Hunting electrons from heavy flavour hadron decays with the ALICE Transition Radiation Detector in proton-proton collisions at $\sqrt{s}$ = 7 TeV

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Introduction

Heavy flavour measurements in proton-proton collisions are a good test of pQCD and provide the reference for heavy-ion collisions. Due to the large excess of Signal over electrons from background sources at high p_T, the semi-leptonic decay-channels are a good tool for heavy flavour studies.
The Transition Radiaton Detector provides a significant contribution to the electron identification and helps to extend the measurement towards higher transverse momenta. In this analysis the Transition Radiation Detector is used in addition to the Time-Of-Flight Detector and the Time Projection Chamber [1]. This method is complementary to the analysis with TPC and EMCal presented in [2].

The ALICE Transition Radiation Detector

TRD geometry in 2010

In the taking period 2010 7 out of 18 supermodules were installed, covering covering |η|<0.9 respectively 340° < φ < 40° and 140° < φ < 220°

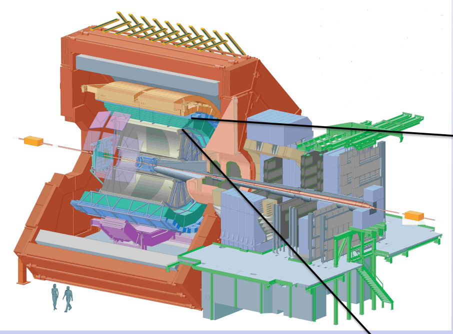

Fig. 1: The ALICE setup

TRD in numbers

- 18 Supermodules (φ)
- 5 Stacks (z)
- 6 Layers (r)

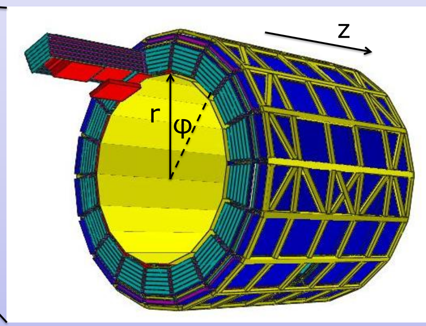

Fig. 2: Overview of the ALICE TRD. A cylindrical coordinate system is applied.

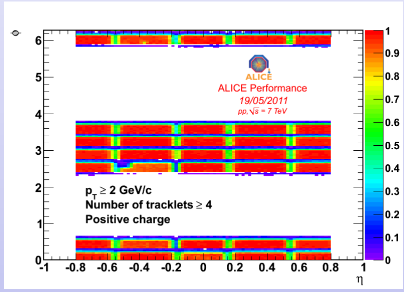

Fig. 3: TRD fiducial volume for the running period 2010 for positive charged tracks. The figure shows all stacks with at least 4 chambers providing signal. Additional loss of acceptance by 12% when requiring 5 chambers

Particle IDentification with the TRD

Signal in the TRD

TRD measures charge deposit in up to 6 chambers for a track. The charge deposit contains energy loss due to ionization for pions and additionally absorption of transition radiation photons in the driftgas. A higher charge is measured for electrons than for pions.

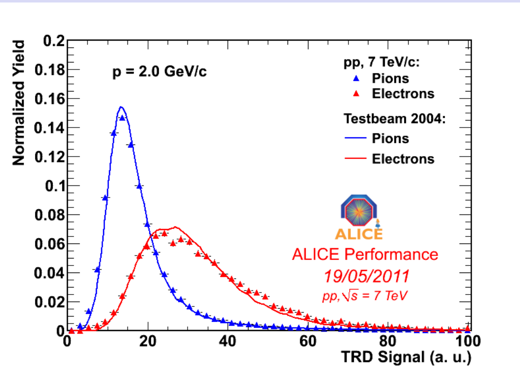

Fig. 4: Charge deposit for a track segment in a chamber, called tracklet, for electrons (red) and pions (blue). A higher average charge deposit is measured for electrons, also due to the absorption of transition radiation photons in the drift gas. The charge deposit distributions from data are in good agreement with the distributions from testbeam measurements

Rejection of Pions

For each track likelihood values for electrons respectively pions are calculated by comparing the measured charge deposit in the TRD to reference distributions from testbeam measurements. Pions are rejected in the TRD by applying a momentum-dependent cut on the likelihood value for electrons which provides a requested electron efficiency. The cut was tuned studying a clean reference sample of electrons from photon conversions.

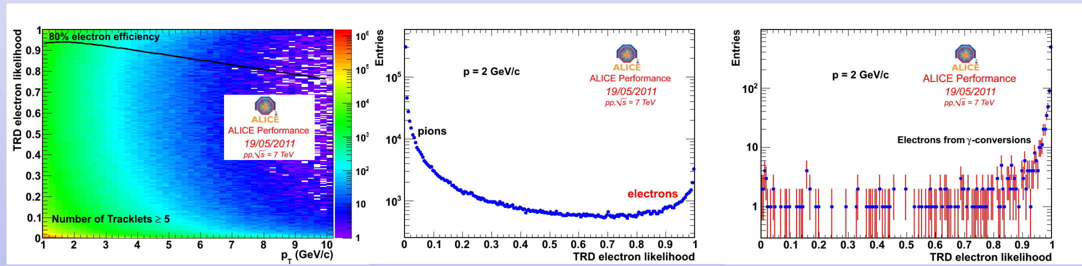

Fig. 5: TRD electron likelihood distribution for electrons and pions as function of p (left), for p = 2 GeV/c (middle) for electron candidates (after TOF) and for electrons from photon conversions at 2 GeV/c (right). A cut providing 80% electron efficiency for all tracks which have at least 5 tracklets in the TRD is applied

