Differential emission measure as a sum of gamma and kappa distribution functions in solar flares based on X-ray and EUV observations

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In recent years there is a growing interest in various analytical distributions, for example, a kappa distribution, which is close to the Maxwellian distribution at low energies and have a power-law tail at high energies [e.g. (Kašparova & Karlický 2009; Oka et al. 2013, 2015)]. For energies much larger than the energy k_BT, it approaches a power-law spectrum and for kappa-index close to infinity - a Maxwellian distribution. It should also be noted that the kappa-distribution is supported by theoretical considerations on the acceleration of particles in collisional plasmas. In addition to kappa-distribution to describe a differential emission measure (DEM), mean electron flux spectrum $\langle nVF \rangle$ and obtain the plasma parameters (emission measure (EM), temperature (T)) a gamma-distribution was introduced [Motorina & Kontar, 2015]. It has an analytical representation of DEM and $\langle nVF \rangle$, which contains the modified Bessel function of the second kind, with three parameters (EM, T_{max}, spectral index α) and approaches to the Maxwellian distribution when α tends to infinity.

EUV observations with Atmospheric Imaging Assembly on board the Solar Dynamic Observatory (AIA/SDO) and X-ray observations with Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI) provide information about hot flaring plasma and energetic particles accelerated during solar flares. RHESSI is more sensitive to hot plasma above ∼10 MK and AIA/SDO characterizes the thermal response at lower temperatures at∼ 0.6-16 MK. Simultaneous observations with AIA/SDO and RHESSI allow to investigate the energy distribution of electrons heated/accelerated over a wide energy range from ∼0.1 keV up to tens of keV [Inglis & Christe, 2014, Motorina & Kontar, 2015, Battaglia et al. 2015]. Using both gamma- and kappa-DEM functions based on RHESSI and AIA/SDO observations one limb flare event was considered. The results of temporal evolution of plasma parameters, DEM functions and mean electron flux spectrum are discussed.

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