T 15: Kosmische Strahlung 1

Zeit: Montag 16:45–19:00 Raum: H 3

T 15.1 Mo 16:45 H 3

Searching High energy muons in IceCube — •Johannes Werthebach for the IceCube-Collaboration — TU Dortmund

Most events measured with the IceCube detector are atmospheric muons. By analysing the high energetic component of these muons it is possible to determine the contribution of the prompt muons to the overall energy spectra. This talk presents a machine learning based selection of these high energetic muons. These selected muons can eventually be used to reconstruct the muons energy spectrum via unfolding.

T 15.2 Mo 17:00 H 3

Das Energiespektrum der höchstenergetischen kosmischen Strahlung im Licht großskaliger Anisotropien — •Daniela Mockler für die Pierre Auger-Kollaboration — Karlsruher Institut für Technologie

Die großskalige Verteilung der Ankunftsrichtung kosmischer Strahlung liefert Hinweise auf ihre Propagation, sowie auf die Verteilung ihrer Quellen. Neueste Analysen der höchstenergetischen kosmischen Strahlung, wie sie mit dem Pierre-Auger-Observatorium gemessen wird, deuten auf eine großskalige Dipolanisotropie hin. Solch eine Dipolstruktur wird durch Ablenkung in Magnetfeldern, aber auch durch die Bewegung der Erde und ihrer Nachbarschaft relativ zum Ruhesystem der kosmischen Strahlung erwartet.

In diesem Beitrag werden mögliche Auswirkungen dieser Dipolstruktur auf das Energiespektrum diskutiert. Dabei wird das Energiespektrum in unterschiedlichen Koordinatensystemen betrachtet und nach Differenzen im Strahlungsfluss in verschiedenen Koordinatenbereichen gesucht.

T 15.3 Mo 17:15 H 3

Atmospheric Neutrino Flux Measurement using the IceCube/DeepCore detector — •Joakim Sandroos and Sebastian Böser for the IceCube-Collaboration — Staudingerweg 7, 55128 Mainz

Atmospheric neutrinos are one of the most readily available neutrino sources and while the spectrum has been studied in detail over the past decades, it is still associated with considerable uncertainty. Accurate knowledge of the flux is important for other measurements of atmospheric neutrino properties. We present the first steps toward a precision measurement of the atmospheric neutrino flux, using the DeepCore array of the IceCube neutrino detector, in the energy range from ~5 to ~500 GeV. We employ a Bayesian (D'Agostini) iterative unfolding approach in order to make the measurement independent from theoretical predictions, and will discuss the method in some detail. In this scenario about 500.000 simulated events are necessary in order to adequately describe the detector response and systematic impacts. Background subtraction is done in our unfolding. In the final analysis we must also consider systematic effects from several other sources such as ice properties, quantum efficiency of the optical modules and input from oscillation parameters.

T 15.4 Mo 17:30 H 3

Photon/Hadron-Unterscheidung in Hybrid-Ereignissen des Pierre-Auger-Observatoriums mit Hilfe der Observable S_4 — Marcus Niechciol, Markus Risse und •Philip Ruehl — Universität Siegen, Department Physik

Die Frage nach der Zusammensetzung der kosmischen Strahlung bei den höchsten Energien (oberhalb von 10^{18} eV) ist eine Schlüsselfrage der Astroteilchenphysik. Der Nachweis ultrahochenergetischer Photonen spielt dabei eine entscheidende Rolle und wäre nicht nur für Astrophysik und Teilchenphysik, sondern auch für die fundamentale Physik von großer Bedeutung. Das Pierre-Auger-Observatorium bei Malargüe, Argentinien, ist das größte Luftschauerexperiment zum Nachweis ultrahochenergetischer kosmischer Strahlung. Es besteht aus ∼1660 Wasser-Čerenkov-Detektoren, die eine Fläche von ∼3000 km^2 abdecken. Eine zusätzliche, unabhängige Nachweismethode ermöglichen 27 Fluoreszenzteleskope an vier Standorten am Rand des Detektorfeldes.

Die Luftschauerobservable S_4 wird in aktuellen Studien verwendet, um Photon-induzierte Luftschauer von hadronischen zu unterscheiden. In diesem Beitrag wird der Einfluss der Detektorgeometrie auf S_4 erläutert. Weiterhin werden verschiedene Methoden diskutiert, einen daraus resultierenden systematischen Fehler zu vermeiden.

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T 15.5 Mo 17:45 H 3

IceScint: A surface scintillation detector array for IceCube-Gen2 — •Thomas Huber[1,2], Aswathi Balagopal V[2], Andreas Haungs[2], Timo Karg[1], Samridha Kunwar[1], Agnieszka Leszczynska[2], Harald Schieler[2], and Andreas Weindl[2] — [1]Deutsches Elektronen-Synchrotron, (DESY) — [2]Institut für Kernphysik (IKP), Karlsruher Institut für Technologie (KIT)

To increase the amount of detected high-energy neutrinos of cosmic origin IceCube-Gen2 is under development.

