# Fachverband Extraterrestrische Physik (EP)

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# Übersicht der Hauptvorträge und Fachsitzungen

(Hörsaal BSZ - Pabel HS)

## Plenarvortrag von EP

| | | | | |
|---|---|---|---|---|
| PV VI | Mi | 9:00– 9:45 | Z6 - HS 0.004 | **Our Dynamic Sun** — •Eric Priest |

## Hauptvorträge

| | | | | |
|---|---|---|---|---|
| EP 1.1 | Mo | 16:30–17:00 | BSZ - Pabel HS | **Recent Advances in Understanding of the Van Allen Radiation Belts** — •Yuri Shprits |
| EP 1.5 | Mo | 17:45–18:15 | BSZ - Pabel HS | **Ionospheric research based on well-established and new monitoring methods** — •Jens Berdermann |
| EP 2.1 | Di | 11:00–11:30 | BSZ - Pabel HS | **New insights into Saturn's magnetosphere: Cassini's final results** — •Norbert Krupp, Elias Roussos, Peter Kollmann, Don Mitchell, Michele Dougherty |
| EP 3.1 | Di | 16:30–17:00 | BSZ - Pabel HS | **Helicity in the solar atmosphere** — •Gherardo Valori, Etienne Pariat |
| EP 6.1 | Mi | 14:00–15:00 | BSZ - Pabel HS | **Struktur und Dynamik des Sonnensystems im Blick der letzten drei Jahrzehnte** — •Hans Joerg Fahr |
| EP 7.1 | Mi | 15:00–15:30 | BSZ - Pabel HS | **Publishing in Astronomy & Astrophysics** — •Hardi Peter |
| EP 9.1 | Do | 11:00–11:30 | BSZ - Pabel HS | **Exoplanet observations: On the road to finding our place in the Galaxy** — •Hans-Jörg Deeg |
| EP 9.2 | Do | 11:30–12:00 | BSZ - Pabel HS | **New Insights into Cosmic Ray induced Biosignature Chemistry in Earth-like Atmospheres** — •Markus Scheucher, John Lee Grenfell, Mareike Godolt, Heike Rauer |
| EP 11.1 | Do | 15:00–15:30 | BSZ - Pabel HS | **Recent advances in heliospheric transport of solar energetic particles** — •Timo Laitinen, Silvia Dalla |
| EP 13.1 | Fr | 9:00– 9:30 | BSZ - Pabel HS | **Instabilities in the modelling of massive stars** — •Cyril Georgy |
| EP 13.2 | Fr | 9:30–10:00 | BSZ - Pabel HS | **Atmospheres and winds of massive stars** — •Sergio Simon-Diaz |

## Hauptvorträge des fachübergreifenden Symposiums SYMD

Das vollständige Programm dieses Symposiums ist unter SYMD aufgeführt.

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| SYMD 1.1 | Mo | 14:00–14:30 | Z6 - HS 0.004 | **The Data Mining Guide to the Galaxy and Beyond** — •Sabrina Einecke |
| SYMD 1.2 | Mo | 14:30–15:00 | Z6 - HS 0.004 | **A novel method for the energy determination of ultra-high energy cosmic rays through radio emission of particle showers** — •Christian Glaser |
| SYMD 1.3 | Mo | 15:00–15:30 | Z6 - HS 0.004 | **Measuring the neutrino mass hierarchy with the future KM3NeT/ORCA detector in the deep sea** — •Jannik Hofestädt |
| SYMD 1.4 | Mo | 15:30–16:00 | Z6 - HS 0.004 | **Milestone toward a nuclear clock: On the direct detection of $^{229\mathrm{m}}$Th** — •Lars von der Wense, Benedict Seiferle, Peter G. Thirolf |

## Hauptvorträge des fachübergreifenden Symposiums SYGR

Das vollständige Programm dieses Symposiums ist unter SYGR aufgeführt.

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| SYGR 1.1 | Di | 14:00–14:30 | Z6 - HS 0.004 | **New horizons in gravity** — •Lavinia Heisenberg |
| SYGR 1.2 | Di | 14:30–15:00 | Z6 - HS 0.004 | **Binary neutron stars: Einstein's richest laboratory** — •Luciano Rezzolla |
| SYGR 1.3 | Di | 15:00–15:30 | Z6 - HS 0.004 | **Search for Dark Matter** — •Christian Weinheimer |
| SYGR 1.4 | Di | 15:30–16:00 | Z6 - HS 0.004 | **From QFT on curved spacetimes to effective quantum gravity** — •Kasia Rejzner |

## Fachsitzungen

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|---|---|---|---|---|
| SYMD 1.1–1.4 | Mo | 14:00–16:00 | Z6 - HS 0.004 | **SMuK Dissertationspreis 2018** |
| EP 1.1–1.8 | Mo | 16:30–19:00 | BSZ - Pabel HS | **Near Earth Space** |
| EP 2.1–2.6 | Di | 11:00–12:45 | BSZ - Pabel HS | **Planets and small Objects** |
| SYGR 1.1–1.4 | Di | 14:00–16:00 | Z6 - HS 0.004 | **Symposium Gravitation - neueste Ergebnisse und Trends** |
| EP 3.1–3.7 | Di | 16:30–18:30 | BSZ - Pabel HS | **Sun and Heliosphere I - Structure (MHD, Corona, TR, SW-acc.-Region)** |
| PV VI | Mi | 9:00– 9:45 | Z6 - HS 0.004 | **Our Dynamic Sun** — •**Eric Priest** |
| EP 4.1–4.5 | Mi | 11:00–12:15 | BSZ - Pabel HS | **Sun and Heliosphere II - Dynamics (MHD, Particles)** |
| EP 5 | Mi | 12:45–13:45 | BSZ - Pabel HS | **AEF-Vorstandssitzung** |
| EP 6.1–6.1 | Mi | 14:00–15:00 | BSZ - Pabel HS | **Arne Richter Lecture** |
| EP 7.1–7.1 | Mi | 15:00–16:00 | BSZ - Pabel HS | **Publishing in Astronomy and Astrophysics** |
| EP 8.1–8.11 | Mi | 16:30–18:30 | BSZ - Pabel HS | **Poster Session** |
| EP 9.1–9.4 | Do | 11:00–12:30 | BSZ - Pabel HS | **Exoplanets und Astrobiology with poster prize talk** |
| EP 10 | Do | 12:30–14:00 | BSZ - Pabel HS | **Mitgliederversammlung** |
| EP 11.1–11.7 | Do | 15:00–17:00 | BSZ - Pabel HS | **Sun and Heliosphere III - Particles** |
| EP 12.1–12.4 | Do | 17:30–18:30 | BSZ - Pabel HS | **Astrophysics I - High-energy and Relativistic Astrophysics** |
| EP 13.1–13.4 | Fr | 9:00–10:30 | BSZ - Pabel HS | **Astrophysics II - Massive stars: Evolution, Winds and Pulsation** |
| EP 14.1–14.5 | Fr | 11:00–12:15 | BSZ - Pabel HS | **Astrophysics III - Magnetic Fields, Stellar Clusters, Cosmic Rays and Cosmology** |
| EP 15.1–15.1 | Fr | 12:15–12:30 | BSZ - Pabel HS | **Alternative Theories** |

## Mitgliederversammlung AEF und Fachverband Extraterrestrische Physik

Donnerstag 22.03.2018 12:30–14:00 Raum: BSZ - Pabel HS

Begrüßung

Feststellung der Beschlussfähigkeit

Kenntnisnahme des Protokolls der Mitgliederversammlung 2017

Bericht des Vorstandes

Bericht des Schatzmeisters (AEF)

Entlastung des Vorstandes (AEF)

Höhepunkte und Veranstaltungen 2017,2018

Bericht aus DPG und der DPG-Sektion Materie und Kosmos (SMuK).

Bericht aus den Kommissionen

Internationale Weltraumwetterinitiative ISWI

Kommissionsstruktur. Satzungsänderung: Verankerung von stellvertretenden Kommissionsvorsitzenden.

Wahlen: stellvertretende Kommissionsvorsitzende

Vorstandsbeschluss: Verlegung der Tagung 2019 von Braunschweig nach München

Abstimmung über Tagungsorte 2020 und 2021 (AEF und DPG-EP).

Webseite und Mitgliederverwaltung (AEF)

Sonstiges

# EP 1: Near Earth Space

Zeit: Montag 16:30–19:00 Raum: BSZ - Pabel HS

**Hauptvortrag** EP 1.1 Mo 16:30 BSZ - Pabel HS

**Recent Advances in Understanding of the Van Allen Radiation Belts** — •Yuri Shprits — Helmholtz Centre Potsdam, GFZ German Centre for Geosciences, Potsdam, Germany — Institute for Physics and Astronomy, University of Potsdam, Potsdam, Germany

The Van Allen radiation belts consist of energetic electrons and ions at energies above 100 keV trapped by the Earth's magnetic field. These very energetic particles, often referred to as killer electrons, may be harmful to satellite electronics and humans in space. During geomagnetic storms, radiation in the near-Earth space can dramatically increase, and numerous anomalies are often reported by satellite operators. Since the discovery of the belts by the first US satellite over half a century ago, the origin of relativistic electrons in the radiation belts and physical mechanisms responsible for the dynamics of the belts has been a focus of extensive scientific research. We present an overview of recently discovered acceleration and loss mechanisms that determine the evolution of the belts, and an overview of the developed models of the space environment. We also present the real-time data assimilative framework based on the Versatile Radiation Belt Code (VERB). Using real-time streams from ACE, Van Allen Probes, GOES, and predictions of Kp index, we issue a highly accurate now-cast by assimilating all available data, and issue a forecast based on the now-cast.

EP 1.2 Mo 17:00 BSZ - Pabel HS

**The Evolution of Turbulence behind the Terrestrial Bow Shock** — •Gerrit Meinhardt, Joachim Saur, and Anne Schreiner — Institut für Geophysik und Meteorologie, Universität zu Köln

Using measurements from the Cluster spacecraft which investigate the Earth's magnetic environment and its interaction with the solar wind plasma, we study turbulence of magnetic fluctuations inside the Earth's magnetosheath. In the solar wind, power spectral densities of magnetic fluctuations follow a Kolmogorov scaling of $f^{-5/3}$ at MHD scales. Power spectral densities inside the magnetosheath were found to scale differently (close to $f^{-1}$) in most observations. We analyze 32 magnetosheath crossings of Cluster in different regions of the Earth's environment. We observe spectral slopes close to -1 as well as close to -5/3 which change with distance from the magnetosheath boundaries. We investigate the processes that lead to the evolution of turbulence in the inertial range of the turbulent cascade and the transition from a scaling with $f^{-1}$ to a Kolmogorov scaling.

EP 1.3 Mo 17:15 BSZ - Pabel HS

**The response of the middle and lower atmosphere to geomagnetic forcing in a coupled chemistry-climate model** — •Miriam Sinnhuber, Sabine Barthlott, and Stefan Versick — Karlsruher Institut für Technologie, Karlsruhe, Germany

Precipitating electrons from the magnetosphere or the radiation belts accelerated in high-speed solar wind streams * called geomagnetic forcing * can affect atmospheric composition, temperatures and wind fields from the thermosphere down to at least the lower stratosphere. In a first instance, chemical composition is affected by impact ionization, which leads to the formation of nitric oxides in the upper mesosphere and thermosphere. Nitric oxide can then be transported down into the stratosphere during polar winter, and destroy ozone there in catalytic cycles. As ozone is one of the key species of radiative heating and cooling of the middle atmosphere, this has a direct impact on temperatures and the thermal wind balance.

