Project Details

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Program Element: Focused Science Topic

Topic: Joint Focus Topics with Planetary Science: Extreme Space Weather Events in the Solar System

Project Title:
Onset Times, Spectra, and Abundances of Historic Large Solar Energetic Particle Events

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Summary:
We propose to study large solar energetic particle (SEP) events, emphasizing the ground level events (GLEs) where GeV protons create radiation sufficient to penetrate the Earth s atmosphere all the way to ground level. These events present a radiation hazard to men and equipment in space and to the passengers and crew of aircraft on polar routes. Spacecraft observations of the onset timing, energy spectra, and element abundances have not previously been studied systematically for most of the 46 GLEs that occurred from 1972 to 2005. Onset times for particles of different velocity define the magnetic path length traversed and the initial particle acceleration time, which we can compare with the timing of H , Radio, and X-ray emissions to distinguish flare and shock acceleration. Previously unanalyzed timing data from Pioneer, IMP, ISEE, Helios, and Voyager spacecraft will be recovered from archived data to reconstruct properties of the events, and will be combined with observations of recent GLEs using data from Wind and ACE. A few of the early GLEs were viewed from multiple spacecraft, at as many as 5 different locations in the inner Heliosphere, allowing a study of spatial variations that has been difficult to duplicate for GLEs during the last 20 years. Acceleration onset times for spacecraft magnetically connected to different solar longitudes may vary as the expanding shock wave encounters them. We believe that multi-spacecraft onset timing can be a powerful new tool to investigate the physics of particle acceleration in GLEs and in SEP events generally. The behavior of an SEP events viewed at different longitudes and different radial distances (e.g from ~0.3 AU to the orbit of Mars) will be studied.

Publication References:

Summary: no summary

Reference: Reames, Donald V.; Ng, Chee K.; (2010), Streaming-limited Intensities of Solar Energetic Particles on the Intensity Plateau, The Astrophysical Journal, Volume 723, Issue 2, pp. 1286-1293, doi: 10.1088/0004-637X/723/2/1286