EP 5: SDO/Sunrise/STEREO

Zeit: Dienstag 16:45–19:00 Raum: G.10.02 (HS 9)

Hauptvortrag EP 5.1 Di 16:45 G.10.02 (HS 9)

Sunrise Mission Highlights — •Tino Riethmüller and Sami Solanki — Max-Planck-Institut für Sonnensystemforschung (MPS), Göttingen, Germany

Solar activity is controlled by the magnetic field, which also causes the variability of the solar irradiance that in turn is thought to influence the climate on Earth. The magnetic field manifests itself in the form of structures of different sizes, starting with sunspots (10-50 Mm) down to the smallest known magnetic features that often have spatial extents of 100 km or less. The study of the fine scale structure of the Sun's magnetic field has been hampered by the limited spatial resolution of the available observations. This has recently changed thanks to new space- and ground-based telescopes. A significant step forward has been taken by the SUNRISE observatory, built around the largest solar telescope to leave the ground, and containing two science instruments. SUNRISE had two successful long-duration science flights on a stratospheric balloon in June 2009 (solar activity minimum) and in June 2013 (at a high activity level) and a number of scientific results have been obtained that have greatly advanced our understanding of solar magnetism, with data analysis still ongoing. After a brief introduction to the SUNRISE mission, an overview of a selection of these results will be given.

Hauptvortrag EP 5.2 Di 17:15 G.10.02 (HS 9)

Highlights of SDO — •Jesper Schou — Max-Planck-Institute für Sonnensystemforschung

The Solar Dynamics Observatory (SDO) was launched in 2010 and has been collecting vast quantities of data over the past nearly five years. SDO has three instruments: HMI (Helioseismic and Magnetic Imager) designed to study the Sun using helioseismology and near surface magnetic fields, AIA (Atmospheric Imaging Assembly) designed to study the Sun's atmosphere using narrow band imaging in the ultraviolet and EVE (Extreme Ultraviolet Variability Experiment) designed to study the solar atmosphere in integrated light at high spectral resolution.

In this talk I will describe some of the discoveries from SDO so far, including both results using the instruments as originally envisioned and entirely unexpected results from more creative uses, including ones not directly related to the Sun.

EP 5.3 Di 17:45 G.10.02 (HS 9)

Coronal Active Region Modeling based on SDO Data — •Stephan Barra[1,2], Thomas Wiegelmann[1], and Horst Fichtner[2] — [1]MPI für Sonnensystemforschung, Göttingen — [2]Ruhr-Universität Bochum

The heating of the solar corona, which has a temperature of order of 106 K compared to 5000K in the photosphere, is yet a puzzling problem. Several models to describe the physical parameters, e.g. temperature or density, along coronal loops with different assumptions for the relevant physical processes (like wave damping) were suggested in the past, for example the RTV78 model by Rosner, Tucker and Vaiana. With these models and the knowledge of the 3D configuration of the magnetic field above an active region it is possible to calculate the radiation emitted by the coronal loops above this region. This 3D field configuration can be provided by different ways of modeling using SDO/HMI vector magnetograms as boundary conditions. We use different fields models and loop models to compute the coronal plasma along these loops, obtaining synthesized images in different wavelength. The images can be compared to observational data from the multispectral imager SDO/AIA. Such comparisons allow us to evaluate the quality of our model approach.

Hauptvortrag EP 5.4 Di 18:00 G.10.02 (HS 9)

Highlights of STEREO — •Marilena Mierla — Royal Observatory of Belgium, Brussels, Belgium — Institute of Geodynamics of the Romanian Academy, Bucharest, Romania

The stereoscopic images obtained by the Sun Earth Connection Coronal and Heliospheric Investigation (SECCHI) instrument suite onboard the Solar TErrestrial RElations Observatory (STEREO), which was launched in October 2006, allow us to make 3D estimations of the structure and kinematic parameters of the dynamical solar phenomena. Among them, coronal mass ejections (CMEs) are of a great importance as they are very energetic, complex phenomena, which, when interacting with the Earth magnetic field can produce major disturbances affecting us directly. This is why it is important to know in advance their kinematic properties and their 3D shape, as well as the properties of the medium through which they propagate. We will present in this talk an update of what was done so far on this aspect. We will outline the constraints on reconstructing the CMEs and possible improvements with the next generation of space missions.

EP 5.5 Di 18:30 G.10.02 (HS 9)

Radial Flow Pattern of a slow Coronal Mass Ejection — •Li Feng[1,2], Bernd Inhester[1], Weiqun Gan[2], and Thomas Wiegelmann[1] — [1]Max Planck Institute for Solar System Research, Germany — [2]Purple Mountain Observatory, China

Height-time plots of the leading edge of a coronal mass ejection (CME) have been often used to study its kinematics. A new method is proposed to analyze the CME kinematics in more details through its mass transport process. The method is able to estimate not only the CME speed at its front but also the radial flow speeds inside the CME. We have applied the method to a slow CME with an average leading edge speed about 487 km s^{-1}. It is found that the radial flow speed increases with distance and decreases with time. CME mass increase is often attributed to two reasons: outflow from the dimming region and solar wind pile-up around the CME. The flow speed profiles of this slow CME reveals that the solar wind pile-up is improbable to make contributions to its mass. A further estimate of the CME kinetic energy indicates that the conventional kinetic energy derived from the total mass and leading edge speed can be two times larger than our value taking into account the internal mass and flow distributions. The Lagrangian trajectories derived from the obtained flow pattern for mass elements at different heights present much more information than the single leading-edge trajectory. We find that with time the leading edge trajectory gradually lag behind the trajectory of mass element with a fastest speed. It implies that the leading edge trajectory does not actually follow a material path as the name suggests.

EP 5.6 Di 18:45 G.10.02 (HS 9)

MHD Simulation of a Confined Solar Filament Eruption — •Alshaimaa Hassanin and Bernhard Kliem — Universität Potsdam- Intsitut für Physik und Astronomie

We present MHD simulations of a confined filament eruption, which produced a solar flare but no coronal mass ejection. The onset of this event (on 2002 May 27) was modeled in Toeroek & Kliem (2005), using the magnetic flux rope equilibrium by Titov & Demoulin (1999) as the initial condition. They found the event to be a good candidate for the occurrence of the helical kink instability. Now we follow the eruption into the main flare phase. This is characterized by a sequence of reconnection events involving the magnetic flux of the rope (the filament) as well as the ambient, overlying flux. First, the top part of the rope reconnects with the ambient flux. Second, the two legs of the split rope approach each other and reconnect. This leads to the reformation of a flux rope, with less twist, and also restores the overlying flux. Further minor reconnection occurs under the new rope, completing its reformation. We find that the shapes of the field lines that reconnect in steps 1 and 2 correspond well to the observed flare loops. The flare loops show considerable brightness, although the eruption remained confined. This appears plausible from the fact that these loops were involved in two phases of reconnection, each of which contributed to the heating of the flare plasma. The reformation of the flux rope may yield a path to homologous flare events. Overall, the sequence of ideal MHD instability and magnetic reconnection corresponds well to the observations of the eruption.