HK 18: Hadron Structure and Spectroscopy II

Time: Tuesday 15:45–17:15 Location: HS 3 Physik

Group Report HK 18.1 Tue 15:45 HS 3 Physik

Forward angle coherent photoproduction off the deuteron - a puzzle of unexpectedly large cross section measurements — •Thomas Jude for the BGOOD-Collaboration — Physikalisches Institut, Universität Bonn

The BGOOD photoproduction experiment at the ELSA facility is uniquely designed to explore kinematics where a charged particle is identified in a forward spectrometer and a recoiling hadronic system is reconstructed in the central calorimeter at low momentum transfer. The setup enables studies of coherent reactions off the deuteron where the deuteron takes the majority of the beam momentum. Due to the small deuteron binding energy this kinematic regime is expected to be heavily suppressed, however measurements of the reactions, $\gamma d \to \pi^0\pi^0 d$, $\gamma d \to \pi^0\eta d$ and $\gamma d \to \pi^0\pi^0\pi^0 d$ exhibit forward differential cross sections an order of magnitude higher than phenomenological model calculations.

The $\gamma d \to \pi^0\pi^0 d$ reaction is consistent with a scenario of intermediate dibaryon formation, including the proposed $d^*(2380)$ hexaquark. Other mechanisms however, such as pion exchange in final state interactions may yet prove to play dominant roles in all three measured reactions.

HK 18.2 Tue 16:15 HS 3 Physik

Determination of polarization observables in the reaction γn→n$\pi^0\pi^0$. — •Nadia Reinartz for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Nussallee 14-16, 53115 Bonn

Investigating the baryon excitation spectrum is essential for understanding the internal dynamics of baryons and quantum chromodynamics (QCD) in the non-perturbative regime. Extracting the baryon resonances and their properties from the data is difficult due to the short lifetime of these exited states which leads to broad and strongly overlapping resonances. Using a polarized beam, a polarized target or using the polarization of the recoiling nucleon allows the measurement of single or double polarization observables, that are needed for an unambiguous partial wave analysis solution.

The CBELSA/TAPS experiment uses polarized photons of up to 3.2 GeV energy and a polarized target to determine single or double polarization observables for various final states. The Crystal Barrel calorimeter in combination with the MiniTAPS calorimeter in forward direction and the ability to detect charged particles, allows measurements in a close to 4π coverage. In the last years, the CBELSA/TAPS experiment in Bonn was upgraded in order to significantly boost the efficiency to trigger on final states with only neutral particles.

In this talk a comparison between results of free and quasi-free protons in the reaction γp→p$\pi^0\pi^0$ are discussed, followed by preliminary results for the reaction γn→n$\pi^0\pi^0$.

Supported by the DFG (505387544)

HK 18.3 Tue 16:30 HS 3 Physik

Determination of Polarization Observables in the $\pi^0\eta$-Photoproduction off the Neutron — •Leoniedas Reschke for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Nussallee 14-16, 53115 Bonn

The extraction of double-meson polarization observables from neutron reactions provides a valuable opportunity to refine theoretical models and to compare production processes off neutrons with those off protons. Measurements of polarization observables off neutrons offer access to resonances which couple stronger to the neutron, making them essential for a comprehensive understanding of nucleon resonances. Final states involving two mesons are particularly sensitive to cascading decays via intermediate states, providing unique insights into baryon dynamics. However, data on neutron, and, especially, double meson-neutron reactions are scarce. At the CBELSA/TAPS experiment in Bonn, photoproduction experiments are conducted using a polarized photon beam and various targets, including a polarized deuterized butanol target. This setup enables photoproduction experiments off the neutron. Since only deuteron-bound neutrons can be polarized, but reactions from all target neutrons are measured, advanced analysis techniques are necessary to exclude contamination from the neutrons bound in oxygen and carbon while also accounting for the Fermi motion of the bound neutrons in the deuteron. In this talk, I will present preliminary results for polarization observables in $\gamma n \to n\pi^0\eta$. Supported by the DFG (Project-Nr.: 505387544).

HK 18.4 Tue 16:45 HS 3 Physik

"Production Mechanism Studies of the N^* and Δ Resonances in Proton-Proton Collisions" — •Saket Kumar Sahu[1], Johan Messchendorp[3], and James Ritman[1,2,3] for the HADES-Collaboration — [1]Ruhr-Universität Bochum — [2]Forschungszentrum Jülich — [3]GSI Helmholtzzentrum fur Schwerionenforschung GmbH

The electromagnetic properties of (excited) hadrons can be investigated through the production of virtual photons in elementary reactions. Our goal is to study Dalitz transitions of N^* and Δ resonances generated in proton-proton collisions. The key challenge is to first understand the production mechanisms of these resonances. A comprehensive understanding of the production mechanisms in elementary reactions will also serve as a crucial reference for interpreting data from heavy-ion collisions. The High Acceptance Di-Electron Spectrometer (HADES) at GSI Darmstadt is a versatile magnetic spectrometer designed for measuring wide range of charged particle final states across large angular acceptance and is ideal for performing these studies. This analysis aims to extract differential cross-sections for the exclusive production of N^* and Δ channels in proton-proton collisions at $\sqrt{s}$ = 3.47 GeV. The data will serve as a good basis to rigorously study the production mechanisms by a detailed comparison with theory calculations. This talk will focus on the initial results of the analysis of proton-proton scattering data collected in February 2022 by the HADES collaboration.

HK 18.5 Tue 17:00 HS 3 Physik

Partial Wave Analysis for Pion-Induced Resonance Studies in the HADES Experiment — •Ahmed Marwan Foda for the HADES-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Deutschland

The High Acceptance Di-lepton Spectrometer (HADES) collaboration at GSI uses a pion-beam to examine baryonic resonances and their decay channels. This pion-beam facility enables baryonic resonance production at a fixed center of mass energy ($\sqrt{s}$) in the s-channel, offering a key advantage over proton-induced reactions and complementing photo-induced studies conducted elsewhere. Partial Wave Analysis (PWA) techniques explore resonance couplings to various final states. HADES focuses on studying vector mesons' role and medium modification in heavy-ion collisions within baryon-dense matter. Elementary pion-induced studies on the proton combined with PWA provide deeper insights into baryonic resonance couplings to ρN and ωN final states, shedding light on the ρ meson melting in heavy-ion collisions and intermediary vector mesons' role in dilepton emissions.

To support broader studies of the resonance regions in pion-proton collisions, a new K-Matrix & ND framework is under development, offering refined resonance mapping. Example fits will showcase its current status and potential.