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Construction and Test of a Prototype Chamber for the Upgrade of the ATLAS Muon Spectrometer

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Abstract

The proposed upgrade of the LHC towards luminosities of up to five times the design value of $1 \times 10^{34}\,\mathrm{cm}^{-2}\mathrm{s}^{-1}$ necessitates the replacement of a large number of tracking detectors of the ATLAS muon spectrometer to avoid deterioration of the muon identification efficiency and the momentum measurement at increased background rates.

Based on the standard ATLAS muon precision chambers (6 or 8 layers of Aluminum drift tubes with 30 mm outer diameter), a faster tracking chamber has been developed using drift tubes with a diameter of 15 mm. The four times higher cell density offers improved redundancy and pattern recognition performance. Combined with a shorter maximum drift time of 200 ns, the rate capability of the new chambers is increased by a factor of 7 to about 10 KHz/cm^2, while retaining the excellent spatial resolution of 40 μm.

A full-sized prototype chamber consisting of 1152 tubes arranged in 2×8 layers and covering an area of 1 m^2 has been built to validate the assembly procedure and to test its performance. We present results of measurements at CERN at the Gamma Irradiation Facility (GIF) at high γ radiation rates, and at the H8 beam line with high momentum muons. Measurements of the response of the drift tubes to highly ionizing radiation such as neutrons and protons will also be discussed.