Extraterrestial Physics Division
Fachverband Extraterrestrische Physik (EP)

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Overview of Invited Talks and Sessions

(Lecture hall H-HS XVIII; Poster Zelt)

Plenary Talk of EP

See PV for details.

PV XIII	Thu	9:45–10:30	H-Aula/HS I/HS X	**Geophysics in Elysium Planitia - First Year Results from the InSight Mars Mission** — •Matthias Grott, Bruce Banerdt, Suzanne Smrekar, Tilman Spohn, Philippe Lognonne, Christopher Russel, Catherine Johnson, Don Banfield, Justin Maki, Matt Golombek, Domeniko Giradini, William Pike, Anna Mittelholz, Yanan Yu, Attilio Rivoldini

Invited Talks

EP 1.1	Mon	16:30–17:00	H-HS VIII	**Erforschung des Weltraumwetters am DLR Institut für Solar-Terrestrische Physik** — •Jens Berdermann
EP 1.4	Mon	17:30–18:00	H-HS VIII	**Using multiple radar stations to examine atmospheric tides and their variability** — •Patrick Espy, Willem van Caspel, Robert Hibbins
EP 2.1	Tue	11:00–11:30	H-HS VIII	**Parker Solar Probe and Solar Orbiter** — •Gottfried Mann
EP 4.1	Wed	10:30–11:00	H-HS VIII	**Linking Solar Eruptions and Energetic Particles through Observations and Modeling** — •Frederic Effenberger
EP 5.1	Wed	14:00–14:30	H-HS VIII	**New Opportunities with the Regularized $\kappa-$Distribution** — •Edin Husidic
EP 5.4	Wed	15:00–15:30	H-HS VIII	**The journey of the Voyagers into the interstellar medium** — •Klaus Scherer
EP 7.1	Thu	11:00–11:30	H-HS VIII	**Juno observations of Jupiter's aurora: Wave-particle Interaction in Jupiter's stressed magnetosphere** — •Joachim Saur
EP 9.1	Thu	14:00–14:30	H-HS VIII	**The CoPhyLab: How to Study Comets in the Laboratory** — •Bastian Gundlach
EP 10.1	Thu	15:00–16:00	H-HS VIII	**Nonthermal astrophysics: cosmic ray particles and cosmic magnetic fields** — •Reinhard Schlickeiser
EP 11.5	Thu	17:30–18:00	H-HS VIII	**Topology-driven magnetic reconnection** — •Raquel Mäusle, Jean-Mathieu Teissier, Wolf-Christian Müller
EP 12.1	Fri	9:00– 9:30	H-HS VIII	**Asteroseismology of red-giant stars** — •Saskia Hekker
EP 13.1	Fri	10:00–10:30	H-HS VIII	**Habitability of extrasolar planets and the impact of interior-atmosphere interactions under different stellar evolutions** — •Mareike Godolt

Invited talks of the joint symposium SYMD

See SYMD for the full program of the symposium.

SYMD 1.1	Mon	14:30–15:00	H-Aula/HS I/HS X	***N*-Particle Scattering and Asymptotic Completeness in Wedge-Local Quantum Field Theories** — •Maximilian Duell
SYMD 1.2	Mon	15:00–15:30	H-Aula/HS I/HS X	**First observation of double electron capture in Xe-124 with the dark matter detector XENON1T** — •Alexander Fieguth
SYMD 1.3	Mon	15:30–16:00	H-Aula/HS I/HS X	**Anisotropic Transport of Galactic Cosmic Rays based on Stochastic Differential Equations** — •Lukas Merten

Sessions

EP 1.1–1.4	Mon	16:30–18:00	H-HS VIII	**Near Earth Space**
EP 2.1–2.5	Tue	11:00–12:30	H-HS VIII	**Sun and Heliosphere I**
EP 3.1–3.15	Tue	16:30–18:30	Zelt	**Poster session**
EP 4.1–4.7	Wed	10:30–12:30	H-HS VIII	**Sun and Heliosphere II**
EP 5.1–5.5	Wed	14:00–15:45	H-HS VIII	**Sun and Heliosphere III**
EP 6.1–6.4	Wed	16:30–18:30	H-HS X	**Combined detector session (joint session HK/T/ST/EP)**
EP 7.1–7.5	Thu	11:00–12:30	H-HS VIII	**Planets and small Objects I**
EP 8	Thu	12:30–13:30	H-HS VIII	**Hauptversammlung AEF und DPG-EP (in German)**
EP 9.1–9.2	Thu	14:00–14:45	H-HS VIII	**Planets and small Objects II**
EP 10.1–10.1	Thu	15:00–16:00	H-HS VIII	**Arne Richter Lecture**
EP 11.1–11.7	Thu	16:30–18:30	H-HS VIII	**Astrophysics I**
EP 12.1–12.2	Fri	9:00– 9:45	H-HS VIII	**Astrophysics II**
EP 13.1–13.9	Fri	10:00–12:30	H-HS VIII	**Exoplanets and Astrobiology**

Mitgliederversammlung AEF und Fachverband Extraterrestrische Physik

Donnerstag, den 02.04.2020, um 12:30 im H-HS XVIII

- Begrüßung
- Feststellung der Beschlussfähigkeit
- Kenntnisnahme des Protokolls der Mitgliederversammlung 2019
- Bericht des Vorstandes
- Bericht aus DPG und der DPG-Sektion Materie und Kosmos (SMuK)
- Bericht des Schatzmeisters (AEF)
- Entlastung des Vorstandes (AEF)
- Höhepunkte und Veranstaltungen 2019, 2020
- Abstimmung über Tagungsorte 2022 und 2024 (AEF und DPG-EP)
- Internationale Weltraumwetterinitiative ISWI
- Bericht aus den Kommissionen
- Kommissionsstruktur
- Webseite und Mitgliederverwaltung (AEF)
- Sonstiges

EP 1: Near Earth Space

Time: Monday 16:30–18:00 Location: H-HS VIII

Invited Talk EP 1.1 Mon 16:30 H-HS VIII

Erforschung des Weltraumwetters am DLR Institut für Solar-Terrestrische Physik — •Jens Berdermann — DLR Institut für Solar-Terrestrische Physik, Kalkhorstweg 53, 17235 Neustrelitz

Das Weltraumwetter hat einen erheblichen Einfluss auf die Leistung und Zuverlässigkeit von weltraumgestützten und bodengestützten technologischen Systemen und kann hierdurch auch indirekt Menschenleben gefährden. Angesichts der wachsenden Bedeutung von Weltraumwetterinformationen ist 2019 die Gründung eines neuen DLR-Instituts am Standort Neustrelitz erfolgt. Das Institut für Solarterrestrische Physik (SO) befindet sich aktuell in der Aufbauphase und forscht im Bereich Weltraumwetter von den Grundlagen bis zur Anwendung. SO untersucht zeitlich variable Bedingungen auf der Sonne und im Sonnenwind sowie deren Wirkung auf das gekoppelte Ionosphären-Thermosphären-Magnetosphären-System und analysiert Weltraumwettereffekte auf betroffene Technologien in den Bereichen Kommunikation, Navigation, Luftfahrt, Satellitenbetrieb, bemannte Raumfahrt, elektrischer Netzbetrieb und Landvermessung. SO wird mit seinen Forschungsergebnissen zu wissenschaftlichen und technologischen Anwendungen z.B. im Bereich der Satellitenkommunikation und Navigation, der Erdbeobachtung, des Krisenmanagements, der Kommunikation für die Luftfahrt und der automatisierten Mobilität beitragen. Im Vortrag wird ein Überblick über die existierenden und geplanten Aktivitäten zum Thema Weltraumwetter am DLR Institut für Solar-Terrestrische Physik, sowie deren Einbindung in internationale Weltraumwetteraktivitäten gegeben.

EP 1.2 Mon 17:00 H-HS VIII

Yield function of the DOSTEL count and dose rates aboard the International Space Station — •Bernd Heber, Maximillian Brüdern, Sönke Burmeister, Anna Caprotti, Dennis Galsdorf, and Konstantin Herbst — Christian-Albrechts-Universität Kiel

The Earth is constantly hit by cosmic rays that have their origin in the galaxy. These GCRs contribute substantially to the radiation dose measured by particle detectors in space. Astronauts on the ISS are partially shielded by the Earth magnetic field. In addition the material of the ISS absorbs several tenth of MeV ions. The DOSTEL is part of the DOSIS 3D experiments and has been installed on board the ISS in 2009. The radiation field is a product of primary energetic particles and particles that are generated by the interaction of the primaries with the surrounding material. Since modeling of this environment is challenging we determined the instruments yield function by analyzing the count rate as well as the dose rate during the latitude scans of the ISS. In order to determine the yield function we utilized published AMS proton and Helium spectra and compute the cut-off rigidity using PLANETOCOSMICS. Here we will present and discuss the first results obtained during moderate solar activity from 2014 to 2017.

EP 1.3 Mon 17:15 H-HS VIII

Middle atmosphere ionization from particle precipitation derived from the SSUSI satellite UV observations — •Stefan Bender and Patrick Espy — Norwegian University of Science and Technology, Trondheim, Norway

Solar, auroral, and radiation belt electrons enter the atmosphere at polar regions leading to ionization and affecting its chemistry. Climate models usually parametrize this ionization and the related changes in chemistry based on satellite particle measurements. Precise measurements of the particle and energy influx into the upper atmosphere are difficult because they vary substantially in location and time. Widely used particle data are derived from the POES and GOES satellite measurements which provide in-situ (≈ 800 km and geostationary) electron and proton spectra.

