HK 52: Hadronenstruktur und -spektroskopie

Zeit: Freitag 11:00–13:00 Raum: HZ 1+2

Gruppenbericht HK 52.1 Fr 11:00 HZ 1+2

Measurement of the Proton Polarizabilities at MAMI — •Vahe Sokhoyan for the A2-Collaboration — The George Washington University, Washington D.C., USA — Institut für Kernphysik, Universität Mainz, Germany

Polarizabilities are fundamental properties related to the internal dynamics of the nucleon. They play a crucial role not only in our understanding of the nucleon, but also in other areas such as precision atomic physics and astrophysics. Recent analyses of unpolarized Compton scattering data have indicated significant model dependence in the extraction of the scalar polarizabilities of the proton, resulting in a gross underestimation of the errors. The four spin polarizabilities of the proton have never been separated and only two linear combinations of those are known.

A program performed by the A2 Collaboration at the MAMI accelerator facility in Mainz aims for the first individual extraction of the nucleon scalar and spin polarizabilities using Compton scattering on the nucleons. The Crystal Ball and TAPS 4π spectrometer setup is used for the corresponding measurements. To extract the proton scalar polarizabilities independently, the beam asymmetry Σ_3 has been measured below pion production threshold. For the determination of the spin polarizabilities the beam asymmetry Σ_3 and the beam-target asymmetry Σ_{2x} were measured at higher energies, where the sensitivity to the spin polarizabilities increases.

In this talk the current results and the plans for the upcoming measurements will be presented.

HK 52.2 Fr 11:30 HZ 1+2

Measurement of the Pion Polarizability with COMPASS — •Stefan Huber for the COMPASS collaboration — Physikdepartment E18, Technische Universitaet Muenchen

Chiral Perturbation Theory predicts a precise value for the charged-pion polarisability. Experiments performed within the last decades are in tension with this value and also do not agree with each other.

At the COMPASS experiment at CERN the pion polarisability is accessible through the Primakoff effect, where the quasi-real photons surrounding the nickel nuclei are used to measure pion-photon scattering. Studying the energy distribution of the outgoing photons, the polarisability value can be extracted.

During the 2009 data taking COMPASS performed a first measurement based on about 60 000 exclusive events. In addition to the measurement with a pion beam a control measurement with a muon beam has been performed in order to control the systematics. The details of the measurement as well as the results will be discussed.

Supported by BMBF, MLL and the Cluster of Excellence Exc153 “Origin and Structure of the Universe”

HK 52.3 Fr 11:45 HZ 1+2

Proton polarizabilities from polarized Compton scattering — •Nadiia Krupina and Vladimir Pascalutsa — Johannes Gutenberg-Universitaet Mainz, Germany

We study the low-energy expansion of polarized Compton scattering off the proton. We show that the leading non-Born contribution to the beam asymmetry of low-energy Compton scattering is given by the magnetic polarizability alone, the electric polarizability cancels out. Based on this fact we propose to determine the magnetic dipole polarizability of the proton from the beam asymmetry. Computing the higher-order (recoil) effects of polarizabilities on beam asymmetry, we show that they are suppressed in forward kinematics. We also present the low-energy expansion of doubly-polarized observables, from which the spin polarizabilities can be extracted.

HK 52.4 Fr 12:00 HZ 1+2

Feasibility studies of $\bar{p}p \to e^+e^-$ for the measurement of proton form factors at PANDA — •Alaa Dbeyssi[1,2], Frank E. Maas[1,3], Luigi Capozza[1], Bertalan Feher[1], Dmitry Khaneft[1], Paul Larin[1], Dexu Lin[1], Cristina Morales[1], Maria Carmen Mora Espi[1], Oliver Noll[1], Roberto Perez[1], David Rodriguez[1], Roserio Valente[1], Manuel Zambrana[1], Iris Zimmermann[1], Egle Tomasi-Gustafsson[2], and Dominique Marchand[2] for the PANDA-Collaboration — [1]Helmholtz-Institut Mainz, Germany — [2]Institut de Physique Nucleaire, Orsay, France — [3]GSI, 64291 Darmstadt, Germany

