HK 26: Hadronenstruktur und -spektroskopie VI

Zeit: Dienstag 16:30–19:00 Raum: HG IV

Gruppenbericht HK 26.1 Di 16:30 HG IV

Messung der Polarisationsobservablen I^s und I^c in $\pi^0\eta$ Photoproduktion mit dem CBELSA/TAPS Experiment — •Eric Gutz für die CBELSA/TAPS-Kollaboration — Helmholtz-Institut für Strahlen und Kernphysik, Nussallee 14-16, 53115 Bonn

Für ein besseres Verständnis der Struktur der Hadronen und ihres Anregungsspektrums sind Meson-Photoproduktionsexperimente wie das Crystal-Barrel/TAPS-Experiment am Bonner Elektronenbeschleuniger ELSA notwendig. Insbesondere im Bereich hoher Anregungen spielen multi-Meson Endzustände eine entscheidende Rolle, bedingt durch ihre Sensitivität auf sequentielle Zerfälle der Resonanzen. Für die umfassende Beschreibung der zu Grunde liegenden Prozesse ist hierbei neben der Messung unpolarisierter Wirkungsquerschnitte auch die Extraktion von Polarisationsobservablen essenziell.
Das Crystal-Barrel/TAPS-Experiment ist insbesondere zur Untersuchung der Photoproduktion neutraler Mesonen am Nukleon geeignet. Dabei zeichnet sich die Detektoranordnung durch eine beinahe vollständige Abdeckung des Raumwinkels und eine hohe Detektionseffizienz für Photonen aus. Durch die Methode der kohärenten Bremsstrahlung stehen energiemarkierte, linear polarisierte Photonen für Polarisationsexperimente zur Verfügung.
Im Vortrag werden neue Ergebnisse für die Polarisationsobservablen I^c und I^s in der Reaktion $\vec{\gamma}p \to p\pi^0\eta$ vorgestellt.

Gefördert durch die Deutsche Forschungsgemeinschaft (SFB/TR-16)

HK 26.2 Di 17:00 HG IV

Suche nach einem seltenen η-Mesonzerfall in der Reaktion $p + p$ bei $E_{kin} = 3.5$ GeV.* — •Patrick Huck, Jürgen Friese, Martin Jurkovič, Alexander Schmah und Michael Weber für die HADES-Kollaboration — Technische Universität München, Physikdepartment E12, 85748 Garching

Das HADES Experiment am SIS 18 Beschleuniger des GSI Helmholtzzentrums, Darmstadt, untersucht mit großer Akzeptanz die Emission virtueller Photonen in elementaren und Schwerionen-induzierten Kernreaktionen. Bei der Messung der e^+e^- invarianten Massenspektren tritt im mittleren Massenbereich eine Signalstärke auf, deren Zusammensetzung noch nicht vollständig verstanden ist. In diesem Massenbereich trägt die η - Mesonproduktion und der nachfolgende Dalitzzerfall signifikant zur Gesamtausbeute bei. Wir haben versucht, aus den Daten der Reaktion p + p bei $E_{kin} = 3.5$ GeV den seltenen 4 - Teilchenzerfall $\eta \to \pi^+\pi^-e^+e^-$ zu rekonstruieren. Die zum invarianten Massenspektrum von $\pi^+\pi^-e^+e^-$ beitragenden Untergrundquellen konnten in umfangreichen Simulationen identifiziert und durch geeignete Datenschnitte unterdrückt werden. Das experimentelle Spektrum wird sowohl qualitativ als auch quantitativ gut beschrieben. Wir stellen die Analyseergebnisse vor und diskutieren die Perspektiven für derartige Experimente in der Zukunft.
* supp. by BMBF(06MT9156), GSI, DFG (Exc.-Clust. 153-Universe)

HK 26.3 Di 17:15 HG IV

Analysis of the eta->e+e-e+e- decay with WASA-at-COSY — •Leonid Yurev — Forschungszentrum Juelich, 52425 and Joint Institute for Nuclear Research, 141980

The decay $\eta \to e^+e^-e^+e^-$ is closely related to the channels with real photons: $\eta \to \gamma\gamma$, $\eta \to \pi^+\pi^-\gamma$, $\eta \to e^+e^-\gamma$ which are driven by the chiral anomaly of Quantum Chromodynamics. The extended interaction region of the electromagnetic processes of the η meson is parameterized by a so-called *transition form factor* – a scalar function of the invariant masses squared of the photons. The decay $\eta \to e^+e^-e^+e^-$ allows to study the form factor in the domain where there are two virtual photons with positive invariant masses squared. The region of interaction of this electromagnetic decay with a dilepton pair cannot be parameterized by a point-like vertex, but by a so-called "transition form factor".