We present electron energy and flux measurements from the Special Sensor Ultraviolet Spectrographic Imagers (SSUSI) satellite instruments. This formation of satellites directly observes the auroral zone in the UV from which electron energies and fluxes are inferred. We use these observed electron energies and fluxes to calculate ionization rates and electron densities in the mesosphere and lower thermosphere. We compare the calculated electron densities to those measured by the EISCAT radars in order to validate the SSUSI derived energies and fluxes as well as the atmospheric ionization models. The validated SSUSI data will help to improve the auroral particle parametrizations used for climate models.

Invited Talk EP 1.4 Mon 17:30 H-HS VIII

Using multiple radar stations to examine atmospheric tides and their variability — •Patrick Espy[1,2], Willem van Caspel[1,2], and Robert Hibbins[1,2] — [1]Norwegian University of Science and Technology, Trondheim, Norway — [2]Birkeland Centre for Space Science, Bergen, Norway

Atmospheric tides and planetary waves (PWs) play an important role in shaping the day-to-day and seasonal variability of the Mesosphere-Lower-Thermosphere (MLT). Measurements of tidal and PW variability in the mid-latitude MLT have however remained sparse. This study uses a new analysis technique on the meteor radar winds from a longitudinal array of SuperDARN radars. These provide hourly measurements of the meridional wind at ~95km altitude from which we are able to investigate tides and PWs in the MLT at 65 degrees North. Using the array of SuperDARNs, we can identify east and westward traveling S1, S2 and S3 wave components over a broad range of frequencies spanning tidal to planetary wave oscillations. We present a study of the variability of the migrating and non-migrating tides and the longitudinal variability resulting from their interaction. Additionally we examine the variability of the 2 and 5-day waves in the MLT, and their interaction with tides during stratospheric warming events.

EP 2: Sun and Heliosphere I

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

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

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

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

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

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

EP 2.2 Tue 11:30 H-HS VIII

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

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

EP 2.3 Tue 11:45 H-HS VIII

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

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

EP 2.4 Tue 12:00 H-HS VIII

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

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

EP 2.5 Tue 12:15 H-HS VIII

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

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

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

EP 3: Poster session

Time: Tuesday 16:30–18:30 Location: Zelt

EP 3.1 Tue 16:30 Zelt

Development of a 360 degree FoV camera system as scientific payload for TRIPLE- IceCraft. — •Lutz Deriks[1], Dirk Heinen[1], Christopher Wiebusch[1], Simon Zierke[1], Clemens Espe[2], Marco Feldmann[2], Gero Francke[2], and Lars Schickendanz[2] — [1]RWTH Aachen University, III. Physikalisches Institut, Templergraben 55, 52056 Aachen, Germany — [2]GSI - Gesellschaft für Systementwicklung und Instrumentierung mbH, Liebigstraße 26, 52070 Aachen, Germany

Within TRIPLE, a project-line for Technologies of Rapid Ice Penetration and subglacial Lake Exploration initiated by the DLR Space Administration, a melting probe (TRIPLE-IceCraft) is currently in development. This melting probe will be suitable to carry a scientific payload through several hundred meters of ice into an ocean or subglacial lake and return the payload to the surface. A camera system is being developed as a payload. This system will generate 360 degree field of view pictures of the penetrated ice and a subglacial lake.

EP 3.2 Tue 16:30 Zelt

Magnetic helicity inverse transfer in supersonic isothermal MHD turbulence — •Jean-Mathieu Teissier[1,3] and Wolf-Christian Müller[1,2,3] — [1]Technische Univesität Berlin, ER3-2, Hardenbergstr. 36a, D-10623 Berlin, German — [2]Max-Planck/Princeton Center for Plasma Physics — [3]Berlin International Graduate School in Model and Simulation Based Research

Magnetic helicity is an ideal invariant of the magnetohydrodynamic (MHD) equations which exhibits an inverse transfer in spectral space. Up to the present day, its transport has been studied in direct numerical simulations only in incompressible or in subsonic or transonic flows. Inspired by typical values of the turbulent root mean square (RMS) Mach number in the interstellar medium, this work presents some aspects of the magnetic helicity inverse transfer in high Mach number isothermal compressible turbulence, with RMS Mach numbers up to the order of ten:

1) a clear Mach-number dependence of the spectral magnetic helicity scaling but an invariant scaling exponent of the co-spectrum of the Alfvén velocity and its curl,

2) the approximate validity of a dynamical balance relation found by incompressible turbulence closure theory,

3) a characteristic structuring of helically-decomposed nonlinear shell-to-shell fluxes that can be disentangled into different spectrally local and non-local transfer processes.

EP 3.3 Tue 16:30 Zelt

ComPol - A CubeSat Compton Telescope — •Matthias Meier — Max-Planck-Institut für Physik, München

Astrophysical objects with a large mass-to-size ratio are referred to as compact objects, e.g. black holes, white dwarfs, neutron stars. Many questions concerning these astrophysical objects are still not answered. Besides optical measurements X-ray and gamma ray survey are essential to improve the understanding of these objects. The objective of the CubeSat mission ComPol is to investigate the black hole binary Cygnus X-1 for one year. The goal is to improve its physical model by measuring spectrum and polarization in the hard X-ray range (20 keV to 2 MeV). The information about the polarization can be extracted from the kinematics of Compton scattering.

The destined detector system is a Compton telescope made up of two detector layers. The first detector layer, a Silicon Drift Detector (SDD), acts as a scatterer for the incoming photons which are subsequently absorbed in the second layer, a crystalline CeBr3 calorimeter. The SDD has been primarily developed for the TRISTAN project, a planned detector upgrade of the KATRIN experiment, to search for sterile neutrinos.

The poster presents the status of the currently ongoing design study for the detector set-up and the estimated sensitivity to detect polarization in an energy range from 20 keV to 300 keV. An outlook to the technical realization and the CubeSat launch will be given.

EP 3.4 Tue 16:30 Zelt

First Steps toward the Verification of Models for the Assessment of the Radiation Exposure at Aviation Altitudes during Quiet Space Weather Conditions — Matthias Meier[1], Kyle Copeland[2], Daniel Matthiä[1], Christopher Mertens[3], and •Kai Schennetten[1] — [1]German Aerospace Center, Institute of Aerospace Medicine, Radiation Biology Department, 51147 Köln, Germany — [2]Numerical Sciences Research Team, Protection and Survival Laboratory, FAA Civil Aerospace Medical Institute, Oklahoma City, OK, USA — [3]NASA Langley Research Center, Hampton, Virginia, USA

Space weather is an important driver of the exposure of aircrew and passengers to cosmic rays at flight altitudes. The assessment of the corresponding radiation doses can be realized by measurements or model calculations that cover the whole range of the radiation field in terms of geomagnetic shielding, atmospheric shielding, and the effects of space weather. Since the radiation field at aviation altitudes is very complex in terms of particle composition and energy distribution, the accurate experimental determination of doses at aviation altitudes is still a challenging task. Accordingly, the amount of data with comparatively small uncertainties is scarce. The Community Coordinated Modeling Center (CCMC) invited FAA, DLR, and NASA to make their radiation models for aviation CARI-7A, PANDOCA, and NAIRAS available for interested users via the CCMC web site. A concomitant comparison of model calculations with measuring data provided information on the predicting capabilities and the uncertainties of the current versions of these models under quiet space weather conditions.

EP 3.5 Tue 16:30 Zelt

FaNS: A Fast Neutron Spectrometer for the Bexus 30/31 campaign — •Hauke Jacobsen, Goerkem Bilgin, Stephan Boettcher, Bernd Heber, Malte Hoerloeck, Friedericke Schattke, and Carsten Wallmann — Christian-Albrechts-Universität Kiel

The interaction of primary cosmic rays with the molecules of the Earth's atmosphere leads to a complex radiation field which consists among others of neutrons. The Fast Neutron Spectrometer (FaNS) has been developed to determine the flux of fast neutrons within the Earth's atmosphere. The instrument consists out of a boron-doped plastic scintillator which is optimized for the energy range from about 0.5 MeV to above 10 MeV. Here we present a description of the measurement concept for a compact instrument that can be flown on weather balloons and aircraft and corresponding results of a GEANT 4 simulation.

EP 3.6 Tue 16:30 Zelt

Thermal Atmospheric Neutron Observation System — •Friederike Schattke, Marc Hansen, Lisa Romaneehsen, Jonas Zumkeller, Patrick Pohland, Bernd Heber, Henning Lohf, Stephan Böttcher, and Patrick Kühl — Christian-Albrechts-Universität zu Kiel, Institut für Experimentelle und Angewandte Physik, Abteilung Extraterrestrische Physik, Deutschland

The Earth is continuously exposed to high energy charged particles from galactic cosmic rays. Due to galactic cosmic rays interacting with atmospheric particles, secondary neutrons are generated. Those are moderated to thermal energies below 0.025 eV through elastic scattering with water particles. This means thermal neutrons indicate the presence of water in the nearby area. As our earth contains a lot if it, we expect to be able to measure thermal neutrons in our atmosphere, thus it is the perfect place to test different detector layouts. The main objective of the Thermal Atmospheric Neutron Observation System (TANOS) is to measure the flux of thermal neutrons in the stratosphere. In order to measure these low energy neutrons we make use of the internal conversion electrons resulting from thermal neutron capture in Gadolinium. Gadolinium is particularly suitable for the experiment due to its high cross section of 49.000 barn. In the atmosphere we expect a radiation field consisting of charged and neutral particles. The flux of secondary particles is the largest at a height of about 20 km, the so called Pfotzer maximum. To characterize this height dependency of the radiation field, TANOS also measures the flux of charged particles.

EP 3.7 Tue 16:30 Zelt

Wave-particle interaction in the Io flux tube — •Sascha Janser and Joachim Saur — Institut für Geophysik und Meteorologie, Cologne, Germany

Observations by the JUNO spacecraft revealed energetic, bidirectional particle populations with broadband energy distributions in the high-latitude region of Jupiter. These measurements indicate that an acceleration mechanism of stochastic nature plays a dominant role for the generation of the intense main auroral oval. In our current work, we investigate the heating of an energetic upward proton population recently observed by JUNO in the Io flux tube wake near Jupiter. We try to infer on the relevant physical acceleration process by considering a resonant as well as a non-resonant wave-particle interaction mechanism, both based on Alfven waves. We focus on necessary temporal scales to drive these mechanisms efficiently and also on the released wave energy by means of the transported Poynting flux along the flux tube.

