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## A Time Projection Chamber for High-Rate Experiments: Towards an Upgrade of the ALICE TPC

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A Time Projection Chamber (TPC) is a powerful detector for 3-dimensional tracking and particle identification for ultra-high multiplicity events. It is the central tracking device of many experiments, e.g. the ALICE experiment at CERN. The necessity of a switching electrostatic gate, which prevents ions produced in the amplification region of MWPCs from entering the drift volume, however, restricts its application to trigger rates of the order of 1 kHz.

Charge amplification by Gas Electron Multiplier (GEM) foils instead of proportional wires offers an intrinsic suppression of the ion backflow, although not to the same level as a gating grid. Detailed Monte Carlo simulations have shown that the distortions due to residual space charge from back-drifting ions can be limited to a few cm, and thus can be corrected using standard calibration techniques. A prototype GEM-TPC has been built which is the detector with the largest active volume of this kind up to now. It has been commissioned with cosmics and particle beams at the FOPI experiment at GSI, and was employed for a physics measurement with pion beams.

For future operation of the ALICE TPC at the CERN LHC beyond 2019, where Pb-Pb collision rates of 50 kHz are expected, it is planned to replace the existing MWPCs by GEM detectors, operated in a continuous, triggerless readout mode, thus allowing an increase in event rate by a factor of 100. As a first step of the RD program, a prototype of an Inner Readout Chamber was equipped with large-size GEM foils and exposed to beams of protons, pions and electrons from the CERN PS.

In this presentation, new results will be shown concerning ion backflow, spatial and momentum resolution of a GEM-TPC in a running experiment, detector calibration,  $dE/dx$  resolution, and high-rate performance with both detector prototypes. The perspectives of a GEM-TPC for ALICE with continuous readout will be discussed and the expected performance will be presented.

### quote your primary experiment

ALICE

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