EP 8: Sonne

Time: Wednesday 14:00–16:00 Location: H46

EP 8.1 Wed 14:00 H46

The inhomogeneous magnetic field of a sunspot penumbra — •Rolf Schlichenmaier — Kiepenheuer-Institut für Sonnenphysik, Schöneckstr. 6, 79104 Freiburg.

A sunspot manifests the concentration of magnetic field in the solar photosphere. It consists of a central dark umbra which is surrounded by a brighter penumbral ring which reveals a radial filamentation on scales of 0.1 arcsec corresponding to some 100 km on the Sun. I will report on spectropolarimetric measurements of the magnetic field, which shows inhomogeneities that correspond to the radial filaments as seen in white light images. From these measurements the topology of the magnetic and velocity fields can be reproduced by modelling the radiative transfer of polarized light in the sunspot atmosphere. It is found that two magnetic field components with different inclinations and strengths co-exist in the penumbral atmosphere. The more inclined component is essentially horizontal and harbors a strong radial outflow, which is known as the Evershed flow. These findings have profound consequences for astrophysical magnetohydrodynamics as it sheds new light on our understanding of magnetoconvection in inclined magnetic fields.

EP 8.2 Wed 14:15 H46

Reconstruction of coronal magnetic fields with the magneto-frictional method — •gherardo valori, bernhard kliem, and axel hofmann — Astrophysikalisches Institut Potsdam, Potsdam, Germany

Coronal mass ejections and solar flares are powered by the magetic energy contained in the coronal field, and their triggering mechanisms are intimately related to the field structure. On the other hand, measurements of vector fields are available only at low altitudes in the solar atmosphere. The numerical extrapolation of photospheric boundary data (vector magnetograms) into the corona is then the only available technique that can provide the missing information about the coronal magnetic field.

We present here extrapolations of a class of solar-relevant, test magnetic equilibria containing a flux rope. We show that the magneto-frictional method can reconstruct force-free magnetic fields with an exceptionally high degree of accuracy, despite the fact that information about the nonlinear field is limited to one boundary only. Additionally, the extrapolation of measured magnetograms is now possible, which allows for comparing eruption models with real measurements. However, the complex magnetic field topology, as well as errors and inconsistency in the magnetograms, make the extrapolation task more challenging. As an example, we present here a successful extrapolation of a measured magnetogram. The obtained magnetic field structure is discussed, together with the influence of small scales and magnetogram inconsistencies on the reconstructed field.

EP 8.3 Wed 14:30 H46

Analysis of the loop stratification and dynamics using a 3D MHD coronal model — •Sven Bingert and Hardi Peter — Kiepenheuer-Institut für Sonnenphysik, Schöneckstr. 6, 79104 Freiburg

The magnetic field strongly influences the structure and the dynamics of the transition region and the corona. In contrast to the photosphere the direction and strength of the magnetic field vector in the upper atmosphere can not be determined. Thus it is valuable to employ a 3D MHD model for the analysis of the evolution of coronal loops. Modeling is done using the complete set of MHD equations including braiding of magnetic field lines as a heating mechanism. Therefrom we derive the magnetic field lines forming the coronal structures as well as their evolution in time. We will present a detailed analysis of the loop stratification and dynamics. Methods using a linear force free or potential field extrapolation to derive a 3D magnetic field from observed photospheric magnetograms will be discussed.

EP 8.4 Wed 14:45 H46

FlareLab: 3D MHD Simulationen expandierender Flußröhren — •Lukas Arnold[1], Jürgen Dreher[1], Rainer Grauer[1], Henning Soltwisch[2] und Holger Stein[2] — [1]Theoretische Physik I, Ruhr-Universität, 44780 Bochum, Germany — [2]Experimentalphysik V, Ruhr-Universität, 44780 Bochum, Germany

Die Erzeugung magnetisierter, stromdurchflossener Plasmabögen im Labor stellt eine Möglichkeit zum weiteren Verständnis solarer Flares dar. In dem FlareLab Experiment werden magnetische Strukturen, ähnlich zu den auf der Sonne, realisiert. Um ein vertieftes Verständnis zu erreichen werden parallel dazu MHD Simulationen durchgeführt. Problematisch ist dabei die Wahl der Parameter, da Messungen im Experiment sich bislang als schwierig erwiesen. Einen zentralen Punkt nimmt dabei die nicht homogene Plasmadichteverteilung ein. Diese wirkt sich bei der Expansion eines solchen Plasmabogens aus, da es sich um einen höchst dynamischen Vorgang handelt. Somit spielen Laufzeiteffekte eine große Rolle. In diesem Vortrag werden sowohl verschiedene Dichtemodelle und deren Einfluss auf die Dynamik vorgestellt, als auch Vergleiche mit experimentellen Ergebnissen. Es werden auch Ausblicke auf mögliche Verknüpfungen zur Sonne gegeben.

