HK 74: Fundamental Symmetries

Time: Thursday 16:30–18:30 Location: H-ZO 70

Group Report HK 74.1 Th 16:30 H-ZO 70

aSPECT - Measuring the proton spectrum in neutron decay — •Martin Simson[1,2], Fidel Ayala Guardia[3], Stefan Baessler[4], Michael Borg[3], Ferenc Glück[5], Werner Heil[3], Igor Konorov[2], Gertrud Konrad[3], Raquel Muñoz Horta[3], Kent Leung[1,2], Yury Sobolev[3], Torsten Soldner[1], Hans-Friedrich Wirth[6], and Oliver Zimmer[1,2] — [1]Institut Laue-Langevin, Grenoble, France — [2]Physik-Department E18, TU München — [3]Institut für Physik, Universität Mainz — [4]University of Virginia, Charlottesville, VA, USA — [5]IEKP, Universität Karlsruhe (TH) — [6]Fakultät für Physik, LMU München

With the aSPECT spectrometer we measure the proton recoil spectrum in the decay of the free neutron. Its shape depends on the angular correlation between the momenta of the antineutrino and electron for kinematic reasons. A precision measurement of this correlation coefficient a allows to test the unitarity of the CKM matrix and provides limits on the existence of scalar and tensor currents.

aSPECT is a retardation spectrometer, i.e. the proton recoil spectrum is measured by counting all decay protons that overcome a potential barrier. By varying the height of the barrier the shape of the proton spectrum can be reconstructed. After the barrier the protons are accelerated to $\sim 15\,\mathrm{keV}$ and detected by a silicon drift detector.

In the last beam time a statistical accuracy of about 2 % per 24 hours measurement time was reached, the total error is expected to be well below 5 %. Details of the spectrometer setup as well as the status of the ongoing data analysis will be presented in the talk.

HK 74.2 Th 17:00 H-ZO 70

Unexpected asymmetry in B(E1) strengths of mirror nuclei ^{67}As and ^{67}Se — •Riccardo Orlandi[1,2], Giacomo de Angelis[1], and Pier Giorgio Bizzeti[3] — [1]Laboratori Nazionali di Legnaro, Legnaro, Italy — [2]The University of the West of Scotland, Paisley, United Kingdom — [3]INFN Sezione di Firenze and Universita' di Firenze, Italy

Discrepancies revealed in a recent measurement of the E1 transition rates of mirror transitions in $^{67}_{33}As_{34}$ and $^{67}_{34}Se_{33}$ can be interpreted to indicate a large isoscalar component in the reduced E1 transition strengths. Neither the explicit inclusion of higher order terms in the transition operator, nor the the mixing with close-lying levels suffice to yield an effect of comparable size. On the other hand, coherent contributions with higher-lying states, via the Isovector Giant Monopole Resonance (IVGMR), would induce an isoscalar term sufficiently large to account for the asymmetries observed in the experiment.

HK 74.3 Th 17:15 H-ZO 70

Search for a two-photon exchange signal at HERMES — •Alejandro Lopez Ruiz for the HERMES-Collaboration — HERMES. DESY. Notkestrasse, 85. 22607 Hamburg. Germany.

Recent extractions of the elastic proton form factors have shown the importance of corrections beyond the one-photon exchange approximation or Born level in electromagnetic processes. A significative contribution that has been identified is the two-photon exchange process, and the need has been made clear to explore its role by measuring quantities sensitive to it. One such observable would be an asymmetry in the number of leptons scattered off a nucleon polarized normal to the scattering plane, which is forbidden at Born level, and therefore a non-zero measurement would give a clear indication of two-photon exchange. Such an asymmetry has been searched for in inclusive deep inelastic lepton- nucleon scattering (DIS) at HERMES, in the range $0.004 < x < 0.9$, and with Q^2 between 0.1 and 20 GeV^2, using unpolarized electron and positron beams with an energy of 27.6 GeV and a transversely polarized proton target. Both in the DIS region and for $Q^2 < 1\ GeV^2$, the asymmetries were found to be consistent with zero within the uncertainties, to the order of 10^{-3}.

HK 74.4 Th 17:30 H-ZO 70

Search for scalar interaction with the WITCH experiment - status & outlook — •Peter Friedag[1], Marcus Beck[1], Jonas Mader[1], Christian Weinheimer[1], Nausikaa Geraert[2], Nathal Severijns[2], Michael Tandecki[2], Emil Traykov[2], Simon van Gorp[2], Frederik Wauters[2], and Alexander Herlert[3] — [1]Institut für Kernphysik, WWU Münster, Wilhelm-Klemm Str. 9, 48149 Munster, Germany — [2]Instituut voor Kern- en Stralingsfysica, K.U.Leuven, Celestijnenlaan 200D, B-3001 Leuven, Belgium — [3]CERN, CH-1211 Geneve 23, Switzerland

The WITCH experiment examines the nuclear beta decay of ions stored in a penning trap using a retardation spectrometer. With this experiment we measure the recoil spectrum, from which one can derive the beta neutrino angular correlation a. This allows us to search for a scalar interaction contribution in the weak interaction. The goal is to measure a with a precision of $\Delta a < 0.5\%$.

