HK 2: Hadron Structure and Spectroscopy I

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

Group Report HK 2.1 Mon 16:15 PHIL C 301
Accessing transition Generalized Parton Distributions with the $N \to N^*$ DVCS and DVMP processes — •Stefan Diehl for the CLAS-Collaboration — II. Physikalisches Institut, JLU Gießen, Gießen, Germany — University of Connecticut, Storrs, CT, USA

The understanding of the internal structure of baryon resonances is of essential important for many fields of nuclear physics. It is known, that Generalized Parton Distributions (GPDs) are a well established tool for characterizing the QCD structure of the ground-state nucleon based on 3D tomographic images of the quark/gluon structure. Transition GPDs extend these concepts to $N \to N^*$ transitions and can be used to characterize the 3D structure and mechanical properties of baryon resonances. They can be probed for example in high-momentum transfer exclusive electroproduction processes with resonance transitions $eN^* \to eMN^*$, such as deeply virtual Compton scattering (M = γ) or meson production (M = π, K ...). Based on the high-intensity, 10.6 GeV electron beam at JLAB and the large acceptance CLAS12 spectrometer, it becomes possible to study these processes in a large kinematic range. The talk will present results of the deeply virtual $ep \to e\Delta^{++}\pi^-$ process, providing a first measurement sensitive to transition GPDs and discuss the feasibility of the study of further $N \to N^*$ DVMP processes with CLAS12. Furthermore, first results for beam spin asymmetries of the $N \to N^*$ DVCS process ($ep \to eN^{*+}\gamma$) will be presented and compared to transition GPD based theory predictions. *The work is partly supported by Deutsche Forschungsgemeinschaft (Project No. 508107918).

Group Report HK 2.2 Mon 16:45 PHIL C 301
Measurement of the proton charge radius at AMBER — •Martin Hoffmann for the AMBER-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn

The AMBER collaboration plans to perform a new precision measurement of the proton electric form factor at low values of the negative squared four-momentum transfer by elastic scattering of high-energy muons off protons. This experiment features a high-intensity 100 GeV muon beam at the M2 beam line of CERN's Super Proton Synchrotron, leading to reduced and different systematic uncertainties compared to low-energy lepton-proton elastic scattering experiments. A high-pressure hydrogen-filled Time Projection Chamber serves as an active target and measures the energy transferred to the recoil proton. The muon trajectories and momenta are reconstructed by high-precision vertex detectors surrounding this chamber and a magnetic spectrometer. In this way, the measurement is over-constrained to cleanly select elastic scattering events.

The completely new free-streaming data acquisition was successfully tested under realistic conditions in 2025. First detectors of each type were installed in the setup and included in this new readout scheme. This talk will present first insights from this measurement and an overview of further developments towards the main experiment, which will be in the commissioning phase during the conference.

Supported by BMFTR.

HK 2.3 Mon 17:15 PHIL C 301
The PRIMA Experiment@MAMI: Simulation work for the pion acceptance determination — •Òscar Andújar Sabán[1], Ning Cao[1], Luigi Capozza[1], Jonas Geisbüsch[1], Ravi Gowdru Majunata[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, German — [2]Institute of Nuclear Physics, Mainz, Germany — [3]PRISMA+ Cluster of Excellence, Mainz, Germany

The significant discrepancy among data-driven models for the pion electromagnetic transition form factor (TFF)$F_{\pi^0\gamma^*\gamma^*}$ must be resolved, as this factor provides a main contribution to the hadronic light-by-light scattering (HLbL) process, which is essential for calculating the hadronic correction to the muon anomalous magnetic moment (a_μ^{QCD}). The PRIMA Experiment is measuring $F_{\pi^0\gamma^*\gamma^*}$ in the low momentum transfer (Q^2) region at the MAMI accelerator in Mainz, utilizing an Electromagnetic Calorimeter (EMC) and an Electron Veto Detector.
Determining the pion acceptance of the calorimeter is essential for this experiment. Consequently, simulation studies are being performed. This talk presents the current work-in-progress and the initial results regarding the pion acceptance.

