T 80: Neutrinophysik 6 (Szintillatorexperimente)

Zeit: Mittwoch 16:45–19:10 Raum: H 2

Gruppenbericht T 80.1 Mi 16:45 H 2

Neutrino Physics with JUNO — •Henning Rebber for the JUNO-Collaboration — Universität Hamburg, Institut für Experimentalphysik

The Jiangmen Underground Neutrino Observatory (JUNO) is a next-generation neutrino experiment currently being built in the province Guangdong in the South of China. Below an overburden of $\sim$ 1900 m.w.e., 20 kt of liquid scintillator will be used to detect reactor antineutrinos from two power plants at a distance of $\sim$ 53 km. The primary goal is to determine the neutrino mass ordering from oscillation measurements. An energy resolution below 3 % @ 1 MeV is intended to reach at least $3\,\sigma$ significance. Furthermore, JUNO can improve the precision on solar oscillation parameters to below 1 %, and allows for the measurement of neutrinos from Earth, Sun, and core-collapse supernovae. The start of data taking is planned for 2020. This talk will review the physics potential of JUNO, as well as the current status of design and construction. This work is funded by the DFG research unit JUNO.

Gruppenbericht T 80.2 Mi 17:05 H 2

Topological track reconstruction in unsegmented multi-kiloton liquid scintillator neutrino detectors — Felix Benckwitz[1], Christoph Genster[2], Caren Hagner[1], Daniel Hartwig[1], •Sebastian Lorenz[3], David Meyhöfer[1], Björn Opitz[1], Henning Rebber[1], Michaela Schever[2], Hauke Schmidt[1], Alexander Tietzsch[4], Katharina Voss[1], Björn Wonsak[1], and Michael Wurm[3] — [1]Univ. Hamburg, Inst. für Experimentalphysik — [2]Forschungszentrum Jülich, Inst. für Kernphysik — [3]Johannes Gutenberg-Univ. Mainz, Inst. für Physik — [4]Eberhard Karls Univ. Tübingen, Physikalisches Inst.

The precise reconstruction of charged particle tracks in unsegmented liquid scintillator (LSc) neutrino detectors, e.g., from muons, is an important prerequisite for the efficient rejection of cosmogenic background events or the analysis of multi-GeV neutrino interactions. Topological information on such events, i.e., the reconstructed 3D density distribution of isotropically emitted scintillation photons, opens up new ways to accomplish these tasks. Especially future multi-kiloton LSc detectors will profit from improved (muon) track reconstruction possibilities, both regarding their low- and high-energy neutrino physics programs. Connected to the international JUNO project in China, a topological track reconstruction method for unsegmented LSc detectors is developed in Germany. Its application to simulated muon events already showed that the particle's differential energy loss $\mathrm{d}E/\mathrm{d}x$ is accessible. This talk summarizes recent developments and the current status of the reconstruction method.

T 80.3 Mi 17:25 H 2

Status of the PALM Experiment for JUNO — •Sabrina Prummer[1], Julia Sawatzki[1], Lothar Oberauer[1], Andreas Ulrich[2], Hans Steiger[1], Mario Schwarz[1], and Philipp Landgraf[1] — [1]TU München, E15, Physik-Dep, Garching — [2]TU München, E12, Physik-Dep, Garching

Status Update of the Precision Attenuation Length Measurement Setup

The planned JUNO detector is a 20kt liquid scintillator neutrino detector. Its primary goal is the determination of the neutrino mass hierarchy. This will be done by precision measurements of the reactor antineutrino survival probability. Due to the spherical detector's diameter of approx. 35.5 m, the optical parameters, especially the attenuation length, of the scintillator have to be known precisely and have to be very good to achieve the required energy resolution of 3%@1MeV. To determine one of the crucial optical parameters, the attenuation length, a new spectrometer experiment, called PALM, was built. Unless the commercially available spectrometers with light paths up to 10 cm, this spectrometer is able to measure light paths up to 2.8 m through the medium, making it possible to determine the attenuation length very precisely. This talk will give a status update on the commissioned PALM setup. This work is supported by the DFG cluster of excellence "Origin and Structure of the Universe"(www.universe-cluster.de), the DFG research unit "JUNO" and the Maier-Leibniz-Laboratorium.

T 80.4 Mi 17:40 H 2

Studies on muon track reconstruction with the JUNO liquid scintillator neutrino detector — •Christoph Genster and Livia Ludhova — Forschungszentrum Juelich, IKP-2

The Jiangmen Underground Neutrino Observatory (JUNO) is a 20 kt liquid scintillator detector. Its main goal is the determination of the neutrino mass hierarchy with neutrinos from two nuclear power plants at 53 km baseline. Fast and effective muon tracking is essential for the veto of atmospheric muons and the detection of atmospheric muon neutrinos. An expected muon rate of 3 / second inside the detector makes a partial veto of volume along the track mandatory. To achieve this, JUNO features an outer water Cherenkov detector around its liquid scintillator central detector. Due to the isotropic emission of light, tracking in liquid scintillator is more difficult than in water. Results for muon tracking in those two subdetectors of JUNO are presented.