In 2008 and 2009 various enhancements of the experimental setup have been carried out. Therefore many components of the system were modified and upgraded. In support of this, we performed tracking simulations and field calculations, that were also used for a further analysis of the measurement from 2006. This talk reviews the current status of the simulations as well as the experiment and gives an outlook for this year.

This project is supported by BMBF under contract number 06MS270.

HK 74.5 Th 17:45 H-ZO 70

Pion form factor measurements at KLOE via Radiative Return method — •Paolo Beltrame for the KLOE-Collaboration — Institut für Kernphysik, J.Gutenberg Universität Mainz, J-J-Becher-Weg, 45 55099 Mainz

The KLOE experiment at the ϕ factory DAΦNE is using ISR to measure $\sigma(e^+e^- \to \pi^+\pi^-\gamma)$ with an absolute normalisation obtained from Bhabha scattering.

$\pi\pi\gamma$ events are obtained with two different selection criteria: (a) requiring photon emission at small angles (SA) (b) tagged photons detected in the calorimeter (LA). With the two samples we cover the complete range of $2m_\pi < \sqrt{s'} = M_{\pi\pi} < m_\phi$. Using a theoretical radiator function H(s) we extract the pion form factor $|F_\pi|^2$ and obtain the two-pion contribution to a_μ^{had}. Results to be presented come from the analysis of 240 pb^{-1} collected in 2002, with very small statistical error ($\sim 0.1\%$) and improved systematic uncertainties ($\sim 1\%$).

Furthermore, using a run of 200 pb^{-1} of data taken at $\sqrt{s} = 1$ GeV, we can minimize the contribution of resonant background processes.

HK 74.6 Th 18:00 H-ZO 70

Analysis of $\eta \to \pi^+\pi^-\gamma$ measured with WASA-at-COSY — •Christoph Florian Redmer for the WASA-at-COSY-Collaboration — Institut für Kernphysik and Jülich Center for Hadron Physics, D-52425 Jülich, Germany

The decay $\eta \to \pi^+\pi^-\gamma$ is driven by the box anomaly of the chiral Lagrangian. Precise studies of the two pion system allow for tests of Chiral Pertubation Theory and its unitarized extensions, as e.g. VMD or the chiral unitary approach. Moreover, this decay channel also provides a test for C-violation in electromagnetic interactions of strongly interacting particles and even a test for a possible flavor-conserving CP-violation.

WASA-at-COSY collected data in October 2008, producing η mesons in the reaction $pd \to {}^3\mathrm{He}\eta$. About $10^7\eta$ mesons have been recorded, tagged only by the registration of the ^{3}He ions which allows also for the determination of absolute branching ratios.

In this presentation the analysis of these data with respect to the $\eta \to \pi^+\pi^-\gamma$ decay will be discussed.

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HK 74.7 Th 18:15 H-ZO 70

Search for Tensor Type Weak Currents by Measuring the Beta Asymmetry Parameter in Nuclear Beta Decay — •Frederik Wauters[1], Nathal Severijns[1], Emil Traykov[1], Simon Van Gorp[1], Michael Tandecki[1], Ilya Kraev[1], Peter Herzog[2], and Dalibor Zakoucky[3] — [1]Katholieke Universiteit, Leuven, Belgium — [2]Helmholtz-Institut fur Strahlen- und Kernphysik, Universität Bonn, Germany — [3]Nuclear Physics Institute, Rez, Czech Republic

Measuring the beta-asymmetry parameter A for pure Gamov-Teller nuclear decays is sensitive to a tensor component in the weak interaction if it is determined at the 1 % precision level. We will present a new method to measure this parameter and competitive with the best results available in literature. The low temperature nuclear orientation technique is used to orient an ensemble of polarize an ensemble of radioactive nuclei. The beta decay is observed by semiconductor

detectors operating at temperatures of about 10K looking directly to the sample. In previous measurements the precision was limited to a few percent by scattering of the beta particles and deflection by he magnetic field. We have developed a method based on GEANT4 Monte-Carlo simulations to gain control over these effects. First results were obtained with 114In and 60Co. The precision is currently at the 1,5% level which is better then the current literature values. The method is further being improved to push the precision and new data is under analysis. Our goal is to reach the 1% level or better.