Measurements of beauty-decay electrons in ALICE at the LHC

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Motivation

- **Heavy quarks in heavy-ion (HI) collisions** — A. Andronic *et al.*, *Eur. Phys. J.* C76 no. 3, (2016) 107
  - Large masses ($m_q \gg \Lambda_{QCD}$) → produced in the early stages of the HI collision with short formation time (t_{charm} ~ $1/m_c$ ~ 0.1 fm/c << τ_{QGP} ~ O(10 fm/c)), traverse the medium interacting with its constituents.
  - Heavy quarks cannot be destroyed/created in the medium and their interactions with QGP don't change flavour identity

  ➡ **natural probe of the hot and dense medium created in HI collisions**

- **Open Heavy-flavour in p-Pb and Pb-Pb collisions**

Pb-Pb collisions

- **Study the interaction of heavy quarks with the medium via parton energy loss (radiative vs collisional) which depends on :**
  - color charge — M. Gyulassy and X.-n. Wang, *Nucl. Phys.* B420 (1994) 583
  - parton mass — Dokshitzer and Kharzeev, PLB 519 (2001) 199
  - path length in the medium — H. van Hees, V. Greco, and R. Rapp, *Phys. Rev. C* 73 (2006) 034913
  - medium density and temperature

➡**expect: $\Delta E_g > \Delta E_{u,d,s} > \Delta E_c > \Delta E_b$**

p-Pb collisions

- **Control experiment for the Pb-Pb measurements**
- **Address cold nuclear matter effects**
  - nuclear modification of parton distribution functions
  - k_T broadening
  - energy loss in cold nuclear matter

shadowing: K.J. Eskola et al., JHEP 0904 (2009) 65 , gluon saturation, Color Glass Condensate: H. Fuji & K. Watanabe, NPA 915(2013) 1, I. Vitev at al., PRC 75 (2007) 064906

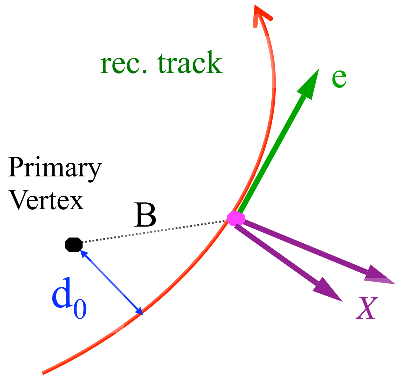
- **Measurement of beauty production in ALICE**
  - Measurements of beauty production are done via **electrons from semi-leptonic decay of beauty hadrons,** thanks to excellent vertexing and impact parameter resolution of Inner tracking system (ITS) and eID capability in ALICE

Electrons from B Hadron Decay via IP cut method

1. Charged particle tracks selected fulfilling **track quality** and **eID cuts** (composed by electrons from photon conversion, Dalitz decays, charm hadron decays, beauty hadron decays)

2. Beauty hadron has **cτ ≃ 500 μm** and **hard momentum spectrum,** which leads to **larger impact parameter** of decay electrons than those from background.

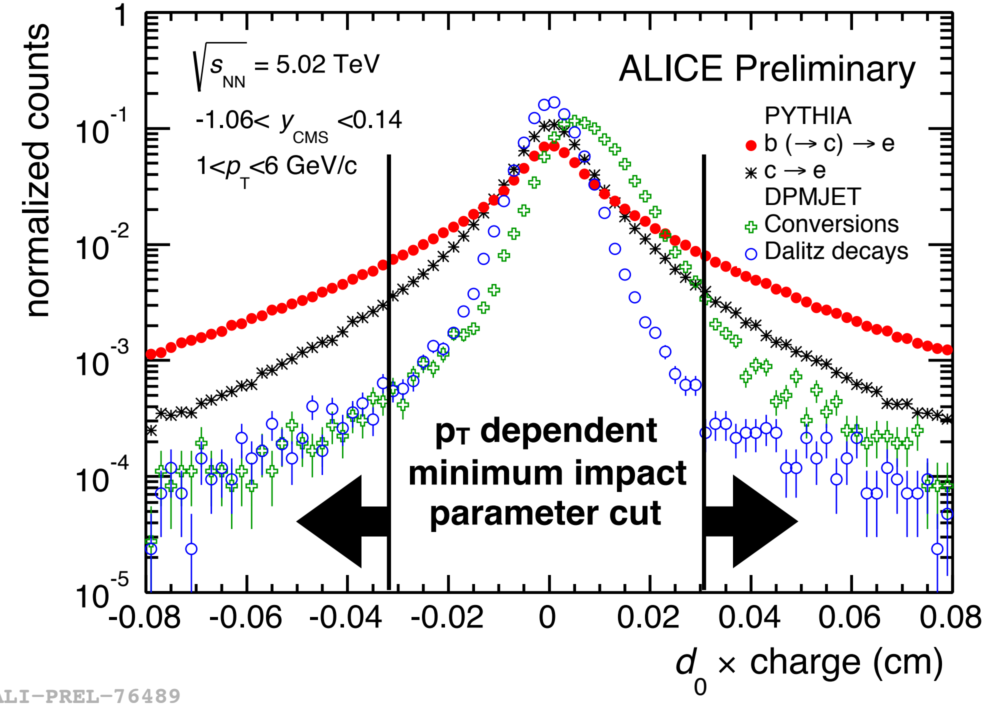
   ➡ Electron tracks from beauty hadron decays features **broader impact parameter distribution** compared to that from background