EP 3.8 Tue 16:30 Zelt

Following the TraCS of exoplanets with Pan-Planets: Wendelstein-1b and Wendelstein-2b — Christian Obermeier[1,2], •Jana Steuer[1,2], Hanna Kellermann[1,2], Roberto Saglia[1,2], Thomas Henning[3], Arno Riffeser[1], Ulrich Hopp[1,2], Gudmundur Stefansson[4,5,6], Caleb Canas[4,5,7], Joe Ninan[4], John Livingston[8], Johannes Koppenhöfer[1,2], Ralf Bender[1,2], and Suvrath Mahadevan[4,5] — [1]Max Planck Institute for Extraterrestrial Physics, Munich — [2]University Observatory Munich (USM) — [3]Max Planck Insitute for Astronomy, Heidelberg — [4]Department of Astronomy & Astrophysics, The Pennsylvania State University — [5]Center for Exoplanets & Habitable Worlds, Pennsylvania — [6]Department of Astrophysical Sciences, Princeton University — [7]Penn State Astrobiology Research Center, Pennsylvania — [8]Department of Astronomy, The University of Tokyo

Hot Jupiters, although abundant among Sun-like stars, seem to get rarer with decreasing stellar mass. The goal of the Pan-Planets transit survey was the detection of such planets and a statistical characterization of their frequency. Here, we announce the discovery and validation of two planets found in that survey, Wendelstein-1b and Wendelstein-2b, two short-period hot Jupiters that orbit late K host stars. We validated them both by the traditional method of radial velocity measurements with the HIRES and HPF instruments and then by their Transit Colour Signature (TraCS). With this, we demonstrate that multi-band photometry is an effective way of confirming transiting exoplanets.

EP 3.9 Tue 16:30 Zelt

Hunting TESS Single Transits — •Jana Steuer[1,2], Frank Grupp[1,2], Arno Riffeser[1,2], Hanna Kellermann[1,2], Ralf Bender[1,2], and Roberto Saglia[1,2] — [1]University Observatory Munich (USM) — [2]Max Planck Institute for Extraterrestrial Physics, Munich

NASA's TESS satellite is monitoring stellar flux of mostly G, K and M dwarfs in search for transiting exoplanet signals in 26 sectors, each observed for roughly 27 days and overall covering about 85% of the entire sky. The number of confirmed exoplanets is expected to be increased dramatically by TESS, a successor to the highly successful Kepler and K2 missions. Ideally, a detected signal is recorded multiple times, thus indicating a period for the stellar companion. However, since many planets detectable by TESS will have periods exceeding 27 days, their signals only have a chance to be detected once, given that they are not positioned within an overlapping sector region. Ignoring these candidates would mean the loss of a huge number of most likely very interesting planets, orbiting at distances large enough to potentially be positioned within the habitable zone.

Our effort aims to find these single detections within the TESS data, infer a period by performing MCMC fitting and following up these signals with ground based radial velocity measurements and, if sensible, photometry observations with the Wendelstein 2.1 m telescope and possibly others to confirm or discard them as planets.

EP 3.10 Tue 16:30 Zelt

Velocity Dispersion Analysis of Corrected SEPT Electron Measurements — Alexander Kollhoff[1], Nina Dresing[1], Raul Gomez-Herrero[2], •Bernd Heber[1], Konstantin Herbst[1], and Andreas Klassen[1] — [1]Christian-Albrechts-Universität Kiel — [2]Universidad de Alcalá, Alcalá de Henares, Spain

SEP events with an impulsive intensity time profile are often accompanied by electrons with energies up to a few hundred keV. The velocity dispersion of these electrons, observed at 1 AU, can provide information about how they are injected and transported through the inner heliosphere. Measurements of the SEPT aboard the STEREO are often used to investigate electrons in SEP events. Due to the instrumental setup, energetic electrons can scatter out of the solid state detector, depositing less than their total energy. Therefore, each SEPT electron channel has a response to electrons with energies above its nominal energy range. This effect of contamination becomes especially significant during the rise time of SEP events, when the energy spectrum is flatter due to velocity dispersion and leading to seemingly earlier onsets in some energy channels. Computation using a GEANT4 simulation of the SEPT instrument resulted in new response functions for electrons. These response functions are used to correct the contamination of highly energetic electrons to lower electron channels. The corrected intensities are used to analyse the velocity dispersion of several SEP events. The corrected data lead to significant different onset times and with it to more realistic path length and injection times compared to uncorrected measurements.

EP 3.11 Tue 16:30 Zelt

Identifying and Quantifying the Role of Magnetic Reconection in Space Plasma Turbulence — •Jeffersson Agudelo[1], Daniel Verscharen[1], Robert Wicks[1], Christopher Owen[1], Andrew Walsh[2], Yannis Zouganelis[2], and Santiago Vargas[3] — [1]University College London, Department of Space and Climate Physics Mullard Space Science Laboratory — [2]European Space Agency, European Space Astronomy Centre — [3]Universidad Nacional de Colombia, Observatorio Astronómico Nacional

One of the outstanding open questions in space plasma physics is the heating problem in the solar corona and the solar wind. In-situ measurements, as well as MHD and kinetic simulations, suggest a relation between the turbulent nature of plasma and the onset of magnetic reconnection as a channel of energy dissipation, particle acceleration and a heating mechanism. Non-linear interactions between counter propagating Alfven waves drives plasma towards a turbulent state. On the other hand, the interactions between particles and waves becomes stronger at scales near the ion gyroradious, and so turbulence can enhance conditions for reconnection and increase the number of reconnection sites. We use fully kinetic particle in cell simulations, to study the onset of reconnection in a 3D simulation box with parameters similar to the solar wind, under alfvenic turbulence. We characteristic features of reconnection sites as steep gradients of the magnetic field strength, formation of strong current sheets and inflow-outflow patters of plasma particles near the difusion regions. These results will be used to quantify the role of reconnection in plasma turbulence.

EP 3.12 Tue 16:30 Zelt

Density Problem in the Early Universe: Solution by Quantum Gravity — •Philipp Schöneberg[1] and Hans-Otto Carmesin[1,2,3] — [1]Gymnasium Athenaeum, Harsefelder Straße 40, 21680 Stade — [2]Bahnhofstraße — [3]Universität Bremen, Fachbereich 1, Postfach 330440, 28334 Bremen

No density can be larger than the Planck density $\rho_P = 5,155 \cdot 10^{96} \frac{\text{kg}}{\text{m}^3}$. The time evolution of the actual light horizon should be traced back until the Planck length $L_P = 1.616 \cdot 10^{-35}$m is reached. However there arises a problem, as the framework of general relativity theory, GRT, that length L_P is only reached at the density $\rho = 6 \cdot 10^{214} \frac{\text{kg}}{\text{m}^3}$.

We present a solution of that model. We illustrate that solution with several model experiments. Additionally we derive the correct solution by using EXCEL in a graphic manner (Carmesin, H.-O. (2019): Die Grundschwingungen des Universums - The Cosmic Unification - With 8 Fundamental Solutions based on G, c and h - With Answers to 42 Frequently Asked Questions. Berlin: Verlag Dr. Köster.).

EP 3.13 Tue 16:30 Zelt

The Actual Controversy of the Hubble - Constant: Evaluation of Observations and Comparison with Theory — •Ole Rademacker[1] and Hans-Otto Carmesin[1,2,3] — [1]Gymnasium Athenaeum, Harsefelder Straße 40, 21680 Stade — [2]Bahnhofstraße — [3]Universität Bremen, Fachbereich 1, Postfach 330440, 28334 Bremen

First, we evaluate observations in order to show that the Hubble-constant is a function of the redshift. Secondly, we discuss the significance of that finding for the standard model of cosmology. Thirdly, we compare our results with a fundamental theory of quantum gravity. Fourthly, we discuss possible questions for future observations (Carmesin, H.-O. (2019): Die Grundschwingungen des Universums - The Cosmic Unification - With 8 Fundamental Solutions based on G, c and h - With Answers to 42 Frequently Asked Questions. Berlin: Verlag Dr. Köster.).

EP 3.14 Tue 16:30 Zelt

The Density Parameter Ω_c of the Dark Matter is a Function of G, c and h — •Hans-Otto Carmesin — Gymnasium Athenaeum, Harsefelder Straße 40, 21680 Stade — Studienseminar Stade, Bahnhofstr. 5, 21682 Stade — Universität Bremen, Fachbereich 1, Postfach 330440, 28334 Bremen

The nature of the dark matter is modeled: First, a very general and fundamental density problem of the early universe is pointed out and resolved by dimensional phase transitions. With it, the concept of the dimensional horizon is introduced. As a consequence, there occurs robust elementary particle of dark matter. Therefrom, $\Omega_c(G, c, h)$ is derived as a function of the universal constants G, c and h. The result is obtained from a completely fundamental theory without any fit parameters (Carmesin, H.-O. (2019): Die Grundschwingungen des Universums - The Cosmic Unification - With 8 Fundamental Solutions based on G, c and h - With Answers to 42 Frequently Asked Questions. Berlin: Verlag Dr. Köster.).