We have recorded $10^7\eta$ events in the reaction $pd \to {}^3\mathrm{He}\eta$ at 1 GeV during a four weeks run in October 2008. The experimental method is similar to that used recently by the CELSIUS/WASA collaboration where two $\eta \to e^+e^-e^+e^-$ decay candidates were identified and an upper limit $BR(\eta \to e^+e^-e^+e^-) < 9.7 \cdot 10^{-5}$ (90% CL) was determined. Since the number of the η decays collected by the WASA-at-COSY collaboration is forty times larger, we expect to extract a statistically significant data sample of $\eta \to e^+e^-e^+e^-$ decays for the first time. In this presentation the status of the analysis of the $\eta \to e^+e^-e^+e^-$ decay channel and preliminary results will be discussed.

HK 26.4 Di 17:30 HG IV

Investigation of the η–^{3}He final state in proton-deuteron collisions — •Michael Papenbrock, Alfons Khoukaz, Ingo Burmeister, Paul Goslawski, Malte Mielke, Tobias Rausmann, and Alexander Täschner for the ANKE-Collaboration — Westfälische Wilhelms-Universität, Münster, Germany

Measurements obtained with the ANKE spectrometer at the COoler SYnchrotron - COSY - of the Forschungszentrum Jülich on the reaction $\mathrm{d+p} \to {}^3\mathrm{He}+\eta$ provided extensive data in the energy range very close to the production threshold. The observed excitation function suggests the presence of an unexpected strong final state interaction and the extracted large scattering length $a_{\eta\,\mathrm{He}}$ might indicate the existence of a quasi-bound state of the $\eta - {}^3$He system.

Further data at excess energies of 20, 40, and 60 MeV have been obtained recently with ANKE to extend the excitation function towards higher energies and to investigate contributions of higher partial waves. Additionally, measurements with a polarised deuteron beam have been performed in order to study in more detail the final state interaction and to disentangle partial wave contributions.

Recent results will be presented and discussed.

Supported by the COSY-FFE program.

HK 26.5 Di 17:45 HG IV

η Photoproduction off ^{3}He — •Lilian Witthauer for the A2-Collaboration — Department of Physics, University of Basel, Switzerland

Quark models predict many more states in the excitation spectrum of the nucleon than observed in experiments. Most previous experiments investigating the excitation spectrum of nucleons are based on elastic scattering of charged pions. This makes it probable that the data is biased against states that couple only weakly to $N\pi$. Hence, one can study different excitation mechanisms and channels as the photoproduction of mesons via excitation of nucleon resonances.

Measurements at ELSA in Bonn investigated the quasi-free η photoproduction off the neutron (I. Jaeglé et al., Phys. Rev. Lett 100 (2008) 252002). The resulting cross section shows a narrow structure at $W = 1.68$ GeV with a width smaller than 60 MeV. This structure is only visible in the cross section on the neutron and not in that on the proton. Experiments of the GRAAL collaboration (V.Kuznetsov et al., arXiv:hep-ex/0606065v2) and LNS-Sendai (F. Miyahara et al., Prog. Theor. Phys. Suppl. 168 (2007) 90) showed the same effect in quasi-free photoproduction off the deuteron. In order to exclude any possibility that the structure could arise from nuclear effects (re-scattering of mesons, final state interaction) we have studied it for a nucleon system with different momentum distribution and different neutron/proton ratio, namely ^{3}He. Preliminary results for the quasi-free η cross section obtained in coincidence with recoil nucleons will be discussed.

Supported by Swiss National Fund and DFG.

HK 26.6 Di 18:00 HG IV

η photoproduction off ^{3}He : Search for η-mesic nuclei — •Francis Pheron for the A2-Collaboration — [a]Institut fuer Physik,Universität Basel, Klingelbergstrasse 82, CH-4056 Basel , (francis.pheron@unibas.ch).

Photoproduction of η-mesons off ^{3}He has been studied via the $\eta \to 2\gamma$ and $\eta \to 3\pi 0$ decay modes at the tagged photon beam of the Mainz MAMI accelerator using the combined 4π Crystal Ball/TAPS calorimeter. In a previous experiment, Pfeiffer et al. had reported evidence (although at low statistical significance) for the formation of a quasi-bound η-^{3}He state. The present experiment aimed at an improved statistical quality for both the excitation function of coherent photoproduction on η-mesons off ^{3}He and the peak-like structure in the excitation function of πo-p back-to-back pairs [1]. The η-mesons have been identified by an invariant mass analysis of 2-photons (respectively 6-photons) events. In the both case also the constraints from the intermediate πo-invariant masses have been used.
The coherent reaction $\gamma^3He \to \eta^3$He has been selected by the suppression of events with observed recoil nucleons and by a missing energy analysis. Preliminary results for the excitation function show an

extremely rapid rise at the production threshold similar to what has been observed in hadronic induced reactions at COSY [T.Mersmann et al.]. At the same time excitation function of πo-p pair shows the peak-like structure at the η-production threshold with much better statistic quality then the previous experiment. Altought strong evidence for the existence of a resonance state has been formed.

