HK 72: Precision Tests of the Standard Model 2

Time: Friday 14:30–16:30 Location: P/H1

Group Report HK 72.1 Fri 14:30 P/H1

Testing Lorentz Invariance in Weak Decays — •Auke Sytema, Elwin Dijck, Steven Hoekstra, Klaus Jungmann, Stefan Müller, Jacob Noordmans, Gerco Onderwater, Coen Pijpker, Rob Timmermans, Keri Vos, Lorenz Willmann, and Hans Wilschut — Van Swinderen Institute, University of Groningen, The Netherlands

Lorentz invariance is the invariance of physical laws under orientations and boosts. It is a key assumption in Special Relativity and the Standard Model of Particle Physics. Several theories unifying General Relativity and Quantum Mechanics allow breaking of Lorentz invariance.

At the Van Swinderen Institute in Groningen a theoretical and experimental research program was started to study Lorentz invariance violation (LIV) in weak interactions. The theoretical work allowed a systematic approach to LIV in weak decays. Limits could be set on parameters that quantify LIV.

A novel beta decay experiment was designed which tests rotational invariance with respect to the orientation of nuclear spin. In particular, using the isotope ^{20}Na, the decay rate dependence on the nuclear polarization direction was measured. Searching for sidereal variations, systematic errors can be suppressed. The result of the experiment will be presented.

HK 72.2 Fri 15:00 P/H1

Systematic Error Investigation of the Spin Tune Analysis for an EDM Measurement at COSY — •Fabian Trinkel for the JEDI-Collaboration — Institut für Kernphysik, Forschungszentrum Jülich, Wilhelm-Johnen-Straße 52428 Jülich

So far there have been no direct Electric Dipole Moment (EDM) measurements for charged hadrons. The goal of the JEDI collaboration (Jülich Electric Dipole moment Investigations) is to measure the EDM of charged particles (p, d and ^3He). A first step on the way for an EDM measurement is the investigation of systematic errors at the storage ring COSY (COoler SYnchrotron). One part for these studies examines the spin tune ν_s of a horizontally polarized deuteron beam. The spin tune is defined as the number of spin rotations in the horizontal plane relative to the particle turns. To first approximation it is given by $|\nu_s| \approx \gamma G$, where γ is the Lorentz factor and G is the anomalous magnetic moment of the particle. The spin precession is observed using elastic deuteron carbon scattering.A measurement of the spin tune is performed for a polarized deuteron beam with a precision of 10^{-10} at COSY. The measurement and possible systematic errors due to acceptance and polarization variation will be discussed.

HK 72.3 Fri 15:15 P/H1

Polarimetry concepts for the EDM precursor experiment at COSY — •Paul Maanen for the JEDI-Collaboration — III. Physikalisches Institut B, RWTH Aachen

The CP violation in the Standard Model is not sufficient to explain the dominance of matter over antimatter in the universe. New CP violating sources could manifest as permanent electric dipole moments (EDM). So far, no direct measurement of a charged particle's EDM has been achieved. The goal of the JEDI (Juelich Electric Dipole moment Investigations) collaboration is to measure the EDM of light nuclei (p,d, 3He). In the chosen method, an EDM manifests as a small buildup of the vertical polarization of a stored hadron beam. Because the effect is very small, great care has to be taken designing the polarimeter. This talk gives an overview of the planned detector concept and discusses first results of simulations and experiments.

HK 72.4 Fri 15:30 P/H1

Bestimmung der Spintuneänderung durch Solenoiden und Steerer am COSY Speicherring — •Dennis Eversmann für die JEDI-Kollaboration — 3. Physikalisches Institut RWTH, Aachen, NRW

Eine notwendige Bedingung für die Entstehung der Baryonenasymmetrie im Universum während der Baryongenese ist die CP Verletzung, wobei bis heute experimentell keine Erklärung für unser Materie dominiertes Universum gefunden werden konnte. Ziel der JEDI Kollaboration (Jülich Electric Dipole moment Investigations) ist es, das permanente elektrische Dipolmoment (EDM) von Proton, Deuteron und Helium-3 in einem Speicherring zu vermessen, was entscheidend zur Beantwortung der oben dargelegten Frage beitragen kann, da EDMs durch P und T (CP) verletzende Prozesse enstehen können. Am Cosy Speicherring werden dazu Machbarkeitsstudien durchgeführt, die zum einen eine möglichst lange Erhaltung der Polarisation anvisieren und zum anderen untersuchen mit welcher Präzision der Spintune der Teilchen bestimmt werden kann. Der Spintune ν_s ist definiert als die Anzahl der Spinumdrehungen während eines Teilchenumlaufs durch den Speicherring und ist in erster Ordnung durch den Lorentzfaktor γ und das anomale magnetische Moment G gegeben: $\nu_s \approx \gamma G$. Ein mögliches EDM würde diese Relation geringfügig modifizieren, womit eine präzise Spintunemessung eine Möglichkeit darstellt das EDM eines Teilchen zu bestimmen. Im Vortrag zur DPG wird gezeigt, dass kleine Spintuneänderungen durch Manipulation mittels eines Solenoiden und eines Steerers im Beschleuniger gemessen werden konnten.

