Contribution ID: **759**   Type: **Parallel**

A new large-area Micromegas detector and its readout electronics for AMBER experiment at CERN

Tuesday 8 July 2025 09:06 (18 minutes)

The Apparatus for Mesons and Baryon Experimental Research (AMBER, NA66) is a high-energy physics experiment at CERN's M2 beam line, with a broad physics program extending beyond 2032. It includes studies on: antiproton production cross-sections on protons, helium and deuterium; the charge radius of the proton, and Kaon and Pion PDFs via the Drell-Yan process.

As part of medium- and long-term upgrades, aging Multi-Wire Proportional Chambers (MWPCs) will be replaced with Micro-Pattern Gaseous Detectors (MPGD). The replacement technology is the resistive bulk MICRO-MEsh-Gaseous Structure (Micromegas or MM) detector. The MM detector composed of three independent modules will cover an acceptance similar to the present MWPC. The large area of the present MWPC will be covered by three independent micromegas detector modules. Each module has an active area of 1x0.5 m², and together the three modules adjacent modules will cover 1x1.5 m² in total. Each detector has includes two readout planes in a face-to-face configuration enabling XUV coordinate measurements, the cathode cathodes are implemented on a thinner central PCB. For lateral modules A uniform 10 MΩ/sq Diamond-Like Carbon (DLC) resistive layer is applied on top of the readout strips for lateral modules.

The mechanical structure and readout planes have been designed, and the first detector was produced in October 2024. First tests comprising in-beam operation beam tests are currently ongoing both at CERN and in Torino. In parallel, a 64-channel mixed-signal front-end ASIC, named ToRA (Torino Readout for AMBER), is being developed at INFN Torino. It is optimized for time and energy measurements leveraging results from simulations and from earlier tests with Micromegas prototypes and TIGER-based electronics. Current efforts focus on characterizing detector performance, noise behavior, and integration with the ToRA ASIC. Both the detector and readout system developments will be presented.

Secondary track

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Session Classification: T11

Track Classification: T11 - Detectors