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A large low-mass GEM detector with zigzag readout strips for forward tracking at EIC

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We present design and first prototyping results for a low-mass Triple-GEM detector for forward tracking at a future Electron-Ion Collider (EIC). In the EIC environment, minimal multiple scattering of tracks must be ensured so that electron tracks can be cleanly matched to calorimeter clusters and so that hadron tracks can efficiently seed RICH ring reconstruction for particle identification. Consequently, the material budget of the forward tracking detectors must be minimized. The trapezoidal detector covers an azimuthal angle of 30.1 degrees and a radius from 8 cm to 103 cm. The construction of the detector builds on the mechanical GEM foil stretching and assembly technique pioneered by CMS for a muon endcap GEM upgrade. As an innovation, the EIC GEM prototype detector has drift and readout electrodes implemented on thin foils instead of on PCBs and omits a backing plate from the design to reduce detector material. The drift and readout foils get stretched mechanically together with three newly designed GEM foils in one stack. This assembly approach also aims at improving the uniformity of drift and induction gap sizes and consequently signal response uniformity. Thin outer frames made from carbon-fiber composite material take up the tension from the stretched stack and provide rigidity to the detector while keeping the detector mass low. The gas volume is closed with aluminized mylar foils. The detector is read out with optimized radial zigzag-strip structures of 1.4 mrad and 4.1 mrad azimuthal pitch that minimize the number of required electronics channels and associated cost while maintaining good spatial resolution below 100 microns. All front-end readout electronics is located at the wide end of the trapezoid.

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