HK 44: Astroparticle Physics II

Time: Wednesday 14:00–15:30 Location: HK-H10

Group Report HK 44.1 Wed 14:00 HK-H10

Results from the first search for axion like particles in storage rings — •Swathi Karanth for the JEDI-Collaboration — Marian Smoluchowski Institute of Physics, Jagiellonian University, Cracow, Poland

The axion was originally proposed to explain the small size of CP violation in quantum chromodynamics. If sufficiently abundant, it might be a candidate for dark-matter in the universe. Axions or axion-like particles (ALPs), when coupled with gluons, induce an oscillating Electric Dipole Moment (EDM) along the nucleon's spin direction. This can be used in an experiment to search for axions or ALPs using charged particles in a storage ring.

In spring of 2019, at the Cooler Synchrotron (COSY) in Jülich, we performed a first test experiment to search for ALPs using an in-plane polarized deuteron beam with a momentum of 0.97 GeV/c. At resonance between the spin precession frequency of deuterons and the ALP induced EDM oscillation frequency there will be an accumulation of the polarization out of the ring plane. Since the axion frequency is unknown, the momentum of the beam was ramped to search for a vertical polarization jump that would occur when the resonance is crossed. At COSY, four beam bunches with different polarization directions were used to make sure that no resonance was missed because of the unknown relative phase between the polarization precession and the EDM oscillations. A frequency window of about 1-kHz width around the spin precession frequency of 121 kHz was scanned. This talk will describe the experiment and provide an upper limit to oscillating EDM.

Group Report HK 44.2 Wed 14:30 HK-H10

The MONUMENT Experiment; ordinary muon capture as a benchmark for $0\nu\beta\beta$ decay nuclear structure calculations — Elisabetta Bossio[1], •Elizabeth Mondragon[1], Stefan Schönert[1], Mario Schwarz[1], and Christoph Wiesinger[1,2] for the MONUMENT-Collaboration — [1]Lehrstuhl für Experimentalphysik E15, Technische Universität München, Garching — [2]Max-Planck Institut für Physik, München

Extracting particle physics properties from neutrinoless double-beta ($0\nu\beta\beta$) decay requires a detailed understanding of the involved nuclear structures. Still, modern calculations of the corresponding nuclear matrix elements (NMEs) differ by factors 2-3. The high momentum transfer of Ordinary Muon Capture (OMC) provides insight into highly excited states similar to those that contribute virtually to $0\nu\beta\beta$ transitions. The precise study of the γ's following the OMC process makes this a promising tool to validate NME calculations. The MONUMENT collaboration is performing a series of explorative OMC measurements involving typical $\beta\beta$ decay daughter isotopes such as ^{76}Se and ^{136}Ba, as well as other benchmark isotopes. In this talk the experiment carried out at the Paul Scherrer Institute and first results from the beamtime in 2021 will be presented. This research is supported by the DFG Grant 448829699.

HK 44.3 Wed 15:00 HK-H10

Characterisation of the plasma in the tritium source of KATRIN with Krypton-83m — •Matthias Böttcher[1], Caroline Fengler[2], Manuel Klein[2], Moritz Machatschek[2], Magnus Schlösser[2], and Jaroslav Storek[2] for the KATRIN-Collaboration — [1]WWU Münster, Germany — [2]KIT, Karlsruhe, Germany

The KATRIN experiment has the aim to measure the electron-antineutrino mass with the unprecedented sensitivity of 0.2 eV/c^2 at 90 % C. L., using a direct kinematic measurement of the tritium beta spectrum. This requires precise understanding of systematic effects in the gaseous tritium source. Within this radioactive source, a low-density plasma at around 80 K forms, consisting of secondary electrons and ionised molecules. The plasma, influenced by the properties of the source tube, exhibits an electric potential distribution which smears out the beta spectrum. To characterize this effect, gaseous Kr-83m can be injected into the tritium source. Its well defined conversion electron lines, especially the narrow N_{23} doublet, allow for precise determination of energy broadenings and shifts. A dedicated measurement phase with an ultra high intensity krypton source was performed in 2021. In this talk, we describe the use of Kr-83m to assess the plasma systematics of the KATRIN source.

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HK 44.4 Wed 15:15 HK-H10

Status of the KATRIN neutrino mass analysis using Monte Carlo propagation and a novel neural network approach — Christian Karl[1,2], Susanne Mertens[1,2], Alessandro Schwemmer[1,2], and •Christoph Wiesinger[1,2] for the KATRIN-Collaboration — [1]Max-Planck-Institut für Physik, München — [2]Physik-Department, Technische Universität München, Garching

The Karlsruhe Tritium Neutrino (KATRIN) experiment probes the effective electron anti-neutrino mass by a precision measurement of the tritium beta-decay spectrum near the endpoint. A world-leading upper limit of $0.8\,\mathrm{eV\,c^{-2}}$ (90 % CL) has been set with the first two measurement campaigns. New operational conditions for an improved signal-to-background ratio, the reduction of systematic uncertainties and a substantial increase in statistics allow to expand this reach. The performance figures of three additional datasets, analysed with the Monte Carlo propagation method, and an outlook on their combination using a novel neural network technique will be presented in this talk.