T 92: Neutrino physics without accelerators VIII

Time: Friday 11:00–12:45 Location: H-HS II

T 92.1 Fri 11:00 H-HS II

Status Update on AURORA — •Wilfried Depnering and Michael Wurm — Johannes Gutenberg-University, Institute of Physics, Staudingerweg 7, 55128 Mainz, Germany

The Jiangmen Underground Neutrino Observatory (JUNO) is a reactor antineutrino experiment which aims to determine the neutrino mass hierarchy with at least 3σ significance. In order to reach that goal, an energy resolution of 3% @ 1 MeV is required. Therefore, the transparency of the liquid scintillator (LSc) has to be sufficiently high (attenuation length $\geq$ 20 m @ 430 nm) and stable during the whole operation time.

One device for in-situ monitoring of the optical LSc quality is AURORA (**A** **U**nit for **R**esearching **O**n-line the LSc t**RA**nsparency) inside the central detector of JUNO. Tiltable, blue laser beams are used to measure the optical attenuation of the LSc allowing the detection of potential aging effects over time. This talk presents the current status of AURORA. The development is funded by the DFG Research Unit "JUNO".

T 92.2 Fri 11:15 H-HS II

Timing Calibration of the OSIRIS detector — David Blum, Marc Breisch, Jessica Eck, Tobias Heinz, Tobias Lachenmaier, Neha Lad, Axel Müller, •Tobias Sterr, and Alexander Tietzsch — Physikalisches Institut, Eberhard Karls Universität Tübingen

The Jiangmen Underground Neutrino Observatory (JUNO) is a 20kt liquid scintillator (LS) detector currently under construction near Kaiping in southern China. For monitoring the very low background rate from radio impurities of the LS filling the OSIRIS (Online Scintillator Internal Radioactivity Investigation System) pre-detector is introduced. This talk will give an overview on the concept and prototyping of the timing calibration system of OSIRIS, which is based an a pico-second pulsed Laser.

T 92.3 Fri 11:30 H-HS II

Background reduction with the shifted analyzing plane configuration in KATRIN — •Alexey Lokhov — University of Muenster, 48149 Muenster, Germany — Institute for Nuclear Research RAS, 117312, Moscow, Russia

To measure the effective electron antineutrino mass mv with a sensitivity of 0.2 eV/c^2 the KATRIN experiment requires the level of background of about 10 mcps. One of the sources of the background electrons are the Rydberg atoms, created in the decay of Po-210, entering the spectrometer and ionized by thermal radiation. This yields low-energy electrons, almost uniformly distributed over the vessel volume.

We present here a technique to reduce this volume-dependent background of the KATRIN main spectrometer by using a specific configuration of the electromagnetic fields (so called shifted analyzing plane with a reduced fluxtube), that effectively decreases the volume of the fluxtube of electrons while preserving the energy resolution and allowing for the required neutrino mass sensitivity. The dedicated tests, which were performed recently, investigated the background reduction in this configuration and studied the EM fields at the shifted analyzing plane by calibration measurements using the Kr-83m conversion electrons and electron gun as reference sources.

T 92.4 Fri 11:45 H-HS II

Source activity monitoring in the KATRIN experiment — •Karol Debowski for the KATRIN-Collaboration — Bergische Universität Wuppertal, Deutschland

The absolute mass scale of neutrinos is one of the open questions in particle physics and cosmology. The KATRIN experiment is set up to measure this parameter with an unprecedented sensitivity of 0.2 eV.

To improve the currently existing mass limits by a factor of 10, all systematic effects in the experimental setup must be controlled. One of the characteristic properties is the activity of the electron source, which is demanded to be stable on the permille level within the time scale of a few hours. To keep track of changes to the total activity, multiple monitoring devices are installed in the KATRIN setup, such as the Forward Beam Monitor (FBM). Located in front of the spectrometers, the FBM measures the total flux of electrons emitted by the source, and thus can provide important information about changing source parameters. Additionally, it can be moved through the whole cross section of the beam tube and measure the flux tube profile.