We use a chemistry-climate model reaching from the surface up to the thermosphere (~220 km) to investigate the impact of high geomagnetic activity on composition, temperatures and wind fields in the middle and lower atmosphere.

EP 1.4 Mo 17:30 BSZ - Pabel HS

**Impact of geomagnetic activity on thermospheric composition and circulation, and their coupling to the middle and upper atmosphere** — •Sabine Barthlott[1], Miriam Sinnhuber[1], Thomas Reddmann[1], Stefan Versick[1], Holger Nieder[2], and Alexey Vlasov[2] — [1]Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany — [2]formerly KIT

External forcing by high-speed solar wind streams and solar coronal mass ejections (so-called geomagnetic forcing) incfluences composition and circulation of the lower thermosphere. Essential processes are photoionisation, particle ionisation and joule heating. Hereby produced changes in the thermosphere also effect other atmospheric layers. Enhanced nitrogen monoxide (NO) due to auroral ionisation subsides and influences atmospheric layers below (e. g. ozone layer). Gravity waves, excited in the lower thermosphere by e. g. geomagnetic storms, can propagate upwards and influence the environment of low-Earth orbit satellites.

To correctly reproduce this coupling with models, it is important, to describe these processes in the lower thermosphere as precisely as possible. We use and further develop the coupled chemistry-climate-model EMAC (used in an extended version up to ∼220 km) is further developed and processes mentioned above (e. g. photoionisation) are implemented. Using the example of winter 2008/2009, results of the further developed model will be compared with standard simulations and observations.

**Hauptvortrag** EP 1.5 Mo 17:45 BSZ - Pabel HS

**Ionospheric research based on well-established and new monitoring methods** — •Jens Berdermann — German Aerospace Center, Institute of Communication and Navigation, Neustrelitz, Germany

The ionosphere is an ionized layer ranging from about 50 km till 1000 km around the earth and is mainly generated by the solar irradiance. Ionospheric key parameters such as electron density, ion composition and plasma temperature are strongly dependent on geographic/geomagnetic location as well as on diurnal, seasonal, solar cycle and space weather effects. During the past decades a growing number of observations are available with the potential to significantly improve monitoring and modelling of the ionosphere. This is important since radio signals transmitted by modern communication, navigation and Earth observation systems are influenced during propagation through or by reflection at the ionosphere, depending on the used frequency. Therefore the combination of ground- and space-based data in combination with appropriate models can provide unique information about the ionosphere. We like to discuss how well established and new ionospheric measuring and modelling methods help to improve our understanding of the ionosphere and its dynamics.

EP 1.6 Mo 18:15 BSZ - Pabel HS

**Mapping and Predicting Ionospheric Conditions based on Geodetic space-techniques and Solar Observations** — •Andreas Goss[1], Eren Erdogan[1], Michael Schmidt[1], Denise Dettmering[1], Florian Seitz[1], Klaus Börger[2], Sylvia Brandert[2], Barbara Görres[3], Wilhelm Kersten[3], Volker Bothmer[4], Johannes Hinrichs[4], and Niclas Mrotzek[4] — [1]Deutsches Geodätisches Forschungsinstitut der Technischen Universität München (DGFI-TUM) — [2]German Space Situational Awareness Center (GSSAC) — [3]Bundeswehr GeoInformation Centre (BGIC) — [4]Institute for Astrophysics at the University of Goettingen (IAG)

The project OPTIMAP is a joint initiative of the BGIC, the GSSAC, the DGFI-TUM and the IAG. The main goal of the project is the development of an operational tool for ionospheric mapping and prediction. The software uses geodetic observation techniques that are sensitive to the free electrons within the Earth*s ionosphere (GNSS, satellite altimetry, radio occultations, and DORIS) in order to provide representations of Vertical Total Electron Content (VTEC) with high spatial and spectral resolution. Since these observations are distributed rather unevenly over the globe, a so called Two-Level-Model (TLM) strategy has been developed, a combination of global and regional models. The additional incorporation of solar observations enables a reliable forecast for upcoming ionospheric conditions in terms of VTEC. In this contribution, we present the high-resolution VTEC products of the TLM, a correlation study of solar parameters and VTEC and the first results of the forecasted ionospheric conditions.

EP 1.7 Mo 18:30 BSZ - Pabel HS

**Scaling thermospheric density of thermospheric empirical models using satellite laser ranging measurements to spherical low orbit Earth satellites** — •Sergei Rudenko, Michael Schmidt, Mathis Blossfeld, and Eren Erdogan — Deutsches Geodätisches Forschungsinstitut der Technischen Universität München (DGFI-TUM), Arcisstrasse 21, 80333 Munich, Germany

Knowledge on the density of the Earth's thermosphere and exosphere is a prerequisite for planning of satellite missions, precise orbit determination, orbit and re-entry prediction, collision avoidance of artificial satellites orbiting the Earth at altitudes below 1000 km. Thermospheric density is usually given by empirical and physical models. Empirical models have been derived from observations, such as mass spectrometer, incoherent scatter radar, orbit and accelerometer data since 1961. Precise Satellite Laser Ranging (SLR) observations (with a precision of 1-3 mm for a normal point) to spherical satellites orbiting the Earth at an altitude below 1000 km can be used to validate and calibrate these models and, if necessary, scale the thermospheric density provided by the models. We present and discuss the results of the estimation of scaling factors of the thermospheric density given by four empirical thermospheric models CIRA86, NRLMSISE00, JB2008 and DTM2013 at the periods of low and high solar activity using SLR measurements to five low-altitude (350 to 425 km) satellites ANDE-RR Active and ANDE-RR Passive (2007), ANDE Castor and ANDE Pollux (2009-2010) and SpinSat (2015-2016).

EP 1.8 Mo 18:45 BSZ - Pabel HS

**Empirical model of nitric oxide in the mesosphere from SCIAMACHY/Envisat satellite observations** — •Stefan Bender[1], Miriam Sinnhuber[2], Patrick Espy[1], and John P. Burrows[3] — [1]Norwegian University of Science and Technology, Trondheim, Norway — [2]Karlsruhe Institute of Technology, Karlsruhe, Germany — [3]University of Bremen, Bremen, Germany

Solar, auroral, and radiation belt electrons as well as soft solar X-rays produce nitric oxide (NO) in the mesosphere and lower thermosphere (MLT, 50–150 km). NO downward transport, in particular during polar winters, influences the lower atmosphere by, for example, catalytically reducing ozone.

We present ten years of daily global NO number density measurements from 60 km to 90 km obtained by the satellite instrument SCIAMACHY on board Envisat. From this data set (from 08/2002 to 04/2012) we construct an empirical model of NO in the mesosphere. In particular, we link NO production and its lifetime to geomagnetic disturbances (given by the AE index) and to the solar UV radiation (using the Lyman-$\alpha$ index). The derived parameters constrain how solar and geomagnetic activity influence the NO content in the mesosphere. Our model will help to fill gaps in measurements and to validate and improve chemistry climate models.

## EP 2: Planets and small Objects

Zeit: Dienstag 11:00–12:45 Raum: BSZ - Pabel HS

**Hauptvortrag** EP 2.1 Di 11:00 BSZ - Pabel HS

**New insights into Saturn's magnetosphere: Cassini's final results** — •Norbert Krupp[1], Elias Roussos[1], Peter Kollmann[2], Don Mitchell[2], and Michele Dougherty[3] — [1]Max-Planck-Institut für Sonnensystemforschung — [2]The Johns Hopkins University Applied Physics Laboratory — [3]Imperial College London

The Cassini spacecraft orbited Saturn for almost 13 years. One of the scientific goals was the characterisation of the second largest magnetosphere in our solar system. Particles and fields measurements onboard Cassini revealed the three-dimensional structure of the Kronian magnetosphere and its temporal and partially seasonal variability.

In this presentation the highlights of magnetospheric measurements in the Saturnian system are summarised. This includes the importance of the moon Enceladus as the major plasma source of the system; the interaction of magnetospheric plasma with the icy moons and Titan; the discovery of unknown moons, moonlets, ring arcs; the discovery of an unknown electric field as well as first results of the formerly unknown region between the planet and the innermost D-ring of Saturn which Cassini studied during the final phase of the mission in 2017.

EP 2.2 Di 11:30 BSZ - Pabel HS

**What's a rubble pile asteroid? DISCUS - a twin CubeSat mission wants to find out.** — •Patrick Bambach[1], Jakob Deller[1], Esa Vilenius[1], Sampsa Pursiainen[2], Mika Takala[2], Hans Martin Braun[3], and Manfred Wittig[4] — [1]Max Planck Institute for Solar System Research — [2]Tampere University of Technology — [3]RST Radar Systemtechnik AG — [4]MEW-Aerospace UG

A big fraction of asteroids with d>240m are suspected to be loose piles of rocks and boulders bound together mainly by gravity and weak cohesion. Still, to date the size and distribution of voids and monolith inside these "rubble-pile" is not known.

To perform a full interior reconstruction a stepped frequency radar is currently under development. The platform for this instrument is a 6U CubeSat, a spacecraft concept that benefits from standardization, high production numbers and cheap launch opportunities. While NASA will launch their first Deep Space CubeSats in 2018, ESA is currently investigating 4 CubeSat mission concepts.
With reference to the ESA concept, we have developed a mission design to fly to an asteroid and perform bi-static radar measurements. Using inversion methods developed for medical tomography the data will allow to reconstruct the interior of a small body.

The results could help to gain a better understanding of the formation of the solar system. In addition, the findings could increase the predictability of asteroid impact consequences on earth and may allow improving future concepts of asteroid deflection.

EP 2.3 Di 11:45 BSZ - Pabel HS

**Are there features with impact origin on 67P/Churyumov-Gerasimenko?** — •Jakob Deller[1], Carsten Güttler[1], Cecilia Tubiana[1], Holger Sierks[1], and the OSIRIS team[2] — [1]Max Planck Institute for Solar System Research (Justus-von-Liebig-Weg 3, D-37077 Göttingen) — [2]MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA

Comet 67P/Churyumov-Gerasimenko shows a large variety of circular structures such as pits, elevated roundish features in Imhotep, and even a single occurrence of a plausible fresh impact crater. Analyzing images of the OSIRIS camera gives a set of detailed characteristics of these features. Using the iSALE code, simulations of impact experiments into a cometary analog material have been performed to investigate the plausibility of an impact origin of these features.

Two types of impacts are modelled: impact processes with rocky impactors and impact velocities varying from ~100 m/s to 7.5 m/s as typical for impacts during the late stage of 76P/Churyumov-Gerasimenko in the inner solar system, and slow (v_imp < 30m/s) impacts by impactors of the same material as the comet body as typical for accretion processes during the formation of the comet.

It is shown, that only the apparent fresh impact crater can directly be linked to impact processes. The prominent pit structures can as well as the elevated circular features found in the Imhotep region can in principle be explained by fast, rocky impactors in the late stage of the comets evolution, but additional erosional processes are needed to explain all observed characteristics of these features.

