# EP 2: Sun and Heliosphere I

Time: Tuesday 11:00–12:30 Location: H-HS VIII

**Invited Talk** EP 2.1 Tue 11:00 H-HS VIII

**Parker Solar Probe and Solar Orbiter** — •Gottfried Mann — Leibniz-Institut f\"ur Astrophysik Potsdam (AIP)

ASA's "Parker Solar Probe" (PSP) and ESA's "Solar Orbiter" will be the most important space missions for solar physics in the next decade. Both spacecraft and additional ground based observations of the Sun as e.g. with the radio interferometer LOFAR will give us new insights in the origin of solar activity, its evolution, and its action into the heliosphere. Since August 2018 PSP is flying around the Sun and will approach it down to a distance of 10 solar radii. The launch of Solar Orbiter is presently scheduled to February 5th, 2020. It will approach the Sun in 2022. The perihel will be about 0.28 AU allowing the co-rotation with the Sun for approx. 10 days. That gives us the opportunity to study the origin and evolution of active regions and their influence into the heliosphere.

Thanks of the support by the German Space Agency DLR German solar physicists are substantially involved in the Solar Orbiter mission and partly into PSP, as e.g. in the X-ray telescope STIX.

The Sun is an active star. Eruptions as flares and coronal mass ejections (CMEs) are accompanied with an enhanced emission of electromagnetic radiation from the radio up to the gamma-ray range indicating the generation of energetic electron during flares. These electrons carry a substantial part of the flare released energy. Hence, the generation of energetic electrons plays an important role in the understanding of the flare process. This is the reason why we focus on this research topic at AIP.

EP 2.2 Tue 11:30 H-HS VIII

**Magnetohydrostatic modelling of the solar atmosphere: Analytical solutions** — •Thomas Wiegelmann[1], Thomas Neukirch[2], and Xiaoshuai Zhu[1] — [1]Max-Planck-Institut für Sonnensystemforschung, Justus-von-Liebig-Weg 3, 37077 Göttingen, Germany — [2]School of Mathematics and Statistics, University of St Andrews, St Andrews, KY169SS, United Kingdom

Our aim is to model the magnetic field and plasma environment in the solar atmosphere and use measured photospheric magnetograms as boundary condition. While the solar corona above active regions can be modelled under the assumption of a vanishing Lorentz-force, we have to consider plasma forces like the plasma pressure gradient force and gravity in the upper photosphere and chromosphere. Fully numerical solutions have been developed, but they are numerically expensive and require high resolution photospheric vector magnetograms as boundary conditions. Nevertheless analytical solutions in 3D are very useful for various reasons: 1.) They require only line-of-sight magnetograms as input. This is an advantage in the quiet Sun, where horizontal fields cannot be measured accurately. 2.) Computations are much quicker than for fully numerical approaches. 3.) New analytic solutions allow an accurate modelling of the transition between the magnetostatic chromosphere and the force-free corona. 4.) Analytic solutions are useful as initial state for numerical computations.

EP 2.3 Tue 11:45 H-HS VIII

**Magnetohydrostatic modelling of the solar atmosphere: Numerical solutions** — •Xiaoshuai Zhu and Thomas Wiegelmann — Max-Planck-Institut für Sonnensystemforschung, Justus-von-Liebig-Weg 3, 37077 Göttingen

We aim to extrapolate the solar atmosphere from vector magnetograms by the optimization technique. Magnetic and non-magnetic forces are equally important in the upper photosphere and chromosphere. Consequently the plasma and magnetic field have to be computed self-consistently, in lowest order with a magnetohydrostatic model. Even though the numerical solutions are much more time-consuming compared with the analytical solutions, their ability to reconstruct the strong localized concentration of electric current and Lorentz force is superior. In this talk, I will present a strict test of the new code with a radiative MHD simulation and its first application to high resolution vector magnetograms measured by SUNRISE/IMaX.

EP 2.4 Tue 12:00 H-HS VIII

**Parametric Study of Torus Instability Threshold** — •Jun Chen[1,2], Bernhard Kliem[2], Tibor Török[3], and Rui Liu[1] — [1]University of Science and Technology of China — [2]University of Potsdam — [3]Predictive Science Inc.

A parametric numerical study of the torus instability threshold for the Titov-Démoulin (tokamak) equilibrium of a line-tied, force-free current channel and flux rope is performed to elucidate the scatter about the nominal value of 3/2 for the critical decay index, which characterizes the equilibrium external poloidal field (the so-called strapping field). Values scattering in the range $\approx 1$–2 are typically found in numerical and observational studies of flux rope eruptions on the Sun. We demonstrate and quantify the stabilizing effects of an external toroidal (shear, or guide) field component and of pure O-type topology, which forms when the bounding separatrix surface of the flux rope fully touches the photospheric boundary, delaying the onset of fast magnetic reconnection relative to the onset of instability. Increasing flux rope thickness, considered for decreasing aspect ratios down to $\approx 2$, is also found to raise the threshold.

EP 2.5 Tue 12:15 H-HS VIII

**Turbulent onset of fast magnetic reconnection in the solar atmosphere** — •Lakshmi Pradeep Chitta[1] and Alexandre Lazarian[2] — [1]Max Planck Institute for Solar System Research, Göttingen 37077, Germany — [2]Astronomy Department, University of Wisconsin, Madison, WI 53706, USA

Magnetic reconnection is a fundamental process in the universe that converts magnetic energy into other forms in astrophysical plasmas. For instance, solar ultraviolet bursts are driven by magnetic reconnection. Similarly, reconnection powers solar flares and even energetic gamma-ray bursts. Fast reconnection on scales of Alfvén time is required to explain the explosive nature of these events. In the solar atmosphere, that corresponds to a few minutes. Despite its importance, the nature of astrophysical fast reconnection is an open question and is a subject of intensive debates.

In this talk, we present results based on high cadence spectroscopic observations of reconnection-powered solar microflares that brighten on timescales of minutes, obtained by the Interface Region Imaging Spectrograph. Our observations capture the complete evolution of microflares and thus provide unprecedented access to plasma dynamics before and during reconnection. We discuss the nature of plasma turbulence at reconnection sites prior to flaring, and its role in inducing fast reconnection.