T 109: Kosmische Strahlung 7

Zeit: Donnerstag 16:45–19:05 Raum: H 3

Gruppenbericht T 109.1 Do 16:45 H 3

Measurement of forward particle production with CMS to better constrain extensive air shower simulations — •Ralf Ulrich, Sebastian Baur, Hauke Woehrmann, Melike Akbiyik, and Alaa Kuotb — Karlsruhe Institut of Technology, Germany

Recent measurements of very-forward hadronic particle production in particular also at 13TeV center-of-mass energy measured with the CMS experiment at the CERN LHC are reported. The CASTOR calorimeter is used to determine for the first time the forward energy distributions as well as jets and rapidity gaps. The data is corrected for detector effect and is compared to model predictions. The performance of the models used for the simulation of extensive air showers is reviewed and the impact of recent model-tunings is shown.

T 109.2 Do 17:05 H 3

Collider input to heavy quark contribution for air shower MonteCarlos — •Jan Doersch, Wolfgang Rhode, Dominik Elsässer, and Dominik Baack — TU Dortmund University, Germany

One of the most decisive breakthroughs for astroparticle physics in recent years has been the detection of cosmic high energy neutrinos with the IceCube detector. This cosmic flux is evident as an excess over the atmospheric neutrino component at high and very high energies.

For the next steps, including more sensitive searches for discrete neutrino source populations, an even more stringent characterization of the hard atmospheric contribution from prompt neutrino production due to the decay of heavier mesons is desirable. The aim of the presented work is to improve the understanding of this prompt atmospheric neutrino component by including existing and possible future measurements of heavy quark production with the LHCb detector in air shower MonteCarlo simulations.

T 109.3 Do 17:20 H 3

Cosmic ray propagation around the Sun — •Mike Kroll[1], Julia Becker-Tjus[1], Paolo Desiati[2], and Frederick Tenholt[1] — [1]Ruhr-Universität Bochum, Bochum, Deutschland — [2]University of Wisconsin-Madison, Madison, USA

The Sun shadow can be measured with the IceCube detector and varies in depth corresponding to the magnetic field. Hence, we are given a possibility to understand cosmic ray propagation in the magnetic field of the Sun, for which a sufficiently good modelling is necessary. We investigate the field with its temporal deviations in strength and orientation. In times of low solar activity, the field can be approximated by a dipole structure. During higher activities, however, the field becomes increasingly inhomogeneous, especially in regions near the solar surface. These regions are spatially constrained and can reach magnetic field strengths of up to 50 Gauss. In this work, we simulate protons with energies up to $E_{\mathrm{p,max}} = 40$ TeV. This energy is the median energy of those cosmic rays that are used in IceCube*s Sun shadow analysis. Its data allows to determine the Sun shadow at different times in the solar cycle and compare the results to our simulation. We obtain solar magnetic field data within the PFSS model from the GONG data archive.

T 109.4 Do 17:35 H 3

Recognizing patterns in the arrival directions of ultra-high energy cosmic rays using deep neural networks — •Marcus Wirtz, Martin Erdmann, Jonas Glombitza, Gero Müller, and David Walz — III. Physikalisches Institut A, RWTH Aachen University, Deutschland

Where the accelerating sites of ultra-high energy cosmic rays are located remains an unanswered research question, since overdensities in the cosmic-ray arrival distribution on small and intermediate angular scales are still largely compatible with isotropic expectations. However, hints for potential point sources may be provided by cosmic-ray deflection in the coherent component of the galactic magnetic field, which forms characteristic patterns in the arrival distribution. We present a method based on deep neural networks that attempts to identify these patterns and to uncover even complex source hypotheses.

T 109.5 Do 17:50 H 3

Eine iterative Methode zur Bestimmung von Ladung und Quellrichtung von ultra-hochenergetischer kosmischer Strahlung mit Hilfe eines galaktischen Magnetfeldspektrometers — •Martin Urban, Martin Erdmann, Gero Müller und Marcus Wirtz — III. Physikalisches Institut A, RWTH Aachen University, Deutschland

Die Bestimmung der Ladung ultra-hochenergetischer kosmischer Strahlung ist ein wichtiger Schritt um ihre Quellen im Universum zu finden. Magnetische Felder und insbesondere das starke galaktische magnetische Feld lenken die Teilchen entsprechend ihrer Ladung auf ihrem Weg von der Quelle zur Erde ab. Parametrisierungen des galaktischen Magnetfelds basierend auf auf Faraday-Rotationsmessungen erlauben eine Bestimmung der Ankunftsrichtung auf der Erde. Wir präsentieren eine iterative Methode, bei der wir den galaktischen Spektrometereffekt ausnutzen, um die Ladung der Teilchen und mögliche Quellrichtungen zu bestimmen.

T 109.6 Do 18:05 H 3

Speed up CORSIKA — •Dominik Baack for the FACT-Collaboration — Technische Universität Dortmund, Dortmund, Germany

For modern physics experiments, simulations are an essential part for the analysis of measured data. With increasing precision of those experiments, more and more simulated data are needed. To reduce the large amount of required calculation time, different approaches are possible. One possibility are experiment specific adjustments of simulation to reduce the number of not measurable particle and events.

