

HK 38: Hadron Structure and Spectroscopy V

Zeit: Donnerstag 14:00–16:15

Raum: F 5

Gruppenbericht

HK 38.1 Do 14:00 F 5

Recent results of polarization observables in π^0 - and η -photoproduction off the proton — ●FARAH AFZAL for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn

A comparison of experimentally observed excited nucleon states to phenomenological quark model predictions or lattice QCD calculations reveal large differences, especially concerning the number of excited states. An important tool to probe the nucleon excitation spectrum is the study of meson photoproduction reactions. In order to extract the contributing resonances from the experimental data partial wave analyses need to be performed. For an unambiguous solution the measurement of single and double polarization observables is essential. Several experimental facilities have dedicated programs to measure polarization observables in different photoproduction reactions using a polarized photon beam and a polarized target, e.g. the CBELSA/TAPS experiment located at the electron stretcher accelerator ELSA in Bonn or the Crystal Ball experiment located at the accelerator facility MAMI in Mainz.

This talk will present recent results concerning the polarization observables Σ and E in the $\gamma p \rightarrow p\pi^0$ and $\gamma p \rightarrow p\eta$ reactions measured at the CBELSA/TAPS and the Crystal Ball experiment and their impact on the nucleon excitation spectrum. This work is supported by the Deutsche Forschungsgemeinschaft (SFB/TR16 and SFB1044) and Schweizerischer Nationalfonds.

HK 38.2 Do 14:30 F 5

Measurement of the double polarization observable G in the reactions $\gamma p \rightarrow p\pi^0/n\pi^+$ — ●KARSTEN SPIEKER for the A2-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn

The nucleon excitation spectrum consists of many overlapping resonances. To obtain information about the contributing resonances, several well chosen single and double polarization observables have to be measured for different final states. These observables are providing the necessary data base for a unique Partial Wave Analyses (PWA) to identify the resonances and determine their properties.

The new polarization observable data reported in this talk were measured with the Crystal Ball experiment at MAMI in Mainz, using polarized photons and polarized nucleons. The setup covers nearly 4π of the solid angle and has a high detection efficiency for neutral and charged final states. The preliminary results of the double polarization observable G in the reactions $\gamma p \rightarrow p\pi^0$ and $\gamma p \rightarrow n\pi^+$ are presented. They have been determined in an energy range $E_\gamma = 266$ –860 MeV, using a linearly polarized photon beam in combination with a longitudinally polarized butanol target.

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HK 38.3 Do 14:45 F 5

Measurement of $\pi^0\pi^\pm$ Photoproduction off the Deuteron with the A2 Experiment — ●SEBASTIAN LUTTERER for the A2-Collaboration — Departement Physik, Universität Basel

Photoproduction of pion pairs off (quasi-) free nucleons is important to investigate the excitation spectrum of the nucleon for low energy QCD, in particular for excited states which decay predominantly via intermediate excited states to the ground state. Quasi-free production of such pairs off heavier nuclei also figures prominently in the study of the in-medium properties of nucleon resonances. Double meson production channels make the largest contribution to the second resonance bump of the nucleon which disappears for photoproduction off nucleons bound in nuclei. The special interest in the mixed charged channels $\pi^0\pi^\pm$ is related to the contribution of the ρ -meson. This decay is forbidden for the $\pi^0\pi^0$ final state due to isospin conservation. The coupling to a ρ could induce substantial in-medium effects when the ρ spectral function itself is modified in the medium. In the present work production of $\pi^0\pi^\pm$ pairs off liquid deuterium is analysed using data taken at MAMI with the A2 experiment as a starting point for a detailed investigation of this channel for nuclear targets. Data for a ^4He target have also already been taken.

HK 38.4 Do 15:00 F 5

Photoproduction of $\pi^0\pi^+$ Pairs off the free Proton — ●SAMUEL ABT for the A2-Collaboration — Departement Physik, Universität Basel

Photoproduction of mesons has been intensively studied during the last decade in view of the nucleon resonance spectrum. Beside single meson production reactions, final states with meson pairs have gained a lot of interest. For free nucleons, such final states can be used to study sequential decays of nucleon resonances via intermediate excited states and determine their branching ratios. Especially for channels with $\pi^+\pi^0$ and $\pi^+\pi^-$ pairs, also resonance decays by emission of the ρ -meson can be studied. The presented work investigates in detail the total cross section, invariant mass distributions, and angular distributions of the $\gamma p \rightarrow \pi^0\pi^+n$ reaction up to incident photon energies of 1.5 GeV. The experiment was carried out at the tagged photon beam of the Mainz MAMI accelerator. The bremsstrahlung photon beam was impinging on a liquid hydrogen target and the pions and the recoil neutron were detected with the combined electromagnetic calorimeters Crystal Ball and TAPS detectors. The most striking finding is a strong contribution of the $D_{13}(1520) \rightarrow N\rho$ branch (comparably large as $D_{13}(1520) \rightarrow \Delta\pi$). The data will provide a precise branching ratio for this reaction. Preliminary results will be discussed.

