SYMD 1: SMuK Dissertationspreis 2018

Zeit: Montag 14:00–16:00 Raum: Z6 - HS 0.004

Hauptvortrag SYMD 1.1 Mo 14:00 Z6 - HS 0.004
The Data Mining Guide to the Galaxy and Beyond — •Sabrina Einecke — Technical University of Dortmund, Germany — The University of Adelaide, Australia

The scientific branches Big Data and Data Mining are increasingly becoming an integral part in astronomy, cosmology and particle physics. Numerous experiments in various energy regimes provide immense amounts of data that need to be accurately combined, analyzed and interpreted. Forthcoming experiments of a new era, such as CTA or SKA, will produce mind-blowing data rates of up to multiple Petabytes per second, demanding close collaborations between the branches.

This dissertation connects these in an interdisciplinary manner, and supports exciting research fields, such as population studies of blazars, the search for dark matter, or follow-up observations of transients. Furthermore, it addresses further questions, such as the origin of astrophysical neutrinos and ultra-high-energy cosmic rays, cosmological evolution, and emission and acceleration mechanisms of Active Galactic Nuclei (AGN). The validity of the newly developed data mining method to search for AGN and blazar candidates and their corresponding multi-wavelength counterparts has been confirmed, and the redshifts of the most confident candidates have been estimated. Based on that, dedicated observations with the MAGIC telescopes of the overall most promising blazar candidate have been analyzed, and have been set in a multi-wavelength context, revealing deeper insights into the object. Moreover, the MAGIC analysis has been successfully optimized by exploiting data mining methods.

Hauptvortrag SYMD 1.2 Mo 14:30 Z6 - HS 0.004
A novel method for the energy determination of ultra-high energy cosmic rays through radio emission of particle showers — •Christian Glaser — University of California, Irvine, USA — Physics Institute 3a, RWTH Aachen University

The origin of ultra-high-energy cosmic rays is one of the foremost question in astroparticle research. For corresponding analyses, reliable reconstruction of the particle properties is essential. Most challenging is an accurate determination of the cosmic-ray energy far above energies reached at earth-bound accelerator facilities. Impinging onto the atmosphere, ultra-high energy cosmic rays induce huge cascades of secondary particles. The novel method to access cosmic-ray energies are measurements of the energy radiated by these air showers in form of MHz radio waves. The amount of radiation increases with the primary cosmic-ray energy and the radiation process is almost independent of variations in the atmospheric conditions. With the transparency of the atmosphere to MHz radio waves, the emitted radiation reaches ground essentially undisturbed. Their measurement with antenna stations is then complemented by calculations from first-principles using classical electrodynamics which together provide the absolute energy of the cosmic ray. These advantages lead to an improved systematic uncertainty compared to established methods. The new method will be discussed for the Engineering Radio Array (AERA) of the Pierre Auger Cosmic-Ray Observatory. It is compared to alternative methods, and put into the context of other world-wide observatories.

Hauptvortrag SYMD 1.3 Mo 15:00 Z6 - HS 0.004
Measuring the neutrino mass hierarchy with the future KM3NeT/ORCA detector in the deep sea — •Jannik Hofestädt — Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP

A key question of particle physics is the ordering of the three neutrino mass eigenstates. This so-called neutrino mass hierarchy can be resolved by measuring the energy- and zenith-angle-dependent oscillation pattern of few-GeV atmospheric neutrinos. This is the primary goal of KM3NeT/ORCA, a future underwater Cherenkov detector at the bottom of the Mediterranean Sea. Among the experimental challenges are the optimisation of the experimental accuracy and efficiency as well as the control of the systematics, including specificities of the natural deep-sea environment, such as optical background due to bioluminescence.

I will present my work performed to investigate and optimise the ORCA sensitivity to the neutrino mass hierarchy, including the development of a new reconstruction algorithm for neutrino events and the optimisation of detector layout and event triggering. With these key ingredients the neutrino mass hierarchy can be determined with ORCA with 3-sigma significance after 3-4 years of operation.

Hauptvortrag SYMD 1.4 Mo 15:30 Z6 - HS 0.004
Milestone toward a nuclear clock: On the direct detection of ^{229m}Th — •Lars von der Wense, Benedict Seiferle, and Peter G. Thirolf — Ludwig-Maximilians-Universität München, 85748 Garching, Germany

The measurement of time has always been an important tool in science and society. ^{229m}Th offers the potential for the development of an ultra-precise nuclear clock that may outperform existing atomic clock technology. However, despite 40 years of past research, no direct decay detection of this nuclear state was achieved. Experiments are described that have led to the first direct detection of the ground-state decay of ^{229m}Th [1] and a first characterization of the isomeric decay parameters [2]. These measurements pave the way for the development of a nuclear clock. Based on this direct detection, a new nuclear laser excitation scheme was proposed [3] and a first laser spectroscopic characterization of ^{229m}Th was performed [4].

[1] L. v.d.Wense et al., Nature 533, 47-51 (2016).
[2] B. Seiferle et al., PRL 118, 042501 (2017).
[3] L. v.d.Wense et al., PRL 119, 132503 (2017).
[4] J. Thielking et al., Nature, in print, arxiv:1709.05325 [nucl-ex].

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