T 36: Neutrino physics without accelerators III

Time: Tuesday 17:00–18:30 Location: L-2.004

T 36.1 Tue 17:00 L-2.004

The OSIRIS-Prototype — Michael Wurm and •Oliver Pilarczyk — Institut für Physik, Johannes Gutenberg-Universität Mainz

The Jiangmen Underground Neutrino Observatory (JUNO) is a 20 kt liquid scintillator detector currently under construction near Kaiping in the province Guangdong in southern China. To be able to fulfill the radiopurity requirements of the liquid scintillator there are several purification subsystems installed in the filling line of the JUNO main detector. The last in row of these subsystems is the OSIRIS detector, which will monitor scintillator samples for approximately one day in search of the decays of radioactive impurities. For this, warmed-up scintillator will be continuously filled from the top into a 3m x 3m cylindrical acrylics tank and drained from the bottom. Intermixing of new warm and old cooling scintillator is to be prevented by a temperature stratification inside the tank. Currently, a 1:10 prototype is being set up in Mainz in order to test the filling procedure and to optimize the geometries of the inlet and outlet diffusors to support stratification. This talk will report the current status of the prototype.

T 36.2 Tue 17:15 L-2.004

Reduction of the ^{14}C-background in the JUNO experiment — •Philipp Kampmann[1,2], Christoph Genster[1], Alexandre Göttel[1,2], Yuhang Guo[1,3], Ruquan Liu[1,2], Livia Ludhova[1,2], Giulio Settanta[1], Cornelius Vollbrecht[1,2], and Yu Xu[1,2] — [1]Institut für Kernphysik, Forschungszentrum Jülich — [2]III. Physikalisches Institut B, RWTH Aachen University — [3]School of Nuclear Science and Technology, Xi'an Jiaotong University, Xi'an 710049, China

The Jiangmen Underground Neutrino Observatory (JUNO) is a next-generation neutrino experiment under construction in China expected to complete the construction in late 2021. As the main goal it aims to address the determination of the neutrino mass hierarchy with 3-4 σ significance in 6 years. Therefore, it will measure the oscillated energy spectrum of electron anti-neutrinos from two nuclear power plants at 53 km baseline with an unprecedented energy resolution of 3% at 1 MeV using a 20 kt liquid scintillator detector. Due to the large target size the probability of event pile-up with internal background events such as from ^{14}C decays is high. This can spoil the resolution of the reconstructed neutrino energies, which is a major systematic uncertainty in the mass hierarchy search of JUNO. In this presentation reconstruction techniques to reduce the impact of the ^{14}C pile-up will be presented. These include a Clusterization algorithm as well as an event reconstruction Likelihood-test of the photon hits.

T 36.3 Tue 17:30 L-2.004

Implications of a fine structure in the reactor neutrino spectrum for JUNO — 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

With the main goal to determine the neutrino mass hierarchy, the Jiangmen Underground Neutrino Observatory (JUNO) is currently constructed in the Guangdong province in southern China. To analyze which mass hierarchy is realized in nature, JUNO measures the reactor neutrino spectrum from two nuclear power plants located in a distance of around 53 km. One crucial aspect for a successful measurement is a precise knowledge of the emitted and therefore unoscillated reactor neutrino spectrum. In the last years, new predictions of the spectrum revealed the possible existence of a spectral fine structure which could impede the mass hierarchy determination with JUNO.

This work will present studies on possible implications of the fine structure in the reactor neutrino spectrum for the sensitivity of the mass hierarchy determination with JUNO.

This work is supported by the Deutsche Forschungsgemeinschaft.

T 36.4 Tue 17:45 L-2.004

Search for the two neutrino double beta decay ^{136}Xe to an excited state of ^{136}Ba — •Henning Schulze Eissing for the XENON-Collaboration — Institut für Kernphysik, WWU Münster, Germany

The XENON1T Dark Matter detector used a dual-phase time projection chamber with 2 tonnes of xenon monitored by photomultiplier tubes.

It is possible to reconstruct the energy and position of an interaction in the detector. A good energy resolution and the possibility to reconstruct events at MeV-energies in combination with a very low background rate allows the search for rare decays with XENON1T.

The two neutrino double beta decay of ^{136}Xe to the ground state of ^{136}Ba was measured by multiple experiments with a half life of about 2.16 x 10^{21} years . Beside the decay to the ground state, decays to excited states of ^{136}Ba are possible, but not yet observed experimentally due to long expected half-lifes of about 10^{25} years. With the 1 t x year exposure of XENON1T multiple of these events could be found in the existing data.

This talk will outline steps necessary to search for this decay including a validation of MC simulations and the development of a machine learning discriminator to distinguish signal and background events.

T 36.5 Tue 18:00 L-2.004

Search for new physics with unconventional double beta decay modes in GERDA Phase II — •Elisabetta Bossio for the GERDA-Collaboration — Physik-Department, Technische Universität München, James-Franck- Straße, 85748 Garching

The main goal of the GERmanium Detector Array (GERDA) experiment at the Laboratori Nazionali del Gran Sasso of INFN (Italy) is the discovery of the $0\nu\beta\beta$-decay of ^{76}Ge, which would unambiguously demonstrate lepton number violation. A large variety of beyond the Standard Model physics can also manifest in the $2\nu\beta\beta$ region of the spectrum: models involving Majorons or Lorentz violating physics predict shapes of the measured two-electrons spectrum different from the conventional shape. In GERDA Phase II, the liquid argon veto system allows to have marginal background in this region of the spectrum and makes the search for exotic processes attractive. Possible deformations of the shape due to systematic uncertainties are investigated and a hybrid Bayesian-frequentist approach is used to include them in the results. The analysis of 32.1 kg·yr of ^{76}Ge exposure will be presented. The half-life of $2\nu\beta\beta$-decay of ^{76}Ge is measured with the highest precision to date. Results on unconventional double beta decay modes will also be presented, half-lives of the Majoron involving decays of the order of 10^{23}-10^{24} years are probed and Lorentz invariance violation is tested with a sensitivity of 10^{-6} GeV on the parameter $\mathring{a}_{of}^{(3)}$.
This work has been supported in part by the German Federal Min-istry for Education and Research (BMBF) and the German ResearchFoundation (DFG) via the SFB1258.

T 36.6 Tue 18:15 L-2.004

Investigating the background of the GERDA experiment by ^{76}Ge(n,p)^{76}Ga reaction studies — •Marie Pichotta, Konrad Schmidt, Steffen Turkat, Birgit Zatschler, and Kai Zuber — TU Dresden IKTP, Dresden, Deutschland

The GERmanium Detector Array (GERDA) is located 1400 m underground in the Gran Sasso mountains (Italy) searching for the neutrinoless double beta decay of ^{76}Ge. The discovery of this extremely rare process with an expected Q-value of 2039 keV would prove the Majorana character of neutrinos and consequently physics beyond Standard Model. For an explicit identification of a signal caused by the neutrinoless double beta decay a precise understanding of the background components is crucial.

Previous work indicates gamma rays from the decay of ^{76}Ga in the region of interest (ROI) which can be produced by neutrons via (n,p)-reactions with ^{76}Ge and therefore contribute to the background in the ROI. For the investigation of this potential background an enriched Ge-sample consisting of the same isotopic composition as the GERDA detectors will be activated by neutrons from a DT generator located at the Helmholtz-Zentrum Dresden-Rossendorf (HZDR). Experimental procedure and preliminary works will be presented. This project is supported by BMBF (05A17OD1).