EP 2.4 Di 12:00 BSZ - Pabel HS

**EnEx-RANGE - Robuste autonome Akustische Navigation in Gletscher-Eis** — •Dirk Heinen[1], Dmitry Eliseev[1], Marion Funken[2], Benjamin Jung[1], Peter Linder[1], Alexander Meyer[1], Sebastian Muth[1], Sebastian Schönitz[2], Lars Steffen Weinstock[1], Christopher Wiebusch[1] und Simon Zierke[1] — [1]III. Physikalisches Institut B, RWTH Aachen University — [2]IMA/ZLW & IfU, RWTH Aachen University

In der Enceladus-Explorer-Initiative werden Navigationstechnologien erforscht, welche die Suche nach außerirdischem Leben z.B. auf dem Saturnmond Enceladus ermöglichen sollen. Eine autonome Schmelzsonde, die EnEx-Sonde, soll eine Flüssigkeitsprobe aus einem unter einem Eispanzer liegenden Ozean entnehmen. Um diese Sonde durch das Eis navigieren zu können, werden zusätzlich zu herkömmlichen Navigationslösungen zwei akustische Systeme verwendet. Das erste System dient der Lokalisierung der Sonde und wird durch ein Netzwerk aus zusätzlichen, akustisch instrumentierten Schmelzsonden realisiert. Diese Sonden lokalisieren sich autonom, über akustische Signale gegenseitig im Gletschereis, optimieren ihre Einschmelztiefe und dienen als Referenzsystem für die EnEx-Sonde. Das zweite System, basierend auf phasengesteuerten Schallwandlern, dient der Vorfelderkundung, sodass Informationen über Hindernisse oder auch Flüssigkeitsspalten gewonnen werden können. Dieser Vortrag stellt das akustische Sensornetzwerk, die akustischen Navigationssysteme der EnEx-Sonde, das Autonomiekonzept und Resultate aus verschiedenen terrestrischen Testszenarios vor.

EP 2.5 Di 12:15 BSZ - Pabel HS

**Bestimmung der akustischen Dämpfung von Schall in Gletschereis für die Exploration von Eismonden** — •Alexander Meyer, Dirk Heinen, Peter Linder, Christopher Wiebusch und Simon Zierke — III. Physikalisches Institut B, RWTH Aachen University

Im Rahmen der Enceladus-Explorer-Initiative des DLR Raumfahrtmanagements werden Navigationstechnologien für zukünftige Raumfahrtmissionen erforscht. Im Vorhaben EnEx-RANGE (**R**obuste autonome **A**kustische **N**avigation in **G**letscher-**E**is) werden akustische In-Eis-Navigationstechnologien entwickelt, die für die Erforschung von Eismonden wie Enceladus und Europa eingesetzt werden können. Hierfür ist es notwendig, verschiedene Eisparameter präzise zu kennen. Im EnEx-Feldtest 2017 wurden Messungen zur akustischen Dämpfung in Gletschereis auf dem Langenferner, einem Alpengletscher in Italien, durchgeführt. Mit Schallwandlern wurden im Abstand von 5 m bis 90 m in einer Tiefe von 2,5 m akustische Signale durch das Eis übertragen. Aus den gemessenen Amplituden wurde die Abschwächlänge vom hörbaren Bereich (2 kHz) bis in den Ultraschall-Bereich (35 kHz) bestimmt.

Dieser Vortrag stellt den Messaufbau, die Durchführung sowie die Ergebnisse in Form der frequenzabhängigen akustischen Abschwächlänge vor.

EP 2.6 Di 12:30 BSZ - Pabel HS

**Dezentrale Synchronisation der Datennahme für ein akustisches Sensornetzwerk** — •Simon Zierke, Dirk Heinen, Peter Linder, Lars Steffen Weinstock und Christopher Wiebusch — III. Physikalisches Institut B, RWTH Aachen University

Im Rahmen der Enceladus-Explorer-Initiative des DLR Raumfahrtmanagements werden Navigationstechnologien für zukünftige Raumfahrtmissionen entwickelt. Ein Vorhaben innerhalb dieser Initiative ist EnEx-RANGE. In EnEx-RANGE werden unter anderem akustisch instrumentierte Eisschmelzsonden entwickelt, die sich als ein akustisches Netzwerk organisieren, um als Referenzsystem für die Lokalisierung einer zentralen, manövrierbaren Schmelzsonde zu dienen. Die Lokalisierung der Sonde wird durch Bestimmung der akustischen Signallaufzeit und anschließender Trilateration durchgeführt. Hierfür muss eine genaue zeitliche Synchronisation ($< 1\mu s$) der akustischen Signalgenerierung und der Datennahme bestehen, ohne eine dedizierte Synchronisationsleitung zu verwenden. In diesem Vortrag wird das hierfür entwickelte dezentrale Synchronisationssystem und Resultate aus terrestrischen Testszenarien präsentiert.

## EP 3: Sun and Heliosphere I - Structure (MHD, Corona, TR, SW-acc.-Region)

Zeit: Dienstag 16:30–18:30 Raum: BSZ - Pabel HS

**Hauptvortrag** EP 3.1 Di 16:30 BSZ - Pabel HS

**Helicity in the solar atmosphere** — •Gherardo Valori[1] and Etienne Pariat[2] — [1]University College London - Mullard Space Science Laboratory - Holmbury St. Mary - Dorking - Surrey - RH5 6NT — [2]Observatoire de Paris-Meudon LESIA Batiment 14 5 Place J. Jansen 92195 Meudon France

Magnetic helicity is a geometrical measure of the entanglement of magnetic field lines that is approximately conserved by the magnetohydrodynamical equations even in the presence of reconnection. It has therefore been proposed as the conceptual tool to understand highly nonlinear dynamical processes in plasmas, like the re-arrangement of post-disruption magnetic fields in tokamaks or the occurrence of coronal mass ejections. However, given its global character and stringent mathematical formulation, magnetic helicity is of difficult application to natural systems as they occur, for instance, in the solar atmosphere. This talk will report on a series of tests on the reliability of magnetic helicity computations, and address the conservations properties of helicity and its link to the stability of coronal structures that are important in modeling coronal mass ejections.

EP 3.2 Di 17:00 BSZ - Pabel HS

**Global non-potential coronal magnetic field models** — Anthony Yeates[1], Tahar Amari[2], Ioannis Contopoulos[3,4], Xueshang Feng[5], Duncan Mackay[6], Zoran Mikic[7], •Thomas Wiegelmann[8], Joseph Hutton[9], Christopher Lowder[1], Huw Morgan[9], Gordon Petrie[10], Laurel Rachmeler[11], Lisa Upton[12], Aurelien Canou[2], Pierre Chopin[2], Cooper Downs[7], Miloslav Druckmueller[13], John Linker[7], Daniel Seaton[14], and Tibor Toeroek[7] — [1]Durham University — [2]CNRS, Paris — [3]Research Center for Astronomy, Athens — [4]MEPhl, Moscow — [5]National Space Science Center, Beijing — [6]University of St. Andrews — [7]Predictive Science, San Diego — [8]MPI for Solar-Sytem-Research, Goettingen — [9]Institute of Mathematics and Physics, Aberystwyth — [10]NSO, Boulder — [11]NASA Marshal Space Flight Center, Huntsville — [12]High Altitude Observatory, Boulder — [13]Brno University of Technology — [14]Royal Observatory of Belgium

Within an international collaboration we compared several static and evolutionary global corona models: non-linear force-free, magnetostatic, evolutionary magneto-frictional, full MHD and zero-beta MHD. The models agree on the amount of open flux, streamer location and broad magnetic topology. They disagree on the shape of helmet streamers and electric currents. Static models are better in active regions, evolutionary models better to model filaments. Our advise is to combine static extrapolations with energysation from evolutionary models.

EP 3.3 Di 17:15 BSZ - Pabel HS

**Coronal magnetic field evolution over the cycle 24** — •Iulia Chifu[1,2], Thomas Wiegelmann[1], and Bernd Inhester[1] — [1]Max Planck Institute for Solar System Research,Goettingen,Germany — [2]Astronomical Institute of Romanian Academy, Bucharest,Romania

Many explosive phenomena, like flares and coronal mass ejections are caused by instabilities in the solar corona. Most of the time there is a strong correlation between the eruptive events and the evolution of the magnetic field. The low density and magnetic field intensity in the solar corona makes it difficult to obtain direct measurements of the magnetic field. We therefore extrapolate photospheric synoptic vector magnetograms from SDO/HMI into the corona. We use the nonlinear optimization method to reconstructed the magnetic field over the cycle 24, assuming that a force-free coronal magnetic field. We analyse this 10-year data set regarding the evolution of the free magnetic energy, correlation with the global flaring activity. We investigate also the location and structure of open field regions (coronal holes) and their separatrices to closed helmet streamer like regions.

EP 3.4 Di 17:30 BSZ - Pabel HS

**An optimization principle with positive-definite pressure and density for reconstructing magnetohydrostatic equilibria in the lower solar atmosphere** — •Xiaoshuai Zhu and Thomas Wiegelmann — Max Planck Institute for Solar System Research, Göttingen, Germany

We developed an optimization principle for computing magnetohydrostatic equilibria with gravity from photospheric measurements. A transformation, which ensures a positive pressure and density, is introduced to optimize the timestep of pressure, density and magnetic field. The code is tested by application to linear MHS solution. The results show our code is able to reconstruct the original solution with high accuracy. There are obstacles still to be overcome before the code can be applied to real data.

EP 3.5 Di 17:45 BSZ - Pabel HS

**On the Magnetic Topology and Extreme Ultraviolet in Solar Flares with Late Phase** — •Jun Chen[1,2], Rui Liu[1], Kai Liu[1], and Yuming Wang[1] — [1]University of Science and Technology of China, Hefei, China — [2]University of Potsdam, Potsdam, Germany

It was recently discovered that some solar flares exhibit a late-phase peak in EUV emission with 'warm' temperatures (e.g., Fe XVI 33.5 nm), which is referred to as EUV late phase. In this paper, we carried out a statistical study of 51 M- and X-class flares with EUV late phase (ELP) during 2010–2015. These flares are categorized as circular-ribbon, two-ribbon, and intricate-ribbon flares, based on the flare morphology observed in the chromosphere. It is found that the circular-ribbon flares with ELP often possess a coronal null and the associated fan and spine, which are typically embedded in a dome-shaped quasi-separatrix layer (DQSL) intersecting with a curved plate-shaped QSL (PQSL). The footprints of the PQSL correspond to an extended ribbon enclosed by the circular-shaped ribbon and a remote ribbon. The coronal loops responsible for ELP are found to be closely associated with not only the spine but more generally the PQSL. The majority of two-ribbon flares with ELP are confined, and the two ribbons are not associated with any preexisting QSLs. It is still an open question whether the ELP is primarily due to plasma cooling or additional heating.

