# Consolidation and upgrade of the ALICE TPC*

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## Preparation for LHC RUN2

In 2014 the long shutdown period of the LHC ended. Several consolidation activities have been carried out to prepare the ALICE TPC for the upcoming data taking period Run2, which will start in mid 2015. During Run2 much higher collision rates as compared to RunI will be produced. The consolidation activities include the replacement of the Ne-$CO_2$ gas mixture by Ar-$CO_2$ and the installation and commissioning of a new Gas Chromatograph to provide the precise gas composition for online calibration. Several faulty front-end electronics cards have been replaced during the shutdown. A redundant Ethernet networking system has been deployed in order to overcome occasional failures of certain hardware located in the experimental cavern. Finally, the high voltage network has been improved by further segmentation of HV channels and by the addition of a fast current monitoring system, in order to gain better understanding of detector behaviour due to e.g. sudden beam losses.

An ambitious project aimed at improving the read-out scheme and the stability under radiation has been developed during the shutdown. A new Read-out Control Unit (RCU2) will allow one to at least double the maximum data read-out speed by doubling the number of read-out buses as compared to the current implementation. This in turn will allow for doubling the statistics for Physics analysis.

The new board has been designed based on a state-of-the-art FPGA, which integrates an inherently reliable flash-based FPGA fabric, a 166 MHz processor, and high-performance communication interfaces, all on a single chip. Extensive tests, including radiation hardness, have been performed on engineering samples. The upgrade will be implemented during the technical stops in 2015.

## TPC Upgrade with GEMs

The TPC Upgrade [1] for Run3 consists of the replacement of the 72 multi-wire proportional readout chambers by new chambers based on GEM technology, and the replacement of the current front-end electronics by new cards which will allow for trigger-less, continuous readout.

Substantial R&D has been carried out by various groups, including the GSI group at CERN, in order to customise a GEM structure capable to provide excellent tracking and particle identification under the extreme occupancies anticipated in RUN3.

With the found solution, the space-charge density produced by back-drifting ions in the absence of a gating technique is minimised by the arrangement of quadruple GEM stacks with different hole spacings. This configuration has proven to be highly efficient in ion trapping and preserves the particle identification capabilities of the TPC. Moreover, it is robust against the development of discharges.

Figure 1: Experimental setup with two full-size prototypes at the CERN Proton Synchrotron.

The GSI group at CERN has coordinated two test beam campaigns at CERN; one at the Proton Synchrotron, where the d$E$/d$x$ performance of full-size prototypes has been demonstrated, and one at the Super Proton Synchrotron, where the discharge rate under hadronic showers has been confirmed to stay below tolerable limits.

A collaboration-wide effort to design a completely new read-out system has seen substantial progress during 2014. In particular, the new TPC read-out electronics will feature continuous read-out of all events at data rates up to 1 TByte/s. Fast data links to remote read-out units and online processing and compression are also being developed.

## References

[1] ALICE Collaboration, CERN-LHCC-2013-020; ALICE-TDR-016.

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