EP 9: Poster

Time: Wednesday 17:30–19:00 Location: HSZ OG1

EP 9.1 Wed 17:30 HSZ OG1

PUNCH4NFDI - Synergies & Services for SMuK — •Michael Zacharias for the PUNCH4NFDI Consortium-Collaboration — LSW, Universität Heidelberg

PUNCH4NFDI (Particles, Universe, NuClei & Hadrons) is a consortium of the NFDI, and merges the SMuK community's efforts to store, manage and connect (big) data streams and their related metadata following the FAIR principles. Here, I will present the Synergies & Services that PUNCH is going to offer to the community at large - with a focus on Astrophysics. The main tool will be the Science Data Platform, where any connected data can be accessed and analyzed. The Marketplace will be a community forum to share and distribute data management tools and scripts. I will present examples for such tools, namely the ontology platform phyics.tools and an arxiv search tool for software products used in research.

EP 9.2 Wed 17:30 HSZ OG1

Extragalactic neutrino factories — •Sara Buson[1], Andrea Tramacere[2], Leonard Pfeiffer[1], Lenz Oswald[1], Gaetan De Fichet Clairfontaine[1], Alessandra Azzollini[1], Vardan Baghmanyan[1], Marco Ajello[3], and Eleonora Barbano[1] — [1]Lehrstuhl für Astronomie, Universität Würzburg, Emil-Fischer-Straße 31, 97074, Würzburg — [2]Department of Astronomy, University of Geneva, Ch. d'Ecogia 16, Versoix, 1290, Switzerland — [3]Department of Physics and Astronomy, Clemson University, Kinard Lab of Physics, Clemson, SC 29634-0978, USA

Identifying the astrophysical sources responsible for the high-energy cosmic neutrinos has been a longstanding challenge. In a previous study, we report evidence for a spatial correlation between blazers from the 5th Roma-BZCat catalog and neutrino data collected by the IceCube Observatory in the Southern celestial hemisphere. The probability that such correlation is found by chance is about one in a million (2 x 10-6). In this conference contribution, we present an extension of the analysis to a complementary IceCube dataset, and put the findings into the context of the previous results.

EP 9.3 Wed 17:30 HSZ OG1

BlaST: A machine-learning estimator for the synchrotron peak of blazars — Theo Glauch and •Tobias Kerscher — Technische Universität München, Physik-Department, James-Frank-Str. 1, Garching bei München, D-85748, Germany

Blazars, jetted Active Galaxy Nuclei (AGN) pointing towards us, occupy an important place in the field of high-energy astrophysics. Their classification depends heavily on the peak frequency of the synchrotron emission in the spectral energy disitribution (SED), yet this value is usually determined manually. In this contribution, we present a tool using machine learning to not only streamline this process, but also give a reliable uncertainty evaluation. By the very nature of this method, additional components of the SED stemming from the host galaxy or disk emission, possible sources of confusion, are accounted for.

EP 9.4 Wed 17:30 HSZ OG1

Analytic solutions for the hadronic time-dependent two-zone blazar model — •Vito Aberham and Felix Spanier — Institut für Theoretische Astrophysik (ITA), Albert-Ueberle-Str. 2, 69120 Heidelberg

Active galactic nuclei's (AGN) distinct variability is examined analytically by applying an evolving two-zone model to their jets. It is focused on hybrid jets containing both electrons and protons, since they allow for the additional emission of neutrinos. The dominant source of variability, jets of AGN are characterized by the cooling process mainly driving the emergence of the spectral energy distribution's high-energy peak. A scenario comprising blazars with proton synchrotron radiation as the predominant emission mechanism for high energies, while, as usual, electron synchrotron radiation drives the low energy emission, is chosen here. Dominant emission due to cascades is among cases considered in upcoming works. Incorporating both their acceleration and cooling in the respective zones, the particle distributions are calculated by solving two coupled partial differential equations while the effect of second-order Fermi acceleration is neglected. The associated photon density is obtained, which, combined with the proton distribution, eventually yields the emerging neutrino flux. Both the according light curves and neutrino fluxes in specific energy bands are ultimately inferred, enabling comparisons to observed blazars. Ultimately, a tool, which simulates a blazar's flare by exploiting the analytical results' dependence on the set of free model parameters, is presented to very quickly cross-check numerical simulations at low computational cost.