EP 3.6 Di 18:00 BSZ - Pabel HS

**Magnetohydrodynamic calculation of the temperature and wind velocity profile of the solar transition region** — Todor Mishonov and •Albert Varonov — Department of Theoretical Physics, Faculty of Physics,
St. Clement of Ohrid University at Sofia, 5 James Bourchier Blvd., BG-1164 Sofia, Bulgaria

The mechanism of the solar corona heating still remains unexplained, almost 80 years after the discovery of the million degree hot solar corona. Observations show that the temperature increases two orders of magnitude in the transition region (TR), the boundary between the solar chromosphere and the solar corona. We are giving a detailed magnetohydrodynamic (MHD) calculation of the height dependence of the temperature and solar wind velocity. The temperature and solar wind velocity profiles are calculated for static frequency dependent spectral density of incoming MHD waves, no time dependent computer simulations have been performed. Heated by the MHD waves, the background plasma temperature increases leading to strong plasma viscosity increase, which results in more efficient MHD wave absorption. Within this calculation, the width of the TR is also evaluated by maximal value of the logarithmic derivative of the temperature. In such a way after 70 years we have returned to the original Alfvén idea [H. Alfvén, *Granulation, Magneto-hydrodynamic waves, and the heating of the solar corona*, MNRAS **107**, Issue 2, pp. 211-219, (1947)] that corona is heated by AW.

EP 3.7 Di 18:15 BSZ - Pabel HS

**Doppler Spectroscopy for the Determination of Speeds and Temperatures in Solar Eruptions** — •Adalbert Ding[1,2] and Shadia Rifai Habbal[3] — [1]Institut für Technische Physik, Berlin — [2]Institut für Optik und Atomare Physik, Technische Universität Berlin — [3]Institute for Astronomy, University of Hawaii, USA

Eruptions from the Solar surface (CMEs, prominences, flares) are events which provide valuable information about the dynamics of the plasma processes at the Sun's surface and in the Solar corona. Using high resolution dual and triple channel partially multiplexed imaging spectrometers (PAMIS) the composition of the particles involved, their speed and their temperature could be determined with outstanding accuracy. We present spectroscopic observations acquired during the 20. March 2015 and the 21. August 2017 total solar eclipses which captured Fe XIV emission from very hot (appr. 2 x $10^6 K$) plasmoids in some cases enshrouding a core of relatively cold ($<$ 2 x $10^5 K$) neutral and singly ionized atoms as well as H and He emission from prominences detaching from the Solar surface. Speeds between 100 and 1500 km/s and temperatures as high as 2 x $10^6 K$ of the particles have been obtained in both instances by measuring the Doppler shift and the Doppler broadening of the relevant emission lines. The present observations explore the most critical region of the Solar corona, namely the acceleration region of the Solar wind which is currently untenable from any other platform or instruments.

## EP 4: Sun and Heliosphere II - Dynamics (MHD, Particles)

Zeit: Mittwoch 11:00–12:15 Raum: BSZ - Pabel HS

EP 4.1 Mi 11:00 BSZ - Pabel HS

**Properties of a Small-scale Short-duration Solar Eruption with a Driven Shock** — •Beili Ying[1,2], Li Feng[1], and Lei Lu[1] — [1]Purple Mountain Observatory, CAS, Nanjing, China — [2]Max-Planck-Institut für Sonnensystemforschung, Göttingen

Large-scale solar eruptions have been extensively explored over many years. However, the properties of small-scale events with associated shocks have been rarely investigated. We present the analyses of a small-scale short-duration event. The impulsive phase of the M1.9-class flare lasted only for 4 minutes. The kinematic evolution of the CME hot channel reveals some exceptional characteristics including a very short duration of the main acceleration phase (<2 minutes), a rather high maximal acceleration rate ($50\,\mathrm{km\,s^{-2}}$) and peak velocity ($1800\,\mathrm{km\,s^{-1}}$). The fast and impulsive kinematics subsequently results in a shock related to a metric type II radio burst with a high starting frequency of 320 MHz of the fundamental band. Through the band split of the type II burst, the shock compression ratio decreases from 2.2 to 1.3, and the magnetic field strength of the shock upstream region decreases from 13 to 0.5 Gauss at heights of 1.1 to 2.3 $R_\odot$. We find that the CME ($4 * 10^{30}$ erg) and flare ($1.6 * 10^{30}$ erg) consume similar amount of magnetic energy. The same conclusions having been drawn for large-scale eruptions imply that small- and large-scale events possibly share the similar relationship between CMEs and flares. The kinematic particularities of this event are possibly related to the small footpoint-separation distance of the associated magnetic flux rope, as predicted by the Erupting Flux Rope model.

EP 4.2 Mi 11:15 BSZ - Pabel HS

**The Ground Level Event on September 10, 2017** — •D. Galsdorf[1], S. Burmeister[1], N. Dresing[1], R. Goméz-Herrero[2], J. Guo[1], B. Heber[1], K. Herbst[1], A. Klassen[1], P. Kühl[1], R. Müller-Mellin[1], and R. Wimmer-Schweingruber[1] — [1]Christian-Albrechts-Universität zu Kiel, Germany — [2]Universidad de Alcalá, Madrid, Spain

Ground level events (GLEs) are the most energetic solar particle events (SEPs). On September 10, 2017 at 15:35~UT a X8.2~X-ray flare from the active region 2673 (S09, W91) was detected that peaked at 16:06 UT. The event was accompanied by a coronal and IP type II radio burst starting at 15:49 UT followed by IP type III radio bursts starting at 15:53 UT and a coronal mass ejection. The event onsets of near relativistic electrons have been detected at 16:06 UT and 21:38 UT at SOHO and STEREO A, respectively. In contrast to observations close to the Earth no strong SEP anisotropies have been observed at STEREO A. The neutron monitor network (NMN) recorded the second GLE for solar cycle 24 with an onset at 16:10 UT at Fort Smith. DOSIS 3d aboard the international space station showed an increase in the dose rate at low cutoff rigidities. The Electron Proton Helium INstrument on board SOHO measured protons with energies of more than 700 MeV. The analysis of the NMN indicates that the interplanetary field direction pointed to areas over South America. The biggest increase of 12% was measured by DOMC with an onset time of 17:03 UT. Data observed at Earth and the longitudinal structure in the inner heliosphere will be discussed.

EP 4.3 Mi 11:30 BSZ - Pabel HS

**Decay Index Profile and Coronal Mass Ejection Speed** — •Bernhard Kliem[1], Tibor Török[2], Georgios Chintzoglou[3], and Jie Zhang[4] — [1]Institute of Physics and Astronomy, University of Potsdam, Germany — [2]Predictive Science Inc., San Diego, CA, USA — [3]LMSAL, Palo Alto, CA, USA — [4]George Mason University, VA, USA

The velocity of coronal mass ejections (CMEs) is one of the primary parameters determining their potential geoeffectiveness. A great majority of very fast CMEs receive their main acceleration already in the corona. We study the magnetic source region structure for a complete sample of 15 very fast CMEs ($v > 1500\,\mathrm{km\,s^{-1}}$) during 2000–2006, originating within 30° from central meridian. We find a correlation between CME speed and the decay index profile of the coronal field estimated by a PFSS extrapolation. The correlation is considerably weaker for a comparison sample in which slower CMEs are included. We also study how the decay index profile is related to the structure of the photospheric field distribution. This is complemented by a parametric simulation study of flux-rope eruptions using the analytic Titov-Demoulin active-region model for simple bipolar and quadrupolar source regions. The simulations provide simple relationships between the photospheric field distribution and the coronal decay index profile. They also help identifying source regions which are likely to produce slow CMEs only,

thus improving the correlation for the remaining CME sample. Very fast, moderate-velocity, and even confined eruptions are found and the conditions for their occurrence quantified.

EP 4.4 Mi 11:45 BSZ - Pabel HS

**Classification of singular points of flow and field in ideal or slightly non-ideal MHD flows** — •Dieter Nickeler[1], Marian Karlicky[1], Thomas Wiegelmann[2], and Michaela Kraus[1] — [1]Astronomical Institute AV CR, Fričova 298, 251 65 Ondrejov, Czech Republic — [2]Max Planck Institute for Solar System Research, Justus-von-Liebig-Weg 3, 37077 Göttingen, Germany

Magnetic reconnection scenarios are often connected with the existence of singular points of plasma flows and magnetic fields. In this talk we want to elucidate the relationship between different classes of magnetic null points and stagnation points and corresponding non-ideal terms. This can enlighten the nature of the "Anti-Reconnection" problem, as not every null point or stagnation point guarantees the existence of a reconnection process. We analyse possible configurations in the vicinity of these singular points, as they may occur, e.g., in solar magnetic cusp and arcade structures, concerning their geometrical and topological structure and that of the non-ideal terms in almost ideal Ohm's law.

EP 4.5 Mi 12:00 BSZ - Pabel HS

**Regularized $\kappa$-distributions with non-diverging moments** — •Klaus Scherer, Horst Fichtner, and Marian Lazar — Institut für Theoretische Physik, Lehrstuhl IV: Weltraum- und Astrophysik, Ruhr-Universität Bochum, D-44780 Bochum, Germany

For various plasma systems the so-called $\kappa$-distribution is widely used to describe suprathermal (non-relativistic) particle components exhibiting a power-law behaviour in velocity or energy. Despite its success the concept of the standard $\kappa$-distribution remains disputable because the latter is defined only for $\kappa > 3/2$ and possesses only a finite number of velocity moments $v^l$ (with the integer $l$ defining the $l$-th moment), some of which, i.e., $l \geqslant 2\kappa - 1$, are diverging. In order to resolve these limitations we introduce the regularized $\kappa$-distribution. After a discussion of its properties and its relation to the standard $\kappa$- as well as to the Maxwellian distribution, we provide a general analytical expression that enables to calculate all of its moments, and illustrate that only fluid results, that critically depend on these moments will change, but not those obtained within the framework of kinetic theory.

## EP 5: AEF-Vorstandssitzung

Zeit: Mittwoch 12:45–13:45 Raum: BSZ - Pabel HS

**AEF-Vorstandssitzung**

## EP 6: Arne Richter Lecture

Zeit: Mittwoch 14:00–15:00 Raum: BSZ - Pabel HS

**Hauptvortrag** EP 6.1 Mi 14:00 BSZ - Pabel HS

**Struktur und Dynamik des Sonnensystems im Blick der letzten drei Jahrzehnte** — •Hans Joerg Fahr — Argelander Institut für Astronomie, Universität Bonn, Auf dem Huegel 71, 53121 Bonn

Über die Jahrzehnte nach 1970 ist klar geworden, dass die Heliosphäre nicht nach dem klassischen Modell einer Strömgren-Sphäre zu verstehen ist. Aufgrund der Eigenbewegung des Sonnensystems relativ zum interstellaren Umgebungsmedium ergibt sich vielmehr die Situation der Wechselwirkung eines windtreibenden Sterns mit der Anströmung eines interstellaren Plasmas. Ein wenig stellt sich dabei das Bild eines jet-getriebenen Flugzeugs mit frei sich adaptierenden Flügelprofilen bei der Bewegung durch das Umgebungsmedium ein. Es zeigt sich überraschend, dass das Sonnensystem ein beschleunigtes System darstellt, das einer supersonischen Grenzgeschwindigkeit zustrebt. Alle entscheidenden Wechselwirkungsflächen sowie Termination Shock und Heliopause sind von den NASA Sonden VOYAGER-1/-2 durch in-situ Messungen identifiziert, lokalisiert und physikalisch analysiert worden. In vielen Punkten mußten die bisherigen theoretischen Vorstellungen gründlich revidiert werden. Hinter uns liegen also gute Jahrzehnte deutlich verbesserter Heliosphärenerkenntnisse.

