Electrons from HF hadron decays in p-Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV with ALICE at the LHC

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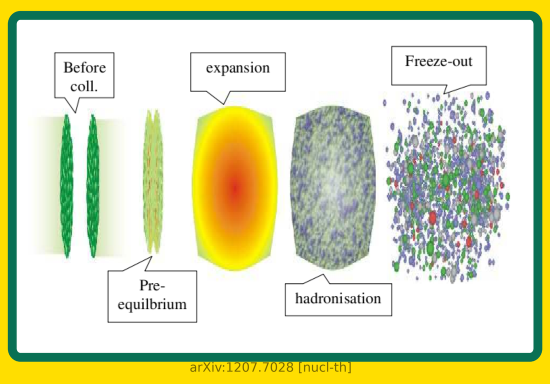
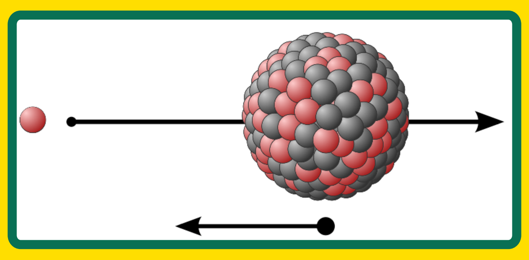
Motivation

Heavy flavour (HF) quarks are important for the study of hot and dense medium created in heavy ion collisions. Charm and Beauty quarks are produced in initial hard interactions and thus probe the medium via their specific energy loss.



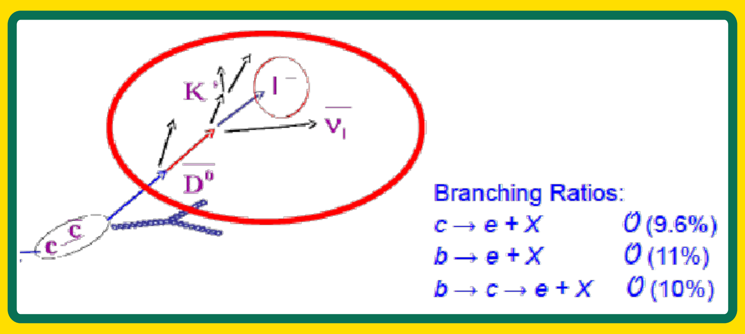


Not only hot medium effects have an influence on heavy flavor. To investigate cold nuclear matter effects, p-Pb collisions can be used, since a hot medium is not expected to be created in these collisions.

To distinguish initial state effects like shadowing from medium effects, the nuclear modification factor R_{pPb} is used.

$$R_{pPb} = \frac{1}{<N_{Coll}>}\frac{dN^{pPb}/dp_T}{dN^{pp}/dp_T}$$

The heavy flavour yield is compared to the yield in pp collisions scaled by the average number of binary collisions in p-Pb.



Because of large branching ratio to single electrons, the study of HF production through their decay electrons is feasible.