EP 9.5 Wed 17:30 HSZ OG1

ComPol - A Compton polarimeter in a Nanosat — •Matthias Meier for the ComPol-Collaboration — Excellence Cluster ORIGINS, Garching, Germany — Technical University of Munich (TUM), Munich, Germany

It is hardly possible to resolve the geometry of astrophysical compact objects due to their small size. One possibility to indirectly learn about their structure are polarization measurements. Especially in the hard X-ray range polarization data is still partially missing. Therefore, the aim of the CubeSat mission ComPol is to improve the physical model of the black hole binary system Cygnus X-1 by measuring the polarization of its hard X-ray spectrum (20-200keV).
The detector system developed for the ComPol project is composed of a Silicon drift detector used as a scatterer and a $CeBr_3$ scintillator read out by a SiPM matrix. From the scintillation light distribution it is possible to determine the absorption position in the $CeBr_3$ which is done to capture the full Compton kinematics. The next step is to perform an event-wise reconstruction from the measured energies and interaction points. The resulting distribution of the azimuthal scatter angles allows to directly infer the polarization of the initial radiation. The talk will give an overview of the scientific motivation, the underlying physics and the detector setup.
This research is supported by the Excellence Cluster ORIGINS which is funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under Germany's Excellence Strategy - EXC-2094-390783311

EP 9.6 Wed 17:30 HSZ OG1

Das Universum als Energiesystem ermöglicht die Große Vereinheitlichte Theorie — •Günter von Quast — Winterweg 4; 76344 Eggenstein-Leopoldshafen

Die *Neue Physik* geht von einem Universum aus, das aus einem Energiefeld besteht. Die physikalischen Parameter dieses Energiefeldes sind die Planck-Einheiten und belegen ein Medium mit Planck-Druck und Planck-Dichte und der Planck-Energie sowie der Planck-Masse und der Planck-Ladung und vielen weiteren physikalischen Parametern und mathematischen Beziehungen. Alle Vorgänge in diesem Energiefeld sind energetische Vorgänge. Dazu gehören die Energetische Strahlung als Licht aller Frequenzen und auch das Wesen der Gravitation. Auch die Materie entsteht in diesem Energiefeld und ist nur ein vorübergehender Aggregatzustand der Raum-Energie und kann sich somit auch wieder zu der Raum-Energie auflösen. Die Fusionsstrahlung der sich abbauenden Sterne füllt den Raum aus. Somit ist die Hintergrundstrahlung die Plancksche Schwarzkörperstrahlung als energetischer Zustand des Raumes. Energie geht nicht verloren und Materie verschwindet nicht in den Schwarzen Löchern der Galaxien, was zu beachten ist. Die Zentren der Galaxien sind Strudelsysteme in dem Feld der Raum-Energie. Die Materie entsteht in den Zenten der Galaxien. Die Materie besteht aus den Strudelfeldern, den Quarks und diese bilden die Elementarteilchen und Atome aus. Die Materie besteht aus der Energie des Feldes der Raum-Energie. Dafür gibt es die *Neue Physik* als Energiefeld-Theorie. Die Standard- Theorien erklären nicht die Natur der Physik des Universums.

EP 9.7 Wed 17:30 HSZ OG1

Unveiling the dense molecular environments of evolved massive stars — •Michaela Kraus[1], María Laura Arias[2], Michalis Kourniotis[1], Andrea Torres[2], and Lydia S. Cidale[2] — [1]Astronomical Institute, Czech Academy of Sciences, Ondřejov, Czech Republic — [2]Instituto de Astrofísica de La Plata, CONICET, UNLP, La Plata, Argentina

The evolution of massive stars passes through states with intense mass-loss and eruptions, leading to the formation of dense and warm circumstellar environments, in which molecules and dust can form. Our research focuses on two specific such evolutionary stages: the B[e] supergiants and the yellow hypergiants, with the aim to reveal the structure and dynamics of their circumstellar matter. For this, we collected high-resolution near-infrared spectra for a sample of stars, using facilities at GEMINI Observatory. We discovered emission from hot CO gas in a few objects, based on which we derive the gas temperature, column density and kinematics within the line-forming regions. Interestingly, the yellow hypergiants and the B[e] supergiants with CO band emission share the same evolutionary tracks, and we discuss possible implications of this finding regarding potential evolutionary connections between these two phases.