## EP 7: Publishing in Astronomy and Astrophysics

Zeit: Mittwoch 15:00–16:00 Raum: BSZ - Pabel HS

**Hauptvortrag** EP 7.1 Mi 15:00 BSZ - Pabel HS

**Publishing in Astronomy & Astrophysics** — •Hardi Peter — MPI for Solar System Research, Göttingen

The peer-reviewed journal Astronomy and Astrophysics, or short A&A, was founded in 1968 replacing a number of smaller national journals in the then rapidly expanding European astronomy community. Soon A&A became one of the leading publications in its field. Today several of the 13 sections of A&A are available in full open access, including the A&A Letters, and all sections become freely accessible 12 months after publication. Besides the regular refereeing process to ensure scientific quality, A&A offers services during the paper writing process and the post-acceptance phase, namely a latex-based collaborative writing studio and language editing. In this overview, I will present the journal from the point of view of authors and referees and will also give some short introduction to the work of the editors and the publisher. This will include the scientific fields covered by A&A, the editing and refereeing process and the policy concerning ethical issues and data availability. This presentation will aim to serve as an initial publishing guideline to young astronomers preparing (one of) their first publication(s) and to stimulate discussions on topics that could be of interest to young and advanced researchers.

**Time for discussion**

## EP 8: Poster Session

Zeit: Mittwoch 16:30–18:30 Raum: BSZ - Pabel HS

**Brief oral introduction of Posters (2 min for each poster)**

EP 8.1 Mi 17:00 BSZ - Pabel HS

**GLE72 as seen by Neutron Monitors** — •Christian Steigies[1], Dennis Galsdorf[1], Rolf Bütikofer[2], Athanasios Papaioannou[3], and Christos Sarlanis[4] — [1]Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel — [2]Physikalisches Institut, Universität Bern, Schweiz — [3]IAASARS, National Observatory of Athens — [4]ISNet Co, Athens

On 10 September 2017 the main sunspot group was the active region

2623. It produced a major X8.2 solar flare, which started on 15:35 UT and peaked at 16:06 UT. At that time this active region was situated at S08W88 on the Sun. The flare was further accompanied by a halo CME, which was recorded by SOHO/LASCO as well as by the STEREO coronographs. The estimated speed of the CME was 3287.6 km/sec. After 16:10 UT several ground based neutron monitors measured an increase in their counting rate caused by the arrival of solar energetic particles (SEPs) (i.e. relativistic protons). The maximum count rate increase, in the 5-minute averaged data, was about 10%. It was observed by the Dome C neutron monitor station in Antarctica. This ground level enhancement (GLE) event, on 10 September 2017 was only the second one after the event on 15 May 2012 (GLE71) in the current solar activity cycle. With the GLE Inversion software developed in the Horizon 2020 project HESPERIA (http://www.hesperia-space.eu) we try to determine the characteristics of the relativistic proton injected into the interplanetary space from the acceleration region at or near the Sun based on data of the worldwide network of neutron monitors publically available from the NMDB database (http://nest.nmdb.eu).

EP 8.2 Mi 17:00 BSZ - Pabel HS

**Investigation of a Boron-doped scintillation counter** — •C. Wallmann, S. Böttcher, S. Burmeister, B. Heber, and R. Wimmer-Schweingruber — Christian-Albrechts-Universität zu Kiel, Germany

Neutron detection and energy measurements in the atmosphere are a complex task. Bonner spheres as deployed on the Zugspitze are used to determine the neutron spectra. In this work an alternative using a boron-doped scintillator is investigated. The plastic scintillator used consists to one half of Hydrogen and has therefore a large cross section for elastic scattering of neutrons. The proton is accelerated and will deposit its energy in the scintillator. The boron captures the slow neutron and decays and an alpha particle is emitted that deposits a characteristic energy of 2.34 MeV in the scintillator. The time delay between the two processes is approximately 2.7$\mu$s. In order to measure incoming neutrons we trigger on signals for that the second pulse corresponds to the capture line. The first pulse then carries information about the incoming energy of the neutron.

EP 8.3 Mi 17:00 BSZ - Pabel HS

**Abstract: Application of Adaptive Filtering Techniques to Measurements in the Upper Atmosphere** — •Jerry Czarnecki, Dimitry Pokhotelov, Gunter Stober, and Jorge Chau — Leibniz Institut für Atmosphärenphysik, Schlossstraße 6, 18225 Kühlungsborn, Germany

Results of upper atmospheric investigations using radar wind measurements suggest the usefulness of using an adaptive filtering technique developed to separate the velocity contributions of gravity wave components from those of planetary waves and tide components. The use of traditional analyses based on Fourier or Wavelet decompositions requires the data to be continuous and evenly-spaced, presenting a challenge when relying on intermittent measurements. The adaptive technique overcomes these limitations by varying the period of the wave components to be extracted according to the oscillation period of the wave to be filtered, i.e. 24-hour or 12-hour tides, and employing a least squares technique within successive time windows to extract these wave components. This work is concerned with investigating whether such adaptive techniques can be used to separate tidal components of waves in the Mesosphere-Lower Thermosphere. A comparison of results using this method on radar data to those given by numerical models is made.

EP 8.4 Mi 17:00 BSZ - Pabel HS

**Error analysis of telescope observations using Monte Carlo tests** — •Stephan Schlegel and Joachim Saur — Universität zu Köln

Telescope observations of faint objects are afflicted with multiple errors, both statistical and systematical. To investigate structures on those objects, their significance has to be calculated. Since the error sources are usually correlated, the analytical forward propagation is often difficult and nontransparent. To address these problems, a Monte Carlo test for a synthetic dataset containing a superposition of two Poisson distributed signals, one for each, background and target signal, was carried out. The background field is considered to be either homogeneous or with a gradient. Furthermore, systematical errors of the detector were added. The aim of this approach is to estimate the significance of the target signal observed by the Hubble Space Telescope using processed telescope data for the Monte Carlo test algorithm including the internal error sources of the instrument. Here we focus on the comparison between commonly used analytical calculation of signal to noise ratio, which were biased by simplifications and assumptions with the newly developed Monte Carlo approach.

EP 8.5 Mi 17:00 BSZ - Pabel HS

**Interpretation of solar energetic particle flux increases as measured with SEPT aboard the STEREO spacecraft in the presence of contamination** — S. Wraase[1], •B. Heber[1], S. Böttcher[1], R. Bucik[2], N. Dresing[1], R. Goméz-Herrero[3], A. Klassen[1], and R. Müller-Mellin[1] — [1]Christian-Albrechts-Universität zu Kiel, Germany — [2]Georg-August-Universität Göttingen, Germany — [3]Universidad de Alcalá, Madrid, Spain

Among others, shocks are known to be accelerators of energetic charged particles. However, the acceleration efficiency and the required conditions are not fully understood and many questions remain. In particular, the acceleration of electrons by shocks is often questioned. Recurrent energetic particle events (REPE) are caused by the passage of Corotating Interaction Regions (CIRs). Measurements of the Solar Electron and Proton Telescope (SEPT) aboard STEREO are utilized to investigate the electron event on August 9, 2011. Due to its measurement principle, the magnet foil technique, ions can contribute to the electron channels. During REPEs the averaged helium to proton ratio is enhanced to more than 10% with energy per nucleon spectra following a Band function. Computations using a GEANT4 simulation of the SEPT instrument resulted in response functions for ions and electrons. These have been utilized to analyze the above mentioned event. We found that electron and ion measurements can be explained by the contribution of helium and protons with a helium to proton ratio of about 16%. Thus no electron enhancements are needed to explain the SEPT measurements.

EP 8.6 Mi 17:00 BSZ - Pabel HS

**Data driven MHD model of a CME** — •Beili Ying[1,2], Thomas Wiegelmann[1], and Li Feng[2] — [1]Max-Planck-Institut für Sonnensystemforschung, Justus-von-Liebig-Weg 3, D-37077, Göttingen, Germany — [2]Key Laboratory of Dark Matter and Space Astronomy, Purple Mountain Observatory, Chinese Academy of Sciences, 210008 Nanjing, China

Improved knowledge of the physical conditions (electron temperatures Te, densities Ne and mass flow velocities $V_{flow}$) of coronal mass ejections (CMEs) is critical to the development of an understanding the physical mechanism transport of mass, momentum and energy. The HI Ly$\alpha$ line provides one of the primary tools for studying the upper corona. Here, we utilize self-similar magnetohydrodynamic (MHD) simulations to model a CME. In this model we combine a MHD solar wind model with the Gibson-Low flux rope model. Making use of the results (Te, Ne, $V_{flow}$) obtained from the MHD simulation, we compute symthetic HI Ly$\alpha$ images, showing the intensity $I_{MHD}$ of the CME. Further, we can determine different parameters (Te, $V_{flow}$) of the observed CME from a comparison between $I_{MHD}$ and the coronagraphic observations of the HI Ly$\alpha$ intensity (supplied by the LST instrument on board the future ASO-S mission of China and the Metis instrument on board the ESA-Solar Orbiter mission).

EP 8.7 Mi 17:00 BSZ - Pabel HS

**Magneto-static modelling from Sunrise/IMaX** — •Thomas Wiegelmann[1], Thomas Neukirch[2], Dieter Nickeler[3], Sami Solanki[1,4], and Sunrise Team[1] — [1]Max-Planck-Institut für Sonnensystemforschung, 37077 Goettingen — [2]School of Mathematics and Statistics, University of St. Andrews, UK — [3]Astronomical Institute, AV CR, Fricova 298, 25165 Ondrejov, Czech Republic — [4]School of Space Research, Kyung Hee University, Yongin, Gyeonggi, 446-701, Republic of Korea

Our motivation is modelling the interface region between solar photosphere and corona. We extrapolate Sunrise/IMaX photospheric magnetic field measurements upwards into the chromosphere and corona. A problem is that the interface layer is very complex. Relative importance of magnetic and plasma forces vary over several orders of magnitude. In the magneto-static approach the Lorentz-force is compensated by the plasma pressure gradient force and the gravity force.

EP 8.8 Mi 17:00 BSZ - Pabel HS

**PAMIS: A Partially Multiplexed High Resolution Imaging Spectrometer** — •Adalbert Ding[1,2] and Shadia Rifai Habbal[3] — [1]Institut für Technische Physik, Berlin — [2]Institut für Optik und Atomare Physik, Technische Universität Berlin — [3]Institute for As-

tronomy, University of Hawaii, USA

A multi-channel partially multiplexed spectrometer (PAMIS) has been developed for the investigation of sparse spectra as they are typical for emission and absorption processes in the Sun and it's corona. The analysed object is imaged onto a slit mirror (a mirror where a slit-like portion has been removed by laser ablation) the image being monitored by a separate camera. Light transmitted through this slit is then analysed by the PAMIS spectrometer. The spectrometer separates the incoming light into different broad spectral regions with the use of multi-layer dichroic mirrors in combination with colour cut-off and band filters. The output from each of these channels is then analysed by a an echelle gratings (one for each channel) operated in higher - typically 40th to 60th - order thus obtaining a resolution between 15000 and 20000 for slit sizes of 50 micron. Each spectral line appears several times in the spectrum in different order, the separation of the lines being a function of wavelength. Due to the well defined positions of each of these higher order lines a unique assignment is possible for at least 200 lines in each channel. Data taken by a 2-channel and a 3-channel PAMIS will be shown which have been collected during the 2015 and the 2017 total Solar eclipses. Data reduction techniques will be discussed.

