

## Motivation

### Heavy quarks: charm and beauty

- Heavy quarks are produced in hard scattering processes in initial stage of the collision
- Heavy quarks experience the full evolution of the system created in collisions A. Andronic et al., Eur. Phys. J. C76 no. 3, (2016) 107  
⇒ Natural probe of the QGP

### Parton energy loss in the medium

- Interaction of partons with the medium (radiative and collisional)
- Depends on color charge, parton mass, path length in the medium, medium density and temperatures  
⇒ Prediction for  $\Delta E$ :  $\Delta E_g > \Delta E_{u,d,s} > \Delta E_c > \Delta E_b$   
Dokshitzer and Kharzeev, PLB 519 (2001) 199
- By separating electrons from beauty quarks from the ones from charm quarks, the mass dependence of the parton energy loss in the QGP can be studied.

### pp collisions

- Test pQCD calculations at LHC energies.
- Reference measurements for p-Pb and Pb-Pb collisions

## Electron analysis with ALICE

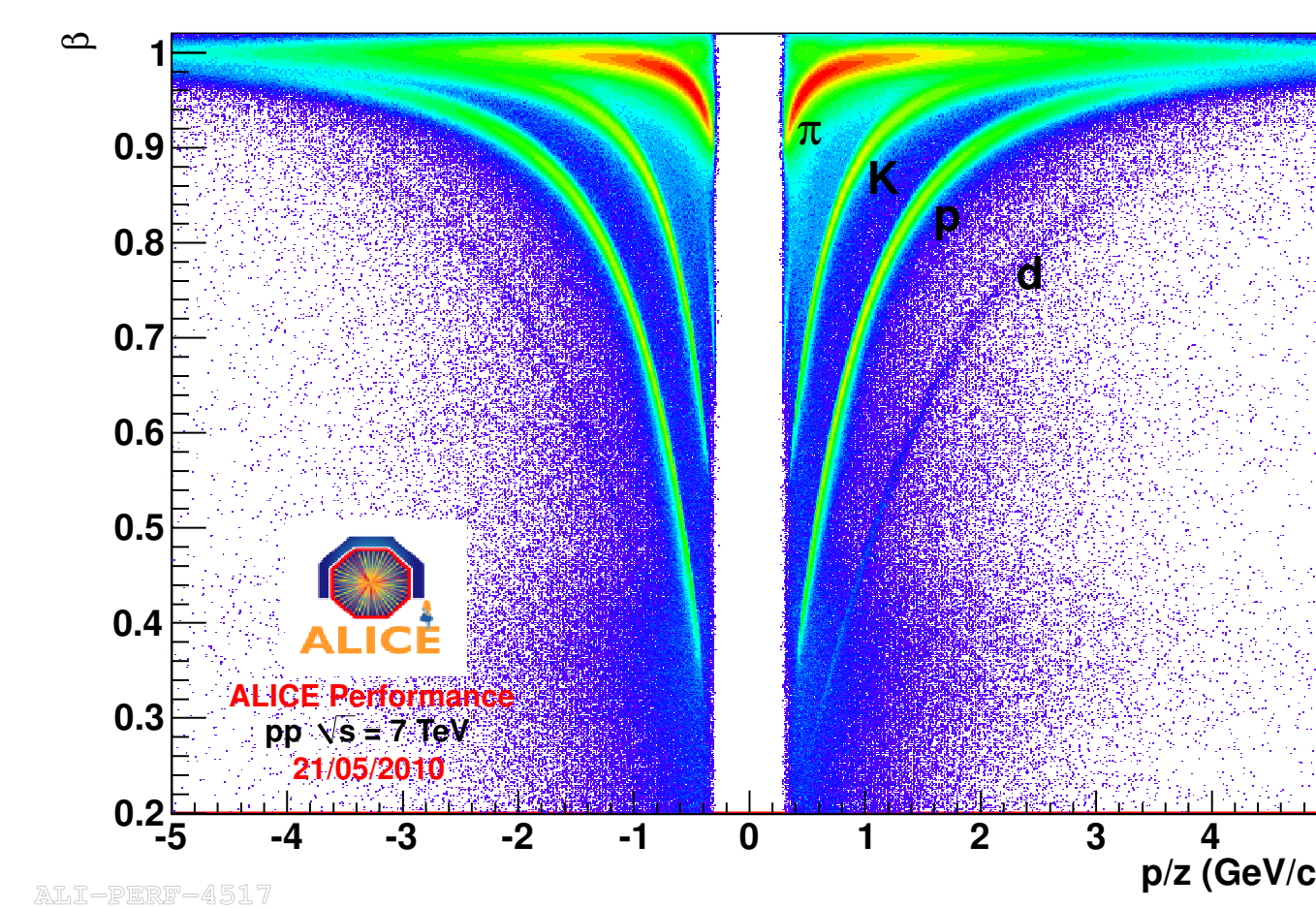
### Beauty measurement via electrons from semi-leptonic decays of beauty-hadrons

