HK 37: Hadron Structure and Spectroscopy VII

Time: Thursday 16:15–18:00 Location: PHIL C 301

Group Report HK 37.1 Thu 16:15 PHIL C 301

Measurements of two-photon scattering reactions at the BESIII experiment as inputs to the Hadronic Light-by-Light contribution to $(g-2)_\mu$ — Achim Denig, Max Lellmann, Jan Muskalla, and •Christoph Florian Redmer for the BESIII-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

While recently agreement between the direct measurements and the Standard Model prediction of the anomalous magnetic moment of the muon was reported, further improvement of the prediction is required to match the precision of the measurement. The prediction is limited by the knowledge of the hadronic contributions, which can be calculated from data-driven approaches. One of these contributions is the hadronic Light-by-Light scattering. It depends on the knowledge of transition form factors of light pseudoscalar, scalar, axial, and tensor mesons as well as the coupling of multi-meson systems to two photons, which are accessible in e^+e^- collisions.

The BESIII experiment, operated at the BEPCII accelerator in Beijing, China, has collected the world's largest data sets of e^+e^- collisions in the τ-charm region between 2 GeV and 5 GeV. The recently completed 20 fb^{-1} data set at 3.773 GeV is ideally suited to study the momentum-transfer dependence of transition form factors at space-like momentum transfers of $Q^2 \approx 1\,\text{GeV}^2$, which is of special relevance in the context of a_μ. In this presentation we discuss recent results, ongoing projects, and future prospects of the measurements at the BESIII experiment. — Supported by DFG FOR5327

HK 37.2 Thu 16:45 PHIL C 301

Probing hyperon-hyperon interactions with CBM at FAIR — •Gandharva Appagere for the CBM-Collaboration — Stockholm University, Stockholm, Sweden

Hyperons play a central role in the composition of dense baryonic matter and are expected to emerge in the cores of neutron stars at supra-nuclear densities, influencing the equation of state. A quantitative understanding of hyperon-hyperon interactions, governed by non-perturbative QCD, is therefore essential for constraining the properties of dense matter. In this contribution, recent studies of multi-strange baryon interactions are presented with the framework of the Compressed Baryonic Matter (CBM) experiment at FAIR as a part of "QCD at FAIR" initiative. Using realistic CBM simulation data for high-rate proton-proton collisions, we investigate $\Lambda\Lambda$ and $\Sigma^+\Sigma^+$ systems. We emphasize on interaction signatures such as cusp effects and near-threshold structures, explored using dispersion-relation-based approaches based up on Monte Carlo simulations of exclusive reaction channels. The presented results establish a solid methodological foundation for future measurements with CBM and illustrate its potential to provide crucial experimental constraints on hyperonic interactions relevant for neutron-star matter.

HK 37.3 Thu 17:00 PHIL C 301

Measurement of the chiral anomaly at COMPASS — •Jan Friedrich for the COMPASS-Collaboration — Physik-Department, Technische Universität München, Garching

Using the Primakoff technique for 190 GeV pions on nuclear targets, we have determined the chiral anomaly in the process $\pi\gamma \to \pi\pi^0$ with unprecedented precision. We report on the challenges of background subtraction, radiative corrections and the luminosity determination.

HK 37.4 Thu 17:15 PHIL C 301

The GSI pion beam program: QCD-driven studies of hadron structure and dynamics — •Marvin Kohls — GSI Helmholtzzentrum für Schwerionenforschung GmbH

We present plans for the upcoming pion beam program at GSI from 2027 on. This program leverages secondary pion beams (< 2 GeV/c) in combination with the HADES spectrometer to address fundamental questions in strong QCD physics with a focus on precision studies in the fields of baryon spectroscopy and structure. We will determine baryon-meson coupling constants and electromagnetic transition form factors in the time-like region. With the planned beam intensities we expect to collect enough statistics to enable detailed partial wave analyses and the study of rare decay channels. These measurements are crucial for understanding hadron structure and for modeling dilepton emission in heavy-ion collisions. As a complementary focus, we study vector meson properties in cold nuclear matter through dielectron spectroscopy. The program will investigate in-medium modifications of vector mesons and their relation to chiral symmetry restoration. This program represents a principal component of the broader QCD-driven roadmap at GSI/FAIR (QCD at FAIR), bridging nuclear, hadron, and heavy-ion physics communities while complementing photon beam facilities worldwide.

HK 37.5 Thu 17:30 PHIL C 301

Physics performance studies of the CBM Neutron Calorimeter (NCAL) — •Dachi Okropiridze[1,2], Dieter Grzonka[2,3], and James Ritman[2,1,3] for the CBM-Collaboration — [1]Ruhr-Universitat Bochum (RUB), Bochum, Germany — [2]GSI Helmholtzzentrum fur Schwerionenforschung GmbH, Darmstadt, Germany — [3]Forschungszentrum Julich (FZJ), IKP-1, Julich, Germany

The Compressed Baryonic Matter (CBM) experiment at FAIR aims to explore the QCD phase diagram at high net-baryon densities. Event characterization and centrality determination are currently provided by the Forward Spectator Detector (FSD), which measures charged projectile spectators. To include neutral spectators, a forward neutron calorimeter (NCAL) based on segmented plastic scintillators is proposed. This upgrade is expected to improve impact-parameter reconstruction and constrain collective flow observables.

In addition to heavy-ion reactions, NCAL enables a vibrant program in elementary reactions using the same experimental setup. We present Monte Carlo studies of channels with final-state neutrons to explore the detector's physics reach. Standalone Monte Carlo simulations characterize the NCAL response, focusing on detection efficiency and energy deposition over the relevant energy range. By propagating simulated events through the model, we obtain detector-level observables. Taken together, these studies provide first estimates of NCAL's performance for spectator measurements in heavy-ion collisions and neutron-sensitive spectroscopy in elementary channels.

HK 37.6 Thu 17:45 PHIL C 301

Performance studies of the CBM Forward Spectator Detector for (pp and) dp-reactions — •Ruijia Yang[1], Frank Goldenbaum[1,2], and Petr Chaloupka[3] for the CBM-Collaboration — [1]Bergische Universität Wuppertal — [2]GSI — [3]Czech Technical University

The Forward Spectator Detector (FSD) of the CBM (Compressed Baryonic Matter) experiment plays a crucial role in both heavy-ion and proton-proton (pp) collisions. In pp interactions, the FSD is designed to identify events with small momentum transfer, typically dominated by elastic or quasi-elastic scattering, where the outgoing protons retain most of their energy and are deflected at very small angles. This contribution presents recent simulation studies performed to optimize the granularity and geometry of the FSD. With the full CBM geometry, the impact of the FSD module size, beam-pipe shape and material budget on the spatial resolution and detection efficiency has been systematically investigated. In addition, two event generators – a Fritiof (FTF) event generator and a PLUTO-based generator – have been implemented to simulate deuteron-proton (dp) reactions in CBM, in order to investigate the capability of CBM to study quasi-free pp and proton-neutron (pn) reactions. Integration of these generators into the CBM simulation is ongoing, and first results – together with updated FSD performance studies – will be presented at the conference.