T 13: Neutrinos I

Time: Monday 16:30–18:00 Location: POT/0251

T 13.1 Mon 16:30 POT/0251

Core-Collapse Supernova detection with JUNO — •Alexei Coretzki, Thilo Birkenfeld, Markus Braun, and Achim Stahl for the JUNO-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

The Jiangmen Underground Neutrino Observatory (JUNO) is a liquid scintillator (LS) detector currently under construction in China. In addition to determining the neutrino mass ordering, JUNO is highly efficient for detecting neutrinos from Core-Collapse Supernovae. In particular, JUNO features the detection of inverse beta decay interactions. Due to its delayed coincidence signature this interaction is unique within the LS. We estimate the maximum distance of detectable supernovae using this interaction. For this we take into account backgrounds, elastic scattering, and other charged current interactions like neutrino-carbon interactions.

T 13.2 Mon 16:45 POT/0251

External Background in JUNO for Solar Neutrinos and DSNB Detection — •Simon Csakli[1], Lothar Oberauer[1], Simon Appel[1], Matthias Mayer[1], and Sebastian Zwickel[2] — [1]Technische Universität München, München, Germany — [2]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany

The Jiangmen Underground Neutrino Observatory (JUNO) is an upcoming 20 kt liquid scintillator detector. In this work, the impact of external backgrounds is studied with the goal of increasing the fiducial volume available for two specific neutrino measurements with JUNO. First, the periodic modulations in the solar neutrino flux are analysed. For this, the sensitivity for the detection of these modulations is determined for several fiducial volume cuts, taking the background caused by radioactive decays in various materials in and around the detector volume into account. The second part focuses on the diffuse supernova neutrino background (DSNB), the constant flux of neutrinos emitted by past core-collapse supernova in the entire visible universe. A crucial background for this signal are fast neutrons induced by spallation processes, which are simulated in this work. The fiducial volume is then determined from the obtained fast neutron data. This work is supported by the DFG research unit "JUNO", the DFG collaborative research centre 1258 "NDM", and the DFG Cluster of Excellence "Origins".

T 13.3 Mon 17:00 POT/0251

JUNO's sensitivity to 7Be, pep and CNO solar neutrinos and strategy for directional analysis of CNO solar neutrinos in JUNO — •Apeksha Singhal[1,3], Runxuan Liu[1,3], Livia Ludhova[1,3], Anita Meraviglia[2,3], Nikhil Mohan[2,3], Luca Pelicci[1,3], Mariam Rifai[1,3], and Cornelius Vollbrecht[1,3] for the JUNO-Collaboration — [1]Forschungszentrum Jülich GmbH, Institut für Kernphysik IKP-2, Jülich, Germany — [2]GSI Helmholtz Centre for Heavy Ion Research, Darmstadt, Germany — [3]III. Physikalisches Institut B, RWTH Aachen University, Aachen, Germany

JUNO Experiment is 20 kt multipurpose LS detector, under construction in China, with planned completion in 2023. Its main goal is Neutrino Mass Ordering determination, exploiting its large target mass and excellent energy resolution (3% at 1 MeV). Due to its unique properties, JUNO will have potential of real-time solar neutrino measurement with unprecedented levels of precision using multivariate (MV) fit. Sensitivity study is performed by considering all possible sources of background, including their various concentration level and full simulation of detector response. Performing directional analysis of CNO solar neutrinos via Correlated and Integrated Directionality method (developed by Borexino collaboration) in JUNO and using it as additional constraint in MV fit has potential to further improve precision of CNO solar neutrino measurement. This talk will summarize methods for sensitivity studies using MV fit and the final results. Investigation of Cherenkov and scintillation light properties using JUNO MC software and strategies of preliminary directional analysis will be shown.

