EP 7: Sonne und Heliosphäre II

Zeit: Mittwoch 8:30–10:30 Raum: GW2 B2880

Hauptvortrag EP 7.1 Mi 8:30 GW2 B2880
Observations of the Sun with the novel radio telescope LOFAR — •Gottfried Mann — Leibniz-Institut fuer Astrophysik Potsdam, Potsdam, Germany

The Sun's activity appears not only in the well-known 11-year sunspot cycle but also in eruptive events like e. g. flares and coronal mass ejections, as well as radio bursts. All these events are accompanied with an enhanced radio emission. Therefore the study of the Sun's radio radiation provides important information on plasma processes associated with the Sun's activity.

LOFAR (Low Frequency Array) is a novel radio interferometer originally designed for the frequency range 10-240 MHz at ASTRON in the Netherlands. It presently consists of 50 stations distributed over central Europe.

Since the radio emission of active processes of the Sun appears in LOFAR's frequency range and because of LOFAR's imaging and spectroscopic capabilities, LOFAR is highly interesting for the solar physics community for observing flares, coronal mass ejections and related phenomena in the corona.

We report on first observations of the Sun with LOFAR and demonstrate that LOFAR is really able to work as a dynamic spectroscopic radio imager of the Sun. For instance, this allows for the first time to track fast moving electron beams in the corona and density measurements in the outer corona. That provides a better understanding of the nature of type III radio bursts.

EP 7.2 Mi 9:00 GW2 B2880
Solar Energetic Particle Events with Protons above 500 MeV between 1995 and 2015 Measured with SOHO/EPHIN — Patrick Kühl, Nina Dresing, •Bernd Heber, and Andreas Klassen — Christian-Albrechts-Universität zu Kiel, Kiel, Germany

The Sun is an effective particle accelerator producing solar energetic particle (SEP) events during which particles up to several GeVs can be observed. Those events observed at Earth with the neutron monitor network are called ground level enhancements (GLEs). In this work, SEP events with protons accelerated to above 500 MeV have been identified using data from the Electron Proton Helium Instrument (EPHIN) aboard the Solar and Heliospheric Observatory (SOHO) between 1995 and 2015. The compliled list of 42 SEP events is discussed based on the fitted spectral slopes and absolute intensities with special emphasis on whether or not an event has been observed as GLE. Furthermore, a correlation between the derived intensity at 500 MeV and the observed increase in neutron monitor count rate has been found for a subset of events.

EP 7.3 Mi 9:15 GW2 B2880
A generalized two-component model of solar wind turbulence — •Horst Fichtner[1], Tobias Wiengarten[1], Sean Oughton[2], Eugene Engelbrecht[3], Jens Kleimann[1], and Klaus Scherer[1] — [1]Ruhr-Universitaet Bochum, Institut fuer Theoretische Physik IV — [2]University of Waikato, Hamilton, New Zealand — [3]Space Research Centre, North-West University, Potchefstroom, South Africa

We extend a two-component model for the evolution of fluctuations in the solar wind plasma so that it is fully three-dimensional and also coupled self-consistently to the large-scale magnetohydrodynamic equations describing the background solar wind. The two classes of fluctuations considered are a high-frequency parallel propagating wave-like piece and a low-frequency quasi-two-dimensional component. For both components, the nonlinear dynamics is dominated by quasi-perpendicular spectral cascades of energy. Driving of the fluctuations by, for example, velocity shear and pickup ions is included. Numerical solutions to the new model are obtained using the CRONOS framework, and validated against previous simpler models. Comparing results from the new model with spacecraft measurements, we find improved agreement relative to earlier models that employ prescribed background solar wind fields. Finally, the new results for the wave-like and quasi-twodimensional fluctuations are used to calculate ab initio diffusion mean-free paths and drift lengthscales for the transport of cosmic rays in the turbulent solar wind.

