T 80: Cosmic Rays IV

Time: Thursday 16:15–18:00 Location: VG 3.102

T 80.1 Thu 16:15 VG 3.102

Investigation of the Diffusion Tensor for Different Turbulence Levels and Rigidities in the Resonant Scattering Regime — •Jan-Niklas Bohnensack[1], Julia Becker Tjus[1,2,3], and Leander Schlegel[1,2] — [1]Theoretical Physics IV: Plasma-Astroparticle Physics, Faculty for Physics & Astronomy, Ruhr-Universität Bochum, D-44780 Bochum, Germany; Supported by SFB1491 — [2]Ruhr Astroparticle And Plasma Physics Center (RAPP Center), Bochum, Germany — [3]Department of Space, Earth and Environment, Chalmers University of Technology, SE-412 96 Gothenburg, Sweden

The quasi-linear theory (QLT) describes the interactions between charged particles and astrophysical plasmas in the limit of $b/B \ll 1$. The goal of the underlying thesis was to verify the QLT's prediction that for small turbulence levels b/B, where b is turbulent magnetic field strength and B is the homogeneous magnetic field strength, the diffusion coefficient behaves like $\kappa \propto \rho^\gamma$ with $\gamma = 1/3$. This is currently only done with smaller statistics (number of propagated particles) due to technical restrictions. To overcome those restrictions a code was developed in the underlying thesis to utilize methods of parallelization that calculate the running diffusion coefficient from particles propagated with CRPropa faster. As part of this, an algorithm was created that can verify the convergence of the given running diffusion coefficient and can stop the simulations accordingly. With diffusion coefficients that were generated for a range of reduced rigidities and turbulence levels that lie in the Resonant Scattering Regime, the behavior of the index γ for smaller b/B according to the QLT was verified.

T 80.2 Thu 16:30 VG 3.102

Anisotropy induced by a modulation of the ultra-high-energy cosmic ray flux — •Janning Meinert[1,2], Leonel Morejón[1], Veronika Vašíčková[1], and Karl-Heinz Kampert[1] — [1]Bergische Universität Wuppertal, Gaußstraße 20, 42119 Wuppertal, Germany — [2]ITP Universität Heidelberg, Philosophenweg 16, 69120 Heidelberg, Germany

We investigate the energy-dependent residence time of extragalactic cosmic rays due to the galactic magnetic field using CRPropa. We examine whether a sudden and substantially increased flux of homogeneously injected ultra-high-energy cosmic rays (UHECR) in the past about 10-100 kiloyears leads to a dipole, as observed by the latest Auger data for proton injection only. Another observable will be the energy dependent amplitude evolution. An agreement with anisotropy data while preserving a homogeneous injection of cosmic rays could strengthen the hypothesis of *one* predominant UHECR source, such as Centaurus A, which may be isotropised due to echoes in the council of giants. While currently mild tensions between the dipole amplitude between Auger data and the simulation are apparent for the highest energies (E $\geq$ 32 EeV), incorporating more realistic simulation scenarios might mitigate those tensions in the future.

**Supported by DFG under SFB 1491*

T 80.3 Thu 16:45 VG 3.102

Study on the transport behavior in blazars in anisotropic magnetic fields* — •Milena Brütting[1,2], Vladimir Kiselev[1,2], and Julia Becker Tjus[1,2] — [1]Theoretical Physics IV, Ruhr-University Bochum, Bochum, Germany — [2]RAPP-Center at Ruhr-University Bochum, Bochum, Germany

Active Galactic Nuclei (AGN) are currently considered a likely source of ultra-high-energy cosmic rays (UHECR). Blazars, in particular, represent highly interesting research objects from an astrophysical point of view due to a complex jet structure which will hopefully yield new information on particle transport behavior. Following this line of research we plan to investigate the effect of anisotropies of the magnetic field on cosmic-ray propagation in the jets of blazars. For this purpose, a modified version of the open-source code CRPropa 3.2 shall be used to allow for cosmic ray transport in blazar jets. Building on previous work, we will attempt to simulate the propagation of high-energy protons in a relativistic plasmoid and investigate their diffusive behavior in the presence of an anisotropic magnetic field.

* Supported by DFG (SFB 1491)

T 80.4 Thu 17:00 VG 3.102

Stochastic analytic expressions for efficient modeling of hadronic interactions — •Leonel Morejon — Bergische Universit\"{a}t Wuppertal, Gau{\ss}str. 20, 42119 Wuppertal

While sources of Ultra-High-Energy Cosmic Rays (UHECRs) are expected to be radiation dominated, subdominant hadronic interactions might, nevertheless, yield observable effects in the spectra of messengers like photons and neutrinos.

