EP 19: Sonne und Heliosphäre II

Time: Friday 10:30–13:00 Location: V55.21

Invited Talk EP 19.1 Fri 10:30 V55.21

Spectropolarimetry of Sunspots using HINODE data — •Morten Franz — Kiepenheuer Institut für Sonnenphysik, Schöneckstr. 6, 79104 Freiburg

Until the present day, it is not fully understood how Sunspots form and why they develop a penumbra. Current penumbral models assume different modes of magneto-convection to explain the penumbral magnetic field topology together with the characteristic Evershed flow. However, these models are still unable to explain all observational features consistently.

In this contribution, I will first summarize recent findings that have been made using data obtained by the HINODE space-borne solar observatory and then focus on how these findings may be used to discriminate between penumbral models. For this purpose, I will concentrate on the small-scale morphology of penumbral plasma flows and the geometry of the magnetic field. To conclude, I will discuss whether these flows are magnetized or not and which of the penumbral models seems favorable in the light of HINODE observations.

EP 19.2 Fri 11:00 V55.21

Fast Cavity Formation in Coronal Mass Ejections — •Bernhard Kliem[1,2], Terry G. Forbes[3], Angelos Vourlidas[4], and Spiros Patsourakos[5] — [1]Institut für Physik & Astronomie, Universität Potsdam, 14476 Potsdam — [2]MSSL, University College London, UK — [3]EOS Institute, University of New Hampshire, USA — [4]Space Science Div., Naval Research Laboratory, Washington DC, USA — [5]Dept. of Physics, University of Ioannina, Greece

We present MHD simulations of flux rope CMEs which address the strong expansion of a cavity in the inner corona recently found for the first time in stereoscopic SECCHI data of a fast CME (Patsourakos et al. 2010). The expansion is found to consist of two components. The first of these is due to an ideal MHD effect. The information of decreasing flux rope current in the course of the rope's ascent propagates into the medium surrounding the flux rope and causes it to expand all around the rope by virtue of flux conservation. The second is due to the addition of flux to the rope by flare reconnection. The ideal MHD effect dominates initially if the ambient field is only weakly sheared, producing a cavity outside of the growing flux rope. This rapidly growing "outer cavity" is a prime candidate for the formation of coronal EUV waves and shocks. Subsequently, the growth of the rope due to flare reconnection leads to an approach of the rope and outer-cavity edges. We conclude that the CME cavity may be larger than the CME flux rope low in the corona if the ambient field is only weakly sheared and that cavity and rope tend to coincide in the outer corona and solar wind.

EP 19.3 Fri 11:15 V55.21

Emissionsprozesse solarer Radio-Bursts — •Urs Ganse[1], Felix Spanier[1] und Rami Vainio[2] — [1]Lehrstuhl für Astronomie, Universität Würzburg — [2]Department of Physics, University of Helsinki

Solare Typ II und III Radio-Bursts sind transiente Phänomene in der Sonnenatmosphäre, die mit energetischen Ereignissen wie Flares (im Fall von Typ III) und koronalen Masseauswürfen (im Fall von Typ II) korelliert sind.

Beiden Radioburst-Typen liegt die Anregung von Plasmawellen durch Elektronen-Strahlpopulationen im Heliosphärischen Plasmahintergrund zu Grunde, die via nichtlinearer Wellen-Wechselwirkung zur Emission elektromagnetischer Wellen führt.

Theoretische Behandlungen dieser Prozesse existieren seit mehreren Jahrzehnten, doch eine Verifikation der Theorie stellte sich als kompliziert heraus: punktförmige in-situ Messungen von Satelliten liefern unzureichende Information, um quantitative Aussagen über Wellenkopplungsvorgänge zu treffen, während Plasma-Simulationen durch die große Bandbreite an auftretenden Längenskalen sehr große numerische Anforderungen stellen.

Mittels des Particle-in-Cell Codes ACRONYM, der am Lehrstuhl für Astronomie die Universität Würzburg entwickelt wurde, haben wir die Emissionsregionen dieser Radiobursts modelliert und stellen Ergebnisse über die Wellenkopplungsvorgänge in dieser Plasmaumgebung vor.

EP 19.4 Fri 11:30 V55.21

Coronal Mass Ejections detected during radio sounding observations with the MEX spacecraft — •Matthias Hahn[1], Sami W. Asmar[5], Micheal B. Bird[4], Bernd Häusler[2], Martin Pätzold[1], Silvia Tellmann[1], Bruce Tsurutani[5], and G. Leonard Tyler[3] — [1]Rheinisches Institut für Umweltforschung, Abteilung Planetenforschung, Cologne, Germany — [2]Institut für Raumfahrttechnik, Universität der Bundeswehr, Munich, Germany — [3]Department of Electrical Engineering, Stanford, CA, USA — [4]Argelander-Institut für Astronomie, Universität Bonn, Bonn, Germany — [5]Jet Propulsion Laboratory, Caltech, Pasadena, CA, USA

The radio sounding technique is a powerful tool to investigate the structure of the solar corona when a radio transmitter is located near superior solar conjunction. Mars Express, in orbit about Mars, underwent solar conjunctions in 2004, 2006, 2008/09 and 2010/11. As part of the Radio Science Experiment MaRS radio-sounding measurements were recorded using the dual-frequency downlinks of the spacecraft during solar conjunctions. The transmitted radio signals propagated through the plasma of the solar corona. Changes in carrier frequency reveal the large-scale coronal structure as a function of distance from the Sun. MaRS observed several Coronal Mass Ejection (CME) events crossing the radio ray path. A detailed interpretation of these events is presented. A CME-model was adapted to the measured electron content in order to derive information on the electron density, plasma velocity and spatial structure of CME features. Results of various simulations are presented and compared with SOHO/LASCO data.

