T 21: Experimentelle Methoden der Astroteilchenphysik I

Zeit: Montag 16:00–18:20 Raum: Z6 - SR 2.013

Gruppenbericht T 21.1 Mo 16:00 Z6 - SR 2.013

Intensity interferometry with CTA - Experiments towards long-baseline interferometry — •Peter Deiml[1], Gisela Anton[1], Stefan Funk[1], Dmitry Malyshev[1], Thilo Michel[1], Felix Pfeifer[1], Raimund Schneider[2], Joachim von Zanthier[2], Adrian Zink[1], and Andreas Zmija[1] — [1]Erlangen Centre for Astroparticle Physics, Universität Erlangen-Nürnberg, 91058 Erlangen — [2]Institut für Optik, Information und Photonik, Universität Erlangen-Nürnberg, 91058 Erlangen

Intensity interferometry forms an image of a stellar source by correlating photon signals which are measured independently at different positions and different times. By use of kilometric arrays of air Cherenkov telescopes like the future Cherenkov Telescope Array (CTA) one may increase the spatial resolution by an order of magnitude. We review the theory of intensity interferometry and the new possibilities offered by such an array as well as the problems that arise. Moreover, we present the first correlations using IceAct telescopes which are originally part of the IceCube experiment at the south pole.

T 21.2 Mo 16:20 Z6 - SR 2.013

Experiments on intensity interferometry — •Andreas Zmija[1], Peter Deiml[1], Adrian Zink[1], Felix Pfeifer[1], Gisela Anton[1], Stefan Funk[1], Dmitry Malyshev[1], Thilo Michel[1], Raimund Schneider[2], and Joachim von Zanthier[2] — [1]Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP — [2]Institut für Optik, Information und Photonik, Universität Erlangen-Nürnberg, Staudtstr. 1, 91058 Erlangen, Germany

Intensity interferometry is a method that allows the measurement of the angular size of a star using at least two telescopes with varying baseline although each telescope cannot resolve the size of the star. The measurement principle is based on the correlation of the light intensities of a thermal source (e.g a star) received at two different positions on earth. Pioneering work has already been carried out several decades ago by Hanbury Brown and Twiss. The future Cherenkov-Telescope-Array CTA might be a good platform to exploit this Hanbury Brown-Twiss (HBT) effect for the investigation of the sizes of celestial objects. We have carried out laboratory experiments using a laser-illuminated ground glass disc and a narrow-bandwidth LED to test our measurement setup. In this contribution, we will briefly review the HBT effect and present our laboratory setup and the test results in detail.

T 21.3 Mo 16:35 Z6 - SR 2.013

Deep learning based Extraction of Radio Signals from Extensive Air Showers at the Pierre Auger Observatory — •Felix Schlueter, Martin Erdmann, and Radomir Smida — III. Physikalisches Institut A, RWTH Aachen University, Deutschland

In the recent decade, radio measurements have become a very active field in detection of ultra-high energy cosmic rays. This technique enables a new perspective on the physics of extensive air showers, e.g. with measurements of the absolute energy of cosmic rays with a duty cycle close to 100%.
For every analysis of radio data, noise reduction is a challenge. Radio signals from extensive air showers are contaminated by environmental and human-made noise and can be significantly smaller than the measured noise. In this talk, an approach is presented to reduce noise based on the autoencoder concept used in deep learning techniques. This approach is evaluated using air shower simulations with realistic noise measured by the Auger Engineering Radio Array (AERA). An outlook to data application is given.

T 21.4 Mo 16:50 Z6 - SR 2.013

Substantial improvement in the MAGIC energy reconstruction through machine learning algorithms — •Kazuma Ishio[1], David Paneque[1], Abelardo Moralejo[2], and Julian Sitarek[3] for the MAGIC-Collaboration — [1]Max-Planck-Institut für Physik — [2]Institut de Fisica d'Altes Energies (IFAE), The Barcelona Institute of Science and Technology, Bellaterra (Barcelona), Spain — [3]Division of Astrophysics, University of Lodz, Lodz, Poland

The MAGIC telescopes perform gamma-ray astronomy at energies above 50 GeV and extending to about 50 TeV. The energy of the detected gamma ray is estimated with a set of parameters extracted from the shower image on the cameras, and using Look-Up-Tables (LUTs) derived from Monte Carlo simulations. In this talk, I will show that a strategy using random forest (RF) can substantially improve (with respect to LUT) both the energy bias (30% improvement below 100 GeV) and the energy resolution (about 50% improvement above TeV energies). I will show that the choice of the image parameters and the procedure of nesting the RF process across the entire energy range play a crucial role in this improvement.

T 21.5 Mo 17:05 Z6 - SR 2.013

MC simulations of KATRIN's source on GPUs* — •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.).

The electrons in the Windowless Gaseous Tritium Source (WGTS), emanating from tritium decay, are emitted isotropically and guided magnetically. Thereby, the electrons undergo different effects, changing their kinetic energy, and angle to the guiding field. The major influence herein is elastic and inelastic scattering.

