T 65: Experimentelle Techniken der Astroteilchenphysik 4

Zeit: Dienstag 16:45–19:00 Raum: S 055

T 65.1 Di 16:45 S 055

Extended implementation of cross sections in the propagation tool of charged leptons PROPOSAL — •Mario Dunsch for the IceCube-Collaboration — TU Dortmund, Deutschland

The recorded data of large underground detectors like the neutrino telescope IceCube are at a stage where in many analyses the sensitivity is rather limited by systematic than the statistical uncertainties. The systematic ones occur from imprecise theoretical descriptions for the Monte Carlo simulations, wherefore it is necessary to improve such descriptions. One part of the Monte Carlo chain used for IceCube is the program PROPOSAL (**Pr**opagator with **o**ptimal **p**recision and **o**ptimized **s**peed for **al**l **l**eptons), which simulates the propagation of leptons through media. The aim of this thesis is to implement and to test improved cross sections in PROPOSAL, whereby the focus is placed on pair production and bremsstrahlung. Furthermore, improved cross sections for supersymmetric staus are implemented which can be used to probe physics beyond the standard model.

T 65.2 Di 17:00 S 055

Corrections to Muon Cross Sections for IceCube Simulation — •Jan Soedingrekso for the IceCube-Collaboration — TU Dortmund, Dortmund, Germany

An important analysis step for neutrino telescopes like IceCube is the energy reconstruction of the detected charged leptons based on Monte Carlo simulations. The energy of electrons and taus can be estimated with high precision, because they are contained events. High energy muons do usually not lose their entire energy within the detector volume, so the energy reconstruction is more complex and is estimated via the energy loss per distance. To reduce the systematic uncertainties of the energy reconstruction for detected muon events, the simulation chain has to be improved. For the propagation of charged leptons carried out by the simulation tool PROPOSAL the interactions with matter have to be known as accurate as possible. In the relevant energy range for astrophysical neutrinos the energy losses originate mainly from pair production, bremsstrahlung and photonuclear interactions. In this talk the current pair production cross section with systematic studies on the effective description of the nuclear interaction is presented.

T 65.3 Di 17:15 S 055

Interaction Type Distinction for Cascade Events in IceCube — •Anna Steuer and Lutz Köpke for the IceCube-Collaboration — Universität Mainz

Cascade event signatures in IceCube originate either from a charged current interaction of electron or tau neutrinos or from a neutral current interaction of all neutrino flavors. The former induces an electromagnetic plus a hadronic shower while the latter initiates a hadronic cascade only. In my talk, I will present promising results of a feasibility study investigating whether an experimental distinction between these types is possible in IceCube. The study, using Geant4, Pythia and DIRE software, exploits the delayed photon signal from neutron capture events, which is more pronounced in hadronic showers.

T 65.4 Di 17:30 S 055

Porting Simulation Software to Geant4 v10r3 and its Application to the Pierre Auger Observatory Surface Detector Simulations. — •Eric Mayotte for the Pierre Auger-Collaboration — Bergische Universität Wuppertal

Geant4 is widely used for accurate simulation of particle detector response. Unfortunately, many implementations of Geant4 are built and tested early on in an experiment and then left unchanged for the lifetime of the project. This is understandable as stability of simulations is a highly desirable quality for all collaborations. However, Geant4 is constantly being improved, providing more accurate physics results and an optimized performance. The upgrade from Geant4 v9 releases to the new Geant4 v10 releases adds many new features and improvements, but also involves some significant changes to the user interface. The Pierre Auger Collaboration recently updated its surface detector (SD) simulations to use the new Geant4 versions. This talk will give a brief overview of the process of porting detector simulations to the new software. Examples of the resulting changes seen in the Pierre Auger Observatory SD simulations when updating from v9r4 to v10r3 will also be shown.

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T 65.5 Di 17:45 S 055

GEANT simulations of KATRIN FBM data — •Norman Haussmann for the KATRIN-Collaboration — Bergische Universität Wuppertal

The KArlsruhe TRItium Neutrino (KATRIN) experiment aims to measure the effective neutrino mass in a model-independent way with a sensitivity of $200\,\mathrm{meV/c^2}$ (90 % C.L.).
In order to extract the neutrino mass, the Windowless Gaseous Tritium Source (WGTS) properties of KATRIN need to be known to a high precision. For this reason several monitoring systems are installed. One of them, situated in the transport section, is the Forward Beam Monitor (FBM). The FBM is capable of recording the electron rate ($10^6\,\mathrm{e/s \cdot mm^2}$) and the differential electron spectra with a high energy resolution and precision.

