HK 4: Hadronenstruktur und -spektroskopie I

Zeit: Montag 16:30–19:00 Raum: HG III

Gruppenbericht HK 4.1 Mo 16:30 HG III

The electric form factor of the neutron at $Q^2 = 1.5\,(\mathrm{GeV/c})^2$ measured at MAMI — •Björn Sören Schlimme for the A1-Collaboration — Institut für Kernphysik, Universität Mainz, J.-J.-Becher-Weg 45, D-55128 Mainz

A measurement of the ratio $G_{\mathrm{en}}/G_{\mathrm{mn}}$ at a four momentum transfer squared $Q^2 = 1.5\,(\mathrm{GeV/c})^2$ has been carried out at the Mainz Microtron in 2008 in order to extract the electric Sachs form factor of the neutron (G_{en}) with the magnetic form factor (G_{mn}) as input.

MAMI-C provided a 1.5 GeV polarized electron beam impinging on a polarized ^{3}He gas target for the study of the reaction $^3\vec{\mathrm{He}}(\vec{e},e'n)pp$. The scattered electrons were detected with a standard magnetic spectrometer of the A1 collaboration and a nucleon detector consisting of an array of plastic scintillators inside a heavy lead shield was installed to detect the recoil neutrons in coincidence. Exploiting beam helicity asymmetries for different target polarization orientations, $G_{\mathrm{en}}/G_{\mathrm{mn}}$ can be extracted with comparatively small systematic uncertainties.

The measurement method and the experimental setup will be illustrated, the performance of the polarized ^{3}He target during the beam time will be shown and the status of the analysis will be presented.

Gruppenbericht HK 4.2 Mo 17:00 HG III

Electromagnetic form factors of the $\Delta(1232)$ resonance — •Tim Ledwig[1], Jorge Martin Camalich[2], Vladimir Pascalutsa[1], and Marc Vanderhaeghen[1] — [1]Institut für Kernphysik, Universität Mainz, Germany — [2]Departamento de Fisica Teorica and IFIC, Universidad de Valencia-CSIC, Spain

After the nucleon, the $\Delta(1232)$ resonance is the most important baryon in hadron physics. However, due to its short life time most of its fundamental properties are experimentally still poorly known. Quantities such as the electric and magnetic moments are inaccesible to usual methods and can only be measured in an indirect way. Only in recent years, a value for the Δ^+ magnetic dipole moment was extracted from a measurement at the Mainzer Microtron accelerator facility MAMI. Further, a new experiment at MAMI is expected to give soon improved results. On the theoretical side, several lattice groups started to extract Δ electromagnetic properties. Eventhough lattice calculations are regarded as an approach from first principles, they are presently still restricted to unphysical quark masses. A proper chiral extrapolation will be needed to confront these results with experiments. In this presentation we discuss the recent progress of such an extrapolation. For this, we use the framework of the relativistic chiral effective field theory where the Δ is incorporated with the δ-counting scheme. Observables in question are the electric quadrupole, magnetic dipole and magnetic octupole moments.

Gruppenbericht HK 4.3 Mo 17:30 HG III

Measurement of the pion form factor between 0.1 and 0.85 GeV^2 with the KLOE experiment — •Stefan E. Müller — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, J.-J.-Becher-Weg 45, 55128 Mainz

The KLOE experiment at the DAΦNE e^+e^- collider in Frascati has performed a new measurement of the pion form factor $|F_\pi|^2$ in the mass range between $0.1 < M^2_{\pi\pi} < 0.85$ GeV^2 using events taken at $\sqrt{s} = 1$ GeV with a photon emitted at large polar angles in the initial state. This "radiative return" to the ρ and ω resonances allows to access the energy region below the nominal DAΦNE energy, which is fixed to values close to M_ϕ. The new measurement extends the $M^2_{\pi\pi}$ region covered by KLOE ISR measurements of the pion form factor down to the two pion production threshold, and allows to determine via a dispersion integral the value of the dipion contribution to the muon anomalous magnetic moment.

The measurement and its impact on the muon anomalous magnetic moment will be presented in the talk, and an outlook on future measurements of the pion form factor will be given. In addition, the role of angular asymmetries on validating phenomenological models for pionic final state radiation and scalar mesons will be discussed.

