Project Details

ROSES ID: NNH20ZDA001N
Selection Year: 2020
Program Element: Focused Science Topic

Topic: The Origin and Consequences of Suprathermal Particles that Seed Solar Energetic Particles

Project Title:
The Acceleration of Energetic Particles in Solar Flares and Their Transport in Solar Eruption Regions

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Summary:
Science goals and objectives:
This proposal's overarching goal is to understand how the flare-accelerated particles contribute to the seed population of large Solar Energetic Particle (SEP) events. While magnetic reconnection is believed to be the driving process for the solar eruption and associated release of magnetic energy, how suprathermal particles get accelerated in the flare region is still not well understood. The accelerated particles travel through complex magnetic fields in the eruption region, get released into heliospheric space, and may actively contribute to large solar energetic particle (SEP) events as a seed population. How this happens is also poorly known and holds the key to further understanding of SEP events. Our proposed research will connect physics understanding of particle acceleration in flare reconnection and large-scale magnetic field evolution and particle release and transport process in the eruption region, including coronal mass ejection (CME) initiation in the very early stage of SEP events. With this study, we will unravel the role of solar flares in large SEP events. The work will provide critical information about how flare related "seed" particles are generated and contribute to large SEP events.

Methodology:
We will achieve the science goals through several well-defined and inter-connected investigations with various theoretical and numerical modeling efforts, including carrying out self-consistent kinetic simulations of local reconnection regions, performing sophisticated magnetohydrodynamic (MHD) simulations of the solar eruption region, and calculating the evolution of high-energy particle distributions in electromagnetic fields obtained from the MHD simulations. With these efforts, we will obtain the spatiotemporal distribution of flare-accelerated particles in the corona region during large-scale solar eruption and quantify how they can further feed into the CME-shock system and contribute to the interplanetary seed particle population.

Relevance and potential contributions:
This proposal directly addresses the scientific objectives of the focused science topic (FST) #3: The origin and consequences of suprathermal particles that seed solar energetic particles by studying the roles of solar flares in large SEP events and investigating particle acceleration mechanisms for producing suprathermal particles in solar flares. In the focused science team, our unique suite of numerical tools will allow us to interact and collaborate closely with team members on observation, theory, and other numerical modeling components to study energetic particle acceleration and transport in a systematic approach. We will provide the team with new models for flare energetic particle production and release and the evolution of SEP composition in space and time. We will clarify the origin and distribution of seed particles and their roles in producing large SEP events.

Publication References:

no references