T 38: Kosmische Strahlung II

Zeit: Dienstag 16:00–18:30 Raum: S13

T 38.1 Di 16:00 S13

Scintillator upgrade of IceTop: An extension of the IceCube surface detector array — •Thomas Huber für die IceCube-Kollaboration — KIT, DESY

The IceCube Collaboration foresees to upgrade the present surface array (IceTop) with scintillation detectors. This array will be used to mitigate the impact of snow accumulation on the reconstruction of cosmic-ray showers detected by IceTop. In addition it will increase the veto capabilities for high energy astrophysical and cosmogenic neutrinos of IceCube. Furthermore, it will serve as a R&D program for a possible future large-scale surface array. Two prototype stations with 7 scintillation detectors each showcasing technological advances have been developed and were deployed at the South Pole in January 2018. Each scintillation detector features 1.5 m* of plastic scintillators and wavelength-shifting fibers which are read out by Silicon Photomultipliers. The detector design, the operation status, first measurements compared to IceTop and prospects of the upgrade will be presented in this contribution. In addition, the science case of the array will be discussed.

T 38.2 Di 16:15 S13

Performance of IceTop enhancement with scintillator array — •Agnieszka Leszczyńska[1], Aswathi Balagopal V.[1], Andreas Haungs[1], Donghwa Kang[1], Marie Oehler[1], Max Renschler[1], Thomas Huber[1,2], and Fiona Ellwanger[1] for the IceCube-Collaboration — [1]KIT, Karlsruhe, Germany — [2]DESY, Zeuthen, Germany

One of the proposed upgrade of IceTop, a surface component of IceCube, will comprise of the scintillation detectors arranged within the present IceTop area. The proposed array will enhance the cosmic-ray measurements and provide an improvement in the background discrimination for the astrophysical neutrino detection in the southern hemisphere sky. The scintillation detectors, due to their complementary response to the air-shower components with respect to the Cherenkov tanks, can boost the current discrimination of the primary cosmic-ray mass.

We conducted a detailed simulation study on the capabilities of the enhanced array in terms of trigger probability and air-shower reconstruction. Moreover an investigation of a possible parameter which is sensitive to the cosmic-ray mass was performed.

T 38.3 Di 16:30 S13

Reconstruction of the cosmic-ray spectrum based on stopping muons in IceCube — •Sebastiano Ninfa — Technische Universität Dortmund

The IceCube-Observatory at the South Pole is primarily intended to detect neutrinos from extra-galactic sources, yet the vast majority of recorded events originates from air showers induced by cosmic rays interacting in the upper atmosphere. While in the context of neutrino astronomy these events have to be considered background, the data from the atmospheric muons can still be used to infer knowledge about the composition and energy spectrum of these cosmic rays.

In this work the cosmic-ray spectrum is reconstructed using a model-independent unfolding approach. The study is conducted on a specific subsample of events, containing only muons which stop inside the detector, since the energy of these events can easily be estimated considering the propagation length from generation to absorption, so that the muon range can be used as a proxy to reconstruct the energy spectrum.

In this talk I will give an overview over the analysis, focusing mainly on the methods employed.

T 38.4 Di 16:45 S13

Up-going high energy showers in the fluorescence detector of the Pierre Auger Observatory — •Ioana Alexandra Caracas — Bergische Universität Wuppertal, Gaußstr. 20, 42119 Wuppertal

The Pierre Auger Observatory is performing a follow-up search of the recent ANITA observations of up-going cosmic ray like showers with energies around 0.1-1 EeV. Because of the vastly larger exposure of the fluorescence detector (FD) compared to ANITA, it is expected the current research will be able to either confirm or reject the recent observations. The 14 years of FD data are already taken and will be analyzed.

Simulations of up-going extensive air showers with elevation of more than ≈ 20 degrees above the horizon represent the first step in this search. These simulations will be used to reject the false positives and provide insight into the nature of these events. The extensive air showers are simulated using CORSIKA with primary energies in the range of 10^{18} - 10^{20} eV. Preliminary results of these simulations, including detector response simulations, will be presented and discussed.

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T 38.5 Di 17:00 S13

AugerPrime Event Reconstruction and Analysis of Data from First Prototypes — •Alvaro Taboada-Nunez[1,2], David Schmidt[1], Alexander Streich[1,2], Markus Roth[1], and the Pierre Auger Colaboration[3] — [1]Karlsruhe Institute of Technology (KIT) — [2]Universidad Nacional de San Martin (UNSAM) — [3]Malargue, Argentina

The measurement of the different components of extensive air showers is of key importance for reconstructing the mass composition of ultra-high-energy cosmic rays. The main goal of AugerPrime, the upgrade of the Pierre Auger Observatory, is the enhancement of the Surface Detector sensitivity to mass composition by installing a 4 m^2 scintillator detector atop of the 1660 water-Cherenkov detectors. A complementary measurement with the two detectors would allow for the disentanglement of the electromagnetic and muonic shower components. The current analysis methods for shower reconstruction using both the scintillator and the water-Cherenkov detectors are presented here. Furthermore, 12 upgraded Surface Detector stations are operating in the field since late 2016; analysis of the data from these first prototypes is also presented.

