HK 10: Hadron Structure and Spectroscopy II

Time: Monday 14:00–15:30 Location: HK-H9

Group Report HK 10.1 Mon 14:00 HK-H9

Experimental Inputs to the Hadronic Light-by-Light Contribution to the Anomalous Magnetic Moment of the Muon from BESIII — •Christoph Florian Redmer, Achim Denig, Nick Effenberger, and Max Lellmann for the BESIII-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Deutschland

Despite being one of the most precisely studied observables in particle physics, there remains a discrepancy of $4.2\,\sigma$ between the average value of the most recent direct measurements and the prediction within the Standard Model of the anomalous magnetic moment of the muon $a_\mu = \frac{(g-2)_\mu}{2}$. The precision of the prediction is limited by the knowledge of the hadronic contributions, which cannot be determined perturbatively, but depend on input from experiments. One of these contributions is the hadronic Light-by-Light scattering, which 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 is 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 data are ideally suited to measure the momentum dependence of transition form factors at space-like momentum transfers of $Q^2 \approx 1\,\mathrm{GeV}^2$, 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.

Group Report HK 10.2 Mon 14:30 HK-H9

Study of exclusive reactions in muon-proton scattering at COMPASS — •Johannes Giarra — on behalf of the COMPASS collaboration - Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Johann-Joachim-Becher-Weg 45, 55099 Mainz

In 2016/17 a measurement of exclusive reactions in the muon-proton scattering was performed in order to determine the cross section of the Deeply Virtual Compton Scattering (DVCS) process and exclusive meson production.
The COMPASS spectrometer is located at the M2 beamline of the CERN SPS, which provides a 160 GeV positively and negatively charged muon beam. The muons were scattered off a 2.5m long liquid hydrogen target. To perform an exclusive measurement of the processes the COMPASS spectrometer was supplemented by an additional electromagnetic calorimeter to increase the acceptance for the detection of large angle photons and a proton recoil detector.
The talk will summarize the current status in the analysis for determining the cross section of the DVCS and the exclusive single π^0 production. A focus will be on a detailed description of the methods and analysis steps used to extract the cross sections. A preliminary result on the t-dependence of the DVCS cross section will be presented.

HK 10.3 Mon 15:00 HK-H9

Measurement of the Proton Radius in High-Energy Elastic Muon-Proton Scattering at AMBER — •Christian Dreisbach 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. The core setup consisting out of silicon tracking detectors up- and downstream of a prototype TPC is studied in a feasibility test measurement in the year 2018 and a pilot run in 2021 under comparable conditions as the proposed measurement. A beam test of a new unified tracking station utilizing scintillating fibers and monolithic pixel-silicon detectors and commissioning of the novel triggerless DAQ system is foreseen in 2022. We present results of the on-going analysis and developments towards a possible setup in 2023.

HK 10.4 Mon 15:15 HK-H9

Radiative corrections to elastic muon-proton scattering — •Norbert Kaiser[1], Yonghui Lin[2], and Ulf-G. Meissner[2] — [1]Physik Department T39, Technische Universität München — [2]HISKP and Bethe Center for Theoretical Physics, Universität Bonn

In support of the upcoming AMBER experiment at CERN to measure the proton charge-radius, the radiative corrections to elastic muon-proton scattering $\mu^\pm p \to \mu^\pm p$ are calculated, keeping the full dependence on the lepton mass. Besides vacuum polarization and the photon-loop form factors $F^\gamma_{1,2}(t)$ of the muon, one has to consider the photon-loop around the proton. The corresponding electric and magnetic form factors $G^\gamma_{E,M}(t)$ consist of infrared-divergent and infrared-finite pieces that are evaluated by including proton structure through electromagnetic form factors (caused by the strong interaction) and the excitation to the $\Delta^+(1232)$-resonance. The same features apply to the computation of the two-photon exchange box-diagrams. It is found that after cancelation of infrared divergences the (soft) photon bremsstrahlung plays a prominent role among the radiative corrections. Therefore, the calculation of bremsstrahlung should be extended beyond the soft photon approximation and adapted to the specific experimental conditions.

This work has been supported in part by DFG (Project-ID 196253076 - TRR 110) and NSFC.