T 68: Neutrinos, Dark Matter VIII

Time: Wednesday 15:50–16:50 Location: POT/0006

T 68.1 Wed 15:50 POT/0006

Determination of electromagnetic fields in the shifted analyzing plane of the KATRIN main spectrometer — •Fabian Block and Alexey Lokhov for the KATRIN-Collaboration — Karlsruhe Institute of Technology

The KATRIN experiment aims to determine the effective electron antineutrino mass with a sensitivity of 0.2 eV (90 % C.L.) by high-resolution spectroscopy of the endpoint region of the tritium β decay spectrum. To reach the sensitivity goal, the experimental setup of KATRIN combines a windowless gaseous tritium source with a high-resolution MAC-E filter, called main spectrometer. The energy analysis of the β-decay electrons in the main spectrometer takes place via a complex interplay of electric and magnetic fields.

To improve the signal-to-background ratio in neutrino mass measurements, the electromagnetic field configuration in the main spectrometer is adapted to the so-called Shifted Analyzing Plane (SAP). The SAP fields need to be known with high precision in order for them to be taken accurately into account in the β-spectrum model applied in the fit of the data. We present in this talk the results of high-statistics SAP characterization measurements employing conversion electrons of Kr-83m as sensitive probes for electromagnetic fields.

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T 68.2 Wed 16:05 POT/0006

Observables of the Electrical Potential of the KATRIN Tritium Source from Calibration with a High-Intensity Krypton-83m Source — •Moritz Machatschek for the KATRIN-Collaboration — Institute for Astroparticle Physics, Karlsruhe Institute of Technology

The KArlsruhe TRItium Neutrino experiment currently provides the best neutrino-mass upper limit of 0.8 eV/c^2 (90 % C. L.) in the field of direct neutrino-mass measurements. Reaching the target sensitivity of 0.2 eV/c^2 at 90 % C. L. not only relies on the ongoing data taking, but also the detailed study of systematic measurement uncertainties.

One major uncertainty is linked to the electric potential inside the tritium source. Inhomogeneities of the potential lead to a distortion of the β-spectrum, which needs to be characterized in order to reduce the systematic bias in the neutrino-mass measurement.

To this end we use conversion electrons from ^{83m}Kr as nuclear standard. Traces of gaseous ^{83m}Kr are circulated alongside tritium in the 10 m long source, such that inhomogeneities of the potential are observable as a broadening of the selected mono-energetic ^{83m}Kr lines. In this talk we describe the result of a three-week long ^{83m}Kr campaign carried out in 2021 and its impact on the neutrino-mass determination.

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 68.3 Wed 16:20 POT/0006

The XENONnT Gd-loaded water n-veto detector and purification system — •francesco Lombardi for the XENON-Collaboration — flombard@uni-mainz.de

The nuclear recoil scattering by Neutrons is the most dangerous background for the XENONnT experiment because they can mimic the expected Dark Matter signal: the single nuclear recoil scattering. To increase the Neutron tagging efficiency, the Muon Veto Water tank has been modified by introducing an additional neutron veto detector surrounding the XENON time projection chamber (TPC) and, in the next phase of the experiment, the 700 ton of water of the Cherenkov detector will be loaded with a solution at 0.48% of Gadolinium Sulfate Octahydrate salt ($Gd_2(SO_4)_3 \cdot 8H_2O$), corresponding to a percentage of 0.2% of Gadolinium of the total mass. In the next phase, the addiction of Gadolinium at 0.2%, will increase the neutron capture efficiency from the 74% of pure water to the 90% of the new solution. Together with the infrastructure of the neutron veto detector, we will also present the filtration plant for purification system and the relative automatic control.

T 68.4 Wed 16:35 POT/0006

Results and updates of the XENONnT neutron-veto — •Daniel Wenz for the XENON-Collaboration — Johannes Gutenberg-Universität Mainz

Nobel liquid time projection chambers (TPC) are playing a key role in the search for WIMP dark matter in the mass range of a few to a few hundred GeV/c^2. Neutrons, emitted by the detector material, pose a great danger for this type of experiments as they can mimic WIMP signals, by undergoing single-scatter nuclear recoils before leaving the sensitive region of the TPC. To mitigate this detector intrinsic background, the XENONnT TPC is enclosed by a water Cherenkov neutron-veto which tags these dangerous signals by measuring in a delayed coincidence the 2.22 MeV gamma-ray released from the neutron-capture on hydrogen. To get a precise calibration of the neutron-veto tagging efficiency, a novel coincidence technique, based on coincidentally emitted neutrons and gammas of an AmBe source, is used. The very same technique is also applied to conduct a very clean calibration of the XENONnT TPC nuclear recoils response.

In this talk, we are going to present the latest results of the XENONnT neutron-veto, including its tagging efficiency calibration as well as the calibration of the NR response of the XENONnT TPC.