T 37: Neutrinos, Dark Matter IV

Time: Tuesday 17:00–18:30 Location: POT/0251

T 37.1 Tue 17:00 POT/0251

Characterisation of the first 166-pixel TRISTAN detector module in a MAC-E filter environment — •Christina Bruch — Technical University Munich, James-Franck-Straße 1, 85748 Garching bei München

One possible Dark Matter candidate is the keV-scale sterile neutrino, that would only interact via the mixing of sterile and active eigenstates. In a tritium beta decay spectrum, this mixing would lead to a characteristic, kink-like signature for sterile neutrinos with masses up to 18.6 keV. The KATRIN experiment will be upgraded with a novel TRISTAN multi-pixel silicon drift detector and readout system to search for this signature.

The final TRISTAN detector will consist of multiple 166 pixel detector modules. This presentation will give an overview of the first characterisation with electrons of one of this 166 pixel detector modules in the KATRIN Monitor Spectrometer, which is a KATRIN-like MAC-E filter environment.

This project has received funding from the European Research Council (ERC) under the European Union Horizon 2020 research and innovation program (grant agreement No. 852845). In addition, this work is supported by BMBF (05A17PM3, 05A17PX3, 05A17VK2, 05A17WO3), KSETA, the Max Planck society, and the Helmholtz Association.

T 37.2 Tue 17:15 POT/0251

Search for Light Sterile Neutrinos with the KATRIN Experiment — •Xaver Stribl for the KATRIN-Collaboration — Chair for Dark Matter E47, Technical University of Munich

Light sterile neutrinos with a mass on the eV-scale could explain several anomalies observed in short-baseline oscillation experiments. The Karlsruhe Tritium Neutrino (KATRIN) experiment is designed to directly determine the effective electron anti-neutrino mass by measuring the tritium beta decay spectrum. The measured spectrum can also be investigated for the signature of light sterile neutrinos.
In this talk we present the status of the light sterile neutrino analysis of the KATRIN experiment. To handle the increasing computational challenge, a neural network is adapted for the analysis and its applicability is validated. This neural network is then used on Monte Carlo data sets to study the sensitivity of the first five measurement campaigns as well as the impact of individual systematic uncertainties. The obtained sensitivity is compared to current results and anomalies in the field of light sterile neutrinos.

T 37.3 Tue 17:30 POT/0251

Penning trap induced background in the KATRIN experiment — •Florian Fraenkle for the KATRIN-Collaboration — Institute for Astroparticle Physics (IAP), Karlsruhe Institute of Technology (KIT)

The KArlsruhe TRItium Neutrino (KATRIN) experiment is a largescale experiment with the objective to determine the effective electron anti-neutrino mass with an unprecedented sensitivity of 0.2 eV/c^2 at 90% CL in a model-independent way based on precision β-decay spectroscopy of molecular tritium. KATRIN is currently in the middle of several physics measurement campaigns and so far has improved the upper bound on the effective electron-neutrino mass to 0.8 eV at a 90% confidence level.

A Penning trap located between the KATRIN spectrometers, in combination with a large flux of β-decay electrons in this area, produces a scan-step-duration-dependent background which is one of the leading systematic uncertainties of KATRIN. This background was successfully mitigated with an optimized configuration of the voltages in the KATRIN beamline and is not present anymore in recent measurement campaigns. This talk will present measurements and a background model to describe the Penning trap induced background.

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 37.4 Tue 17:45 POT/0251

WISPLC: Search for Dark Matter with LC Circuit — •Zhongyue Zhang[1], Oindrila Gosh[2], and Dieter Horns[1] — [1]Institut für Experimentalphysik, Universität Hamburg, Luruper Chausseee 149, 22761 Hamburg — [2]I. Institute of Theoretical Physics, Universität Hamburg, Notkestraße 9-11, 22607 Hamburg

The focus on dark matter search has expanded to include low-mass particles such as axions or axion-like particles (ALPs). Assuming dark matter is composed of axions, in presence of a strong magnetic field, they induce a displacement current that generates a magnetic field detectable by state-of-art superconducting quantum interference devices (SQUIDs). The Weakly Interacting Slender Particle detection with LC circuit (WISPLC) is a precision direct detection experiment that will search for light dark matter candidates such as ALPs in part of the parameter space previously unexplored. The key facility is a large cryogen-free magnetic system that can produce a maximum solenoidal magnetic field of 14 Tesla at the center of the bore, inducing an axion-sourced toroidal magnetic field which can be captured by a superconducting pickup loop. We present two detection scheme: a broadband detection with up to 2 MHz bandwidth, and a resonant scheme where a LC circuit is used to enhance the signal with an expected Q factor $\sim 10^4$. Taking into account the irreducible flux noise of SQUIDs, we estimate the sensitivity of the experiment in the axion mass range between 10^{-11} eV and 10^{-6} eV to reach a detectable axion-photon coupling of $g_{a\gamma\gamma} \approx 10^{-15}$ GeV^{-1}, making it possible to probe mass ranges corresponding to ultralight axions motivated by string theory.

T 37.5 Tue 18:00 POT/0251

Towards direct neutrino mass measurement with the Project 8 experiment — •Larisa Thorne for the Project 8-Collaboration — Johannes Gutenberg University Mainz

There have been significant gains in characterizing neutrino properties in recent years, however the absolute neutrino mass scale continues to be elusive. The Project 8 collaboration seeks to probe this quantity directly via kinematic analysis of tritium beta decay, using the novel cyclotron radiation emission spectroscopy (CRES) technique with an atomic tritium source. CRES employs a frequency-based approach to measure tritium beta decay spectra in the endpoint region, where the spectral shape is most sensitive to distortions from the neutrino mass. Here we present a roadmap of Project 8 towards neutrino mass, with a design sensitivity of 40 meV. This includes recent results from our successful demonstrator experiment with tritium, as well as status updates on the components comprising the experiment's future full-scale version.

T 37.6 Tue 18:15 POT/0251

Precise Temperature Characterization of an Atomic Hydrogen Source — •Brunilda Muçogllava and Martin Fertl for the Project 8-Collaboration — Johannes Gutenberg Universität Mainz

In order to achieve a neutrino mass sensitivity of 40 meV, Project 8 aims to use the Cyclotron Radiation Emission Spectroscopy technique to analyze the tritium beta decay spectrum. To that end, a tritium atomic beam must be constructed and employed. Due to tritium's radioactive nature, initial measurements have been carried out using a Hydrogen Atom Beam Source (HABS) at the Mainz atomic test stand. The HABS produces hydrogen atoms via a 1 mm diameter tungsten capillary radiatively heated to ~ 2300 K by a filament. Precise capillary temperature measurements with low uncertainty at this high temperature are required for accurate characterization of the source. This is particularly important to understand the dissociation efficiency from molecular into atomic hydrogen, the key performance parameter for the atomic source. In this talk, the results of several temperature measuring devices will be discussed: a thermocouple inside the HABS, an optical spectrometer operated from outside the vacuum system, and a camera looking into the interior of the capillary.