T 8: Neutrino astronomy I

Time: Monday 16:30–18:05 Location: H-HS VI

Group Report T 8.1 Mon 16:30 H-HS VI
KM3NeT: Physikziele und erste Daten — •Matthias Bissinger für die KM3NeT-Kollaboration — Erlangen Centre for Astroparticle Physics, Erwin-Rommel-Str. 1, 91058 Erlangen, Germany

Die im Bau befindliche Forschungsinfrastruktur KM3NeT vor den Küsten Frankreichs und Siziliens wird sowohl fundamentale Aspekte der Neutrinophysik erforschen als auch Quellen kosmischer Neutrinos. Dabei kommen zwei Detektoren zum Einsatz, ORCA und ARCA, die aus technisch identischen Wasser-Cherenkov-Modulen bestehen. Aus den Daten von KM3NeT/ORCA lassen sich die Oszillationswahrscheinlichkeiten von Neutrinos, die in der Erdatmosphäre entstehen, ableiten. Dadurch soll es gelingen, die Neutrino-Massenhierarchie zu bestimmen. KM3NeT/ARCA, welcher mit einem Kubikkilometer ein wesentlich größeres Detektorvolumen aufweist als ORCA, wird nicht nur das Gesichtsfeld des IceCube-Neutrinoeleskops am Südpol auf die gesamte Himmelskugel erweitern, sondern strebt insbesondere auch den Nachweis von Neutrinos aus Quellen in unserer Galaxis an. Die Inbetriebnahme erster Detektoreinheiten von KM3NeT/ORCA und ARCA ist erfolgt und der Vortrag wird neben den wissenschaftlichen Zielen von KM3NeT einen Überblick zur Aufbauphase und zu den ersten Messergebnissen geben.

T 8.2 Mon 16:50 H-HS VI
Studies of systematic uncertainty effects on IceCube's real-time angular uncertainty — •Cristina Lagunas Gualda for the IceCube-Collaboration — DESY Zeuthen

Sources of astrophysical neutrinos can be potentially discovered through the detection of neutrinos in coincidence with electromagnetic or gravitational waves. Real-time alerts generated by IceCube play an important role in this search since they act as a trigger for follow-up observations with more sensitive instruments.

Once a high-energy event is detected by the IceCube real-time program, an automatic GCN notice is generated within the first tens of second using a fast and crude reconstruction method. Then a more sophisticated and time-consuming method is run in order to calculate a more accurate localization and uncertainty estimate including an estimate on systematic uncertainties. There is a discrepancy between the spatial uncertainty contours from the two methods with the latter once being significantly larger.

To investigate this discrepancy and especially the effect of systematic uncertainties, we focus on individual high-energy events and simulate similar events in direction and energy for different ice model realizations. This makes use of a novel simulation tool, which allows the treatment of systematic uncertainties with multiple and continuously varied nuisance parameters.

T 8.3 Mon 17:05 H-HS VI
Up-going simulations of neutrino induced Extensive Air Showers with the Fluorescence Detector of the Pierre Auger Observatory* — •Ioana Caracas for the Pierre Auger-Collaboration — Bergische University Wuppertal, Germany

The Pierre Auger Observatory is performing a follow-up of the recent ANITA observations of up-going cosmic ray-like showers with energies around 0.1-1 EeV. These anomalous events could be seen within the Fluorescence Detector (FD) of the observatory. As the exposure of the FD for 14 years of data taking is exceeding the exposure of ANITA by a factor of at least 100, it is strongly believed the current research will be able to either confirm or infirm the recent observations.

Simulations of up-going extensive air showers with elevation of more than $\approx$ 20 degrees below the horizon represent the first step in this search. The extensive air showers are simulated using CORSIKA with primary energies in the range of 10^{17} - $10^{18.5}$ eV; three different primaries are simulated: protons, electrons and tauons, as the main candidates resulted from a neutrino charged current (CC) interaction. The detector response is simulated using the Offline software of the collaboration. These simulations will be used to estimate the sensitivity of the FD to these evens, to optimize the selection of events in real data and reduce the chance of false positives, as well as to provide insight into the nature of these events. Preliminary results of these simulations and estimated exposures will be presented and discussed.

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T 8.4 Mon 17:20 H-HS VI
Cosmic ray detection efficiency and implications for in-ice radio detectors for high-energy neutrinos — •Lilly Pyras for the RNO-G-Collaboration — Humboldt-Universität zu Berlin — DESY Zeuthen

A promising technique to measure neutrinos above 10 PeV is the detection of the radio signals generated by the Askaryan effect. The effect is caused by neutrino-induced particle cascades in dense media i.e. ice. Starting in 2020 a new detector using this technique and containing in-ice detector strings will be deployed in Greenland. One of the main challenges of the data analysis will be distinguishing between a cosmic ray muon and a real neutrino event. By building the detector with surface antennas we can use the established method of radio detection of air showers to identify incoming muons and use these signals as a veto mechanism in the neutrino detection. The data is analysed utilizing a Python based software tool, NuRadioReco, a general reconstruction software used for both neutrino and air shower radio arrays. An efficient veto trigger will lend higher confidence in identifying neutrinos and prevent the false positive neutrino detections caused by muons. This report presents the development of this mechanism and analyses its performance.

T 8.5 Mon 17:35 H-HS VI
Latest results of the ANTARES deep-sea neutrino telescope — •Sara Rebecca Gozzini for the ANTARES-KM3NeT-Erlangen-Collaboration — ECAP / Universität Erlangen-Nürnberg

ANTARES is the largest undersea neutrino detector, installed in the Mediterranean Sea, and is primarily sensitive to neutrinos in the TeV-PeV energy range. Data taking with the telescope has been continous since 2008. In a multitude of analyses ANTARES investigates the southern sky for neutrino signals from possible steady point sources, transient and extended neutrino emitters. A special focus is set on work towards an independent confirmation of the diffuse cosmic neutrino flux discovered by IceCube. ANTARES also contributes actively to multi-messenger and multi-instrument analyses. Sensitive searches for dark matter and exotic particle states, as well as results on neutrino oscillations in the conventional three-flavour picture and beyond complement the ANTARES research program. The contribution gives a selected overview of the latest results.

T 8.6 Mon 17:50 H-HS VI
Study of double cascade sensitivity in IceCube-Gen2 — •Fuyudi Zhang for the IceCube-Collaboration — DESY, Zeuthen

The IceCube Neutrino Observatory is a cubic kilometer in-ice Cherenkov detector located at the South Pole. At high energies, the neutrino flux of $\nu_e : \nu_\mu : \nu_\tau$ is expected to be observed in the ratio of 1 : 1 : 1 on Earth. A ternary particle identification technique on the basis of three event topologies, single cascades, double cascades, and tracks, has been developed. While tracks arise mainly from charged-current muon neutrino interactions, single cascades from neutral-current interactions of all neutrino flavors and many charge-current interactions of ν_e. Double cascades arise from ν_τ charged-current interactions and subsequent non-muonic decay of the taus if the decay length is large enough to be resolved (E $> \sim$ 100 TeV). Such double cascades are unique to tau neutrinos and can be used to identify them. The next-generation neutrino observatory, IceCube-Gen2 will have an instrumented volume nearly 10 times greater than IceCube and a different geometry with larger string spacing. In this work I will present a study to estimate the double cascade identification efficiency in IceCube-Gen2, by analyzing the IceCube high-energy starting event sample but only using a subset of the optical sensors that is similar in layout to the future IceCube-Gen2 geometry.