EP 9.8 Wed 17:30 HSZ OG1

Evolution and radio emission of interacting plasma bunches in pulsar magnetospheres — •Jan Benáček[1], Patricio Muñoz[2,3], Jörg Büchner[3,2], and Axel Jessner[4] — [1]Intitute for Physics and Astronomy, University of Potsdam, Germany — [2]Max Planck Institute for Solar System Physics, Göttingen, Germany — [3]Center for Astronomy and Astrophysics, Technical University of Berlin, Germany — [4]Max Planck Institute for Radio Astronomy, Bonn, Germany

Pulsars are neutron star that emits coherent radio beams out of their magnetic poles. However, the origin of their radio emission is still under investigation. One of the proposed emission mechanisms exploits plasma bunches/clouds of electron-positron pairs created during spark events in gap regions. We utilized particle-in-cell simulations of relativistically hot bunches to investigate the bunch's nonlinear evolution and radiation by linear acceleration emission. We found that the main parameter influencing the bunch evolution is the initial drift velocity between electrons and positrons. For zero drift, the bunches can freely expand, and adjacent bunches may overlap in the phase space and form relativistic streaming instability. Otherwise, for non-zero drifts, the bunches are constrained from expansion and form strong oscillating electrostatic fields. Plasma particles may oscillate in these fields and emit radio waves. Furthermore, we found that the bunches constrained from expansion have similar observational characteristics as those observed for pulsars. Their spectrum contains a flat part for low frequencies and power-law profiles for higher frequencies.

EP 9.9 Wed 17:30 HSZ OG1

Quantitative spectroscopy of B-type supergiants — •David Wessmayer[1], Norbert Przybilla[1], and Keith Butler[2] — [1]Institut für Astro- und Teilchenphysik, Universität Innsbruck, Technikerstr. 25/8, 6020 Innsbruck, Austria — [2]LMU München, Universitätssternwarte, Scheinerstr. 1, 81679 München, Germany

B-type supergiants are a resourceful tool in adressing various astrophysical questions concerning stellar atmospheres, stellar and galactic evolution and the cosmic distance scale. To facilitate a comprehensive analysis of these objects we assess the applicability of a hybrid non-LTE approach, in which line-blanketed model atmospheres computed under the assumptions of local thermodynamic equilibrium (LTE) are combined with non-LTE line-formation calculations. High-resolution Echelle spectra – constituting an observational sample of 14 Galactic B-type supergiants with masses below about 30 $M_{\odot}$ – serve as the basis of this investigation. The results of the analysis, including atmospheric and fundamental stellar parameters, multi-species abundances and derived spectroscopic distances, are probed via multiple checks of consistency. Finally, we also test the employed methodology for analyses of intermediate-resolution spectra of extragalactic B-type supergiants.

EP 9.10 Wed 17:30 HSZ OG1

Characterization of B supergiant variability — •Suryani Guha[1,2], Michaela Kraus[1], and Julieta Arias Sanchez[1] — [1]Astronomical Institute, Czech Academy of Sciences, Ondrejov, Czech Republic — [2]Charles University, Prague, Czech Republic

B supergiants (BSGs) are famous for their spectroscopic variability that has been assigned to pulsations and related changes in their stellar wind properties. The pulsation modes of BSGs are strongly correlated to the stellar evolution phase. When a massive star has lost significant mass during its red-supergiant stage, it would return to the blue region in the Hertzsprung-Russell diagram and spend a part of the core-He burning stage as a BSG. In this particular phase it excites many pulsation modes including radial strange modes. The latter have been proposed to facilitate mass-loss. Our studies utilize data from the TESS (Transiting Exoplanet Survey Satellite) mission, which revealed that numerous BSGs display a rather irregular behaviour of their light curves, a likely indicator of radial strange mode pulsations. The optical spectra obtained from our observation campaign with the PEREK 2-m telescope are analyzed to search for variations in temperature and radius. Any detected variability can be directly linked with radial pulsations. Moreover changes in the strength and profile of the H-alpha line provide complementary information about wind variability. In this poster we will present highlights from a few interesting stars selected from our target list.

