HK 43: Astroparticle Physics II

Zeit: Donnerstag 14:00–16:15 Raum: F 073

Gruppenbericht HK 43.1 Do 14:00 F 073

The Jiangmen Underground Neutrino Observatory — •Paul Christian Hackspacher for the JUNO-Collaboration — Johannes Gutenberg-Universität Mainz & Excellence Cluster PRISMA

The Jiangmen Underground Neutrino Observatory (JUNO) is a reactor neutrino experiment currently being built near the town of Kaiping in the Guangdong province in southern China. From 2020 onwards, the 20 kt liquid scintillator detector under 1900 mwe overburden is going to measure low-energy electron antineutrinos from two nuclear power plants, each with an oscillation baseline of 53 km to the experimental hall. By probing the flux spectrum with an energy resolution of 3% @ 1 MeV, the experiment is set out to determine the neutrino mass hierarchy with at least $3\,\sigma$ significance. Further goals are improving the precision of solar oscillation parameters to below 1%, examining geoneutrinos and supernova neutrinos as well as the search for dark matter, sterile neutrinos and non-standard interactions. This will be an overview talk, presenting the current design, status and physics potential of the JUNO experiment.

Gruppenbericht HK 43.2 Do 14:30 F 073

Status and commissioning of the KATRIN experiment — •Philipp Ranitzsch for the KATRIN-Collaboration — Institut für Kernphysik, Universität Münster

The goal of the **KA**rlsruhe **TRI**tium **N**eutrino experiment (KATRIN) is to investigate the neutrino mass with a sensitivity of $0.2\,\mathrm{eV/c^2}$ by a high-resolution and high-statistics measurement of the end-point region of the ^{3}H β-spectrum. For this task it uses an experimental setup made of two main parts, firstly a source and transport section including a windowless gaseous tritium source, a differential and a cryogenic pumping section. This system provides a clean current of ^{3}H β-electrons that are analyzed and detected in the second part, namely the spectrometer and detector section. The latter section consists of two electrostatic spectrometers based on the MAC-E filter technique and a multi-pixel silicon semiconductor detector.

At the experimental site at the Karlsruhe Institute of Technology (KIT), all major components have arrived in summer 2015 and the complete beam line has been assembled. The inauguration of the full beam line, the "First Light", took place in October 2016 and was followed by a "First Light Plus" commissioning campaign, that finished in December 2016.

This talk gives an overview of the current status of the KATRIN experiment, focusing on the recent "First Light Plus" campaign and the upcoming steps towards the first tritium measurements.

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HK 43.3 Do 15:00 F 073

Search for Invisible Dark Photon Decays — •Martin Ripka and Achim Denig for the BESIII-Collaboration — KPH JGU Mainz

The direct detection of dark matter is still an open topic of highest interest in particle- and astrophysics. While the experimental search is ongoing, more and more parts of the parameter-space of many intuitive extensions to the Standard Model like super-symmetry are ruled out. Newer state of the art theories attempt to describe the dark sector more generally. A kinetic mixing of the Standard Model photon with a proposed dark photon opens the so called vector-portal to the dark sector. The dark photon may be heavier than other dark matter particles, such that it would predominantly decay invisibly. We report a search for invisible decays of dark photons with the BESIII detector at the BEPCII storage ring in Beijing, China. The dark photons are produced in the Initial State Radiation (ISR) method. Since the dark photon decays into light dark matter particles that cannot be detected, we look for narrow structures in the recoil mass spectrum of the ISR photon. The available data allow for a search of the dark photon with masses between 0-3 GeV. We can set an upper limit at the 90% confidence level on the mixing parameter of the dark photon, which completely excludes an invisibly decaying dark photon as an explanation of the Muon g-2 puzzle.

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HK 43.4 Do 15:15 F 073

Internal backgrounds in the XENON100 experiment — •Dominick Cichon and Sebastian Lindemann for the XENON-Collaboration — Max-Planck-Institut für Kernphysik (MPIK), Heidelberg, Germany

Astrophysical observations hint towards the existence of a non-baryonic component in the universe's total mass content, called dark matter. In the search of weakly interacting massive particles (WIMPs), which are postulated to explain dark matter, several liquid xenon (LXe) dual-phase time projection chambers (TPCs), like XENON100, have already been employed to provide limits on possible WIMP interactions. XENON100's successor experiment, XENON1T, has recently been commissioned and aims to be sensitive to spin-independent WIMP-nucleon cross-sections down to $\sigma \sim 1.6 \cdot 10^{-47}\mathrm{cm}^2$ at a WIMP mass of 50 GeV/c^2.