3. **Minimum impact parameter cut to increase S/B ratio**

4. **Subtract remaining background(nonHFE and charm hadron decay electrons)** based on ALICE measurement

5. Correct subtracted electron spectra for acceptance and efficiency



Electrons from B Hadron Decay via IP fit method

ALICE
A JOURNEY OF DISCOVERY

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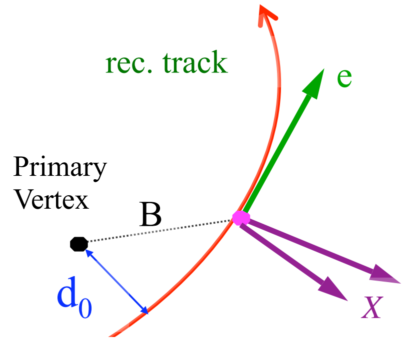
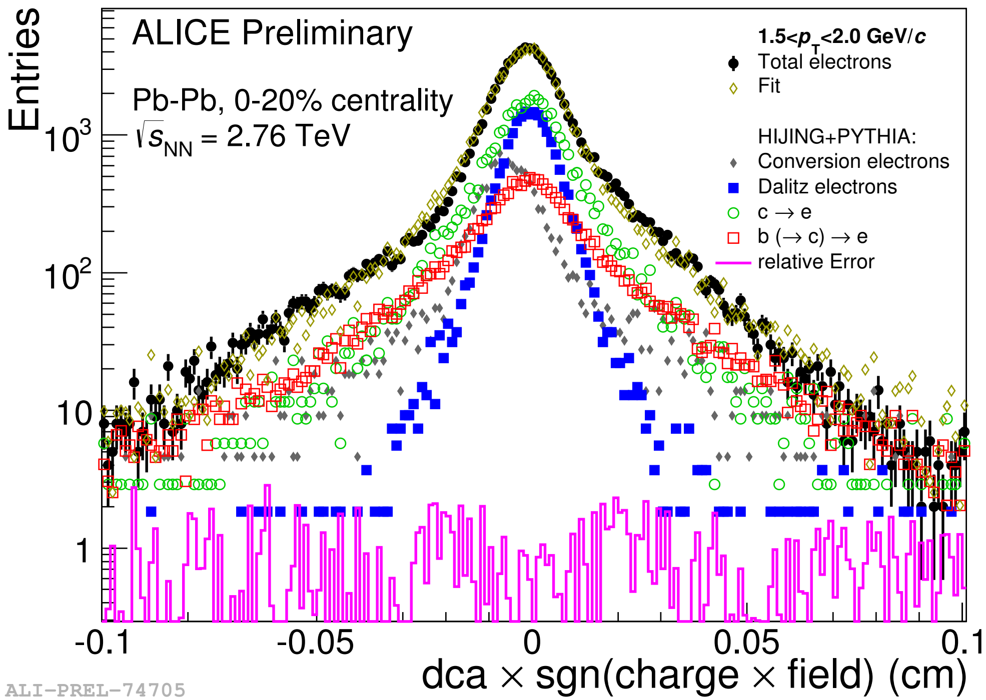


3. **Get Impact Parameter distributions of electrons from different sources from MC as template for each p_T bins**

4. **Fit templates of impact parameter distributions** of signal and background contributions

