T 60: Astroteilchenphysik: Methoden III

Zeit: Mittwoch 16:00–18:15 Raum: S12

T 60.1 Mi 16:00 S12

IceAct, SiPM based Imaging Air Cherenkov Telescopes for IceCube — •Jan Auffenberg, Pascal Backes, Thomas Bretz, Erik Ganster, Maurice Günder, Merlin Schaufel, Johannes Schumacher, and Aatif Waza for the IceCube-Collaboration — RWTH Aachen University

The development of cost effective and compact Silicon Photomultipliers (SiPM) based Imaging Air Cherenkov Telescopes enables new measurements using a hybrid configuration with ground based detectors. IceAct is a proposed surface array of such telescopes above IceCube. During January 2019, two new versions of IceAct telescope demonstrators featuring 61 SiPM pixels and improved optics were installed in the center of the IceTop surface detector at the geographic South Pole. Combining information from these telescopes and IceCube, it is possible to test the performance in primary particle discrimination, energy calibration, and veto capabilities. We present the status of the project and the prospects of the upcoming data taking season during the antarctic winter.

T 60.2 Mi 16:15 S12

Primary Particle Identification for IceAct Cherenkov Telescopes — •Lenka Tomankova[1,2,4], Jan Auffenberg[3], Pascal Backes[3], Lasse Ebener[1,2], Erik Ganster[3], Merlin Schaufel[3], and Julia Tjus[1,2] for the IceCube-Collaboration — [1]Ruhr-Universität Bochum, Theoretische Physik IV — [2]Ruhr Astroparticle and Plasma Physics (RAPP) Center — [3]RWTH Aachen University, III. Physikalisches Institut — [4]Erlangen Centre for Astroparticle Physics (ECAP), Friedrich-Alexander-Universität Erlangen-Nürnberg

IceAct, a planned array of compact, SiPM-based Imaging Air Cherenkov Telescopes at the IceCube Neutrino Observatory, was designed to fulfill manyfold functions, including a cosmic-ray veto to open the southern sky for astrophysical neutrino detection and an enhancement of composition and gamma-ray measurements at the South Pole. An essential part of the latter is an effective separation of gamma- and hadron-induced showers, which we approach with multi-variate tools, in particular with boosted decision trees. In this contribution we present the first results of a study performed on a CORSIKA-simulated data set spanning the energy range from 10 to 100 TeV. Special focus is placed on pushing the energy threshold for an effective gamma/hadron separation to lower energies.

T 60.3 Mi 16:30 S12

Large-Size Composite SiPM Pixel Tests in the Imaging Camera of the MAGIC IACT — •Alexander Hahn[1], Antonios Dettlaff[1], David Fink[1], Daniel Mazin[1,2], Razmik Mirzoyan[1], and Masahiro Teshima[1,2] — [1]Max-Planck-Institut für Physik, München, Deutschland — [2]Institute for Cosmic Ray Research, the University of Tokyo, Tokyo, Japan

Silicon photomultipliers (SiPMs) are becoming increasingly popular as light detectors in Imaging Atmospheric Cherenkov Telescopes (IACTs). Yet, an in-situ performance comparison of SiPMs and photomultiplier tubes (PMTs) is missing. At the Max Planck Institute for Physics we built three prototype detector modules based on composite SiPM pixels. These modules are installed to one of the Major Atmospheric Gamma Imaging Cherenkov (MAGIC) telescopes. The MAGIC camera structure allows the installation and parallel operation of up to six prototype detector modules at the rim of the existing PMT imaging camera. This outer rim is not part of the trigger, so to minimize the systematic effects on our performance comparison we installed one SiPM based prototype into the camera centre for a single night.

The collected data consist of artificial light pulses from a light flasher as well as real Cherenkov light from extensive air showers in the atmosphere.

In this talk, we will present a comparison of our SiPM-based prototype light detector modules to the existing modules of the PMT imaging MAGIC camera.