EP 19.5 Fri 11:45 V55.21

On the role of slow mode shocks in the reconnection region for generating energetic electrons during solar flares — •Gottfried Mann, Henry Aurass, Hakan Oenel, and Alexander Warmuth — Leibniz-institut fuer Astrophysik Potsdam, An der Sternwarte 16, D-14482 Potsdam, Germany

A flare is defined as an sudden enhancement of the emission of electromagnetic radiation of the Sun covering a broad range of the spectrum from the radio up to the gamma-ray range. That indicates the generation of energetic electrons during flares, which are considered as the manifestation of magnetic reconnection. According to this model, the inflow region of the reconnection region is separated from the outflow one by pairs of slow mode shocks. At them, the magnetic field energy is efficiently annihilated and tranfered into a strong heating of the outflow plasma leading to the generation of energetic electrons as needed for the hard X-ray radiation at large flares.

The slow mode shocks are studied in terms of the Rankine-Hugoniot relationships. Especially, the jump of the temperature and the magnetic field across the shock is evaluated to study the heating of the plasma in the outflow region. The resulting fluxes of energetic electrons in the outflow region are calculated in a fully relativistic manner. Due to the strong heating of the plasma at the slow mode shocks, electrons with energies beyond 40 keV are generated in the outflow region as needed for the hard X-ray radiation. The theoretically obtained fluxes of energetic electrons agree well with those as measured by RHESSI satellite during large flares.

EP 19.6 Fri 12:00 V55.21

MHD simulation of the inner-heliospheric magnetic field — •Tobias Wiengarten — Institut für Theoretische Physik IV, Ruhr-Universität Bochum

Maps of the radial magnetic field at a heliocentric distance of ten solar radii are used as boundary conditions in the MHD code CRONOS to simulate a 3D inner-heliospheric solar wind emanating from the rotating Sun. The input data for the magnetic field are the result of solar surface flux transport modelling (*Jiang et al.(2010)*) using observational data of sunspot groups coupled with a current–sheet source surface model. Amongst several advancements, this allows for higher angular resolution than that of comparable observational data from synoptic magnetograms. The required initial conditions for the other MHD quantities are obtained following the empirical approach by *Detman et al.(2006)*, who use an inverse relation between flux tube expansion and radial solar wind speed. The computations are performed for representative solar minimum and maximum conditions, and results at the Earth's orbit are obtained. After a successful comparison of the latter with observational data, they can be used to drive outer-heliospheric models.

EP 19.7 Fri 12:15 V55.21

Transport modeling of STEREO-A/B and ACE electron observations on 7 February 2010 — •Wolfgang Dröge[1], Yulia Kartavykh[1], Raul Gómez-Herrero[2], Nina Dresing[2], and Bernd Heber[2] — [1]Institut für Theoretische Physik und Astrophysik, Universität Würzburg, D-97074 Würzburg, Germany — [2]Institut für Experimentelle und Angewandte Physik, Universität Kiel, D-24118 Kiel, Germany

We present an analysis of near-relativistic electrons which were observed simultaneously by the EPAM instrument onboard ACE and the SEPT instruments onboard the two STEREO spacecraft following a solar flare on 7 February 2010. At the time of the event the longitudinal separation of the two STEREO spacecraft was approximately 130 degrees. We have applied our numerical three-dimensional transport model which incorporates pitch angle diffusion, focusing and pitch-angle dependent diffusion perpendicular to the magnetic field to model intensity profiles and angular distributions observed on the three spacecraft. An attempt is made to disentangle the effects of a longitudinal dependence of electron injection close to the Sun from transport perpendicular to the magnetic field in interplanetary space.

Invited Talk EP 19.8 Fri 12:30 V55.21

Solar Orbiter - Linking the Sun and the Heliosphere — •Robert F. Wimmer-Schweingruber — Institute for Experimental and Applied Physics\\Christian-Albrechts-University Kiel\\Leibnizstr. 19\\24098 Kiel

This decade will see the launch of two spectacular missions to dive deep into the inner heliosphere and unveil mysteries of the Sun and how it controls space around us. Solar Orbiter and Solar Probe Plus with their unique and highly complementary payloads will reshape our understanding of the Sun, corona, and how it affects our life. Solar Orbiter, with its highly optimized combined remote-sensing and insitu payload will allow us to link in microscopic detail the Sun and the heliosphere in ways previously not possible. In a nutshell, it will allow us to understand how the Sun creates and controls the heliosphere.