EP 9: Sun III and Heliophysics I

Zeit: Mittwoch 13:00–16:45 Raum: Zahnklinik

Hauptvortrag EP 9.1 Mi 13:00 Zahnklinik
Energetic Particles at 1 AU - STEREO Observations — •Robert F. Wimmer-Schweingruber[1], Bernd Heber[1], Reinhold Müller-Mellin[1], Stephan Böttcher[1], Raul Gomez-Herrero[1], Janet G. Luhmann[2], Robert P Lin[2], Glenn M. Mason[3], Richard A. Mewaldt[4], Tycho T. von Rosenvinge[5], Christopher T. Russell[6], Mario Acuna[5], and Antoinette B. Galvin[7] — [1]Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel — [2]Space Sciences Laboratory, University of California, Berkeley, USA — [3]Applied Physics Laboratory, John Hopkins Uniersity, Laurel, Maryland, USA — [4]Space Research Laboratory, California Institute of Technology, Pasadena, USA — [5]Goddard Space Flight Center, Greenbelt, Maryland USA — [6]University of California, Los Angeles, USA — [7]University of New Hampshire, Durham, USA

The dual-spacecraft mission STEREO carries with it a full complement of instruments to detect heliospheric particles from solar wind up to 100 MeV/nuc. The low solar activity and the relatively simple heliospheric structure in 2007/2008 has allowed detailed studies of corotating interaction regions (CIRs) and related energetic particle increases. The quiet Sun also allowed studies of an other source of low-energy particles observed up to 1900 R_E upstream from the Earth. Solar eruptions and CME-driven shocks accelerated particles which in turn were also observed by STEREO.

This talk will summarize STEREO observations of energetic particles in the years 2007 and 2008 and give a brief outlook at expected future measurements.

Hauptvortrag EP 9.2 Mi 13:30 Zahnklinik
Der "Interstellar Boundary Explorer" (IBEX) - die erste Mission zur globalen Beobachtung der Heliosphäre — •Horst Fichtner — Institut für Theoretische Physik, Ruhr-Universität Bochum

Die Raumsonde IBEX wurde im Oktober 2008 erfolgreich gestartet und auf die vorgesehene Umlaufbahn gebracht. Sie wird uns über einen mehrjährigen Zeitraum durch die Messung von energiereichen Neutralatomen "Bilder" der gesamten äußeren Heliosphäre liefern und damit helfen, die Natur des Terminations-Schocks, der dort stattfindenden Beschleunigungsprozesse energiereicher Teilchen, der heliosphärischen Grenzschicht und des interstellaren Mediums jenseits der Heliopause zu verstehen. Im Vortrag werden die Mission beschrieben, Modellvorstellungen erläutert und mit den Ergebnissen der ersten IBEX-Messungen konfrontiert.

EP 9.3 Mi 14:00 Zahnklinik
Experimental Simulation of Solar Flares — •Henning Soltwisch[1], Lukas Arnold[2], Jürgen Dreher[1], Holger Stein[1], and Jan Tenfelde[1] — [1]Ruhr-Universität Bochum — [2]Forschungszentrum Jülich

In this contribution a custom-built laboratory experiment will be introduced, which is aimed at detailed studies into the behavior of plasma configurations with initially loop-shaped magnetic field lines under the influence of driving boundary conditions. In its first version, the setup has been used to reproduce and extend previous studies of Bellan et al. (Phys. Plasmas 5 (1998), 1991). At present, the device is redesigned to mimic a model that was proposed by Titov and Demoulin (Astron. Astrophys. 351 (1999), 707) to investigate twisted magnetic configurations in solar flares. The observed dynamics of the magnetic flux tubes will be analysed by means of extensive 3-dimensional MHD simulations in order to determine the influence of parameters like, e.g. the initial magnetic field geometry on magnetic stability.

EP 9.4 Mi 14:15 Zahnklinik
Einfluss photopherischer Bewegungen auf die koronalen Struturen der Sonne — •Jörn Warnecke, Sven Bingert und Hardi Peter — Kiepenheuer-Institut für Sonnenphysik, Freiburg, Germany

Die Bewegungen in der Photosphäre werden durch die oberflächennahe Konvektion hervorgerufen, die sich in der Bildung der granularen Struktur zeigt. Diese horizontalen Strömungen bewirken ein Verflechten der Magnetfelder in der Atmosphäre der Sonne. Daraus entwickeln sich Ströme, die durch Ohm'sche Heizung dissipiert werden, wobei die Heizrate nach oben hin exponentiell abfällt. Vereinfachte numerische Simulationen zeigen, dass die grobe Struktur der Korona und die Skalenhöhe des Abfalls der Heizrate unabhängig von der genauen Gestalt der photosphärischen Geschwindigkeiten sind, wobei aber Unterschiede im Detail erkennbar sind, z.B. bezüglich des Speichervermögens magnetischer Energie. Die Ergebnisse zeigen, dass bis zu einem gewissen Grad die Details des photosphärischen Treibers auf die koronale Dynamik nur geringen Einfluss haben.

