EP 7: Solar-Terrestrische Beziehungen

Time: Tuesday 16:15–18:45 Location: H46

Invited Talk EP 7.1 Tue 16:15 H46

Space Weather Monitoring by Ground and Space based GNSS Techniques — •Norbert Jakowski and Christoph Mayer — Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Institut für Kommunikation und Navigation, Kalkhorstweg 53, 17235 Neustrelitz

Since the availability of GPS signals in the early nineties, ionosphere sounding techniques using Global Navigation Satellite Systems (GNSS) such as GPS and GALILEO are well established. Due to the dispersive nature of the ionospheric plasma, dual frequency signals can effectively be used to derive the integral of the electron density along the ray path called Total Electron Content (TEC).

Dense networks of ground receivers allow constructing regional and global TEC maps which may effectively be used to study the solar control of ionospheric processes. GNSS receivers installed on Low Earth Orbit (LEO) satellites may be used to derive vertical electron density profiles from the satellite orbit height downward by radio occultation measurements. The space based navigation signals received by the zenith viewing antenna onboard a LEO satellite provide a unique data set to reconstruct the topside ionosphere/plasmasphere electron density distribution.

The talk reviews specific observations obtained in DLR Neustrelitz by ground based GPS measurements in Europe and at both polar regions. Reported are results obtained from space based radio occultation measurements in the limb sounding mode and navigation measurements onboard the German geo-research satellite CHAMP.

EP 7.2 Tue 16:45 H46

Cluster observations of energy conversion in the plasma sheet — •Octav Marghitu[1,2], Maria Hamrin[3], Berndt Klecker[1], and Kjell Rönnmark[3] — [1]Max-Planck-Institut für extraterrestrische Physik, Garching, Germany — [2]Institute for Space Sciences, Bucharest, Romania — [3]Physics Department, Umeå University, Umeå, Sweden

The Cluster mission provides, for the first time, a platform for the *in-situ* investigation of energy conversion in key magnetospheric regions. Cluster data can be used to infer the electric field and current density vectors, $\mathbf{E}$, $\mathbf{J}$, and further to evaluate the power density, $\mathbf{E} \cdot \mathbf{J}$. When $\mathbf{E} \cdot \mathbf{J} < 0$ the plasma behaves as a generator, and mechanical energy is converted into electromagnetic energy. When $\mathbf{E} \cdot \mathbf{J} > 0$ the plasma behaves as a load and the conversion sense is reversed. We present preliminary results of a search for energy conversion events, using plasma sheet Cluster data from the summer and fall of 2001. As expected, the North–South spacecraft crossings, at about $18 R_E$, show most of the time a large scale load character. Concentrated loads with high power densities can be located around the neutral sheet, in particular close to midnight. Both concentrated load and generator regions, with low to moderate power densities, are observed in the plasma sheet boundary layer. Energy conversion appears to be always associated with the intensification of the bulk plasma flow, and sometimes with temperature anisotropy.

EP 7.3 Tue 17:00 H46

Determining orientation, thickness, and velocity for a 2D, non-planar magnetopause — •Adrian Blăgău[1,2], Berndt Klecker[1], Götz Paschmann[1], Manfred Scholer[1], Stein Haaland[1,3], Octav Marghitu[2,1], and Elizabeth Lucek[4] — [1]Max-Planck-Institut für extraterrestrische Physik, Garching, Germany — [2]Institute for Space Sciences, Bucharest, Romania — [3]University of Bergen, Norway — [4]Imperial College, London, UK

Since the Cluster mission became operational we benefit from correlated measurements taken simultaneously at four points in space. The differences in the position and time of the satellites' encounter with the terrestrial magnetopause (MP) can be used in a timing method to infer its orientation, thickness and velocity. This multi-spacecraft technique, which assumes a planar MP, proves reliable and offers an independent check for various single-spacecraft techniques. We will present a case when the techniques of Minimum Variance Analysis on the magnetic field (MVAB), and Minimum Faraday Residue (MFR) provide different individual MP normals, included approximately in the same plane. Such a configuration is not necessarily related to experimental errors, but can have natural causes like a local bulge/indentation in the MP or a large amplitude traveling wave on this surface. The timing technique yields a normal well apart from the single-spacecraft normals, indicating that the underlying planar assumption is questionable. We explain our case by considering a 2D, non-planar magnetopause and discuss the influence of such a geometry on the results based on MVAB, MFR and DeHoffmann-Teller techniques.

