EP 18 Sonne: Energetische Teilchen, Sonnenwind und CMEs

Zeit: Donnerstag 10:45–12:45 Raum: B

Fachvortrag EP 18.1 Do 10:45 B

Acceleration and Transport Modeling of Solar Energetic Particle Charge States for the Event of 1998 September 9 — •W. Dröge[1], Y. Y. Kartavykh[2], B. Klecker[3], and G. M. Mason[4] — [1]Institut für Theoretische Physik und Astrophysik, Universität Würzburg, D-97074 Würzburg — [2]Joffe Physical-Technical Institute, St. Petersburg 194021, Russia — [3]Max-Planck-Institut für extraterrestrische Physik, D-85741 Garching, Germany — [4]Johns Hopkins University, Applied Physics Lab., Laurel, MD 20723

The 1998 September 9 solar particle event was a 3He-rich solar particle event that showed a strong increase of Fe ionization states in the energy range below 1 MeV/nucleon. We have investigated this event by fitting Wind and ACE observations using a model of acceleration and stripping near the Sun, followed by particle transport in the interplanetary medium, taking account of particle focusing, pitch-angle scattering, adiabatic deceleration and convection. The simulation provides a reconstruction of the injection function of the energetic particles released from the Sun and their time, energy and charge dependence. We find that electrons and Fe ions are injected almost impulsively, whereas the injection of protons takes place on a much longer time scale, or even consists of two distinct injection processes. We are able to obtain good overall fits to the observations. This suggests that our model can be used to obtain information about the conditions in the acceleration region such as density, temperature and the time scales of the acceleration process, if sufficiently accurate modeling of the particle transport in the solar wind is possible.

Fachvortrag EP 18.2 Do 11:30 B

Velocity ditribution functions of solar wind ions from ACE/SWICS using a maximum likelihood analysis technique — •Lars Berger[1], Muharrem Köten[1], Jim Raines[2], Robert F. Wimmer-Schweingruber[1], and Thomas H. Zurbuchen[2] — [1]Institut für Experimentelle und Angewandte Physik, University of Kiel, D-24098 Kiel, Germany — [2]University of Michigan, Atmospheric, Oceanic, and Space Sciences 2455 Hayward St., Ann Arbor, MI 48109, USA

By studying the velocity distribution of solar wind ions we can learn a lot about the acceleration processes in the inner heliosphere. The shape of the distribution can help us to distinguish between heating by coulomb-interaction and wave-heating. Previous studies have shown that the velocity distribution of solar wind ions follows a thermal(maxwellian) distribution extended with a superthermal tail. These superthermal ions are rare and former analysis techniques have great uncertainties applied to them. We have analysed data from the solar wind ion spectrometer(SWICS) on the advanced composition explorer(ACE) using a maximum likelihood analysis technique based on poissonian statistics, to improve the results especially for low count rates. We present results for different solar wind types.

Fachvortrag EP 18.3 Do 11:45 B

Determination of absolute fluxes of heavy solar wind ions with ACE/SWICS — •Muharrem Köten[1], Lars Berger[1], Jim Raines[2], Christian T. Steigies[1], Robert F. Wimmer-Schwingruber[1], and Thomas H. Zurbuchen[2] — [1]Institut für Experimentelle und Angewandte Physik, University of Kiel, D-24098 Kiel, Germany — [2]University of Michigan, Atmospheric, Oceanic, and Space Sciences 2455 Hayward St., Ann Arbor, MI 48109, USA

SWICS (Solar Wind Ion Composition Spectrometer) is a linear time-of-flight mass spectrometer that allows the determination of energy, mass, and charge of solar wind ions and suprathermal particles. We developed an advanced efficiency model which calculates the probability that the instrument will detect an ion with given mass m, charge q, and velocity $\vec{v}$. Using that model and measured count rates from the instrument in space we determine the absolute fluxes of different heavy solar wind ions in different solar wind regimes.

Fachvortrag EP 18.4 Do 12:00 B

Formulierung magnetischer Randbedingungen für numerische Simulationen solarer Flußröhren — •Lukas Arnold, Jürgen Dreher und Rainer Grauer — Theoretische Physik I, Ruhr-Universität-Bochum, 44780 Bochum

Zur Untersuchung der Stabilität magnetischer Strukturen wird häufig die Verdrillung von Flußröhren durch photosphärische Konvektion numerisch simuliert. Üblich ist dabei die Vorgabe eines divergenzfreien Geschwindigkeitsfeldes in der Photosphäre, für das Magnetfeld steht in der Regel keine physikalische Randbedingung zur Verfügung. In diesem Beitrag werden gängige Extrapolationsverfahren in Verbindung mit konservativen und nicht-konservativen Diskretisierungen analysiert. Simulationen von aufsteigenden Flußröhren und deren Eruptionen werden vorgestellt.

Fachvortrag EP 18.5 Do 12:15 B

The torus instability in coronal mass ejections — •Bernhard Kliem[1] and Tibor Török[2] — [1]Astrophysikalisches Institut Potsdam — [2]Mullard Space Science Laboratory, University College London

We model coronal mass ejections (CMEs) as expanding toroidal current rings. The ring is unstable against expansion if the external poloidal field B_{ex} decreases sufficiently rapidly with distance R from torus centre. For steep profiles of $B_{\mathrm{ex}}(R)$, representative of active regions, the expansion accelerates initially nearly exponentially, followed by a nearly linear further expansion. For only slightly supercritical profiles of $B_{\mathrm{ex}}(R)$, representative of the quiet Sun, the acceleration profile increases very slowly with R so that a nearly constant acceleration is observed during the expansion over many initial radii R_0. The two apparently disparate classes of fast and slow CMEs are thus described in a uniform manner by the model. While the photospheric line tying of flux ropes acts stabilizing with regard to the torus instability, it raises the acceleration and extends the radial range of significant acceleration in comparison to an untied, freely expanding ring if the instability occurs. It also enforces an overproportional expansion of the minor radius with the consequence that a cavity and hence the classical three-part structure of CMEs are formed. We discuss the relationship of the torus instability to the helical kink instability in CMEs. The two related ideal MHD instabilities can explain the onset of CMEs and their essential properties (rise profiles, helical shape, three-part structure), leaving the formation of unstable flux ropes as the main open question of a flux rope model for CMEs.

Fachvortrag EP 18.6 Do 12:30 B

ICME detections with ESA's Solar Orbiter and NASA's IHS (Inner Heliospheric Sentinels) — •Roland Rodde[1], Richard Marsden[2], Adam Szabo[3], and Robert F. Wimmer-Schweingruber[1] — [1]Institut für Experimentelle und Angewandte Physik, University of Kiel, D-24098 Kiel, Germany — [2]European Space Agency, ESTEC, Netherlands — [3]Goddard Space Flight Center, Laboratory for Solar and Space Physics, Greenbelt, MD 20771 United States

Solar Orbiter and IHS (Inner Heliospheric Sentinels) will explore the inner heliosphere between sun and earth from 2015 onwards. These missions will provide unique capabilities for multi in-situ measurements of magnetic fields and particles at small distances from the sun. One scientific goal common to both missions is to improve our understanding of ICME propagation and evolution. Numerical simulations were carried out to determine the ratio of detected ICMEs relative to released CMEs for different combinations of spacecraft. A main aspect is the difference in detection efficiencies between a three and four spacecraft configuration for the IHS.