Electromagnetic form factors of hadrons are fundamental quantities which describe the structure and the internal dynamics of these system. The electromagnetic structure of the proton is parametrized in terms of electric G_E and magnetic G_M form factors. The channels $\bar{p}p \leftrightarrow e^+e^-$ allow to access the Time-Like region. At the future accelerator complex FAIR, in Darmstadt, the PANDA (antiProton ANnihilation at DArmstadt) collaboration plans to measure proton Time-Like form factors using an antiproton beam of momentum up to 15 GeV/c. Feasibility studies of the reaction $\bar{p}p \to e^+e^-$ for the Time-Like proton form factor measurements at PANDA are presented here. The background reactions are also studied, in particular the $\bar{p}p \to \pi^+\pi^-$ channel. The results obtained from a realistic Monte Carlo simulation using the simulation framework of the experiment (PANDARoot) show that the proton form factors can be measured at PANDA with unprecedented accuracy.

HK 52.5 Fr 12:15 HZ 1+2

Machbarkeitsstudien zur Messung der zeitartigen, elektromagnetischen Formfaktoren des Protons in Reaktionen von $\bar{p}p \to \mu^+\mu^-$ am PANDA-Experiment. — •Iris Zimmermann für die PANDA-Kollaboration — Helmholtz-Institut Mainz

Die Messung der zeitartigen, elektromagnetischen Formfaktoren G_E und G_M in Prozessen von $\bar{p}p \to \mu^+\mu^-$ ermöglicht einen Zugang zur inneren Struktur des Protons. Die Machbarkeit solcher Studien bei PANDA kann in Simulationsstudien unter Verwendung des Softwarepakets PANDARoot untersucht werden. Eine besondere Herausforderung stellt dabei die Unterdrückung des dominierenden, hadronischen Untergrundkanals dar, welcher in Form von Paaren aus gegensätzlich geladenen Pionen auftritt. Ein Ziel ist es daher, eine gute Signal-Untergrund-Trennung zu ermöglichen. Der aktuelle Status der laufenden Studien für das Signal sowie des wichtigsten Untergrundkanals wird vorgestellt.

HK 52.6 Fr 12:30 HZ 1+2

Measurement of the $e^+e^- \to \pi^+\pi^-$ Cross Section Using Initial State Radiation at BESIII — •Benedikt Kloss and Achim Denig — Institut für Kernphysik Mainz

The magnetic moment of the muon is one of the most precisely measured quantities in modern particle physics. The theoretical prediction and the experimental measurement differ by more than 3.6 standard deviations. The hadronic cross section of $e^+e^- \to \pi^+\pi^-$ is an important impact for the theoretical prediction of the hadronic contribution to the magnetic moment of the muon. The experimental measurement of this cross section was performed by the KLOE and the BABAR experiment with high precision. These experiments dominate the world average but they differ below 1 GeV by 2.0 standard deviations. Another comparable experiment is needed. This measurement can be done at the BESIII experiment in Beijing, China. Using the technique of initial state radiation it might be possible to measure this hadronic cross section below 3.0 GeV with a comparable precision to BABAR and KLOE. This talk will give an overview of the current status of this analysis.

HK 52.7 Fr 12:45 HZ 1+2

Tau Spectral Functions in a Linear Sigma Model with Weak Interactions. — •Anja Habersetzer — Goethe-Universität, Frankfurt, Deutschland

The decay of the Tau lepton is governed by weak interactions. After implementing weak interaction into a Linear Sigma Model with global U(2)_L x U(2)_R symmetry including scalar, pseudoscalar, vector and axial-vector mesons we determined the vacuum coupling constant of the weak bosons to hadrons and calculated the vector and axial-vector spectral functions. The results are in good agreement with the ALEPH data and confirm that rho and a1 meson are chiral partners.