HK 72.5 Fri 15:45 P/H1

Resultate des A4-Compton-Rückstreu-Polarimeters — •Yoshio Imai[1], David Balaguer Ríos[1], Sebastian Baunack[1], Luigi Capozza[1], Jürgen Diefenbach[1], Boris Gläser[1], Jeong-Han Lee[1,2], Frank Maas[1,3,4], Maria Carmen Mora Espí[1], Ernst Schilling[1], Dietrich von Harrach[1] und Christoph Weinrich[1] — [1]Institut für Kernphysik, Johannes Gutenberg-Universität, Johann-Joachim-Becher-Weg 45, 55128 Mainz — [2]jetzt Institute for Basic Science, Yuseong-daero 1689-gil, Yuseong-gu, Daejeon, Korea, 305-811 — [3]Helmholtz-Institut Mainz, Johann-Joachim-Becher-Weg 36, 55128 Mainz — [4]PRISMA Cluster of Excellence, Johannes Gutenberg-Universität, 55099 Mainz

Um die Strahlpolarisation für das A4-Experiment am MAMI-Elektronenbeschleuniger der Universität Mainz zu bestimmen, wurde erstmals ein Compton-Rückstreu-Polarimeter in internal-cavity-Bauweise aufgebaut. Die Verwendung des internen Laserresonators erlaubt es, die Luminosität des Systems bei geringen Teilchenströmen zu erhöhen. Nach einer erfolgreichen Erprobungsphase wurde das Polarimeter seit 2009 regulär für den Experimentierbetrieb eingesetzt. Dieser Beitrag soll das Designkonzept und die Herausforderungen beim Aufbau und Betrieb dieses Systems beleuchten und Meßergebnisse präsentieren.

HK 72.6 Fri 16:00 P/H1

Status of the TRIGA User Facility at Mainz — Klaus Eberhardt[2], Christopher Geppert[2], Werner Heil[1], Jan Peter Karch[1], •Fabian Kories[1], Tobias Reich[2], Yury Sobolev[1], and Norbert Trautmann[2] — [1]Institut für Physik, Johannes Gutenberg-Universität Mainz — [2]Institut für Kernchemie, Johannes Gutenberg-Universität Mainz

Ultra-cold neutrons (UCN) offer unique opportunities for investigating the properties of the free neutron with exceptionally high precision such as the measurement of its lifetime.

At the pulsed TRIGA reactor in Mainz, a superthermal UCN source using solid deuterium as converter is operational and delivers up to 10 UCN/cm^3 in typical storage volumes of 10 l. [Karch, et al., Eur. Phys. J. A (2014) 50: 78]

Within PRISMA Cluster of excellence, this source will be upgraded to a targeted strength of 50 UCN/cm^3 in order to transform TRIGA Mainz into a world-leading user facility for UCN research. Besides the installation of a He liquefier to sustain long-term experiments, the existing neutron guides have to be replaced by high-quality guides with low surface roughness which are internally coated with ^{58}Ni to increase the phase space for UCN transport.

The talk gives a status report on the activities at the UCN source at TRIGA Mainz and describes the application process and experimental options for future users.

HK 72.7 Fri 16:15 P/H1

Status report of the neutron lifetime experiment tauSPECT — •Jan Peter Karch[1], Marcus Beck[1], Simo Dragisic[1], Christopher Geppert[2], Jan Haak[1], Werner Heil[1], Sergei Karpuk[2], Fabian Kories[1], Simon Kunz[1], Yury Sobolev[1,2], and Dietmar Stepanow[1] — [1]Institut für Physik, University of Mainz, Germany — [2]Institut für Kernchemie, University of Mainz, Germany

The decay of the free neutron into a proton, electron and antineutrino is the prototype of the semi-leptonic weak decay and plays a key role in particle physics and astrophysics. Nowadays, the accuracy achieved is limited by systematic errors, mainly caused by anomalous losses during storage of neutrons (ultracold neutrons) in material vessels. The magnetic storage of neutrons aims to avoid these systematic limitations and is expected to reach an accuracy of 0.1-0.3 s in the lifetime of the neutron. In this talk, the magnetic spectrometer tau-SPECT is presented, which uses a combination of magnetic multipole fields for radial storage and the field configuration of the superconducting aSPECT magnet [1] for longitudinal storage of ultracold neutrons. This storage experiment benefits greatly from the new ultracold neutron source at the pulsable TRIGA reactor Mainz [2]. The talk will give an overview of the experimental status: Proton detection system and adiabatic fast passages device. [1] S. Baeßler et al., Eur. Phys. J. A 38, 17-26 (2008) [2] J. Karch et al., Eur. Phys. J. A 50, 78-88 (2014)