Project Details

ROSES ID: NNH10ZDA001N
Selection Year: 2011
Program Element: Focused Science Topic

Topic: Factors that Control the Highly Variable Intensity and Evolution of Solar Particle Events

Project Title:
Understanding the Variable Intensity and Evolution of CME-Shock-Accelerated Solar Energetic Particles

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Summary:
Comprehensive solar energetic particle (SEP) measurements of the last 10-15 years have clearly revealed that CME-driven shock-accelerated SEP events vary dramatically, not only in terms of their peak intensities and fluences, but also in their spectral shape, elemental composition, rise time and peak intensity times. Orders of magnitude variations have been observed in the proton intensities and Fe/O abundances of SEP events associated with CMEs having similar speeds. In order to improve the ability to accurately forecast intense SEP events and the onset of hazardous radiation conditions, it is critical to assess and understand the contributions to SEP variability made by factors such as CME speed, spatial extent, mass, and kinetic energy; pre-existing interplanetary conditions; shock strength, orientation, spatial extent and evolution; and the presence and characteristics of seed particle populations.

We propose to combine the high-sensitivity measurements made by SEP sensors on the ACE, STEREO, and GOES spacecraft with detailed remote sensing observations of CMEs using instruments on SOHO and STEREO to investigate and characterize the influence of various factors (such as those listed above) on the properties of SEP events. The study s multipoint focus, obtained by utilizing both STEREO and near-Earth spacecraft, will result in a better understanding of the longitudinal evolution of such factors as well as lead to more accurate determinations of CME characteristics. Using results from this study we will suggest improvements for current forecasting tools as well as identify possibly useful or critical measurements to be made in the future.

By working closely with other FST teams we expect to contribute significantly to the joint effort of understanding the causes of SEP variability and to the developing of algorithms and strategies that will allow space weather forecasters to evaluate the potential radiation hazards following the eruption of a CME using the first few hours of real-time CME data. We will provide the FST team with a number of data products related to SEP and CME properties, both as measured by a single spacecraft and, when possible, measured simultaneously at different longitudes relative to the solar source. We will work with the FST teams to adjust our data products in ways deemed most useful to the team effort. Additionally we will provide observational tests for any modeling studies performed under this FST solicitation and secondary measurements for other observational studies as appropriate.

We anticipate that our proposed work will benefit from expertise provided by other teams, including theoretical and modeling knowledge. Studies of solar wind turbulence and its variability, the solar context in which SEP events occur, and radio investigations of coronal and interplanetary shocks will compliment our own work. Such collaborations will augment the knowledge gained by the teams independently.

Within our team we have members of the SOHO, STEREO, ACE, and Wind instrument teams. This allows us complete access to the relevant data and brings to the investigation significant expertise and experience in combining data sets and intercalibrating measurements from different sensors and separate spacecraft.

Publication References:

Summary: no summary

Reference: Li, G.; Moore, R.; Mewaldt, R. A.; Zhao, L.; Labrador, A. W.; (2012), A Twin-CME Scenario for Ground Level Enhancement Events, Space Science Reviews, Volume 171, Issue 1-4, pp. 141-160, doi: 10.1007/s11214-011-9823-7