

Upgrade of the ALICE-TPC read-out electronics

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A large volume (90 m³) Time Projection Chamber (TPC) is exploited at the dedicated heavy ion experiment ALICE ("A Large Ion Colliding Experiment") at CERN LHC as the main tracking detector. Equipped with 557,578 active read-out channels distributed over 4,356 Front-End Cards (FECs) and two endplates of 1.8-5 m in diameter, it is designed to track up to 20,000 particles emerging from a single, head-on PbPb collision. The huge number of active elements together with a fine sampling of the arrival time (960 samples over 96 ns of drift time) results in raw event sizes of about 700 MByte, a number that gets reduced to around 70 MByte for central collisions by sophisticated on detector digital signal processing.

Currently the read-out network is partitioned into 216 independent units, each connected via a 160 MByte/s optical link to the off-detector data acquisition. Extrapolating the experience gathered from $\sqrt{s}=7$ TeV pp collisions, this set-up would allow for reading out minimum bias PbPb collisions at about 300 Hz.

The increasing capabilities of online data reconstruction and selection of interesting events, however, asks for much higher rates. Using state of the art electronics allows to reduce the size of the read-out units such that a significantly higher read-out network density can be achieved. The planned upgrade consists of 4,356 interface cards that establish a high speed serial connection between FECs and about 500 concentrator nodes. The latter provide the link to the trigger and data acquisition systems as well as to the detector control system. To connect to this "outside world" the backend is targeting the "versatile link", the radiation hard link tailored to LHC experiments, which is currently developed at CERN.

The current read-out is reviewed with focus on limiting factors that are addressed by the upgrade. Studies from first prototypes, theoretical considerations and a detailed planning for the upgrade are presented and put in context with the current LHC and ALICE planning. Emphasis is also given to the decision to use the versatile link - making the TPC one of its first large-scale users.

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