EP 3.15 Tue 16:30 Zelt

The effect of a strongly stratified layer in the upper part of Mercury's core on its magnetic field — •Patrick Kolhey[1], Daniel Heyner[1], Johannes Wicht[2], and Karl-Heinz Glassmeier[1] — [1]Technische Braunschweig, Institut für Geophysik und extraterrestrische Physik, Braunschweig, Germany — [2]Max Planck Institut for Solar System Research, Göttingen, Germany

Since its discovery Mercury's magnetic field has puzzled the community and modelling the dynamo process inside the planet's interior is still a challenging task. Therefore new non-Earth-like models were developed over the past decades trying to match Mercury's peculiar magnetic field. One promising model suggests a stably stratified layer on the upper part of Mercury's core. Such a layer divides the fluid core in a convecting part and a non-convecting part, where the magnetic field generation is mainly inhibited. As a consequence the magnetic field inside the outer core is damped very efficiently passing through the stably stratified layer by a so-called skin effect. Additionally, the non-axisymmetric parts of the magnetic field are vanishing, too, such that a dipole dominated magnetic is left at the planet's surface.In this study we present new direct numerical simulations of the magnetohydrodynamical dynamo problem which include a stably stratified layer on top of the outer core. We explore a wide parameter range, varying mainly the Rayleigh and Ekman number in the model under the aspect of a strong stratification of the stable layer. We show which conditions are necessary to produce a Mercury-like magnetic field and give a inside about the planets interior structure.

EP 4: Sun and Heliosphere II

Time: Wednesday 10:30–12:30 Location: H-HS VIII

Invited Talk EP 4.1 Wed 10:30 H-HS VIII

Linking Solar Eruptions and Energetic Particles through Observations and Modeling — •Frederic Effenberger — Helmholtz Centre, GFZ German Centre for Geosciences, Potsdam, Germany

The relation between different energetic particle populations accelerated in the solar atmosphere and detected in interplanetary space is not well established. Observational studies during the last years demonstrated the still poorly understood existence of a connection between solar flare signatures of accelerated particles at the Sun and the corresponding solar energetic particles (SEPs) detected at 1 AU. It is thus important to make progress towards answering the question: Under which circumstances do these two observations point to the same population of accelerated particles? Here, we will discuss recent progress concerned with this issue. We illustrate the potential for observations and simultaneous modeling of the escaping and precipitating electron populations to constrain the plasma properties of the flaring region and interplanetary medium. In particular, with the recently launched Parker Solar Probe and Solar Orbiter missions, which will explore the Sun from a close distance and with unprecedented detail, new insights into these questions can be expected. We emphasize the importance of such studies for the fundamental understanding of physical processes in space plasmas and for our space weather forecasting capabilities.

EP 4.2 Wed 11:00 H-HS VIII

Helicity Shedding by Flux Rope Eruption — •Bernhard Kliem and Norbert Seehafer — Universität Potsdam, Institut für Physik und Astronomie

It has been suggested that coronal mass ejections (CMEs) remove the magnetic helicity of active regions from the Sun. Such removal is often regarded to be necessary due to the hemispheric sign preference of the helicity, which inhibits a complete annihilation by magnetic reconnection between volumes of opposite helicity. We have monitored the relative magnetic helicity contained in the coronal volume of erupting magnetic flux ropes. The torus instability, or a combination of helical kink and torus instability, leads to eruption and ejection of the flux rope, which is a model for CMEs. It is found that the fraction of helicity ejected depends strongly on the characteristics of the initial force-free equilibrium of the flux rope. For a rather strongly twisted, initially kink-unstable flux rope of 2.5 field line turns, which has a relatively large fraction of self-helicity, not only the normalized total initial helicity (< 0.1) but also the ejected helicity (about 30 per cent) are relatively small. For a weakly twisted (solely torus-unstable) flux rope, which has a relatively large fraction of mutual helicity, up to 2/3 of the much higher initial helicity (0.2–0.3) are shed. This supports the conjecture hat helicity shedding by CMEs is an important aspect of the solar magnetism.

EP 4.3 Wed 11:15 H-HS VIII

Estimating uncertainties for Solar Energetic Particle anisotropies — •Maximilian Brüdern, Nina Dresing, Bernd Heber, Lars Berger, Alexander Kollhoff, and Patrick Kühl — IEAP Christian Albrechts Universität zu Kiel

Solar Energetic Particles (SEPs) can routinely be observed at 1 AU depending on their origin at the Sun and their transport through the interplanetary medium. Their energy is mostly determined close to the Sun. As SEPs propagate outward along the Interplanetary Magnetic Field (IMF) the pitch-angle with respect to the local field is systematically focused due to the radial decreasing IMF. While stochastic changes are induced by scattering at fluctuations of the IMF. Often the first order anisotropy of SEPs is calculated to disentangle imprints of source and transport. Strong anisotropies indicate periods of weak pitch-angle scattering. Although many modeling and observational studies are based on the anisotropy, its uncertainty is often neglected which could result in inaccurate conclusions. Therefore, we propose a new method based on a bootstrap approach where we consider (1) directional instrument responses, (2) the variation of the magnetic field, and (3) the stochastic nature of detection. Here, we present our procedure and final results for different SEP events using measured data of the IMF and particle fluxes by the Solar Electron and Proton Telescope (SEPT) on board of each STEREO spacecraft. The SEPT provides four viewing directions with a view cone of 0.66 sr each on a three axis stabilized spacecraft. In future we plan to apply our method to the Electron and Proton Telescope (EPT) on board Solar Orbiter.

EP 4.4 Wed 11:30 H-HS VIII

Charged particle transport in MHD simulations — •Felix Spanier[1,2] and Alex Ivascenko[2] — [1]Institut für Theoretische Astrophysik, Universität Heidelberg — [2]Centre for Space Research, North-West University, Potchefstroom, South Africa

Transport and acceleration of charged particles in turbulent media is a topic of great interest in space physics and interstellar astrophysics. These processes are dominated by the scattering of particles off magnetic irregularities. These irregularities are often described as plasma waves.
We report on incompressible MHD simulations combined with charged test particle simulations using the GISMO code. Here we describe a new method to derive the diffusion coefficients $D_{\mu\mu}$ and $D_\perp$ from these numerical experiments which is applicable even in the case of strong turbulence where quasi-linear theory is no longer valid. Results for these parameters are presented where a special emphasis is on the transport characteristics at $\mu = 0$.

EP 4.5 Wed 11:45 H-HS VIII

Scattering of the electron strahl in the solar wind — •Daniel Verscharen[1,2], Benjamin Chandran[2,3], Seong-Yeop Jeong[1], Chadi Salem[4], Marc Pulupa[4], and Stuart Bale[4,5,6] — [1]Mullard Space Science Laboratory, University College London, UK — [2]Space Science Center, University of New Hampshire, USA — [3]Department of Physics and Astronomy, University of New Hampshire, USA — [4]Space Sciences Laboratory, University of California, Berkeley, USA — [5]Physics Department, University of California, Berkeley, USA — [6]The Blackett Laboratory, Imperial College London, UK

We investigate the scattering of strahl electrons by microinstabilities as a mechanism for creating the electron halo in the solar wind. We develop a mathematical framework for the description of electron-driven microinstabilities and discuss the associated physical mechanisms. We find that an instability of the oblique fast-magnetosonic/whistler (FM/W) mode is the best candidate for a microinstability that scatters strahl electrons into the halo. We derive approximate analytic expressions for the FM/W instability threshold in two different β_c regimes, where β_c is the ratio of the core electrons' thermal pressure to the magnetic pressure, and confirm the accuracy of these thresholds through comparison with numerical solutions to the hot-plasma dispersion relation. The comparison of our theoretical results with data from the *Wind* spacecraft confirms the relevance of the oblique FM/W instability for the solar wind. We make predictions for the electron strahl close to the Sun, which will be tested by measurements from *Parker Solar Probe* and *Solar Orbiter*.

EP 4.6 Wed 12:00 H-HS VIII

Nonlinear diffusion of energetic particles — •Dominik Walter — Ruhr-Universität Bochum

In recent years the nonlinearity of the cosmic ray transport in various astrophysical environments has been emphasized. While nonlinearity is mostly often described by mutually coupled equations for the dynamics of the thermal plasma and the cosmic ray transport or for the transport of the plasma waves and the cosmic rays, we study the case of a single but nonlinear advection-diffusion equation. The latter can be approximatively solved analytically or semi-analytically, which has the advantage that these solutions are easy to use and, thus, can facilitate a quantitative comparison to data. We present a variety of possible solution strategies, ranging from exact solutions for a diffusion-only equation, to integral mehtods and finally an expanding strategy, that solves the problem using fundamental solutions. For the latter case we will also look at a radially symmetric model.

EP 4.7 Wed 12:15 H-HS VIII

The kappa-cook book — •Klaus Scherer, Horst Fichtner, Marian Lazar, and Edin Husidic — Ruhr Universität Bochum, Institute for Theoretical Physics IV

Recently the standard kappa-distribution (SKD) was extended by the regularized kappa distribution (RKD), to avoid some of the problems of the SKD. Here we present a generalization of the kappa distributions and discuss the applicability of the various cases to data. We compare some of the different kappa distribution commonly used in literature. We show that for kappa values larger than three all of these distributions lead to very similar results, but for lower kappa values one has to use the regularized types to avoid unphysical behavior, for example too high contributions from superluminal particles.

EP 5: Sun and Heliosphere III

Time: Wednesday 14:00–15:45 Location: H-HS VIII

Invited Talk EP 5.1 Wed 14:00 H-HS VIII
New Opportunities with the Regularized $\kappa-$Distribution — •Edin Husidic — Institut für Theoretische Physik, Lehrstuhl IV: Plasma-Astroteilchenphysik, Ruhr-Universität Bochum, D-44780 Bochum, Germany

The solar wind is a rich field for various plasma waves and instabilites, which can be studied by solving the kinetic dispersion relation. By assuming small perturbations, a linear dispersion analysis is often sufficient, and except some special cases, the general solutions of the dispersion relation are usually obtained using numerical solvers. Among the standard solvers dedicated to a certain family of model distribution functions, e.g., Maxwellian or Kappa power-laws, those that allow for arbitraty distributions are more practical, as the measured particle distributions do not follow idealized distributions. In the solar wind the observed distributions deviate from a Maxwellian, showing enhanced suprathermal tails, which can be well fitted by the so-called standard $\kappa-$distribution (SKD). Due to a series of unphysical limitations and characteristics of the SKD, such as diverging velocity moments, a non-extensive entropy and a non-desirable contribution to macroscopic quantities from unphysical superluminal particles, the regularized κ-distribution (RKD) has been introduced. The RKD can reproduce as limit cases both the Maxwellian and the SKD with the benefit of overcoming the limitations of an SKD. The dispersion curves as well as growth and damping rates of different plasma instabilities based on the (anisotropic) RKD are computed and discussed.

