



Contribution ID: 10

Type: Oral presentation

From gated to continuous readout: the GEM upgrade of the ALICE TPC

Wednesday 24 May 2017 10:10 (20 minutes)

The ALICE Collaboration is planning a major upgrade of its central barrel detectors to be able to cope with the increased LHC luminosity beyond 2019. In order to record at an increased interaction rate of up to 50 kHz in Pb–Pb collisions, the TPC will be operated in an ungated mode with continuous readout. This demands for a replacement of the currently employed gated Multi-Wire Proportional Chambers by GEM-based (Gas Electron Multiplier) readout chambers, while retaining the performance in particular in terms of particle identification capabilities via the measurement of the specific energy loss.

The present baseline solution for the TPC upgrade consists of a stack of four large-size GEM foils as amplification stage. This arrangement, under a specific high-voltage configuration, has been proven to fully meet the design specifications in terms of ion backflow, energy resolution and stable operation under LHC conditions. In order to further guarantee operational stability for the readout chambers during construction, commissioning and final operation in the TPC, a sophisticated quality assurance scheme has been established to thoroughly monitor the quality of the GEM foils throughout the whole production process.

The increase in interaction rate and the requirements of a trigger-less, continuous readout demand for newly developed front-end cards and significant modifications of the computing system and the corresponding calibration, reconstruction and simulation framework.

In this talk, the key aspects of the completed R&D phase will be presented, as well as the current status of the new readout electronics and the computing system. Furthermore, we will present an update on the mass production of the readout chambers.

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Session Classification: Applications at future nuclear and particle physics facilities - 4 (Chair: Kondo Gnanvo)