- Substantial branching ratio:  $b \rightarrow e + X$  ( $\sim 11\%$ ),  $b \rightarrow c \rightarrow e + X$  ( $\sim 10\%$ )

### Electron identification

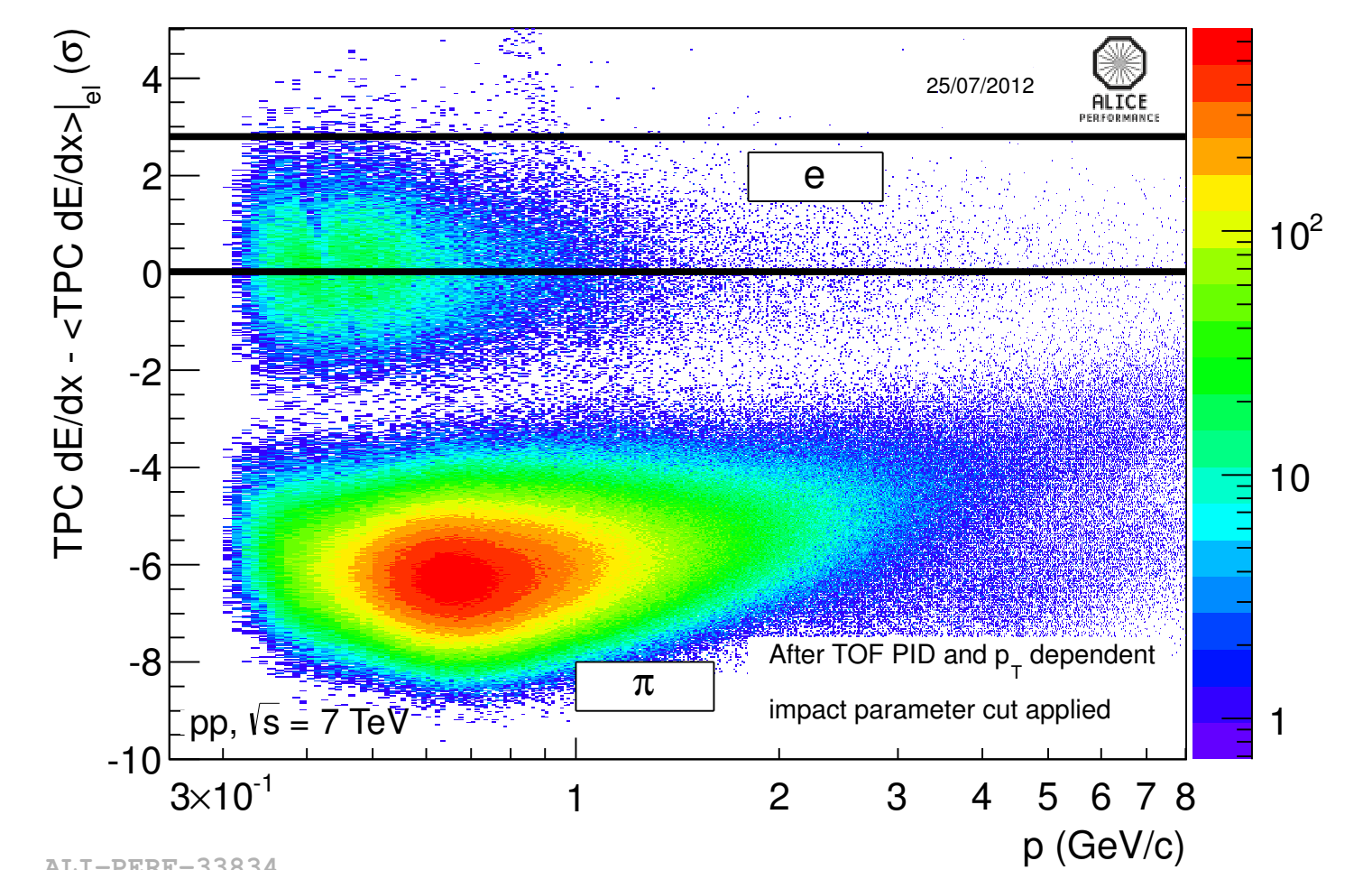
#### The Time-of-Flight detector (TOF)