HK 2.4 Mon 17:30 PHIL C 301
Feasibility studies of hyperon transition form factors with CBM at FAIR — •Shreya Roy for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH Planckstraße 1 64291 Darmstadt

Electromagnetic transition form factors (eTFFs) probe the internal structure of baryons. In the timelike region ($q^2 > 0$), they are accessible, for example via Dalitz decays $Y^* \to Y\, e^+e^-$. Previous results from HADES exist for light baryons (e.g. $\Delta(1232)$, $N^*(1520)$) that tested vector–meson dominance and revealed meson–cloud effects. To take the studies to the next level, the feasibility of extending this program to the strange sector with the Compressed Baryonic Matter (CBM) experiment at FAIR, Darmstadt, has been investigated. This contribution will cover details of the analysis strategy for exclusive Λ reconstruction in the $pp \to pK^+\Lambda$ channel using CBM tracking, PID, and kinematic fitting in the simulation. We then extend the study to the Dalitz channel $pp \to pK^+\Lambda(1520)$ with $\Lambda(1520) \to \Lambda\, e^+e^-$ to assess the sensitivity to timelike eTFFs and the possible kaon-cloud dynamics. Background simulation is under investigation. The obtained invariant-mass resolution, acceptance×efficiency, expected signal rates at CBM luminosities, form-factor sensitivity, and the accessible baryon radius will be presented.

HK 2.5 Mon 17:45 PHIL C 301
Beam rastering system for P2 collaboration at MESA — •Sumedh Kulkarni and Tyler Kutz for the P2-Collaboration — KPH, Johannes Gutenberg University of Mainz

The P2 collaboration at the MESA facility aims for a high precision measurement of the parity violating asymmetry in the elastic scattering of polarized electrons off of unpolarized protons. The expected asymmetry is on the order of 40 parts per billion (ppb), with a precision goal of better than 1 ppb. Thus, the experiment requires very high event rates to achieve the necessary statistical precision. Achieving such rates demands an intense, continuous electron beam incident on a thick target. P2 will carry out the measurement with a 150 μA electron beam on a 60 cm liquid hydrogen target. The resulting large power deposition can damage or destabilize the target without proper precautions. One way to mitigate this risk is to raster the electron beam with fast steering magnets, in order to distribute the power over a larger area of the target. For this, P2 will develop a rastering system that uses two electromagnetic dipoles to steer the electron beam by the desired angle. We used computer simulation to optimize ferrite yoke geometries and to determine the coil specifications for the required magnetic field strength. From these simulations, the most suitable yoke design and coil specifications were chosen. Here we present results of these simulations and further construction steps of the rastering system for the P2 experiment at MESA.

HK 2.6 Mon 18:00 PHIL C 301
Sieve optimization for calibration of the MAGIX spectrometers — •Alen Gajer for the MAGIX-Collaboration — KPH, JGU, Mainz, Germany

The MAGIX experiment, currently under development at the MESA accelerator in Mainz, will enable a broad range of precision measurements using electron scattering on fixed targets. The core component are two high-resolution magnetic spectrometers that separate scattered particles according to their momentum and detect them at the focal plane.

To extract scattering variables at the target, accurate reconstruction of the particle trajectories from focal-plane measurements is required. This is achieved through spectrometer optics, using a matrix formalism method that relates measured and target variables. Determining the corresponding transport tensor components demands a dedicated calibration run with a sieve collimator placed in front of the spectrometers entrance.

Since the performance of the calibration directly depends on the sieve geometry, designing it is a nontrivial task. We present a simulation-based optimization approach, which evaluates the sieve pat-

tern based on the quality of the reconstruction.

HK 2.7 Mon 18:15 PHIL C 301

Investigation of initial Antiproton Polarization — •Vincent Verhoeven for the P371-Collaboration — Ruhr-University Bochum — GSI

The preparation of a polarized antiproton beam, useful for experiments aiming at exploring new physics topics, remains a challenge. No simple and efficient polarization method has yet been established. The CERN P371 experiment aims to investigate whether antiprotons produced in a high-energy proton beam collision with an unpolarized solid target are initially polarized. The polarization can be determined by measuring the asymmetry of elastic $\bar{p}p$-scattering with a known analyzing power in the Coulomb-Nuclear Interference region. The experiment was carried out in July and August 2025 using the T11 beam line of the Proton Synchroton in the East Area. As a track reconstruction is required even to determine the number of antiprotons in the beam, the data analysis is challenging and currently ongoing.