EP 3: Astrophysik

Zeit: Montag 16:30–18:30 Raum: GW2 B2880

EP 3.1 Mo 16:30 GW2 B2880

Proton and Helium Injection Into First Order Fermi Acceleration at Shocks: Hybrid Simulation and Analysis — •Adrian Hanusch[1], Mikhail Malkov[2], and Tatyana Liseykina[1] — [1]Universität Rostock — [2]University of California, San Diego

The problem of cosmic ray (CR) origin is more than a hundred-year-old. Most likely, their acceleration occurs at collisionless shocks in supernova remnants by diffusive shock acceleration (DSA). By this mechanism, charged particles gain energy by crossing the shock front occasionally, while being scattered by magnetic perturbations in the shock vicinity.

The mechanism is physically simple and robust, but some important aspects are still not well understood. One difficulty is connected already with its start, when the shock must select a tiny fraction of particles to keep on crossing its front and gaining energy continuously. This initial phase of the DSA is referred to as "injection." Recent measurements of PAMELA [1] and AMS-02 [2] show a difference between He^{2+} and proton spectra. The elemental composition of galactic CR might hold the key to their origin. A comparison of injection rates of particles with different mass to charge ratio is a powerful tool for studying the injection process and the DSA in general.

We performed a series of one dimensional hybrid simulations and analyzed the impact of He^{2+} admixture on the injection of both protons and helium.

[1] O. Adriani *et al.*, Science, 332, 69 (2011).
[2] M. Aguilar *et al.*, Phys. Rev. Lett. 115, 211101 (2015).

EP 3.2 Mo 16:45 GW2 B2880

HAWC High Energy Upgrade with a Sparse Array — •Vikas Joshi — Max Planck Institute for Nuclear Physics, Saupfercheckweg 1, 69117 Heidelberg, Germany

The High Altitude Water Cherenkov (HAWC) gamma-ray observatory has been fully operational since March 2015. It is situated on the flanks of Sierra Negra (Mexico) at an altitude of 4100 m above the sea level. HAWC consists of 300 Water Cherenkov Detectors, each containing 200 ktons of purified water and 4 PMT's (three 8" and one 10"), that cover a total surface area of 20,000 m^2. HAWC observes gamma rays in the 0.1-100 TeV energy range and has a sensitivity to TeV-scale gamma-ray sources an order of magnitude better than previous air-shower arrays. Its two steradians field-of-view and $> 90\%$ duty cycle make HAWC an ideal instrument for surveying the high-energy sky.

HAWC collects multi-TeV gamma rays with an effective area of 10^5 m^2, but many of them are not well-reconstructed because the shower core falls outside the main array. An upgrade that increases the present fraction of well reconstructed multi-TeV showers by a factor of 3-4 can be done with a sparse outrigger array of small water Cherenkov detectors that pinpoint the core position and by that improve the angular resolution of the reconstructed showers. Such an outrigger array would be of the order of $\sim$300 small water Cherenkov detectors of 2.5 m^3 equipped with one 8" PMT, placed over an area four times larger than HAWC. In this contribution, we will discuss the different outrigger array components and the simulation results to optimize it.

EP 3.3 Mo 17:00 GW2 B2880

Astrophysikalische MHD-Schockstrukturen am Beispiel von λ Cephei — •Lennart Robin Baalmann — Ruhr-Universität Bochum, Deutschland

Der Einfluss des Magnetfeldes auf die Wechselwirkung zwischen supersonischem, super-Alfvénischem Sternwind und supersonischem, super-Alfvénischem interstellarem Wind wird anhand von numerischen Einfluid-MHD-Simulationen untersucht. Die stationären MHD-Modelle einer Astrosphäre werden in Vergleich zu ihren hydrodynamischen Gegenstücken betrachtet; sowohl der Fall ohne als auch der mit Kühl- und Heizfunktion werden untersucht. Es stellt sich heraus, dass die schnelle magnetosonische Schockstruktur der sonischen ähnelt und eine Alfvénische sowie eine langsame magnetosonische Schockstruktur von geringer Ausdehnung im äußeren Astrosheath existieren.

EP 3.4 Mo 17:15 GW2 B2880

An improved analytical model of the local interstellar magnetic field: The extension to compressibility — •Jens Kleimann[1], Christian Röken[2], and Horst Fichtner[1] — [1]Theoretische Physik IV, Ruhr-Universität Bochum, Germany — [2]Fakultät für Mathematik, Universität Regensburg, Germany

The analytical magnetohydrodynamic (MHD) model for the local interstellar magnetic field in the vicinity of the heliopause by Röken et al. (2015) is an exact solution to the induction equation of ideal MHD for an interstellar magnetic field being passively advected in a Rankine-type heliospheric velocity field. I will first review basic properties of this model, and then present a recent generalization from incompressible to compressible flow. Both the exact solution and realistic approximations to the resulting density structure will be discussed. The usefulness of this still analytical solution as an approximation to self-consistent magnetic field configurations obtained numerically from the full MHD equations is illustrated by quantitative comparisons.

