HK 34: Hadron Structure and Spectroscopy IV

Time: Wednesday 17:30–18:45 Location: HS 3 Physik

HK 34.1 Wed 17:30 HS 3 Physik

Partial-Wave Analysis of the $\omega\pi\pi$ Final State at COMPASS* — •Philipp Haas for the COMPASS-Collaboration — Technische Universität München

The study of mesons beyond $q\bar{q}$ configurations is of core interest in meson spectroscopy to extend our understanding of QCD. In the non-strange light-meson sector the $\pi_1(1600)$ is the only established of those, so-called exotic, mesons. The COMPASS experiment studied the $\pi_1(1600)$ in great detail in the $\rho(770)\pi$, $\eta\pi$, and $\eta'\pi$ final states and greatly contributed to the foundation of the $\pi_1(1600)$. Recent lattice QCD calculations predict the $b_1(1235)\pi$ decay mode as dominant decay channel with a partial decay width more than 10 times larger than all other decay channels. Further, the decay $\pi_1(1600) \to \rho(770)\omega$ is predicted to be negligible. Both the $b_1(1235)\pi$ and $\rho(770)\omega$ decay prominently to the $\omega\pi\pi$ final state. Thus, the analysis of $\omega\pi\pi$ allows the study of the $\pi_1(1600)$ in its supposedly dominant decay and verification of lattice QCD predictions.

In this talk we present results of the partial-wave analysis of the $\omega\pi^-\pi^0$ final state in COMPASS data. Using the so-far largest $\omega\pi\pi$ dataset allows an analysis of this challenging final state of unmatched precision. We study the decays of $\pi_1(1600)$ to $b_1(1235)\pi$ and $\rho(770)\omega$. Further, we extract resonance parameters and measure decay modes of multiple states, including poorly known ones.

* funded by the DFG under Germany's Excellence Strategy - EXC2094 - 390783311.

HK 34.2 Wed 17:45 HS 3 Physik

Understanding COMPASS data on $\pi^- + p \to \eta^{(\prime)} + \pi^- + p$ in the double-Regge region — •Henri Pekeler, David Spülbeck, and Bernhard Ketzer for the COMPASS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, Germany

The COMPASS experiment at CERN's SPS provides a very large data set to study the light-meson spectrum in several final states including $\eta^{(\prime)}\pi^-$, which is known to be the golden channel to investigate the lightest hybrid-meson candidate, the $\pi_1(1600)$. One challenge in the extraction of resonance parameters, like pole positions, is the separation of resonant and non-resonant processes.

To better constrain the non-resonant production mechanism of this final state, we analyse its high-mass region, i.e. $2.4\,\text{GeV} < m_{\eta^{(\prime)}\pi^-} < 6\,\text{GeV}$ using the double-Regge exchange model published by the JPAC collaboration. It was based on fits of published COMPASS data in the mass region below 3 GeV. By performing an event-based likelihood fit to the full COMPASS data set, we expand and test the model up to very high invariant masses. We find that by including the daughter trajectory of the a_2, the a_2', the data can be fitted with only 8 free parameters. The relative strengths of the contributing amplitudes as well as the trajectory parameters for the a_2', determined by the fit, will be shown.

Supported by BMBF.

HK 34.3 Wed 18:00 HS 3 Physik

Partial Wave Analysis of the process $\gamma^*\gamma \to f_1(1285) \to \eta\pi^+\pi^-$ at BESIII — •Jan Muskalla, Achim Denig, Chistoph Redmer, and Max Lellmann — 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 (SM). However, large discrepancies persist between SM predictions and experiment. The uncertainties of the SM prediction are currently dominated by hadronic contributions. Improving the precision requires more accurate measurements of transition form factors (TFFs) for axial-vector mesons contributing to hadronic light-by-light scattering (HLbL). These TFFs serve as experimental input to theoretical calculations and can be accessed from the cross section of meson production in $\gamma\gamma$ collisions at e^+e^- machines.

The BESIII experiment at the Beijing Electron Positron Collider (BEPCII) is collecting data in the τ-charm energy region and offers large datasets ideally suited for studying $\gamma\gamma$ interactions. With a data set of $20\,\text{fb}^{-1}$ at $\sqrt{s} = 3.77\,\text{GeV}$, the process $\gamma^*\gamma \to f_1(1285)$ is investigated in a single tag configuration, where only one of the scattered electrons is detected. This allows the measurement of the momentum dependence of the TFF. To study the interference effects in the decay $f_1(1285) \to \eta\pi^+\pi^-$, a partial wave analysis (PWA) is performed. This talk will discuss the data analysis, amplitudes for the PWA and techniques to extract the TFFs for the different helicity configurations of the $f_1(1285)$.

HK 34.4 Wed 18:15 HS 3 Physik

Investigation of the exclusive pp → ppKK reaction using data collected by HADES — •Valentin Kladov[1,2], Johan Messchendorp[2], and James Ritman[1,2,3] for the HADES-Collaboration — [1]Ruhr-Universität Bochum — [2]GSI Helmholtzzentrum — [3]Forschungszentrum Jülich

This study presents the exclusive analysis of the $pp \to ppK^+K^-$ reaction with data taken with the HADES detector in February 2022 at a center-of-mass energy of 3.5 GeV. A neural network-based particle identification was developed, which compensates for simulation-experiment discrepancies via domain adversarial technique. The background was suppressed by the means of kinematic refit with a 4C constraint, corresponding to the conservation of 4-momentum, which allowed us to obtain a high-purity sample of data with $S/B \approx 15$. Clear signals from $\phi(1020) \to K^+K^-$ and $\Lambda(1520) \to pK^-$ decays were observed with their parameters consistent with those published by the PDG. Moreover the importance of K^+K^- non-resonant final state interactions was confirmed. This talk will discuss the details of our event selection, efficiency corrections and present a number of intermediate results, including total cross section and ϕ/K ratio measurements.

HK 34.5 Wed 18:30 HS 3 Physik

Investigating Proton-Proton Elastic Scattering with the Upgraded HADES Spectrometer — •Gabriela Perez Andrade[1], James Ritman[1,2,3], and Peter Wintz[3] for the HADES-Collaboration — [1]Ruhr Universität Bochum — [2]GSI Helmholtzzentrum für Schwerionenforschung — [3]Forschungszentrum Jülich

An experiment focused on hyperon production was carried out in 2022 with the upgraded HADES spectrometer. The upgrade includes a Forward Detector system (FD) consisting of two PANDA-type Straw Tracking Stations, and an RPC. The measurements were performed with a T = 4.5 GeV proton beam impinging onto a LH_2 target.

Proton-proton elastic scattering events were selected based on kinematic observables, requiring that one proton was detected in the FD ($\theta_{FD} < 6°$) and the other proton within the main HADES acceptance ($70° < \theta_H < 79°$). These events, after corrections for acceptance and reconstruction efficiency, were used for the determination the time-integrated luminosity recorded during the experiment.

The measured differential cross-section $d\sigma$ as a function of the square of the 4-momentum transfer t is well described by the function $d\sigma/dt = d\sigma/dt|t = 0 \cdot e^{-B|t|}$, enabling extraction of the optical point $A = d\sigma/dt|t = 0$ and the nuclear slope parameter B. In this talk, the selection method for elastic scattering events will be explained in detail. Preliminary results for the integrated luminosity, as well as the parameters A and B, will be presented and compared to data from other experiments.