T 60.4 Mi 16:45 S12

IACTs for IceAct and HAWCs Eye - A versatile and cost effective design — •Merlin Schaufel[1], Jan Audehm[2], Jan Auffenberg[1], Pascal Backes[1], Thomas Bretz[2], Johannes Buscher[1], Erik Ganster[1], Adrianna García[2], Maurice Günder[1], Martin Rongen[1], Johannes Schumacher[2], and Christopher Wiebusch[2] — [1]III. Physikalisches Institut B, RWTH Aachen University — [2]III. Physikalisches Institut A, RWTH Aachen University

The development of cost effective, compact and wide field-of-view imaging air-Cherenkov telescopes (IACTs) enables a broad range of applications for the detection of extensive air showers. Combining the IACT technology with ground based detectors like IceCube/IceTop (IceAct) or HAWC (HAWCs Eye) improves and cross calibrates the direction and energy reconstruction. The complementary shower information shows promising discrimination power for primary particle determination. We present the updated design of a SiPM based 61-pixel telescope featuring a sealed Fresnel optic and a versatile DAQ and slow control concept for the IceAct and the HAWCs Eye project.

T 60.5 Mi 17:00 S12

Hybrid measurements with the HAWCs Eye telescope and the HAWC detector — •Jan Audehm[1], Jan Auffenberg[2], Thomas Bretz[1], Adrianna García[1], and Merlin Schaufel[2] — [1]III. Physikalisches Institut A, RWTH Aachen University — [2]III. Physikalisches Institut B, RWTH Aachen University

The High Altitude Water-Cherenkov Observatory (HAWC) is designed for the observation of gamma rays as well as cosmic rays in the TeV energy range. Located near Puebla in Mexico, it is surveying the northern sky for sources of these particles using 300 water tanks equipped with photomultipliers. Hybrid measurements merging the detection principles of air shower arrays and Air-Cherenkov telescopes give the opportunity to improve the reconstruction of primary particle properties such as energy or arrival direction. The compact imaging Air-Cherenkov telescope HAWCs Eye with its 64 SIPM pixel camera is well suited as an expansion of the HAWC detector providing additional shower information. An installation of multiple HAWCs Eye telescopes at the HAWC Observatory offers the opportunity to investigate possible improvements by taking stereoscopic hybrid data.

T 60.6 Mi 17:15 S12

Improving the Direction Reconstruction for CTA — •Konstantin Pfrang — Deutsches Elektronen-Synchrotron Zeuthen

The Cherenkov Telescope Array (CTA) will be the next generation Imaging Air Cherenkov Telescope array (IACT) for gamma-ray astronomy, with more than 100 telescopes located at two sites in the southern and northern hemispheres. The accurate reconstruction of the initial gamma-ray direction is a crucial factor for the IACT performance. In the CTA calibration and low-level data analysis framework *ctapipe* a geometrical direction reconstruction based on the Hillas parameterization of the images is applied. CTA will be the first IACT using such a large number of telescopes and consequently it will record many images of the same air shower. However, their quality is not uniform and giving more importance to appropriate images will improve the performance of the reconstruction.

In this work, the importance of the individual images for the direction reconstruction for simulations of CTA south in *ctapipe* is investigated and the weighting is reviewed. The influence is estimated using look-up tables for the distance of closest approach between the semi-major axis of the parameterized image to the true direction in the camera. This weighting of the images improves the reconstruction for point source and diffuse simulations over the default weights calculated from an analytic expression.