T 38.6 Di 17:15 S13

Air shower universality in the context of AugerPrime — •Maximilian Stadelmaier, Markus Roth, and Ralph Engel — Institut für Kernphysik, KIT, Karlsruhe, Deutschland

The mass composition of the ultra-high energy cosmic rays (UHECRs) is an open question in astroparticle physics. The Pierre Auger Observatory, being the largest cosmic ray observatory in the world, is capable to detect extensive air showers induced by UHECRs at the exa electronvolt scale and beyond. Air shower universality is a principle stating that the overall development of an extensive air shower and therefore also the signal at ground solely depend on the mass-sensitive observables $X_{\max}$, N_μ and the energy of the primary particle. Reconstructing these observables in the context of air shower universality with the information obtained from the scintillators, which are currently being deployed within the AugerPrime update, will boost our understanding of extensive air showers and cosmic accelerators. We will present the status of the signal model development and future perspectives for AugerPrime.

T 38.7 Di 17:30 S13

EmCa - Electromagnetic Cascades — •Stephan Meighen-Berger and Matthias Huber — Technische Universität München, München, Deutschland

The Electromagnetic Cascade package (EmCa) is a simulation package for electromagnetic cascades in different materials. It uses one dimensional, discretized, cascade equations to calculate particles fluxes from a few MeV up to PeV scales. EmCa's large range of validity is a result of the inclusion of low and high energy effects, such as ionization- and dieelectric-effects for the former and the Landau*Pomeranchuk*Migdal effect for the latter. Using pre-tabulated interaction rates, average particle fluxes can be calculated in a few seconds. Unlike a Monte-Carlo regime, where the simulations take longer, this allows for systematic studies of the results. Currently EmCa's results agree with experimental and Monte-Carlo data. An upcoming extension will be full 3D simulations, allowing the inclusion of additional effects, such as magnetic and geometry effects. The package is offered as a stand-alone as well as an extension to MCEq, which is a similar package for the calculation of hadronic cascades. This allows the simulation of hadronic and electromagnetic cascades in a single framework. In this talk we will introduce EmCa, the underlying methods therein and future plans to extend the simulation package.

T 38.8 Di 17:45 S13

Status of the new TAIGA hybrid detector — •Andrea Porelli for the TAIGA-Collaboration — DESY, Zeuthe,Germany

The new TAIGA (Tunka Advanced Instrument for cosmic ray physics and Gamma Astronomy) hybrid detector aims to address gamma-ray astronomy at energies from a few TeV to several PeV, as well as cosmic ray physics above 100 TeV. By combining the wide angle (0.6sr) Cherenkov timing detector TAIGA-HiSCORE with the 4-m class Imaging Atmospheric Cherenkov Telescopes TAIGA-IACT (10x10 degrees FoV), it provides a cost effective-way to instrument large areas (>10km^2). The EAS reconstruction provided by TAIGA-HiSCORE (energy, incoming direction and its core position) allows to increase the distance between the IACTs up to 1000-1200 m. In addition to the Cherenkov light detectors, we intend to deploy an array of muon detectors (TAIGA-Muon array) spread over an area of 1 km^2 with a total area of about 2000 m^2. The TAIGA-IACT, together with the TAIGA-Muon array, will be used for selection of gamma-ray induced EAS. At present, the TAIGA first stage has been constructed in Tunka valley, ~50 km West from the Lake Baikal. The detector consists of 47 TAIGA-HiSCORE Cherenkov stations distributed over an area of 0.5 km^2, and the first IACT of the TAIGA-IACT array. During 2018-2019 we intend to increase number of the TAIGA-HiSCORE stations up to 100-120, covering an area of 1 km^2, and to deploy 1 - 2 additional TAIGA-IACTs. The first experimental results with the TAIGA first stage will be reported.

T 38.9 Di 18:00 S13

Study of Attenuation of Extensive Air Showers — •Martin Schimassek[1], Darko Veberič[1], Ralph Engel[1], and the Pierre Auger Collaboration[2] — [1]Karlsruher Institut für Technologie — [2]Malargüe, Argentina

The understanding of the attenuation of the air showers on their passage through different amounts of atmospheric matter is crucial for the reconstruction of their energy. Using established techniques like the constant-intensity-cut method it is possible to estimate this attenuation function from the gathered data itself. Another approach is the use of Monte-Carlo simulations to estimate the attenuation. The different methods imply different systematic uncertainties: The MC based attenuation suffers from the differences between, and uncertainties of, the used hadronic interaction models, but can naturally incorporate a potential energy dependence of the attenuation functions. Whereas the data-driven method does not depend on any hadronic interaction model, it suffers from a low statistics when an estimation of the energy dependence is desired.

This contribution highlights the properties of different methods and with the help of extensive Monte-Carlo studies reviews systematic uncertainties of these methods.

T 38.10 Di 18:15 S13

Thinning algorithm for the simulation of large signals in surface detector stations at the Pierre Auger Observatory — •David Schmidt for the Pierre Auger-Collaboration — Karlsruhe Institute of Technology, Karlsruhe, Germany

Extensive air showers induced by ultra-high-energy cosmic rays result in a massive number of particles reaching Earth's surface. Simulations of the surface detector of the Pierre Auger Observatory consist of injecting these particles into virtual volumes containing its water-Cherenkov detector stations. In such simulations, the shower core sometimes lands very close to such a station resulting in the injection of a colossal number of particles and correspondingly large run-times. As the electronics in such stations saturate, disproportionately large amounts of CPU and memory resources are therefore used to simulate signals that will eventually be clipped and discarded. Here, we present a station-level algorithm that greatly reduces run-times in such cases by randomly decimating injection candidates and scaling resulting signals accordingly. The method eliminates outliers in the distribution of simulation run-times and reduces the average run-time by dozens of hours without a significant cost to the quality of simulated signals. Meanwhile, it still allows for the full simulation of station signals up to the point of saturation, which differs from other speed-oriented algorithms relying on parameterizations that often inadequately describe the rare interactions and odd geometries relevant in the case of low statistics.