EP 11: Sun and Heliosphere III - Particles

Zeit: Donnerstag 15:00–17:00 Raum: BSZ - Pabel HS

Hauptvortrag EP 11.1 Do 15:00 BSZ - Pabel HS

Recent advances in heliospheric transport of solar energetic particles — •Timo Laitinen and Silvia Dalla — Jeremiah Horrocks Institute, University of Central Lancashire, Preston, UK

Solar Energetic Particles (SEPs), accelerated during solar eruptions, are typically observed with in situ instruments in the interplanetary space. Their propagation from the Sun to the observer is controlled by the interplanetary magnetic field, which consists of a mean Parker spiral field and turbulent fluctuations. Recent multi-spacecraft SEP observations made with the STEREO, SOHO and ACE spacecraft have shown that SEPs have access to wide range of heliolongitudes, across the mean Parker field spiral field. Thorough analysis of the observations has implied that the wide SEP events are to significant extent caused by propagation of the particle across the mean field. In this presentation, we will review the current understanding of SEP propagation across the mean magnetic field in a turbulent heliosphere. In particular, we will discuss the often-used spatial cross-field diffusion model, and the recently-introduced model in which the particles follow non-diffusively the turbulently meandering field-lines before relaxing time-asymptotically to spatial cross-field diffusion. We will also consider the influence of the large-scale structure of the heliospheric field on the SEP event. We discuss the implications of the transport models to our understanding of the nature of wide SEP events.

EP 11.2 Do 15:30 BSZ - Pabel HS

Nonlinear Diffusion and Anomalous Transport of Cosmic Rays — •Horst Fichtner[1], Yuri Litvinenko[2], and Dominik Walter[1] — [1]Ruhr-Universitaet Bochum, Institut fuer Theoretische Physik IV, Univesitaetsstrasse 150, 44780 Bochum — [2]Department of Mathematics, University of Waikato, P. B. 3105, Hamilton 3240, New Zealand

We investigate analytically and numerically the transport of cosmic rays away from a shock or another localized acceleration site. Observed cosmic-ray distributions in the vicinity of heliospheric shocks imply that anomalous, superdiffusive transport plays a role in the propagation of energetic particles. Previously, anomalous diffusion scalings, as implied by the data, have been quantitatively described with solutions of a fractional transport, although the physical basis of the fractional diffusion model remains uncertain. We explore an alternative model of the cosmic-ray transport: a nonlinear diffusion equation that follows from a self-consistent treatment of the resonantly interacting cosmic-ray particles and their self-generated turbulence. The nonlinear model naturally leads to superdiffusive scalings, and in the presence of convection, it yields a power-law dependence of the particle density on the distance upstream of the shock. The new solutions are tested by fitting them to spacecraft measurements.

EP 11.3 Do 15:45 BSZ - Pabel HS

Transport of suprathermal protons in the inner heliosheath — •Adama Sylla and Horst Fichtner — Ruhr-Universitaet Bochum, Institut fuer Theoretische Physik IV, Universitaetsstrasse 150, 44780 Bochum

A quantitative understanding of the phase-space transport of suprathermal protons in the inner heliosheath is highly desirable, as it represents the basis for the modelling of so-called energetic neutral atoms (ENAs) observed with the Interstellar Boundary Explore (IBEX). A consistent modelling of all-sky maps of ENA fluxes at different energies will provide insight into the large-scale structure of the outer heliosphere, which is a welcome supplement to the in-situ measurements made with the Voyager spacecraft. Numerical solutions of the transport equation of supratherml protons will be presented. These solutions allow to compute the ENA production rate in the inner heliosheath and, subsequently, the resulting energy-dependent flux from a given direction.