In gamma-ray astronomy, it is common to use the software package CORSIKA for the simulation of cosmic-ray induced air showers. Two new modules have been developed to allow for an efficient customization of the simulation. Both modules are designed as an API to configure the simulation precisely to a specific experiment. The first module enables the user to modify and remove particles during the calculation of the air shower. The second module enables sending and receiving of arbitrary data to an external server, which is programmed to analyze incoming data from multiple simulations running in parallel. The server can send specific commands to CORSIKA to discard a calculating event or request the simulation of certain particle.

First studies for FACT showed, that these developments reduce the calculation time and memory space by more than 30% each. In this talk, the developed modules will be introduced and results of the optimization using the example of some selected use cases will be presented.

T 109.7 Do 18:20 H 3

Cosmogenic Neutrinos Challenge the Proton Dip Model — •Jonas Heinze[1], Denise Boncioli[1], Bustamante Mauricio[2], and Winter Walter[1] — [1]Deutsches Elektronen-Synchrotron (DESY), Platanenallee 6, 15738 Zeuthen, Germany — [2]Center for Cosmology and AstroParticle Physics (CCAPP), The Ohio State University, Columbus, OH 43210, USA

We fit the recent UHECR spectrum measurements from the Telescope Array experiment under the assumption of pure proton composition, as assumed by the proton dip model.

We present a a full scan of the three main physical model parameters of UHECR-injection: source redshift evolution, injected maximal proton energy and spectral power-law index. We discuss how the result qualitatively changes compared to earlier two-parameter fits in the literature: a mild preference for a maximal energy cutoff at the sources instead of the Greisen*Zatsepin*Kuzmin (GZK) cutoff, hard injection spectra, and strong source evolution.

We show that the predicted neutrino flux exceeds the IceCube limit for any parameter combination. As a result, the proton dip model is challenged at more than 95% C.L. This is strong evidence against the dip-model independent of mass composition measurements.

T 109.8 Do 18:35 H 3

Galactic extension of CRPropa3 — •Lukas Merten and Julia Tjus — Ruhr Astroparticle and Plasma Physics Center (RAPP Center), Ruhr-Universität Bochum, Institut für Theoretische Physik IV/ Plasma-Astroteilchenphysik, Germany

The propagation of charged cosmic rays through the Galactic environment ifluences all aspects of the observation at Earth. Energy spectrum, composition and anisotropy are changed due to deflections in magnetic fields and nteractions 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).

We present a method to solve the transport equation using stochastic differential equations. This is possible since Ito's Lemma shows that a parabolic partial differential equation (like the Parker transport equation) is equivalent to a corresponsding set of stochastic differential eqautions. This technique is used e.g. in heliospheric transport problems.

We developed a new module for the publicly available CRPropa3 software which performs the propagation of pseudo particles which trace the phase space. The code is able to handle anisotropic diffusion tensors in realistic magnetic background fields as e.g. the regular component of the JF12 field. The validation of the code and first examples are shown.

T 109.9 Do 18:50 H 3

Einfluss von Lorentz-Verletzung im Photon-Sektor auf ausgedehnte Luftschauer — Frans R. Klinkhamer[1], •Marcus Niechciol[2] und Markus Risse[2] — [1]Institut für Theoretische Physik, Karlsruher Institut für Technologie (KIT) — [2]Department Physik, Universität Siegen

Aufgrund ihrer extrem hohen Teilchenenergien (bis zu 10^{20} eV) eignet sich die kosmische Strahlung bestens für die Suche nach Verletzungen der Lorentz-Invarianz. Bisher wurden untere Grenzen auf den Parameter $\kappa < 0$, der im Rahmen der Standard Model Extension (SME) isotrope, nicht-doppelbrechende Lorentz-Verletzung im Photon-Sektor beschreibt, mit Hilfe von Messungen aus dem Bereich der TeV-Gamma-Astronomie bestimmt. In dem Beitrag wird ein neuer Zugang zur Bestimmung einer unteren Grenze auf κ vorgestellt, der auf der Messung von Luftschauern basiert, die von Teilchen der kosmischen Strahlung in der Atmosphäre induziert werden. Hierzu wurde der Einfluss von Lorentz-verletzenden Prozessen (z.B. Photon-Zerfall) auf die longitudinale Entwicklung von Luftschauern, insbesondere auf die atmosphärische Tiefe des Schauermaximums $X_{\max}$, untersucht. Dabei werden zum einen ein analytisches Modell, basierend auf dem klassischen Heitler-Modell zur Beschreibung elektromagnetischer Kaskaden, zum anderen aber auch Monte-Carlo-Simulationen, basierend auf dem um Lorentz-verletzende Prozesse erweiterten CONEX-Code, verwendet. Es zeigt sich, dass $\langle X_{\max} \rangle$ für Schauer mit Primärenergien oberhalb von 10^{18} eV um einen Betrag verringert wird, der weit oberhalb der Auflösung aktueller Luftschauer-Experimente liegt.