T 60: Niederenergie-Neutrinophysik I

Zeit: Dienstag 16:45–19:10 Raum: VMP9 SR 07

Gruppenbericht T 60.1 Di 16:45 VMP9 SR 07
SOX: Search for Sterile Neutrinos with Borexino — •Mikko Meyer for the BOREXINO-Collaboration — Institut für Experimentalphysik, Universität Hamburg

Several observed anomalies in the neutrino sector could be explained by a 4th (sterile) neutrino with a squared mass difference in the order of $1eV^2$ to the other three standard neutrinos. This hypothesis can be tested with an artificial kCi antineutrino (Ce-144/Pr-144) source deployed near or inside a large low background detector like Borexino. The SOX project (short baseline neutrino oscillation with Borexino) aims for the detection of sterile neutrinos and offers the almost unique possibility to observe the characteristic antineutrino oscillation pattern within the detector. The talk will summarize this concept and will show the sensitivities for the possible phases of the experiment.

T 60.2 Di 17:05 VMP9 SR 07
Study of systematics for 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 radioactive electron (anti-)neutrino sources underneath the Borexino detector. Oscillations will be observed via a reduction of the detected interaction rate of the electron(anti-)neutrinos and an oscillatory pattern as a function of the neutrino energy and travelled distance.

The talk will give an overview of the experiment with the focus on the systematics and their impact on the sensitivity for a 100kCi ^{144}Ce source.

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

T 60.3 Di 17:20 VMP9 SR 07
Performance of a high-precision calorimeter for the measurement of the antineutrino-source strength in the SOX experiment — •Konrad Altenmüller for the BOREXINO-Collaboration — Technische Universität München

A calorimeter was developed to measure the thermal power and thus the antineutrino-generation rate of a ^{144}Ce – ^{144}Pr antineutrino-source with $< 1\%$ overall accuracy for the SOX experiment. SOX is searching for neutrino oscillations at short baselines with the Borexino detector to investigate the existence of eV-scale sterile neutrinos. The calorimeter design is based on a copper heat exchanger with integrated water lines for the heat extraction, mounted around the source. A high precision measurement is possible thanks to an elaborate thermal insulation.

In this talk, the design of the calorimeter is reviewed and results of calibration measurements are presented. The thermal insulation of the system was examined and heat losses were quantified. The methods to reconstruct the source power and the decay rate from measurements are described.

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

T 60.4 Di 17:35 VMP9 SR 07
Efficiency of the Borexino Muon Veto — •Dominik Jeschke — Technische Universität München — Borexino Collaboration

The Borexino detector is situated at the LNGS under the Gran Sasso massiv aiming for the detection of solar neutrinos. For these analyses, cosmic muons impose an important background, directly and through the production of cosmic radionuclides in the scintillator. For this reason, a very efficient identification of cosmic muons passing through the detector is crucial.

In this talk, the development of the efficiency of muon identification at Borexino will be analyzed. The angular distribution of muons as well as their seasonal modulation will further be illustrated.

Gruppenbericht T 60.5 Di 17:50 VMP9 SR 07
The Jiangmen Underground Neutrino Observatory — •Julia Sawatzki — Technische Universität München, Physik Department E15, James-Franck-Straße 1, 85748 Garching

The Jiangmen Underground Neutrino Observatory (JUNO) is a next-generation medium-baseline reactor neutrino experiment located in southern China, close to Kaiping. The construction of the 700 m deep underground facility already started and the experiment is scheduled to start data-taking in 2020, and is expected to operate for at least 20 years. The 20 kt liquid scintillator detector will detect low-energy neutrinos with an unprecedented energy resolution of 3% (at 1 MeV). The primary experimental goal is the determination of the neutrino mass hierarchy at 3σ significance from the measurement of the reactor neutrino energy spectrum. Two nuclear power plants: Yangjiang and Taishan are located at a distance of ~ 53 km from the detector. Moreover, JUNO will measure the solar neutrino mixing parameters and the atmospheric neutrino squared-mass splitting with a precision $< 1\%$. In addition, supernova neutrinos, geo-neutrinos, sterile neutrinos as well as solar and atmospheric neutrinos can be studied. This talk will review the status of the project and highlight important scientific objectives.

T 60.6 Di 18:10 VMP9 SR 07
Development of Intelligent Photomultipliers for the JUNO Detector — •Florian Lenz, Marta Meloni, Michael Soiron, Achim Stahl, Jochen Steinmann, and Christopher Wiebusch — III. Physikalisches Institut B, RWTH Aachen University, 52056 Aachen, Germany

The JUNO experiment will be a 20kt liquid scintillator neutrino detector near Kaiping, China, 50km from two nuclear power plants. Its main goal is the determination of the neutrino mass hierarchy from a precise measurement of the energy spectrum of neutrinos. Due to the detector size it is not possible to digitize the signal outside the detector cavern. Therefore FPGAs with a low-level reconstruction combined with a fast adc mounted on the base will convert the PMTs into intelligent sensors. Advantages and disadvantages of this design will be discussed and first measurements will be shown.