EP 9.11 Wed 17:30 HSZ OG1

Local HD flows at the Apex of an Astropause — •Kuljeet Singh Saddal[1,2] and Dieter H Nickeler[1] — [1]Astronomical Institute AV CR Ondrejov, Fricova 298, 25165 Ondrejov, Czech Republic — [2]Charles University, Faculty of Mathematics and Physics, V Holešovickách 2, 180 00 Praha 8, Czech Republic

Astrospheres are the interaction regions between the stellar wind and the ambient interstellar medium, which consists of various HD (or MHD) discontinuities. Astropause is a contact discontinuity that separates the two flows, and its structure is described by one of the separatrices of the fluid flow. In 2D, there must be at least one X-type null point (X-point) close to the apex. This analysis aims to study hydrodynamically the geometrical and topological structures of the streamlines in the vicinity of the X-point. As the flow close to the apex can be considered incompressible, one can make use of stream functions to describe such flows. The definition of streamlines, along with the equations of ideal HD, gives a single, (non-)linear elliptic partial differential equation, known as the Grad-Shafranov equation (GSE). This equation is analysed by approximating the stream function close to the null point as a series of polynomials to various orders, and assuming specific forms for the pressure function. Depending on the choice of the pressure function and the order at which the polynomial is truncated, either the original null point can become an X-point of higher order, or more null points can appear in its vicinity. Moreover, an isotropic pressure might not exist for every choice of stream functions, and hence adding an extra anisotropic term becomes important.

EP 9.12 Wed 17:30 HSZ OG1

The Liquid Metallic Hydrogen Model of the Sun — •Alexander Unzicker — Pestalozzi-Gymnasium München

Though the standard solar model based on a gaseous plasma dominates the scientific discourse, a considerable amount of experimental evidence may also be interpreted assuming a real, liquid surface of the sun, as proposed by Robitaille (Progress in physics vol.3, 2011). Data from new missions must be open to such a different paradigm.

EP 9.13 Wed 17:30 HSZ OG1

Extending SOHO-EPHINs energy range for Helium nuclei — •Malte Hörlöck, Bernd Heber, Patrick Kühl, and Stefan Jensen — Christian-Albrechts-Universität zu Kiel

Galactic cosmic rays are composed mainly of protons, helium nuclei and electrons. The flux of these particles is modulated due to the heliospheric magnetic field that shields lower energy particles from the heliosphere. Hence, the flux depends on the solar activity. During phases of low and high solar activity, a maximum and minimum in the flux is observed, respectively. The SOlar and Heliospheric Observatory (SOHO) was launched in 1995. The Electron Proton Helium INstrument (EPHIN) onboard SOHO is a particle telescope, consisting of a stack of 6 silicon semiconductor detectors surrounded by an anticoincidence detector. The instrument stops protons and helium nuclei up to energies of 51 MeV/nucleon. At higher energies, these particles penetrate the telescope. As shown previously EPHIN provides sufficient information to obtain the flux of protons up to an energy of about a GeV. Here we investigate the instrument capabilities to obtain helium fluxes for energies above 51 MeV/nucleon using the dE/dx-dE/dx-method. However, the task is hampered by the fact that two detectors became noisy in 1998 and 2017, respectively. Thus, extensive modeling utilizing the GEANT4 package is needed in order to derive helium fluxes up to about 100 MeV/nucleon.

EP 9.14 Wed 17:30 HSZ OG1

Flux-rope nonequilibrium in the slow-rise phase of solar eruptions — •Bernhard Kliem — Universität Potsdam, Institut für Physik und Astronomie

Solar eruptions are nearly always preceded by a slow-rise phase that comprises an ascent of the eventually erupting filament (or prominence) in the corona and a slow increase of the soft X-ray flux. This is a distinct phase characterized by intermediate velocities of typically several 10 km s^{-1} (in active regions up to $\sim$100 km s^{-1}), 1–2 orders of magnitude faster than the quasi-static evolution during energy storage, which scales with the driving photospheric velocities, and 1.5–3 orders of magnitude below the coronal Alfvén velocity, V_A, which is the scaling parameter of eruption speeds and their upper limit. Proposed mechanisms of this phase range from distributed small-scale ("tether-cutting") reconnection events in sheared field to a nonequilibrium and even ideal magnetohydrodynamic instability of a flux rope. I present simulations of flux cancellation that show the formation of a flux rope, a quasi-static evolution with a rise speed similar to the imposed photospheric driver, then a slightly faster rise, gradually accelerating up to $\approx 10^{-2}\ V_A$, and eventually the eruption of the rope by onset of the torus instability. The flux rope is shown to be in a nonequilibrium state during the slow rise.