HK 26.7 Di 18:15 HG IV

Measuring $\eta \to \pi^+\pi^-e^+e^-$ with WASA-at-COSY — •Daniel Coderre and James Ritman for the WASA-at-COSY-Collaboration — Institut für Kernphysik and Jülich Center for Hadron Physics, Forschungszentrum Jülich, Germany and Institut für Experimentalphysik, Ruhr Universität Bochum, Germany

The analysis of $\eta \to \pi^+\pi^-e^+e^-$ has two purposes: measurement of the branching ratio and probing of possible non Standard Model CP Violation in this decay. The existing experimental results on the branching ratio are not conclusive, but the higher rates of η production at WASA-at-COSY will allow a statistically significant sample to be identified and a precise determination of the branching ratio to be made. To probe the CP-Violating contribution the asymmetry between the electron and pion decay planes in the η reference frame will be measured. Currently, the upper limit for this asymmetry is about 1%.

We have on disk roughly 3x10^7 η decays produced with the reaction $pd \to {}^3He\eta$ just above threshold energy. The analysis focuses on proper track identification and efficient background rejection. Particle identification is particularly important not only for mass assignments, but for proper measurements of the decay plane angle. This presentation will show both the analysis methods and the first sample of candidates for this decay.

HK 26.8 Di 18:30 HG IV

Polarization Observables in η-Electroproduction — •Konrad Griessinger for the A1-Collaboration — Institut für Kernphysik, Universität Mainz, J.-J.-Becher-Weg 45, 55128 Mainz

The polarization observables of the η-meson are crucial for a better understanding of the structure of the nucleon. In the investigation of nucleon resonances via scattering cross-sections it is rather difficult to extract resonances besides the $\Delta(1232)$ due to its overwhelming production rate. When producing η-mesons this problem does not exist, since the η-meson has isospin $T = \frac{1}{2}$. The Δ-resonances have isospin $T = \frac{3}{2}$, and therefore cannot be part of the background in η-production. Still, by measuring the cross-section of η-production only a very limited amount of information can be extracted, because the $S_{11}(1535)$-resonance strongly dominates the cross-section. Thus the polarization observables of the η must be studied in order to examine the role of other resonances.
In this experiment of the A1-Collaboration at MAMI the polarization observables of the η-meson in electroproduction were investigated. Two settings were measured, both at $\varepsilon = 0.718$, $Q^2 = 0.1$ GeV^2, $\phi = 0$, one at $\Theta = 90°$, $W = 1525$ MeV, the other at $\Theta = 120°$, $W = 1500$ MeV. Preliminary results of our recent measurements will be presented and will be compared to theory and previous data.

HK 26.9 Di 18:45 HG IV

Messung der Doppelpolarisationsobservablen E in den Reaktionen $\vec{\gamma}\vec{p} \to p\eta$ und $\vec{\gamma}\vec{p} \to p\pi^0$ — •Jonas Müller für die CBELSA/TAPS-Kollaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Nussallee 14-16, D-53115 Bonn

Ein Ziel des Crystal-Barrel/TAPS-Experiments an der Elektronenbeschleunigeranlage ELSA ist es, zu einem guten Verständnis des Spektrums und der Eigenschaften von Baryonresonanzen beizutragen.

Um die beitragenden Resonanzen aus den Daten zu extrahieren ist die Messung von Polarisationsobservablen unverzichtbar. Nur so kann eine eindeutige Lösung in der Partialwellenanalyse erzielt werden; für die Photoproduktion eines pseudoskalaren Mesons wird hierbei ein Satz von mindestens acht unabhängigen Observablen benötigt.

Das Crystal-Barrel/TAPS-Experiment eignet sich durch seine nahezu vollständige Raumwinkelabdeckung und seine hohe Detektionseffizienz für Photonen insbesondere gut zur Untersuchung der Photoproduktion von neutralen Mesonen am Nukleon. Mit dem longitudinal polarisierten 'frozen-spin'-Butanoltarget sowie den linear- oder zirkularpolarisierten, energiemarkierten Photonen werden entsprechende Doppelpolarisationsmessungen durchgeführt.

In diesem Vortrag werden Ergebnisse der Messung der Doppelpolarisationsobservablen E für die Reaktionen $\vec{\gamma}\vec{p} \to p\eta$ und $\vec{\gamma}\vec{p} \to p\pi^0$ vorgestellt.

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