To achieve this goal, great care has to be taken to understand potential background sources and to limit them. Of all relevant sources, ^{222}Rn and ^{85}Kr belong to the largest contributors. One of the reasons for this is, that they dissolve in the LXe target medium. As a consequence, they cause background events which cannot be rejected using position reconstruction techniques. This talk outlines methods for identifying decays of ^{85}Kr and those from the ^{222}Rn chain in XENON100 data to estimate the expected amount of background events from both. In addition, the relevance of the techniques presented herein to the estimation of background in XENON1T is illustrated, as ^{222}Rn and ^{85}Kr belong to the most relevant sources for both experiments.

HK 43.5 Do 15:30 F 073

Prospects on radon mitigation using surface treatment techniques — •Florian Jörg, Hardy Simgen, and Guillaume Eurin — Max-Planck-Institut für Kernphysik (MPIK), Heidelberg, Germany

For experiments dedicated to the search for rare events, background control and its reduction are of crucial concern. Examples for these experiments are liquid xenon detectors searching for dark matter such as XENON1T. One of the biggest contributions to its background is due to ^{222}Rn emanated from detector materials. Besides radon removal using liquid xenon distillation and selection of materials that emanate as little radon as possible, surface treatment can provide further improvement.

It has proven that the application of a coating of several hundreds of nm on the material surface can reduce the amount of radon emanation. Several coating techniques, such as plasma deposition and sputtering were considered in partnership with German companies. In addition, surface cleaning by enhanced electropolishing of several tens of μm has been investigated. In order to determine the reduction factor on radon emanation, relative measurements before and after the application of surface treatment techniques are performed. Due to the very low expected activities, highly sensitive proportional counters and radon monitors were employed. In this talk, first promising results and prospects on radon mitigation will be presented.

HK 43.6 Do 15:45 F 073

Das Minidex-Experiment zur Vermessung Myonen-induzierter Neutronen — •Raphael Kneissl[1], Iris Abt[1], Allen Caldwell[1], Christopher Gooch[1], Xiang Liu[1], Béla Majorovits[1], Matteo Palermo[2], Qiang Du[1], Oliver Schulz[1] und Laura Vanhoefer[1] — [1]Max-Planck-Institut für Physik, München, Deutschland — [2]University of Hawaii, US

Die Beobachtung sehr seltener Prozesse, wie z.B des neutrinolosen Doppelbetazerfalls, erfordert extrem strahlungsarme Umgebungen und Detektoren. Um die nötige Sensitivität zu erreichen, ist es wichtig, die noch vorhandenen Strahlungsuntergründe zu unterdrücken sowie diese zu verstehen. Einer dieser Untergründe sind Myon-induzierte Neutronen, die außerhalb im Gestein oder direkt in den Abschirmungsmaterialien des Experiments erzeugt werden. Die Neutronenproduktionsraten durch Myonen in verschiedenen Materialien sind nicht genau vermessen. Um genauere Vorhersagen darüber machen zu können, welcher Untergrundbeitrag in zukünftigen Experimenten erwartet wird, wurde der Minidex (Muon induced neutrons indirect detection experiment) Aufbau im Tübinger Untergrundlabor errichtet. Mit diesem Aufbau können Neutronen, die im untersuchten Material durch Myonen induziert wurden, nachgewiesen werden. Dies geschieht mit HPGe Detektoren, die den thermischen Einfang von Neutronen an Wasserstoffatomen nachweisen. Es sollen Neutronenproduktionsraten in verschiedenen Abschirmmaterialien untersucht werden. Im Vortrag werden der Aufbau, die Datenanalyse sowie die Resultate des Minidex-Experiments vorgestellt.

HK 43.7 Do 16:00 F 073

Fast neutron detector data analysis, MC simulation and preliminary result in the context of Minidex — Iris Abt[1], Allen Caldwell[1], •Qiang Du[1], Christopher Gooch[1], Raphael Kneissl[1], Xiang Liu[1], Béla Majorovits[1], Matteo Palerno[2], Oliver Schulz[1], and Laura Vanhoefer[1] — [1]Max-Planck-Institut für Physik, Deutschland — [2]University of Hawaii, US

Muon-induced neutrons are a background in current and future low-background experiments. A Gd doped liquid scintillator detector has been operated in Munich and Tübingen to measure neutrons induced by muons in lead in parallel to the Minidex (Muon-induced neturons indirect detection experiment) setup. The neutron detector data will give a crosscheck to the results of Minidex. Neutrons are captured by gadolinium after thermalization in the scintillator resulting in neutron capture gamma-rays with about 8 MeV total energy. This leads to the possibilty of applying a time coincident cut which reduces the background significantly. The data analysis of the fast neutron detector will be introduced, including calibration with thorium 228, cobalt 60 and AmBe neutron sources. Also, the data to Monte Carlo comparison will be shown. Furthermore, some preliminary result on the investigation of muon-induced neutrons will be discussed.