Electrons from heavy flavour decays with ALICE at the LHC

R.Bailhache for the ALICE collaboration
Goethe-University Frankfurt
email: rbailhache@ikf.uni-frankfurt.de • phone: +49 69798 47043

Introduction

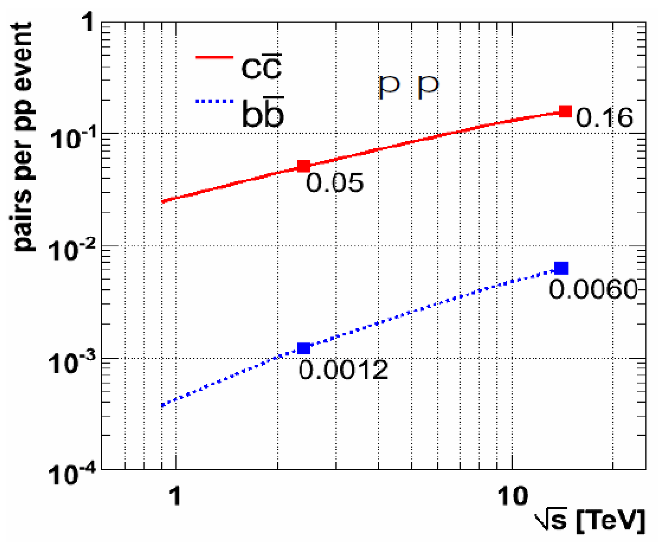


Fig.1: Fixed Order (NLO) calculations in pp collisions [1]. The theoretical uncertainty on the total cross section is a factor of 2.

Heavy quarks and electrons from heavy flavour decays production

system : $\sqrt{s_{NN}}$:	Pb-Pb (0-5%) 5.5 TeV	Pb-Pb (0-5%) 2.75 TeV	pp 14 TeV	pp 7 TeV
$\sigma^{Q\bar{Q}}_{NN}$ [mb]	3.4 / 0.14	2.1 / 0.075	11.2 / 0.5	6.9 / 0.23
$N^{Q\bar{Q}}_{tot}$	90 / 3.7	56 / 2	0.16 / 0.007	0.10 / 0.003
$C^{EKS\ 98}_{shadowing}$	0.58 / 0.77	0.60 / 0.85	--	--

Tab.1: NLO calculations [1] with CTEQ6M parton distribution function for charm and beauty production. Binary scaling is used including shadowing (mean of EKS98/EPS08 [2]) for Pb-Pb. The theoretical uncertainty is a factor of 2.

Hadronization and semi-electronic decays:

c->D->e B.R=9.6%

b->B->e B.R=10.86% b->B->D->e B.R=10%

Motivation

*In pp collisions:
- A test of pQCD
- Reference for medium effects in heavy-ions collisions

In PbPb collisions:
- Heavy quark energy loss in the medium
- Reference for quarkonia production

