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PRESTO: Vacuum-compatible, ultra low material budget precursor of the Micro Vertex Detector for the CBM experiment at FAIR

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The Compressed Baryonic Matter Experiment (CBM) is one of the core experiments of the future FAIR facility at Darmstadt/Germany. The fixed-target experiment will explore the phase diagram of strongly interacting matter in the regime of high net baryon densities with numerous probes, among them open charm. The Micro Vertex Detector (MVD) will contribute to the secondary vertex determination on a 10 µm scale, background rejection in dielectron spectroscopy and reconstruction of weak decays. The detector comprises four stations placed at 5, 10, 15 and 20 cm downstream the target and inside vacuum. The stations are populated with highly-granular Monolithic Active Pixel Sensors implemented in the 0.18 µm Jazz/Tower CMOS process. The sensors feature a spatial resolution of <5 µm, a non-ionizing radiation tolerance of >1013 neq/cm², an ionizing radiation tolerance of 3 Mrad and a readout speed of few 10 µs/frame.

In the upcoming Forum in Tracking Detector Mechanics, we would like to focus on presenting a next step w.r.t. mechanical integration, that is the precursor of the quadrant of the third CBM-MVD station, meeting the following requirements: material budget of x/Xo < 0.5 %, vacuum compatibility, double-sided sensor integration, heat evacuation of ˜350 mW/cmˆ2/sensor with temperature gradient of a few K/cm. The precursor (working name: "PRESTO") has been recently assembled and hosts 15 CMOS sensors: nine populated on the front side and six on a back side, respectively. The sensors are the MIMOSA-26 CPS and they were developed at IPHC Strasbourg. The sensors were probe tested prior to populating them on a 380 µm thin Thermal Pyrolytic Graphite (TPG) carrier with a precision better than 30 µm (edge-to-edg) proven during assembly of dummy modules The custom-made, low modulus, low viscosity and radiation-hard glue developed at Rutherford Appleton Laboratory allows a for vacuum-compatible sensor and cable assembly, keeping the material budget as low as possible. After integrating the PRESTO module, our research focused on a full characterization regarding vacuum compatibility and thermal management as well as aspects of metrology, e.g. survey of sensor positions and alignment. We aim at reporting on the PRESTO construction as well as on the first results regarding cooling efficiency, vacuum compatibility and R/O performance.

Summary

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