

Measurement of electrons from semi-leptonic heavy-flavour hadron decays in proton-proton collisions at $\sqrt{s} = 7$ TeV with ALICE

Markus Fasel on behalf of the ALICE-Collaboration

Research Division and ExtreMe Matter Institute, GSI Helmholtzzentrum für Schwerionenforschung, Planckstraße 1, 64219 Darmstadt



ALICE
A JOURNEY OF DISCOVERY



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Introduction

Heavy-flavour measurements in pp collisions

- Test for perturbative QCD
- Reference for Pb-Pb collisions

Why electrons?

- Complementary to measurements in hadronic and semi-muonic channels
- Large branching ratios
- Measurement possible down to low p_t
- Large Signal/Background ratio at high p_t

Branching ratios:

- $c \rightarrow e$: $\approx 9.6\%$
- $b \rightarrow e$: $\approx 10\%$
- $b \rightarrow c \rightarrow e$: $\approx 11\%$

Selection of electrons

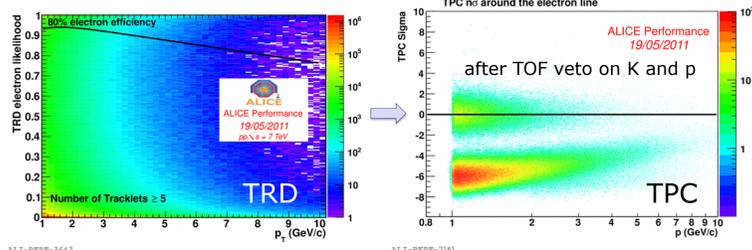
Two complementary analyses

"TOF-TRD-TPC"

TOF: Rejection of kaons (below 1.5 GeV/c) and protons (below 3 GeV/c) using time-of-flight information

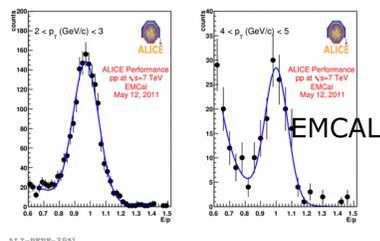
TRD: Suppression of pions based on a threshold providing constant efficiency

TPC: Selection of electrons using dE/dx versus p



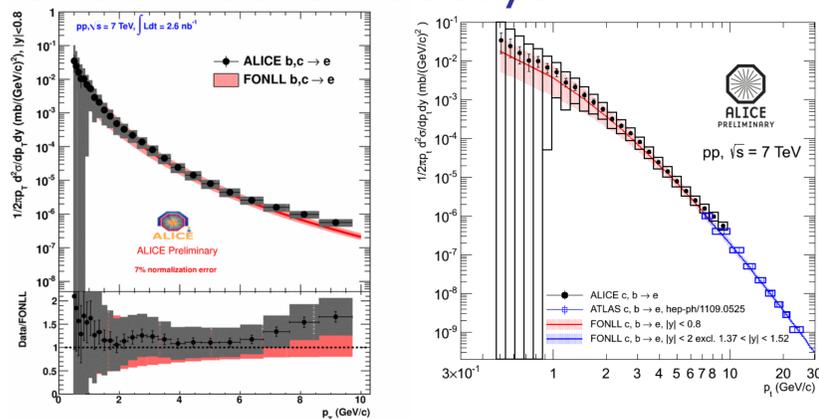
"TPC-EMCAL"

EMCAL: Selection of electrons using cuts on energy over momentum



⇒ Correction for acceptance and efficiency

p_t spectrum of electrons from heavy-flavour hadron decays



p_t differential cross section of electrons from heavy-flavour hadron decays in good agreement with FONLL [2] pQCD calculation
ALICE and ATLAS [3] results are consistent within the uncertainties.
Combining the measurements allows to cover a wide p_t -range. A unique coverage is provided by ALICE at low p_t

Pb-Pb analysis

The analysis of electrons from charm and bottom hadron decays provided a measurement of the nuclear modification factor R_{AA} . A suppression is seen in the most central collisions. The analysis of the electrons from bottom hadron decays is ongoing.

A Large Ion Collider Experiment

TOF

- Rejection of kaons and protons
- Coverage in φ : 2π
- Coverage in η : $|\eta| < 0.9$

ITS

- Inner tracking
- Vertex reconstruction
- Coverage in φ : 2π
- Coverage in η : $|\eta| < 0.9$

TPC

- Track reconstruction
- Electron selection
- Coverage in φ : 2π
- Coverage in η : $|\eta| < 0.9$