EP 5.2 Wed 14:30 H-HS VIII
A numerical model of solar wind turbulence beyond the termination shock — •Jens Kleimann[1], Sean Oughton[2], and Horst Fichtner[1] — [1]Ruhr-Universität Bochum, 44780 Bochum, Germany — [2]University of Waikato, Hamilton 3216, New Zealand

A pre-existing self-consistent model (Wiengarten et al. 2015, 2016) of incompressible MHD fluctuations and their transport in and interaction with the solar wind is extended into the inner heliosheath. This region has been explored in recent years by the two Voyager spacecraft that, particularly, provided evidence for compressive fluctuations. Dynamical equations for the Reynolds-averaged turbulence quantities, such as total fluctuation energy, cross-helicity and the associated lengthscales, are coupled to the large-scale single-fluid MHD equations and numerically integrated using the CRONOS code until a steady state is reached. This includes non-linear interactions with the background fields, as well as turbulence driving by pick-up ions and possibly other sources such as velocity shear. The resulting configurations are discussed and compared to those from other groups such as Usmanov et al. (2011, 2016).

EP 5.3 Wed 14:45 H-HS VIII
The relevance of suprathermal particles for the pressure equilibrium in the heliosheath — •Hans Jörg Fahr — Argelander Institut für Astronomie, Universität Bonn

We are studying solar wind electrons and protons in the heliosheath, after passage over the solar wind termination shock. Due to the electric nature of this shock, downstream electrons become highly energized with non-equilibrium distribution functions. The moments of these functions show that the electron pressure is higher than the proton pressures. Even when pressure contributions from superluminal particles are removed it turns out that electron and proton pressures are of the same order of magnitude. When this is taken into account, it is revealed that there is no pressure deficit in the heliosheath with respect to the ram pressure of the surrounding LISM plasma as recently claimed by Rankin et al.(2019).

Invited Talk EP 5.4 Wed 15:00 H-HS VIII
The journey of the Voyagers into the interstellar medium — •Klaus Scherer — Ruhr Universität Bochum, Institute for Theoretical Physics IV

The Voyager mission was original planned as planetary mission to visit Jupiter and Saturn. Voyager 2 was then sent to Uranus and Neptune. The final destination of both spacecraft was after the crossing of the termination shock, that is the discontinuity where the supersonic solar wind becomes subsonic, to go beyond the heliopause, i.e. the tangential discontinuity separating the solar wind from the interstellar medium. Voyager 1 has crossed the heliopause in 2012 and recently Voyager 2 passed also through it, so that both are in the interstellar medium now. It is very interesting to compare the two crossings, because of the large separation of the two spacecraft. Moreover, only Voyager 2 has an operating plasma instrument on-board, while that of Voyager 1 was damaged during the Jupiter flyby. I will present a short history and the highlights of these missions, especially with respect of the heliopause crossing of Voyager 2.

EP 5.5 Wed 15:30 H-HS VIII
Potential Insights about the Heliosphere from ENA Measurements with an Interstellar Probe — Andre Galli[1], Peter Wurz[1], •Horst Fichtner[2], Yoshifumi Futaana[3], and Stas Barabash[3] — [1]Physics Institute, University of Bern, Switzerland — [2]Fakultät für Physik und Astronomie, Lehrstuhl IV, Ruhr-Universität Bochum, Germany — [3]IRF Swedish Institue of Space Physicsm Kiruna, Sweden

Several concepts for heliospheric missions operating at heliocentric distances far beyond Earth orbit are currently investigated by the scientific community. The mission concept of an Interstellar Probe aims at reaching a heliocentric distance of 1000 au within this century. Such mission would not only allow for a direct sampling of the unperturbed interstellar medium, but also for visits to Kuiper Belt objects, a comprehensive view on the interplanetary dust populations, or infrared astronomy free from the foreground emission of the zodiacal cloud. Particularly, it would also allow to obtain a global view of the heliosphere from an outside vantage point by measuring energetic neutral atoms (ENAs) originating from various heliospheric plasma regions. In the presentation a simple empirical model of ENAs from the heliosphere will be discussed and basic requirements for an ENA instrumentation on board an Interstellar Probe. For this purpose the full energy range of heliospheric ENAs from 10 eV to 100 keV is considered because each part of the energy spectrum has its merits for heliospheric science. The sensitivity of corresponding ENA measurements to the global shape of the heliosphere is quantitatively analyzed.

EP 6: Combined detector session (joint session HK/T/ST/EP)

Time: Wednesday 16:30–18:30 Location: H-HS X

Invited Talk EP 6.1 Wed 16:30 H-HS X
Detectors for Measuring Space Radiation — •Robert F. Wimmer-Schweingruber and and the Kiel Extraterrrestrial Physics Team — Christian-Albrechts-Universität zu Kiel, Kiel, Germany

Radiation in the solar system comes from various sources, primarily galactic cosmic radiation (GCR) and solar (cosmic) radiation, as well as particles trapped and/or accelerated in and at planetary magnetospheres and traveling shock waves. While measurements of radiation on Earth and in its atmosphere have been performed for more than a century, measuring space radiation is more complicated, mainly because of the limited resources available on spacecraft. In this talk I will discuss examples of how to measure space radiation on Mars, the Moon, and in the inner solar system, i.e., between the Sun and Earth, thus covering measurements on a body with a (thin) atmosphere, with no atmosphere, and in free space. The examples include the Radiation Assessment Detector (RAD) on NASA*s Mars Science Laboratory (MSL), the Lunar Lander Neutrons and Dosimetry (LND) instrument on China*s Chang*E 4 lander on the far side of the Moon, and the four sensors STEP, EPT, SIS, and HET on ESA*s Solar Orbiter which is scheduled for launch on February 7, 2020, at the time of writing this abstract.

Invited Talk EP 6.2 Wed 17:00 H-HS X
Modern Timing Detectors in HEP — •Jörn Lange — II. Physikalisches Institut, Georg-August-Universität Göttingen, Germany

Particle detectors with precise time information are traditionally used in HEP as time-of-flight detectors. A new generation of high granularity and radiation-hard timing detectors with a precision of few tens of picoseconds is being developed for event time measurements at the High-Luminosity upgrades of the LHC experiments. By measuring the arrival time of each particle in the detector, its underlying collision vertex can be identified to suppress the background from event pileup in an environment with up to 200 collisions per proton-proton bunch crossing. This is made possible thanks to the rapid advance of new detector technologies like Silicon Low Gain Avalanche Detectors (LGADs). For the longer term future, 4D tracking detectors are being developed, which combine precise timing with the high granularity and spatial resolution of today's pixel detectors, enabling enhanced pattern recognition in high density track environments. This presentation will motivate and introduce the novel timing detectors and their technologies. New developments such as 4D-tracking and possible other applications will be discussed as well.

Invited Talk EP 6.3 Wed 17:30 H-HS X
Experimental time resolution limits of modern SiPMs and TOF-PET detectors — •Stefan Gundacker — CERN, Esplanade de Particules 1, 1211 Meyrin, Switzerland — UniMIB, Piazza dell'Ateneo Nuovo, 1-20126, Milano, Italy

Time Of Flight (TOF) information applied in Positron Emission Tomography (PET) has shown to improve the image quality, shorten scan times and reduces the patient radiation dose. A Coincidence Time Resolution (CTR) in the range of 20 ps FWHM would enable to access image voxels of 3x3x3mm^3 along the line of response and is likely to revolutionize clinical PET. Inorganic scintillator-based detectors are able to record the 511 keV annihilation gammas with high sensitivity and have strongly benefited from the appearance of solid-state photodetectors (e.g. the SiPM), new crystal types (e.g. LYSO:Ce codoped with divalent ions) and improved front-end electronic readout. Such developments enabled commercial PET systems to achieve CTRs around 210 ps FWHM (Siemens Biograph vision). Nevertheless, a complete assessment of state-of-the-art scintillators and SiPMs in terms of their currently achievable time resolution limits was still missing and will be given in this paper. That is important, as it helps to define future strategies and directions of research in order to improve the system CTR by at least an order of magnitude. Furthermore, general aspects of the theoretical CTR limits in TOF-PET will be discussed along with some considerations on how to bring promising laboratory results into real world medical applications.

Invited Talk EP 6.4 Wed 18:00 H-HS X
260 megavoxel camera with continuous readout - the upgraded ALICE TPC — •Laura Fabbietti for the ALICE-Collaboration — JamesFranckstr. 1

The ALICE Time Projection Chamber (TPC) is the world largest detector of this type. It is the main tracking and PID device of the ALICE detector. It is currently being upgraded with a new readout system, including new GEM-based Readout Chambers and new front-end electronics. The upgraded TPC will operate in continuous mode, recording the full minimum-bias interaction rate of 50 kHz in Pb-Pb offered by the LHC in Run 3 and beyond. This will result in a significant improvement on the sensitivity of rare probes*that are considered key observables to characterise the QCD matter created in such*collisions. In this presentation I will discuss the physics potential of the upgraded TPC and show the status of the TPC upgrade activities during the ongoing LHC Long Shutdown 2. First results of the commisioning tests will be presented.