EP 7.4 Tue 17:15 H46

Toward understanding the rise profile of coronal mass ejections — •Bernhard Kliem[1], Tibor Toeroek[2], Christopher Elmore[3], Carolus J. Schrijver[3], and Alan M. Title[3] — [1]Astrophysikalisches Institut Potsdam — [2]Mullard Space Science Laboratory, University College London — [3]Lockheed Martin Advanced Technology Center, Palo Alto, USA

The nature of the rapid, nonlinear rise of erupting prominences that evolve into fast ($\gtrsim 700$ km s^{-1}) coronal mass ejections has been the subject of intense study. Exponential and power-law rise profiles were successfully fitted to various observations, but the quality of the height measurements has so far been insufficient to permit a distinction between the two laws. Theory predicts an initially exponential rise if the eruption is driven by an instability, and indicates a power-law rise after a catastrophic loss of equilibrium.

We present a detailed analysis of two filament eruptions observed with high precision in the EUV by the *TRACE* satellite. In both cases the morphology of the eruption suggests the action of the torus instability but a power law with an index near 3 gives a better fit than an exponential. We found, both semi-analytically and in MHD simulations, that a substantial initial velocity can modify the expansion profile of the instability such that it gets closer to a power law (with the fitted index value) than to an exponential in the observed range. While this agreement is encouraging, the result undermines the hope that the good coverage of rise profiles, expected from combined *TRACE* and *STEREO* data, will permit a distinction between the models.

EP 7.5 Tue 17:30 H46

Comparison of calculated CME parameters based on Neutron monitor measurements with measured data — •Manfred Thomann, Christian Steigies, Robert Wimmer-Schweingruber, and Bernd Heber — Christian Albrechts Universität, 24098 Kiel, Germany

Solar energetic particle events have been measured by neutron monitors for many years. Only 70 of these increases are detected until now and in comparison with intensity decreases, called Forbush decrease (Fd), they are "'rare"'. While the corresponding plasma parameters can only be measured by satellites, neutron monitors provide the possibility to determine the particle environment outside the earth's magnetosphere by simulation calculations. The energy range detected by neutron monitors is defined by the cutoff rigidity for the station, which avoids measurements of particles with lower rigidity, and the detection efficiency for different energies, so different stations see different parts of the energy spectra. Using the world wide neutron monitor network data this presentation will show possibilities and limitations of simulation calculations by means of events during highly and slightly disturbed magnetosphere.

EP 7.6 Tue 17:45 H46

Synthetische Radio Karten von Koronalen Massenauswuerfen (CMEs) in der unteren Sonnenkorona — •Joachim Schmidt — Am Waldrand 2, 37154 Northeim

Es werden synthetische Radiokarten von CME-Beobachtungen in der Sonnenkorona diskutiert, wie sie mithilfe von 2 1/2 D und 3 D magnetohydrodynamischen Simulationen abgeleitet werden koennen. Ein Film in 3 D wird ein zeitlich aufgeloestes tomographisches Bild der Plasmastrahlung einer solchen Eruption zeigen, wie sie mithilfe von Radioteleskopen wie dem niederlaendischen LOFAR (LOw Frequency ARray) beobachtet werden koennen. Solche Radiokarten koennen dazu benutzt werden, Schockwellen zu verfolgen, die von CMEs erzeugt werden. Diese Schockwellen sind fuer die Beschleunigung von hochenergetischen Teilchen im Sonnenwind verantwortlich, tragen signifikant zum Energietransport von der Sonne zum interplanetaren Raum bei und koennen Zerstoerungen in elektrischen Anlagen hier auf der Erde bewirken. Ein zweiter Film wird ein animiertes tomographisches

Bild eines solchen Schockwellenereignisses zeigen.

