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Measurement of identified charged hadron spectra with ALICE using the ITS in proton-proton collisions at the LHC

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Abstract. The method used by ALICE to measure identified charged hadron spectra in the Inner Tracking System (ITS) is presented. The analysis results are compared with measurements using the Time Projection Chamber and Time-of-Flight detector at larger transverse momentum.

1. Introduction

The measurement of identified charged hadron spectra is among the first measurements that are performed with the ALICE experiment in proton-proton collisions at $\sqrt{s} = 900$ GeV collected in 2009. The results provide basic insights into particle production processes. They also give the possibility to test and tune commonly used event generators at LHC energies. In addition, they are the baseline for measurements in heavy-ion collisions.

The ALICE experiment features multiple particle identification systems, including: the Time Projection Chamber (TPC), the Inner Tracking System (ITS), a dedicated time-of-flight system (TOF) and a Ring-imaging Cherenkov detector. With these detector systems, ALICE can identify charged hadrons in the momentum range from 100 MeV/ c up to 5 GeV/ c . More details about the ALICE experiment can be found in [1, 2, 3].

The ITS is the detector of ALICE placed closest to the interaction point. It is built out of three subdetectors. Each subdetector contains two concentric silicon layers. The innermost part of the ITS is the SPD (Silicon Pixel Detector), the middle part is the SDD (Silicon Drift Detector) and the outer one is the SSD (Silicon Strip Detector). The ITS provides high resolution tracking for the identification of secondary vertices of heavy flavour weak decays and improved momentum resolution at high transverse momentum (p_T). In addition, the ITS is used for standalone tracking to measure tracks at very low p_T which do not reach the TPC.

The measurement of the identified charged hadron spectra in the ITS is based on particle energy loss in 4 (SSD and SDD) out of 6 silicon layers. This measurement is performed for global tracks (TPC+ITS) and for ITS standalone tracks. Global tracks are reconstructed using information from the TPC, the ITS and other ALICE tracking detectors (e.g TOF). Standalone tracks are reconstructed using only information from the ITS (6 layers). The p_T spectra obtained from both methods are compared to p_T spectra obtained from the TPC and the TOF.

Before the p+p data taking in 2009, the ITS was aligned using the cosmic ray data collected by ALICE in 2008. The corresponding procedure is described in [4]. The status of the ITS

energy loss calibration for 2009 data is shown in Figures 1 and 2. The SDD was calibrated at the module level in 2009. For the SSD, which has more modules than the SDD, the amount of collected data was not sufficient to perform the calibration at the module level. As can be seen from Figure 2, the module to module fluctuations of the most probable value of the charge deposition are at the per cent level, which is small compared to the intrinsic resolution.

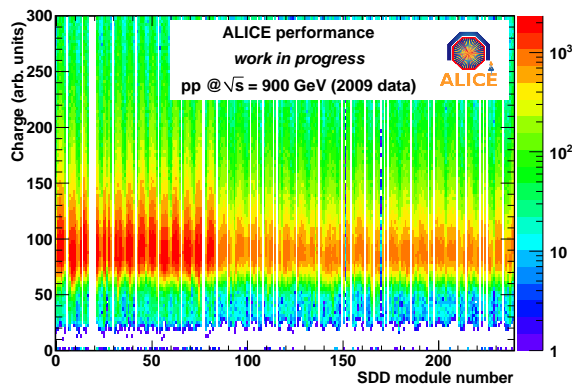


Figure 1. The SDD calibration in 2009 data. Distribution of measured cluster charge per unit path length in each module of the SDD.

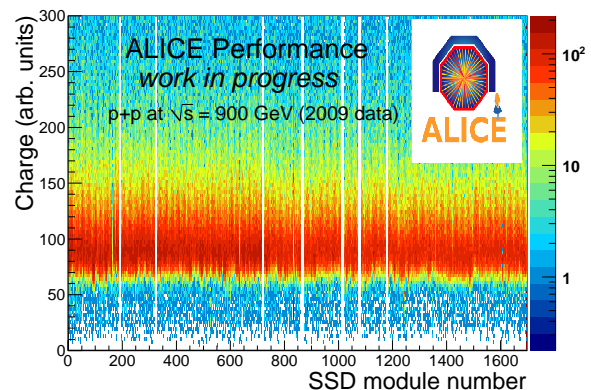


Figure 2. The SSD calibration in 2009 data. Distribution of measured cluster charge per unit path length in each module of the SSD.

2. Particle identification in the ITS

Only tracks with 3 or 4 measured points in the SDD and SSD are used in the analysis. The charge deposit measured in each layer is normalised to the energy loss per 300 μm (thickness of the SDD and SSD modules) of silicon using the local track angles as reconstructed by the tracking algorithm. A truncated mean is calculated using the two lowest normalised charge signals. Figure 3 shows the measured energy loss signal in the ITS (value of the truncated mean) as function of the total momentum for global tracks, compared to the parametrized response for pions, kaons and protons (black lines). This parametrization is based on a formula from [5], with an additional polynomial correction for the low momentum part.