EP 7: Planets and small Objects I

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

Invited Talk EP 7.1 Thu 11:00 H-HS VIII
Juno observations of Jupiter's aurora: Wave-particle Interaction in Jupiter's stressed magnetosphere — •Joachim Saur — University of Cologne, Germany

Observations by NASA's Juno spacecraft which is in a polar orbit around Jupiter have revolutionized our understanding of Jupiter's aurora. In our talk we will review particle and field measurements taken by the Juno spacecraft above Jupiter's main auroral oval and within the auroral tails of Jupiter's Galilean moons. We will show that wave-particle interactions of Alfvén waves plasma plays a crucial role in particle energization within Jupiter's magnetosphere. The radial transport of plasma outward from Io's orbit causes the magnetospheric plasma to sub-corotate, which generates large scale magnetic stresses that couple the magnetosphere to the ionosphere. These stresses are the root cause for the reacceleration of the magnetospheric plasma towards corotation. The magnetic stresses also include small scale, non-force balanced magnetic field fluctuations, which partly travel as Alfvén waves along Jupiter's magnetospheric field lines. We show that wave-particle interaction of these Alfvén waves occurs within distances of approximately L= 30 dominantly at high latitudes leading to auroral electron acceleration.

EP 7.2 Thu 11:30 H-HS VIII
MHD-Simulation of Io's Alfven Wings — •Stephan Schlegel and Joachim Saur — Institut für Geophysik und Meteorologie, Universität zu Köln

The electromagnetic interaction between Jupiter and its innermost Galilean moon Io is a prime example for moon-planet and star-planet interaction. A very striking feature is the Io Foot Print (IFP) in Jupiter's upper atmosphere.

With the Juno spacecraft orbiting Jupiter, new insights about the complex structure of the IFP have been achieved which can not be fully explained by the current models. A deeper understanding is necessary to explain current observations. For that purpose a simulation of the system with the single fluid MHD-Code Pluto is set up to analyse the effects of different aspects of the interaction. In this ongoing study, parameters like the density profile along the flux tube and the assymetry and substructure of Io's ionosphere are investigated.

EP 7.3 Thu 11:45 H-HS VIII
TRIPLE-IceCraft - A Retrievable Melting Probe for Transporting Scientific Payloads — •Dirk Heinen[1], Lutz Deriks[1], Christopher Wiebusch[1], Simon Zierke[1], Clemens Espe[2], Marco Feldmann[2], Gero Francke[2], and Lars Schickendanz[2] — [1]RWTH Aachen University, III. Physikalisches Institut, Templergraben 55, 52056 Aachen — [2]GSI - Gesellschaft für Systementwicklung und Instrumentierung mbH, Liebigstraße 26, 52070 Aachen

Within TRIPLE, initiated by the DLR Space Administration, Technologies for Rapid Ice Penetration and subglacial Lake Exploration are being researched. The TRIPLE scenario is divided into three components and aims to explore the subglacial ocean of the Jovian moon Europa. The first component is a melting probe which penetrates the icy shield and navigates to the ocean below. It anchors itself at the ice water boundary and releases the second component into the water: The nanoAUV, a small autonomous submarine, will explore the ocean, identify points of interests and take samples. The samples will be transported back to the melting probe and then processed and analysed by the AstroBioLab, the third component. We present the concept of the TRIPLE-IceCraft, a melting probe which is currently in development. It will be a modular bus system for transporting standardized payloads through ice. The current design will be suitable for the transport of a scientific payload through several hundred meters of ice penetrating into a subglacial ocean or lake and return later to the surface. For the demonstration the TRIPLE-IceCraft aims for an analog scenario at the Ekström Ice Shelf in Antarctica in 2022.

EP 7.4 Thu 12:00 H-HS VIII
Das MPO-MAG Magnetometer auf dem Weg zum Merkur — •Daniel Heyner — TU Braunschweig, Institut für Geophysik und extraterrestrische Physik, Mendelssohnstr. 3, 38106 Braunschweig

BepiColombo ist auf dem Weg nach Merkur. Der Messausleger mit den Magnetometern (MPO-MAG-Instrument) wurde am 25. Oktober 2018 im Weltraum ausgeklappt. Dadurch wurden die magnetischen Störungen, die vom Raumfahrzeug ausgehen, stark verringert. Seitdem messen die Fluxgate-Sensoren kontinuierlich das Sonnenwindmagnetfeld. Umfangreiche Kalibrierungs- und Datenverarbeitungsaktivitäten haben es uns ermöglicht, die Stärke der von Raumfahrzeugen erzeugten Störungen erheblich zu senken. Diese Aktivitäten sind ein wichtiger Schritt vor der weiteren wissenschaftlichen Analyse. Wir stellen einige Fälle magnetischer Störungen vor und diskutieren die Auswirkungen auf die Hauptfeldbestimmung vom Planeten Merkur. Wir vergleichen auch MPO-MAG-Messungen mit Beobachtungen vom Sonnenwindmonitor Advanced Composition Explorer. Wir schließen mit einem Überblick über die wissenschaftlichen Ziele des Instrumententeams für die In-Orbit-Missionsphase.

EP 7.5 Thu 12:15 H-HS VIII

Laboratory studies on laser-induced plasma shockwaves for LIBS measurements on Mars — •Fabian Seel[1,2], Susanne Schröder[1], David Vogt[1], Peder Hansen[1], and Michael Gensch[1,2] — [1]Institut für Optische Sensorsysteme, DLR, Berlin, Germany — [2]IOAP, TU Berlin, Germany

With the upcoming launch of the NASA Mars 2020 rover, a new mobile laboratory will be on the way to Mars. The rover will carry the sensor suite SuperCam, combining different spectroscopic methods to study the composition of geological samples at the rover's landing site. One of the applied methods is laser-induced breakdown spectroscopy (LIBS). For the first time, the rover will also carry a microphone to detect audible signals from Mars, which can also be used to improve the analysis of the LIBS measurements [*Space Sci. Rev.* 2012, 170:167-227., *Spectroscopy* 2017, 32.]. When taking a LIBS measurement, a pulsed laser is used to generate a plasma that can be analysed spectroscopically. An acoustic wave is emitted from the pressure shock of the expanding plasma plume that can be recorded to gain insight into material properties and laser-matter interaction [*Spectrochim. Acta B* 2019, 153:50-60., *EPSC* 2017, #239]. The laser-induced plasma in experimentally simulated Martian atmospheric conditions is studied with temporally and spatially resolved spectra. We investigate the plasma and its shockwave for applications on Mars in particular to link the acoustic signal to the LIBS spectral features [*LPSC* 2019 #2793]. First results will be presented here.

EP 8: Hauptversammlung AEF und DPG-EP (in German)

Time: Thursday 12:30–13:30 Location: H-HS VIII

Tagesordung siehe gesonderte Einladung

EP 9: Planets and small Objects II

Time: Thursday 14:00–14:45 Location: H-HS VIII

Invited Talk EP 9.1 Thu 14:00 H-HS VIII

The CoPhyLab: How to Study Comets in the Laboratory — •Bastian Gundlach — Institut für Geophysik und extraterrestrische Physik, Technische Universität Braunschweig, Deutschland

Comets are kilometer-sized objects, composed of different volatile and refractory species, i.e., ice and dust. They formed in the protoplanetary disc by the gravitational collapse of pebble clouds, typically consisting of mm- to cm-sized aggregates of dust and ice. After their formation, comets were scattered into the outer regions of our solar system and the bulk cometary material remained almost unaltered. Thus, comets are among the most primitive objects of our solar system. When a cometary nucleus enters the inner solar system, the cometary surface warms up and the volatile components start to sublimate. Particles, aggregates and chunks are then ejected off the cometary surface into space. This process leads to the formation of the cometary coma, the dust tail and the dust trail. However, the physical processes related to the ejection of material are still not understood. Laboratory experiments are one possible tool to investigate the activity of comets. This task is currently addressed by the CoPhyLab (Comet Physics Laboratory) an international collaboration among six Partner Institutes with the aim to study the physical processes connected to cometary activity by various experiments and thermophysical modeling.

EP 9.2 Thu 14:30 H-HS VIII

Dielectric properties of surface ice on Enceladus' southpole — •Pia Friend, Alex Kyriacou, and Klaus Helbing — Bergische Universität Wuppertal

Saturn's icy moon Enceladus is with its roughly 500 km diameter a differentiated, geological active body that harbours a liquid ocean between its rocky core and icy mantle. This ocean is among the most promising places to host extraterrestrial life in our solar system. At Enceladus' south pole terrain, active geysers form a passage from the ocean to the surface; erupting ice, dust and gas particles. Most of those particles escape the moon's gravity, but some portion falls back to the surface. Considering the current output, and depending on the timescale the geysers are active at the same location, the snow layer could have a thickness of some km already. A first model of the density profile of the snow layer as a function of the ice/vacuum ratio will be provided at the conference. From this, it is possible to define the dielectric properties of the snow layer. A well-defined dielectric profile in turn could help to radar navigate a melting probe through the ice on Enceladus during a possible future space mission.

EP 10: Arne Richter Lecture

Time: Thursday 15:00–16:00 Location: H-HS VIII

Invited Talk EP 10.1 Thu 15:00 H-HS VIII

Nonthermal astrophysics: cosmic ray particles and cosmic magnetic fields — •Reinhard Schlickeiser — Institut für Theoretische Physik, Lehrstuhl IV: Weltraum- und Astrophysik, Ruhr-Universität Bochum, D-44780 Bochum, Germany — Institut für Theoretische Physik und Astrophysik, Christian-Albrechts-Universität zu Kiel, Leibnizstr. 15, D-24118 Kiel, Germany

During the last 45 years of my career I almost exclusively did research on topics of nonthermal astrophysics including gamma-ray astronomy, radio astronomy, cosmic ray transport and acceleration in partially turbulent electromagnetic fields, astroparticle physics, kinetic theory of fluctuations in collision-poor plasmas and cosmological magnetogenesis. I had the privilege to meet and interact with a number of splendid and marvelous scientists including Arne Richter. In the talk I will cover important milestones of my career and summarize my positive experiences with fellow scientists.