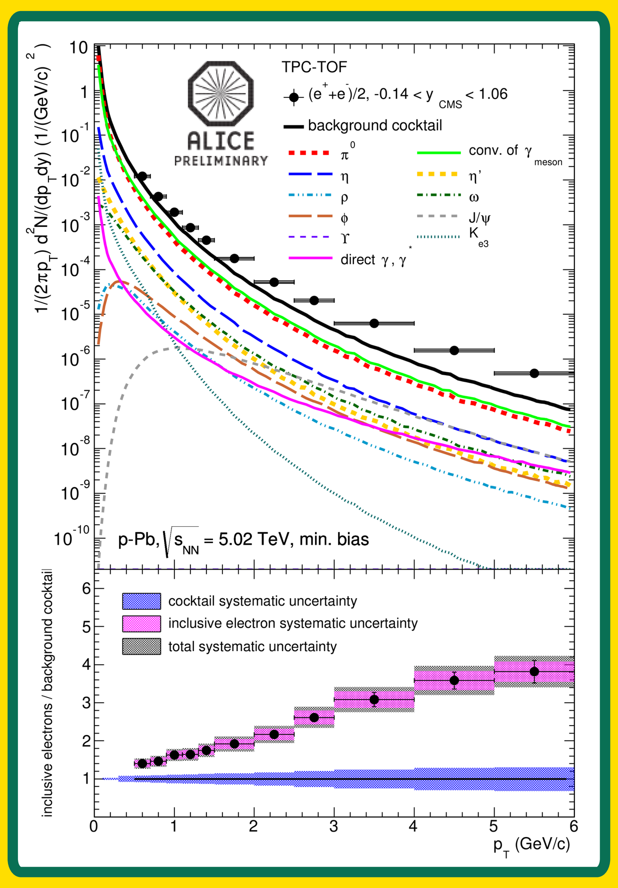
Efficiency correction

The inclusive electron spectrum is corrected for the finite efficiency and acceptance of the detector. The efficiency is estimated with dedicated MC simulations using the DPMJET [1] event generator. The generated particles are propagated using GEANT3 [2], the same reconstruction algorithms as for data taking were applied.

Non-HF electron background

Non-HF electrons in the inclusive electron spectrum are mainly from these sources:

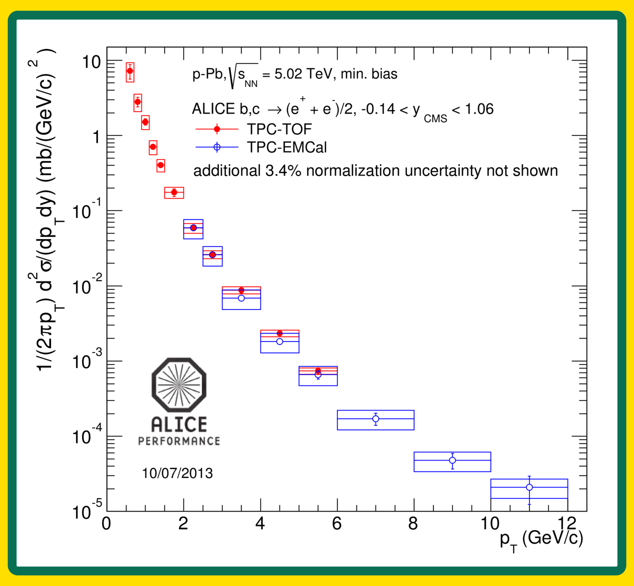
- Electrons from Dalitz decays: Estimated using a measured Pion spectrum and m_T scaling for the other light mesons.
- Gamma conversions: Calculations with the known material budget.
- Weak Kaon decays (K_{e3}): Simulations using the detector setup.
- Charmonium: Interpolated J/ψ cross section from pp measurements is used as input.

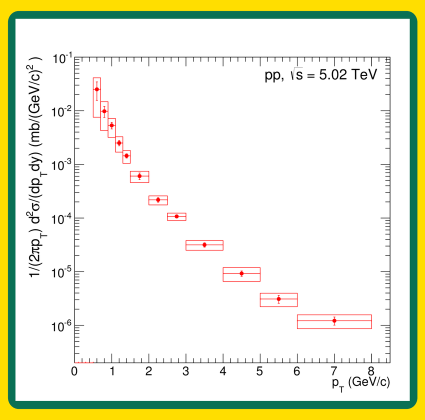


The different electron sources are combined to a total non-HF electron background cocktail.