- TOF measures the velocity  $\beta$  of the particles
- Cut at  $3\sigma$  around electron hypothesis



#### Time Projection Chamber (TPC)

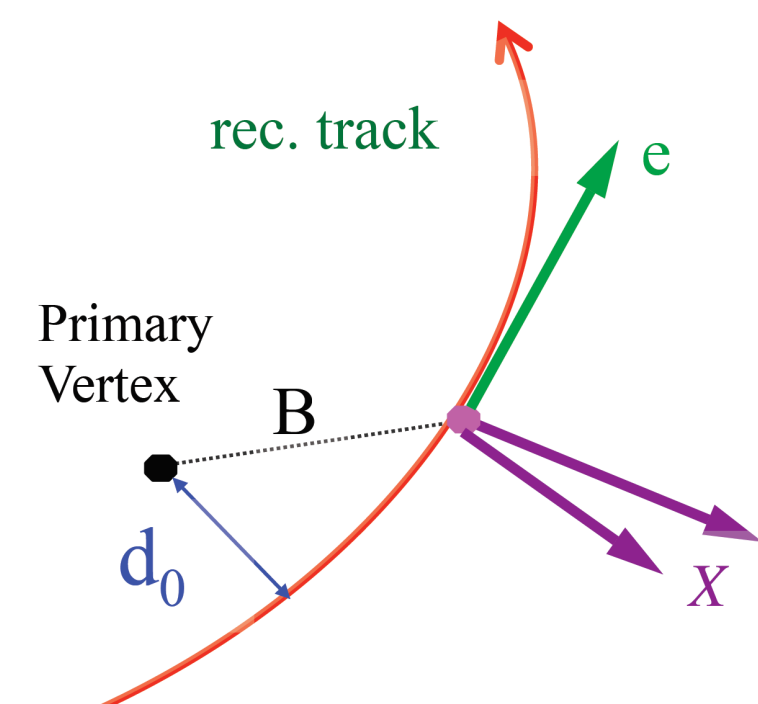
- TPC measures ionisation energy loss of charged particles passing through the gas volume in the TPC.
- Cut around electron hypothesis