T 60.7 Mi 17:30 S12

Identification of Cherenkov Signal in Shower Images Recorded by CTA — •Johan Wulff[1,2], Jonas Hackfeld[1,2], Julia Tjus[1,2], and Lenka Tomankova[1,2,3] for the CTA-Collaboration — [1]Ruhr-Universität Bochum, Theoretische Physik IV — [2]Ruhr Astroparticle and Plasma Physics (RAPP) Center — [3]Erlangen Centre for Astroparticle Physics (ECAP), Friedrich-Alexander-Universität Erlangen-Nürnberg

The Cherenkov Telescope Array (CTA) is the next-generation ground-based gamma-ray observatory surpassing current instruments by roughly an order of magnitude in sensitivity. This unprecedented sensitivity bears new challenges for the on-site analysis and brings about the necessity to reduce the recorded data stream by about two orders of magnitude to allow for efficient handling and off-site transfer. This process will take place on-the-fly and must not significantly deteriorate physics performance.

We present a data reduction approach based on identifying camera pixels containing Cherenkov signal and suppressing those containing only noise. The procedure is applied to individual air shower images, both gamma- and hadron-induced. We employ deep learning (DL) methods, in particular convolutional neural networks (CNNs), which show great pattern recognition in image analysis tasks. Following the introduction of the method itself, we discuss its application to and performance in data reduction for CTA, including a comparison with non-DL methods.

T 60.8 Mi 17:45 S12

Ein GCN-basiertes Tool zur Optimierung der Detektion von transienten Ereignissen mit CTA — •Anke Yusafzai[1,2,4], Fabian Schüssler[4], Julia Tjus[1,2] und Lenka Tomankova[1,2,3] für die CTA-Kollaboration — [1]Ruhr-Universität Bochum, Theoretische Physik IV — [2]Ruhr Astroparticle and Plasma Physics (RAPP) Center — [3]ECAP, Friedrich-Alexander-Universität Erlangen-Nürnberg — [4]Irfu, CEA Paris-Saclay

Mit CTA (Cherenkov Telescope Array), dem terrestrischen Gamma-Observatorium der nächsten Generation, sollen weit mehr hochenergetische Gammaquellen als bisher beobachtet werden. Flares von bekannten Quellen und unerwartete transiente Erscheinungen können auf verschiedenen, teilweise wenige Sekunden kurzen Zeitskalen ablaufen, was eine besondere Herausforderung an die Echtzeitanalyse der Teleskopdaten darstellt. Zur Optimierung der Echtzeitanalyse und Maximierung des Entdeckungspotentials soll ein Übersichts-Tool entwickelt werden, das eine schnelle Identifikation von Veränderungen in beobachteten Himmelsregionen erleichtert und eine umfassende Analyse fördert. Als Basis dafür dient eine auszuführende Analyse des GCN der NASA, aus der eine graphische Darstellung und Zusammenfassung der interessanten Eckdaten resultieren wird. Es wird schnell eine Übersicht der bekannten Quellen in der relevanten Himmelsregion und die dort in bestimmten Zeitfenstern registrierten Ereignisse liefern. In Abhängigkeit des zu beobachtenden Ereignisses sind physikalisch sinnvolle Zeitskalen und Energiebereiche zu wählen. In diesem Vortrag wird ein erstes Konzept zur Ausarbeitung dieses Tools vorgestellt.

T 60.9 Mi 18:00 S12

Status of CORSIKA 8 — Maximilian Reininghaus[1], Felix Riehn[2], and •Ralf Ulrich[1] — [1]Institut für Kernphysik, Karlsruher Institut für Technologie (KIT), Karlsruhe, Deutschland — [2]Laboratório de Instrumentação e Física Experimental de Partículas, Lissabon, Portugal

Current and future challenges in astroparticle physics require novel simulation tools to achieve higher accuracy and more flexibility. For the last three decades the FORTRAN version of the Monte Carlo air shower simulation package CORSIKA served the community in an excellent way. However, the effort to maintain and further develop this complex package has become increasingly difficult. To overcome existing limitations we are developing CORSIKA 8 in modern C++, designed as a modular framework and open platform useful for all particle cascade simulations in astroparticle physics. In this contribution, we give a status report on the project and show first simulations of hadronic showers.