HK 11: Hadron Structure and Spectroscopy III

Time: Tuesday 16:15–18:30 Location: PHIL C 301

Group Report HK 11.1 Tue 16:15 PHIL C 301
Recent results from the CBELSA/TAPS experiment and plans for a new experiment at ELSA: INSIGHT — •Tobias Seifen for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Nussallee 14-16, 53115 Bonn

Based on the high quality photoproduction data, our understanding of the spectrum and the properties of N^*- and Δ^*-baryons has substantially improved. Polarization data, as taken by the CBELSA/TAPS experiment for various final states, are a key to resolve the baryon spectrum. The measurement of polarization observables is indispensable for performing an unambigious partial wave analysis to extract the resonances from the data.

In contrast to the non-strange baryon sector, so far, little is known about the excited Λ and Σ spectrum. For decades, progress in the strange baryon sector has been hampered by the lack of data.

Here, the new INSIGHT experiment at ELSA will provide high quality data and therefore crucial information on Λ^* and Σ^* resonances and will also investigate the possible existance of multi-quark states in the strange quark sector.

INSIGHT features a unique combination of an almost complete angular coverage for high-resolution photon measurements, charged-particle detection and the ability to perform measurements using a transversally or longitudinally polarized target.

This talk will discuss recent results from the CBELSA/TAPS experiment as well as the plans for the future INSIGHT experiment at ELSA.

Group Report HK 11.2 Tue 16:45 PHIL C 301
The study of unconventional baryon structure in the light quark sector with the BGOOD and INSIGHT experiments — •Thomas Jude for the BGOOD-Collaboration — Physikalisches Institut, Universität Bonn

The existence of exotic multi-quark states beyond valence three quark and quark-antiquark systems has been unambiguously confirmed in the heavy quark sectors and equivalent structures may be evidenced in the light, *uds* sector. The BGOOD photoproduction experiment at ELSA is ideal to study spatially extended, molecular-like structure which may manifest in reaction mechanisms. BGOOD is comprised of a central calorimeter for neutral meson momentum reconstruction and complemented by a magnetic spectrometer in forward directions for charged particle identification.

Our published results in the strangeness sector suggest a dominant role of meson-baryon dynamics which may have an equivalence to the P_C states in the charmed sector. This includes structure in $K^0\Sigma^0$ and $K^+\Sigma^+$ photoproduction at the K^*Y thresholds.

The new INSIGHT experiment at ELSA will be an important upgrade for both the BGOOD and CBELSA/TAPS experiments and will feature a unique combination of almost complete angular coverage for high-resolution photon identification and charged-particle detection with polarised beams and targets.

I will present BGOOD results and anticipated INSIGHT measurements using simulated data.

HK 11.3 Tue 17:15 PHIL C 301
Production Mechanism Studies of the N^* and Δ Resonances in Proton-Proton Collisions — •Saket Kumar Sahu[1,2], Ahmed Marwan Foda[2], Johan Messchendorp[2], James Ritman[1,2,3], and Deborah Rönchen[3] — [1]Ruhr University Bochum — [2]GSI Helmholtzzentrumfür Schwerionenforschung GmbH — [3]Forschungszentrum Jülich

Excited nucleon states (N^* and Δ resonances) help us to probe the non-perturbative regime of Quantum Chromodynamics (QCD) and baryon structure. One way to access their internal properties is through their coupling to virtual photons produced in elementary reactions. Our long-term goal is to study Dalitz transitions of N^* and Δ resonances generated in proton-proton collisions. In this work, we study the production mechanisms of these resonances which will also serve as a baseline measurement for interpreting data from heavy-ion collisions. The High Acceptance Di-Electron Spectrometer (HADES) at GSI Darmstadt, which is a versatile magnetic spectrometer designed for measuring wide range of particles across large angular acceptance, 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 and also their coupling strengths in proton-proton collisions. This talk will present results of the analysis of proton-proton scattering data collected in February 2022 by the HADES collaboration, along with preliminary comparisons to fits using the Jülich*Bonn (JüBo) dynamical coupled*channel model.

HK 11.4 Tue 17:30 PHIL C 301
$K^+\Sigma(1385)^-$ photoproduction at the BGOOD experiment — •Martin Ludwig for the BGOOD-Collaboration — Physikalisches Institut, Universität Bonn

In the past twenty years, many exotic multi-quark states have been discovered in the heavy-quark sector. Although their exact binding mechanism is still under discussion, their proximity to certain thresholds suggests they may be molecular-like states. If so, one may expect similar states to appear in the light (uds) sector as well.

