Project Details

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Project Title:
Connecting Shock Parameters to the Radiation Hazard from Energetic Particles

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Summary:
The highest intensities of energetic particles have been observed at interplanetary shock passage. These produce the greatest radiation hazard to astronauts. We focus on shocks driven by ejected material from the Sun, which from the start of the ejection, are associated with particle acceleration, in some cases into GeV energy levels. The study of the relationship between particle acceleration and the spatial extent of the shock takes advantage of an available, extended coverage of Helios and IMP-8 of the solar cycle 21st, including the solar maximum interval near 1980 with many solar energetic events. First we identify the character of the shock by estimating the likely location of the monitor relative to the shock nose and comparing the shock strength at three wide by different locations in longitude. Second we take into consideration the presence or absence of its driver, and the intensity of the energetic particle seed population at the time of coronal mass ejection (CME). Shock measurements, then are organized by their spatial extent, proximity to the shock-nose, and identified presence of energetic particle seed population at the start of the event. For these categories we identify the relationship between energetic particle acceleration at the shock are the local shock speed and strength evaluated using shock parameters consistent with the thermodynamic Rankine-Hugoniot condition. For those shocks observed with Wind, GEOTAIL and IMP-8, and later also with ACE, we perform a correlation study of the local changes in the upstream solar wind conditions at the passage of the shock and their influence on the acceleration process of energetic particles. During the Wind era it is also possible to obtain an almost continuous coverage of the likely source of the solar transient (CME observations with LASCO/SOHO, and the tracking of the shock in the interplanetary medium with WIND/WAVES instrument.) The understanding we achieve from the proposed study will provide the space community with the skill to predict levels of radiation at shock passage when the initial radiation levels, shock front extension, and ejecta speed at Sun are measured remotely near the Sun. The proposed work addresses the need to improve our scientific knowledge of space environment conditions with a new, multi-spacecraft use of proved observational techniques.

Publication References:

no references