EP 8.5 Wed 15:00 H46

Tracking of moving magnetic flux concentrations around sunspots in the photosphere — •Xiaobo Li[1,2], Jörg Büchner[1], and Jun Zhang[2] — [1]Max-Planck-Institut für Sonnensystemforschung, Max-Planck-Str.2, 37191 Katlenburg-Lindau, Germany — [2]Solar Magnetism and Activity Group, The National Astronomical Observatories, CAS, 20A Datun Road, Chaoyang District, Beijing, 100012 China

During the decay process of sunspots, their magnetic flux decreases with time. The still open question is, where does this flux go? For example, small flux concentrations were observed to move away from sunspots, however, both same and opposite to the sunspots' magnetic field directed polarities are seen. Using time series of MDI/SOHO high-resolution line-of-sight magnetograms, we traced the flow of flux concentrations around several mature sunspots. For this purpose, we developed an automatic computerized tracking method. We statistically analyzed the kinematic and magnetic characteristics of these flows. We studied the effects of sunspots' geometry and developing phase upon these statistical values. The relationship between the flows and the decrease in the sunspots' total flux is discussed.

EP 8.6 Wed 15:15 H46

ChroTel: Full-disk observations of the solar chromosphere — •Christian Bethge and Hardi Peter — Kiepenheuer-Institut für Sonnenphysik, Schöneckstr. 6, 79104 Freiburg

In June 2006, a new robotic telescope was installed at the solar observatory at Tenerife to observe the full disc of the Sun. The goal of this 15 cm Chromospheric Telescope (ChroTel) is to observe the solar chromosphere in its three most prominent spectral lines: Ca II K (393 nm), H-alpha (656 nm) and He I (1083 nm). This will be done with a cadence below one minute and a spatial resolution of about two arcseconds. It will be the first synoptic telescope providing images in all these three lines, and it is the only instrument next to a full-scale solar telescope. Thus the Doppler maps to be acquired in the He I channel can be calibrated by spectroscopic observations.

Through an analysis of intensities and Doppler shifts in the chromosphere, ChroTels observations aim to increase our understanding of eruptive processes in the solar atmosphere, such as flares or coronal mass ejections, of the structure and dynamics of prominences and the role of the chromosphere in general.

The current status of the project and first images will be presented.

EP 8.7 Wed 15:30 H46

Magnetic structure of the solar transition region as observed in various ultraviolet lines emitted at different temperatures — •Eckart Marsch[1] and Chuanyi Tu[2] — [1]Max-Planck-Institut für Sonnensystemforschung, Katlenburg-Lindau — [2]Department of Geophysics, Peking University, Beijing, China

The structure of the solar transition region (TR) in a polar coronal hole of the Sun is studied. In particular, the detailed association of the coronal magnetic field with the radiance patterns of the TR, when seen in various far ultraviolet (FUV) emission lines, is investigated. A comparison is made of the coronal magnetic field, as obtained by extrapolation of the NSO/Kitt-Peak photospheric field to heights of several tens of megameters, with the radiances of many FUV lines, which are emitted by ions of various elements at different ionization stages, corresponding to different local coronal temperatures. By a correlation analysis of the emission pattern with the magnetic field

(network and carpet of loops), the so-called correlation height of the emission can be determined. In particular, at mesoscopic scales of several megameters the regions with strong emission (originating from multiple small closed loops) are found to be located at low heights, whereas weak emissions (coming from locally open, i.e. far reaching fields) appear to originate at greater heights. These findings are consistent with results obtained at large scales for large-size loops and big coronal holes. Our correlation-height analysis of the emission lines confirms the notion that plasma at different temperature can coexist at the same height.

EP 8.8 Wed 15:45 H46

high frequency electron/electron modes in solar plasma: linear approach — •KUANG WU LEE[1], NINA ELKINA[1,2], and JÖRG BÜCHNER[1] — [1]Max-Planck-Institut für Sonnensystemforschung, Max-Planck-Str.2, 37191 Katlenburg-Lindau, Germany. — [2]M.V. Keldysh Institute for Applied Mathematics Miusskaya sq., 4 Moscow 125047, Russia

RHESSI and the spacecraft observations have shown that during solar flares a large amount of nonthermal electromagnetic radiation is emitted from the corona. This implies the generation of energetic electron beams, eventually radiates X-rays through bremsstrahlung mechanisms. Kinetic turbulence exited by two-electron-streams (current-neutralized) configuration modifies the distribution function and generate emission. We perform parametric studies by means of linear stability analysis in a wide range of possible parameters (density, temperature, velocity ratio). Earlier work in analysis of plasma-beam systems concentrated mainly on a limited one-dimensional case with a highly diluted electron beam, which the maximal linear growth rate of beam-driven mode is parallel to the beam propagation direction (magnetic field). We study the linearly unstable modes of beam-plasma configuration with different densities, and also the general electromagnetic three-dimensional magnetized plasma, i.e. for arbitrary propagation angles, referred to the direction of magnetic field and drift velocity. Different high-frequency modes such as electron-acoustic waves become unstable as well. We discuss the possible role of such instabilities for generating the observed X-ray radiation.