TRD

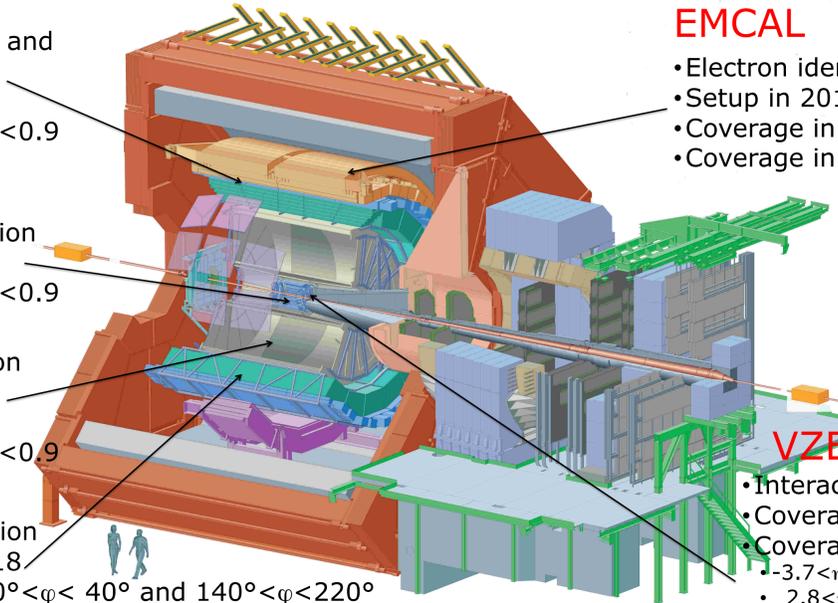
- Electron identification
- Setup in 2010: 7/18
- Coverage in φ : $340^\circ < \varphi < 40^\circ$ and $140^\circ < \varphi < 220^\circ$
- Coverage in η : $|\eta| < 0.9$

EMCAL

- Electron identification
- Setup in 2010: 4/10
- Coverage in φ : $\Delta\varphi < 40^\circ$
- Coverage in η : $|\eta| < 0.7$

VZERO

- Interaction trigger
- Coverage in φ : 2π
- Coverage in η : $-3.7 < \eta < -1.7$
- $2.8 < \eta < 5.1$



Non-heavy-flavour background subtraction

Electron background from various sources:

- Photon conversions in the beam pipe and the pixel layers
- Dalitz decays of light mesons ($\pi^0, \eta, \rho, \omega, \varphi$)
- Dielectron decay of light vector mesons (ρ, ω, φ)
- J/ψ
- Υ
- direct photons from QCD hard scattering

Cocktail including all background sources

- Input: π^0 and η -spectrum measured by ALICE
- Other light mesons: m_π -scaling
- $J/\psi, \Upsilon$: measurement data from ALICE and CMS
- Direct photons: NLO pQCD calculation [1]

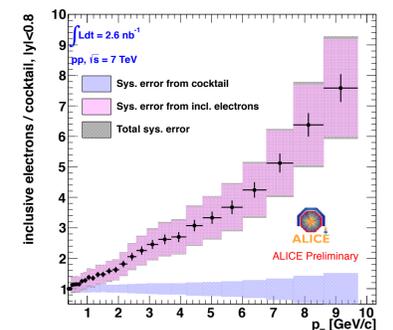
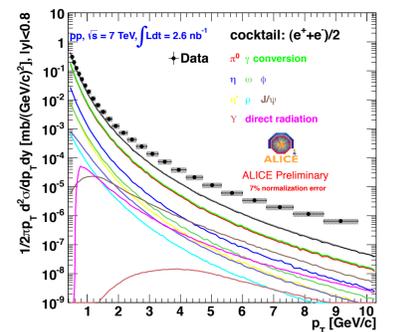
Different Requirement in the ITS for "TOF-TRD-TPC" (hit in the first ITS pixel) and "TPC-EMCAL" (hit in any of the ITS pixels) analysis

⇒ Different amount of photon conversions

Excess of inclusive electrons over cocktail

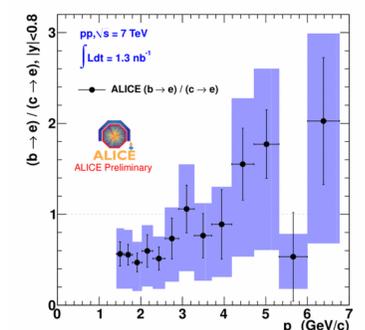
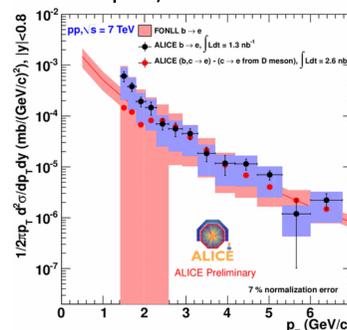
⇒ Electrons from charm and bottom hadron decays

Signal to background increases with p_t



Contribution from bottom hadron decays

The bottom contribution to the p_t -differential cross section is measured by applying a cut on the impact parameter distribution. The subtraction of the contribution electrons from charm hadron decays, estimated using the measurement of D mesons in the hadronic channels measured with ALICE as input, allows a consistency check



- Described well by FONLL pQCD calculations
- Bottom contribution to electrons from heavy-flavour hadron decays increases with p_t

References

- [1] Gordon, Vogelsang, Phys. Rev. D 50 (1994) 1901
- [2] Cacciari, Greco, Nason, JHEP05(1998)007
- [3] ATLAS Collaboration, Phys.Lett.B 707 (2012) 438