HK 38.5 Do 15:15 F 5

Studies on η production in pd fusion to $^3\text{He}\eta$ with WASA-at-COSY* — ●NILS HÜSKEN, FLORIAN BERGMANN, KAY DEMMICH, and ALFONS KHOUKAZ for the WASA-at-COSY-Collaboration — Westfälische Wilhelms-Universität Münster, Münster, Germany

The production of η mesons in proton-deuteron fusion to $^3\text{He}\eta$ has been studied for a long time. As the attractive s -wave ηN potential causes a strong final state interaction between the ^3He -nucleus and the η -meson, the near threshold region has received considerable attention already and is still subject to active research. Away from threshold, the available database is more sparse with detailed comparisons being hindered by systematics between the different experiments. Various theoretical models have tried to describe both the total as well as the differential cross section observed by different experiments, with none of them being regarded as the generally accepted model for η production away from threshold. Our new measurement performed with the WASA-at-COSY experiment covers 15 excess energies in the region between $Q \approx 13$ MeV and $Q \approx 81$ MeV, allowing a detailed study of the development of differential distributions with rising excess energy with minimal systematics, therefore acting as a valuable benchmark to existing and future theoretical models. The current status of the ongoing analysis will be presented along with future possibilities the dataset presents.

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HK 38.6 Do 15:30 F 5

Determination of the η' -nucleus potential at low momenta* — MARIANA NANOVA and ●VOLKER METAG for the CBELSA/TAPS-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität Gießen

The real part of the η' -nucleus potential has been determined at low momenta by analyzing the η' kinetic energy distribution and the excitation function in photoproduction of η' mesons off C in coincidence with forward going protons. The forward going protons take over most of the momentum of the incoming photon beam and thus allow a study of the η' -nucleus interaction at very low energies. This experimental approach was previously used in the determination of the ω -nucleus potential at low momenta [1]. The present measurement extends earlier determinations of the η' -nucleus potential at higher average momenta [2,3] towards the production threshold. A comparison of the data with calculations by E. Paryev [4] indicates that also at low momenta deep η' -nucleus potentials of ≥ 100 MeV, predicted in [5], can be excluded, in agreement with [6].

[1] S. Friedrich et al., *Phys. Lett. B* **87** (2013) 045201

[2] M. Nanova et al., *Phys. Lett. B* **727** (2013) 417

[3] M. Nanova et al., *Phys. Rev. C* **94** (2016) 025205

[4] E. Paryev, *J. Phys. G* **43** (2016) 015106

[5] H. Nagahiro et al., *Phys. Rev. C* **74** (2006) 045203

[6] Y. Tanaka et al., *Phys. Rev. Lett.* **117** (2016) 202501

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HK 38.7 Do 15:45 F 5

Determination of the $3\pi^0$ photoproduction cross-section for $E_\gamma \in [1.42, 1.58]$ GeV — •MARTIN WOLFES and WOLFGANG GRADL for the A2-Collaboration — Institut für Kernphysik, JGU Mainz, Germany

The A2 Collaboration uses an electron beam provided by the MAMI accelerator in Mainz to produce an energy tagged photon beam. Photon induced reactions are studied with the Crystal Ball/TAPS 4π calorimeter, which is optimized for neutral final states. Identification of charged particles is accomplished by an inner detector system.

In the course of the year 2014 this experimental setup was used to gather a large data sample of photon-proton reactions. Eg. the production of π^0 , ω , η or η' mesons. This presentation will show the status of the ongoing analysis to determine cross-sections for triple π^0 production. We will show how to get a precise value for the luminosity and how to identify the main background channels, namely the kinematically identical process of the η decaying to three π^0 and the reaction $\gamma p \rightarrow \Sigma^+ k^0$ with the k^0 decaying to two neutral pions.

HK 38.8 Do 16:00 F 5

Photoproduction of neutral pion pairs and triplets of deuteron — •MICHAEL SVEN GÜNTHER for the A2-Collaboration — Departement Physik, Universität Basel, Basel, Schweiz

Photoproduction of multiple-meson final states is an efficient tool for the study of sequential decays of nucleon resonances, i.e. decays involving intermediate excited states. When pions are involved in the decay the isospin degree of freedom is important. Apart from quasi-free production reactions off neutrons bound in light nuclei, such as the deuteron, coherent production mechanisms off light nuclei may serve as an isospin filter. So far, such reactions have almost not been explored due to the small production cross sections and the background from quasi-free processes. Here we summarize preliminary results for the coherent photoproduction of π^0 pairs and π^0 triples off deuterium nuclei. Coherent photoproduction of π^0 pairs has gained a lot of interest because this is a possible production channel for the much discussed $d^*(2380)$ di-baryon resonance. Coherent photoproduction of π^0 triples offers an elegant way to study three-pion production processes in an energy range where in free and quasi-free processes this final state is completely dominated by the $3\pi^0$ decay of the eta meson. The experiments were done at the tagged photon beam of the Mainz MAMI accelerator using a liquid deuterium target and the combined Crystal Ball/TAPS electromagnetic calorimeter.