HK 4.4 Mo 18:00 HG III

Pion form factor in chiral EFT with explicit vector mesons — Dalibor Djukanovic[1], •Jambul Gegelia[1,2], Arne Keller[1], and Stefan Scherer[1] — [1]Institut für Kernphysik, Johannes Gutenberg-Universität, D-55099 Mainz, Germany — [2]High Energy Physics Institute of TSU, 0186 Tbilisi, Georgia

Electromagnetic form factor of the Pion is calculated in the framework of chiral effective field theory with vector mesons included as dynamical degrees of freedom. Results are given for the time-like region up to $q^2 \sim 1\mathrm{GeV}^2$. To construct an effective field theory with a consistent power counting the complex-mass-renormalization scheme is applied. This can be interpreted as the on-mass-shell renormalization scheme for unstable particles. Reasonably good description of the data is obtained already at next-to-leading order within the given approach.

HK 4.5 Mo 18:15 HG III

Zwei-Photon Austausch in dem Prozess $p\bar{p} \to e^+e^-$ — •Julia Guttmann[1], Nikolai Kivel[2] und Marc Vanderhaeghen[1] — [1]Institut für Kernphysik, Johannes Gutenberg-Universität, Mainz, Deutschland — [2]Institut für theoretische Physik II, Ruhr-Universität, Bochum, Deutschland

Die Diskrepanz zwischen den Daten unpolarisierter Rosenbluth-Messungen und den Polarisationsexperimenten bei der Bestimmung der raumartigen elektromagnetischen Formfaktoren durch Elektron-Proton Streuung, hat zu einer Vielzahl von Untersuchungen des Zwei-Photon Austausches im raumartigen Bereich geführt. Für den zeitartigen Bereich existieren dagegen keine vergleichbaren Berechnungen. In diesem Vortrag werden die Korrekturen des Zwei-Photon Austausches in der Reaktion $p\bar{p} \to e^+e^-$ und dessen Bedeutung für die Bestimmung der zeitartigen Formfaktoren diskutiert. Dabei wird der Zwei-Photon Beitrag für große Impulsüberträge im Rahmen eines pQCD-Ansatzes bestimmt und Berechnungen für zukünftige Experimente bei PANDA@FAIR werden präsentiert.

HK 4.6 Mo 18:30 HG III

Messung des Protonen-Ladungsradius mit elastischer Elektronenstreuung* — •Jonny Birkhan, Andreas Krugmann, Peter von Neumann-Cosel, Iryna Poltoratska, Inna Pysmenetska, Sarla Rathi, Achim Richter, Gerhard Schrieder und Artem Shevchenko — Institut für Kernphysik, TU Darmstadt

Der Ladungsradius des Protons stellt eine elementare Größe in der Kernphysik dar, die z.B. für Präzisionstests der QED von großer Bedeutung ist. Die übliche Methode zur Bestimmung des Radius ist elastische Elektronenstreuung. Die Daten vergangener Experimente und theoretischer Vorhersagen sind nicht vollständig miteinander verträglich und besitzen teilweise große Unsicherheiten. Daher wurde ein neues Elektronenstreuexperiment entworfen und am Darmstädter Elektronenbeschleuniger S-DALINAC durchgeführt. Um die Fehlerbeiträge verschiedener experimenteller Parameter zu reduzieren, wurden statt der Elektronen die Rückstoßprotonen über einen großen Winkelbereich mit Silizium-Detektoren simultan nachgewiesen. Die Energie der einfallenden Elektronen betrug 80 MeV. Dies entsprach Impulsüberträgen zwischen 0.18 fm^{-1} und 0.72 fm^{-1} [1]. Erste Resultate werden vorgestellt.

[1] Inna Pysmenetska, Dissertation D17, TU Darmstadt (2009). *Gefördert von der DFG innerhalb des SFB 634

HK 4.7 Mo 18:45 HG III

Investigation of the η-Dalitz decay and measurement of the electromagnetic form factor. — •Henning Berghaeuser — for the A2-Collaboration, II. Physikalisches Institut, Gießen, Deutschland, supported by European Graduate School, Giessen-Copenhagen

The main experimental problem in measuring Dalitz decays of neutral mesons is a clean $e^{-/+}/\pi^{-/+}$ discrimination. It is shown that these decays can be measured with the Crystal Ball and TAPS detector setup at MAMI-C in Mainz despite of the fact, that these detectors are pure calorimeter systems. The η-Dalitz decay ($\eta \to e^+e^-\gamma$) was measured exclusively, thus all particles in the final state were detected. This allowed to exploit the full kinematic information (such as momentum conservation) to reconstruct the Dalitz events with satisfactory statistics. The electromagnetic formfactor of the η meson has been extracted. These results will be presented. An extension of these studies to the ω meson is discussed.