HK 70: Hadron Structure and Spectroscopy IX

Time: Thursday 15:45–17:15 Location: HBR 62: EG 18

Group Report HK 70.1 Thu 15:45 HBR 62: EG 18

Proton charge radius measurement at AMBER — •Martin Hoffmann[1] and the GSI PRM group[2] for the AMBER-Collaboration — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

The AMBER collaboration plans to perform a new precision measurement of the proton electric form factor at low squared four-momentum transfers (Q^2) 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 (TPC) 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 the TPC and a magnetic spectrometer. In this way, the measurement is over-constrained to cleanly select elastic scattering events.

In 2021, the core setup was studied under realistic beam conditions in a pilot run utilizing a prototype TPC and silicon strip detectors. Prototypes of the required tracking detectors and a free-running data acquisition were tested in 2022 and 2023. This talk will present ongoing analyses and an overview of further developments towards the main experiment.

Supported by EU.

HK 70.2 Thu 16:15 HBR 62: EG 18

The Silicon Tracking System of the E16 experiment at J-PARC: commissioning and results from the test beam — •Dairon Rodriguez Garces, Maksym Teklishyn, Adrian Rodriguez Rodriguez, Alberica Toia, Joerg Lehnert, Kazuya Aoki, Rento Yamada, Shuta Ochiai, and Kyoichiro Ozawa for the CBM-Collaboration — GSI. Darmstadt, Germany

The J-PARC E16 experiment has the goal to search for signatures of the spontaneously broken chiral symmetry and its (partial) restoration, through the study in-medium modification of the vector mesons, particularly the phi meson, decaying via di-electron channel, with a high intensity 30 GeV proton beam interacting with C and Cu targets at rates up to 10 MHz. For this purpose, the experiment will use modules constructed using the same technology and procedures as the modules of the Silicon Tracking System (STS) of the CBM experiment.

A total of 10 modules were assembled, tested, characterized and then installed in the E16 detector setup. The detector was commissioned in a beam test experiment at Tsukuba, where the detector modules could be exposed to a 3 GeV electron beam. In preparation for the beam test the modules were characterized and performance studies accomplished to assess the quality of the setup. In the beamtime 3 modules were operated and illuminated in two planes by the electron beam.

This work will show the results of commissioning and operation of the E16 modules, as well as the status of the data analysis and the insights that we have gained from it, in view of the upcoming series production of STS modules for the CBM experiment.

HK 70.3 Thu 16:30 HBR 62: EG 18

Design of a luminosity monitor for the P2 parity violating experiment at MESA — Sebastian Baunack[1], Maarten Boonekamp[2,4], Boris Gläser[1], Rahima Krini[1], Frank Maas[1,2,3], Moran Neher[1], •Tobias Rimke[1], David Rodriguez Pineiro[2], and Malte Wilfert[1] for the P2-Collaboration — [1]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz, Johannes Gutenberg-Universität Mainz — [3]PRISMA Cluster of Excellence, Johannes Gutenberg-Universität Mainz — [4]IRFU, CEA, Université Paris-Saclay, Gif-sur-Yvette, France

The P2 experiment at the future MESA accelerator in Mainz plans to measure the weak mixing angle $\sin^2(\theta_W)$ in parity violating elastic electron-proton scattering. The aim of the experiment is a very precise measurement of the weak mixing angle with an accuracy of 0.14% at a low four-momentum transfer of $Q^2 = 4.5 \cdot 10^{-3}$ GeV^2. In order to achieve this accuracy, it is necessary to monitor the stability of the electron beam and the liquid hydrogen target. Any helicity correlated fluctuation of the target density leads to false asymmetries.

Therefore, it is planned to install a luminosity monitor in forward direction close to the beam axis. The motivation and challenges for designing an air Cherenkov luminosity monitor will be discussed in this talk. Furthermore, I show the current prototype design with results from promising tests run with the electron beam of the MAMI accelerator and detailed simulation studies with the prototype.

HK 70.4 Thu 16:45 HBR 62: EG 18

Scintillating Fiber Hodoscopes for the Proton Radius Measurement at AMBER — Christian Dreisbach[1], •Karl Eichhorn[1], Jan Friedrich[1], Igor Konorov[1], Martin J. Losekamm[1], Stephan Paul[1], and Thomas Poeschl[1,2] for the AMBER-Collaboration — [1]School of Natural Sciences, Technical University of Munich, Garching, Germany — [2]CERN

The AMBER collaboration aims to measure the electric-charge radius of the proton by elastic scattering of high-energy muons on an active hydrogen target at the M2 beamline at CERN's Super Proton Synchrotron. For muon tracking, novel Unified Tracking Stations equipped with silicon pixel detectors in combination with Scintillating Fiber Hodoscopes (SFH) will be used. The SFH consists of 500-μm scintillating-plastic fibers read out with silicon photomultipliers (SiPMs), covering an active area of (9x9) cm^2. We present ongoing studies and results from a test beam experiment performed in 2023 with a detector prototype.

HK 70.5 Thu 17:00 HBR 62: EG 18

A feasibility study for the dark photon search at the BGOOD experiment — •Vlera Hajdini for the BGOOD-Collaboration — Physikalisches Institut, Universität Bonn

Investigating the potential feeble interaction between particles in the Standard Model (SM) and the Dark Matter (DM) sector is a significant frontier in particle physics. One possible manifestation of this feeble interaction is the dark photon, theorized as a vector gauge mediator that interacts very weakly with SM fermions.

The BGOOD photoproduction experiment combines a central electromagnetic calorimeter with a forward spectrometer for charged particle detection. This configuration enables the complete detection of reaction final states such as $\pi^0 p$, ηp, and $2\pi^0 p$. These are well-suited channels for the study of the mass resolution with regard to the dark photon search. The missing mass of the photons from η and π^0 decays were used to determine the mass resolution of the detector. Kinematic fitting techniques are also used to enhance the mass resolution, a critical element for accurate particle identification in high-energy experiments.