Efficiency and Performance

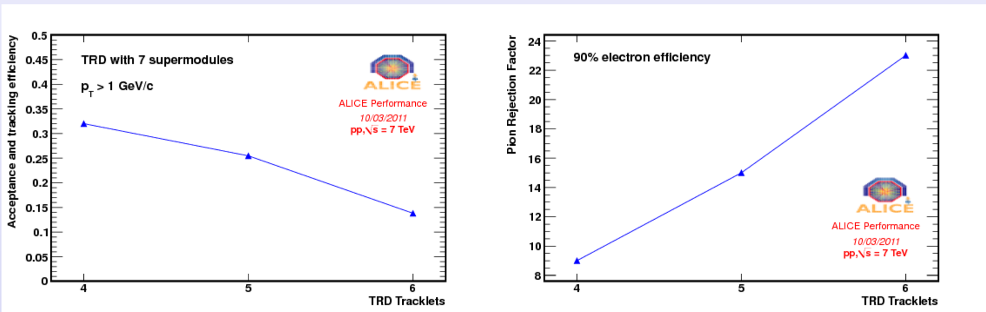

Fig. 6: Integrated tracking efficiency and acceptance above 2 GeV/c (left) and pion rejection factor (right) as function of the number of tracklets

Tracking efficiency and acceptance depend on the requirement on the number of tracklets. However these also influences the rejection power. A requirement of 5 tracklets and 80% electron efficiency was applied since it provides the optimal compromise between purity and acceptance.

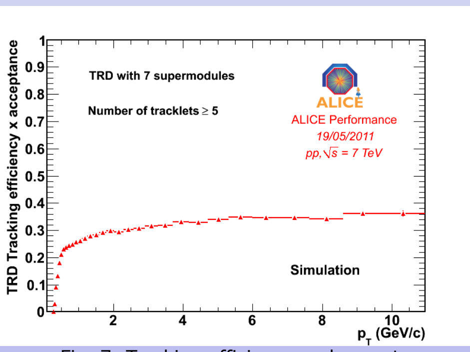

Fig. 7: Tracking efficiency and acceptance as function of p_T when requiring at least 5 tracklets

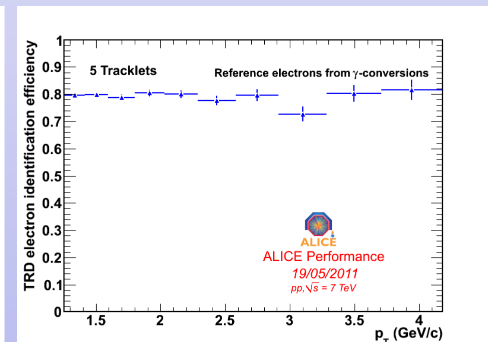

Fig. 8: Electron identification efficiency as function of momentum up to 4 GeV/c derived using a clean sample of electrons from photon conversions

Results

The inclusive electron spectrum is compared to the electron cocktail containing background from different sources

- γ-conversions
- Dalitz-decays of light mesons
- dielectron decay of vector mesons
- direct radiation

Systematic errors are evaluated by varying the electron selection cuts. A systematic error of 10% is assigned to the electron identification in the TRD. The heavy flavour electron spectrum is derived by subtracting the cocktail from the inclusive electron spectrum. A good agreement to FONLL [3] predictions can be observed

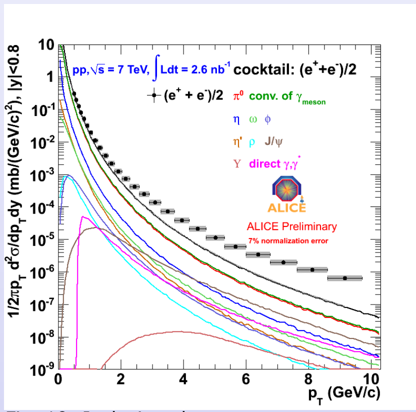

Fig. 10: Inclusive electron spectrum compared to the cocktail of electrons from various sources

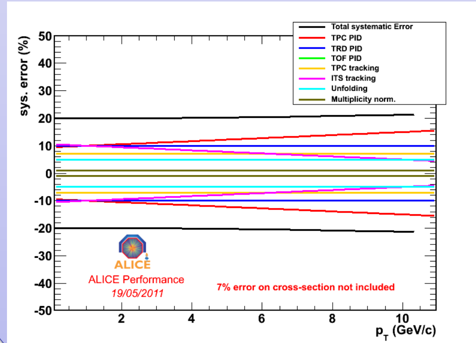

Fig. 9: Systematic errors for different cuts applied in the analysis.

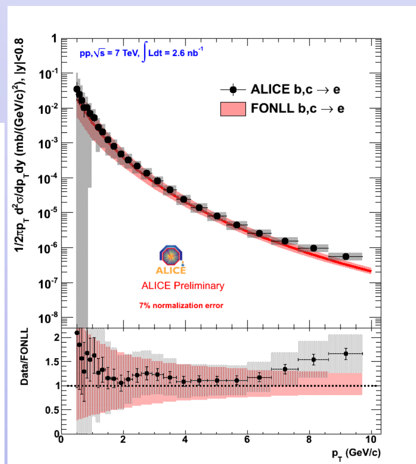

Fig. 11: Heavy flavour electron spectrum compared to FONLL predictions

References

[1] S. Masciocchi, Quark Matter 2011, Talk, ID 509
[2] S. Sakai, Quark Matter 2011, Poster, ID 604
[3] Cacciari, Greco, Nason, JHEP05(1998)007

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