Hadronic interactions are usually modeled with suitable generators to create production tables that are convolved with the spectra of primary UHECRs to predict the spectra of secondary particles. This method works reasonably well when the number of interactions is sufficiently large, but does not apply when fluctuations are important, as is the case for UHECR sources.

This work shows that the stochastic behavior in optically thin scenarios can be described with analytic expressions. Such expressions are used to compute the spectra of secondaries like photons and neutrinos produced in the sources, for suitable examples.

T 80.5 Thu 17:15 VG 3.102

Cosmic-ray induced ionisation and spatio-temporal correlations between supernova remnants and molecular clouds — Hanno Jacobs[1], Vo Hong Minh Phan[2], •Mareike Berkner[1], and Philipp Mertsch[1] — [1]Institute for Theoretical Particle Physics and Cosmology, RWTH Aachen University — [2]Sorbonne Université, Observatoire de Paris, PSL Research University, LERMA, CNRS UMR 8112, 75005 Paris, France

MeV cosmic rays can penetrate dense molecular clouds and oftentimes dominate the ionisation, thus contributing to the physical and chemical dynamics of star forming regions. The effect of cosmic rays can be quantified by their ionisation rate. Interestingly, the ionisation rate predicted from the locally measured cosmic-ray fluxes is one to two orders of magnitude lower than the observed ionisation rates. This disagreement is known as the ionisation puzzle. Previously, it was shown that the point-like nature of cosmic-ray sources implies a stochastic scatter in the stochastic ionisation rates. Drawing distances between clouds and supernova remnants randomly, the discrepany between model and observations could be reduced. Here, we extend this model by considering spatial and temporal correlation between source and cloud positions. These are to be expected to a certain degree as supernova remnants are likely formed in the same cloud complexes. We will present the predictions for different assumptions on the correlations and compare to ionisation data.

T 80.6 Thu 17:30 VG 3.102

Observing the Prompt Component of the Atmospheric Muon Flux Using IceCube — •Leander Flottau — TU Dortmund University, Dortmund, Germany

Atmospheric muons are created by the decays of secondary particles generated in cosmic ray interactions with the upper atmosphere. Based on the muons' parent particles, they can be categorized into conventional muons, originating from pions and kaons, and prompt muons, generated by the decays of more short-lived particles. While the conventional component dominates at lower energies, prompt muons become dominant at high energies, around 1 PeV and above.

Measuring these muons using the IceCube neutrino telescope is useful for studying hadronic interactions at a combination of center-of-mass energies and rapidities that are difficult to replicate in any current collider experiment. Due to the low overall flux at the energies where the prompt component dominates, no analysis to date has been able to significantly measure it.

The talk will cover the process of investigating the normalization of the prompt muon flux using a forward fit. This involves testing the method's ability to identify the prompt component using simulations, as well as its intended subsequent application to actual IceCube data.

T 80.7 Thu 17:45 VG 3.102

An approach to classify the prompt neutrino component of cosmic ray showers with IceCube. — •Roman Peschin — TU Dortmund University, Dortmund, Germany

The earth's atmosphere is like a translucid veil. It is nearly transparent for the human eye, but not to high-energy cosmic particles. Our atmosphere allows these particles to interact with the air molecules, which then produce a cascade of secondary particles. Prompt neutrinos are one component of these cosmic ray showers and dominante in the energy regimes above roughly 20 TeV for electron neutrinos and above about 1 PeV for muon neutrinos. While conventional neutrinos are mainly produced by pions and kaons, prompt neutrinos originate from the decay of charmed mesons.

The IceCube Neutrino Observatory is a cubic kilometer neutrino detector located at the South Pole that is constantly gaining information about the outter space. Besides the intended detection of astrophysical neutrinos, IceCube is particularly sensitive to secondary particles, like muons, from cosmic ray showers. These muons behave like a background noise for neutrino detection and are the main challenge for the classification of the prompt neutrino component.

For that purpose we use a deep neural network as an attempt to seperate the prompt element from the muon background. One approach is to look for coincident events produced by the same cosmic ray shower. The final goal is to improve the classification of the prompt neutrinos, leading to a better understanding of the composition of cosmic rays and the mechanisms of neutrino production.