The FBM-detector electronics are shielded by a stainless steel plate with a cutout for two PIN-diodes. The effects of this plate as well as the reflection of electrons on the source's rear-wall are investigated and their influence on the spectral shape.
Since the detector is situated far outside of the flux tube, the influence of secondary electrons has to be investigated, they originate from the source's and transport section's walls.
The simulations and the latest results are presented in this talk.

T 65.6 Di 18:00 S 055

FACT - Time series analysis of unevenly sampled data — •Max Mahlke and Thomas Bretz — III. Physikalisches Institut A, RWTH Aachen University, Aachen, Germany

The light curves of astrophysical sources are the result of numerous underlying processes taking place simultaneously. The apparent complexity in the time-domain can be disentangled in the frequency-domain by successive application of statistical methods. As the light curves typically contain gaps due to factors such as bad weather and source visibility, the methods have to be suitable for unevenly spaced data. Arising systematic features in the spectra are reduced by iterative deconvolution with the spectral window. The significance of true peaks in the noisy background is assessed with bootstrapping and harmonic filters.

Blazars like Markarian (Mrk) 501 are hosts to various high-energy phenomena. Therefore, the light curves promise to contain interesting features in their power spectra. In the particular case of Mrk 501, a 23-day periodicity has been claimed in the past.

Among other sources, the First G-APD Cherenkov Telescope (FACT) has been monitoring Mrk 501 and Mrk 421 for the past five years. The light curves are subjected to the described time series analysis in the search for both systematic and source periodicities.

T 65.7 Di 18:15 S 055

Reconstruction of Gamma Rays with AMS-02 — •Bastian Beischer — RWTH Aachen University, Aachen, Germany

AMS-02 is a high-precision multi-purpose particle detector mounted externally on the International Space Station (ISS). Although primarily designed for the measurement of charged cosmic rays, AMS-02 is able to precisely reconstruct photons in two complementary modes. Electrons from photon conversions in the upper part of the detector can be reconstructed due to the excellent tracking capabilities of the detector. In addition AMS-02 features a 17 radiation length electromagnetic calorimeter with a standalone trigger, which allows for a precise measurement of the properties of showers induced by gamma rays. The AMS-02 Tracker, TRD and Time-of-Flight systems provide a reliable veto for charged cosmic rays.

Techniques for the analysis of photons in AMS-02 will be discussed.

T 65.8 Di 18:30 S 055

Rejection of Transient Noise at the Auger Engineering Radio Array — •Christoph Welling, Christian Glaser, Martin Erdmann, Florian Briechle, and Raphael Krause — III. Physikalisches Institut A, RWTH Aachen University

One of the challenges that radio detectors for air showers face is contamination by pulsed radio noise which may coincide with a cosmic-ray event. These noise pulses can originate from a multitude of sources, such as power lines or radiocommunication devices. In order to perform reliable cosmic-ray measurements it is necessary to be able to identify and reject such noise. In this talk, we present rejection methods based on the timing, shape and polarization of the measured radio pulse as well as the positions of the radio stations with a detected signal. The rejection algorithms were tested and optimized for use at the Auger Engineering Radio Array (AERA) in Monte Carlo studies using air shower simulations combined with a full detector simulation including on-site recordings of radio noise.

T 65.9 Di 18:45 S 055

Accuracy of Energy Measurements at Cosmic-Ray Observatories — •Christian Glaser, Florian Briechle, Martin Erdmann, Raphael Krause, and Christoph Welling — III. Physikalisches Institut A, RWTH Aachen University

Ultra-high-energy cosmic rays are measured indirectly via air showers which are huge particle cascades that develop in the atmosphere. Thereby the atmosphere acts as a giant calorimeter that is read out from the ground. The currently most accurate method is the measurement of fluorescence light where the systematic uncertainty in the energy measurement can be reduced to 14% requiring extensive monitoring efforts as the creation as well as the attenuation of fluorescence light depend on the actual conditions of the atmosphere. In this contribution, we present an alternative detection technique that is less dependent on atmospheric conditions and thus potentially reduces the systematic uncertainty in the cosmic-ray energy measurement significantly. Air showers emit short radio pulses in the MHz regime such that the cosmic-ray energy can be determined via the measurement of the energy radiated by the air shower in form of radio waves. Two attractive aspects are that the atmosphere is transparent to MHz radio waves and the radio emission can be calculated from first-principles using classical electrodynamics. We will present the systematic uncertainties of the radio method and the efforts to apply the radio technique for an improved absolute energy calibration of the Pierre Auger Observatory.