One way to search for such states is via photoproduction off the proton or neutron. The BGOOD experiment at the ELSA facility is ideally suited for these studies, as it combines a central calorimeter with a forward spectrometer that enables charged-particle reconstruction at extreme forward angles. These forward angles correspond to low momentum transfer to the recoil baryon, which may be a favourable condition for the formation of loosely bound molecular states.

Previous studies of strangeness-photoproduction channels at BGOOD have provided hints that exotic hadrons similar to the P_c pentaquarks may actually exist in the light-quark sector. In this context, another interesting channel to investigate is $\gamma n \to K^+\Sigma(1385)^-$. Preliminary results for its differential cross section for beam energies ranging from threshold up to 2050 MeV will be presented.

HK 11.5 Tue 17:45 PHIL C 301
$K^{*+}\Lambda$ and $K^{*+}\Sigma^0$ photoproduction at the BGOOD experiment — •Amelia Carina de Lope Fend for the BGOOD-Collaboration — Physikalisches Institut, Universität Bonn

In recent years exotic multi-quark states such as the XYZ mesons and the P_c pentaquark states have been discovered in the charm quark sector. Structures in $\gamma p \to K^+\Sigma^0$ and $\gamma p \to K^0\Sigma^+$ cross sections may be evidence of an equivalence in the light quark sector where $(K^*\Sigma)^+$ and $K^{*+}\Lambda$ dynamically generated states may exist.

The BGOOD experiment at the ELSA facility is especially suited to investigate this, as it provides a unique forward spectrometer for K^+ identification and momentum reconstruction and a central calorimeter for neutral hadron decays.

Current studies of the photoproduction reactions $\gamma p \to K^{*+}\Lambda$ and $\gamma p \to K^{*+}\Sigma^0$ are archieved via the identification of the decay $K^{*+} \to K^+\pi^0$ and focus on measuring the differential cross section with high statistical precision at forward K^{*+} angles. Preliminary results will be presented.

HK 11.6 Tue 18:00 PHIL C 301
$K^0\Sigma^0$ photoproduction at the BGOOD experiment — •Adrian Sonnenschein for the BGOOD-Collaboration — Physikalisches Institut, Nussallee 12, 53115 Bonn, Germany

The BGOOD experiment at the ELSA accelerator facility uses an energy tagged bremsstrahlung photon beam to investigate hadronic excitations in meson photoproduction in the light quark sector.

The associated photoproduction of K^0_S and hyperons is of particular interest. A cusp-like structure observed in the $\gamma p \to K^0_S\Sigma^+$ reaction at the K^* threshold is described by models including multi-quark resonances through dynamically generated vector meson-baryon interactions. This is the same model which predicted the P_C pentaquark states observed at LHCb through $D^*\Sigma_c$ interactions and if proven correct, would provide evidence of molecular-like states in the strangeness sector. The model predicts a peak like structure in $K^0_S\Sigma^0$ photoproduction at the K^* threshold, which is the motivation for the measurement present here.

The reaction $\gamma n \to K^0_S\Sigma^0$ has been measured at BGOOD from threshold to a beam energy of 2600 MeV. The analysis procedure is based upon a previous BGOOD publication, however employing additional kinematic fitting techniques with improved statistical precision. Preliminary differential cross section measurements will be presented.

HK 11.7 Tue 18:15 PHIL C 301

Energy Calibration of an Electromagnetic Calorimeter for the PRIMA Experiment at MAMI — Òscar Andújar Sabán[1], Ning Cao[1], Luigi Capozza[1], Jonas Geisbüsch[1], Ravi Gowdru Manjunata[1], Frank Maas[1,2,3], Antoine Martinet[1], Oliver Noll[1,2], Paul Schöner[1], Christoph Rosner[1], •Pierre Vijayan[1], and Sahra Wolff[1] for the PANDA-Collaboration — [1]Helmholtz-Institut Mainz, Mainz, Germany — [2]Institute of Nuclear Physics, Mainz, Germany — [3]PRISMA+ Cluster of Excellence, Mainz, Germany

The PRIMA experiment which was conducted at the MAMI accelerator facility in Mainz aims to measure the doubly virtual transition form factor (TFF) of the π^0 via the π^0-electroproduction in the Primakoff kinematics. A modified version of the PANDA backward calorimeter (EMC) was installed in the A1 spectrometer hall at MAMI, for detecting both the scattered electron and the π^0 decay γ-particles. The experiment will give new input to the hadronic corrections of the anomalous magnetic moment of the muon (g_μ-2 puzzle). In order to achieve a precise measurement of the TFF, the kinematics of this process needs to be determined with high precision.
For this purpose, a reliable energy calibration procedure of the EMC is mandatory. The talk therefore gives insight into the energy calibration of the electromagnetic calorimeter for the PRIMA-setup at MAMI.