For each track fulfilling the track quality requirements, the rapidity is calculated using three different mass hypotheses: pion, kaon and proton. Tracks with $|y| < 0.5$ are selected. For each mass hypothesis in all p_t bins, a histogram is filled with the difference between the logarithm of the measured energy loss signal in the ITS and the expected value calculated using the parametrization $\ln[dE/dx]_{\text{meas}} - \ln[dE/dx]_{\text{calc}}$. This procedure gives a series of three histograms for each charged particle in all p_t bins. Each histogram has one, two or three maxima depending on the momentum. Figure 4 shows an example of these distributions for the kaon mass hypothesis. The area below the peak centered at zero is the raw yield of particles from the mass hypothesis in the given p_t bin. The raw yield is determined by fitting the histograms with the function show in Figure 4: a sum of three asymmetric Gaussians for the ITS standalone analysis and a sum of a Gaussian with an exponential tail and the tail of the peak at lower dE/dx for the TPC+ITS analysis. The raw yield is then corrected for the contamination from secondary particles (products of weak decays and particles coming from interactions with the detector material) and the efficiency. Pions are also corrected for the contamination of electrons and muons which can not be distinguished from pions based on the measured energy loss signal in the ITS. All corrections are calculated from the simulation using the PYTHIA 6.4 event generator [6] (tune D6T) [7] and GEANT3 [8]. The contamination corrections will be calculated

from the data for the final result.

Figure 5 shows the efficiencies for both analyses. The standalone analysis has a larger efficiency at low p_t , where tracks do not reach the TPC. In addition, the efficiency for kaons is larger over the full p_t range, because the combined tracking rejects a large fraction of the kaons that decay inside the TPC.

The final result is compared to spectra measured in the TPC and the TOF. This is shown in Figure 6.

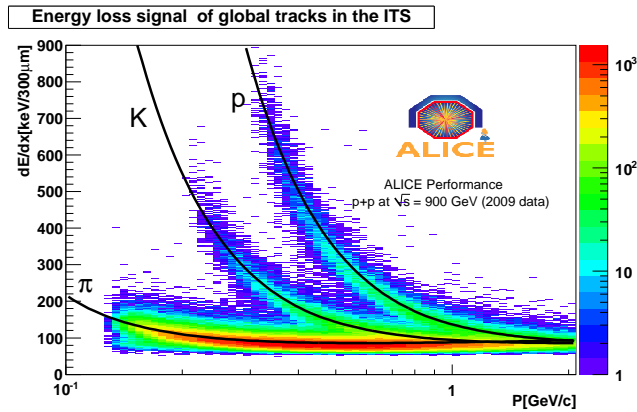


Figure 3. Energy loss signal as a function of momentum for global tracks. The solid lines show the expected signal for pions, kaons and protons.

