HK 33: Fundamental Symmetries I

Time: Wednesday 14:00–15:30 Location: SCH/A252

Group Report HK 33.1 Wed 14:00 SCH/A252

τSPECT - A fully magnetic gradient trap to measure the free neutron lifetime — •Martin Fertl for the tauSPECT-Collaboration — Institut für Physik, Johannes Gutenberg-Universität Mainz

The free neutron lifetime τ_n critically influences the primordial nucleosynthesis and is indispensible to perform a CKM-matrix unitarity test without nuclear structure corrections related to the extraction of V_{ud} from $0^+ \rightarrow 0^+$ nuclear transitions. The τSPECT collaboration has implemented a 3D magnetic field gradient trap for ultracold neutrons (UCN) with the aim to determine τ_n with a statistical sensitivity below 1 s, complementary to the precision obtained with the current state-of-the-art magneto-gravitational UCN traps. Spin-polarized UCN are loaded into the storage volume via a double-spin-flip sequence and counted after a preset storage time with an in-situ UCN detector. This report will introduce the concept, the implementation and results from the commissioning runs at the UCN source facility at TRIGA Mainz.

Group Report HK 33.2 Wed 14:30 SCH/A252

Degaussing of a Magnetically Shielded Room for the ^{3}He-^{129}Xe Comagnetometer Experiment in Heidelberg — •Benjamin Brauneis[1], Fabian Allmendinger[1], Werner Heil[2], and Ulrich Schmidt[1] — [1]Physikalisches Institut, Universität Heidelberg — [2]Institut für Physik, Universität Mainz

The permanent Electric Dipole Moment (EDM) of ^{129}Xenon is an experimentally accessible signal for potential sources of CP-violation not described by the Standard Model. It can be measured in a clock comparison experiment using a gas mixture of free spin precessing nuclear polarized ^{3}He and ^{129}Xe. To reach the desired accuracy this experiment has to be performed at low frequencies (few Hz) and therefore within a Magnetically Shielded Room (MSR). Furthermore, very small field gradients (pT per cm) are required in order to reach a sufficiently large spin coherence time. Our MSR consisting of three layers of Mu-metal and one layer of copper-plated aluminum was constructed in Heidelberg 2021. Efforts are made to develop an advanced degaussing routine yielding to reproducible low residual magnetic fields within the MSR. We report on the current status of preparation for next Xe-EDM measurements in Heidelberg with special focus on the degaussing procedure and the performance for our MSR.

HK 33.3 Wed 15:00 SCH/A252

Tracking of the spatial magnetic field distribution for the Fermilab Muon g−2 experiment — •Mohammad Ubaidullah Hassan Qureshi, René Reimann, and Martin Fertl for the Muon g–2-Collaboration — Institute of Physics and Excellence Cluster PRISMA+, Johannes Gutenberg University Mainz, 55099 Mainz, Germany

The Fermilab Muon g−2 experiment E989 aims to measure the anomalous magnetic moment of the muon to a precision of 140 ppb. This experiment consists of muons stored in a ring-shaped quasi-penning trap within a uniform magnetic field of 1.45 T. The measurement is composed of a ratio of two frequencies, the anomalous spin precession frequency of the muons (ω_a) and the muon-weighted spin precession frequency of protons ($\tilde{\omega}_p$). $\tilde{\omega}_p$ is fundamentally the measure of the magnetic field experienced by these precessing muons, we measure this magnetic field using nuclear magnetic resonance (NMR) based probe systems. In this talk, I will be reviewing two of the sub-systems of the magnetic field measurement chain, namely, the trolley probe and the fixed probe systems which measure the magnetic field periodically and continuously, respectively. This will be followed by an overview of the procedure for synchronising the measurements of the two sub-systems in time and the independent cross-check performed on the procedure for removing the trolley system's magnetic signature in the fixed probe system.

HK 33.4 Wed 15:15 SCH/A252

The Search for Electric Dipole Moments of Charged Particles in Storage Rings — •Achim Andres for the JEDI-Collaboration — Institute for Nuclear Physics IV, FZ Jülich, Germany — III. Physikalisches Institut B, RWTH Aachen University, Germany

The matter-antimatter asymmetry in the universe cannot be explained by the Standard Model of elementary particle physics. According to A. Sakharov CP violating phenomena are needed in order to understand the matter-antimatter asymmetry. Permanent Electric Dipole Moments (EDMs) of subatomic elementary particles violate both time reversal and parity asymmetries and therefore also violate CP if the CPT-theorem holds. Storage rings offer the possibility to measure EDMs of charged particles by observing the influence of the EDM on the spin motion. The Cooler Synchrotron (COSY) at Forschungszentrum Jülich provides polarized protons and deuterons up to a momenta of 3.7 GeV/c and is therefore an ideal starting point for the JEDI - Collaboration (Jülich Electric Dipole moment Investigations) to perform the first direct measurement of the deuteron EDM. During this talk, recent results of the first deuteron EDM measurements are presented.