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.