T 83: Kosmische Strahlung

Zeit: Mittwoch 16:45–19:05 Raum: VMP9 SR 30

Gruppenbericht T 83.1 Mi 16:45 VMP9 SR 30

An alternative explanation for the GeV excess in the Fermi gamma ray data. — Iris Gebauer, •Wim de Boer, and Alexander Neumann — Karlsruhe Institute of Technologie, Karlsruhe, Germany

Towards the Galactic center the diffuse Fermi Gamma Ray data show a 1-3 GeV excess, which has been interpreted previously as a new source, like dark matter annihilation, contributions from millisecond pulsars or cosmic rays interacting with molecular clouds. We search for this excess in the whole Galactic Plane and find it to be perfectly correlated with the spatial distribution of the 26Al line, thought to be a tracer of SNRs. So the excess is not only found in the Galactic Center, but found everywhere, where there are molecular clouds (MCs). This excludes the dark matter annihilation interpretation. If we assume the proton spectrum in MCs to be depleted at energies below 14 GeV by a combination of trapping, solar winds and energy losses, we find a perfect description of the whole gamma ray sky. In this case the excess is not an excess, but a depletion of low energy gamma rays below a few GeV due to the depletion of the protons in MCs below 14 GeV, which happens not only in the Galactic Center, but everywhere in the Galactic Plane, where there are MCs with star formation, as proven by the identical morphology of the excess and the 1.8 MeV line of 26Al, observed by Comptel and Integral.

T 83.2 Mi 17:05 VMP9 SR 30

High-energy neutrinos from AGN — •Marius Toschke[1,2], Julia Becker Tjus[1], and Wolfgang Rhode[2] — [1]Ruhr-Universität Bochum — [2]TU Dortmund

In the outer space there are galactic and extragalactic sources like gamma-ray bursts (GRB), active galactic nuclei (AGN), supernovae or other phenomena which produce high-energy neutrinos. In contrast to supernovae, GRBs and AGN are supposed to generate neutrinos at the highest energies. Neutrinos have a tiny cross section as they mainly suffer from the weak interaction. Therefore, they are useful messenger particles providing information about the direction of the source. With observations of the gamma flux from galactic and extragalactic sources, it is possible to make predictions for the neutrino flux. We suppose that neutrinos are predominantly generated by inelastic proton-proton interactions and derive the possible galactic and extragalactic sources. In this talk, first results are presented.

T 83.3 Mi 17:20 VMP9 SR 30

Neutrino and Gamma-ray connections during flaring states of Mrk 421 — •Stefan Coenders[1], Maria Petropoulou[2], and Stavros Dimitrakoudis[3] — [1]Technische Universität München, Boltzmannstr. 2, 85748 Garching — [2]Department of Physics and Astronomy, Purdue University, 525 Northwestern Avenue, West Lafayette, IN 47907, USA — [3]Department of Physics, University of Alberta, Edmonton, Alberta T6G 2E1, Canada

Blazars, being highly variable sources across the electromagnetic spectrum, may serve as promising targets for high-energy neutrino detection, especially during flaring activity. The nearby blazar Mrk 421 provides a unique testbed using unprecedented multi-wavelength data during a 13-day flaring period to create a detailed model of the hadronic interactions. From that, connections of the neutrino spectrum above TeV energies with gamma-rays can be deduced, resulting in predictions of the neutrino event rate observable by cubic kilometre neutrino observatories. Within the data available, IceCube reaches sensitivities low enough to test the hadronic emission model of Mrk 421. We report about the modelling of Mrk 421 and implications for observations with the IceCube Neutrino Observatory.

T 83.4 Mi 17:35 VMP9 SR 30

Propagating ultra-high energy cosmic rays through galactic and extragalactic space using CRPropa 3* — Rafael Alves Batista[1], Andrej Dundovic[1], Martin Erdmann[2], Karl-Heinz Kampert[3], •Daniel Kuempel[2], Gero Müller[2], Guenter Sigl[1], Arjen van Vliet[1,4], David Walz[2], and Tobias Winchen[3,5] — [1]II. Institut für Theoretische Physik, Hamburg University — [2]III. Physikalisches Institut A, RWTH Aachen University — [3]Fachbereich C, Wuppertal University — [4]IMAPP Department of Astrophysics, Radboud University — [5]Astrophysical Institute, Vrije Universiteit Brussel

The interpretation of the measured energy spectrum, composition and arrival direction of ultra-high energy cosmic rays (UHECRs) above $\sim 10^{17}$ eV is still under controversial debate. The development and improvement of numerical tools to propagate UHECRs in galactic and extragalactic space is a crucial ingredient to interpret data and to draw conclusions on astrophysical parameters. In this contribution recent developments of the publicly available propagation code CRPropa 3 are outlined. Examples are given for 1D and 3D simulations in structured magnetic fields including secondary messengers such as photons and neutrinos. To take into account cosmological effects, also 4D simulations are possible and discussed in the talk.