HF electron spectra

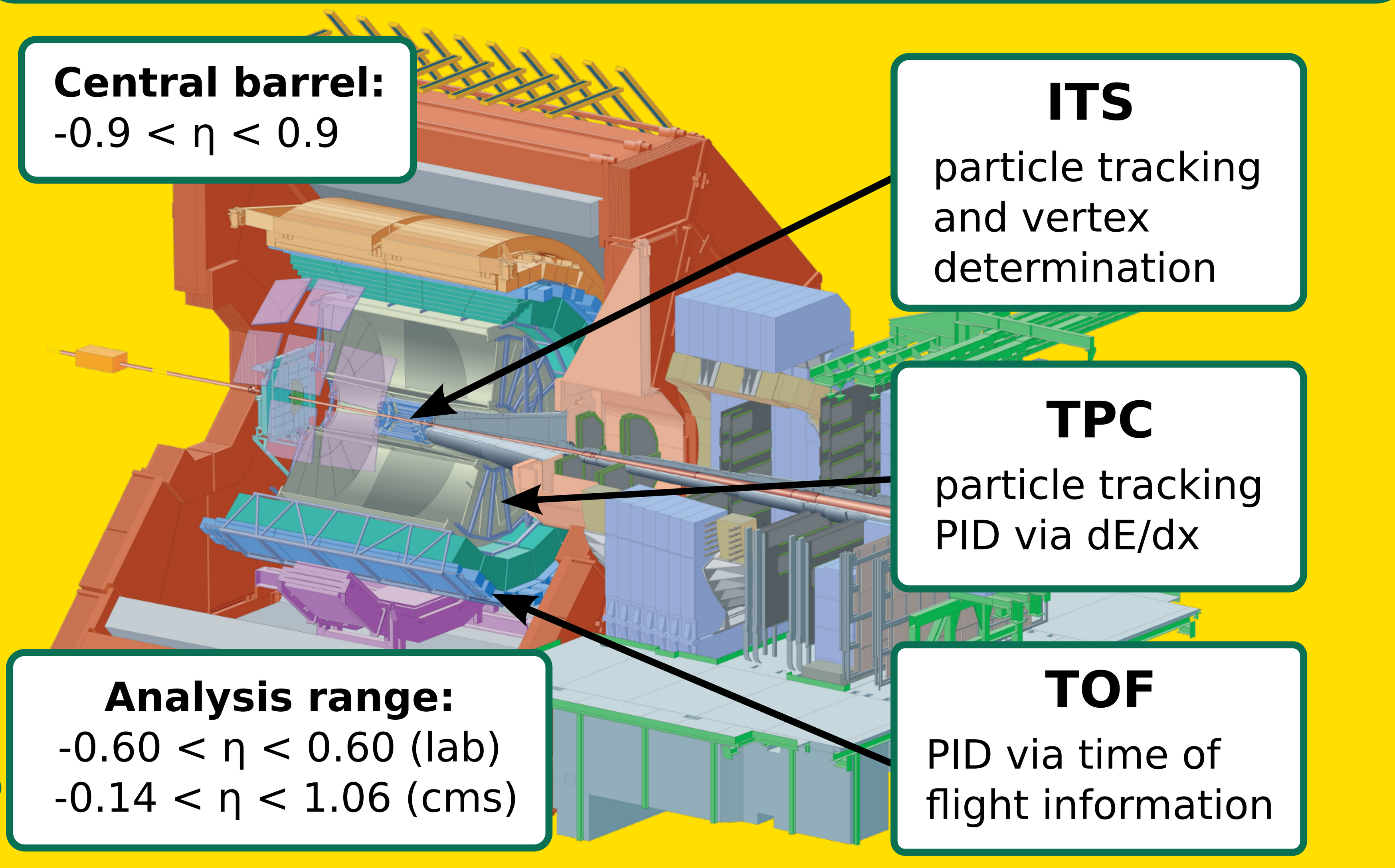
The p_T-differential invariant yield of electrons from heavy flavour decays is obtained after subtraction of the background cocktail. The results agree with an alternative analysis [3] using the Electromagnetic Calorimeter (EMCal) and a different electron background estimation.





For the R_{pPb} a pp reference was extrapolated to 5.02 TeV collision energy using FONLL [4].

