitude, suggesting efficient acceleration even during this early phase of the flare.