EP 9.15 Wed 17:30 HSZ OG1

Neutral Current Sheet Displacement in Reaction to the Radial Interplanetary Magnetic Field at Mercury: Statistical Results from MESSENGER Data. — •Daniel Heyner[1], Kristin Pump[1], David Hercik[2], Willi Exner[3], Yasuhito Narita[4], Ferdinand Plaschke[1], Daniel Schmid[4], Jim Slavin[5], and Martin Volwerk[4] — [1]TU Braunschweig, Braunschweig, Germany — [2]Institute of Atmospheric Physics, Prague, Czech Republic — [3]ESA, Noordwijk, Netherlands — [4]IWF, Graz, Austria — [5]University of Michigan, Ann Arbor, USA

Mercury possesses a small magnetosphere and on the nightside, a neutral current sheet elongates the magnetic field lines. From hybrid simulations it is known that this current sheet reacts to changes in the interplanetary magnetic field (IMF). The radial IMF at Mercury facilitates magnetopause reconnection in high latitudes which decreases the magnetic pressure in one of the magnetospheric lobes depending on the radial IMF polarity. This produces a north-south shift of the neutral sheet. We present statistical results from in-situ MESSENGER magnetic field data analysis on the IMF direction as well as the neutral sheet displacement. MESSENGER was a single probe in orbit around Mercury and it was blind to the IMF after having entered the bow shock. We need to estimate the current IMF radial polarity for the time with the probe inside the magnetosphere. We evaluate different interpolation methods with an adapted bootstrap analysis method on solar wind data at Mercury. The analysis results on the neutral sheet displacement is compared to hybrid simulations done in the past.

EP 9.16 Wed 17:30 HSZ OG1

Concepts for the measurement of permittivity profiles in extraterrestrial cryospheres to improve subsurface radar images — •Gianluca Boccarella, Fabian Becker, Alexander Kyriacou, and Klaus Helbing — Bergische Universität Wuppertal, Gaußstraße 20, 42119 Wuppertal

Icy moons like Europa and Enceladus may contain microbial life in their subsurface oceans. Surface and subsurface imaging with radar is a promising technique to investigate their interior and identify a target for a subsurface exploration with melting probes. The main uncertainty of radar images is the unknown permittivity (ϵ) of the medium through which the electromagnetic waves travel. Therefore, we developed two methods to measure the ϵ from the medium of interest. Both methods were successfully tested on alpine glaciers as comparable terrestrial environments and the results will be presented. The initiatives involved are the DLR-funded projects EnEx and TRIPLE.

The first method is a cross-borehole FMCW radar: by sending signals between two antennas, it is possible to use the time of flight for permittivity reconstruction. An inversion of radio propagation simulations is used to reconstruct the permittivity profile from time of flight measurements at different depths. The second approach is to use a permittivity sensor, which is placed in a melting probe with an integrated radar system. This sensor can measure in the near field of the melting probe and immediately corrects the radar image. It represents a part of the forefield reconnaissance system being developed for melting probes.

EP 9.17 Wed 17:30 HSZ OG1

About the Radiative Transfer (RT) and inversion codes used in the characterization of planetary atmospheres — Rengel Miriam[1] and •Adamczewski Jakob[1,2] — [1]Max-Planck-Institut für Sonnensystemforschung — [2]Georg-August-Universität Göttingen

This contribution represents a tour on Radiative Transfer (RT) and inversion codes used in the planetary and exoplanetary communities from the perspective of a user. Such codes predict and interpret spectra of planetary atmospheres (hydrostatic equilibrium atmospheres and expanding comas) and infer atmospheric properties like temperature and abundance profiles (forward modelling and inversion algorithm, respectively). The retrieved atmospheric properties can offer crucial information into the atmospheric physico-chemical processes of planets and their formation mechanisms.

