T 144: Cosmic Ray VII

Time: Thursday 17:30–19:00 Location: POT/0013

T 144.1 Thu 17:30 POT/0013

Effects of magnetic fields on anisotropies in a catalog based research — •Luca Deval, Ralph Engel, Thomas Fitoussi, and Michael Unger — Karlsruhe Institute of Technology, Karlsruhe, Germany

Ultra high energy cosmic rays (UHECRs) are charged particles which origins is still an open question in modern astrophysics. For the identification of valid sources, a key role is played by the Galactic magnetic field (GMF) which influences the arrival direction of charged particles.

Recent studies, by the Pierre Auger Collaboration, on the arrival direction of UHECRs showed the presence of anistropies above 40 EeV which indicates the contribution from nearby sources such as starburst galaxied (SBG) and active galactic nuclei (AGN). The likelihood analysis revealed a significance of 4.2σ for the starburst sample although the coherent deflections related to the GMF have not been considered.

In this work we focus our attention on the SBG catalog and we conduct the likelihood analysis on simulated datasets. The mock datasets are constructed by employing CRPropa3 for the extragalactic propagation and by adding an isotropic background. A lensing technique, considering the JF12 model for the GMF, is then applied to the simulated particles.

Our results show that the parameters as reported by the Pierre Auger Collaboration occur for 20% of all data sets. However, due to the neglected coherent deflections, the inferred anisotropy fraction is a biased estimator and the true anisotropic fraction is always larger than the one derived from the likelihood fit.

T 144.2 Thu 17:45 POT/0013

An all-sky search method for coherent magnetic field deflections of ultra-high-energy cosmic rays — •Josina Schulte[1], Teresa Bister[2], and Martin Erdmann[1] — [1]III. Physikalisches Institut A, RWTH Aachen University — [2]Institute for Mathematics, Astrophysics and Particle Physics, Radboud Universiteit Nijmegen

We present a method of searching for coherent deflection patterns in ultra-high-energy cosmic ray arrival directions induced by the Galactic magnetic field. These patterns are described by a variable magnetic field strength in combination with adaptable coefficients of a spherical harmonics expansion in our approach. The reconstruction of the free model parameters from the arrival directions is performed with a likelihood-free method in a Bayesian approach based on normalizing flows. This allows for a straightforward assessment of the uncertainty on the model prediction. We evaluate the sensitivity of the method to identify the presence of coherent magnetic field deflections on a realistic simulated astrophysical scenario.

T 144.3 Thu 18:00 POT/0013

The effects of a ΛCDM extension on the propagation of UHECRs — •Janning Meinert — Bergische Universität Wuppertal, Gaußstraße 20, 42119 Wuppertal, Germany

Current tensions in the cosmological parameters of ΛCDM (such as H_0, Ω_m, σ_8) motivate a possible extension. Treating the photon propagation in thermal equilibrium with an SU(2) gauge group instead of a U(1) gauge group gives the photon more degrees of freedom and thus changes the temperature redshift relation. This pushes the emergence of the CMB, recombination, to higher redshifts and dilutes the photon density. Since CMB photons interact with ultra-high energy cosmic rays (UHECRs), I will examine the effects of this particular ΛCDM extension on the interaction with UHECRs. In particular, the spectral shape of the cosmogenic neutrino flux is distorted and the GZK cutoff might be shifted to slightly higher energies.

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T 144.4 Thu 18:15 POT/0013

Cosmic-ray signatures in dwarf galaxies: astrophysical foreground and dark-matter background* — •Athithya Aravinthan[1,2], Lukas Merten[1,2], Julia Becker Tjus[1,2], and Jurek Völp[1,2] — [1]Theoretische Physik IV, Ruhr-Universität Bochum, Bochum, Germany — [2]RAPP-Center, Ruhr-Universität Bochum, Bochum, Germany

Dwarf galaxies are a convenient testing ground in the search for Dark Matter (DM), owing to their low, astrophysical background in the radio and gamma-ray energies. Studying the multimessenger signatures of dwarf galaxies can lead to a more precise astrophysical background for DM searches, thereby improving the current limits on indirect DM detection. This motivates the study of nearby starburst galaxies like IC10, which produces non-thermal radio emission coupled to complex Cosmic Ray (CR) propagation.

The goal of this work is to understand the role of CRs in low-mass dwarf galaxies by modelling their propagation using the open-source tool CRPropa 3.2. First test results, starting with a general propagation environment in CRPropa, are pursued in a generic starforming-type magnetic field for IC10, and will later be modified for other low-mass galaxies. For the first time, the modelling is done in combination with astrophysical data on magnetic field structure and gas densities with the goal of pursuing a coherent understanding of the outflow produced in dwarf galaxies. *Supported by DFG (SFB 1491).

T 144.5 Thu 18:30 POT/0013

Stochastic modelling of cosmic ray sources for diffuse high-energy neutrinos — •Anton Stall and Philipp Mertsch — Institute for Theoretical Particle Physics and Cosmology (TTK), RWTH Aachen University, Aachen, Germany

Cosmic rays of energies up to a few PeV are believed to be of Galactic origin, yet individual sources have still not been firmly identified. Due to inelastic collisions with the interstellar gas, cosmic-ray nuclei produce a diffuse flux of high-energy gamma-rays and neutrinos. Fermi-LAT has provided maps of galactic gamma-rays at GeV energies which can be produced by both hadronic and leptonic processes. Neutrinos, on the other hand, are exclusively produced by the sought-after hadronic processes, yet they can be detected above backgrounds only at hundreds of TeV. To predict diffuse emission at these high energies, one can extrapolate from the GeV maps, but it is an open question to what extend this is justified. It can be expected that the consideration of individual cosmic-ray sources instead of a smooth density limits the correlation of the maps at TeV energies compared to the ones at GeV energies. Such a modelling of sources should be done stochastically. In a first step, we investigate the modelling of multiple point sources and the extension to a stochastic model.

T 144.6 Thu 18:45 POT/0013

Diffuse Emission of Galactic High-Energy Neutrinos from a Global Fit of Cosmic Rays — •Georg Schwefer[1,2,3], Philipp Mertsch[2], and Christopher Wiebusch[3] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Deutschland — [2]Institute for Theoretical Particle Physics and Cosmology (TTK), RWTH Aachen University, 52056 Aachen, Deutschland — [3]III. Physikalisches Institut B, RWTH Aachen University, 52056 Aachen, Deutschland

In the standard picture of galactic cosmic rays, a diffuse flux of high-energy gamma-rays and neutrinos is produced from inelastic collisions of cosmic ray nuclei with the interstellar gas. The neutrino flux is a guaranteed signal for high-energy neutrino observatories such as IceCube, but has not been found yet. Experimental searches for this flux constitute an important test of the standard picture of galactic cosmic rays. Both the observation and non-observation would allow important implications for the physics of cosmic ray acceleration and transport. In this talk, we present `CRINGE`, a new model of galactic diffuse high-energy gamma-rays and neutrinos, fitted to recent cosmic ray data from AMS-02, DAMPE, IceTop as well as KASCADE. We also discuss the uncertainties for the predicted emission from the cosmic ray model as well as from the choice of source distribution, gas maps and cross-sections and consider the possibility of a contribution from unresolved sources.