EP 8.9 Mi 17:00 BSZ - Pabel HS

**A regularised full-Newton VARPRO iteration for the stereoscopic reconstruction of loops in EUV images** — Bernd Inhester[1] and •Iulia Chifu[1,2] — [1]Max Planck Institute for Solar System Research,Goettingen,Germany — [2]Astronomical Institute of Romanian Academy, Bucharest,Romania

The reconstruction of bright coronal loops from stereo pairs of EUV images is considered an important tool to disentangle the complex 3D topology of the coronal magnetic field. Reconstructed loops have been used in different cases for the study of the magnetic field topology. Also, stereoscopically reconstructed prominences when seen as arch-like structures have been used in the determination of the CME kinematics.

For the stereoscopic reconstruction one must follow two steps. First step is the tie-pointing of the same loop structure in each of the pair images. In this work, we present a reconstruction approach which takes care of the second step which is stereoscopic inversion. The procedure can take the placed tie-points from an image pair and calculate a spline-based approximation of the 3D loop shape from them. A preliminary version of our procedure has already been applied to observed image data in several cases. The work we present now is more robust since is using precise projective geometry for the image projection and can systematically be extended to any number of view directions.

EP 8.10 Mi 17:00 BSZ - Pabel HS

**Reproducibility of a given anisotropic power spectrum using single- and multi-spacecraft analysis methods** — •Marc Kreger, Supratik Banerjee, and Joachim Saur — Department of Geophysics and Meteorology, University of Cologne, Germany

The anisotropy of solar wind turbulence is often investigated in terms of the magnetic power spectra. For single spacecraft data, the power spectra is calculated using the wavelet transform technique whereas in the case of multi-spacecraft data, the power spectral indices are calculated indirectly through the scaling relations of structure functions. Our main objective is to compare those two methods using artificial/ synthetic data. The present study concentrates on the synthetic data which are generated for a given critically balanced power spectrum which contains power on MHD scales representing Alfvenic fluctuations (Goldreich & Sridhar,1995).

Here we follow the methodology of (Klein et al., 2012). For a known power law, we calculate the magnetic power spectrum. Then by taking the Fourier transform of its square-root, we generate the magnetic field data. The field components are attributed phases which are consistent with the divergence-free condition of the magnetic field and for simplicity we assume axisymmetry. In future, this data will be applied to obtain a power spectrum and its anisotropy based on the synthetic spacecraft data.

EP 8.11 Mi 17:00 BSZ - Pabel HS

**Electron acceleration by turbulent plasmoid reconnection** — •Xiaowei Zhou[1,2], Jörg Büchner[1], Fabian Widmar[3], and Patricio Munoz[1] — [1]MPI for Solar System Research, Göttingen, Germany — [2]Purple Mountain Observatory, Nanjing, China — [3]CEA, IRFM, France

In space and astrophysical plasmas, e.g., in planetary magnetospheres, energetic electrons are often found near current sheets (CSs). The observation of CSs hints at electron acceleration by magnetic reconnection. In this study, we aim to investigate electron acceleration by turbulent plasmoid reconnection via test particle guiding center calculations together with MHD simulations. In order to avoid to resolve scales beyond the grid resolution of MHD simulations, a mean-field turbulence model is used to describe the turbulence in the sub-grid scales and their effects on the grid-scale dynamics via turbulent electromotive force(EMF). In particular, the mean-fields model we consider in this study describes the turbulent EMF as a function of the mean values of current density, vorticity, magnetic field as well as of the energy, cross-helicity and residual helicity of the turbulence. We found that, around X-points of turbulent reconnection, localized strong EMFs cause enhanced electron acceleration and energetic electrons following power-law spectra. Magnetic-field-aligned EMFs, caused by the turbulence, dominate the electron acceleration process. Scaling the acceleration processes to parameters of, e.g., the Hermean magnetotail, electron energies up to 60 keV can be reached out of the thermal plasma.

## EP 9: Exoplanets und Astrobiology with poster prize talk

Zeit: Donnerstag 11:00–12:30 Raum: BSZ - Pabel HS

**Hauptvortrag** EP 9.1 Do 11:00 BSZ - Pabel HS

**Exoplanet observations: On the road to finding our place in the Galaxy** — •Hans-Jörg Deeg — Instituto de Astrofísica de Canarias, Tenerife, Spain

An overview will be given over the development of exoplanet detection and characterization, which have shown us a large and unexpected variety of planetary systems. The radial velocity and the transit methods have been responsible for the vast majority of currently known planet systems. Furthermore, they are often used jointly on the same target, leading to the best-characterised planets and planet systems. Currently the most detailed knowledge on some planets is derived from spectroscopic observations during transits, of which some examples are being shown. These observations require large ground-based facilities and are among the principal drivers for instrument development on the next generation of very large telescopes. Lastly, on overview over upcoming exoplanet related space missions will be given, mainly the American TESS mission, currently scheduled for launch on March 20, 2018, and the European PLATO mission, set for launch in 2026. Both of these missions should provide a huge sample of planet detections on bright targets. Comparative exoplanetology based on statistical analyses of larger samples may then be expected to become a central field in the research on exoplanets. We may then also finally be able to put our solar system into context with our galactic neighbourhood.

**Hauptvortrag** EP 9.2 Do 11:30 BSZ - Pabel HS

**New Insights into Cosmic Ray induced Biosignature Chemistry in Earth-like Atmospheres** — •Markus Scheucher[1], John Lee Grenfell[2], Mareike Godolt[1], and Heike Rauer[1,2] — [1]Technische Universität Berlin, 10623 Berlin, Germany — [2]Deutsches Zentrum für Luft- und Raumfahrt, 12489 Berlin, Germany

With the recent discoveries of terrestrial planets around active M-dwarfs, better understanding of atmospheric responses to the stellar environment becomes of high importance. We investigate the habitability and potential biosignatures of planets having Earth-like ($N_2$-$O_2$ dominated) atmospheres orbiting in the habitable zone of quiet and active M-dwarf stars. Such atmospheres are strongly bombarded by high energetic particles, such as Galactic Cosmic Rays and Stellar Energetic Particles. We study the effect of stellar radiation and the incoming energetic particle fluxes upon atmospheric composition, temperature, and spectral information, by varying secondary particle production profiles and $NOx(=N+NO+NO_2+NO_3)$ and $HOx(=H+HO+HO_2)$ chemical production efficiency, in a cloud-free 1D climate-chemistry model. Our results show that uncertainties in flaring strength and particularly atmospheric chemical production efficiency of NOx and HOx from cosmic rays can become important for determining biosignature signals for terrestrial planets around active M-dwarfs. We further show that this is especially the case for high flaring scenarios where weakened water, methane, and ozone features followed by $HNO_3$ build-up may even become detectable in the future in primary transit spectra.

EP 9.3 Do 12:00 BSZ - Pabel HS

**The Impact of Stellar Radiation on Bioindicators** — •Vanessa Schmidt and Miriam Sinnhuber — Institute of Meteorology and Climate Research, Karlsruhe Institute of Technology, Hermann-von-Helmholtz-Platz 1, D-76344 Eggenstein-Leopoldshafen, Germany

Within the past year, several terrestrial planets have been detected in the habitable zone (HZ) of M-dwarf stars. Since these types of stars are typically significantly more active than our own sun, it is expected that the effects of their stellar activity on the chemical composition of the exoplanets' atmosphere are much more pronounced than in the case of Earth and Sun.

In our work, we study Earth-like planets in the HZ of M-dwarf stars with a particular focus on the interaction of ionizing radiation with the atmosphere of the planet. Assuming an Earth-like N2-O2 base atmosphere, we can quantify the impact of stellar radiation on molecules influenced by biogenic processes such as, e.g., ozone, nitrous oxide, and methane.

To this end, we develop and apply a 1-dimensional stacked box column model of the neutral and ionized atmosphere to obtain the production rates of several important neutral species, which allows us to determine the long time effect of stellar activity on atmospheric concentrations of bioindicators.

EP 9.4 Do 12:15 BSZ - Pabel HS

**COMBUSTION-EXPLOSION IN EXOPLANETARY ATMOSPHERES** — •John Lee Grenfell[1], Stefanie Gebauer[1], Mareike Godolt[2], Barbara Stracke[1], Ralph Lehmann[3], and Heike Rauer[1,2] — [1]Dept. Extrasolar Planets and Atmospheres, DLR, Berlin Adlershof — [2]Centre for Astronomy and Astrophysics, TU Berlin — [3]Alfred-Wegener-Institute, Potsdam

Super-Earths could possess a large amount of molecular hydrogen depending on disk, planetary and stellar properties. Some Super-Earths have been suggested to possess large amounts of O2(g) produced abiotically. If these two constituents were present simultaneously, such large amounts of H2(g) and O2(g) however will likely react - to form up to ~10 Earth oceans - over timescales dictated by gas-phase chemistry. This limits the abiotic build-up O2(g) on such worlds. In cases where photochemical removal is slow so that O2(g) can indeed build up abiotically, it could then reach a threshold composition termed the combustion-explosion limit. Above this limit H2(g) and O2(g) react quickly to form water and modest amounts of hydrogen peroxide. This limit sets a constraint for H2(g), O2(g) atmospheric compositions in Super-Earth atmospheres. Our initial global mean analysis suggests that photochemical oxidation of H2(g) by O2(g) likely plays an important role in limiting abiotic O2(g) build-up. An analysis of the gasphase oxidation pathways suggests that H2(g) is oxidized by O2(g) into H2O(g) mostly via HOx and mixed HOx-NOx catalyzed cycles. We further analyze other atmospheric species-pairs including (CO-O2) and (CH4-O2) in an exoplanetary context.

## EP 10: Mitgliederversammlung

Zeit: Donnerstag 12:30–14:00 Raum: BSZ - Pabel HS

**Mitgliederversammlung DPG-EP + AEF**

## EP 11: Sun and Heliosphere III - Particles

Zeit: Donnerstag 15:00–17:00 Raum: BSZ - Pabel HS

**Hauptvortrag** EP 11.1 Do 15:00 BSZ - Pabel HS

**Recent advances in heliospheric transport of solar energetic particles** — •Timo Laitinen and Silvia Dalla — Jeremiah Horrocks Institute, University of Central Lancashire, Preston, UK

Solar Energetic Particles (SEPs), accelerated during solar eruptions, are typically observed with in situ instruments in the interplanetary space. Their propagation from the Sun to the observer is controlled by the interplanetary magnetic field, which consists of a mean Parker spiral field and turbulent fluctuations. Recent multi-spacecraft SEP observations made with the STEREO, SOHO and ACE spacecraft have shown that SEPs have access to wide range of heliolongitudes, across the mean Parker field spiral field. Thorough analysis of the observations has implied that the wide SEP events are to significant extent caused by propagation of the particle across the mean field. In this presentation, we will review the current understanding of SEP propagation across the mean magnetic field in a turbulent heliosphere. In particular, we will discuss the often-used spatial cross-field diffusion model, and the recently-introduced model in which the particles follow non-diffusively the turbulently meandering field-lines before relaxing time-asymptotically to spatial cross-field diffusion. We will also consider the influence of the large-scale structure of the heliospheric field on the SEP event. We discuss the implications of the transport models to our understanding of the nature of wide SEP events.