EP 7.7 Tue 18:00 H46

First light from the Solar Electron and Proton Telescop — •Bernd Heber[1], Reinhold Müller-Mellin[1], Stephan Böttcher[1], Robert Wimmer-Schweingruber[1], Jan Gieseler[1], Andreas Klassen[1], Raul Gomez-Herrero[1], Horst Kunow[1], and Wolfgang Dröge[1,2] — [1]Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität Kiel, Germany — [2]Institut für Theoretische Physik und Astrophysik, Universität Würzburg, Germany

The Solar Electron and Proton Telescope (SEPT) onboard the twin STEREO spacecraft will detect electrons from 35 to 485 keV, and protons from 75˜keV to 7 MeV. There are two sensors per spacecraft. Each sensor unit consists of a dual double-ended magnet/foil solid state detector particle telescope. This technique allows to separately measure electrons and ions in the energy ranges given above. One of the major scientific goals of the STEREO mission is the investigation of particle acceleration and propagation from the Sun to the Earth. Electrons, as measured by the SEPT, play a crucial role in the study of energetic processes on the Sun as they provide a direct link to the sites of particle acceleration. The semiconductor detectors of SEPT are currently saved against Sun illumination by titanium doors which will be opened after the last spacecraft manoeuvre in January 2007. In this contribution we will report on the first SEPT measurements.

EP 7.8 Tue 18:15 H46

Electron acceleration by the reconnection outflow shock during solar flares — •Gottfried Mann — Astrophysikalisches Institut Potsdam, An der Sternwarte 16, D-14482 Potsdam

During solar flares a large amount of nonthermal electromagnetic radiation up to the $\gamma-$ray range is emitted from the corona implying the generation of energetic electrons. Within the framework of the magnetic reconnection scenario, jets appear in the outflow region and can establish standing fast-mode shocks if they penetrate with a super-Alfvénic speed into the surrounding plasma. These shocks can be a source of energetic electrons. During the solar event on October 28, 2003 an enhanced flux of hard X− and $\gamma-$rays up to an energy of 10 MeV has been observed by the INTEGRAL spacecraft indicating the generation of relativistic electrons. The radio signature of a standing shock wave appeared simultaneously with the enhanced hard X− and $\gamma-$ray fluxes. Here, this shock is assumed to be the source of the highly energetic electrons needed for the hard X− and $\gamma-$ray as well as the nonthermal radio radiation. The electrons are energized by shock drift acceleration, which is necessarily treated in a fully relativistic manner. After acceleration, the electrons travel along the magnetic field lines towards the denser chromosphere, where they emit hard X− and $\gamma-$ray radiation via bremsstrahlung.

EP 7.9 Tue 18:30 H46

Acceleration and Transport of Energetic Particles in the 20 January 2005 Solar Event — •Wolfgang Droege[1,2], Bernd Heber[1], Andreas Klassen[1], Christian Steigies[1], Manfred Thomann[1], and Julia Kartavykh[3] — [1]Institut für Experimentelle und Angewandte Physik, Universität Kiel, Leibnizstr. 11, 24098 Kiel — [2]Institut für Theoretische Physik und Astrophysik, Universität Würzburg, D-97074 Würzburg — [3]Ioffe Physical-Technical Institute, St. Petersburg 194021, Russia

The 20 January 2005 solar event produced one of the hardest spectra of accelerated particles in space, and was accompanied by the largest flare ever observed. We model the fluxes of interplanetary particles observed on Wind, SOHO, Ulysses, and neutron monitors, and reconstruct their injection time histories and energy spectra. We compare our results with gamma-ray signatures of particles accelerated in the associated flare and discuss the question whether the two populations or parts of them origin in the same acceleration process. An understanding of a possible flare contribution to interplanetary particle fluxes in the 20 January 2005 event, which was one of the best observed events with modern instruments, might provide new insights into the acceleration of high-energy particles at the Sun and their transport in the Heliosphere.