HK 13: Fundamental Symmetries I

Zeit: Montag 16:30–18:30 Raum: HS 16

Gruppenbericht HK 13.1 Mo 16:30 HS 16

The Neutron Lifetime Experiment PENeLOPE — •Dominic Gaisbauer — TU München, Garching, Deutschland

The neutron lifetime $\tau_n = 880.2 \pm 1.0\ s$ is an important parameter in the Standard Model of particle physics and in Big Bang cosmology. Several systematic corrections of previously published results reduced the PDG world average by several s in the last years and call for a new experiment with complementary systematics.

The experiment PENeLOPE, currently under construction at the Physik-Department of Technische Universität München, aims to determine the neutron lifetime with a precision of 0.1 s. It will trap ultra-cold neutrons in a magneto-gravitational trap using a large superconducting magnet and will measure their lifetime by both neutron counting and online proton detection.

This presentation will give an overview over the latest developments of the experiment. The project is supported by the Maier-Leibnitz-Laboratorium (Garching), the Deutsche Forschungsgemeinschaft and the Excellence Cluster "Origin and Structure of the Universe".

Gruppenbericht HK 13.2 Mo 17:00 HS 16

Precision Measurement of the Beta Asymmetry in Neutron Beta Decay with Perkeo III — •Heiko Saul[1], Hartmut Abele[2], Dirk Dubbers[3], Michael Klopf[2], Bastian Märkisch[1], Holger Mest[3], Alexandr Pethoukov[4], Christoph Roick[1], Torsten Soldner[4], Xiangzun Wang[2], and Dominik Werder[3] — [1]Physik Department ENE, Technische Universität München — [2]Atominsititut, Technische Universität Wien — [3]Physikalisches Institut, Universität Heidelberg — [4]Institut Laue-Langevin, Grenoble

Within the standard model of particle physics semi-leptonic weak decay is described by only two free parameters, the ratio of vector and axial vector couplings, λ, and the first element of the CKM-matrix V_{ud}. Due to the absence of nuclear structure, neutron beta decay is an ideal probe to test the structure of the weak interaction.

Measuring the beta asymmetry, A, is the most precise way of measuring λ. The spectral shape of the experimental beta asymmetry furthermore contains information about hypothetical scalar- and tensor interactions via the Fierz interference term.

In this talk we present the result of the world's most precise measurement of the beta asymmetry performed with the decay spectrometer Perkeo III. This measurement has been carried out at the PF1B cold neutron beam facility at the Institut Laue-Langevin.

Gruppenbericht HK 13.3 Mo 17:30 HS 16

The P2 experiment: A high precision measurement of the weak mixing angle — Sebastian Baunack[1], Dominik Becker[1], Frank Maas[1,2,3], David Rodriguez Pineiro[2], and •Malte Wilfert[1] for the P2-Collaboration — [1]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz, Johannes Gutenberg-Universität Mainz — [3]PRISMA Cluster of Excellence, Johannes Gutenberg-Universität Mainz

The weak mixing angle $\sin^2\theta_w$ can be measured in parity violating elastic electron-proton scattering. The aim of the P2 experiment is a very precise measurement of the weak mixing angle with a precision of 0.15% at a low four-momentum transfer of $Q^2 = 4.5 \cdot 10^{-3}\,\mathrm{GeV}^2$. This precision is comparable to existing measurements at the Z pole. The experiment will be built at the future MESA accelerator in Mainz.

In this talk, the motivation for the measurement and the theoretical and experimental challenges will be discussed.

HK 13.4 Mo 18:00 HS 16

Neutron beta decay studies with PERC — •Bastian Märkisch for the PERC-Collaboration — Physik-Department, Technische Universität München

Neutron beta decay is an excellent system to study the charged weak interaction experimentally. The decay is precisely described by theory and unencumbered by nuclear structure effects. Observables are numerous correlation coefficients which e.g. relate the spin of the neutron and the momenta of the particles, spectra and the lifetime. Precision measurements in neutron beta decay are used to search for hypothetical scalar and tesor couplings and to derive the element V_{ud} of the Cabibbo-Kobayashi-Maskawa matrix.

The Proton Electron Radiation Channel (PERC) instrument is currently under construction at the MLZ, Garching. It designed to improve measurements of several correlation coefficients by an order of magnitude. In this talk, we will present the concept of the instrument and its current status.

HK 13.5 Mo 18:15 HS 16

Towards Sympathetic Cooling of Single Protons and Antiprotons — •Markus Wiesinger[1,2], Matthew Bohman[1,2], Georg Schneider[3], Christian Smorra[2], Andreas Mooser[1,2], Pascal Blessing[2,4], Jack Devlin[2,5], James Harrington[1,2], Elise Wursten[2,5], Klaus Blaum[1], Yasuyuki Matsuda[6], Wolfgang Quint[5], Jochen Walz[3], and Stefan Ulmer[2] — [1]Max-Planck-Institut für Kernphysik, Germany — [2]Ulmer Fundamental Symmetries Laboratory, RIKEN, Japan — [3]Johannes Gutenberg-Universität Mainz, Germany — [4]GSI, Germany — [5]CERN, Switzerland — [6]University of Tokyo, Japan

We, the BASE collaboration, perform most precise tests of the CPT symmetry in the baryon sector by measurement of the proton and antiproton magnetic moment and the proton-to-antiproton charge-to-mas ratio.

Our latest high-precision measurement of the proton magnetic moment at the proton g-factor experiment in Mainz is limited by statistics. The reason is that the current use of sub-thermal cooling of a single proton by a resistive method - an extremely time-consuming technique - leads to cycle times of hours.

To overcome this limitation sympathetic cooling by laser-cooled Be^+ ions is planned in a common-end-cap Penning trap: The method not only promises to produce protons or antiprotons with mK temperatures within tens of seconds but also achieves separation of the cooled ion and the refrigerator ion - a feature distinct from other ongoing efforts to sympathetically cool antiprotons.

We present the current setup of the proton g-factor experiment and report on the status of our laser cooling experiments.