HK 43: Fundamental Symmetries II

Time: Wednesday 15:45–17:15 Location: SCH/A252

Group Report HK 43.1 Wed 15:45 SCH/A252

The search for Charged Lepton Flavour Violation with the Mu2e experiment — •Anna Ferrari[1], Stefano Di Falco[2], Valerio Giusti[3], Stefan E. Müller[1], Oliver Knodel[1], Vitaly Pronskikh[4], and Reuven Rachamin[1] for the Mu2e-Collaboration — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]INFN Pisa, Pisa, Italy — [3]University of Pisa, Pisa, Italy — [4]Fermi National Accelerator Laboratory, Batavia, IL, USA

The Mu2e experiment, currently under construction at Fermilab (USA), will search for the charged-lepton flavor violating neutrino-less conversion of negative muons into electrons in the field of an aluminum nucleus. A conversion signal would require physics beyond the Standard Model, and the aim of Mu2e is to reach a sensitivity four orders of magnitude better than previous experiments. To achieve such a goal, a reliable estimate of the relevant particle yields and a rigorous control of all backgrounds are mandatory, together with an accurate normalization of signal events.

An extensive campaign of Monte Carlo simulations has been therefore performed to investigate key yields and beam and cosmic rays-related backgrounds. In addition, at the Helmholtz-Zentrum Dresden-Rossendorf the pulsed Bremsstrahlung photon beam at the ELBE facility has been used to study the performance of the detector system that will monitor the rate of the stopped muons in the aluminum target.

The design and present status of the Mu2e experiment will be presented, together with the main results of the background and sensitivity studies, and a summary of the results of the ELBE campaign.

Group Report HK 43.2 Wed 16:15 SCH/A252

Status of the COMET experiment — •Andreas Jansen, Thomas Kormoll, Dominik Stöckinger, and Kai Zuber — TU Dresden, Institut für Kern- und Teilchenphysik, Germany

The COMET experiment, currently being built in Tokai, Japan, will search for the coherent neutrinoless transition of muons to electrons in the Coulomb field of atomic nuclei ($\mu^- + \mathrm{N} \rightarrow e^- + \mathrm{N}$). While the total lepton number L is conserved, with no out-going neutrinos the individual lepton flavors L_e and L_μ are violated by one unit.

This charged lepton flavor violation involving muons is one of the most promising Beyond Standard Model (BSM) fields currently under investigation. Not only do recent results regarding the muon anomalous magnetic moment (g-2) present a very strong motivation for muon BSM, but also current best experimental limits barely fall short of the predicted conversion rate in many widely acknowledged BSM theories (e.g. supersymmetric theories).

In order to realize stringent requirements on the detector system and muon beam, the COMET experiment will follow a staged approach. Phase-I aims to improve the current branching ratio limit of 7×10^{-13} by two orders of magnitude while also allowing data taking of beam dynamics and validation of Monte Carlo simulations. In Phase-II the branching ratio limit will be additionally improved by at least two orders of magnitude.

This talk will give an experimental overview of both phases, recent updates on the facility and the current detector development status.

HK 43.3 Wed 16:45 SCH/A252

Effect of magnet cycling on the magnetic field tracking uncertainties in the Fermilab g–2 experiment — •René Reimann, Mohammad Ubaidullah Hassan Qureshi, and Martin Fertl for the Muon g–2-Collaboration — Institute of Physics and Excellence Cluster PRISMA+, Johannes Gutenberg University Mainz, 55099 Mainz, Germany

The Muon g–2 Collaboration has presented the most precise measurement of the anomalous magnetic moment a_μ with an uncertainty of 460 ppb. To achieve the goal of 140 ppb uncertainty, more than a factor of nine times the published data have been recorded, but systematic uncertainties must also be reduced. A key parameter in determining a_μ is the precise value of the homogeneous 1.45 T magnetic field in which the muons are stored. Two systems using nuclear magnetic resonance (NMR) techniques are used to track the magnetic field in the muon storage ring. One system measures the spatial magnetic field distribution every few days in the storage region itself, and the other system measures the magnetic field drift continuously with probes in the walls of the vacuum chambers of the storage ring. Cycling the storage ring magnet introduces additional field drifts which are challenging for the tracking of the averaged magnetic field. In this talk, I will present the effect of magnet cycling on the tracking of the magnetic field and its uncertainty.

HK 43.4 Wed 17:00 SCH/A252

Upgrading antihydrogen production in AE$\bar{\mathrm{g}}$IS — •Saiva Huck — CERN, Meyrin, Switzerland — University of Hamburg, Inst. f. Experimental Physics, Hamburg, Germany

The AE$\bar{\mathrm{g}}$IS (Antimatter Experiment: Gravity, Interferometry, Spectroscopy) collaboration, based at CERN's Antiproton Decelerator (AD) complex, produces antihydrogen atoms in the form of a pulsed, isotropic source with a precisely defined production time. $\bar{\mathrm{H}}$ is formed by means of a charge exchange reaction: antiprotons are captured from the AD inside a Penning-Malmberg trap, further sympathetically cooled with electrons, and then combined with positronium atoms, which are previously laser-excited to Rydberg states.

The focus of research in AE$\bar{\mathrm{g}}$IS is on the formation of a pulsed horizontal beam of $\bar{\mathrm{H}}$ atoms utilized to investigate their vertical deflection due to the influence of gravity, thereby probing the Weak Equivalence Principle for antimatter and providing a test of the CPT theorem.

Since the first $\bar{\mathrm{H}}$ formation in 2018, AE$\bar{\mathrm{g}}$IS has undergone several significant upgrades aimed at improving the efficiency of antihydrogen production and fully benefiting from the newly added ELENA (Extra Low ENergy Antiproton) decelerator at the AD, which commenced operation in fall of 2021 and yields antiprotons in larger numbers at lower energies. Subsequently, work is being undertaken to re-establish $\bar{\mathrm{H}}$ production, in larger numbers, and move towards beam formation.

This contribution gives an overview of the improvements to the AE$\bar{\mathrm{g}}$IS setup, results obtained during the first beam times with ELENA, and progress towards the formation of a pulsed $\bar{\mathrm{H}}$ beam.