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The COMPASS experiment gets its new hybrid GEM-Micromegas pixelized detectors to track high particle flux

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New large size Micromegas gaseous detectors (40x40 cm^2 active area) were developed since 2009 in view of the forthcoming COMPASS new physics programs starting this year, which uses the CERN high intensity muon and hadron beams of a few hundred GeV scattered on thick fixed targets. Compared to previous Micromegas installed in 2001-2002, the new detectors feature a huge reduction of the discharge rate, a major issue for Micromegas at high hadron flux, by a factor of above 100 using the hybrid solution where a pre-amplifying GEM foil is placed 2 mm above the micro-mesh electrode. COMPASS is indeed the first high energy physics experiment using high flux hadron beam to be fully equipped with Micromegas detectors not impacted by discharges. A pixelized read-out was also added in the center of the detector, where the beam is going through and where old detectors were blind, in order to track particles scattered at very low angles. The combination of the hybrid structure, the pixelized central anodes, and an APV-based read-out electronics allows to detect particle flux above 10 MHz/cm^2 with very good detection efficiencies and spatial resolution.

After several years of R&D, 12 detectors and additional spares were built, based on large bulk boards (80x60 cm^2) produced by the ELVIA company in France. The Micromegas-based tracking system was fully equipped with the new hybrid detectors for the Drell-Yan run started in May 2015. During this run the detectors were impacted by an important flux of very low energy hadron particles and neutrons leaked from the hadron absorber placed just after the target. The impact on detector performance is however limited.

A short summary on important results of the R&D will be presented, including the optimization of the printed circuit board design in order to connect a large number of pixels through a limited space. The aspects of the industrialization of the fabrication process of the PCB at ELVIA will also be shown. An overview of the performance of the tracking based on these new hybrid Micromegas detectors in high hadron flux environment will be presented, in particular in term of detection efficiencies, and spatial and time resolutions of the reconstructed particles. The impact of low energy hadron and neutron flux will also be discussed.

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