EP 3.5 Mo 17:30 GW2 B2880

Linear Disturbances in the Local Interstellar Medium: The Plasma-Gas Interaction in the Two-Fluid Approximation — •Lukas Westrich — Institut für theoretische Physik IV, Ruhr-Universität Bochum, Deutschland

In this scientific presentation, linear disturbances in the local interstellar medium (LISM) are examined. Background is a scenario which proposes a local density enhancement in the LISM as the cause of the IBEX ribbon. Therefore must be probed whether such an increase in the LISM can exist. For this purpose, the plasma-gas mixture of LISMs is described with a two-fluid model, in order to subsequently apply the linear perturbation theory. In addition, is examined with this model, what processes take place inside the heliosphere with these density waves as precisely as possible to get an idea of how realistic this scenario of the local density enhancement is. The result is that such a density wave can propagate without damping after its creation along the interstellar magnetic field and is damped only in the heliosphere. The damping within the termination shock is stronger than outside.

EP 3.6 Mo 17:45 GW2 B2880

What matter(s) at the Event Horizon? Radio Interferometry at highest resolution — •Silke Britzen[1], Anton Zensus[1], Christian Fendt[2], Andreas Eckart[1,3], and Vladimir Karas[4] — [1]Max-Planck-Institut für Radioastronomie, Bonn, Germany — [2]Max-Planck-Institut für Astronomie, Heidelberg, Germany — [3]I. Physikalisches Institut der Universität zu Köln, Germany — [4]Astronomical Institute, Academy of Sciences, Prague, Czech Republic

M87 is the central elliptical galaxy in the Virgo cluster and at a distance of 16.7 Mpc the closest active black hole to our galaxy. The bright jet and counter-jet have been studied intensively in all wavelength regimes (radio to TeV). Most detailed information for this show-case jet has been obtained in the radio regime with increasing observing frequencies and resolution in recent years. This source is a prime object to be studied in exquisite detail with the upcoming Event Horizon Telescope (EHT) observations since it promises to allow a direct view on the jet launching process itself. I will present our most recent results based on an analysis of 16 years of radio interferometric monitoring data which reveal for the first time details concerning the physical processes of the jet loading of M87. I will discuss the implications for the jet launching mechanism. In addition, I will present the current status of the EHT-observations to image the photon sphere around the event horizon of M87 (and Sgr A*)and possible tests of General Relativity (GR).

EP 3.7 Mo 18:00 GW2 B2880

Validierung des Flussmodells zur Charakterisierung der Strahlungsumgebung im interplanetaren Raum anhand aktueller Rosetta-Daten — •Vanessa Wyrwoll[1], Sascha Lüdeke[1], Hugh Evans[2] und Björn Poppe[1] — [1]Carl von Ossietzky Universität Oldenburg — [2]ESA/ESTEC, Noordwijk, The Netherlands

Das relevante Energiespektrum der hochenergetischen Teilchenstrahlung im Weltall reicht von wenigen MeV bis zu einigen hundert MeV. Die Rosetta Mission der ESA stellt auf Grund ihrer einzigartigen Flugbahn eine hervorragende Möglichkeit dar, Teilchenstrahlung bzw. den Teilchenfluss im interplanetaren Raum zu untersuchen. Hierfür wurde Rosetta mit einem Strahlungsdetektor SREM (Standard Radiation Environment Monitor) ausgerüstet. In dieser Arbeit soll überprüft werden, ob trotz der relativ einfachen Detektorlogik des Monitors (15

energiediskriminierende Kanäle) eine Überprüfung galaktischer Teilchenflussmodelle, wie etwa dem Iso 15390 möglich ist.

Hierfür wurden zunächst für Ionen von Wasserstoff bis Sauerstoff Ansprechfunktionen für den SREM Detektor auf Rosetta für den Energiebereich 5 MeV bis 100 GeV unter Zuhilfenahme der Monte-Carlo Umgebung Geant4 (Version 10.01) /Gras (Version 03.04) berechnet. Mithilfe des ISO-Modells wurde dann eine zeitaufgelöste theoretische Teilchenverteilung am Ort der Sonde berechnet und mittels der gewonnenen Ansprechfunktionen die erwartete Zählrate bestimmt.

Aus diesen Ergebnissen kann dann durch Vergleich mit realen Zählratenmessungen die Übereinstimmung der beiden Methoden verifiziert werden. In der Arbeit werden erste Ergebnisse präsentiert.

EP 3.8 Mo 18:15 GW2 B2880

Response Functions to High Energetic Particle Radiation of the Standard Radiation Monitor (SREM) On-board the Rosetta Mission — •Sascha Lüdeke[1], Vanessa Wyrwoll[1], Hugh Evans[2], and Björn Poppe[1] — [1]University of Oldenburg, Germany — [2]ESA/ESTEC, Noordwijk, The Netherlands

To study the flux and composition of galactic cosmic rays and to monitor the radiation burden many space missions are equipped with radiation monitors. One of these monitors is the Standard Radiation Environment Monitor (SREM) on-board the Rosetta Mission. Measurements of these monitors can only be evaluated in detail when the response functions of the monitors are known. They can be determined by measurements, which is impractical considering the energy range of galactic cosmic rays, or simulation, as done in this work. At first the monitor geometry was implemented for use in a Monte-Carlo simulation environment based on Geant4(10.01)/GRAS(03.04). Then a setup to simulate an isotropic radiation environment was implemented and response functions to protons calculated. The radiation environment is comprised of 648 individual planar sources, approximating an omnidirectional spherical source radiating inwards. The response of the SREM channels to each planar source is determined and combined into an omnidirectional response function by summing with a weight corresponding to the solid angle. After benchmarking, the simulations were extended for galactic cosmic ray particles from Helium to Oxygen with energies up to 100GeV/u. Future work will characterize the influence of the Rosetta orbiter on the response of the SREM to GCR radiation.