Project Details

ROSES ID: NRA-NNH04ZSS001N
Selection Year: 2005
Program Element: Focused Science Topic

Topic: To relate solar-energetic particles to their origin at the sun and inner heliosphere.

Project Title:
Data Analysis and Modeling of Large Solar Energetic Particle Events of Cycle 23

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Summary:
Shock waves driven by coronal mass ejections are presently believed to be responsible for producing large gradual solar energetic particle events or SEPs that can pose significant radiation hazard for humans and technological systems near Earth. However, our present ability to accurately predict various properties of SEPs (e.g., peak intensities, energy spectra, and composition) is somewhat limited. Reliable prediction of these properties depends on developing a detailed understanding of particle acceleration at CME-driven shocks and their subsequent transport out to 1 AU, understanding and modeling the propagation of these shocks through the interplanetary medium, characterizing the ambient solar wind plasma, the magnetic field, and the interplanetary suprathermal ion population through which these CMEs propagate en route to Earth, and specifying key properties such as mass, momentum, and speed of the CMEs near the Sun. We propose a detailed experimental study combined with an extensive modeling effort focused toward understanding the event-to-event variability in the fluxes, spectra, and composition of various ion species during several large gradual SEP events of cycle 23. Specifically, we will survey the ACE/ULEIS and ACE/SIS heavy ion composition and energy spectra over the 0.1-100 MeV/n. energy range in SEP events and characterize them in terms of properties of the associated CMEs, flares, IP shocks, and the local interplanetary magnetic field fluctuations. We will then use the observed properties of the CMEs, IP shocks, and turbulence as inputs to constrain both 1D and 2D time-dependent shock acceleration models and compare their predictions with the measured ion intensities, composition, and spectra. This study will clearly improve current understanding of the physical processes responsible for producing SEP events and will provide a sound framework for other CME and shock acceleration models. This proposal is directly related to the focused science topic (d) of the LWS TR&T Program " to relate solar-energetic particles to their origin at the Sun and inner heliosphere, and therefore addresses a highly elusive problem for Space Weather.

Publication References:

Summary: no summary

Reference: Desai et al. 2006; ApJ Letters 645, L81, 2006

Summary: no summary

Reference: Allegrini et al. 2008; ApJ vol. 682, pp. 690-695

Summary: no summary

Reference: Ng & Reames, 2008 October 20, ApJ Letters

Summary: no summary

Reference: Desai, M. I.; Mason, G. M.; Gold, R. E.; Krimigis, S. M.; Cohen, C. M. S.; Mewaldt, R. A.; Mazur, J. E.; Dwyer, J. R.; (2007), Evidence for a Two-Stage Acceleration Process in Large Solar Energetic Particle Events, The Composition of Matter: Symposium honouring Johannes Geiss on the occasion of his 80th Birthday. By Rudolf von Steiger, George Gloeckler and Glenn M. Mason. Previously published in Space Science Reviews, Volume 130, Issues 1-4, 2007. ISBN-13 978-0-387-74183-3. Published by Springer Science+Business Media, LLC, New York, NY USA, 2007, p.243, doi: 10.1007/978-0-387-74184-0_24

Summary: no summary

Reference: Desai, M. I.; Mason, G. M.; Gold, R. E.; Krimigis, S. M.; Cohen, C. M. S.; Mewaldt, R. A.; Mazur, J. E.; Dwyer, J. R.; (2007), Evidence for a Two-Stage Acceleration Process in Large Solar Energetic Particle Events, Space Science Reviews, Volume 130, Issue 1-4, pp. 243-253, doi: 10.1007/s11214-007-9219-x

Summary: no summary

Reference: Desai, M. I.; Mason, G. M.; Gold, R. E.; Krimigis, S. M.; Cohen, C. M. S.; Mewaldt, R. A.; Dwyer, J. R.; Mazur, J. E.; (2008), Seed Populations for Large Solar Particle Events Of Cycle 23, PARTICLE ACCELERATION AND TRANSPORT IN THE HELIOSPHERE AND BEYOND: 7th Annual International Astrophysics Conference. AIP Conference Proceedings, Volume 1039, pp. 124-130, doi: 10.1063/1.2982434