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Future upgrade and physics perspectives of the ALICE TPC

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The Time Projection Chamber (TPC) is one of the main tracking and PID devices in the central barrel of the ALICE detector at the CERN Large Hadron Collider.

It provides precise charged-particle tracking, momentum measurement, and particle identification in very high multiplicity heavy-ion collisions.

The readout rate of the TPC is currently limited by the necessity to prevent ions from the amplification region of the MWPC-based readout chambers to drift back into the drift volume, which is achieved through active ion gating by operating a dedicated Gating Grid. The relevant ion drift times limit the maximum trigger rate of the TPC to about 3.5 kHz.

In order to make full use of the increase in luminosity after the second long shutdown of the LHC, it is foreseen to operate the detector in an ungated mode with continuous readout.

Therefore the existing MWPC readout will be replaced by a Gas Electron Multiplier (GEM) readout, which provides intrinsic ion capture capability without additional gating.

Furthermore, new readout electronics will be implemented to match the requirements of continuous readout with GEMs.

Together with advanced techniques for online space-charge corrections, the upgrade will enable the detector to perform to specifications at collision rates of up to 50 kHz foreseen for the LHC Pb-Pb program in RUN 3.

After the upgrade of the TPC, the data collection rate of the TPC in Pb-Pb will be increased by about a factor 100

as compared to the present system, which will enable improved measurements to understand heavy quark and quarkonium production, low-mass dielectron production, jets and jet correlations, and the production of exotic hadrons.

In this talk, the expected physics performance and status of the extensive R&D program to reach this ambitious goal will be presented.

On behalf of collaboration:

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