EP 9.5 Mi 14:30 Zahnklinik
Radiosondierung der Sonnenkorona mit Rosetta, Mars Express und Venus Express in 2004, 2006 und 2008/2009 — •Matthias Hahn[1], Martin Pätzold[1], Silvia Tellmann[1], Bernd Häusler[2] und Mike Bird[3] — [1]Institut für Umweltforschung (RIU), Abteilung Planetenforschung, Köln — [2]Institut für Raumfahrttechnik, Universität der Bundeswehr München, München — [3]Argelander Institut für Aeronomie, Universität Bonn, Bonn

Während der oberen Sonnenkonjunktion von Mars Express im Jahr 2004, 2006 und 2008/2009 sowie von Rosetta und Venus Express im Jahr 2006, konnten mit den Radioscience-Experimenten auf diesen Sonden Beobachtungen der Sonnenkorona durchgeführt werden. Dabei durchlaufen die gesendeten Radiosignale (8,4 GHz X-Band und 2,3 GHz S-Band) das dichte Plasma der Sonnenkorona. Aus Frequenzverschiebungen und Laufzeitverzögerungen des Signals lassen sich Rückschlüsse auf großskalige koronale Strukturen, den Elektroneninhalt entlang des Radiostrahls sowie die Dichte und Turbulenz im Plasma ziehen.

Das Radioscience-Experiment MaRS auf Mars Express konnte die Konjunktionen im August/September 2004, Oktober/November 2006 und Dezember/Januar 2008/2009 abdecken. 2004 konnten hierbei mehrere CMEs, die den Radiostrahl durchquerten, beobachtet werden. Hier soll ein Vergleich der Daten mit SOHO/LASCO Bildern gezeigt werden. Desweiteren werden Ergebnisse der Anpassung eines Modells an die Messdaten gezeigt, welches Rückschlüsse auf Geschwindigkeit, Elektronendichte und Struktur der CMEs gibt.

EP 9.6 Mi 14:45 Zahnklinik
Compton-Getting Correction for STEREO/SEPT — •Jan Gieseler, Raúl Gómez-Herrero, Andreas Klassen, Reinhold Müller-Mellin, Bernd Heber, and Stephan Böttcher — Christian-Albrechts-Universität Kiel

The Solar Electron and Proton Telescope (SEPT) aboard each of the two STEREO spacecraft consists of two dual double-ended magnetic/foil particle telescopes which separate and measure electrons (from 30 to 400 keV) and ions, mainly protons and α-particles (from 70 keV to 6.5 MeV). One telescope is looking in the ecliptic plane (SEPT-E), the other perpendicular to this plane (SEPT-NS). Thus there are four looking directions for each spacecraft: one pointing to the Sun along the nominal Parker spiral (45° west from the S/C-Sun line), one pointing to the opposite direction, away from the Sun along the Parker spiral, and two apertures looking North and South perpendicular to the ecliptic. Since the velocity of several tens of keV ions is only by a factor of about 10 higher than the solar wind speed, it is expected that an isotropic pitch angle distribution in the solar wind frame becomes anisotropic in the spacecraft frame. We developed a method to correct the SEPT ion data for this so-called Compton-Getting effect. Telescopes such as SEPT that measure the total energy of the ion, but not its nuclear charge, cannot distinguish between protons and α-particles. Therefore our method is also designed to account for He contribution. Finally, we will show that with our method the measurements of SEPT can be transformed successfully to the solar wind frame, and apply it to selected particle events.

EP 9.7 Mi 15:00 Zahnklinik
Multi-spacecraft observations of CIR-associated ion increases during June to October 2007 — •Nina Dresing, Raúl Gómez Herrero, Bernd Heber, Reinhold Müller-Mellin, Robert Wimmer-Schweingruber, and Andreas Klassen — IEAP, Christian-Albrechts-Universität zu Kiel

The period between June 21 and October 8, 2007 (Carrington rotations 2058 to 2061), comprising the Ulysses ecliptic plane crossing, was characterized by low solar activity. Several CIR-related ion increases between 100 keV and 10 MeV were investigated using multipoint observations from Ulysses, ACE, and the twin STEREO spacecraft. The ballistic backmapping technique has been used to correlate in-situ observations of these spacecraft with remote-sensing observations of coronal holes. Due to larger latitudinal separation between Ulysses and the other spacecraft in Carrington rotations 2058 and 2061, we concentrate on the two Carrington rotations 2059 and 2060 for a more detailled study of CIR events. Therefore two siginficant CIR-associated ion increases from day 5 to day 10 of August 2007 and from day 25 to day 31 of August 2007 lend themselves to a more undisturbed comparison. Using the multi spacecraft measurements we could determine a radial gradient, which is consistent with previous results by van Hollebeke in 1978 of 350 %/AU using Helios and Pioneer data.

