T 9: Neutrinophysik IX

Zeit: Montag 16:00–18:30 Raum: Z6 - HS 0.002

T 9.1 Mo 16:00 Z6 - HS 0.002

First Measurements of Lifetime and Formation Probablility of Orthopositronium in the Linear Alkylbenzene Based Scintillator of JUNO — •Mario Schwarz, Sabrina Franke, Marc Tippmann, Hans Steiger, Lothar Oberauer, Philipp Landgraf, Konstantin Schweizer, and Julia Sawatzki — Technische Universität München, Physik Department, Lehrstuhl für experimentelle Astroteilchenphysik, James-Franck-Str. 1, 85748 Garching bei München

The planned JUNO (Jinangmen Underground Neutrino Observatory) detector will use 20 kt of liquid scintillator (LS) based on LAB (Linear AlkylBenzene) as neutrino target. Reactor antineutrino interactions will be detected by means of inverse beta decay with the emission of a positron and analysis of the resulting luminescent light. An experimental setup for a lifetime determination of orthopositronium formed by positrons in the LS has been developed in Munich. In this talk an overview of the setup is presented as well as data obtained by detailed Monte-Carlo simulations and final measurement results. This work is supported by the DFG Cluster of Excellence ”Origin and Structure of the Universe”, the DFG research unit ”JUNO” and the Maier-Leibniz-Laboratorium.

T 9.2 Mo 16:15 Z6 - HS 0.002

Monitoring Systems for the Filling of the Central Detector of JUNO — •Hans Th. J. Steiger, Mathias Walter, Philipp Landgraf, Lothar Oberauer, Andreas Ulrich, Sabrina Franke, Julia Sawatzki, Mario Schwarz, Konstantin Schweizer, and Marc Tippmann — Technische Universität München, Physik Department, James-Franck-Straße 1, 85748 Garching bei München

In the planned JUNO (Jinangmen Underground Neutrino Observatory) Detector 20 kt of liquid scintillator (LS) will be used as neutrino target. A 120 mm thin highly transparent acrylic hollow sphere stores the target in a water tank. Slightly different filling levels in the tank and the sphere during the filling of these volumes could cause fatal damage of the detector. Therefore precise monitoring of the hydrostatic and gas pressure in both volumes as well as controling the mechanical stress on the acrylic is necessary. Also the filling levels in the water tank and the sphere has to be monitored. For this tasks first concepts and developements carried out in Munich are presented in this talk. This work is supported by the DFG Cluster of Excellence "Origin and Structure of the Universe", the DFG research unit "JUNO" and the Maier-Leibniz-Laboratorium.

T 9.3 Mo 16:30 Z6 - HS 0.002

Status update on the laser system for monitoring the liquid scintillator transparency in JUNO — •Wilfried Depnering for the JUNO-Collaboration — Institute for Physics, JGU Mainz, Germany

In the last years, large-volume liquid scintillator (LS) detectors have made important contributions to low-energy neutrino physics. A future neutrino detector scaling this technology to 20 kt is the Jiangmen Underground Neutrino Observatory (JUNO). Its primary goal is to determine the neutrino mass hierarchy with at least 3σ significance. To reach that goal, an energy resolution of 3% @ 1 MeV is required. Therefore, the transparency of the LS has to be sufficiently high and stable during the whole operation time (attenuation length $\geq$ 20 m @ 430 nm).
One device for in-situ monitoring of the optical LS quality is a laser system inside the central detector of JUNO. It allows to detect potential aging effects of the liquid and a gradient in its refractive index. The latter can be caused by a temperature gradient and would lead to curved light propagation, which would need to be taken into account during the event reconstruction.
This talk presents the current status of the laser system. The development is funded by the DFG research unit “JUNO”.

T 9.4 Mo 16:45 Z6 - HS 0.002

Cavity enhanced long light path attenuation length measurement — •Tobias Heinz, Tobias Lachenmaier, David Blum, Alexander Tietzsch, Axel Müller, Tobias Sterr, and Marc Breisch — Physikalisches Institut, Universität Tübingen

In large liquid scintillator detectors like the JUNO detector a high optical transparency for the produced scintillation light is one of the key requirements for the detector material. To quantify the optical transparency a measurement of the attenuation length is crucial.

