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A Triple-GEM Detector with Pixel Readout for High-Rate Beam Tracking

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For its physics program with a high-intensity hadron beam of $2 \cdot 10^7$ particles/s, the COMPASS experiment at CERN requires tracking of charged particles scattered by very small angles with respect to the incident beam. While good resolution in time and space is mandatory, the challenge is imposed by the high beam intensity, requiring radiation hard detectors which add very little material to the beam path in order to minimize secondary interactions. To this end, a set of triple-GEM detectors with pixel readout in the beam region and 2-D strip readout in the periphery is being built. The pixel size has been chosen to be $1 \times 1 \text{ mm}^2$, which constitutes a compromise between spatial resolution and number of readout channels. Peripheral to the pixel area, a 2-D strip readout with a pitch of $400 \mu\text{m}$ has been realized on the same printed circuit. In total an active area of $10 \times 10 \text{ cm}^2$ is covered using 2048 readout channels. An analogue readout via the APV25-S1 ASIC has been chosen to profit from amplitude measurements on neighboring strips or pixels during clustering. A detector prototype has been tested successfully in the $5 \cdot 10^7 \mu\text{s}$ COMPASS muon beam, as well as in a focused hadron beam. The design of the detector and first results concerning its performance as a beam tracker will be presented.

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