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Development of a new large area Micromegas detector and its ToRA-based readout electronics for AMBER experiment at CERN

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In the context of the Physics-Beyond Colliders initiative at CERN, AMBER (NA66) is a fixed-target experiment at M2 beam line of the SPS, devoted to various fundamental QCD measurements. Several upgrades of the spectrometer are planned for the medium and long-term AMBER program. Among the R&D plans, a portion of the COMPASS Multi-Wire Proportional Chambers (MWPCs) will be replaced to address their structural aging. The chosen technology to substitute the most aged MWPCs is the Micro-Pattern Gaseous Detectors (MPGD), specifically a resistive bulk MICRO-MEsh-Gaseous Structure (micromegas) detector. Three adjacent large-area micromegas detectors will cover a total active area of roughly $1 \times 1.5 \text{ m}^2$; each micromegas module having an area of about $1 \times 0.5 \text{ m}^2$. Each module has two readout planes in a face-to-face configuration and a common cathode providing an XUV space measurement. For the lateral modules a uniform $10 \text{ M}\Omega/\text{sq}$ Diamond-Like Carbon (DLC) layer will be deposited above the readout strips, whereas the central module is planned with a double resistive layer configuration.

Currently, both the mechanical structure and the readout planes of the lateral micromegas detector have been designed, and the production of the first module is underway, expected to be ready within the end of September 2024. The first test with TIGER-based front-end electronics is foreseen in October 2024. Leveraging results gained from prior tests, with TIGER based FEs, and relying on the expected signal properties for both Micromegas and Wire chambers, a new 64-channel mixed-signal front-end Application Specific Integrated Circuit (ASIC) for time and energy measurements is under development together with the detector. The ongoing work on the detector and on the front-end electronics based on the new ASIC ToRA (Torino Readout for AMBER), will be presented.

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