

## HK 6: Hadronenstruktur und -spektroskopie

Zeit: Montag 11:00–13:00

Raum: HSZ-304

**Gruppenbericht**

HK 6.1 Mo 11:00 HSZ-304

**Measurement of charged decays of the  $\eta$  meson with WASA-at-COSY** — ●DANIEL CODERRE for the WASA-at-COSY-Collaboration — Forschungszentrum Jülich, Germany

The WASA-at-COSY experiment is a  $4\pi$  detector installed at the COSY storage ring at the Jülich Research Center. The detector is designed to measure decays of light mesons in hadronic interactions and is capable of measuring both charged and neutral decay products. This presentation will focus on a data sample of  $3 \times 10^7$   $\eta$ -mesons which were collected in the  $pd \rightarrow {}^3\text{He}\eta$  reaction.

Precision studies of decays of the  $\eta$  meson allow probes of symmetry-breaking reactions as well as precise tests of theoretical calculations. The current analysis is focused on charged decays of the  $\eta$ , including the anomalous decays  $\eta \rightarrow \pi^+\pi^-\gamma$  and  $\eta \rightarrow \pi^+\pi^-e^+e^-$  as well as the leptonic reactions  $\eta \rightarrow e^+e^-\gamma$  and  $\eta \rightarrow e^+e^-e^+e^-$ . The primary goal of the analysis is a precise and consistent measurement of the branching ratios of these channels. Additionally the electromagnetic transition form factor in the reaction  $\eta \rightarrow e^+e^-\gamma$  and the dihedral angle in  $\eta \rightarrow \pi^+\pi^-e^+e^-$ , which is an observable for possible CP-violation outside the standard model, are measured. The C-violating reaction  $\eta \rightarrow \pi^0e^+e^-$  is also analyzed in an attempt to improve the experimental upper limit on its branching ratio. Results of these analyses will be presented.

This work is supported by COSY-FFE.

HK 6.2 Mo 11:30 HSZ-304

**Messung des differentiellen und totalen Wirkungsquerschnitts der  $\eta'$ -Photoproduktion an MAMI** — ●PATRIK OTT für die A2-Kollaboration — Institut für Kernphysik, Universität Mainz, Germany

Am Crystal-Ball (CB) Experiment am Elektronenstrahl-Beschleuniger MAMI in Mainz werden Nukleonen und weitere Hadronen mittels eines reellen Photonenstrahls untersucht. Mit der neuen Beschleunigerstufe, MAMI-C, steht ein intensiver polarisierter Strahl mit einer Energie von bis zu 1,604 GeV zur Verfügung. Zur Energiemarkierung von Bremsstrahlungspotonen mit den höchsten Energien wurde ein neues Spektrometer in Betrieb genommen (Endpunkt-Tagger). Damit konnte die  $\eta'$ -Photoproduktion von der Schwelle  $E_\gamma = 1,447\text{GeV}$  bis  $E_\gamma = 1,59\text{GeV}$  erstmals an MAMI studiert werden. Die  $\eta'$ -Mesonen wurden über den Zerfall  $\eta' \rightarrow \eta\pi^0\pi^0 \rightarrow 6\gamma$  identifiziert. Ich präsentiere in diesem Vortrag vorläufige Ergebnisse der Messung des differentiellen und totalen Wirkungsquerschnitts der  $\eta'$ -Photoproduktion.

HK 6.3 Mo 11:45 HSZ-304

**Narrow Structure in  $\eta$ -Photoproduction off  ${}^2\text{H}$  and  ${}^3\text{He}$**  — ●LILIAN WITTHAUER and DOMINIK WERTHMÜLLER for the A2-Collaboration — Department of Physics, University of Basel, Switzerland

Large efforts have been made in the last years to investigate the complicated excitation spectrum of the nucleons. Especially  $\eta$ -Photoproduction has been studied by many collaborations. Experiments at CBELSA/TAPS and GRAAL revealed a bump-like structure in the quasi-free  $\eta$ -Photoproduction on the neutron, which is not seen on the proton (I. Jaeglé et al., PRL 100 (2008), V.Kuznetsov et al., PLB 647 (2007)).

To examine this structure high statistics experiments using the A2 detector setup with the Crystal Ball calorimeter and the TAPS detector at the electron acceleration facility MAMI have been carried out. To exclude any possibility that the structure could arise from nuclear effects,  $\eta$ -photoproduction in coincidence with recoil nucleons has been measured on two different targets, namely  ${}^2\text{H}$  and  ${}^3\text{He}$ .

This talk gives an overview over the final results on quasi-free inclusive and exclusive  $\eta$ -Photoproduction off quasi-free protons and neutrons.

Supported by Swiss National Fund and DFG.

HK 6.4 Mo 12:00 HSZ-304

**Measurement of  $\sigma_{1/2}$  and  $\sigma_{3/2}$  in Photoproduction of  $\eta$  and  $2\pi^0$  Mesons off Protons and Neutrons** — ●MANUEL DIETERLE for the CBELSA/TAPS-Collaboration — Department of Physics, University of Basel, Klingelbergstrasse 82, 4056 Basel, Switzerland

The excitation spectrum of meson photoproduction consists of many

broad and overlapping nucleon resonances. The identification of the relevant amplitudes and therefore of the quantum numbers of a prospective nucleon resonance requires the measurement of single and double polarisation observables. Due to the different isospin dependence of the electromagnetic interactions the resonance contributions to the cross sections on the proton differ from those on the neutron. Whereas in the case of the free proton the experimental programs are already well established, new programs using deuterated butanol as neutron targets are running in parallel at the electron accelerator facilities MAMI in Mainz and ELSA in Bonn.