EP 11.2 Do 15:30 BSZ - Pabel HS

**Nonlinear Diffusion and Anomalous Transport of Cosmic Rays** — •Horst Fichtner[1], Yuri Litvinenko[2], and Dominik Walter[1] — [1]Ruhr-Universitaet Bochum, Institut fuer Theoretische Physik IV, Univesitaetsstrasse 150, 44780 Bochum — [2]Department of Mathematics, University of Waikato, P. B. 3105, Hamilton 3240, New Zealand

We investigate analytically and numerically the transport of cosmic rays away from a shock or another localized acceleration site. Observed cosmic-ray distributions in the vicinity of heliospheric shocks imply that anomalous, superdiffusive transport plays a role in the propagation of energetic particles. Previously, anomalous diffusion scalings, as implied by the data, have been quantitatively described with solutions of a fractional transport, although the physical basis of the fractional diffusion model remains uncertain. We explore an alternative model of the cosmic-ray transport: a nonlinear diffusion equation that follows from a self-consistent treatment of the resonantly interacting cosmic-ray particles and their self-generated turbulence. The nonlinear model naturally leads to superdiffusive scalings, and in the presence of convection, it yields a power-law dependence of the particle density on the distance upstream of the shock. The new solutions are tested by fitting them to spacecraft measurements.

EP 11.3 Do 15:45 BSZ - Pabel HS

**Transport of suprathermal protons in the inner heliosheath** — •Adama Sylla and Horst Fichtner — Ruhr-Universitaet Bochum, Institut fuer Theoretische Physik IV, Universitaetsstrasse 150, 44780 Bochum

A quantitative understanding of the phase-space transport of suprathermal protons in the inner heliosheath is highly desirable, as it represents the basis for the modelling of so-called energetic neutral atoms (ENAs) observed with the Interstellar Boundary Explore (IBEX). A consistent modelling of all-sky maps of ENA fluxes at different energies will provide insight into the large-scale structure of the outer heliosphere, which is a welcome supplement to the in-situ measurements made with the Voyager spacecraft. Numerical solutions of the transport equation of supratherml protons will be presented. These solutions allow to compute the ENA production rate in the inner heliosheath and, subsequently, the resulting energy-dependent flux from a given direction.

EP 11.4 Do 16:00 BSZ - Pabel HS

**Modelling the Jovian Electron Spectrum** — •Adrian Vogt[1], N. Eugene Engelbrecht[2], Bernd Heber[1], Andreas Kopp[2,3], Marius Potgieter[2], and R. Du Toit Strauss[2] — [1]Christian-

Albrechts-Universität zu Kiel — [2]North-West University, Potchefstroom Campus — [3]Universite Libre de Bruxelles

The unique properties of the Jovian source have been utilized since it's discovery in the 1970s to investigate charged particle transport. Solving Parker's transport equation via the stochastic differential equation method, we aim to further restrain the parameter space and derive these parameters more self consistently. We both implemented a newly derived Jovian source spectrum and an improved approach to calculate the mean free paths. We like to show preliminary results of modelling the Jovian spectrum at earth and how they relate to electron spectra measurements by various spacecraft.

EP 11.5 Do 16:15 BSZ - Pabel HS

**Transport modeling of supra-thermal electrons in the 20 October 2002 solar event** — •Yulia Kartavykh[1,2], Wolfgang Dröge[1], Linghua Wang[3], and Roberto Bruno[4] — [1]Institute for Theoretical Physics and Astrophysics, University of Würzburg, D-97074, Würzburg, Germany — [2]Ioffe Physical-Technical Institute, St. Petersburg 194021, Russia — [3]School of Earth and Space Sciences, Peking University, 100871 Beijing, China — [4]INAF-IAPS Istituto di Astrofisica e Planetologia Spaziali, I-00133 Roma, Italy

The modeling of solar particle propagation offers the possibility to derive transport coefficients and to test the validity of theories describing the interaction of energetic charged particles with magnetic field fluctuations. Here we analyze electrons in the energy range of 1 - 180 keV, observed by the Wind spacecraft following an impulsive solar flare on 20 October 2002. The event is characterized by weak, but measurable pitch angle scattering which allows a characterization of the pitch angle scattering coefficient $D_{\mu\mu}(\mu)$, as well as by particle reflection at an outer boundary. Based on numerical solutions of the focused transport equation we present fits to the observed electron fluxes, with emphasis on a detailed modeling of the particles' angular distributions. We compare the derived values of $D_{\mu\mu}(\mu)$ for several energy ranges with the ones obtained from an analysis of the magnetic fluctuations observed during the event and current transport theories. Preliminary results indicate that the scattering of electrons at low energies is much weaker than predicted by the above models, and that at large wave numbers the slab component makes up only a few percent of the fluctuations.

EP 11.6 Do 16:30 BSZ - Pabel HS

**GEANT4 simulation of the Helios E6 - Proton contamination of relativistic electron measurements** — •M. Hörlöck, J. Marquardt, and B. Heber — Christian-Albrechts-Universität zu Kiel, Germany

HELIOS A and HELIOS B were launched on December 10, 1974 and January 15, 1976, respectively. The two almost identical space probes were sent into ecliptic orbits around the Sun. The Kiel experiment, E6 is one of three particle detectors aboard HELIOS that allows to study the flux of energetic particles in the energy range from 1.3 MeV/nucleon to above 1000 MeV/nucleon for ions and from 0.3 to 8 MeV for electrons. A GEANT 4 simulation has been set up to calculate the response functions for protons and electrons in the energy range from 1 to 60 MeV and from 50 keV to 10 MeV, respectively. Due to the detector design there is substantial contamination of protons in the electron measurements that is quantified in this contribution. A method for correcting the electron time flux profiles will be presented and applied to a set of solar energetic particle events.

EP 11.7 Do 16:45 BSZ - Pabel HS

**Energy spectra of carbon and oxygen with HELIOS E6 - Radial gradients of Anomalous Cosmic Ray oxygen within 1 AU** — •J. Marquardt[1], B. Heber[1], M.S. Potgieter[2], and R.D. Strauss[2] — [1]Christian-Albrechts-Universität zu Kiel, Germany — [2]Centre for Space Research, North-West-University, Potchefstroom, 2520, South Africa

HELIOS A and HELIOS B were launched on December 10, 1974 and January 15, 1976, respectively. The two almost identical space probes were sent into ecliptic orbits around the Sun. The Kiel experiment, E6 is one of three particle detectors aboard HELIOS that allows to study the flux of energetic particles in the energy range from 1.3 MeV/nucleon to above 1000 MeV/nucleon for ions and from 0.3 to 8 MeV for electrons. We present here the energy spectra of galactic cosmic ray (GCR) carbon and oxygen, as well as of ACR oxygen during solar quiet time periods between 1975 to 1977, utilizing both HELIOS spacecraft at distances between 0.3 and 1 AU. The radial gradient ($G_r \approx 50\%$/AU) of 9-28.5 MeV ACR oxygen in the inner heliosphere is about three times larger than the one determined between 1 and 10 AU by utilizing the Pioneer 10 measurements.

## EP 12: Astrophysics I - High-energy and Relativistic Astrophysics

Zeit: Donnerstag 17:30–18:30 Raum: BSZ - Pabel HS

EP 12.1 Do 17:30 BSZ - Pabel HS

**On the Detection Potential of Short Blazar Flares for Current Neutrino Telescopes** — •Michael Kreter[1], Matthias Kadler[1], Felicia Krauss[2], Karl Mannheim[1], and Joern Wilms[3] — [1]Lehrstuhl für Astronomie, Universität Würzburg, Emil-Fischer-Strasse 31, 97074 Würzburg, Germany — [2]Anton Pannekoek Institute for Astronomy, University of Amsterdam, Postbus 94249, 1090 GE Amsterdam, Netherlands — [3]Dr. Remeis Sternwarte & ECAP,Universität Erlangen-Nürnberg, Sternwartstrasse 7, 96049 Bamberg, Germany

High-confidence associations of individual neutrinos with individual blazars could be achieved via spatially and temporally coincident detections of high-energy neutrinos (>100 TeV) from short blazar flares. It has been suggested that the current IceCube neutrino detector is sufficiently sensitive to detect neutrinos from such short flares. We test this prediction by calculating the expected number of neutrinos produced in the IceCube detector for the 50 brightest short blazar flares in the sky. We find that the fluence of most individual blazar flares is far too small to yield a substantial Poisson probability for the detection of one or more neutrinos with IceCube. The integrated fluence of the 50 highest-ranked flares yields only about 50% of Poisson probability for the detection of a single high-energy neutrino. For the most spectacular short blazar flares, however, Poisson probabilities of up to 2% are calculated, so that the possibility of associated neutrino detections in future data unblindings of IceCube and KM3NeT seems reasonable.

EP 12.2 Do 17:45 BSZ - Pabel HS

**The blazar family as a joint source of neutrinos and cosmic-ray nuclei** — •Xavier Rodrigues, Anatoli Fedynitch, Shan Gao, Denise Boncioli, and Walter Winter — DESY Zeuthen

The origin of the ultra-high-energy cosmic rays (UHECR) and the astrophysical neutrinos observed by IceCube is a subject still shrouded in mystery. PeV-energy neutrinos must originate from (photo-)hadronic interactions in astrophysical environments that are able to accelerate and confine UHECR. However, the stacking analyses by IceCube have not yet unveiled a correlation between the directions of astrophysical neutrinos and known gamma-ray sources. This may indicate that a population of yet undetected extragalactic objects may be responsible for the cosmic-ray and diffuse neutrino fluxes. In this work we investigate blazars (relativistic outflows driven by super-massive black holes) as multi-messenger sources, under the assumption that they contain accelerated nuclei heavier than protons in the jet. Our calculation includes a sophisticated model of photo-nuclear interactions within the source and a three-zone model to take into account external photon fields in Flat Spectrum Radio Quasars (FSRQs). We then compute and study the emission of cosmic rays and neutrinos across the blazar sequence. Our results demonstrate that the neutrino and cosmic ray production efficiencies are inversely related to each other with respect to the source luminosity, and that there is no ideal source for the emission of both messengers. In our latest calculations, we study the contributions from different blazar classes to the diffuse cosmic-ray and neutrino flux.

EP 12.3 Do 18:00 BSZ - Pabel HS

**Detecting and quantifying the relativistic Kelvin-Helmholtz instability in interstellar jets via radiation observable on Earth** — •Richard Pausch[1,2], Michael Bussmann[1], Axel Huebl[1,2], Ulrich Schramm[1,2], Klaus Steiniger[1,2], René Widera[1], and Alexander Debus[1] — [1]Helmholtz-Zentrum Dresden - Rossendorf — [2]TU Dresden

We present a microscopic model of the radiation emitted during the relativistic Kelvin-Helmholtz instability (KHI) and validate our findings with particle-in-cell simulations at unprecedented spatial resolution and size that including complete far-field radiation spectra.

The KHI is expected in shear flow regions of astrophysical plasma jets, which are significant sites for particle acceleration and radiation. We demonstrate that the emitted polarized radiation can be used to identify and characterize the microscopic plasma dynamics of a KHI light-years away. We have simulated the radiation of the KHI using the particle-in-cell code PIConGPU. With this code's synthetic radiation diagnostic, based on Liénard-Wiechert potentials, quantitative predictions of the far field radiation for hundreds of observation directions and a frequency range covering 3 orders of magnitude were performed on the TITAN cluster at Oak Ridge National Laboratory. The simulation showed that the time-dependent changes in the radiation polarization and power correlate directly with the stages of the KHI. This allows identifying the linear growth phase of the KHI and quantifying its characteristic growth rate as predicted by our microscopic model.

