Position resolution with prototypes for the ALICE TRD

A. Andronic[1], H. Appelshäuser[2], C. Blume[1], P. Braun-Munzinger[1], D. Bucher[3], O. Busch[1], A. Castillo Ramirez[1], G. Cătănescu[4], M. Ciobanu[4], H. Daues[1], A. Devismes[1], C. Garabatos[1], N. Herrmann[2], M. Ivanov[1], T. Lister[3], T. Mahmoud[2], T. Peitzmann[3], M. Petrovici[4], K. Reygers[3], R. Santo[3], R. Schicker[2], S. Sedykh[1], R.S. Simon[1], J. Stachel[2], H. Stelzer[1], G. Tsiledakis[1], B. Vulpescu[2], J. Wessels[2], O. Winkelmann[3], B. Windelband[2], C. Xu[2]
[1]GSI Darmstadt, [2]Universität Heidelberg, [3]Universität Münster, [4]NIPNE Bucharest (for the ALICE Collaboration)

In addition to electron identification [1], an important aspect of the performance of the ALICE Transition Radiation Detector (TRD) is its capability to provide a trigger for high momentum electrons [2]. A good position resolution of the drift chamber (DC) of about 400 μm is necessary in oder to achieve the challenging tasks of the TRD trigger [2].

We present results on the position reconstruction performance using a single drift chamber with chevron pad readout, tested using pion and electron beams of 1 GeV/c at GSI. The drift region of 3 cm is sampled in 14 time bins of 100 ns each. The displacement along the anode wire direction is calculated for each time bin using a center of gravity method. The angle of incidence with respect to the drift field, α, is extracted from a straight line fit of the displacements as a function of drift time. This reconstructed angle is biased by the Landau fluctuations of the energy deposit along the track. We use two methods to correct the data: i) the correlation of the reconstructed angle with the drift time position of the average signal, $t_{\langle Q\rangle}$; ii) a tail cancellation (TC) algorithm.

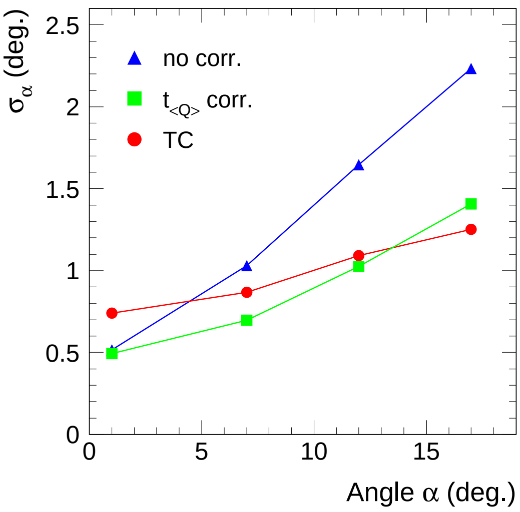

Figure 1: Angular resolution as a function of the incident angle.

In Fig. 1 we present the angular resolution, σ_α, as a function of the incident angle. The uncorrected data (triangles) are compared to the values with the $t_{\langle Q\rangle}$ correction (squares) and with the tail cancellation (dots). Both methods improve the angular resolution drastically and in addition remove the strong dependence of the angular resolution on the incident angle exhibited by the uncorrected values.

In Fig. 2 we show the point resolution, σ_R (variance of the residuals of the fit) and the angular resolution, σ_α, as a function of signal-to-noise ratio, S/N, at the incident angle of 17°. The different methods discussed above are compared. The dashed line in the upper panel is a $1/\sqrt{S/N}$ function, arbitrarily normalized. In the lower panel, the dashed and the dotted curves are the expected angular resolutions derived from the point resolutions under the assumption of 14 and 8 independent fit points, respectively.

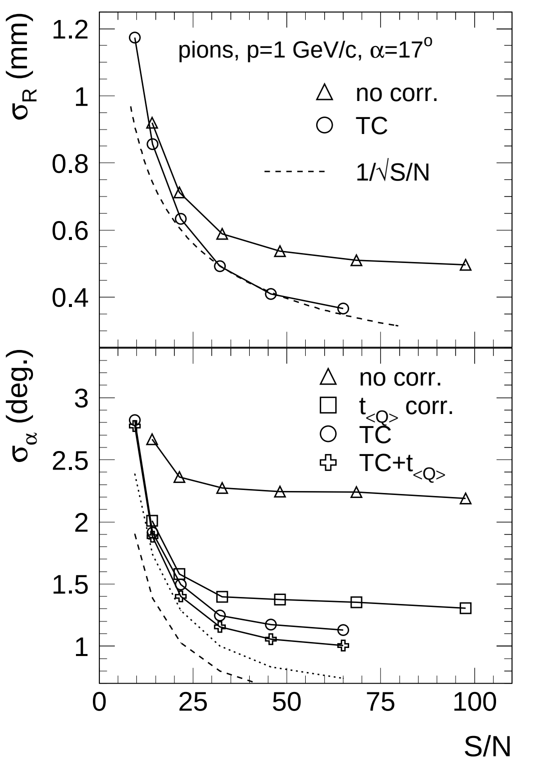

Figure 2: Position resolution as a function of signal-to-noise ratio, S/N. Upper panel: point resolutions, lower panel: angular resolution. The different methods are discussed in the text.

Obviously, the $t_{\langle Q\rangle}$ correction cannot improve the point resolution, but improves only the angular resolution. The crosses in the lower panel indicate the case of tail cancellation to which an additional $t_{\langle Q\rangle}$ correction is applied. One can notice that the saturation towards large values of S/N is different for the various cases presented. The corrected values have a more pronounced dependence of S/N, as expected after removing the systematic contributions.

References

[1] A. Andronic et al., IEEE Trans. Nucl. Sc., vol. 48, 1259 (2001) [nucl-ex/0102017]

[2] ALICE TRD Technical Design Report, CERN/LHCC 2001-021 (2001), *http://www.gsi.de/∼alice/trdtdr*