We will present preliminary results of an experiment with the Crystal-Barrel/TAPS setup at ELSA using a longitudinally polarised deuterated butanol target and a circularly polarised tagged photon beam. The measurement of the helicity dependent cross sections  $\sigma_{1/2}/\sigma_{3/2}$  (photon and target spin antiparallel/parallel), allows a first interpretation of the resonance contributions.

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HK 6.5 Mo 12:15 HSZ-304

**Status of the Investigations of the  $I(J^P) = 0(3^+)$  Resonance Structure in the Two-Baryon-System\*** — ●MIKHAIL BASHKANOV for the WASA-at-COSY-Collaboration — Physikalisches Institut der Universität Tübingen

The double-pionic fusion reaction  $pn \rightarrow d\pi^0\pi^0$  has been observed [1] to be dominated by a resonance structure at  $\sqrt{s} = 2.37$  GeV with  $\Gamma \approx 70$  MeV and  $I(J^P) = 0(3^+)$ , which is tightly correlated with the so-called ABC effect, an intriguing low-mass enhancement in the spectrum of the  $\pi\pi$  invariant mass. In order to reveal the nature of this structure we have measured its possible decay channels  $d\pi^+\pi^-$ ,  $pp\pi^0\pi^-$ ,  $np\pi^0\pi^0$ ,  $NN\pi$  and  $pn$  by  $pd$  collisions in the quasi-free reaction mode utilizing WASA at COSY.

The isospin decomposition of the  $d\pi^+\pi^-$  data confirms that the resonance shows up in the isoscalar ( $d\pi^0\pi^0$ ), but not in the isovector ( $d\pi^+\pi^0$ ) fusion channel.

The  $pp\pi^0\pi^-$  data are consistent with a decay branch also into this channel. The impact of this observation onto the vertex formfactor used in the description [1] of the  $d\pi^0\pi^0$  channel will be discussed.

The  $pn$  decay channel, the *experimentum crucis*, as well as the  $np\pi^0\pi^0$  channel have been measured by use of vector-polarized deuterons in inverse kinematics. The data analysis of this beamtime is in progress, its status will be reported.

[1] P. Adlarson et al., Phys. Rev. Lett. **106** 242302 (2011)

\*supported by BMBF and COSY-FFE (FZ Jülich)

HK 6.6 Mo 12:30 HSZ-304

**Towards a measurement of the  $\omega\pi$  transition form factor** — ●FARHA ANJUM KHAN for the WASA-at-COSY-Collaboration — Forschungszentrum Juelich, Juelich, Germany

Experiments using the reaction  $pd \rightarrow {}^3\text{He}\omega$  have been performed with the WASA detector at COSY to determine the transition form factor for the  $\omega \rightarrow \pi^0e^+e^- \rightarrow \pi^0\gamma^*$  decay. For the study of the background contributions, an analysis of the real photon case  $\omega \rightarrow \pi^0\gamma$  and the decay  $\omega \rightarrow \pi^0\pi^+\pi^-$  is being performed. Using selective conditions the multi-pion background has to be substantially reduced. The number of  $\omega$  mesons is estimated and cross-checked with the branching ratio of  $\pi^0\gamma$  relative to  $\pi^0\pi^+\pi^-$ . Kinematic fitting is used to improve background suppression. The analysis for the  $\omega \rightarrow \pi^0e^+e^-$  decay is performed with the expectation of less than 40  $\omega \rightarrow \pi^0e^+e^-$  events after reasonable suppression of the multi-pion background and subtraction of the in-peak contributions from other  $\omega$  decays. As an initial step towards a form factor measurement the branching ratio for  $\omega \rightarrow \pi^0e^+e^-$  is estimated, providing a first hint at the size of the form factor.

HK 6.7 Mo 12:45 HSZ-304

**Measuring the relative branching ratio and the  $E_\gamma$ -distribution of  $\eta \rightarrow \pi^+\pi^-\gamma$  with WASA-at-COSY** — DANIEL LERSCH<sup>1</sup> and ●FRANK GOLDENBAUM<sup>1,2</sup> — <sup>1</sup>Jülich Center for Hadron Physics, Forschungszentrum Jülich — <sup>2</sup>Bergische Universität Wuppertal, FB C

The decay channel  $\eta \rightarrow \pi^+\pi^-\gamma$  provides the opportunity to study QCD anomalies at the chiral limit. The decay width and the shape

of the  $E_\gamma$ -distribution of this channel are sensitive to the box anomaly term which is part of the Wess-Zumino-Witten-(WZW) Lagrangian. However, the theoretically predicted decay width and  $E_\gamma$ -distribution do not agree with the experimental results, if final state interactions are not included by unitarized extensions of the WZW-Lagrangian. The experimental observables for testing these extensions are (i) the (relative) branching ratio (done by CLEO and KLOE) and (ii) the distribution of the photon energy  $E_\gamma$ .

In order to measure both observables in one experiment, the WASA-at-COSY collaboration has measured the reaction  $pp \rightarrow pp[\eta \rightarrow \pi^+\pi^-\gamma]$ . The status on reconstructing this channel will be presented together with results on the channel  $\eta \rightarrow \pi^+\pi^-\pi^0$  which is a major component of the background to the channel of interest, and is needed to normalise the measured partial width. In this presentation the methods and preliminary results will be presented.