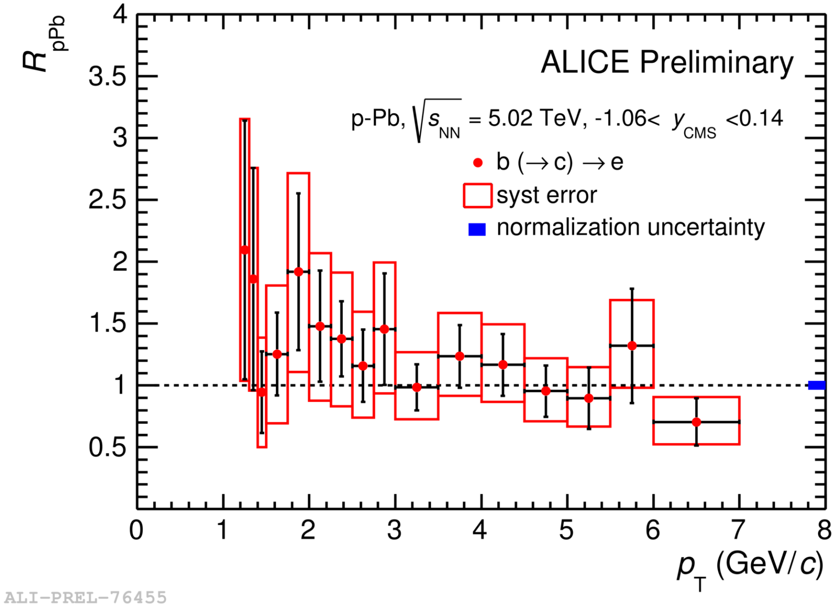
5. Correct subtracted electron spectra for acceptance and efficiency



Nuclear modification factors of b→e

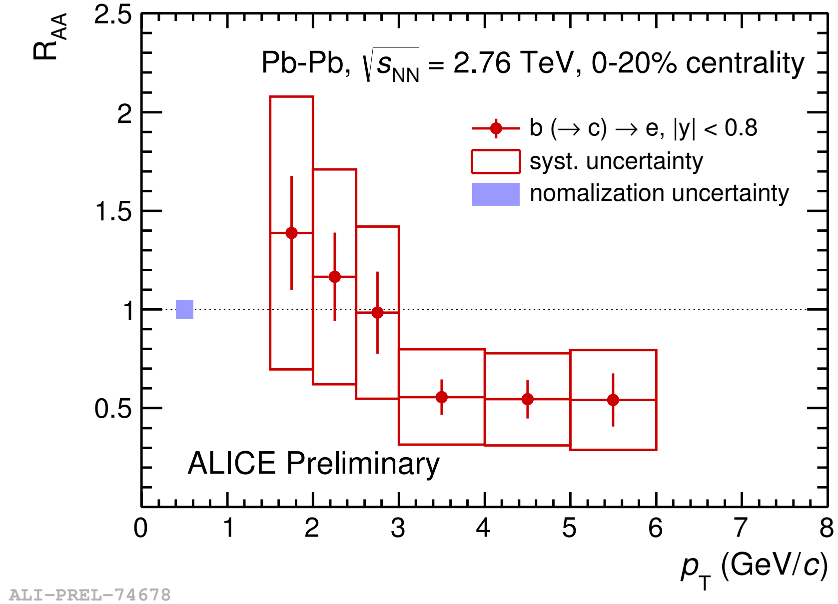
p-Pb $\sqrt{s_{NN}}$= 5.02 TeV

- $R_{pA} = \frac{1}{A}\frac{d\sigma_{pA}/dp_T}{d\sigma_{pp}/dp_T}$, A: number of nucleons in the nucleus
- $R_{pA} \neq 1$: Address possible cold nuclear matter effects



Pb-Pb $\sqrt{s_{NN}}$= 2.76 TeV

- $R_{AA} = \frac{dN_{AA}/dp_T}{\langle N_{coll}\rangle \times dN_{pp}/dp_T}$, $\langle N_{coll}\rangle$: number of binary collisions
- RAA ≠ 1 : medium effect at high p_T



- Nuclear modification factor of beauty-decay electrons in p-Pb collisions is compatible with unity within uncertainties
- Suppression of beauty-decay electrons for p_T > 3 GeV/c in 0-20% central Pb-Pb collisions
- Suppression measured in Pb-Pb collisions can be due to the parton energy loss in the hot and dense medium
- Results with smaller uncertainties will be published soon

Thanks for your attention!