EP 8: The Sun and Heliosphere II

Zeit: Dienstag 16:45–19:00 Raum: KGI-Aula

EP 8.1 Di 16:45 KGI-Aula

Electron acceleration by DC electric fields during solar flares — •Gottfried Mann and Hakan Önel — Astrophysikalisches Institut Potsdam, An der Sternwarte 16, D-14482 Potsdam

During solar flares a huge amount of energy is suddenly released in the solar corona. They are accompanied by an enhanced emission of energetic particles and broadband electronmagnetic radiation from the radio up to the hard X-ray range. A large amount of the flare released energy is deposited into the energetic electrons. It is still not fully understood in which way electrons are accelerated up to high energies within a fraction of seconds. Here, we present a flare model in terms of an electric circuit located in the photosphere and corona. The circuit is driven by the photospheric plasma motion. The electrons are accelerated by the DC electric field appearing in coronal loops while the circuit is closed via the corona.

EP 8.2 Di 17:00 KGI-Aula

Proton core heating and beam formation via parametrically unstable Alfvén-cyclotron waves — Jaime Araneda[1], •Eckart Marsch[2], and Adolfo Viñas[3] — [1]Departmento de Física, Facultad de Ciencias Físicas y Matemáticas, Universidad de Concepción, Chile — [2]Max-Planck-Institut für Sonnensystemforschung, Katlenburg-Lindau, Germany — [3]Nasa/Goddard Space Flight Center, Greenbelt, MD, USA

Vlasov theory and one-dimensional hybrid simulations are used to study the effects that compressible fluctuations driven by parametric instabilities of Alfvén/cyclotron waves have on proton velocity distributions. Field-aligned proton beams are generated during the saturation phase of the wave-particle interaction, with a drift speed which is slightly greater than the Alfvén speed and is maintained until the end of the simulation. The main part of the distribution becomes anisotropic due to phase mixing as is typically observed in the velocity distributions measured in the fast solar wind. We identify the key instabilities and also find that even in the parameter regime where fluid theory appears to be appropiate strong kinetic effects still prevail.

EP 8.3 Di 17:15 KGI-Aula

Universal Lévy laws and monoscaling in solar wind turbulence — •Wolf-Christian Müller[1] and Mahdi Momeni[2] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstr. 2, 85748 Garching — [2]Faculty of Physics, Tabriz University, Tabriz 51664, Iran

Probability density functions (PDFs) of scale-dependent energy fluctuations, $P[\delta E(\ell)]$, are studied in high-resolution direct numerical simulations of Navier-Stokes and incompressible magnetohydrodynamic (MHD) turbulence. MHD flows with and without a strong mean magnetic field are considered. For all three systems it is found that the PDFs of inertial range energy fluctuations exhibit self-similarity and monoscaling in agreement with recent solar-wind measurements [B. Hnat et al., Geophys. Res. Lett. 29(10), 86-1 (2002)]. Furthermore, the energy PDFs exhibit similarity over *all* scales of the turbulent system showing no substantial qualitative change of shape as the scale of the fluctuations varies. This is in sharp and surprising contrast to the well-known behavior of PDFs of turbulent field fluctuations e.g. of velocity and magnetic field. In all three cases under consideration the $P[\delta E(\ell)]$ resemble Lévy-type Gamma distributions $\sim \Delta^{-1}\exp(\delta E/\Delta)|\delta E|^{-\gamma}$ in agreement with the solar-wind observations. The observed Gamma distributions exhibit a scale-dependent width $\Delta(\ell)$ and a system-dependent γ. They are apparently a characteristic and universal consequence of turbulent energy transfer even outside of the self-similar inertial range. A simple theory explains the appearance of Gamma-type PDFs as consequence of a cascade process and also accounts for the observed monoscaling exponents.

EP 8.4 Di 17:30 KGI-Aula

Quasi-oscillations between two turbulent regimes in 2D magnetoconvection — •Dan Škandera and Wolf-Christian Müller — Max-Planck-Institute for Plasma Physics, 85748 Garching, Germany

Spectral and statistical properties of two-dimensional turbulent magnetoconvection are studied by means of direct numerical simulations in the frame of Boussinesq magnetohydrodynamic (MHD) approximation. Turbulent fluctuations are driven by a mean horizontal temperature gradient. The spectra of kinetic and total energy indicate that during its time evolution the investigated system performs quasi-oscillations with time periods of turbulence dominated by nonlinear MHD interactions and turbulence dominated by buoyancy. It is shown that the presence of a particular turbulent regime depends on the mutual alignment between velocity and magnetic field. In addition, a simple phenomenological model that explains the observed quasi-oscillations is presented.

EP 8.5 Di 17:45 KGI-Aula

Kinetische Betrachtung des parallelen magnetohydrodynamischen Schocks — •Daniel Verscharen — Argelander-Institut für Astronomie der Universität Bonn

Üblicherweise werden astrophysikalische Schocks wie der heliosphärische Sonnenwindschock (termination shock) mit den aus Erhaltungssätzen folgenden magnetohydrodynamischen Sprungbedingungen (Rankine-Hugoniot) beschrieben. In der Vergangenheit zeigte sich jedoch zunehmend, daß diese Beschreibung in vielen Detailfragen unzureichend und nicht aussagekräftig genug bleibt. Eine kinetische Betrachtung wird zur genaueren Untersuchung notwendig.

