EP 12: Heliophysics II

Zeit: Donnerstag 14:00–15:00 Raum: Zahnklinik

EP 12.1 Do 14:00 Zahnklinik

Modulation of galactic cosmic ray protons and electrons during an unusual solar minimum — •Bernd Heber[1], Andreas Kopp[1], Jan Gieseler[1], Reinhold Müller-Mellin[1], Horst Fichtner[2], and Klaus Scherer[2] — [1]Christian-Albrechts-Universität Kiel — [2]Ruhr-Universität Bochum

During the latest Ulysses out-of-ecliptic orbit the solar wind density, its pressure and the magnetic field strength have been lowest ever observed in the history of space exploration. Since cosmic ray particles respond to the heliospheric magnetic field variations in the expanding solar wind and its turbulence, a weak heliospheric magnetic field, low plasma density, and pressure is expected to cause the smallest modulation since the 1970's. In contrast to this expectation the galactic cosmic ray proton flux measured in 2008 at the Ulysses spacecraft and Earth does not exceed the one observed in the 1960's and 1980's significantly. In contrast to the protons flux, that of galactic cosmic ray electrons exceeds those measured during the 1990's by 10% after having corrected the data for Ulysses' latitude and radial distance. Although solar activity, as indicated by the Sunspot number, has been low, the tilt angle remained at intermediate values. Therefore, so far, current sheet, gradient and curvature drifts prevent the galactic cosmic ray flux to rise to real solar minimum values. The observed galactic cosmic ray intensities at 2.5 GV should increase by a factor of 1.25 ± 0.05 if the tilt angle would reach values below 10 degrees.

EP 12.2 Do 14:15 Zahnklinik

Scattering of solar energetic electrons in interplanetary space — •Christian Vocks and Gottfried Mann — Astrophysikalisches Institut Potsdam

Solar energetic electrons are observed to arrive between 10 and up to 30 minutes later at 1 AU, as compared to the expectation based on their generation in a solar flare and the travel time along the Parker spiral. Both a delayed release of the electrons at the Sun and scattering of the electrons in interplanetary space are discussed as underlying mechanisms. We have investigated to what extent scattering of energetic electrons in interplanetary space does influence the arrival times of energetic electrons at a solar distance of 1 AU, as a function of electron energy and for different scattering models. A kinetic model for electrons in interplanetary space is used to study the propagation of solar-flare electrons injected into the corona. The electrons are scattered by resonant interaction with a whistler-wave spectrum that is based on observed magnetic field fluctuation spectra in the solar wind.

The simulation results show a significant influence of the scattering on electron arrival times. Electrons with energies in the range of several tens of keV are delayed up to about one minute for a pure pitch-angle scattering model. It is demonstrated that this simplification is not applicable, and the full quasi-linear diffusion equation needs to be considered. This reduces the delays to values below 30 s. Thus, it follows from these numerical studies that scattering of electrons in interplanetary space cannot explain the observed delays of about 600 s, unless an unrealistic wave spectrum is assumed.

EP 12.3 Do 14:30 Zahnklinik

Three-dimensional anisotropic transport of solar energetic particles in the inner heliosphere — •Wolfgang Dröge[1], Julia Kartavykh[2], Berndt Klecker[3], and Gennadi A. Kovaltsov[2] — [1]Institut für Theoretische Physik und Astrophysik, Universität Würzburg, D-97074 Würzburg, Germany — [2]Ioffe Physical-Technical Institute, St. Petersburg 194021, Russia — [3]Max-Planck-Institut für extraterrestrische Physik, Garching, Germany

We investigate the combined effects of particle propagation parallel and perpendicular to the large-scale magnetic field in the solar wind. Numerical methods employing stochastic differential equations are used incorporating pitch angle diffusion, focusing and pitch-angle dependent diffusion perpendicular to the magnetic field. Spatial distributions of the particles for various combinations of values for the parallel and perpendicular mean free path are presented. Intensity-time histories at different angular and radial distances wit respect to the assumed injection region on the Sun will be discussed and compared with results of multi-spacecraft observations of solar particles.

EP 12.4 Do 14:45 Zahnklinik

Energetische Elektronen-Ereignisse am Jupiter: Beobachtungen und Modellierung — •Andreas Kopp[1,2], Phillip Dunzlaff[1] und Bernd Heber[1] — [1]Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel, 24118 Kiel — [2]Theoretische Physik IV, Ruhr-Universität Bochum, 44780 Bochum

Jupiter ist die dominierende planetare Teilchenquelle in der Heliosphäre. Die in den frühen 70er Jahren an der Erde beobachteten und als "Quiet-time increases" bezeichneten Elektronen konnten nach dem Vorbeiflug der Pioneer-Sonden aufgrund ihres charakteristischen Spektrums als vom Jupiter stammend identifiziert werden. Daneben zeigten die Messungen weitere Charakteristika dieser MeV-Elektronen: Sie treten in Ausbrüchen von bis zu einigen Tagen Dauer auf, und ihr Spektralindex variiert zeitlich mit der Rotationsperiode des Planeten von knapp zehn Stunden. 1992 fand Ulysses die sogenannten "Jovian Jets", die sich von den Quiet-time increases durch eine kürzere Dauer und eine starke Anisotropie entlang des Magnetfeldes auszeichnen. Dabei zeigte sich, dass die 10h-Periodizität ab einer Entfernung von 0.5 AU von Jupiter nicht mehr feststellbar ist. Wir gehen folgenden Fragen nach: (1) Sind die Jets bereits in den Pioneer-Daten zu finden? (2) Wie kann man das Zustandekommen der Periodizität und ihr Verschwinden ab einer gewissen Entfernung erklären? Zur Beantwortung dieser Fragen haben wir die Daten von Pioneer 10 mit besserer Zeitauflösung erneut ausgewertet und die Ausbreitung der Teilchen in den Jets mit Hilfe numerischer Simulationen untersucht.