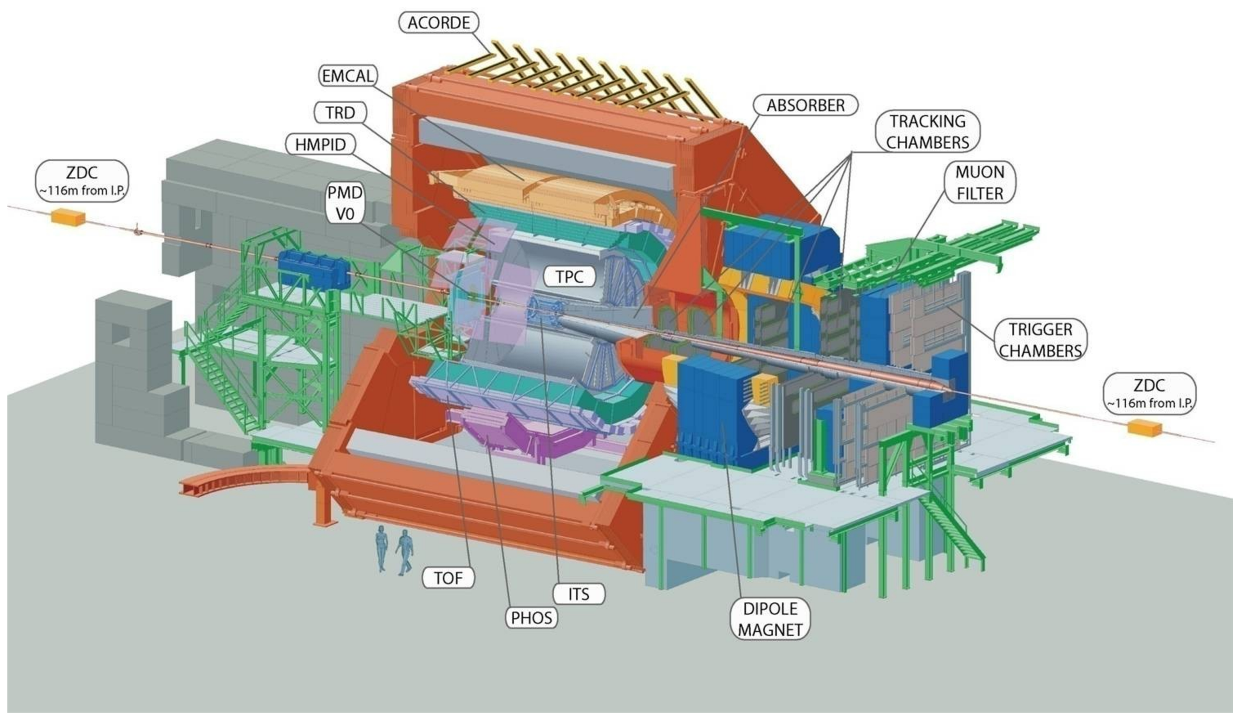
The ALICE Experiment

Inner Tracking System
Position of the primary and secondary vertices, tracking and identification of charged particles via dE/dx

Time Projection Chamber
Tracking and identification of charged particles via dE/dx

Transition Radiation Detector
Tracking of charged particles, e/π separation for momenta above 1 GeV/c and trigger on high momentum electrons

Time Of Flight
Particle identification



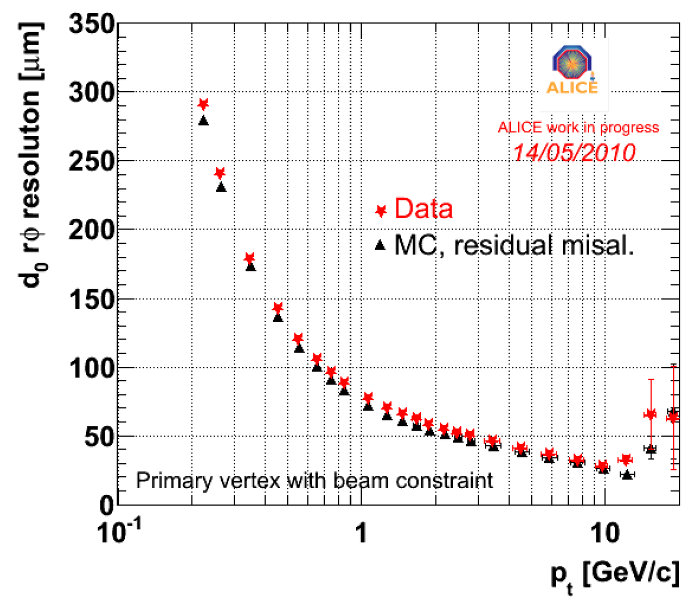


Fig.2: Transverse impact parameter resolution for charged particles tracked in the TPC and the ITS with respect to the primary vertex. The resolution is the convolution of the track position and the primary vertex resolution.

Different strategies to measure electrons from heavy flavour decays

- Inclusive single electron spectrum
The final spectrum includes electrons from hadron decays, photon conversions in the first ITS layer and heavy flavour decays.
- Select electrons from heavy flavour decays via minimum distance of closer approach cuts
D and B have a decay length cτ ~ 200-400 μm and do not point to the primary vertex
- B tagging
Select jets containing one displaced electron

Focus on the inclusive single electron spectrum

Trigger, Event and track selection

Trigger

The detector readout was triggered requiring
* the LHC bunch-crossing signals
* signals from the two beam pick-up counters
* signal in at least one of the two first ITS layers or one of the VZERO scintillator hodoscopes (MB1)

Event selection

* Fulfill the MB1 trigger condition also offline
* Not flagged as beam-gas by either V0A or V0C
* One primary vertex reconstructed within ±30 cm in the beam direction and 1 cm in the xy directions

Track selection

Require the following quality cuts:
- $|\eta| < 0.8$
- Track refitted in the ITS and TPC
- Not identified as a kink candidate
- With a maximum distance of closer approach to the primary vertex of 10 standard deviation of the tracking resolution

