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Design of the FCC-hh Muon Detector and Trigger System

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The design of a muon detector and first-level muon trigger system for the FCC-hh baseline experiment is presented. Drift-tube chambers operated with Ar:CO2 (93:7) gas mixture at 3 bar provide a robust and cost effective solution for precise track point and angle measurement over large areas (about 1200 m2) with the required resolution of better than 50 μm and 70 μrad, respectively. To achieve this precision, only one layer of chambers is needed which, for this purpose, consist of two quadruple-layers of drift tubes separated by a 1 m high spacer frame. The wire positioning accuracy has to be better than 20 μm. This is feasible in mass production with the construction technique developed for the small-diameter Muon Drift Tube (sMDT) chambers used for the upgrade of the ATLAS muon spectrometer at High-Luminosity LHC (HL-LHC). With continuous triggerless readout, the drift-tube chambers also provide a highly selective first-level muon trigger which will be applied in ATLAS at HL-LHC. Each drift-tube chamber is combined with a double layer of thin-gap RPC chambers which provide bunch crossing identification with better than 1 ns time resolution, muon trigger seeds and coordinate measurement along the tubes. A complete layout of this detector technology has been developed for the barrel and endcap regions. The diameter of the aluminum drift tubes varies from 30 mm in the barrel and part of the endcaps to 15 mm in the innermost endcap regions depending on the background rates. The performance determined from detailed simulations is discussed. Prototype chambers are under construction for the ATLAS upgrades and have been tested in the CERN Gamma Irradiation Facility up to background rates well above the ones expected in the muon detector at FCC-hh.

Authors: KORTNER, Oliver (Max-Planck-Institut fur Physik (DE)); KORTNER, Sandra (Max-Planck-Institut fur Physik (DE)); KROHA, Hubert (Max-Planck-Institut fur Physik (DE)); PODKLADKIN, Sergey (Max-Planck-Institut fur Physik (DE)); Dr RICHTER, Robert (Max-Planck Institute for Physics)

Presenter: KORTNER, Oliver (Max-Planck-Institut fur Physik (DE))

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