HK 52: Hadron Structure and Spectroscopy IX

Time: Wednesday 16:00–17:30 Location: HK-H8

HK 52.1 Wed 16:00 HK-H8

Recent polarization observable results in η- and η'-photoproduction off the proton. — •Jakob Krause for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn.

While generally good agreement exists for low lying baryonic resonances, especially for high masses there are much more resonances predicted than actually found. This is also known as the problem of the "missing resonances", indicating the poor understanding of QCD in the non-perturbative region. Studying meson photoproduction off the nucleon promises to give further insight into the nucleon excitation spectrum. The analysis thereof requires partial wave analysis (PWA) to identify contributing resonances. It is essential to measure single and double polarization observables in order to find unambiguous PWA solutions. The CBELSA/TAPS experiment located at the electron stretcher accelerator ELSA in Bonn is dedicated to measuring different polarization observables in meson photoproduction employing a polarized photon beam and a polarized target.

This talk will present preliminary results concerning the polarization observable Σ in the reactions $\gamma p \to p\eta$ and $\gamma p \to p\eta'$ measured at the CBELSA/TAPS experiment, which were obtained using Bayesian inference.

HK 52.2 Wed 16:15 HK-H8

Study of neutral-pion pair production in two-photon scattering at BESIII — •Max Lellmann, Achim Denig, and Christoph Florian Redmer for the BESIII-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

The anomalous magnetic moment of the muon, a_μ, is one of the most precisely measured observables of the Standard Model, yet it shows a discrepancy of 4.2σ between Standard Model prediction and measurement. It is still unclear whether this discrepancy is due to a mistake in the measurement, due to a hint for New Physics, or due to a poor understanding of strong interaction at low energies.

The uncertainty of the standard model prediction of a_μ is currently limited by the calculation of the hadronic contributions. The hadronic Light-by-Light contribution to a_μ yields the largest relative uncertainty of all contributions. It is crucial to obtain a better understanding of the coupling of photons to hadrons, especially at small momentum transfers.

The BESIII experiment, located at the institute of high energy physics in Beijing/China, offers a perfect test bed for the investigation of two-photon processes at small momentum transfers. The process $e^+e^- \to e^+e^-\pi^0\pi^0$ is measured at the BESIII experiment at centre-of-mass energies between 3.77 and 4.6 GeV with a total integrated luminosity of more than $10\,\mathrm{fb}^{-1}$. This presentation will discuss the current status of the analysis.

HK 52.3 Wed 16:30 HK-H8

Study of the diffractively produced $\pi\pi\omega$ Events at COMPASS — •Philipp Haas — Physik-Department E18, Technische Universität München

The COMPASS experiment is a multi-purpose fixed-target experiment at the CERN SPS. One of its major goals is the search for so-called exotic mesons that cannot be described as quark-antiquark states. To this end, COMPASS has acquired large data samples on diffractive production of exited light mesons by a $190\,\mathrm{GeV}/c$ π^- beam on a proton target. The $\pi_1(1600)$ meson with spin, parity, and charge-conjugation quantum numbers $J^{PC} = 1^{-+}$, which are forbidden for $q\bar{q}$ states, is a promising candidate for a hybrid meson and agrees with predictions from lattice QCD. Lattice QCD further predicts that the $\pi_1(1600)$ dominantly decays into $b_1(1235)\pi$.

While $\pi_1(1600)$ signals have been found in the COMPASS data on $\rho(770)\pi$, $\eta\pi$, and $\eta'\pi$ decay modes, the $b_1(1235)\pi$ channel has so far not been studied. We will present first results of an analysis of COMPASS data on the diffractive process $\pi^-p \to \pi^-\pi^0\omega(782)p$, which includes the $b_1(1235)\pi$ channel. We performed an event selection resulting in a data sample of 730000 events. These data contain clear signals for $b_1(1235) \to \omega(782)\pi$ and will help us to study the $\pi_1(1600)$, and to verify the $\pi_1(2015)$ signal claimed by the BNL E852 experiment.

HK 52.4 Wed 16:45 HK-H8

The full COMPASS dataset of the diffractively produced $\eta^{(\prime)}\pi^-$ final state — •Henri Pekeler, Simon Havemann, David Spülbeck, Mathias Wagner, and Bernhard Ketzer for the COMPASS-Collaboration — Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany

The diffractive production of the $\eta^{(\prime)}\pi^-$ system in the $p + \pi^- \to \eta^{(\prime)}\pi^- + p$ channel is very exciting because the partial wave with orbital angular momentum $L = 1$ between the two pseudoscalars carries spin-exotic quantum numbers $J^{PC} = 1^{-+}$. The observation of a resonance in this wave is considered a smoking gun for a hybrid meson with gluonic degrees of freedom.

Data for diffractive π^- proton scattering was taken by COMPASS in two different years. In the talk, we will present the full data set, which, together with recent improvements for the reconstruction, yields an increase of the data sample around a factor of 2 with respect to the data published previously by COMPASS, and around a factor of 4 compared to earlier data sets collected by the E852 collaboration. This allows us to perform a 2-dim. PWA in bins of the invariant mass and the 4-momentum transfer squared t.

Supported by BMBF.

HK 52.5 Wed 17:00 HK-H8

Analysis of data from a pilot run to measure the proton charge radius at AMBER — •Martin Hoffmann for the AMBER-Collaboration — Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany

The proton charge radius can be determined either by measuring the slope of the electric form factor via elastic lepton-proton scattering at low squared four-momenta Q^2 or by laser spectroscopy of hydrogen. Previous measurements of elastic electron-proton scattering as well as laser-spectroscopy of muonic and ordinary hydrogen yielded contradicting results. The AMBER collaboration plans to conduct a precision measurement of the proton electric form factor using high-energy muon-proton elastic scattering. This complementary approach avoids many of the systematic uncertainties of low-energy electron-proton elastic scattering.

The recoil proton is going to be detected in a high-pressure hydrogen time projection chamber (TPC), measuring the transferred momentum. The muon kinematics will be measured with silicon tracking detectors surrounding the TPC and parts of the upgraded COMPASS spectrometer. In 2021, a pilot run was performed in order to study key parts of the full setup under realistic beam conditions.

This contribution presents preliminary results of the pilot run analysis and on-going Monte Carlo simulations.

Supported by EU.

HK 52.6 Wed 17:15 HK-H8

Unified Tracking Stations for the Proton-Radius Measurement at AMBER — •Karl Eichhorn for the AMBER-Collaboration — Technische Universität München, Physik-Department, Garching, Germany

The proton radius can be determined by measuring the slope of the electric form factor G_E at small squared four-momentum transfer Q^2. Numerous elastic scattering and laser spectroscopy measurements of the proton radius have been performed with contradicting results – the so-called proton radius puzzle. We propose to measure the proton radius in high-energy elastic muon-proton scattering at the M2 beam line of CERN's Super Proton Synchrotron in the year 2023. A high-precision measurement at low Q^2 realized with a high-pressure hydrogen TPC can contribute to a solution of the puzzle, especially in view of the systematics of this approach compared to electron scattering. A combined measurement of the recoil proton and the muon trajectory will be performed. In addition to the precise information about the recoil proton provided by the TPC, a novel unified tracking station is foreseen for an accurate measurement of the scattered muon. Thin scintillating fibers read out by SiPMs joint with monolithic silicon-pixel detectors are used for the reconstruction of the scattered muon. A first prototype beam test is foreseen in the year 2022. We present on-going studies and developments of this unified tracking station.