Electron identification

TPC + TOF

Electrons can be identified with TPC and TOF up to momenta of about 4 GeV/c

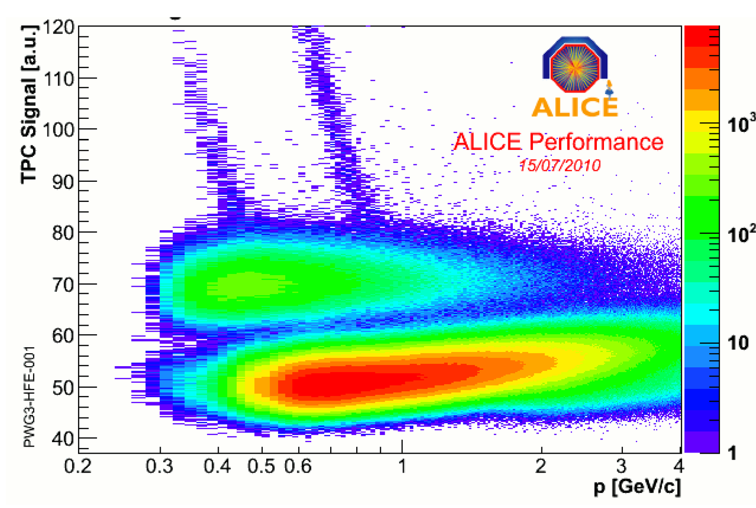


Fig.3: TPC dE/dx signal for 7 TeV pp collisions after selecting tracks which fall within three standard deviations of the TOF resolution for electrons.

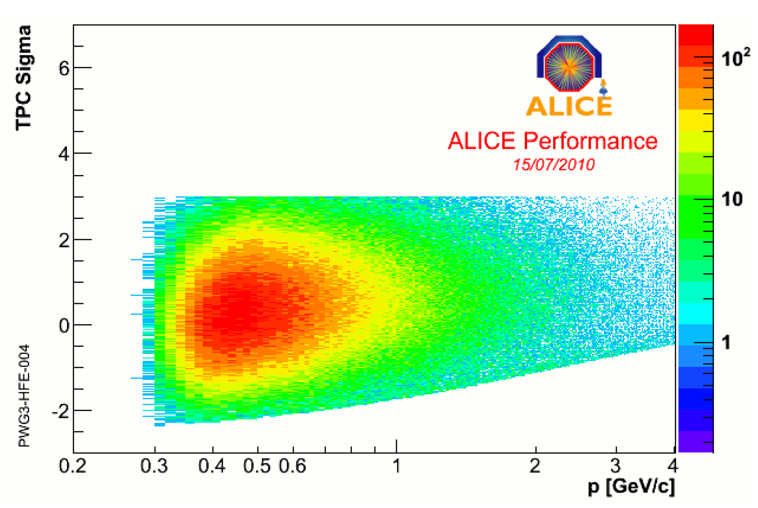


Fig.4: Further selection of electrons by cutting on the number of sigmas from the electron line in the TPC

TRD

The performance of the TRD can be estimated by selecting a pure sample of electrons and pions. The K^0_S decays and photon conversions in the material have a typical V0 topology which makes it possible. The charge deposited in the TRD by these electrons and pions is then compared with reference spectra from earlier test beams (Fig.5 upper panel). The signal as a function of time shows a clear difference between electrons and pions due to higher dE/dx and the transition radiation produced only by electrons (Fig.5 lower panel)

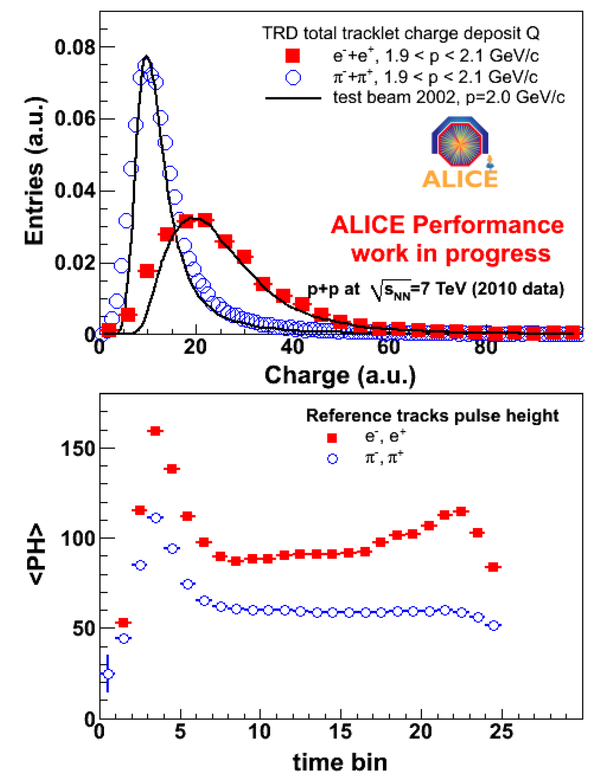


Fig.5: Energy deposited integrated over time (upper panel) and as a function of time (bottom panel) for electrons and pions with momentum of 2 GeV/c in pp collisions compared to earlier testbeam data.

