SYAM 2: Atomic Anti-Matter Physics II

Time: Thursday 14:30–16:30 Location: P 1

Invited Talk SYAM 2.1 Thu 14:30 P 1

Muon g-2 — •Klaus Jungmann — Van Swinderen Institute, University of Groningen, The Netherlands

The magnetic anomaly of the muon has been measured to o.54ppm at the Brookhaven National Laboratory, USA. The theoretical value of this quantity has been calculated using several approaches which have converged at a value which differs from the experimental result by about 3.5 standard deviations. In order to clarify whether a significant difference (>5 standard deviations) exists an improved experiment is underway at the Fermi National Laboratory, USA. It uses in all essential parts the same approach and technological concepts, in particular the very same storage ring of 7m radius in which muons at magic momentum are stored in 1.45 Tesla magnetic field. At J-PARC, Japan, a second experiment is underway. It uses different rather technology in many essential parts, in particular higher magnetic field and a much smaller radius magnet. The perspectives for both experiments will be discussed together with the possible implications of a measurement at higher accuracy.

Invited Talk SYAM 2.2 Thu 15:00 P 1

Antihydrogen physics at ASACUSA and AEGIS — •Chloé Malbrunot — CERN, Geneva, Switzerland

A growing number of collaborations are performing experiments at the CERN Antiproton Decelerator (AD), the only available facility providing slow antiprotons suitable for precision measurements with anti-atoms. The majority of these experiments are forming antihydrogen atoms with the main goal of probing their atomic transitions which have been measured in hydrogen to a remarkable precision. The precise comparison between the hydrogen and antihydrogen transitions has indeed the potential to provide one of the most sensitive tests of CPT symmetry. More recently, experiments have begun to employ antihydrogen atoms to test the validity of the Weak Equivalent Principle on antimatter by measuring the fall of these anti-atoms in the Earth's gravitational field. The ASACUSA-CUSP and AEGIS collaborations are both aiming at forming a cold beam of antihydrogen atoms in order to measure their ground-state hyperfine splitting (ASACUSA) and free fall in the Earth gravitational field (AEGIS) in an electromagnetic field-free region. After shortly describing the experimental setups adopted by those collaborations and discussing their respective sensitivities, I will highlight the latest developments and the upcoming experimental challenges towards CPT and gravity tests with antihydrogen atoms.

Invited Talk SYAM 2.3 Thu 15:30 P 1

An experiment to measure the anti-hydrogen Lamb shift — •Paolo Crivelli — ETH Zurich, Institute for Particle Physics, 8093 Zurich, Switzerland

The upcoming operation of the Extra Low ENergy Antiprotons (ELENA) ring at CERN, the upgrade of the anti-proton decelerator (AD), and the installation in the AD hall of an intense slow positron beam with an expected flux of 10^8 e^+/s will open the possibility for new experiments with anti-hydrogen ($\bar{H}$). In this talk we will present an experiment to measure the Lamb shift of $\bar{H}$ at the 100 ppm level. This will provide a test of CPT and the first determination of the anti-proton charge radius at the level of 10%.

SYAM 2.4 Thu 16:00 P 1

Monitoring o-Ps formation by means of the scintillating fibre detector at AEgIS (CERN) — •Benjamin Rienäcker — Physics Department, CERN, 1211 Geneva 23, Switzerland

The AEgIS experiment at CERN aims to directly measure Earth's gravitational force on antihydrogen with a precision of 1%. To achieve this, antihydrogen will be produced by charge exchange reaction between cold antiprotons and Rydberg-positronium. As an intermediate step, ground-state ortho-positronium is produced by implanting a bunch of several 10^7 positrons into a nanochanneled Si-target. Here, a novel method to use the Fast Annihilation Cryogenic Tracking (FACT) scintillating fibre detector to monitor the formation of ortho-positronium atoms inside the 1T magnet of the AEgIS experiment is described. A single scintillating fibre was coupled to a PMT and irradiated by flashes of about 6×10^6 gamma rays (511 keV) produced by 10 ns FWHT positron bursts. Results have been used to demonstrate the possibility to time-tag the decay of ortho-positronium in vacuum by using the FACT detector as a digital calorimeter.

SYAM 2.5 Thu 16:15 P 1

Permanent Electric Dipole Moment Search in 129Xe — •Olivier Grasdijk[1], Fabian Allmendinger[2], Peter Blümler[3], Werner Heil[3], Klaus Jungmann[1], Sergei Karpuk[3], Hans-Joachim Krause[4], Andreas Offenhäusser[4], Maricel Repetto[3], Ulrich Schmidt[2], Yury Sobolev[3], Lorenz Willmann[1], and Stefan Zimmer[3] — [1]VSI, University of Groningen — [2]Universität Mainz — [3]Universität Heidelberg — [4]Forschungszentrum Jülich

A permanent electric dipole moment (EDM) implies breakdown of P (parity) and T (time reversal) symmetries. Provided CPT holds, this implies CP violation. Observation of an EDM at achievable experimental sensitivity would provide unambiguous evidence for physics beyond the Standard Model and limits towards matter-antimatter asymmetry. Our experiment uses differential spin precession of 3He and 129Xe, cooccupying the same volume, to measure the EDM of xenon. We have reached in a first test already sensitivity in the range 10-28 ecm. I will present the current status of the experiment and challenges like long term (weeks) tight control over magnetic and electric fields.