HK 42: Fundamental Symmetries II

Time: Thursday 16:15–17:30 Location: AM 00.021

Group Report HK 42.1 Thu 16:15 AM 00.021

The Search for Electric Dipole Moments of Charged Particles in Storage Rings — •Achim Andres — GSI, Darmstadt, Germany

Electric dipole moments (EDMs) are probes of physics beyond the Standard Model and are closely related to the search for new sources of CP violation required to explain the matter-antimatter asymmetry of the universe. Permanent EDMs violate time-reversal and parity symmetries and, assuming the CPT theorem, imply CP violation. In addition, axions and axion-like particles (ALPs), proposed to solve the strong CP problem and as candidates for dark matter, are predicted to induce oscillating EDMs.

The COoler SYnchrotron (COSY) at Forschungszentrum Jülich provided polarized deuteron beams and was an ideal starting point for the JEDI Collaboration to develop storage-ring-based EDM searches. Over recent years, several milestones were achieved at COSY, including high-precision spin-tune measurements, spin-coherence times exceeding 1000 s, and operation of radio-frequency (rf) devices for spin manipulation. These achievements enabled the first direct measurement of the deuteron's permanent EDM in a storage ring and the first search for oscillating EDMs, both observed through the build-up of vertical polarization. This presentation summarizes the experimental results obtained and discusses upcoming steps toward high-precision storage-ring EDM measurements.

Group Report HK 42.2 Thu 16:45 AM 00.021

Status report of the free neutron lifetime experiment τSPECT — •Martin Fertl for the tauSPECT-Collaboration — Institute of Physics, Johannes Gutenberg University Mainz, 55099 Mainz, Germany

The accurate determination of the free neutron lifetime τ_n is of particular interest in low-energy precision particle physics. The Standard Model relates the neutron lifetime τ_n to the CKM matrix element V_{ud} and the ratio $\lambda = g_V/g_A$ through precisely calculated radiative corrections. A neutron-based determination of V_{ud} provides a nuclear-structure free input to the test of the CKM matrix unitarity. The τSPECT experiment pursues the approach of suspending ultracold neutrons in a three-dimensional fully-magnetic trap with the goal to determine τ_n with an uncertainty of < 0.3 s. Magnetic storage minimizes experimental systematic uncertainties related to neutron losses on material walls. We present the status of τSPECT currently operated at the Paul Scherrer Institute (PSI) in Switzerland. We address the optimization of UCN loading, systematic studies, and comparisons with simulations. Ideas for experimental developments for future improvements below will < 0.3 s be presented.

HK 42.3 Thu 17:15 AM 00.021

Status of the neutron decay experiment PERC — •Lilli Löbell — School of Natural Sciences, Technische Universität München, Germany

The decay of free neutrons is a powerful tool for precision tests of the Standard Model of particle physics. Correlation coefficients - such as the beta asymmetry A and the Fierz interference term b - serve as input for the determination of the CKM matrix element V_{ud} and for searches for (effective) scalar and tensor as well as right-handed couplings.

The neutron decay spectrometer PERC (Proton Electron Radiation Channel), which is set up at the research reactor FRM II in Garching, Germany, aims to improve the accuracy of several correlation coefficients by up to one order of magnitude. PERC consists of a 12 m long superconducting magnet system, in which the neutron beam is contained by a non-depolarizing neutron guide. The magnetic field guides electrons and protons produced in the neutron decay towards the main detector, which will initially be a scintillation detector with photomultiplier tube readout and later be upgraded to a silicon detector. A second detector system, which consists of a scintillator read out by silicon photomultipliers, is installed in the upstream area of PERC and allows to identify backscatter events. First measurements are planned for the end of 2026 after the restart of the FRM II.

The talk gives an overview of PERC and presents the current status.

PERC was supported by the Priority Program SPP 1491 of the DFG and the cluster of excellence "Origin and Structure of the Universe".