Es wird nun ein Prozeß für den Fall des parallel zur Schocknormalen verlaufenden magnetischen Feldes vorgestellt, der zu einer Verlangsamung des Sonnenwindstromes am termination shock auf eine unterschallschnelle Strömungsgeschwindigkeit führt. Für die Modellierung wird die Abbremsung der Sonnenwindionen durch das Anlaufen gegen ein elektrisches Potential angenommen, woraus notwendigerweise die Elektronen des Sonnenwindes eine deutliche Beschleunigung erfahren (over-shooting). Dieser daraus resultierende two-stream-instabile Zustand erfährt in der Folge eine Angleichung der beiden Teilchensorten durch eine Welle-Teilchen-Wechselwirkung mit elektrostatischen Plasma-Wellen. Somit ergibt sich hinter dem Schock eine verlangsamte Strömung, in der sich Ionen und Elektronen mit annähernd gleicher Geschwindigkeit fortbewegen.

EP 8.6 Di 18:00 KGI-Aula

The modulation of Galactic Cosmic Rays in the Outer Heliosheath — Horst Fichtner[1], Stefan Ferreira[2], Marius Potgieter[2], and •Klaus Scherer[1] — [1]Institut für Theoretische Physik,Lehrstuhl IV: Weltraum- und Astrophysik,Ruhr-Universität Bochum, D-44780 Bochum, Germany — [2]Unit for Space Physics, North-West University, 2520, Potchefstroom, South Africa

The current paradigm of galactic cosmic ray propagation and modulation assumes that the outer boundary for these processes is the heliopause. We demonstrate here that low energetic galactic cosmic rays (< 100 MeV) are already modulated in the Outer Heliosheath, i.e. ahead of the heliopause. The reason is that the supersonic interstellar plasma flow undergoes a transition to a subsonic plasma at the bow shock. The plasma in the region between the bow shock and the heliopause, i.e. the Outer Heliosheath, is then heated, its turbulence levels increase, and the interstellar magnetic field is compressed. This leads to changes in the diffusion tensor in the Outer Heliosheath compared to that in the interstellar medium such that a decrease of the low energetic galactic cosmic ray intensities occurs already downstream of the bowshock. First results will be presented.

EP 8.7 Di 18:15 KGI-Aula

Charge sign dependent latitudinal gradients of galactic cosmic rays — •Jan Gieseler[1], Bernd Heber[1], Raul Gomez-Herrero[1], Andreas Klassen[1], Reinhold Müller-Mellin[1], and Richard A. Mewaldt[2] — [1]Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel — [2]California Institute of Technology, Pasadena, CA, USA

We study the spatial gradients of galactic cosmic ray protons and electrons in the inner heliosphere using data from the Kiel Electron Telescope (KET) aboard Ulysses and the Cosmic Ray Isotope Spectrometer (CRIS) aboard the Advanced Composition Explorer (ACE) for the time period from 1997 to 2008. This covers the solar minimum in the A>0-solar magnetic epoch, the solar magnetic reversal to an A<0-magnetic epoch at solar maximum and the declining phase of solar cycle 23. In order to calculate the galactic cosmic ray intensity distribution in the inner heliosphere we used the 125-250 MeV/nuc helium channel from KET and a combination of carbon channels from the CRIS instrument on ACE. Our analysis results in a radial and latitudinal intensity gradient of $G_r = 4.7 \pm 0.6\%$/AU and $G_\vartheta = 0.00 \pm 0.06\%$/degree for 1.2 GV helium, respectively. If we assume that the temporal variation and the radial gradient is the same for protons and electrons during the fast latitude scan of Ulysses in 2007, we obtain the first ever measurement of a positive latitudinal gradient for 2.5 GV electrons of about 0.2%/degree.

EP 8.8 Di 18:30 KGI-Aula

Helium energy spectra from 5 to >150 MeV/n from SOHO EPHIN — •Johannes Labrenz, Raúl Gómez-Herrero, Reinhold Müller-Mellin, Oliver Rother, and Bernd Heber — IEAP CAU Kiel

Since its launch in Dec 1995 the SOHO spacecraft is providing observations of energetic particles at the lagrangian point L1. On board is the Electron Proton Helium Instrument (EPHIN), which measures nominally electrons in the energy range from 250 keV to >10 MeV, protons from 4 MeV to >53 MeV and helium from 4 MeV/n to >53 MeV/n. The instrument is based on six semiconductor silicon detectors with an anticoincidence scintillator. The total thickness for stopping particles is 13.45mm. The well-proven De/dx-E method is used to determine energy and mass of the stopping particles. However, penetrating particles, i.e. electrons >10 MeV and nuclei >53 MeV/n, are registered in a single integral channel. In this work we make use of the dE/dx-dE/dx method and show that the energy range can successfully be extended to 150 MeV/n for helium. Energy spectra as well as their temporal evolution are presented in the investigation of the modulation of Anomalous cosmic rays (ACR) and Galactic cosmic rays (GCR).

EP 8.9 Di 18:45 KGI-Aula

Solare Modulation kosmischer Strahlung mit dem Karlsruher Muonteleskop — •Isabel Braun[1], Jörg R. Hörandel[2], Joachim Engler[3] und Jens Milke[3] — [1]Institut für Kernphysik, Universität Karlsruhe, jetzt ETH Zürich — [2]Institut für Kernphysik, Universität Karlsruhe, jetzt Radboud University Nijmegen — [3]Forschungszentrum Karlsruhe

Seit 1993 wird im Forschungszentrum Karlsruhe die Rate einzelner Myonen mit einer Energieschwelle von 0.7 GeV aufgezeichnet. Die registrierten Ereignisse stammen überwiegend von primärer kosmischer Strahlung mit Energien um 15 GeV. Die gemessene Rate wird auf Luftdruckschwankungen und Veränderungen im Druckprofil der Atmosphäre korrigiert. Neben Variationen des Myonflusses auf Zeitskalen des Sonnenzyklus oder der Erdrotation wurden auch mehrere Forbush-Ereignisse nachgewiesen und mit den Daten des Jungfraujoch Neutronmonitors verglichen.