30 min. break

EP 9.8 Mi 15:45 Zahnklinik

Budget of energetic electrons during solar flares — •Gottfried Mann — Astrophysikalisches Institut Potsdam, An der Sternwarte 16, D-14482 Potsdam

Solar flares are basically defined as a strong enhancement of the emission of electromagnetic waves, from the radio up to the γ-ray range. They are accompanied with the production of a large number of energetic electrons as seen in the nonthermal radio and X-ray radiation. Observations of the RHESSI satellite show that 10^{36} electrons with energies > 20 keV are typically produced per second during large flares. They are related with a power of about 10^{22} W. These electrons carry a substantial part of the energy released during a flare. The flare is regarded within the framework of the magnetic reconnection scenario. In which way so much electrons are accelerated up to high energies during a fraction of a second is a still open question. The region of acceleration is considered a a black box. The conditions in the acceleration region are deduced by using the conservation of the total electron number and energy. In result, the acceleration takes place in regions of large Alfvén speeds of about 4300 km/s.

EP 9.9 Mi 16:00 Zahnklinik

Perpendicular Transport in the Inner Heliosphere — •Florian Lampa and May-Britt Kallenrode — University of Osnabrueck, Department of Physics, Barbarastraße 7, 49076 Osnabrueck, Germany

In previous studies, transport of solar energetic particles in the inner heliosphere has been regarded as one dimensional along the archimedian field spiral; any perpendicular transport is neglected. We have extended Ruffolo's equation of focused transport for solar energetic particles to accommodate perpendicular transport in the plane of ecliptic. Numerically, this additional term is solved with the implicit and stable Laasonen scheme. For typical ratios $\kappa_\perp/\kappa_\parallel$ between 0.02 and 0.1 at 1 AU as suggested in non linear guiding center theory and a scaling of $\kappa_\perp$ with r^2 as suggested from the random walk of field lines we find that (a) azimuthal spread over some ten degrees occurs within a few hours, (b) the variation of maximum intensities with longitude is comparable to the ones inferred from multi-spacecraft observations, and (c) on a given field line intensity- and anisotropy-time profiles are modified such that fits with the 2D transport model give different combinations of injection profiles and mean free paths.

Implications for the interpretation of intensity and anisotropy time profiles observed in interplanetary space and consequences for our understanding of particle propagation and acceleration in space will be discussed. We will also address the question whether and how the modeling of flux dropouts and propagation channels is possible in the presence of perpendicular diffusion as the ultimate leveler.

EP 9.10 Mi 16:15 Zahnklinik

Simulation of the preferential heating and acceleration of alpha-particles by Alfven-cyclotron waves — •Yana Maneva[1], Jaime Araneda[2], and Eckart Marsch[1] — [1]Max-Planck-Institut für Sonnensystemforschung, 37191 Katlenburg-Lindau — [2]Departamento de Fisica, Universidad de Concepcion, 4070386, Chile

The observed preferential heating and acceleration of heavy ions in the solar corona and solar wind represent a long-standing theoretical problem in space physics, and are distinct experimental signatures of kinetic processes occurring in a hot collisionless plasma. Here we show that fast and slow ion-acoustic waves (IAW) and transverse cyclotron waves, driven by parametric instabilities of an Alfven-cyclotron wave train can selectively destroy the coherent fluid motion of the different ion species, and in this way, lead to their differential heating and acceleration. Trapping of the lighter and more abundant protons by the fast IAW generates a field-aligned proton beam with a drift speed of about the Alfven speed, consistently with observations. Due to their larger mass and lower plasma beta, the alpha-particles do not become significantly trapped and start, by conservation of total ion momentum, drifting relative to the receding bulk protons. Thus the resulting core protons and the alpha-particles are differentially heated via pitch-angle scattering by the transverse waves.

EP 9.11 Mi 16:30 Zahnklinik

Fokussierte Diffusion solarer kosmischer Strahlung — •Jenny Reimchen und Reinhard Schickeiser — Ruhr-Universität Bochum, Deutschland

Der Transport energiereicher geladener Teilchen in der inneren Heliosphäre wird duch Fokker-Planck-Gleichung beschrieben, in der unter anderen Effekt der Fokussierung berücksichtigt wird. Im Vortrag wird die Lösung der Transportgleichung für die Fokussierungslänge L und Magnetfeld $B(z) = z^m$ gezeigt.