MAS20-2020-000164

Abstract for an Invited Paper
for the MAS20 Meeting of
the American Physical Society

Solar flare energetic electron diagnostics: Beyond hard X-ray power-law spectra

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During solar flares, a large flux of highly energetic electrons is transported from the tops of reconnecting magnetic flux tubes toward the lower solar atmosphere. Substantial progress has been made in understanding the interaction of these flare-accelerated energetic electrons with their environment through observations of their X-ray spectra using the Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI). I will review previous conclusions regarding the accelerated electron distribution and the environment in which the nonthermal beam propagates, with a focus on recent advances about how observational deviations from single power-law distributions provide new constraints on particle propagation mechanisms and the accelerated distribution of electrons. I will present recent observational and theoretical progress toward understanding the following fundamental questions: How are the acceleration and propagation regions coupled? How much energy is deposited and at what depths in the solar atmosphere? To what extent is the shape of X-ray spectra, especially the flattening observed at lower energies (a few tens of keV) a consequence of the acceleration mechanism or propagation processes?