T 80.5 Mi 17:55 H 2

Topological track reconstruction for Borexino — •Björn Opitz[1], Björn Wonsak[1], Daniel Bick[1], Sebastian Lorenz[2], and Michael Wurm[2] — [1]Universität Hamburg, Institut für Experimentalphysik — [2]Johannes Gutenberg-Universität Mainz, Institut für Physik

In unsegmented liquid scintillator detectors like Borexino, signal and background events are recorded by measuring the scintillation light from charged particle interactions in the detector volume. A novel event reconstruction technique, currently being developed at several German institutes, allows an improved reconstruction of track topologies within the detector (see the overview talk by Sebastian Lorenz, Uni Mainz). In particular, particle showers induced by cosmic muons can be identified and analyzed. Up to now, the method has been implemented and used for Monte Carlo studies concerning the planned experiments LENA and JUNO. Adopting the reconstruction technique for Borexino allows the use of real data and a comparison with standard reconstruction methods for both neutrino and muon events. The current status of the implementation is presented.

T 80.6 Mi 18:10 H 2

Improvement of Position Reconstruction in Borexino — •Johann Martyn for the Borexino-Collaboration — Johannes Gutenberg-Universität Mainz

Borexino is measuring neutrinos through scintillation events in the target volume, which are intrinsically undistinguishable from the radioactive background. Using time of flight of the scintillation light to reconstruct the position of the events it is possible to construct a fiducial volume wich greatly surpresses the gamma background. Currently the neutrino interaction point in the Borexino detector is reconstructed with an uncertainty of 15cm at 1 MeV and shows systematic shifts at the edge of the detector. For the Borexino experiment this behaviour can be handled by using a fiducial volume, but for the upcoming search for sterile neutrinos in Borexino (SOX) it is important to use a maximal volume and thus to understand the systematic shifts close to the detector edge and if possible remove them and it is useful to have a position reconstruction as good as possible. This talk will present the improvements on the current position reconstruction algorithm of Borexino and describe the systematic shifts and their handling.

T 80.7 Mi 18:25 H 2

Borexino Detector Studies with Background Components — •Stefan Weinz for the Borexino-Collaboration — Universität Mainz

The SOX experiment searches for sterile neutrinos by placing a radioactive $\bar{\nu}_e$ source below the Borexino detector. Oscillations of active to sterile neutrinos are identified by a disappearance pattern of $\bar{\nu}_e$ events within the detection volume. Sensitivity can be increased by enlarging the detection volume as much as possible towards the border of the inner vessel that holds the liquid scintillator. Here, light collection is deteriorating and spill-out effects of γ's into the passive buffer region distort energy and spatial reconstruction.

This talk presents strategies for characterising this peripheral detector region by employing well-defined background events. For this data-driven approach cosmogenic neutron captures on hydrogen and α decays of ^{210} are used, since both are mono-energetic events which allow for the energy response studies. Futhermore cosmogenic neutrons are useful messengers for detector response studies due to their isotropical distribution.

T 80.8 Mi 18:40 H 2

Data Selection in the SOX experiment — •Birgit Neumair for the Borexino-Collaboration — James-Franck-Straße 1, 85748 Garching bei München

In the last years, several neutrino oscillation experiments reported results not compatible within the 3-neutrino model, which hint at the existence of light sterile neutrinos. To test this hypothesis, the SOX (Short distance neutrino Oscillations in BoreXino) experiment will search for oscillations from active to sterile neutrinos by placing a (100-150) kCi ^{144}Ce - $\bar{\nu}_e$ - source underneath the liquid scintillator detector Borexino. Oscillations will be observed via a reduction of the detected interaction rate of the $\bar{\nu}_e$ and an oscillatory pattern as a function of the neutrino energy and travelled distance. In the talk the data selection will be presented.

The work is supported by the DFG cluster of excellence "Origin and Structure of the Universe".

T 80.9 Mi 18:55 H 2

Vertex reconstruction in unsegmented liquid scintillator detectors — Caren Hagner[1], Sebastian Lorenz[2], •David Meyhöfer[1], Henning Rebber[1], and Björn Wonsak[1] — [1]Univ. Hamburg, Inst. für Ex- perimentalphysik — [2]Forschungszentrum Jülich, Inst. für Kernphysik

Large unsegmented liquid scintillator detectors play a key role in modern neutrino physics. Event start time and position are essential parameters for the MeV energy range and usually are determined with a vertex reconstruction. On the other hand, for events in the GeV range, vertex reconstructions have been neglected. But in the case of more sophisticate high energy track reconstructions a vertex determination can provide important initial parameters.

In this talk a vertex reconstruction applicable for MeV events and GeV events will be introduced. It was developed for the LENA detector, but can be used with any unsegmented liquid scintillator detector and no prior knowledge of the event is needed. The basic idea of this vertex reconstruction and preliminary results will be discussed.