EP 7.4 Mi 9:30 GW2 B2880
The uncertainty of local background magnetic field orientation in anisotropic plasma turbulence — •Felix Gerick, Joachim Saur, and Michael von Papen — Institute of Geophysics and Meteorology, University of Cologne, Cologne, Germany

In order to resolve and characterize anisotropy in turbulent plasma flows a proper estimation of the background magnetic field is crucially important. Various approaches to calculate the background magnetic fields, ranging from local fields to globally averaged fields, are commonly used in the analysis of turbulent data. Here we investigate how the uncertainty in the orientation of a scale dependent background magnetic field influences the ability to resolve anisotropy. Therefore we introduce a quantitative measure, the uncertainty angle, which characterizes the uncertainty of the orientation of the background magnetic field turbulent structures are exposed to. The angle uncertainty can be used as a condition to estimate the ability to resolve anisotropy with certain accuracy. We apply our description to resolve spectral anisotropy in fast solar wind data. We show that if the uncertainty angle grows too large, the power of the turbulent fluctuations is attributed to false local magnetic field angles, which affects the spectral anisotropy. However, the anisotropy in the spectral index remains intact until very large averaging widths due to unequal change of power depending on the frequency. The frequency dependent angle uncertainty is a measure which can be applied to any turbulent system.

EP 7.5 Mi 9:45 GW2 B2880
Model for Reduced Power Spectra of Critically Balanced Solar Wind Turbulence with Damping by Kinetic Alfvén Waves — •Anne Schreiner[1], Joachim Saur[1], Michael von Papen[1], Olga Alexandrova[2], and Catherine Lacombe[2] — [1]Universität zu Köln, Institut für Geophysik und Meteorologie — [2]Paris Observatory Meudon

The observed spectral structure of magnetic turbulence at electrons scales in the solar wind is still not sufficiently understood. Analytical dissipation models for solar wind turbulence are usually derived in the three-dimensional wavenumber space. However, in-situ observations of magnetic fluctuations are obtained in a one-dimensional reduced form in the spacecraft frame, where various wavevectors contribute to the spectral energy density at a certain frequency. Based on a forward modeling approach by von Papen & Saur (2015), we calculate reduced spectral energy densities from a three-dimensional energy distribution in wavenumber space under the assumption of critically balanced turbulence and damping via wave-particle interactions of kinetic Alfvén waves. The damping is described through the imaginary part of the kinetic Alfvén wave frequency, which we obtain from linear Vlasov theory. We compare the spectral energy densities to a set of observations obtained from one-dimensional magnetic field measurements of the Cluster spacecraft analyzed in Alexandrova et al. (2012).

EP 7.6 Mi 10:00 GW2 B2880
The role of electron-scale turbulence in 3D guide field magnetic reconnection — •Patricio Muñoz and Jörg Büchner — Max-Planck-Institut für Sonnensystemforschung, Göttingen, Germany

The role of plasma turbulence in magnetic reconnection is fundamental to understand energy dissipation in laboratory, space and astrophysical plasmas. Previous studies have mostly focused in Alfvénic/low-frequency turbulence, but the effects of self-consistently generated turbulence by kinetic electron-scale instabilities in collisionless plasmas have remained mostly unknown.

We aim to explain features of the high frequency turbulence which develops during magnetic reconnection in laboratory experiments like MRX and VINETA-II, as well as of current in-situ measurements in the Earth's magnetosphere by the MMS spacecraft.

For this sake, we carried out 3D fully-kinetic Particle-in-Cell (PiC) code numerical simulations of force free current sheets with a guide magnetic field, a common situation in the plasma environments of interest. We show that the dynamically evolving kinetic turbulence spectra in reconnecting current sheets is broadband and develops starting from the lower-hybrid frequency to the kinetic electron-scale. The evolution of the turbulence spectra correlates with the growth and rate of magnetic reconnection and can be explained by (kinetic) streaming instabilities and waves, mostly due to the electron current.

EP 7.7 Mi 10:15 GW2 B2880

How hot is the heliosheath? — •Klaus Scherer[1], Hans-Jörg Fahr[2], Horst Fichtner[1], Adama Sylla[1], and John Richardson[3] — [1]Theoretische Physik IV, Ruhr Universität Bochum — [2]Argelander Institut, Universität Bonn — [3]MIT

The temperatures along the Voyager 2 trajectory are determined by assuming an underlying Maxwellian distribution function. It was recently discussed that the underlying distribution function is most probably a kappa distribution. The temperatures determined with a kappa distribution can largely differ to those given by a Maxwellian. We discuss here that the "temperature" is not unique, but depends on the assumed distribution function. Moreover, for the kappa-distribution we give a simple straightforward formula which connects the Maxwellian and kappa temperatures, only depending on the kappa index. Thus knowing a variable kappa index along the Voyager 2 trajectory we can easily estimate the respective temperatures. We demonstrate that using a model in which the kappa indices are calculated.