T 80: Neutrinophysik VIII

Zeit: Donnerstag 16:30–18:35 Raum: Z6 - HS 0.001

Gruppenbericht T 80.1 Do 16:30 Z6 - HS 0.001
KM3NeT/ORCA: status and perspective — •Jannik Hofestädt for the ANTARES-KM3NeT-Erlangen-Collaboration — Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP

ORCA is the low-energy part of KM3NeT, the next-generation underwater Cherenkov neutrino detector under construction in the Mediterranean Sea. ORCA's primary goal is to resolve the long-standing question of the neutrino mass hierarchy by measuring matter-induced modulations on the oscillation probabilities of few-GeV atmospheric neutrinos. ORCA features a dense configuration of optical modules, optimised for the study of interactions of neutrinos with energies down to a few GeV. The same technology, albeit in a sparser configuration, is also used for high-energy (TeV-PeV) neutrino astronomy with the ARCA neutrino telescope, the other part of KM3NeT. The first ORCA detection unit was successfully deployed on 22.9.2017 and is providing high-quality data since then.

In this talk, the status of the ORCA detector construction and the performance of the first detector modules in the deep sea will be reported. The expected sensitivity of ORCA to the neutrino mass hierarchy and oscillation parameters are discussed.

T 80.2 Do 16:50 Z6 - HS 0.001
Tau-neutrino appearance with KM3NeT/ORCA — •Steffen Hallmann for the ANTARES-KM3NeT-Erlangen-Collaboration — Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP

The deep-sea neutrino detector KM3NeT/ORCA – currently under construction in the Mediterranean Sea – is optimised to study oscillations of atmospheric neutrinos in the few GeV energy range. Within its instrumented volume of more than 7 Mm^3 of sea water, an unprecedented statistics of >3k neutrinos per year are detected which have oscillated from a purely ν_μ and ν_e initial flux into the ν_τ-channel along their passage through Earth. As the major contribution comes from $\nu_\mu \longrightarrow \nu_\tau$ conversion, the ν_τ flux can be determined as a statistical excess of shower-like event topologies.

The contribution will present the sensitivity of KM3NeT/ORCA to ν_τ-appearance. Recent improvements in the detector geometry, trigger and reconstruction algorithms with respect to the performance presented in the Letter of Intent for KM3NeT 2.0 are taken into account. KM3NeT/ORCA will confirm the exclusion of non-appearance within the first months of operation. In the longer run, a precise measurement of the ν_τ normalisation will allow to put stringent experimental constraints on the commonly presumed unitarity of the PMNS matrix describing 3-flavour neutrino mixing.

T 80.3 Do 17:05 Z6 - HS 0.001
Results from Measuring the Neutrino Mass Ordering with IceCube DeepCore — •Martin Leuermann, Martin Rongen, Marius Wallraff, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut B, Otto-Blumenthal-Str., 52074 Aachen

The measurement of the Neutrino Mass Ordering (NMO), i.e. the ordering of the neutrino mass eigenstates, is one of the outstanding questions in Neutrino Physics which is in the focus of many experiments. One experimental strategy is to measure matter effects in the oscillation pattern of atmospheric neutrinos, while propagating through Earth, as proposed for PINGU as part of the IceCube-Gen2 Neutrino Observatory. With three years of data from the currently running IceCube Deepcore detector, we have explored this type of measurement, resembling the methods as proposed for PINGU. However, due to the higher energy threshold, the sensitivity is lower. In this talk, we present the results of this first measurement.

T 80.4 Do 17:20 Z6 - HS 0.001
Combining JUNO and PINGU to determine the neutrino mass hierarchy — •Jan Weldert, Thomas Ehrhardt, Sebastian Lorenz, Michael Wurm, and Sebastian Böser — Johannes Gutenberg-Universität Mainz

The neutrino mass hierarchy (NMH) - i.e., the order of the mass eigenstates ν_1, ν_2, ν_3 - is one of the fundamental open questions in neutrino physics. Both the Jiangmen Underground Neutrino Observatory (JUNO) and the Precision IceCube Next Generation Upgrade (PINGU) will carefully examine the oscillation behavior of neutrinos to determine the NMH. For this purpose, JUNO will measure the energy dependent flux of MeV reactor neutrinos, whereas PINGU specializes in the measurement of the energy and direction dependent flux of GeV atmospheric neutrinos. More precisely, JUNO searches for the NMH via tiny wiggles in the energy spectrum due to the reactor neutrino survival probability in vacuum. PINGU, on the other hand, looks for NMH-dependent oscillation signatures from terrestrial matter effects. The combination of these approaches and the excellent energy resolution of JUNO together with the high statistic of PINGU are expected to yield sensitivity beyond the purely statistical combination because of the different impacts of the mass difference $\Delta m^2_{31} = m^2_3 - m^2_1$ in the two experiments. This talk covers the current status of a combined analysis of JUNO and PINGU.