EP 11: Astrophysics I

Time: Thursday 16:30–18:30 Location: H-HS VIII

EP 11.1 Thu 16:30 H-HS VIII

Reconstruction of the events recorded by the Pierre Auger Observatory — •Quentin Luce for the Pierre Auger-Collaboration — IKP - KIT, Eggenstein-Leopoldshafen, Germany

For the last fifteen years, the Surface Detector (SD) of the Pierre Auger Observatory is continuously recording, at ground level, the footprint of Extensive Air Showers (EAS) initiated by Ultra-High Energy Cosmic-Rays. Each triggered Water-Cherenkov Detectors, distant of 1500 m from each other and constituting an event, thus provides two information: the time at which the first particles of the shower hit the detector and the signal produced by all the particles going through it.

While from the timing information, the arrival direction of cosmic-rays is reconstructed, its energy is estimated, using the signal information, with the reconstruction of the lateral profile and the determination of the shower size S(1000). With the increase of the statistic and the evolution of our knowledge, this reconstruction procedure is evolving. The last developments of the algorithms: change of the shape of the lateral profile and improvement of its parametrisation, used to reconstruct the properties of the cosmic-rays and the resolution associated to them will be described in this presentation.

EP 11.2 Thu 16:45 H-HS VIII

Automated Imaging of VLBI Data for Morphology Studies of TeV Radio Galaxies — •Yvonne Kasper and Kevin Schmidt — TU Dortmund

An identified source for cosmic rays are Active Galactic Nuclei (AGN), which accelerate particles in large relativistic outflows (jets). To understand their acceleration mechanisms, the characteristics and morphologies of the sources are studied. Well suited targets are TeV radio galaxies, since very high energy gamma ray emission as well as a extended jet structure can be observed at the same time. This makes these sources excellent candidates for multi-wavelength studies, in which information from different wavelengths are combined. Observations with radio interferometers like the Very Long Baseline Array allow to resolve the morphologies of TeV radio galaxies. To get reproducible images from the obtained data, it is necessary to have fast and reliable imaging software. In this talk, we present results of imaging the TeV radio galaxy IC310 with the WS-Clean imager by André Offringa. The optimal cleaning parameters are acquired by a grid search approach, where the produced images are scored by the level and the occurrence of structures in the remaining noise of the image.

EP 11.3 Thu 17:00 H-HS VIII

3C 84/NGC 1275: Jet precession in 43 GHz data on sub-parsec scales — •Rune Dominik and Lena Linhoff — TU Dortmund

3C84, also known as NGC1275 and located in the Perseus galaxy cluster, is a radio galaxy, that has been observed at multiple energies by a variety of experiments for many years. Although well observed, some key properties of 3C84 remain unknown. One of this properties is the viewing angle, where a wide range of values can be found in literature. Recent studies have shown a precessing behavior of 3C84s jet on parsec scales in radio maps at 15 GHz. We analyzed this precessing behavior also on sub-parsec scales in 43 GHz data and found hints for an additional nutation. Using publicly available data from the VLBA-BU-BLAZAR Program, we focus on an open-source and reproducible analysis.

EP 11.4 Thu 17:15 H-HS VIII

Dust tomography and Faraday charting of the Milky Way — •Torsten Ensslin, Sebastian Hutschenreuter, and Reimar Leike — MPI für Astrophysik

The interstellar medium of the Milky Way is a complex multi-component system. Recent progress in charting out its components with the aid of information field theory (IFT) are presented here. IFT based Galactic dust tomography permitted to map the dust distribution in and around the local super-bubble in three dimensions. The simultaneously reconstructed power spectrum of the dust structures is consistent with dust fragmentation simulations. Furthermore, IFT based modelling of the Galactic Faraday rotation signal incorporating free-free emission data not only provides an improved Faraday sky map, it also reveals the preferred alignment of the local Galactic magnetic field with the Orion spiral arm.

Invited Talk EP 11.5 Thu 17:30 H-HS VIII

Topology-driven magnetic reconnection — •Raquel Mäusle[1], Jean-Mathieu Teissier[1,2], and Wolf-Christian Müller[1,2,3] — [1]Technische Universität Berlin, Berlin, Germany — [2]Berlin International Graduate School in Model and Simulation Based Research — [3]Max-Planck/Princeton Center for Plasma Physics, Princeton, NJ, USA

Magnetic reconnection is a process that occurs in plasmas, during which the topology of the magnetic field is changed in the presence of finite electrical resistivity. It is observed in solar flares, the Earth's magnetosphere as well as magnetic confinement devices.

We study a three-dimensional model of reconnection driven by magnetic field topology. In this framework, a high entanglement of magnetic field lines amplifies the influence of resistive effects and can thereby trigger reconnection. We investigate this model numerically using a finite-volume scheme to solve the magnetohydrodynamic (MHD) equations. This is done with a simple setup, in which an initially constant magnetic field is driven to high complexity. We study the dynamics of this system and observe a phase transition from a stationary to a chaotic state, which is potentially caused by the onset of reconnection. Furthermore, we find that the entanglement of field lines and the occurrence of reconnection events are temporally correlated.

In this talk I will introduce the model and numerical method employed and present our preliminary results.

EP 11.6 Thu 18:00 H-HS VIII

Hydrodynamical Models of Circumstellar Ring and Spiral Structures — •Dieter Nickeler and Michaela Kraus — Astronomical Institute, Czech Academy of Sciences, Ondrejov, Czech Republic

Spiral arms, interrupted spiral arms, so-called arcs, and ring structures have been observed in the vicinity of evolved (massive) stars. Such highly structured material, being the result of eruptive mass-loss episodes, possibly reflects complex geometrical flow structures around these stars. To model these flows geometrically, we solve non-linear Poisson equations, which are a mathematical equivalent formulation of the Euler equation and additional constraints. The equations are treated with conformal and non-conformal mappings, a well-suited technique from magneto-hydrostatics. Preliminary results for selected geometries are presented.

EP 11.7 Thu 18:15 H-HS VIII

On the simulation of bow shock perturbations — •Lennart R. Baalmann — Ruhr-Universität Bochum

Small inhomogeneities in an otherwise homogeneous interstellar medium, so called Tiny-Scale Atomic Structures, create perturbations of an astrosphere's bow shock, resulting in a variety of observable bow shock features. We simulate this scenario by first computing a numerical single-fluid 3D MHD astrosphere until it reaches stationarity and then start such an inhomogeneity in front of the bow shock. While the inhomogeneity must have a constrained range of parameters (density, pressure, velocity, magnetic field) in order to be both physical and stable enough to reach the bow shock, its size, shape and position/angle of impact at the bow shock is varied in a wide range of the parameter set. Here, the first results will be presented.

EP 12: Astrophysics II

Time: Friday 9:00–9:45 Location: H-HS VIII

Invited Talk EP 12.1 Fri 9:00 H-HS VIII
Asteroseismology of red-giant stars — •Saskia Hekker — Max Planck Institut für Sonnensystemforschung, Göttingen, Germany — Stellar Astrophysics Centre, Aarhus, Denmark

Over the past decades we experienced a revolution in asteroseismology of red-giant stars. In this talk, I will discuss this revolution and first insights gained from asteroseismology into the stellar structure of red-giant stars.

EP 12.2 Fri 9:30 H-HS VIII
Evidence of an evolved nature of MWC 349A — •Michaela Kraus[1], Maria Laura Arias[2], Lydia Cidale[2], and Andrea Torres[2] — [1]Astronomical Institute, Czech Academy of Sciences, Ondrejov, Czech Republic — [2]Institute of Astrophysics, CONICET-UNLP, La Plata, Argentina

The Galactic emission-line object MWC 349A is one of the brightest radio stars in the sky. The central object is embedded in an almost edge-on oriented Keplerian rotating thick disk that seems to drive a rotating bipolar wind. The dense disk is also the site of the hot molecular emission such as the CO bands with its prominent band heads in the near-infrared spectral range. Despite numerous studies, the nature of MWC 349A is still controversial with classifications ranging from a pre-main sequence object to an evolved supergiant. To study the molecular disk of MWC 349A, and in particular to search for the isotope 13CO, we collected new high-resolution near-infrared spectra using the GNIRS spectrograph at Gemini-North. The amount of 13CO, obtained from the 12CO/13CO ratio, is recognized as an excellent tool to discriminate between pre-main sequence and evolved massive stars. We detect CO band emission with considerably lower intensity and CO gas temperature compared to previous observations. Moreover, from detailed modeling of the mission spectrum, we derive an isotope ratio of 12CO/13CO of 4. Based on this significant enrichment of the circumstellar environment in 13CO we conclude that MWC 349A belongs to the group of B[e] supergiants, and we discuss possible reasons for the drop in CO intensity.

EP 13: Exoplanets and Astrobiology

Time: Friday 10:00–12:30 Location: H-HS VIII

Invited Talk EP 13.1 Fri 10:00 H-HS VIII
Habitability of extrasolar planets and the impact of interior-atmosphere interactions under different stellar evolutions — •Mareike Godolt — Zentrum für Astronomie und Astrophysik, Technische Universität Berlin, Germany

Habitability of extrasolar planets is often defined by the potential availability of liquid water on the planetary surface. This depends on various factor, such as the water inventory of the planet as well as the atmospheric pressure and temperature at the planetary surface, which are the result of various processes and factors. Relevant factors include the size and mass of the planet via the gravitational acceleration, the atmospheric mass, as well as the atmospheric composition, which is a result of planetary formation and subsequent interactions with the interior and space as well as atmospheric chemistry. The atmospheric chemical composition and mass determine the impact of the stellar irradiation via radiative but also convective processes which dominate the heating and the cooling processes of the planet. In this talk I will review current knowledge of central factors for habitability and highlight the relevance of the common evolution of the planetary interior with the atmosphere and the host star. Furthermore, I will present studies evaluating the detectability of atmospheres of small, potentially habitable planets with near future instrumentation.

