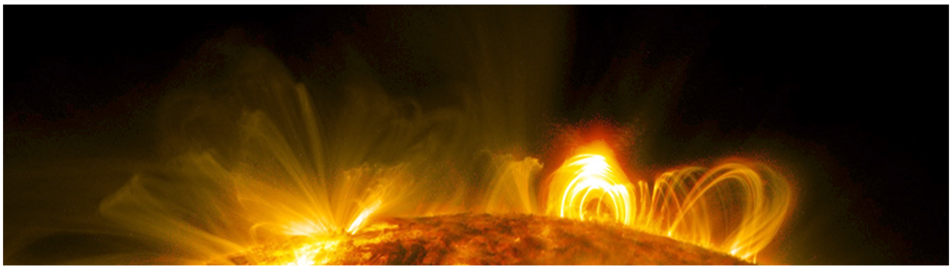

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Electron acceleration in solar flares

Tuesday, 16 November 2021 09:45 (30 minutes)

Magnetic reconnection is a significant driver of energetic particles in flares both on the sun and the broader universe. Single x-line models fail to explain the large number of energetic electrons seen in flares. However, simulations reveal that reconnection becomes turbulent in the flare environment, consistent with observations of non-thermal broadening of spectral lines. Magnetic energy release and particle acceleration therefore take place in a multi-x-line environment. A major surprise is that the energy gain of the most energetic electrons is dominated by Fermi reflection in growing and merging magnetic flux ropes rather than parallel electric fields. The implication is that the kinetic scale boundary layers that control the parallel electric field are not important in flare energy release where the separation of scales can reach 10^{10}. A new computational model, *kglobal*, has been developed that blends MHD dynamics with electron particles but eliminates all kinetic scales. Feedback of the energetic electrons on the MHD is included. Simulations of reconnection in a macro-scale system reveal electron powerlaw distributions that extend nearly three decades in energy and that the dominant control parameter is the ambient out-of-plane (guide) magnetic field. PIC models fail to produce such spectra because of inadequate separation of scales. The electron spectral indices match those measured by RHESSI and EOVSA for the September 10, 2017, flare. Major challenges are to understand how relativistic electrons are "confined" as they gain significant energy. The results suggest that modeling of particle acceleration in realistic macro-scale flare geometry will be possible.

Primary author: DRAKE, James (University of Maryland, College Park)

Co-author: THE SOLFER TEAM

Presenter: DRAKE, James (University of Maryland, College Park)

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