The performance of the FBM during the first neutrino mass campaigns is presented as well as an outlook on future activities and investigations.

T 92.5 Fri 12:00 H-HS II

Background at the KATRIN experiment: Investigations of Radon and Rydberg induced events — •Alessandro Schwemmer for the KATRIN-Collaboration — Max-Planck-Institut für Physik

To achieve the design sensitivity of the **Ka**rlsruhe **Tri**tium **N**eutrino (KATRIN) Experiment of $m_\nu = 0.2\,\mathrm{eV\,c^{-2}}$ (90 % CL), a low background rate is essential. The residual background is dominated by two processes: Decays of radon emanated from the getter material and ionization of Rydberg states created by alpha decays in the spectrometer walls. To determine the individual fractions, Monte Carlo simulations are performed with the particle tracking software Kassiopeia (Furse et al. "Kassiopeia: A Modern, Extensible C++ Particle Tracking Package" (2016)) and compared to measurements. This contribution presents first results and gives an outlook on the possibility of discriminating between β-electrons and Rydberg-induced electrons.

T 92.6 Fri 12:15 H-HS II

Measurement of the Energy Loss Spectrum of 18.6 keV Electrons in Tritium at KATRIN — •Caroline Rodenbeck for the KATRIN-Collaboration — Institut für Kernphysik, WWU Münster

The Karlsruhe Tritium Neutrino experiment (KATRIN) measures the beta decay spectrum of a windowless gaseous tritium source (WGTS) for a model independent investigation of the absolute neutrino mass scale with an estimated sensitivity of 0.2 eV/c^2 (90% C.L.).

Beta decay electrons can scatter elastically and inelastically off tritium molecules inside the WGTS and lose energy in the process. A precise description of the the energy loss shape is provided by measurements with a pulsed photo-electron source, shooting mono-energetic electrons through the WGTS. By applying a time-of-flight cut a differential energy loss spectrum is obtained.

The energy loss and the resulting response function of the experiment are essential for neutrino mass analysis of the beta decay spectrum and are used in the analysis of the recent KATRIN neutrino mass runs. The talk will give an overview on the measurements and the analysis to obtain the energy loss function and an insight on how KATRIN's response function is constructed. This work is funded by BMBF under contract number 05A17PM3.

T 92.7 Fri 12:30 H-HS II

Development of novel Water based Liquid Scintillators for the THEIA Neutrino Experiment — Hans Theodor Josef Steiger[1], Lothar Oberauer[1], •Andreas Steiger[1], Matthias Raphael Stock[1], Daniele Guffanti[2], and Michael Wurm[2] — [1]Technische Universität München (TUM), Physik-Department, James-Franck-Straße 1, 85748 Garching bei München — [2]Institute of Physics and Excellence Cluster PRISMA, Johannes Gutenberg-Universität (JGU) Mainz, 55099 Mainz

New developments in liquid scintillators, high-efficiency, fast photon detectors, and chromatic photon sorting have opened up the possibility for building a large-scale (up to 100 kt) neutrino detector called THEIA that is planned to be able to discriminate between Cherenkov and scintillation signals. Currently Water-based Liquid Scintillator (WbLS) is a potential candidate for this type of detector. By introducing a small amount (typically 1%-10%) of organic liquid scintillator by the use of surfactants into water, the liquid yield can be adjusted to allow detection of particles below Cherenkov threshold while not sacrificing directional capability. Typically, such mixtures can be considered to be cheaper than organic scintillators and to be less hazardous for the environment. In this talk some new WbLS cocktails (developed at TUM and JGU) and the techniques for their production as well as selected properties of the mixtures are discussed. This work is supported by the Bundesministerium für Bildung und Forschung (BMBF) in the frame of the Verbundprojekt 05H2018, the Excellence Cluster PRISMA+ and the Maier-Leibnitz-Laboratorium (MLL).