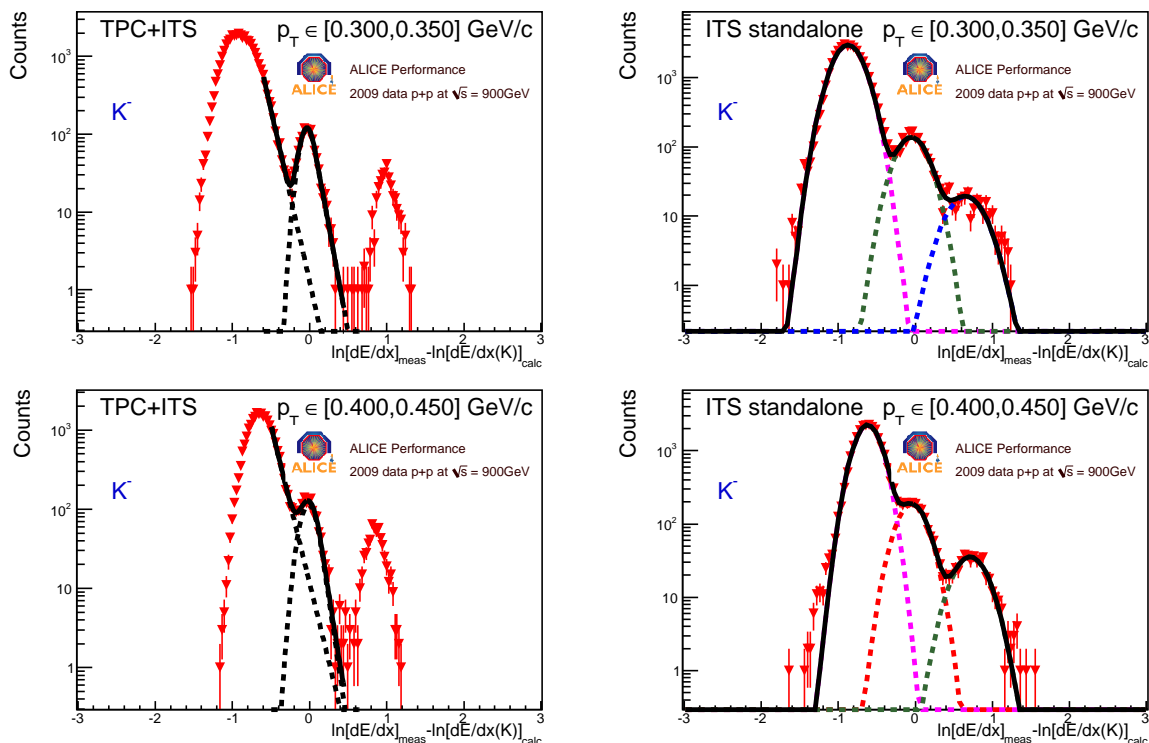


Figure 4. Distributions of the difference between the logarithm of the measured energy loss signal in the ITS and the expected value for Kaon, for a global (TPC+ITS, left) and a standalone (right) track sample. The solid curves show the fit used to determine the raw yield of Kaons.

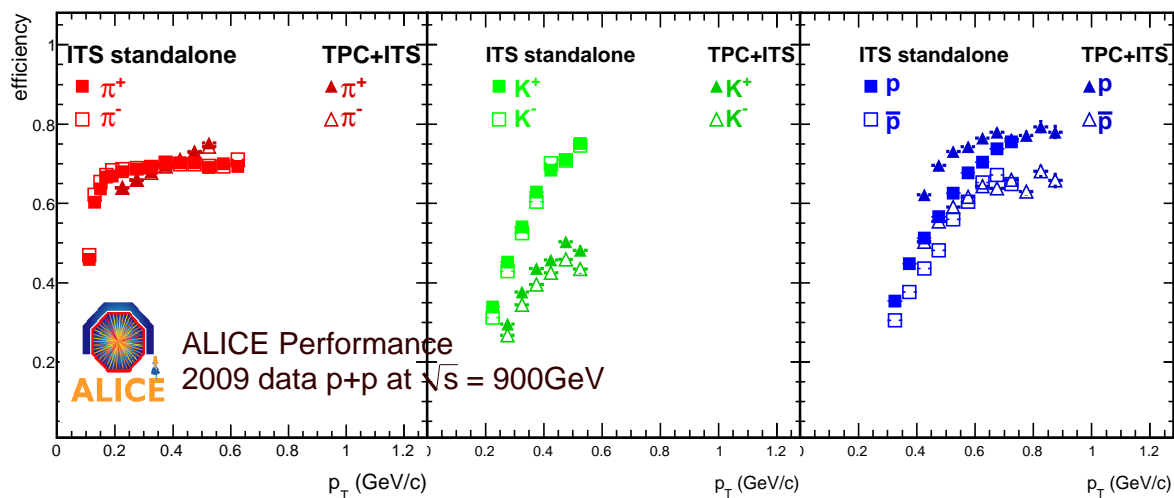


Figure 5. Efficiency as function of p_t of global (TPC+ITS) and standalone tracks for each particle species.

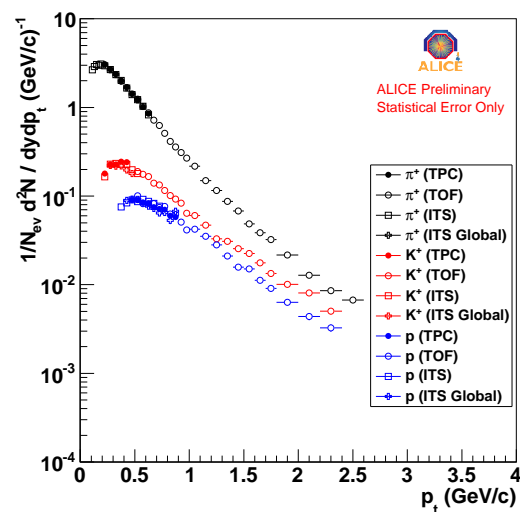


Figure 6. Transverse momentum spectra of identified positive hadrons in p+p collisions at 900 GeV measured in different ALICE detectors. Two ITS spectra are shown: a standalone (ITS) and a global (ITS Global)

3. Summary

The identified charged hadron spectra measured in the ITS are in a good agreement with the measurements performed in other ALICE detectors.

References

- [1] B. Alessandro *et al.* [ALICE Collaboration], *J. Phys. G* **32** (2006) 1295
- [2] F. Carminati *et al.* [ALICE Collaboration], *J. Phys. G* **30** (2004) 1517
- [3] K. Aamodt *et al.* [ALICE Collaboration], *JINST* **3** (2008) S08002
- [4] K. Aamodt *et al.* [ALICE Collaboration], *JINST* **5** (2010) P03003
- [5] B.B. Back *et al.* [PHOBOS Collaboration], *Phys. Rev. C* **75** 2007 024910
- [6] T.Sjostrand, S.Mrenna, P.Z Skands, *JHEP* **05**, 026 2006, hep-ph/0603175
- [7] M.G Albrow *et al.*, (Tev4LHC QCD Working group), arXiv:hep-ph/0610012
- [8] R.Brun, F. Carminati, S. Giani CERN-W5013