The required attenuation length for the liquid scintillator used in the JUNO detector should be greater than 22 m @ 430 nm. The measurement of such a high value is difficult with commercial UV-VIS spectrometers due to the shortness of commonly used absorption cells and the corresponding small decrease in light intensity. This talk will present an alternative method to measure the attenuation length of liquid scintillators using an optical cavity to extend the effective light path through the medium and therefore increases the precision of the attenuation measurement. The current status of the experimental setup and some first results will be presented.

This work is supported by the Deutsche Forschungsgemeinschaft.

T 9.5 Mo 17:00 Z6 - HS 0.002

Status Update of the PALM Setup — •Sabrina Franke[1], Julia Sawatzki[1], Lothar Oberauer[1], and Andreas Ulrich[2] for the JUNO-Collaboration — [1]Technical University of Munich, Physics Department, E15, James-Franck-Str 1, 85748 Garching — [2]Technical University of Munich, Physics Department, E12, James-Franck-Str 1, 85748 Garching

Status update of the Precision Attenuation Length Measurement Setup (PALM) in the framework of the JUNO collaboration. The Jiangmen Underground Neutrino Observatory is a 20 kt liquid scintillator neutrino detector. Its primary goal is the determination of the neutrino mass hierarchy. To achieve this, precision measurements of the reactor antineutrino survival probability will be done. Due to the detector's diameter of approx. 40 m, the attenuation length is a crucial parameter for the energy resolution an can not be measured with commercially available spectrometers in the needed order of magnitude (10 cm vs. meter range). Therefore, the PALM setup was developed, which make it possible to measure light paths through the medium up to approx. 2.9 m and to determine the attenuation length very precisely. In this talk, a status update on measurements with the PALM experiment will be given. This work is sponsored by the DFG - JUNO funding.

T 9.6 Mo 17:15 Z6 - HS 0.002

Radon Monitoring in gaseous Nitrogen used for the Filling of the Central Detector of JUNO — •Hans Th. J. Steiger, Philipp Landgraf, Lothar Oberauer, Mathias Walter, Hermann Hagn, Sabrina Franke, Julia Sawatzki, Mario Schwarz, Konstantin Schweizer, and Marc Tippmann — Technische Universität München, Physik Department, James-Franck-Straße 1, 85748 Garching bei München

The planned JUNO (Jinangmen Underground Neutrino Observatory) Detector will use 20 kt of liquid scintillator (LS) based on LAB (Linear AlkylBenzene) as neutrino target within an acrylic sphere with a diameter of 35.4 m. For the filling of this sphere with LS pressurized gaseous nitrogen will be used. To avoid a contamination of the LS with ^{222}Rn, it's content in the nitrogen gas will be monitored. In this talk the status of a prototype radon monitoring system based on a proportional chamber as well as a setup for nitrogen scintillation counting, developed at Technische Universität München, are presented. This work is supported by the DFG Cluster of Excellence "Origin and Structure of the Universe", the DFG research unit "JUNO" and the Maier-Leibniz-Laboratorium.

T 9.7 Mo 17:30 Z6 - HS 0.002

The OSIRIS pre-detector - A radioactivity monitor for the JUNO liquid scintillator — •Paul Christian Hackspacher[1], Michael Wurm[1], Sebastian Lorenz[1], and Christoph Genster[2] for the JUNO-Collaboration — [1]Johannes Gutenberg Universität Mainz — [2]Forschungszentrum Jülich

The Jiangmen Underground Neutrino Observatory (JUNO) is a 20 kt liquid scintillator reactor neutrino experiment currently being built in the Guangdong province in southern China. In order to reliably reconstruct neutrino-induced inverse beta decay events from photomultiplier signals, scintillator purity is imperative. Potential air leaks in the filling and cycling lines or failures of the purification plants are risks that endanger the high radiopurity necessary to obtain clean signals within such a large active target volume. The Online Scintillator Internal Radioactivity Investigation System (OSIRIS) is being developed as a failsafe monitor to assess the quality of the scintillator batches before filling them into the central detector. A Monte Carlo simulation serves as a feasibility study and is used to investigate the sensitivity limits of such a system. This talk will present the current status, estimated sensitivity and future plans for the OSIRIS pre-detector.