T 60.7 Di 18:25 VMP9 SR 07
Präzisionsmessungen der Abschwächlänge für den JUNO-Detektor — •Sabrina Prummer[1], Dominikus Hellgartner[1], Lothar Oberauer[1], Julia Sawatzki[1] und Andreas Ulrich[2] — [1]Technische Universität München E15, James-Franck-Straße, 85748 Garching — [2]Technische Universität München E12, James-Franck-Straße, 85748 Garching

Das geplante JUNO-Experiment ist ein 20 kt Flüssigszintillatordetektor. Das primäre Ziel des Experiments ist die Bestimmung der Neutrino-Massen-Hierarchie durch eine Präzisionsmessung der Reaktor(antielektron)-Neutrino-Überlebenswahrscheinlichkeit. Geplant ist ein kugelförmiger Detektor mit ca 30 m Durchmesser. Dies setzt hohe Anforderungen an die optischen Eigenschaften des Szintillators, speziell an die Abschwächlänge. Das Lösungsmittel LAB wurde mit verschiedenen Aluminiumoxiden aufgereinigt und die optischen Abschwächlängen verglichen. Die Abschwächlänge wurde mit einem UV/Vis-Spektrometer in handelsüblichen 10 cm Küvetten gemessen. Aufgrund des kurzen Lichtwegs sind die resultierenden Fehler sehr groß. Um diese zu verringern und präzise Aussagen treffen zu können, wurde ein neues Spektrometer-Experiment konzipiert und aufgebaut, welches Lichtwege von bis zu 2.9 m ermöglicht. Damit sind präzise Messungen für die Abschwächlänge möglich. Das Ziel ist die für JUNO angepeilte Abschwächlänge von mehr als 22 m (@430nm) mit einem relativen Fehler von maximal 5% zu bestimmen.Unterstützt vom DFG Cluster of Excellence "Origin and Structure of the Universe" und vom Maier-Leibniz-Laboratorium.

T 60.8 Di 18:40 VMP9 SR 07
Non linearities in the light yield of liquid scintillators — •Tobias Drohmann, Lothar Oberauer, Corbinian Oppenheimer, Sabrina Prummer, Julia Sawatzki, Stefan Schönert, and Vincenz Zimmer — Physik-Department and Excellence Cluster Universe, Technische Universität München, D-85747 Garching

The organic liquid scintillator based JUNO experiment (Jiangmen Underground Neutrino Observatory) has the aim to determine the neutrino mass hierarchy. To achieve this goal an unprecedented energy resolution of 3% at 1 MeV is crucial. Therefore the energy dependent light yield for electrons depositing energy in the scintillator has to be known precisely.

Currently there is an experiment in preparation at the Technical University Munich to measure the non linearity in the light yield of low energy electron events with a low threshold of ∼10 keV. A photomultiplier tube (PMT) is used to detect the light produced by a Compton electron in a liquid scintillator sample. A High Purity Germanium Detector, operated in coincidence with the PMT, is used to determine the deposited energy in the scintillator by measuring the remaining energy of the Compton scattered γ-ray. The talk will present the status of this experiment.

This research was supported by the DFG cluster of excellence 'Origin and structure of the Universe', the Maier-Leibnitz-Laboratorium (MLL) in Garching and the DFG JUNO-Forschergruppe.

T 60.9 Di 18:55 VMP9 SR 07

A PMT Mass Testing Facility for the JUNO Experiment
— •Alexander Tietzsch[1], Isabell Alsheimer[1], Bosse Bein[2], Daniel Bick[2], David Blum[1], Joachim Ebert[2], Caren Hagner[2], Tobias Lachenmaier[1], Henning Rebber[2], Lisa Steppat[2], Tobias Sterr[1], and Björn Wonsak[2] — [1]Physikalisches Institut, Universität Tübingen — [2]Institut für Experimentalphysik, Universität Hamburg

The JUNO (Jiangmen Underground Neutrino Observatory) experiment will be one of the big neutrino oscillation experiments starting in the next years. The main goal of JUNO is the determination of the neutrino mass hierarchy. To detect the sub-dominant effects in the oscillation pattern which depend on the mass hierarchy, the JUNO detector is planned with almost 20 kt fiducial volume, high light yield and energy resolution of better than 3%. In order to reach this, roughly 17000 newly developed high QE PMTs for the central detector, and additionally 2000 for the veto will be used. Each PMT has to be tested and characterized before it will be mounted in the experiment. This talk will give an overview on our plans and strategy for the mass test of all PMTs, and on the current status of the experimental test setup and next steps. The testing facility will be developed in a cooperation between the Physical Institutes in Tübingen and Hamburg within the JUNO collaboration. This work is supported by the Deutsche Forschungsgemeinschaft.