T 57: Neutrinophysik 5 (Reaktorneutrinos)

Zeit: Dienstag 16:45–19:05 Raum: VSH 07

Gruppenbericht T 57.1 Di 16:45 VSH 07

Recent results of the Double Chooz reactor neutrino experiments — •Christian Buck for the Double Chooz-Collaboration — MPIK Heidelberg

The main goal of the Double Chooz reactor neutrino experiment is a precision measurement of the neutrino mixing angle $\theta 13$. This smallest of the three known mixing angles is determined from the disappearance of electron antineutrinos emitted by two nuclear reactors in Chooz, France. Neutrino interactions with the protons of an organic liquid scintillator produce a coincidence signal consisting of the energy depositions of a prompt positron and a delayed neutron allowing efficient background suppression. The reactor neutrino flux is measured in two detectors at different baselines to the source. The near detector at 400 m from the reactors provides a reference measurement almost without an oscillation effect. The far detector at 1.05 km distance is located close to the first oscillation minimum. First two detector results will be presented. A precise measurement of $\theta 13$ with the running reactor neutrino experiments is a crucial input for upcoming projects sensitive to CP-violation and atmospheric mass hierarchy observables.

T 57.2 Di 17:05 VSH 07

Consistencies of the neutron detection efficiency in the Double Chooz reactor neutrino detectors — •Helena Almazan, Christian Buck, Julia Haser, and Manfred Lindner — Max-Planck-Institut für Kernphysik (MPIK)

The Double Chooz experiment, analysing the reactor antineutrino signal from the nuclear power plant in Chooz (France), aims for a precision measurement of the neutrino mixing angle θ_{13} with the new data collected at the near and far detectors. An accurate and precisely known detection efficiency of the electron antineutrino interaction $\bar{\nu}_e + p \rightarrow e^+ + n$, called inverse beta decay (IBD), is required in order to reach that goal. The detection efficiency of the correlated signal caused by the IBD reaction produces strongly depends on the performance of the neutron detection, and it comprises one of the dominant uncertainties in the θ_{13} estimation. Among other calibration methods, the deployment of a ^{252}Cf radioactive source at the detector center and along a deployment tube is used to study the neutron capture signal in different detectors' inner volumes.

The recently collected ^{252}Cf data has been studied and compared to Monte Carlo simulations. In that way, the fraction of n-captures on Gadolinium (atoms loaded in the neutrino target) has been estimated to prove the time stability and consistency between detectors, and to study the behaviour of the neutron captures at the inner volume borders. These results and the performed estimation of the systematic uncertainties of the neutron capture efficiency provide a crucial input for the antineutrino oscillation analysis with two detectors.

T 57.3 Di 17:20 VSH 07

Background studies for the neutrino oscillation experiment Double Chooz — •Matthias Koch, Simon Appel, Marianne Göger-Neff, Lothar Oberauer, and Stefan Schönert — Physik Department E15, Technische Universität München

The two detectors of the Double Chooz experiment in France are investigating the neutrino mixing angle θ_{13}. In this work a background analysis for the first sample of data from the near detector with an absolute live time of 364 days was performed. The analysis was done by searching for the distinctive pattern of a beta particle from the decay of ^{214}Bi and ^{212}Bi followed by an alpha particle from the decay of ^{214}Po and ^{212}Po within a short time period, known as BiPo coincidence. Because ^{214}Bi and ^{214}Po are members of the uranium chain and ^{212}Bi and ^{212}Po are part of the thorium chain looking for BiPo coincidences is a good method to estimate the level of radiopurity inside the detector. It was found that the number of coincidences is constant over the time indicating radioactive equilibrium in the uranium and the thorium decay chain. Also the mass concentration of uranium and thorium in the inner detector was calculated to be less than 10^{-13} g/g, which agrees well with the specification.

This work was supported by the DFG (GO 1729/1-1), the MLL at Garching and the Excellence Cluster 'Universe'.

T 57.4 Di 17:35 VSH 07

Design and optimization of the Double Chooz final fit — Ilia Bekman, Denise Hellwig, Philipp Kampmann, Stefan Schoppmann, •Philipp Soldin, Achim Stahl, and Christopher Wiebusch — RWTH Aachen University - III. Physikalisches Institut B

The Double Chooz experiment is a reactor anti-neutrino experiment for the purpose of a precise measurement of the neutrino mixing angle θ_{13}. The experimental setup consists of two identical liquid scintillator detectors at an average baseline of about 400m and 1km to two reactor cores at the nuclear power plant in Chooz, France. The neutrinos are detected by measuring the signature of the inverse beta decay (IBD), which consists of a prompt positron signal and a delayed neutron capture signal. By performing a simultaneous likelihood fit and taking into account the detector neutrino rates, the energy spectral shape and all relevant backgrounds, the neutrino mixing angle θ_{13} can be obtained. In this talk the method, design, performance and optimisation of such a likelihood fit are presented. Furthermore a crosscheck for the latest final fit results are shown.

