Offline Signal Tail-Correction for the ALICE TPC*

M. Arslandok[1], *H. Appelshäuser*[1], *M. Ivanov*[2] *for the ALICE Collaboration*
[1]Institut für Kernphysik (IKF), Goethe-Universität, Frankfurt; [2]GSI, Darmstadt

The ALICE Time Projection Chamber (TPC) is the main tracking and particle identification (PID) detector of ALICE at the CERN-LHC [1]. It was designed for multiplicities of up to 20,000 primary and secondary charged particles emerging from a single central Pb-Pb collision. The PID in the TPC is calculated from the specific energy loss measurement (dE/dx), which is derived from the pulse height distribution of charged particle tracks measured along 159 read-out planes. The signals from the Multi Wire Proportional Chambers (MWPC) show a characteristic long undershoot after the signal, which is due to the long ion drift times in the MWPC amplification region. Such an ion tail may lead to a loss of signal amplitude for the following signals on the same readout pad. Eventually this results in a deterioration of the dE/dx resolution, in particular in the high multiplicity environment of Pb-Pb collisions. Therefore, it was aimed to improve the dE/dx resolution and thus the PID quality via an offline correction.

Signal-Tail Shape Studies

In order to investigate the raw signal shape, the TPC Laser System was used. It generates 336 straight laser tracks similar to ionising particle tracks, at known positions in the drift volume of the TPC.

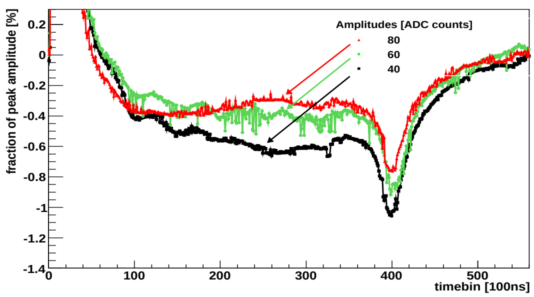

Figure 1: Side pad time response functions for different signal amplitudes.

Several dedicated laser runs with different anode voltage settings were taken. Analysis of these data allowed us to draw the following conclusions;

- The lower anode voltage settings lead to a slower drift of ions in the amplification region which results in a longer ion tail along the time direction.
- The shape of the time response function depends on the relative position of the pad with respect to the cluster position.
- The central pad of a cluster does not show a dependency of the shape on the signal amplitude, while neighbouring pads (side pads) do.

Fig.1 illustrates the amplitude dependence of the side pad time response function, where the x-axis is the length of the ion tail in units of timebins [100ns] and the y-axis shows the amplitude relative to the peak amplitude of the signal in percent.

Offline Signal Tail-Correction

The two readout planes of TPC are composed of 18 sectors each having 159 radial pad rows. For each row in a sector the signals are clusterized into matrices of 5×5 *pad*×*timebin*. The dE/dx calculation is based on either Q_{tot} or Q_{max} of the clusters, where Q_{tot} is defined as the sum of all charge and Q_{max} is the charge at the centre bin of a cluster. In the offline correction procedure it is tried to recover the loss in Q_{tot} and Q_{max} of the clusters later in time.

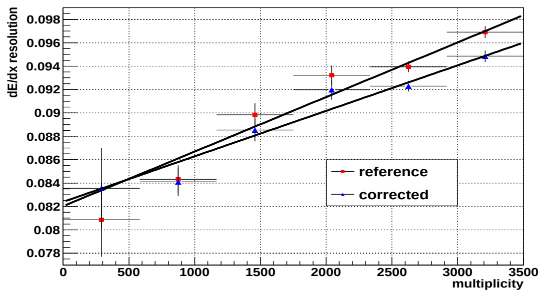

Figure 2: dE/dx resolution for different multiplicity bins.

For this, several pad time response functions were produced from laser tracks, in order to be used for different running conditions. A row by row algorithm was applied iteratively along the drift time from the earliest to the latest cluster read out. Fig.2 shows the first results (with relatively low statistics) of the improvement in the dE/dx resolution for different multiplicity bins. The method will be tested with higher statistics and applied to the Pb-Pb collision data sets taken in 2010 and 2011.

References

[1] ALICE TPC Collaboration, Nucl. Instr. Meth. A622, 316-367, (2010); arxiv.org/abs/1001.1950.

* Work supported by GSI, BMBF, HGS-HIRe, and Helmholtz Alliance HA216/EMMI