* Gefördert durch die BMBF-Verbundforschung Astroteilchenphysik

T 83.5 Mi 17:50 VMP9 SR 30

Astroparticle tests of Lorentz symmetry — •Jorge Diaz — Karlsruhe Institute of Technology, Karlsruhe, Germany

Lorentz symmetry is a cornerstone of modern physics. As the spacetime symmetry of special relativity, Lorentz invariance is a basic component of the standard model of particle physics and general relativity, which to date constitute our most successful descriptions of nature. Deviations from exact symmetry would radically change our view of the universe and current experiments allow us to test the validity of this assumption. In this talk, I will describe effects of Lorentz violation in cosmic rays and gamma rays that can be studied in current observatories.

T 83.6 Mi 18:05 VMP9 SR 30

Bubbles, Superbubbles and their impact on cosmic ray transport — •Matthias Weinreuter, Iris Gebauer, Wim de Boer, and Alexander Neumann — KIT, Karlsruhe

The Fermi-LAT data on diffuse gamma rays show variations in the gamma ray intensity, which are linked to either variations in the gas density or variations in the cosmic ray density. Such small scale variations are not modeled in current state-of-the-art models for galactic cosmic ray propagation. Inhomogeneities in the interstellar material can be formed by cavities like the so-called Local Bubble, an underdense region surrounding our Sun, which was created by several supernova explosions in the past. We show that the Local Bubble can have a strong impact on the cosmic ray energy spectra and density. In particular, it enhances cosmic ray scattering in the surrounding molecular cloud complexes and can significantly distort the cosmic ray arrival directions. We briefly discuss the consequences for pulsar searches in energetic positrons and electrons. By making simple assumptions on the level of inhomogeneity in the interstellar medium we investigate if the observed variations in the diffuse gamma ray emission can indeed be explained by cavities similar to the Local Bubble.

T 83.7 Mi 18:20 VMP9 SR 30

Analytic investigation of extended Heitler-Matthews model — •Stefan Grimm, Darko Veberič, and Ralph Engel — KIT, http://www.ikp.kit.edu/

Many features of extensive air showers are qualitatively well described by the Heitler cascade model and its extensions. The core of a shower is given by hadrons that interact with air nuclei. After each interaction some of these hadrons decay and feed the electromagnetic shower component. The most important parameters of such hadronic interactions are inelasticity, multiplicity, and the ratio of charged vs. neutral particles. However, in analytic considerations approximations are needed to include the characteristics of hadron production.

We discuss extensions of the simple cascade model by analytic description of air showers by cascade models which include also the elasticity, and derive the number of produced muons. In a second step we apply this model to calculate the dependence of the shower center of gravity on model parameters. The depth of the center of gravity is closely related to that of the shower maximum, which is a commonly-used composition-sensitive observable.

T 83.8 Mi 18:35 VMP9 SR 30

Studie zu einem Fixed-Target Experiment mit LHC Strahl für die Astroteilchenphysik — •Uwe Krämer, Ralf Ulrich, Colin Baus, Felix Riehn und Tanguy Pierog — Karlsruher Insti-

tut für Technologie (KIT), Institut für Kernphysik (IKP)

Mit Hilfe von Monte Carlo Modellen wurden Simulationen zu einem Fixed-Target Experiment mit LHC Strahl durchgeführt. Von besonderem Interesse ist die Möglichkeit von Kohlenstoff als Target sowie die Messung bis in den hohen x_f-Bereich. Solche Messungen sind z.B. wichtig für die Interpretation von Ultra-hochenergetischen kosmischen Strahlen. Zudem kann die Charm Produkion im hohen x_f-Bereich detailliert gemessen werden, welche eine der Unsicherheiten für die PeV Neutrinos darstellt. Die speziellen experimentellen Probleme eines solchen Fixed-Target Experiments werden vorgestellt und mögliche Lösungsansätze aufgezeigt.

T 83.9 Mi 18:50 VMP9 SR 30

Simulation of Galactic cosmic ray propagation using CrPropa3 — •Lukas Merten and Julia Tjus — Ruhruniversität Bochum, Germany

The propagation of charged cosmic rays through the Galactic environment influences all aspects of the observation at Earth. Energy spectrum, composition and anisotropy are changed due to deflections in magnetic fields and interactions with the interstellar medium. Today the transport is simulated with different simulation methods either based on the solution of a transport equation (multi-particle picture) or a solution of an equation of motion (single-particle picture).

This talk evaluates the possibility of a single-particle simulation of the Galactic propagation. In difference to the multi-particle picture this approach makes additional information available, e.g. trajectory information and concrete interaction positions of single particles. Furthermore, stochastic energy losses can be implemented very easily and even backtracking of particles is possible in some cases.

In doing so, the publicly available simulation software CrPropa3 is extended to suit Galactic modelling needs. This is done using a random walk ansatz for the diffusive Galactic propagation. This new procedure increased the performance of the program by a factor of more than 1 000 and is still sufficiently accurate. We will discuss the current status of this ansatz in this talk.