Project Details

ROSES ID: NNH19ZDA001N
Selection Year: 2019
Program Element: Focused Science Topic

Topic: Variable Radiation Environment in the Dynamical Solar and Heliospheric System

Project Title:
High-energy Particle Acceleration by Extreme Coronal Shocks

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Summary:
Science Goals and Objectives
The primary objective of this proposal is to understand the acceleration of high-energy solar energetic particles (SEPs) by extremely fast shocks driven by coronal mass ejections (CMEs). These most extreme SEP acceleration gives rise to ground level enhancement events with an increase of energetic particle flux at hundreds of MeV. Our theoretical and numerical investigations will address the physics involved the most intense and highest energy SEP events which can have important effects on Earth and spacecraft hardware.

Methodology
We will model low-energy proton injection at shocks using hybrid simulations (kinetic protons and fluid electrons) of coronal shocks, with different magnetic field orientation in the upstream region. This is to determine the injection process from a pool of thermal solar wind or pre-accelerated superthermal particles. High-energy proton acceleration by diffusive shock acceleration with injection constraint by outcome of the hybrid simulations. Again consider the importance of upstream magnetic field configuration.

Proposed Contributions to the Focused Science Team Effort
The project directly addresses Science Goal #1 of the 2012 NAS Heliophysics Decadal Survey: Determine the origins of the Sun's activity and predict the variation in the space environment. It also fits well with the LWS program objective: Understand how the Sun varies and what drives solar variability. We will provide to the Team new models and understandings of high-energy particle acceleration. We will clarify for the Team the roles of fast CMEs in producing most energetic particles. Our proposed work is essential for determining the variability and predictability of the SEP environment. We will combine our first-principles based studies with the observational studies of the Team to make substantial progress on achieving the FST goal of understanding the acceleration and transport of SEPs.

Publication References:

no references