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Particle Identification in ALICE TPC

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Abstract

The particle identification based on the dE/dx measurements in ALICE TPC is discussed. The particle ID efficiency and the contamination are shown. The identified particle spectra are presented for the inclusive sample. Also, the event-by-event spectra are discussed.

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1 Introduction

The ALICE TPC has been designed not only as the main tracker, but also should provide the particle ID using the dE/dx information. In [1] the dE/dx resolution has been obtained and the separation power for different particle species has been determined. In this note the particle ID by dE/dx and the identified particle spectra are discussed in details.

2 Simulations

The TPC data have been simulated using the GALICE [2] package with the Slow Simulator [3] incorporated. The SHAKER [4] event generator with $dN/dy = 8000$ at midrapidity has been used. The dE/dx for a given track has been obtained as the truncated mean. In Fig. 1 the dE/dx resolution for

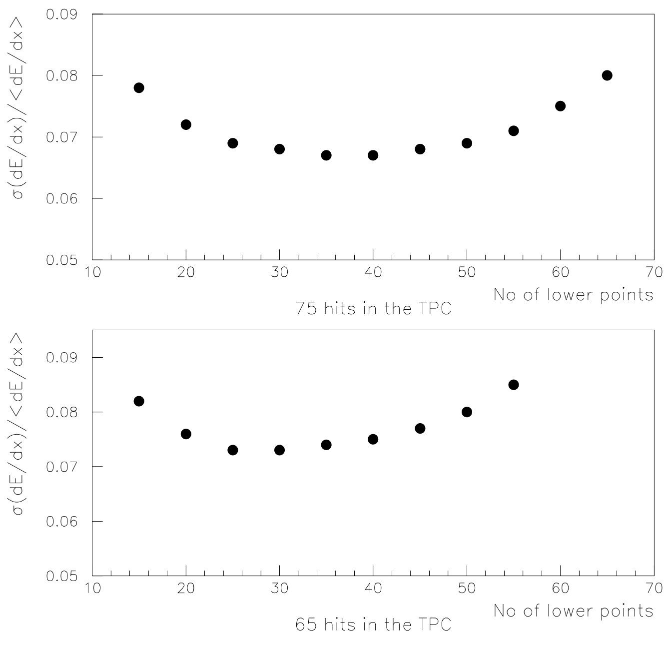

Figure 1: dE/dx resolution as a function of number of accepted points for different numbers of TPC hits.

different truncation and different number of TPC hits is shown. For further studies it has been assumed $\sigma_{dE/dx} = 7\%$ for 75 TPC hits and $\sigma_{dE/dx} = 8\%$ for 65 TPC hits. This takes into account the deterioration of the dE/dx resolution in the regions of a high track density. In Fig. 2 the energy loss as a function of the total momentum is presented, assuming $\sigma_{dE/dx} = 7\%$. It is

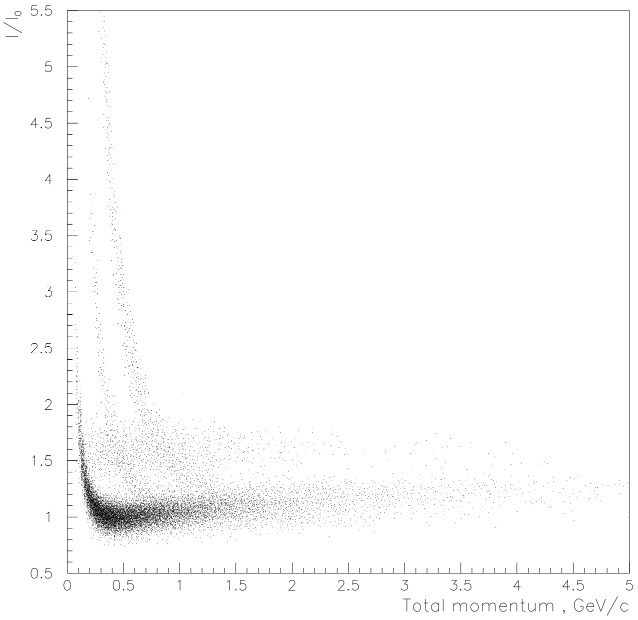

Figure 2: Energy loss as a function of the total momentum in ALICE TPC. The dE/dx resolution is assumed to be 7%.

seen, as expected, that the ALICE TPC can offer the PID for electrons below 5 GeV/c, while for hadrons it is restricted to the low momentum, below 600–800 MeV/c. It should be stressed that electrons from the γ-conversions, as the non-vertex tracks, can be rejected at the tracking stage. In this analysis they were not taken into account.

3 Results

In Fig. 3 the particle identification efficiency as well as the contamination is shown. It is assumed that the particle trajectory reaches the 75th pad row. Losses due to particle decays and secondary interactions are taken into account. In this analysis the contamination should be understood in the following way: any particle is taken as misidentified if its unambiguously determined ID is different from the true one. It means that the ambiguities like p/K, π/K etc. are not taken into account.