T 9.8 Mo 17:45 Z6 - HS 0.002

First results from the PMT Mass Testing System for JUNO — •Alexander Tietzsch[1], Björn Wonsak[2], Tobias Lachenmaier[1], Caren Hagner[2], Tobias Sterr[1], Malte Stender[2], Henning Rebber[2], David Meyhöfer[2], David Blum[1], Tobias Heinz[1], Axel Müller[1], and Marc Breisch[1] for the JUNO-Collaboration — [1]Physikalisches Institut, Universität Tübingen — [2]Institut für Experimentalphysik, Universität Hamburg

To reach the goal of determining the neutrino mass hierarchy, all parts of the JUNO experiment need to hit certain quality criteria, especially those which are related to the final energy resolution of the detector. This is relevant in particular for the 20'000 20-inch photomultiplier tubes (PMTs) intended to be used in JUNO. Therefore, all PMTs will be checked and characterized with a PMT mass testing facility before being mounted into the JUNO detector. With this PMT mass testing system, several key characteristics like dark rate, peak-to-valley ratio, photon detection efficiency and timing resolution are targeted to be measured in a stable and comparable way and compared to the requirements of JUNO.

In this talk, we will focus on the data taking with the PMT mass testing facility for JUNO, the current status of the data acquisition methods, the progress in the PMT testing and some preliminary results from the first batch of PMTs will be presented.

This work is supported by the Deutsche Forschungsgemeinschaft.

T 9.9 Mo 18:00 Z6 - HS 0.002

The PMT Mass Testing System for the JUNO Experiment using commercial shipping containers — Caren Hagner[1], David Meyhöfer[1], Henning Rebber[1], •Malte Stender[1], Björn Wonsak[1], David Blum[2], Marc Breisch[2], Tobias Heinz[2], Tobias Lachenmaier[2], Axel Müller[2], Tobias Sterr[2], and Alexander Tietzsch[2] for the JUNO-Collaboration — [1]Institut für Experimentalphysik, Universität Hamburg — [2]Physikalisches Institut, Eberhard Karls Universität Tübingen

JUNO is a 20 kt liquid scintillator detector, which observes reactor antineutrinos. To reach its goal of determining the neutrino mass hierarchy, an energy resolution of 3 % @ 1 MeV or better is one of the key requirements of the upcoming JUNO experiment, which is currently under construction in China. Therefore, an optical coverage greater than 75 % and a photon detection efficiency greater than 27 % are needed. This will be realized by about 20000 20-inch-PMTs and up to 25000 3-inch-PMTs used in the experiment.

Further, it is indispensable that every PMT used in JUNO is tested and characterised with respect to e.g. quantum efficiency, dark noise rate and time resolution. The testing takes place in commercial shipping containers equipped with a PMT mass testing facility setup.

In this talk, we present the concept of the test facility, give details about the used structure and electronics and report about the commissioning of the first system in southern China during the last year.

This work is supported by the Deutsche Forschungsgemeinschaft.

T 9.10 Mo 18:15 Z6 - HS 0.002

Studies on trigger configuration for the JUNO experiment — •Rikhav Shah[1], Yaping Cheng[1], Christoph Genster[1], Philipp Kampmann[1], Livia Ludhova[1], Michaela Schever[1], Achim Stahl[2], Christopher Wiebusch[2], and Yu Xu[1] — [1]IKP-2 Forschungszentrum Jülich — [2]III. Physikalisches Institut B, RWTH Aachen University

Jiangmen Underground Neutrino Observatory (JUNO) is a 20 kton liquid scintillator neutrino detector under construction in China, aiming to determine the neutrino mass hierarchy, one among other open questions in neutrino physics. The measurement of the oscillation pattern of reactor electron anti-neutrinos reaching the detector is expected to lead to a 3-4 σ sensitivity on the mass hierarchy within 6 years of data taking. The detector is designed to achieve an energy resolution of 3% at 1 MeV. In addition, the effect of the dark rate of the 18,000 20-inch PMTs must be carefully considered. A study of the realistic dark-noise and other background hits in the PMTs and their effect on the detection of low-energy events will be presented.