# T 78: Niederenergie-Neutrinophysik II

Zeit: Mittwoch 16:45–19:15 Raum: VMP9 SR 07

T 78.1 Mi 16:45 VMP9 SR 07

**The History of Neutrino Physics from a Methodological Point of View** — •Alexander Unzicker — Pestlozzi-Gymnasium München

A famous letter by Wolfgang Pauli in 1930, directed at the participants of the Naturforschertagung in Tübingen, marked the beginning of neutrino physics.

Since then, the field has undergone a dramatic change, though each conceptual step seemed to be a minor modification of the paradigm of the time.

A summary review of the crucial experiments and their interpretations is given: the early period, the Cowan-Reines experiment, the discovery of flavours, and ultimately, the establishment of neutrino oscillations that was rewarded with the Nobel Prize in 2016.

The current state of the field is discussed from a historical perspective. It is argued that there are distinct patterns regarding the methods that have appeared several times.

T 78.2 Mi 17:00 VMP9 SR 07

**New reconstruction method for liquid scintillator – First results for muon tracks** — Caren Hagner[1], •Sebastian Lorenz[1,2], Björn Wonsak[1], and Michael Wurm[2] — [1]Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg — [2]Johannes Gutenberg-Universität Mainz, Institut für Physik, Staudinger Weg 7, 55128 Mainz

An efficient veto-based rejection of muon-induced background is an important prerequisite for experiments in low-energy neutrino physics. For unsegmented liquid scintillator detectors, common tools in this field, this requires the precise reconstruction of muon tracks within the active volume based on the isotropically emitted scintillation photons.

A novel reconstruction technique for this challenging task, which could be employed in the future large-volume detector of JUNO, is in development. The method aims to reconstruct the 3D number density distribution of photon emissions, which reflects an event's geometry and topology. Based on single muons simulated in the LENA detector, first results on the method's performance are presented.

T 78.3 Mi 17:15 VMP9 SR 07

**Light yield and timing of the JUNO detector as function of scintillator transparency** — •Wilfried Walter Depnering for the JUNO-Collaboration — Johannes Gutenberg - Universität & EC PRISMA, Mainz, Deutschland

In the last years, large-volume liquid scintillator detectors have made important contributions to low-energy neutrino physics. One of these future neutrino detectors is JUNO with its primary goal to determine the neutrino mass hierarchy. To be able to reach that goal a resolution of at least 3% at a neutrino energy of 1 MeV is needed. For this reason, at least 1200 photoelectrons need to be registered within the photomultipliers at the verge of the detector, independent of their creation point. Therefore, a high light yield and high transparency of the liquid scintillator are crucial. This talk is about a study investigating the expected amount of photoelectrons considering different absorption- and scattering lengths for the used liquid scintillator LAB. In addition to that, the impact of these optical parameters on the rise time of the emission profile is examined, determining the time resolution of event reconstruction.

T 78.4 Mi 17:30 VMP9 SR 07

**Development of a scintillator-purity monitor for JUNO** — •Heike Enzmann for the JUNO-Collaboration — Johannes Gutenberg Universität, Ec Prisma, Mainz, Deutschland

The unknown mass hierarchy of the neutrinos is one of the open issues of the standard model. The Jiangmen Underground Neutrino Observatory (JUNO) which is currently under construction in China is designed to determine the hierarchy via the measurement of the survival probability of reactor electron antineutrinos. These neutrinos are detected in a 20kt liquid scintillator. High optical purity of the scintillator is required to reach the aimed measurement precision. This talk discusses the development of an online monitor for optical transparency. To assure that the necessary quality levels of the scintillator are fulfilled over the entire filling process, the device will be installed in the filling line to continuously monitor the purity of the scintillator via a measurement of the attenuation length.

T 78.5 Mi 17:45 VMP9 SR 07

**Measurement of the Rayleigh scattering length in liquid scintillators for JUNO** — •Paul Hackspacher for the JUNO-Collaboration — Johannes Gutenberg-Universität Mainz & PRISMA Excellence Cluster

In liquid scintillator neutrino detectors such as the upcoming Jiangmen Underground Neutrino Observatory (JUNO), neutrino interactions are being detected by means of inverse beta decay and analysis of the resulting luminescent light. In order to reliably reconstruct these events from photomultiplier signals, the scattering properties of the detector materials need to be sufficiently well known. In the LAB-based liquid scintillator that has been proposed for JUNO, the primary contribution to the scattering process comes from Rayleigh scattering. The characteristic Rayleigh scattering length can be experimentally obtained in an optical laboratory setup. This talk will present the approach, the current status and the future plans of the experiment.