In addition to in-ice veto strategies, cosmic-ray showers can be directly vetoed on the ice surface. A surface veto detector built up by scintillators and extended to large areas of several tens of km^2 can be used to detect cosmic-ray showers and veto the in-ice muons and neutrinos they produce.

For the readout of the scintillators SiPMs *(Sillicon Photomultiplier)* are foreseen. These solid-state sensors are similar in detection efficiency compared to classical photomultiplier tubes. Beside this, SiPMs have additional advantages like a more compact structure, a low bias voltage and provide a better performance at low temperatures like found at the South Pole.

The detector design and first prototype measurements will be presented in this talk.

T 15.6 Mo 18:00 H 3

A Method of Reconstructing Ultra-High Energy Cosmic Rays at the Pierre Auger Observatory using Deep Learning — •Jonas Glombitza, David Walz, Marcus Wirtz, Gero Müller, and Martin Erdmann for the Pierre Auger-Collaboration — III. Physikalisches Institut A, Aachen, Deutschland

The surface detector of the Pierre Auger Observatory in Argentina measures the footprint of muons and electromagnetic particles of ultra-high energy cosmic ray induced air showers on ground level. Reconstructing the properties of the primary cosmic ray such as energy, direction and mass with optimal resolution remains a challenging task. Recently, great progress has been made in multiple fields of machine learning by using deep neural networks and associated techniques. In this talk we present a new method to reconstruct the properties of the ultra-high energy cosmic rays, by training deep neural networks to the detector response of the surface detector. By training the network to identify suitable features in all the available event information, this method has the potential to surpass currently employed methods which build on algorithms processing selected observables. In this context we discuss suitable data representations and compare different network architectures and training procedures. Finally, we assess the performance of the method on simulated air showers.

T 15.7 Mo 18:15 H 3

High-Energy Atmospheric Muons in IceCube and IceTop — •Frederik Tenholt for the IceCube-Collaboration — Ruhr-Universität Bochum

High-energy atmospheric muons can yield information about the prompt contribution to atmospheric lepton fluxes also relevant for neutrino studies as well as complement results from collider experiments in the forward region of particle physics.

In this talk, two different analyses studying high-energy atmospheric muons are presented. In order to obtain a suitable event sample, cut parameters capable of tagging events that contain a muon dominant within the bundle are introduced and validated. In the first analysis, the resulting sample is used to obtain the differential muon flux between $\sim 6\,\text{TeV}$ and $\sim 400\,\text{TeV}$ in the zenith range $0^\circ < \theta < 34.6^\circ$. In the second analysis, a proof of concept for the measurement of an effective Feynman-x of atmospheric muons, quantifying the forwardness of these particles, is presented, resulting in an observable well correlated with the true value obtained from simulations.

This project is BMBF-supported (FKZ: 05A14PC1).

T 15.8 Mo 18:30 H 3

Mass discrimination using air shower universality at the Pierre Auger Observatory — •Ariel Bridgeman, Alexander

Schulz, and Markus Roth for the Pierre Auger-Collaboration — Karlsruhe Institute of Technology, Karlsruhe, Germany

Data from the Pierre Auger Observatory's surface detector is used to study the primary composition of cosmic rays at the highest energies. Updates to a reconstruction based on the paradigm of air shower universality have reduced the bias in and improved the resolution of reconstructed mass-sensitive variables–namely, the depth of shower maximum and number of muons. By fitting measured distributions of those variables to predictions from various hadronic interaction models, we examine the implied composition and derive the multiplicative shift needed to correct for the deficit of the number of muons found when comparing simulations to data. Systematic uncertainties stemming from the measurements of the surface and fluorescence detectors are detailed. Initial studies involving the enrichment of a light sample for anisotropy purposes are also shown.

T 15.9 Mo 18:45 H 3

Simulation study for an extended IceTop Detector for IceCube-Gen2 — •Agnieszka Leszczyńska[1], Aswathi Balagopal V.[1], Andreas Haungs[1], and Thomas Huber[1,2] for the IceCube-Collaboration — [1]KIT, Karlsruhe, Germany — [2]DESY, Zeuthen, Germany

The next generation of the IceCube experiment will be a powerful high-energy neutrino detector, sensitive to resolve the sources of astrophysical neutrinos. The new facility will be able to measure the GZK neutrino flux providing also information about the composition of the highest energy cosmic-rays. The big challenge of the measurements is here to discriminate the astrophysical signal from the atmospheric background. This can be resolved by a large surface extension of present IceTop with scintillation detectors. If the in-ice event is detected in coincidence with the air-shower signal at the surface detectors it can be vetoed obtaining only the astrophysical neutrinos. The first step is the enhancement of IceTop in the present area, which will also improve the cosmic-ray composition measurements of IceCube. This talk will show a simulation study for the first phase of the deployment of scintillator detectors.