HK 54: Fundamental Symmetries II

Time: Thursday 15:45–17:15 Location: SR 0.01 Erw. Physik

Group Report HK 54.1 Thu 15:45 SR 0.01 Erw. Physik
Achieving and measuring ultra-low magnetic field gradients for measurements of the 129Xe-EDM- — •Felix Grüner — Physikalisches Institut, Uni Heidelberg

In the Standard Model, the electric dipole moment (EDM) of ^{129}Xe arises solely from the CP violation of the weak interaction. Additional sources of CP violation beyond the SM, as needed to explain e.g. baryon asymmetry, should cause a larger xenon EDM. The method used to measure smallest EDMs, comagnetometry, requires exceptionally homogeneous magnetic fields with field gradients of the order of pT/cm. Achieving this requirement necessitates advanced magnetic shielding.

The goal of the Helium-Xenon Experiment is to set a new upper limit on the xenon EDM. For this purpose, a Magnetically Shielded Room (MSR) was constructed at the Physikalisches Institut at Heidelberg University. This talk focuses on how the MSR achieves those low field gradients by active and passive shielding, as well as the determination of magnetic field gradients within the MSR of the order of pT/cm by measuring spin relaxation time constants.

Group Report HK 54.2 Thu 16:15 SR 0.01 Erw. Physik
Ultra-cold neutron storage and lifetime measurement in the fully magnetic trap τSPECT — •Sylvain Vanneste for the tauSPECT-Collaboration — Institut für Physik , Johannes Gutenberg University, Mainz, Germany

The accurate determination of the free neutron lifetime is of particular interest in modern precision physics. Its value is closely linked to the mixing of up and down quarks, as well as the abundance of primordial elements formed during Big Bang nucleosynthesis. Currently, two distinct measurement techniques yield results that are inconsistent, giving rise to the so-called neutron lifetime puzzle.

To minimize experimental systematic uncertainties caused by neutron losses on material walls, the experiment τSPECT employs a fully magnetic trap for Ultra-Cold Neutrons (UCNs). This work presents the latest commissioning results of τSPECT at the Paul Scherrer Institute (PSI) in Switzerland, including UCN loading optimization, systematic studies, comparisons with simulations, neutron lifetime measurements, and proposed future improvements.

HK 54.3 Thu 16:45 SR 0.01 Erw. Physik
Status of the neutron decay facility PERC and its main detector — •Lilli Löbell for the PERC-Collaboration — 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. By determining decay correlation coefficients such as the beta asymmetry A, one can test the unitarity of the CKM matrix and search for physics beyond the Standard Model via new effective couplings.

The neutron decay spectrometer PERC (Proton Electron Radiation Channel), which is currently set up at the FRM II research reactor in Garching, aims to improve the accuracy of several correlation coefficients by 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. Electrons and protons produced in the neutron decay are guided by the magnetic field towards the main detector, which will initially be a scintillation detector with photomultiplier tube readout.

The talk will present the design of the main detector as well as the current status of the installation of PERC.

HK 54.4 Thu 17:00 SR 0.01 Erw. Physik
Proton Transport from the Antimatter Factory of CERN — •Marcel Leonhardt[1,2], Daniel Schweitzer[1,3], Fatma Abbass[1,3], Satoshi Endo[2,4], and Christian Smorra[1] for the BASE-Collaboration — [1]Institut für Experimentalphysik, Heinrich-Heine-Universität, Düsseldorf, Germany — [2]RIKEN, Ulmer Fundamental Symmetries Laboratory, Wako, Saitama, Japan — [3]Institut für Physik, Johannes Gutenberg-Universität, Mainz, Germany — [4]Graduate School of Arts and Sciences, University of Tokyo, Tokyo, Japan

The most precise CPT invariance tests in the baryon sector are currently conducted at CERN's world-unique antimatter factory. Within this program, the BASE collaboration compares the fundamental properties of antiprotons and protons using state-of-the-art cryogenic Penning-trap systems. To push the limits of our measurements to higher fractional accuracy, we built the autonomous, open, transportable Penning-trap system BASE-STEP to transport antiprotons to our dedicated high-precision offline laboratory currently under construction at Heinrich Heine University Düsseldorf, Germany. I will present the most critical milestone in realizing antiproton transport: The successful demonstration of all essential techniques required for its implementation using protons. Specifically, we achieved lossless transport of 100 trapped protons via truck across the CERN Campus and continued seamless operation of the system after transport. Our demonstration validates the feasibility of the concept, paving the way for future offline antiproton precision studies.