HK 64: Fundamental Symmetries I

Time: Thursday 14:00–15:30 Location: HK-H9

Group Report HK 64.1 Thu 14:00 HK-H9

Probing charged lepton flavor violation with the Mu2e experiment — •Stefan E. Müller, Anna Ferrari, Oliver Knodel, and Reuven Rachamin for the Mu2e-Collaboration — Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany

The Mu2e experiment, which is currently under construction at the Fermi National Accelerator Laboratory near Chicago, will search for the neutrinoless conversion of muons to electrons in the field of an aluminum nucleus. This process, which violates charged lepton flavor, is highly suppressed in the Standard Model and therefore undetectable. However, scenarios for physics beyond the Standard Model predict small but observable rates. The Mu2e experiment aims for a sensitivity four orders of magnitude better than previous experiments. This is achieved by a rigorous control of all backgrounds that could mimic the monoenergetic conversion electron.

At the Helmholtz-Zentrum Dresden-Rossendorf, we use a pulsed Bremsstrahlung photon beam at the ELBE radiation facility to study the performance of the detector system that will monitor the rate of stopped muons in the aluminum target. Additionally, Monte Carlo simulations are performed for both the pion production target and the muon stopping target.

In the presentation, the design and status of the Mu2e experiment and its detectors will be presented, and results from ELBE beamtimes and the simulation studies will be given.

HK 64.2 Thu 14:30 HK-H9

Fierz interference term in neutron decay — •Max Lamparth[1], Karina Bernert[1], Hartmut Abele[3], Andreas Doblhammer[3], Erwin Jericha[3], Jens Klenke[2], Annabel Kropf[1], Kathrin Lehmann[2], Heiko Saul[1], Ulrich Schmidt[5], Torsten Soldner[4], and Bastian Märkisch[1] — [1]TUM Physik-Department, Garching, Germany — [2]Forschungsreaktor München, Garching, Germany — [3]Atominstitut Wien, Wien, Austria — [4]Institut Laue-Langevin, Grenoble, France — [5]Physikalisches Institut Heidelberg, Heidelberg, Germany

Neutron beta decay is an excellent system to test the structure of the charged weak interaction. The Fierz interference term b is sensitive to hypothetical scalar and tensor interactions and absent in the Standard Model. The signature of a non-zero Fierz term in neutron beta decay is an extra energy-dependent phase-space contribution. Major systematic effects are hence related to the detector response: calibration, temporal stability, spatial uniformity and non-linearity effects.

The spectrometer PERKEO III was installed at the Institute Laue-Langevin, Grenoble, France, with the aim to determine the Fierz interference term with a precision of $5 * 10^{-3}$ from the beta spectrum. We present the measurement and discuss the status of the analysis.

HK 64.3 Thu 14:45 HK-H9

Electron Spectroscopy with PERC — •Karina Bernert[1], Jens Klenke[2], Max Lamparth[1], Manuel Lebert[2], Kathrin Lehmann[2], and Bastian Märkisch[1] — [1]Technische Universität München, Garching, Germany — [2]Forschungsreaktor München, Garching, Germany

The PERC (Proton Electron Radiation Channel) instrument is a neutron decay facility currently being set up at the research reactor FRM II of the Heinz Maier-Leibnitz Zentrum in Garching. Its main component is a 12-meter long superconducting magnet system, which was recently delivered to the FRM II. We aim to measure several correlation coefficients in neutron beta decay one order of magnitude more precisely than currently possible. From the results, we will derive the nucleon axial coupling and the CKM matrix element V_{ud} and search for scalar and tensor couplings.

The spectrum of electrons from neutron decay will be obtained using two detector systems: the primary detector downstream will be a scintillation or silicon detector. The secondary detector system, used to identify backscattering events, consists of two pixelated scintillation detectors read out by silicon photomultipliers. In this talk, we present the status of the experiment and its main components with a focus on the backscatter detector.

PERC is developed in cooperation with scientists from TU Vienna, Universität Heidelberg, Johannes Gutenberg-Universität Mainz and the ILL.

HK 64.4 Thu 15:00 HK-H9

The backward angle measurement at P2 — Sebastian Baunack[1], Maarten Boonekamp[4], Boris Gläser[1], Kathrin Imai[1], Rahima Krini[1], Frank Maas[1,2,3], Tobias Rimke[1], 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 — [4]IRFU, CEA, Université Paris-Saclay, Gif-sur-Yvette, France

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 an accuracy of 0.15% at a low four-momentum transfer of $Q^2 = 4.5 \cdot 10^{-3}\,\mathrm{GeV}^2$. In combination with existing measurements at the Z pole with comparable accuracy, this comprises a test of the standard model with a sensitivity towards new physics up to a mass scale of 50 TeV. The experiment will be built at the future MESA accelerator in Mainz.

In addition to the measurement under forward angle, a measurement under backward angle will be performed. This measurement will reduce the uncertainty on the axial form factor and the strange magnetic form factor and thus reducing the systematic uncertainty on the weak charge of the proton. The motivation and challenges for this measurement will be discussed in this talk.

HK 64.5 Thu 15:15 HK-H9

Search for low Q-value beat decays for neutrino mass determination — •zhuang ge[1,2], Tommi Eronen[2], and IGISOL collaboration[2] — [1]GSI Helmholtzzen-trum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany — [2]Department of Physics, University of Jyväskylä, P.O. Box 35, FI-40014 Jyväskylä, Finland

The scale of neutrino masses is one of the burning open questions in physics. The β decay experiments search the electron neutrino mass by measuring the slight distortion and energy deficit of the end-point of the β spectrum. As small as possible decay energy (Q value), is essential to maximize decay events near the end-point. We map out nuclei that potentially undergo β decay with an ultra-low Q value (< 1 keV) to an excited state in the daughter nucleus. A precise and accurate determination of these ultra-low Q values requires the measurements of the groud-state-to-groud-state (gs-to-gs) Q values to $\sim$ 100-eV level. We have measured gs-to-gs decay Q values of several candidates with the JYFLTRAP Penning trap setup. The high-precision Q-value measurement from our experiment combined with the nuclear energy level data will be used to determine whether the possible low Q-value β-decay candidate for the neutrino mass are energetically allowed and, if positive, how small. In this report, the experimental techniques of TOF-ICR and PI-ICR methods to determine the gs-to-gs Q value to a relative precision of $\sim 10^{-9}$ for the application of neutrino mass determination will be discussed and the preliminary results of some prospective cases will be presented.