The differential electron spectrum, emitted at the source, needs to be well-understood in order to monitor the source parameters, to look for sterile neutrinos, and to fit the neutrino mass.

Monte-Carlo simulations of the source need high computational power. So far, KATRIN's own software package KASSIOPEIA was used to perfom these simulations. In order to improve the simulation speed by at least two orders of magnitude the code has been rewritten to run on GPUs aiming at a full MC simulation of the experiment.

Solutions for the obstacles of MC simulations on GPUs, optimizations, and speed comparisons are presented in this talk.

** Gefördert durch das BMBF.*

T 21.6 Mo 17:20 Z6 - SR 2.013

Models of the signal response from SiPMs and PMTs — •Oleg Kalekin — Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP

New model of the single photoelectron charge distribution from PMTs is presented. This model features the asymmetrical shape of the distribution with a high tail towards small amplitudes in contrast to the simple Gaussian distribution frequently used. New model of the SiPM signal response with cross-talk is presented. Influence of the cross talk is modelled with a multinomial distribution. This model demonstrates good results when fitting the SiPM signal charge distribution.

T 21.7 Mo 17:35 Z6 - SR 2.013

Cascade reconstruction in an IceCube-Gen2 detector equipped with multi-PMT Optical Modules — •Cristian Jesus Lozano Mariscal, Lew Classen, and Alexander Kappes for the IceCube-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster

In addition to an enlarged instrumented volume of 5-10 km^3, a further increase in sensitivity of the planned successor of the IceCube neutrino observatory at the South Pole, IceCube-Gen2, is anticipated from new optical sensor concepts. One of these concepts is the multi-PMT optical module (mDOM), which, in contrast to the conventional IceCube module with its single 10-inch PMT, features 24 3-inch PMTs facing in all directions. In particular, the added information on the arrival direction of the photons obtained through this segmentation of the photosensitive area, is expected to improve the directional reconstruction of events. The contribution presents first results of studies on the performance of an IceCube-Gen2 detector equipped with mDOMs in the reconstruction of cascade events.

T 21.8 Mo 17:50 Z6 - SR 2.013

A new end-to-end calibration of the Fluorescence Detector of the Pierre Auger Observatory * — •Eric Mayotte for the Pierre Auger-Collaboration — Bergische Universität Wuppertal, Gaußstraße 20, 42119 Wuppertal

The Fluorescence Telescopes are crucial to the science goals of the Pierre Auger Observatory. Currently, to ensure the accuracy of their measurements, a relative calibration of each telescope is performed

nightly. To improve upon this established calibration, as well as to improve the time-dependent end-to-end calibration of each telescope's optics and camera, a new absolute calibration process has been developed. The core of the technique consists of scanning a calibrated Lambert-sphere UV light source across the aperture of the outermost component of each of the telescope's optics and reading out the response of the PMT camera. The camera response is then compared to the known light source characteristics and simulated end-to-end optical performance of the instrumentation in order to provide a real-world absolute calibration of each telescope. This talk will give a brief overview of the method as well as the absolute calibration of the Lambert-sphere light source. Preliminary measurements on the light source output intensity, uniformity, and time-stability will also be presented.
* Gefördert durch die BMBF Verbundforschung Astroteilchenphysik (Vorhaben 05A17PX1 und 05A17VK1)

T 21.9 Mo 18:05 Z6 - SR 2.013

Search for Cosmic Particles on the ZeV Scale with the Moon and LOFAR — •Tobias Winchen[1], A. Bonardi[2], S. Buitink[1], A. Corstanje[2], H. Falcke[2,3,5], B. Hare[4], J. R. Hörandel[2,3], P. Mitra[1], K. Mulrey[1], A. Nelles[2,3,7], J. P. Rachen[2], L. Rossetto[2], P. Schellart[2,8], O. Scholten[4,6], S. ter Veen[5], S. Thoudam[2], and T.N.G. Trinh[4,6] — [1]Vrije Universiteit Brussel (Belgium) — [2]Radboud University Nijmegen (The Netherlands) — [3]NIKHEF (The Netherlands) — [4]KVI-CART (The Netherlands) — [5]ASTRON (The Netherlands) — [6]University of Groningen (The Netherlands) — [7]Now at University of California Irvine (USA) — [8]Now at Princeton University (USA)

A significant challenge to answer the long standing question about the origin and nature of ultra-high energy cosmic rays (UHECR) is given by their extremely low flux. Even lower fluxes of neutrinos with energies beyond the ZeV (10^{21} eV) scale are predicted in certain Grand-Unifying-Theories (GUTs) and e.g. models for super-heavy dark matter (SHDM). The significant increase in detector volume required to detect these particles can be achieved by employing Earth's moon as detector and search for radio pulses that are emitted when a particle interacts in the lunar rock with a radio telescope. Here, we give an overview on the design and status of a corresponding search with the LOFAR radio telescope.