Inclusive electron spectrum

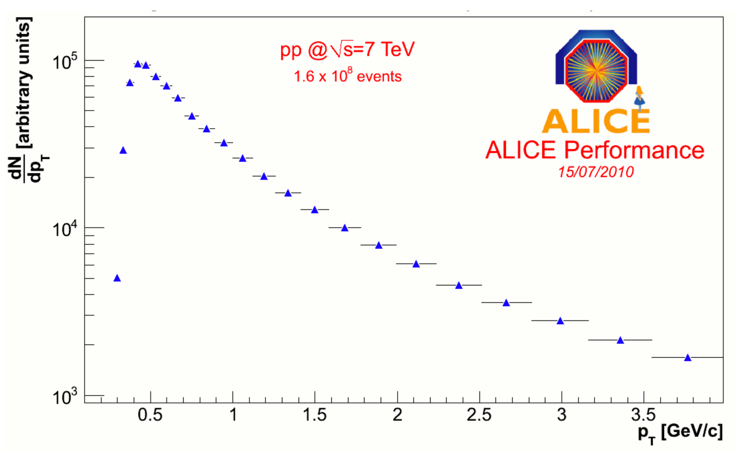


Fig.6: Uncorrected single electron inclusive spectrum obtained with 1.6x10[8] minimum-bias pp events at 7 TeV using TPC+TOF PID

After tracking and electron PID the raw single electron spectrum needs corrections for:
* Trigger reconstruction efficiency
* Event reconstruction efficiency
* Track reconstruction efficiency (including geometric acceptance)

Final spectrum contains electrons from:
* Light hadron decays (mainly π^0 Dalitz decays)
* Photon conversions in the material
* Direct radiation
* Charm and beauty hadron decays

Background sources subtracted via a cocktail

Construction of a cocktail

- Cross-check the material budget via the reconstruction of photon conversions
- Measure the π^0 spectrum via photon conversions
- Deduce the contributions of other sources assuming m_T scaling when no direct measurements are available.

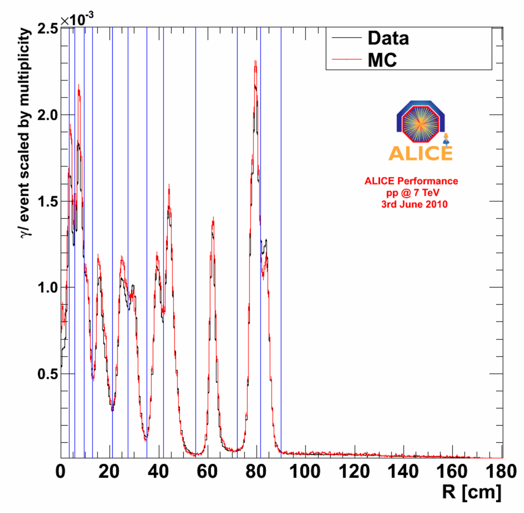


Fig.7: Radial distribution of the photon conversion points. The photon conversions are reconstructed via their V0 topology and TPC PID for the electron-positron pair.

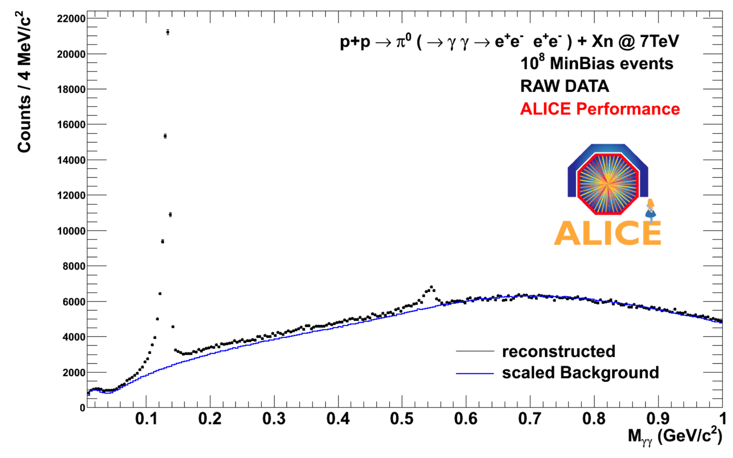


Fig.8: Invariant mass distribution of two photons. π^0 and η are seen. The combinatorial background is deduced from mixed events

Conclusion and Outlook

* Reconstruction of a single electron spectrum up to a momentum of about 4 GeV/c with the TPC and TOF PID
* Good knowledge of the material budget via photon conversions reconstruction

Outlook:
* Better PID up to momenta of about 15 GeV/c with the TRD
* Understanding of the efficiencies needed
* Reconstruction of charm/beauty production

References

1. Mangano, Nason, Ridolfi, NPB373 (1992) 295.
2. Eskola,Kothinen and Salgado Eur. Phys. J. C9 (1999) 61, arXiv:0802.0139v1