Here we present a mini overview of some existing forward and inversion codes used in the planetary science and some examples of applications. Space and ground-based telescope facilities used in the field (feasibility studies, observational planning, etc.) depend on the quality and extent of these codes.

EP 9.18 Wed 17:30 HSZ OG1

Retrieval of planetary albedo and cloud's properties of Earth with spectropolarimetry — •Giulia Roccetti[1,2], Michael Sterzik[1], Claudia Emde[2], and Mihail Manev[2] — [1]European Southern Observatory, Garching bei München, Germany — [2]Ludwig-Maximilians-Universität München, München, Germany

To prepare the search for life outside our Solar System, we must characterise Earth as an exoplanet. In this work we present a novel approach to retrieve the planetary albedo and cloud's properties (mean water cloud optical depth and cloud cover) of Earth with spectropolarimetry. Incoming (unpolarised) stellar light is polarised by molecular or particle scattering in the Earth's atmosphere or from reflection at the planetary surface. The polarization phase curve, and its spectral dependencies, allow to constrain many atmospheric and surface properties of the planet.

We show that planetary albedo can be retrieved analyzing the slope of the polarization spectra, while for the could's properties we use a two-tier approach: we first determine the mean optical depth using the cloudbow feature at small phase angles (for a wavelength in the near-infrared range), and then we estimate the cloud cover using the maximum of the phase curve (for a wavelength in the B band).

The results are compared with Earthshine observations, i.e. sunlight scattered by the dayside Earth and reflected back to Earth from the darker portion of the visible moon, which allows to observe the Earth as an exoplanet at different phase angles, as the relative Sun-Earth-Moon viewing geometry changes.

EP 9.19 Wed 17:30 HSZ OG1

Empirical modelling of SSUSI-derived auroral ionization rates — •Stefan Bender[1,2], Patrick Espy[1,2], and Larry Paxton[3] — [1]Norwegian University of Science and Technology, Trondheim, Norway — [2]Birkeland Centre for Space Science, Bergen, Norway — [3]APL, Johns Hopkins University, Laurel, Maryland, USA

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. Widely used particle data are derived from the POES and GOES satellite measurements which provide in-situ electron and proton spectra.

Here we use the electron energy and flux data products from the Special Sensor Ultraviolet Spectrographic Imager (SSUSI) instruments on board the Defense Meteorological Satellite Program (DMSP) satellites. The currently three operating satellites directly observe the auroral emissions in the UV on a ≈3000 km wide swath with a $\approx 10\times 10$ km^2 pixel resolution. From the UV emissions electron energies and fluxes are inferred in the range from 2 keV to 20 keV. We use these observed electron energies and fluxes to calculate auroral ionization rates in the lower thermosphere (90–150 km). We present an empirical model of these ionization rates according to magnetic local time and geomagnetic latitude. The model is particularly targeted for use in climate models that include the upper atmosphere, such as WACCM-X or EDITh. We also present a comparison to current implementations for ionization rates used in these two models.

EP 9.20 Wed 17:30 HSZ OG1

Modeling of the count and dose rate of the DOSimetry TELescope (DOSTEL) aboard the International Space Station — Hanna Giese, Sönke Burmeister, •Bernd Heber, Konstantin Herbst, and Lisa Romaneehsen — Christian-Albrechts-Universität Kiel

The DOSimetry Telescope (DOSTEL) measures the radiation environment within the Columbus module of the International Space Station (ISS) by utilizing two semiconductor detectors. The Earth is continuously exposed to galactic cosmic rays and occasionally by Solar Energetic Particles. The magnetized solar wind in the heliosphere and the Earth's magnetic field alters the flux of these particles. In addition these particles need to propagate through the Earth magnetosphere leading to maximum and minimum fluxes at polar and equatorial latitudes. This dependency can be described by the Dorman function. In combination with the primary spectra of ions approximated by the force field solution, the Dorman function is ideally suited to describe the response of the instrument within the ISS. Thus it is sufficient to determine the response function (yield) for a few selected periods. In order to validate the yield function we predict the measurements for other periods including Forbush Decreases and compare to the actual observations.

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