EP 13.2 Fri 10:30 H-HS VIII
The Size and Shape of Planetary Proto-Atmospheres — •Tobias Moldenhauer[1], Rolf Kuiper[1], Wilhelm Kley[1], and Chris Ormel[2] — [1]Universität Tübingen, Tübingen, Deutschland — [2]Tsinghua University, Beijing, China

Protoplanets formed by core accretion can become massive enough to accrete gas from the disk they are born in. If the planetary proto-atmosphere exceeds a critical mass, runaway gas accretion starts and the planet collapses into a gas giant. In recent years, many close-in super-Earths have been observed which raises the question on how they avoided becoming hot Jupiters. We use three-dimensional radiation-hydrodynamics to simulate the proto-atmosphere in the local frame around the planet. The simulations converge to a quasi-steady state where the velocity field of the gas does not change anymore. In post-processing we then use tracer particles to calculate the shape of the atmosphere and the recycling timescale. Recycling of the atmosphere counteracts the collaps by preventing the gas from cooling efficiently.

EP 13.3 Fri 10:45 H-HS VIII
Star-planet interaction: Alfvén wings and Stellar winds — •Christian Fischer and Joachim Saur — Institut für Geophysik und Meteorologie, Universität zu Köln

Star-planet interaction is the equivalent process of the well known moon-planet interaction in our solar system. The differences between both processes lie in the geometries of the background magnetic fields and the plasma flow relative to the magnetic field. In the case of star-planet interaction the resulting Alfvén wing and other wave structures of the exoplanet are controlled by structures in the stellar wind. Therefore we apply an MHD model to simulate how different stellar wind conditions affect Alfvén wings. In our presentation we show results of theses MHD simulations and discuss their implication on properties of star-planet interaction.

EP 13.4 Fri 11:00 H-HS VIII
Classifying Exoplanet Candidates with Convolutional Neural Networks: Application to the Next Generation Transit Survey — •Alexander Chaushev[1] and Liam Raynard[2] — [1]TU Berlin, Berlin, Germany — [2]University of Leicester, Leicester, UK

A key bottleneck in the discovery of transiting exoplanets is the large number of false positives produced by existing detection algorithms. Currently the solution to this problem is to vet the candidates by hand, however this is time consuming and can be inconsistent. Recently convolutional neural networks (CNNs), a type of 'Deep Learning' algorithm, have been shown to be effective at this task [Shallue+19].

Here I will present results from the on-going effort to automate the Next Generation Transit Survey (NGTS) candidate vetting process using a CNN. Currently we are able to exclude ~50% of false positives, while recovering ~90% of our manually identified candidates and all currently known planets in the NGTS dataset [Chaushev+19]. A key goal of the project is to understand and improve the network performance in the lowest signal to noise regimes. In this regard, NGTS provides a unique dataset as it has been continually pushing to find planets on the edge of detectability, leading to the discovery of NGTS-4b the shallowest transit discovered from the ground to date [West+19]. This makes NGTS an ideal testing ground for CNNs, and improvements made in the techniques here can readily be applied to space based data from K2 and TESS currently, and PLATO in the future.

EP 13.5 Fri 11:15 H-HS VIII
Machine learning inference of the interior structure of low-mass exoplanets — •Philipp Baumeister[1], Sebastiano Padovan[2], Nicola Tosi[1,2], Gregoire Montavon[3], Nadine Nettelmann[2], Jasmine MacKenzie[1], and Mareike Godolt[1] — [1]Centre of Astronomy and Astrophysics, Technische Universität Berlin — [2]Institute of Planetary Research, German Aerospace Center (DLR), Berlin — [3]Institute of Software Engineering and Theoretical Computer Science, Technische Universität Berlin

We explore the application of machine learning based on mixture density neural networks (MDNs) to the interior characterization of low-mass exoplanets up to 25 Earth masses constrained by mass, radius, and fluid Love number k_2. With a dataset of 900 000 synthetic planets, consisting of an iron-rich core, a silicate mantle, a high-pressure ice shell, and a gaseous H/He envelope, we train a MDN using planetary mass and radius as inputs to the network. We show that the MDN is able to infer the distribution of possible thicknesses of each planetary layer from mass and radius of the planet. This approach obviates the time-consuming task of calculating such distributions with a dedicated set of forward models for each individual planet. The fluid Love number k_2 bears constraints on the mass distribution in the planets' interior and will be measured for an increasing number of exoplanets in the future. Adding k_2 as an input to the MDN significantly decreases the degeneracy of possible interior structures.

EP 13.6 Fri 11:30 H-HS VIII

In-situ permittivity measurements for characterising amorphic snow and ice for Enceladus Explorer — •Alexander Kyriacou, Pia Friend, Uwe Naumann, and Klaus Helbing — Gaußstr. 20 42119 Wuppertal

The detection of organic rich salt-water geysers on Saturn's ice-moon Enceladus by Cassini is evidence of a subsurface ocean, a possible habitat for extra-terrestrial life. A robotic space mission, Enceladus Explorer (EnEx) from the DLR space administration, has been proposed to land in safe proximity to a geyser and deploy a melting probe to search a near-surface aquifer for microbes. Forward ice-penetrating radar, from orbit and the surface will be crucial to locate the target reservoir, a safe landing position, and identify and localise obstacles for any given path of the IceMole. A tracking radar may also be used to track the IceMole's trajectory through the ice using antennae on the surface and from orbit.

Given the uncertain density and composition of the surface ice and geyser deposit layer, accurate and high resolution localisation would be aided by in-situ measurement of the dielectric depth profile. The concept for a near-field permittivity sensor, utilising mutual impedance between electrodes placed on the hull of a melting probe is presented. Alternative methods, utilising in-ice active transponders and target focusing are also discussed. The performance of these methods are tested using laboratory tests, simulations and field measurements in the Alps. The enhancement of radio-imaging and profiling with the use of the probe is examined with radio propagation simulations.

EP 13.7 Fri 11:45 H-HS VIII

On the interior of exoplanets with the Love number h_2 — •Hugo Hellard and Szilárd Csizmadia — DLR Berlin, Germany

The characterization of the interior of exoplanets will unveil precious information on their formation, structure, and evolution. The Love numbers h_2 and k_2, which describe the planet's response to external perturbations, contain information beyond the planetary mean density (e.g., radial density profile, rheological properties). Their knowledge will decrease the intrinsic degeneracy of the mass-radius diagram. While Love numbers are known for several Solar System bodies, they remain unmeasured for exoplanets. First, we introduce both Love numbers and summarize how h_2 can be directly measured from (exo)planetary transit light curves. Second, we present the capability of the Hubble Space Telescope to measure h_2 of the hot-Jupiter WASP-121b before the high-quality data to be returned by the James Webb Telescope and the PLATO telescope in the next decade.

EP 13.8 Fri 12:00 H-HS VIII

Atmospheric Characterization via Broadband Color Filters on the PLAnetary Transits and Oscillations of stars (PLATO) Mission — •John Lee Grenfell[1], Mareike Godolt[2], Juan Cabrera[1], Ludmila Carone[3], Antonio Garcia Munoz[2], Daniel Kitzmann[4], Alexis M. S. Smith[1], and Heike Rauer[1,2,5] — [1]DLR-EPA, Berlin — [2]ZAA, TU Berlin — [3]MPIA, Heidelberg — [4]CSH, Bern — [5]PRS, FU Berlin

We assess broadband color filters for the two fast cameras on the PLAnetary Transits and Oscillations (PLATO) of stars space mission with respect to exoplanetary atmospheric characterization. We focus on Ultra Hot Jupiters and Hot Jupiters placed 25pc and 100pc away from the Earth and low mass low density planets placed 10pc and 25pc away. Our analysis takes as input literature values for the difference in transit depth between the broadband lower (500-675nm) wavelength interval (hereafter referred to as *blue*) and the upper (675-1125nm) broadband wavelength interval (hereafter referred to as *red*) for transmission, occultation and phase curve analyses. Planets orbiting main sequence central stars with stellar classes F, G, K and M are investigated.

EP 13.9 Fri 12:15 H-HS VIII

Planet Earth in spectropolarimetry — •Mihail Manev[1], Claudia Emde[2], Michael Sterzik[3], and Stefano Bagnulo[4] — [1]Meteorological Institute, Ludwig-Maximilians-University, Theresienstr. 37, D-80333 Munich, Germany — [2]Meteorological Institute, Ludwig-Maximilians-University, Theresienstr. 37, D-80333 Munich, Germany — [3]European Southern Observatory, Karl-Schwarzschild-Str. 2, D-85748 Garching, Germany — [4]Armagh Observatory and Planetarium, College Hill, Armagh BT61 9DG, UK

In the next ten years several new powerful telescopes are expected to see first light and bring many exciting discoveries of terrestrial exoplanets. Knowledge of Earth as an exoplanet is vital in order to be able to interpret these future measurements.

We analyzed spectropolarimertic observations of Earthshine, carried out at the VLT (Sterzik et al., Spectral and Temporal Variability of Earth Observed in Polarization, A&A, Vol. 622, A41, 2019), utilizing the state-of-the art Monte Carlo radiative transfer model MYSTIC (Emde et al., Influence of aerosols, clouds, and sunglint on polarization spectra of Earthshine, A&A, Vol. 605, A2, 2017).

The results reveal, which characteristics of Earth can be infered from spectropolarimetry and what signatures are expected from Earth-like exoplanets.