EP 11.4 Do 16:00 BSZ - Pabel HS

Modelling the Jovian Electron Spectrum — •Adrian Vogt[1], N. Eugene Engelbrecht[2], Bernd Heber[1], Andreas Kopp[2,3], Marius Potgieter[2], and R. Du Toit Strauss[2] — [1]Christian-Albrechts-Universität zu Kiel — [2]North-West University, Potchefstroom Campus — [3]Universite Libre de Bruxelles

The unique properties of the Jovian source have been utilized since it's discovery in the 1970s to investigate charged particle transport. Solving Parker's transport equation via the stochastic differential equation method, we aim to further restrain the parameter space and derive these parameters more self consistently. We both implemented a newly derived Jovian source spectrum and an improved approach to calculate the mean free paths. We like to show preliminary results of modelling the Jovian spectrum at earth and how they relate to electron spectra measurements by various spacecraft.

EP 11.5 Do 16:15 BSZ - Pabel HS

Transport modeling of supra-thermal electrons in the 20 October 2002 solar event — •Yulia Kartavykh[1,2], Wolfgang Dröge[1], Linghua Wang[3], and Roberto Bruno[4] — [1]Institute for Theoretical Physics and Astrophysics, University of Würzburg, D-97074, Würzburg, Germany — [2]Ioffe Physical-Technical Institute, St. Petersburg 194021, Russia — [3]School of Earth and Space Sciences, Peking University, 100871 Beijing, China — [4]INAF-IAPS Istituto di Astrofisica e Planetologia Spaziali, I-00133 Roma, Italy

The modeling of solar particle propagation offers the possibility to derive transport coefficients and to test the validity of theories describing the interaction of energetic charged particles with magnetic field fluctuations. Here we analyze electrons in the energy range of 1 - 180 keV, observed by the Wind spacecraft following an impulsive solar flare on 20 October 2002. The event is characterized by weak, but measurable pitch angle scattering which allows a characterization of the pitch angle scattering coefficient $D_{\mu\mu}(\mu)$, as well as by particle reflection at an outer boundary. Based on numerical solutions of the focused transport equation we present fits to the observed electron fluxes, with emphasis on a detailed modeling of the particles' angular distributions. We compare the derived values of $D_{\mu\mu}(\mu)$ for several energy ranges with the ones obtained from an analysis of the magnetic fluctuations observed during the event and current transport theories. Preliminary results indicate that the scattering of electrons at low energies is much weaker than predicted by the above models, and that at large wave numbers the slab component makes up only a few percent of the fluctuations.

EP 11.6 Do 16:30 BSZ - Pabel HS

GEANT4 simulation of the Helios E6 - Proton contamination of relativistic electron measurements — •M. Hörlöck, J. Marquardt, and B. Heber — Christian-Albrechts-Universität zu Kiel, Germany

HELIOS A and HELIOS B were launched on December 10, 1974 and January 15, 1976, respectively. The two almost identical space probes were sent into ecliptic orbits around the Sun. The Kiel experiment, E6 is one of three particle detectors aboard HELIOS that allows to study the flux of energetic particles in the energy range from 1.3 MeV/nucleon to above 1000 MeV/nucleon for ions and from 0.3 to 8 MeV for electrons. A GEANT 4 simulation has been set up to calculate the response functions for protons and electrons in the energy range from 1 to 60 MeV and from 50 keV to 10 MeV, respectively. Due to the detector design there is substantial contamination of protons in the electron measurements that is quantified in this contribution. A method for correcting the electron time flux profiles will be presented and applied to a set of solar energetic particle events.

EP 11.7 Do 16:45 BSZ - Pabel HS

Energy spectra of carbon and oxygen with HELIOS E6 - Radial gradients of Anomalous Cosmic Ray oxygen within 1 AU — •J. Marquardt[1], B. Heber[1], M.S. Potgieter[2], and R.D. Strauss[2] — [1]Christian-Albrechts-Universität zu Kiel, Germany — [2]Centre for Space Research, North-West-University, Potchefstroom, 2520, South Africa

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9-28.5 MeV ACR oxygen in the inner heliosphere is about three times larger than the one determined between 1 and 10 AU by utilizing the Pioneer 10 measurements.