T 13.4 Mon 17:15 POT/0251

Combined analysis of the first five KATRIN measurement campaigns with KaFit — •Stephanie Hickford[1], Leonard Köllenberger[1], and Weiran Xu[2] for the KATRIN-Collaboration — [1]Institute for Astroparticle Physics, Karlsruhe Institute of Technology — [2]Massachusetts Institute of Technology

The KATRIN collaboration aims to determine the neutrino mass with a sensitivity of 0.2 eV/c^2 (90 % CL). This will be achieved by measuring the endpoint region of the tritium β-electron spectrum. Combined analysis of the first two KATRIN measurement campaigns yielded a neutrino mass limit of $m_\nu \leq 0.8$ eV (90 % CL).

Analyses of data from the first five measurements campaigns are currently underway. One of the combined analyses is performed using the `KaFit/SSC` model within the `KASPER` software framework. In this analysis systematic uncertainties are propagated as additional fit parameters with constraints (the "pull term" method). An overview of the collected data and the expected combined sensitivity on the neutrino mass from these five measurement campaigns will be presented in this talk.

This work is supported by the Helmholtz Association, the Ministry for Education and Research BMBF (05A17PM3, 05A17PX3, 05A17VK2, and 05A17WO3), the Helmholtz Alliance for Astroparticle Physics (HAP), and the Helmholtz Initiative and Networking Fund (W2/W3-118).

T 13.5 Mon 17:30 POT/0251

A Look at General Neutrino Interactions with KATRIN — •Caroline Fengler for the KATRIN-Collaboration — Institute of Experimental Particle Physics, Karlsruhe Institute of Technology

The KATRIN experiment aims to measure the neutrino mass by precision spectroscopy of tritium β-decay with a target sensitivity of 0.2 eV. Recently, KATRIN has improved the direct upper bound on the effective electron-neutrino mass to 0.8 eV at 90 % CL [1]. However, the scientific potential of KATRIN extends well beyond the neutrino mass analysis. In particular, General Neutrino Interactions (GNI) [2] can be investigated through a search for potential shape variations of the β-spectrum. For this purpose, all theoretically allowed interaction terms for neutrinos are combined in one Effective Field Theory. This enables a model-independent description of novel interactions. Such potential modifications can then be identified in the β-spectrum measured with KATRIN by means of energy-dependent contributions to the rate. The talk will introduce the theory of GNI and present recent sensitivity studies on first year KATRIN data.

[1] The KATRIN Collab. *Nat. Phys.* 18, 160-166, 2022.
[2] I. Bischer and W. Rodejohann. *Nucl. Phys. B*, 947, 2019.

This work is supported by the Helmholtz Association, the Ministry for Education and Research BMBF (05A17PM3, 05A17PX3, 05A17VK2, and 05A17WO3), the Helmholtz Alliance for Astroparticle Physics (HAP), and the Helmholtz Initiative and Networking Fund (W2/W3-118).

T 13.6 Mon 17:45 POT/0251

Sensitivity of eV-scale sterile neutrino search with KATRIN using KaFit — •Shailaja Mohanty for the KATRIN-Collaboration — Institute for Astroparticle Physics, Karlsruhe Institute of Technology

KATRIN has recently reported a direct sub-eV upper bound on the neutrino mass from tritium beta-decay spectrum measurements. Along with the neutrino mass search, KATRIN has published recent results on searching for a fourth neutrino with a mass in the eV-range using the precision beta-decay spectra.

The fourth neutrino mass-eigenstate introduces an additional branch into the tritium β-spectrum which manifests as a kink in the differential spectrum. The position and amplitude of this kink correspond to the sterile neutrino mass m_4 and effective mixing angle $\sin^2(\theta) = |U_{e4}|^2$, respectively. In this work sensitivity studies to light sterile neutrinos based on new science runs and the effect of systematic uncertainties are presented. A grid scan is performed in the $[m_4^2, \sin^2(\theta)]$ 2-D plane using the fitting tool "KaFit" and sensitivity contours are calculated within this parameter space. Approach for a combined analysis of successive measurement campaigns are discussed.

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