HK 19: Fundamental Symmetries II

Time: Tuesday 17:00–18:30 Location: J-HS B

Group Report HK 19.1 Tue 17:00 J-HS B

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

COMET is an experiment at the Japan Proton Accelerator Research Complex (J-PARC), which will search for coherent neutrinoless transition of muons to electrons in the coulomb field of atomic nuclei ($\mu^- + \mathrm{N} \rightarrow e^- + \mathrm{N}$). Since this process violates charged lepton flavor conservation it is highly suppressed in the Standard Model and thus provides a promising channel to constrain new physics.

The COMET experiment will operate in two stages. Phase-I is currently under construction at J-PARC and is aiming at two orders of magnitude improvement over the current limit. In Phase-II this will be additionally improved by at least two orders of magnitude. Refinements on the experimental design based on ongoing investigations and experience gained from Phase-I will be used to push this even further for a total improvement of five orders of magnitude.

This talk will give an overview of both phases, along with recent updates about the facility and the current status of detector developments.

Group Report HK 19.2 Tue 17:30 J-HS B

Muonic X-ray measurements with the MiniBall germanium detector array. — •Frederik Wauters — Johannes Gutenberg Universität Mainz

Negative muons at rest quickly get captured by nearby atoms in highly excited atomic states. The muonic atom de-excites until the muon ends up in the 1S orbital. The photons emitted during this process are called muonic X-rays. Due to the large overlap between the muon wave function and the nucleus, they are sensitive to the nuclear size and structure and short range interactions. The MuX collaboration performs muonic X-ray measurements at the Paul Scherrer Institute (PSI) with medium- and high-Z nuclei. The physics program focuses on atomic parity violation (APV), with first measurements performed in 2017 and 2018. During the fall of 2019, the high-resolution MiniBall germanium detector array was brought from the ISOLDE/CERN facility to PSI. This opportunity sparked an extensive and diverse measurement program. In this talk I will give a summary of this year's campaign. The main goal of the 2019 run was to measure the muonic X-rays of 226Ra to determine it's charge radius. Radium is a promising candidate for a high-precision APV measurement at low Q2. We also measured the 2S1S transition in muonic Zn, investigating the feasibility of an experiment measuring APV directly with muonic atoms. Two weeks of beam time were dedicated to investigate nuclei of interest for neutrinoless double beta-decay experiments. In addition, muonic X-ray spectroscopy measurements were performed on archaeological artifacts to determine their elemental and isotopic composition.

HK 19.3 Tue 18:00 J-HS B

Spin Tune Measurements for Electric Dipole Moment Searches — •Abhiroop Sen for the JEDI-Collaboration — Institut für Kernphysik, Forschungszentrum Jülich — III. Physikalisches Institut B, RWTH Aachen

The electric dipole moment (EDM) of particles is an important property that can be studied to shed light on physics beyond the Standard Model, as well as answer questions about the matter-antimatter asymmetry in the universe (since it is CP violating). The JEDI Collaboration, using the Cooler Synchtrotron (COSY) at Forschungszentrum Jülich, is working towards measuring the EDM of charged particles (protons and deuterons), which would be the first step to further, more detailed, studies about EDMs.

EDMs are measured by studying their influence on the spin motion. One important quantity in this context is the so called spin tune, defined as the number of times the spin precesses about the polarisation axis per particle turn in the ring. Using different approaches, one can analyse the spin tune of particle bunches in COSY and determine the spin coherence time (SCT), which is an estimate of how long the spins of the particles remain in phase, while they precess in the horizontal plane. This talk will concentrate on the analysis of spin tunes for longer cycles of $\sim 10^3$ s.

HK 19.4 Tue 18:15 J-HS B

Polarization measurements for storage ring electric dipole moment Investigations — •Achim Andres for the JEDI-Collaboration — Institute for Nuclear Physics II , 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 additonal 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. They could thus provide this additional CP violation.

The JEDI-Collaboration (Jülich Electric Dipole moment Investigations) is preparing a direct EDM measurement for protons and deuterons: first at the storage ring COSY (COoler SYnchrotron) at Forschungszentrum Jülich and later at a dedicated storage ring. As COSY is an all magnetic storage ring, a direct measurement of the EDM is not possible as polarization build up effects due to the EDM cancel out over time. The basic idea is to modulate the spin oscillation of deuterons and protons with a radio frequency (RF) Wien filter without perturbing the beam itself to measure a net vertical polarization build up due to the EDM. In this talk, a new method to match the fields inside the Wien Filter as well as the resonance frequency of the kicks of the magnetic field B_{WF} to the spin precession vector will be presented.