EP 12.4 Do 18:15 BSZ - Pabel HS

**Flux sensitivity of a mono MST telescope** — •Thomas Jung — Tu Dortmund, Dortmund, Deutschland

The ground-based gamma-ray astronomy have a huge potential in astrophysics and cosmology. The Cherenkov telescope array (CTA) is covering the Energy from 100MeV to 100TeV.

To compare CTA with other telescopes the flux sensitivity is very important. Therefor we calculate the sensitivity of a mono MST telescope in the Energy range of 3GeV to 350TeV to check the sensitivity improvement. This talk will give an introduction how to calculate the flux sensitivity for CTA telescopes.

## EP 13: Astrophysics II - Massive stars: Evolution, Winds and Pulsation

Zeit: Freitag 9:00–10:30 Raum: BSZ - Pabel HS

**Hauptvortrag** EP 13.1 Fr 9:00 BSZ - Pabel HS

**Instabilities in the modelling of massive stars** — •Cyril Georgy — Geneva Observatory, Geneva University, Geneva, Switzerland

In this review,I will discuss how instabilities are included in state-of-the-art stellar evolution codes. In particular, I will review the status of the modelling of convection and instabilities linked to rotation. I will highlight the uncertainties linked to this modelling and discuss how hydrodynamics simulations can help in improving our understanding of these instabilities.

**Hauptvortrag** EP 13.2 Fr 9:30 BSZ - Pabel HS

**Atmospheres and winds of massive stars** — •Sergio Simon-Diaz — Instituto de Astrofisica de Canarias, La Laguna, Tenerife, Spain

TBD

EP 13.3 Fr 10:00 BSZ - Pabel HS

**Pulsations as a mass-loss trigger in B-type supergiants** — •Michaela Kraus[1], Lydia Cidale[2], Maximiliano Haucke[2], Anna Aret[1,3], Indrek Kolka[3], Dieter Nickeler[1], and Sanja Tomić[1] — [1]Astronomical Institute, Czech Academy of Sciences, Ondřejov, Czech Republic — [2]National University of La Plata, La Plata, Argentina — [3]Tartu Observatory, Tõravere, Estonia

The evolutionary path of massive stars from the main-sequence to their deaths as supernovae is still most uncertain. It comprises various extreme transition phases, in which the stars shed huge amounts of material into their environments, typically via episodic, sometimes even eruptive events. These objects are luminous super- or hypergiants populating the upper, luminous part of the HR diagram and spreading from spectral type O to F or even later. As mass-loss is crucial for the fate of a star, understanding the mechanisms behind mass ejection phases and exploring the mass lost during such events is essential.

We focus on B supergiants which are known to display photometric and spectroscopic variability which has been suggested to be linked to pulsations. To elucidate the influence of pulsations on their mass-loss behavior we initiated a spectroscopic monitoring campaign. Our analysis reveals that B supergiants on a blue-loop evolution tend to pulsate in multiple modes, including radial strange-modes which are known to facilitate mass-loss. Moreover, we find that these stars display variable mass-loss on time-scales that correlate with the suspected period of strange mode pulsation, suggesting a tight relation between strange modes and phases of enhanced mass loss in these objects.

EP 13.4 Fr 10:15 BSZ - Pabel HS

**Multi-Wavelength Observations of Astrospheres** — •Dominik Bomans and Kerstin Weis — Astronomical Institute, Ruhr-University Bochum, Germany

Stars with supersonic motions relative to the surrounding interstellar medium (ISM) and stars at rest in a supersonicely moving ISM both form bow shock nebulae, which allow the derivation of otherwise difficult to determine parameters of the stellar wind and the ISM. In this talk I will discuss observations of a few different cases. I will also comment on the effects of the interstellar magnetic field and discuss low frequency radio continuum emission of bow shock nebulae.

## EP 14: Astrophysics III - Magnetic Fields, Stellar Clusters, Cosmic Rays and Cosmology

Zeit: Freitag 11:00–12:15 Raum: BSZ - Pabel HS

EP 14.1 Fr 11:00 BSZ - Pabel HS

**Interacting multiple stellar winds in stellar clusters** — •Alexander Noack[1], Klaus Scherer[1], Horst Fichtner[1], Jens Kleimann[1], and Kerstin Weis[2] — [1]Ruhr-Universitaet Bochum, Institut fuer Theoretische Physik IV, Universitaetsstrasse 150, 44780 Bochum — [2]Ruhr-Universitaet Bochum, Astronomisches Institut, Universitaetsstrasse 150, 44780 Bochum

Several studies have investigated large-scale cluster winds resulting from an intra-cluster interaction of multiple stellar winds, but as yet no details of the bordering flows inside a given cluster have been provided. The present work aims at exploring the principal structure of the combined flow resulting from the interaction of multiple stellar winds inside stellar clusters. The theory of complex potentials is applied to analytically investigate stagnation points, boundaries between individual outflows, and the hydrodynamic structure of the asymptotic large-scale cluster wind. In a second part, these planar considerations are extended to fully three-dimensional, asymmetric configurations of wind-driving stars. It is found (i) that one can distinguish regions in the large-scale cluster wind that are determined by the individual stellar winds, (ii) that there exist comparatively narrow outflow channels, and (iii) that the large-scale cluster wind asymptotically approaches spherical symmetry at large distances. In summary, the combined flow inside a stellar cluster resulting from the interaction of multiple stellar winds is highly structured.

EP 14.2 Fr 11:15 BSZ - Pabel HS

**Solenoidal improvements for the JF12 Galactic magnetic field** — •Jens Kleimann[1,2], Timo Schorlepp[1,2], Lukas Merten[1,2], and Julia Becker Tjus[1,2] — [1]Theoretische Physik IV, Ruhr-Universität Bochum, Germany — [2]Ruhr Astroparticle and Plasma Physics (RAPP) Center

The popular JF12 (Jansson & Farrar 2012) analytic model provides a quantitative description of the Galaxy's large-scale magnetic field that is widely used in various astrophysical applications. However, both the poloidal X-type component and the spiral disk component of JF12 exhibit regions in which the magnetic divergence constraint is severely violated. We first propose a cure for this problem, resulting in a truly solenoidal large-scale field. Second, the otherwise straight field lines of the X-type component exhibit kinks in the Galactic plane that, while not unphysical, pose difficulties for, e.g., numerical tracing of cosmic-ray particles. We propose and discuss two possible strategies to mitigate this problem. All corrections are kept as minimal as possible in order not to destroy the agreement to observational data that the unmodified JF12 field was based on. Furthermore, the performance of our improved version of the field model is quantitatively assessed by test simulation using the CRpropa Galactic cosmic-ray propagation code.

EP 14.3 Fr 11:30 BSZ - Pabel HS

**MHD simulation of the interplanetary solar magnetic field** — •Edin Husidic — Ruhr-Universität Bochum, Lehrstuhl für Weltraum- und Astrophysik

Results of 3D magnetohydrodynamic (MHD) simulations of the interplanetary magnetic field (IMF) of the Sun are presented. To this end the MHD equations were solved numerically by using the Cronos code. After a few tests validating the correct performance of Cronos (Parker's solar wind model (Parker, 1965) and the Brio and Wu shock tube (Brio and Wu, 1988)), the actual model for the IMF was implemented. Using this as a background, following Akasofu's work (Akasofu et al., 1983), two-dimensional simulations of propagating disturbances caused by a single solar flare were performed. Finally, these simulations were extended to three spatial dimensions.

EP 14.4 Fr 11:45 BSZ - Pabel HS

**Measurement of the Cosmic-ray Proton Spectrum with the Fermi Large Area Telescope** — •David Green for the The Fermi Large Area Telescope-Collaboration — Max Planck Institut für Physik, Munich, DE

We present the measurement of the cosmic-ray proton spectrum between 54 GeV and 9.5 TeV using 7 years of Pass 8 flight data from the Fermi Large Area Telescope (LAT). We developed a dedicated proton event selection with an acceptance of 0.25 $m^2$ sr. Our event selection yields a large dataset with a statistical uncertainty under 2% and residual contamination less than 5% across the entire energy range. The systematic errors associated with the acceptance, energy measurement, and GEANT4 Monte Carlo simulations are an order of magnitude larger than the statistical uncertainty. The resulting event selection and spectral measurement create the opportunity for additional proton analyses with the LAT, such as a dedicated proton anisotropy search.

EP 14.5 Fr 12:00 BSZ - Pabel HS

**Explanation of Cosmic Inflation by Quantumgravitation** — Hans-Otto Carmesin[1,2,3] and •Matthias Carmesin[4] — [1]Universität Bremen, Fachb. 1, Pf. 330440, 28334 Bremen — [2]Studienseminar Stade, Bahnhofstr. 5, 21682 Stade — [3]Gymnasium Athenaeum, Harsefelder Str. 40, 21680 Stade — [4]Universität Göttingen, Fak. f. Physik, 37077 Göttingen

From the Cosmic Microwave Background CMB the flatness problem and the horizon problem arose. An extraordinarily rapid increase of distances in the early universe, the Cosmic Inflation, was proposed by Guth in 1981 as a possible solution, whereby suggested mechanisms for such an increase have been criticized (Steinhardt: Scientific American 2011). We propose a theory that explains the Cosmic Inflation by Gravitation and Quantum Physics (Carmesin, H.-O.: Vom Big Bang bis heute mit Gravitation, Model for the Dynamics of Space. Berlin: Verlag Dr. Köster 2017.). We discover a sequence of dimensional phase transitions at critical densities. Our theory applies fundamental constants only, namely the gravitational constant G, the velocity of light c and the Planck constant h. Our results are in excellent quantitative agreement with observations, namely the critical density, the duration of cosmic inflation, the temperature fluctuations and the factor of increase correspond to the CMB. The flatness and horizon problems are solved. More precise observations would be particularly interesting concerning the factor of increase and possible scattering at dark matter.

## EP 15: Alternative Theories

Zeit: Freitag 12:15–12:30 Raum: BSZ - Pabel HS

EP 15.1 Fr 12:15 BSZ - Pabel HS

**Warum Gravitationsgleichungen nicht reichen und zum Materiebegriff** — •Helmut Hille — Fritz-Haber-Straße 34, 74081 Heilbronn

Ich halte es für erforderlich, in der Kosmologie die Gravitationsgleichung durch einen Term für die kosmische Fliehkraft zu ergänzen, die allen astronomischen Objekten beim Big Bang verliehen wurde. Großräumige Geschwindigkeitsmessungen sind nur durch die Berücksichtigung der kosmischen Fliehkraft verständlich zu interpretieren. Auch nicht berücksichtigt ist meines Wissens bis heute ebenfalls, dass infolge der Quantelung der Energie die Reichweite von Gravitationsfeldern begrenzt ist. Neben Newtons Axiomen und den Erhaltungssätzen sind immer auch die bewährten Vorgaben der Quantenphysik zu beachten, die u. a. mit der Entdeckung von Verschränkungen den Materiebegriff entschieden erweitert hat.