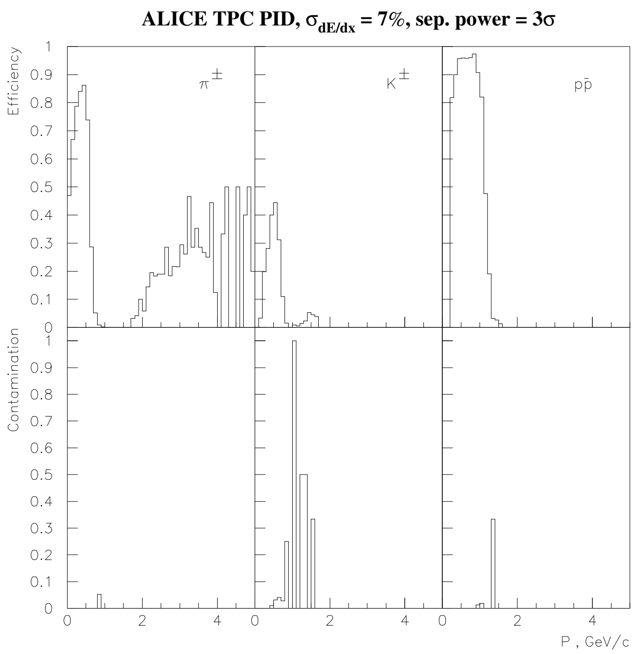

Figure 3: Particle ID efficiency and the contamination as a function of the total momentum in ALICE TPC. The dE/dx resolution is assumed to be 7%.

particle ID	vertex	identified
π	5.5 ± 0.03	5.55 ± 0.03
K	5.1 ± 0.3	4.7 ± 0.3
p	4.8 ± 0.3	4.7 ± 0.3

Table 1: Slopes of inclusive spectra of identified particles. The $1/m_t\, dN/dm_t$ distribution was fitted with an exponent.

3.1 Inclusive spectra

In Table 1 slopes of the inclusive transverse mass spectra of identified particles are presented. Due to the limited efficiency and, as in the case of kaons and protons, limited statistics, the analysis has been restricted to a certain part of the phase-space. The following y–p_t cuts have been applied:

- for pions: $-0.8 < y < 0.8,\ 0.1 < p_t < 0.5$ GeV/c
- for kaons: $-0.5 < y < 0.5,\ 0.2 < p_t < 0.6$ GeV/c
- for protons: $-0.4 < y < 0.4,\ 0.3 < p_t < 1.0$ GeV/c

Rather good agreement between vertex particles and identified particles spectra is seen.

3.2 Event-by-Event spectra

Due to the limited statistics and not very high efficiency, the EbyE spectra have been obtained only for pions. In Fig. 4 the m_t spectra obtained for identified pions for 10 central SHAKER [4] events are compared with those for vertex particles. The agreement is rather satisfactory.

4 Summary

The efficiency of the particle ID in ALICE TPC have been discussed. It has been shown that the inclusive spectra of the identified pions, kaons and protons can be obtained, while the event-by-event analysis is restricted only to pions.

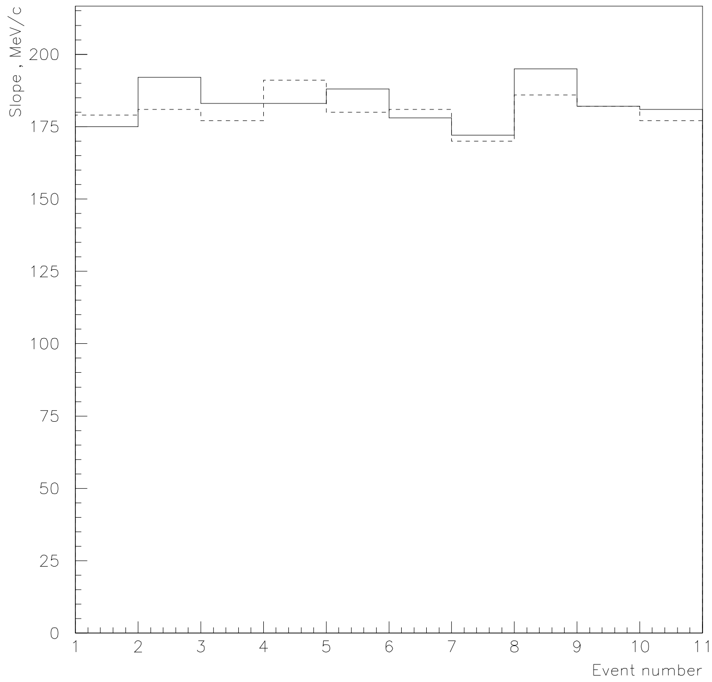

Figure 4: Slopes of the pions m_t spectra, event-by-event. Solid line indicates results for vertex particles, dashed one - for reconstructed ones.

5 Acknowledgements

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References

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