A Large Ion Collider Experiment



Central barrel: -0.9 < η < 0.9

ITS particle tracking and vertex determination

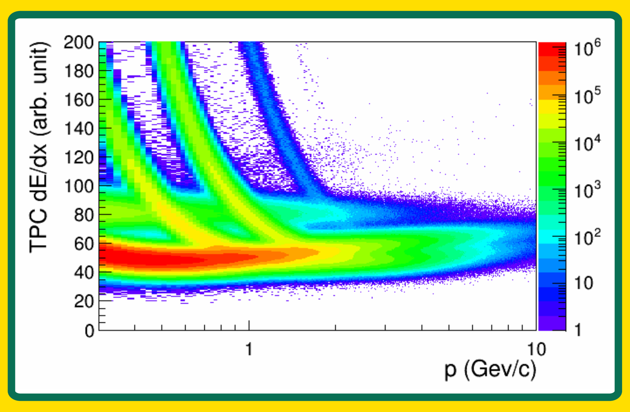
TPC particle tracking PID via dE/dx

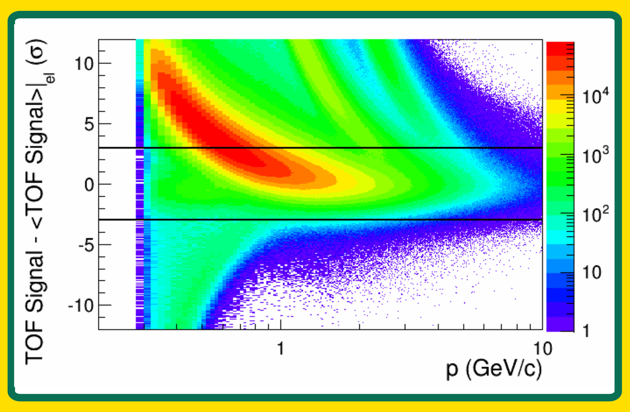
TOF PID via time of flight information

Analysis range: -0.60 < η < 0.60 (lab) -0.14 < η < 1.06 (cms)

Electron identification

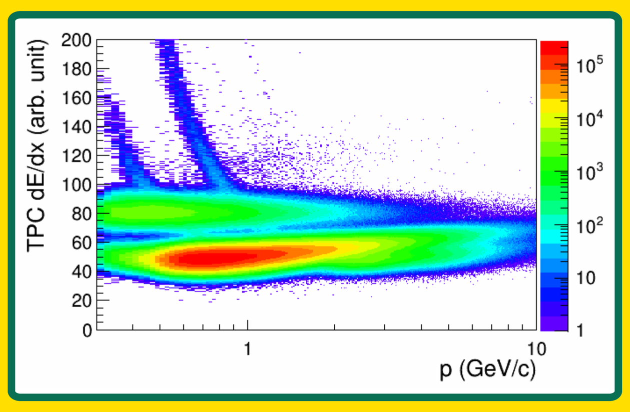
Charged particles are identified via their specific energy loss dE/dx in the TPC gas. The electron candidates are obtained selecting a certain range in the spectrum. Due to overlapping regions from Kaons, Protons and Deuterons, the hadron contamination is still substantial.

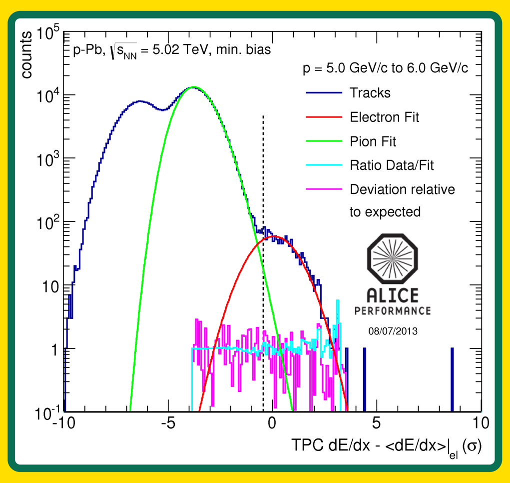




With the Time Of Flight (TOF) detector it is possible to remove (heavier) hadrons at low momentum. The lines in the plot indicate the selection band (3σ).

Using the TOF information in the dE/dx distribution, a large part of the hadron background is removed.