T 80.5 Do 17:35 Z6 - HS 0.001
Determining the neutrino mass with the Megaton Ice Cherenkov Array (MICA) — •Elisa Lohfink, Maike Jung, Thomas Ehrhardt, Lutz Köpke, and Sebastian Böser — Johannes Gutenberg-Universität Mainz, Mainz, Germany

The Megaton Ice Cherenkov Array (MICA) is an envisioned low-energy extension of the IceCube neutrino telescope. It aims at the detection of extragalactic supernovae at distances of up to 10 Mpc through a large effective volume and a sensor spacing optimized for MeV neutrinos. This results in a supernova detection rate at the order of one per year, as compared to the rate of galactic supernovae of one per century to which existing detectors are sensitive. In addition to the rich information on supernova- and astrophysics that could be obtained with such a detector we show the possibility to determine the neutrino mass using mass-dependent delays in the neutrino time-of-flight. For supernova neutrinos, this causes an energy- and distance-dependent shift of the arrival time spectrum. With the SN detection range of MICA of up to 10 Mpc, this effect will be significantly enhanced compared to galactic supernovae. Using only data from MICA, the biggest uncertainty stems from the exact explosion time and onset of the neutrino flux. External information on the explosion time, e.g. from future gravitational wave detectors, would therefore further improve the obtained mass limits especially for distant supernovae.

T 80.6 Do 17:50 Z6 - HS 0.001
Investigating the atmospheric neutrino to antineutrino ratio with IceCube DeepCore — •Lasse Halve, Marvin Beck, Martin Leuermann, Saskia Philippen, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

The IceCube Neutrino Observatory, located at the geographic South Pole, measures neutrinos and antineutrinos produced in cosmic-ray showers in the atmosphere. Neutrinos and antineutrinos cannot be distinguished on an event-to-event basis within IceCube. However, they show different distributions in the inelasticity parameter y for deep inelastic scattering. Based on a new reconstruction of y with machine-learning methods in the muon-neutrino channel, we present a first analysis dedicated to measure the energy-dependent $\nu/\bar{\nu}$ ratio above 100 GeV.

T 80.7 Do 18:05 Z6 - HS 0.001
Model Independent Measurement of the Atmospheric Muon Neutrino Energy Spectrum with 3 Years of IceCube Data — •Mathis Börner, Mirco Huennefeld, Tobias Hoinka, Thorben Menna, and Maximillian Meier for the IceCube-Collaboration — U Dortmund, Lehrstuhl für Experimentelle Physik 5b, Otto-Hahn-Straße 4a, 44227 Dortmund

The main array of the IceCube neutrino observatory is the largest running neutrino detector in the world and covers neutrino energies starting at a few hundred GeV and ending in the PeV region. This allowed to prove the existence of astrophysical neutrinos and now with increasing data to probe the detailed spectral shape of the different flux components. In this contribution a model independent unfolding of the muon neutrino spectrum between 125 GeV and 2.5 PeV is presented. This covers the transition between an atmospheric to an astrophysical dominated spectrum.

The analysis consists of a selection to obtain a sample of muon neutrino events and a subsequent unfolding. The event selection utilizes modern machine learning techniques to achieve maximal efficiency while preserving a signal purity over 99%. For the first time in IceCube, data from multiple years are used in a dedicated unfolding analysis. In conjunction with the efficient event selection this analysis provides the most precise model independent measurement of the muon neutrino flux in this energy region.

T 80.8 Do 18:20 Z6 - HS 0.001

Myonspurrekonstruktion bei SNO+ — •Johann Dittmer, Mikko Meyer und Kai Zuber — TU Dresden, Institut für Kern- und Teilchenphysik, Germany

SNO+ ist ein Flüssigszintillator-Experiment, bestehend aus einer Acrylsphäre mit 12 m Durchmesser. Aufgebaut ist das Experiment in 2 km Tiefe in einer Mine bei Sudbury, Ontario, Kanada. Das Hauptziel ist die Suche nach dem neutrinolosen Doppel-Betazerfall ($0\nu\beta\beta$) bei ^{130}Te; es können aber auch solare, Geo-, Reaktor- und Supernova-Neutrinos vermessen werden. Nach einer anfänglichen Wasser-Phase wird der Detektor mit Flüssigszintillator sowie 0,3-0,5 % natürlichen Tellur gefüllt.

Der Vortrag behandelt die Spurrekonstruktion von kosmischen Myonen, die den Detektor erreichen und dort Untergrundprozesse induzieren. Mit Hilfe der Spurrekonstruktion können solche Prozesse selektiert werden.