T 57.5 Di 17:50 VSH 07

A PMT Mass Testing Setup for the JUNO Experiment using commercial shipping containers — •Alexander Tietzsch[1], David Blum[1], Caren Hagner[2], Tobias Lachenmaier[1], Henning Rebber[2], Lisa Steppat[2], Tobias Sterr[1], and Björn Wonsak[2] — [1]Physikalisches Institut, Eberhard Karls Universität Tübingen — [2]Institut für Experimentalphysik, Universität Hamburg

To reach the goal of determining the neutrino mass hierachy, an energy resolution of 3 % @ 1 MeV or better is a key property of the JUNO experiment, which is currently under constrcution in China. This can only be fulfilled with a high optical coverage in the experiment - realized by about 17000 20-inch-PMTs and up to 34000 3-inch-PMTs - and using PMTs with a high photon detection efficiency. Here it is necessary that every PMT used in JUNO hit some important requirements like high quantum efficiency, low dark noise rate and a sufficient time resolution. So, each of the 20-inch-PMTs has to be tested before being mounted into the detector. In this talk we present our concept of testing up to 20000 20-inch-PMTs by developing a testing facility using commercial shipping containers, that were eqipped with all the necessary electronics for a mass characterization of all PMTs. We present the setup developed in Hamburg and Tübingen, report the progress during the last year and give an outlook for the soon starting PMT testing phase in spring 2017 at the JUNO site in China. This work is supported by the Deutsche Forschungsgemeinschaft.

T 57.6 Di 18:05 VSH 07

Determination of the kB parameter of LAB based scintillators for the JUNO experiment — •Konstantin Schweizer, Lothar Oberauer, Sabrina Prummer, and Stefan Schönert — Technische Universität München, Physik Department, Lehrstuhl für experimentelle Astroteilchenphysik, James-Franck-Str. 1, 85748 Garching bei München

The planned JUNO experiment is a 20 kt liquid scintillator neutrino detector based on a three component scintillator technology. 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 35 m and the required energy resolution of 3% at 1 MeV, the optical parameters of the scintillator have to be known very precisely and have to be very good. Therefore, the kB parameter which describes the quenching factor of the scintillator has to be determined in order to interpret the results of the neutrino mass hierarchy correctly. In order to measure the kB parameter a coincidence experiment between a photomultiplier tube measuring the scintillation light and a high-purity germanium detector has been set up. This talk will give the status of this setup and its 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 57.7 Di 18:20 VSH 07

Online monitoring system for the liquid scintillator transparency in the JUNO Central Detector — •Wilfried Walter Depnering for the JUNO-Collaboration — JGU Mainz

In the last years, large-volume liquid scintillator (LS) detectors have made important contributions to low-energy neutrino physics. A fu-

ture 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. Therefor, the transparency of the LS has to be sufficiently high and stable during the whole operation time (attenuation length $\geq$ 20 m). This talk is about a laser system inside the detector for an online measurement of optical LS properties. 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 will lead to curved light propagation, which has to be taken into account in spatial event reconstruction. This work is funded by the DFG research unit "JUNO".

T 57.8 Di 18:35 VSH 07

An On-line Attenuation lenght Monitor for JUNO — •Heike Enzann for the JUNO-Collaboration — Johannes Gutenberg-Unversität, Ec Prisma, Mainz, Deutschland

The Jiangmen Underground Neutrino Observatory (JUNO) with its 20 kt liquid scintillator (LS) detector is designed to determine the neutrino mass hierarchy via a precise survival probability measurement of reactor antineutrinos. It is currently under construction in China and will start data taking in 2020.

To reach the required measurement precision, high optical purity of the LS is necessary . This talk covers the development and testing of an on-line attenuation length monitor for LS quality control. The device will be installed as part of the filling system to monitor the purity of each LS batch before it is inserted into the central detector via a measurement of the attenuation length. This work is supported by DFG research unit "JUNO".

T 57.9 Di 18:50 VSH 07

Waveform reconstruction with the deconvolution method for JUNO — Livia Ludhova and •Michaela Schever — Forschungszentrum Jülich GmbH, Jülich, Germany

To determine the neutrino mass hierarchy by measuring reactor antineutrinos 53 km baseline, the JUNO 20 kton liquid-scintillator detector has to achieve an outstanding energy resolution of $3\%/\sqrt{E(\mathrm{MeV})}$. One of the prerequisites of this challenge is the ability to reconstruct the charge and arrival times of individual photons detected by each single PMT. The talk presents the current status of the waveform analysis for MeV neutrino events in Germany. The study is based on the deconvolution method which unfolds the photo-electron hit pattern and the single photo-electron response employing transforms of the signal between the time and frequency domain. An additional aspect is the reconstruction of the first hit time of muons.