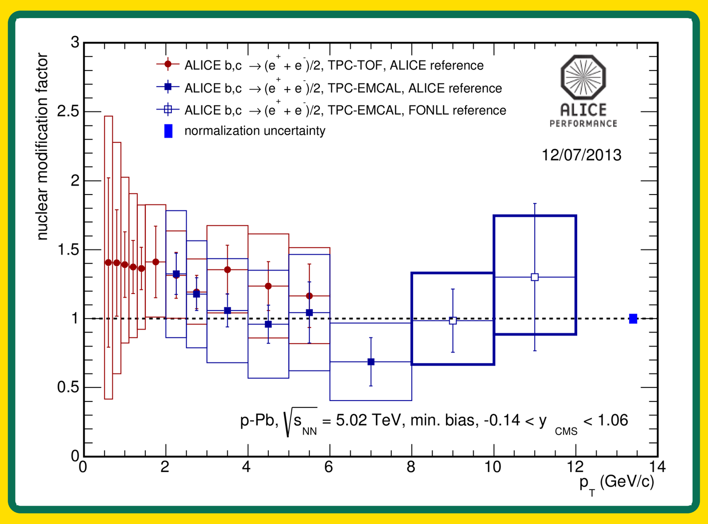


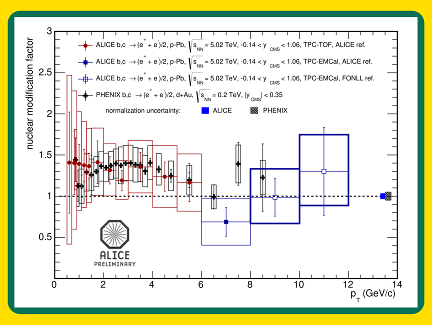


To remove the remaining pion and Kaon contamination, the dE/dx spectrum is fitted in momentum slices as shown on the left. The electron distribution is assumed to be Gaussian while the Pion peak is fitted with a Landau distribution with exponential tail.

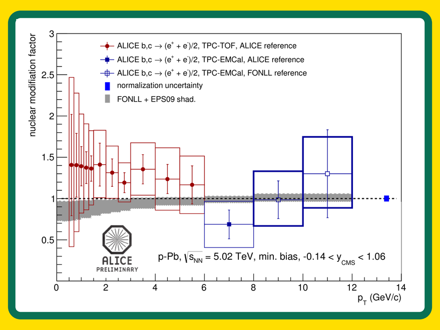
R_{pPb}

R_{pPb} of electrons from heavy-flavour decays. Results from TPC-EMCal analysis shows good agreement. R_{pPb} is consistent with one within the errors.





R_{pPb} compared to RdAu from d-Au collisions at $\sqrt{s_{NN}}$ =200 GeV measured at PHENIX [5].



R_{pPb} with shadowing effects based on EPS09 parametrization [6].

Conclusion

The current HF electron analysis yield to a R_{pPb} equal one within the errors. The results agree with measurements from PHENIX at lower collision energy. No sign of suppression due to initial state effects is observable.

[1] S. Roesler, R. Engel, and J. Ranft. The monte carlo event generator dpmjet-iii. arXiv:hep-ph/0012252, 2000.
[2] R. Brun et al. GEANT Detector Description and Simulation Tool, 1994. CERN Program Library Long Write-up, W5013.
[3] Jahnke, C. et al. Heavy Flavor Decay Electron R pPb at s = 5.02 TeV using TPC and EMCal detectors. ALICE Analysis Note.
[4] R. Averbeck, et al. Reference Heavy Flavour Cross Sections in pp Collisions at √s=2.76 TeV using a pQCD-driven √s-Scaling of ALICE Measurements at √s=7 TeV. 2011.
[5] A. Adare et al. Cold-nuclear-matter effects on heavy-quark production in d + au collisions at √sNN =200 GeV. Phys. Rev. Lett., 109:242301, Dec 2012.
[6] K.J. Eskola, H. Paukkunen, and C.A. Salgado. EPS09: A New Generation of NLO and LO Nuclear Parton Distribution Functions. JHEP, 0904:065, 2009.