T 78.6 Mi 18:00 VMP9 SR 07

**Reconstruction of proton decay events in a densely instrumented neutrino telescope-like detector** — •Maria Tselengidou and Alexander Kappes for the IceCube-Collaboration — ECAP, Erlangen, Germany

After successfully lowering IceCubes neutrino threshold to 10 GeV with its DeepCore infill-array, ideas arose to leverage the optically quiet Antarctic deep-ice to build an extremely densely instrumented, large-volume detector sensitive to MeV neutrinos. Among several interesting physics topics, such a detector would be able to pursue detection of proton decay. Using decays of protons into pi0 and positron, the talk presents the status of the reconstruction of such events via Cherenkov-ring identification. Different detector configurations are examined in order to determine the optimal design for the reconstruction.

T 78.7 Mi 18:15 VMP9 SR 07

**Current status of the SOX mockup and simulation** — •Michael Gschwender, Tobias Lachenmaier, Stephanie Göggelmann, and Sebastian Rottenanger — Physikalisches Institut, Universität Tübingen, Germany

The **S**hort distance neutrino **O**scillations with Bore**X**ino (SOX) Experiment is committed to the search of sterile neutrinos in the eV-scale. SOX is searching for the disappearance of antineutrinos from a radioactive source ($^{144}$Ce - $^{144}$Pr).

If no distinct oscillationary pattern will be found, it will be of utmost importance to know the number of the emitted antineutrinos from the source with an overall accuracy <1%. This is achieved by a calorimeter, which is able to measure the thermal power of the source, from which the activity can be derived.

In order to accomplish a precise measurement, a calibration of the calorimeter is crucial. A dummy source (mockup), using electrical heaters, is able to deposit a known amount of power inside the calorimeter. The goal of this talk is to give an update of the current status of the mockup as well as the concomitant simulation. This simulation was build using the commercial finite element simulation environment Comsol.

This work is funded by the Deutsche Forschungsgemeinschaft.

T 78.8 Mi 18:30 VMP9 SR 07

**Betaspectroscopy of a Ce/Pr-144 sample for the SOX experiment** — •Simon Appel for the BOREXINO-Collaboration — TU München

The very low radioactive background of the Borexino detector, its large size, and the well proved capability to detect both low energy electron neutrinos and anti-neutrinos make an ideal case for the study of short distance neutrino oscillations in the ev scale, which is the goal of the SOX experiment.

As neutrino generator SOX will use a Ce/Pr-144 source with expected activity aorund 100 kCi. The experiment will look for distortions in the anti-neutrino spectrum. Therefore it is crucial to have a good understanding of the original spectrum. This is done via betaspectroscopy of a Ce/Pr-144 sample, based on a plastic scintillator setup.

To distinguish electron and gamma particles the setup is equipped with an multi-wire-chamber.

This talk will present the latest results of the setup.

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

T 78.9 Mi 18:45 VMP9 SR 07

**Reducing deadtime with a modified Li-He veto in BoreXino** — •Stefan Weinz and Michael Wurm — Physics Institute, University of Mainz

Although the BoreXino detector is located in a deep underground lab in Gran Sasso with huge of rock overburden (≈ 3500m water equivalent), a non-negligible flux of high energetic cosmic muons is still able to penetrate the fiducial volume of the detector. These muons can be tagged with high efficiency, but more dangerously, a muon passing the detector may interact with the $^{12}C$ nuclei of the liquid scintillator, thus creating cosomogenic radioisotopes. A prominent example for these unstable nuclei are $^{8}He$ and $^{9}Li$ isotopes, whose decay products can mimic very well the $\nu$-signature of inverse $\beta$-decay. To suppress this serious background source, the common strategy in BoreXino is to simply veto the whole fiducial volume for two seconds, introducing an overall deadtime of ≈ 10%. This muon-induced deadtime can be greatly reduced by introducing cuts based on the study of muon properties which may be related to the production of $^{8}He$ and $^{9}Li$ isotopes. The talk presents the muons cuts in three observables as well as their performance and limitations.

T 78.10 Mi 19:00 VMP9 SR 07

**SOX Sensitivity Study** — •Johann Martyn for the BOREXINO-Collaboration — Johannes Gutenberg-Universität, Mainz, Germany

To this day most experimental results on neutrino oscillations can be explained in the standard three neutrino model. There are however a few experiments that show anomalous behaviour at a very short baselines. These anomalies can hypothetically be explained with the existence of one or additional more light neutrino states that do not take part in weak interactions and are thus called sterile. Although the anomalies only give a hint that such sterile neutrinos could exist the prospect for physics beyond the standard model is a major motivation to investigate the neutrino oscillations in new very short baseline experiments. The SOX (Short distance Oscillations in BoreXino) experiment will use the Borexino detector and a $^{144}$Ce source to search for sterile neutrinos via the occurance of an oscillation pattern at a baseline of several meters. This talk will examine the impact of the Borexino detector systematics on the experimental sensitivity of SOX. The work is supported by the funds of the Deutsche Forschungsgemeinschaft.