## Beauty production measurement via impact parameter

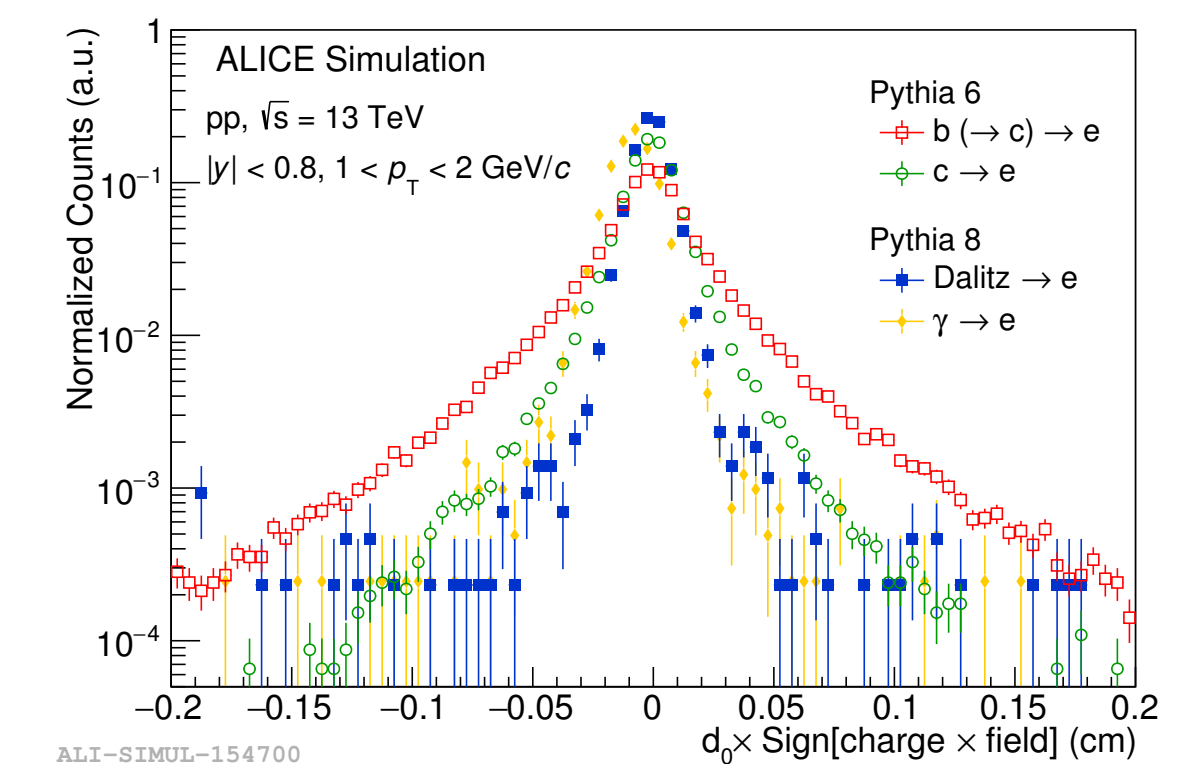
### Impact parameter:

- Distance of closest approach of reconstructed track to the primary vertex.
- b quarks hadronize mainly to B mesons which have long lifetime ( $c\tau \approx 500 \mu\text{m}$ )  
⇒ Larger impact parameter of  $B \rightarrow e$



### Impact parameter distributions

- Inclusive electron contributions from:
  - Semi-leptonic **beauty-hadron** decays
  - Semi-leptonic **charm-hadron** decays
  - Dalitz decays of **light mesons**
  - Photon conversions** in the detector material



## Analysis strategy

### Cut method

- Applying minimum impact parameter cut and subtracting remaining background based on measured light-meson and D-meson spectra.

### Procedure

- Minimum impact parameter cut is applied to increase S/B.
- Background is estimated by weighting relevant electron source yields in MC simulation using measured spectra:
  - Electrons from charm-hadron decays via measured D-meson cross section
  - Electrons from Dalitz/di-electron decays and  $\gamma$  conversions via measured light-meson cross sections

### Fit Method

- Fitting Monte Carlo templates of impact parameter distributions of signal and background contributions for each  $p_T$  bin.

### Correction for background template

- Background is corrected by weighting relevant electron source yields in MC simulation using measured spectra:
  - Charm-hadron decays via measured D-meson cross section
  - Dalitz decays and  $\gamma$  conversions via measured light flavour hadron cross sections

### Fitting procedure

Barlow, Beeston, Comput. Phys. Commun. 77, 2 (1993) 219-228

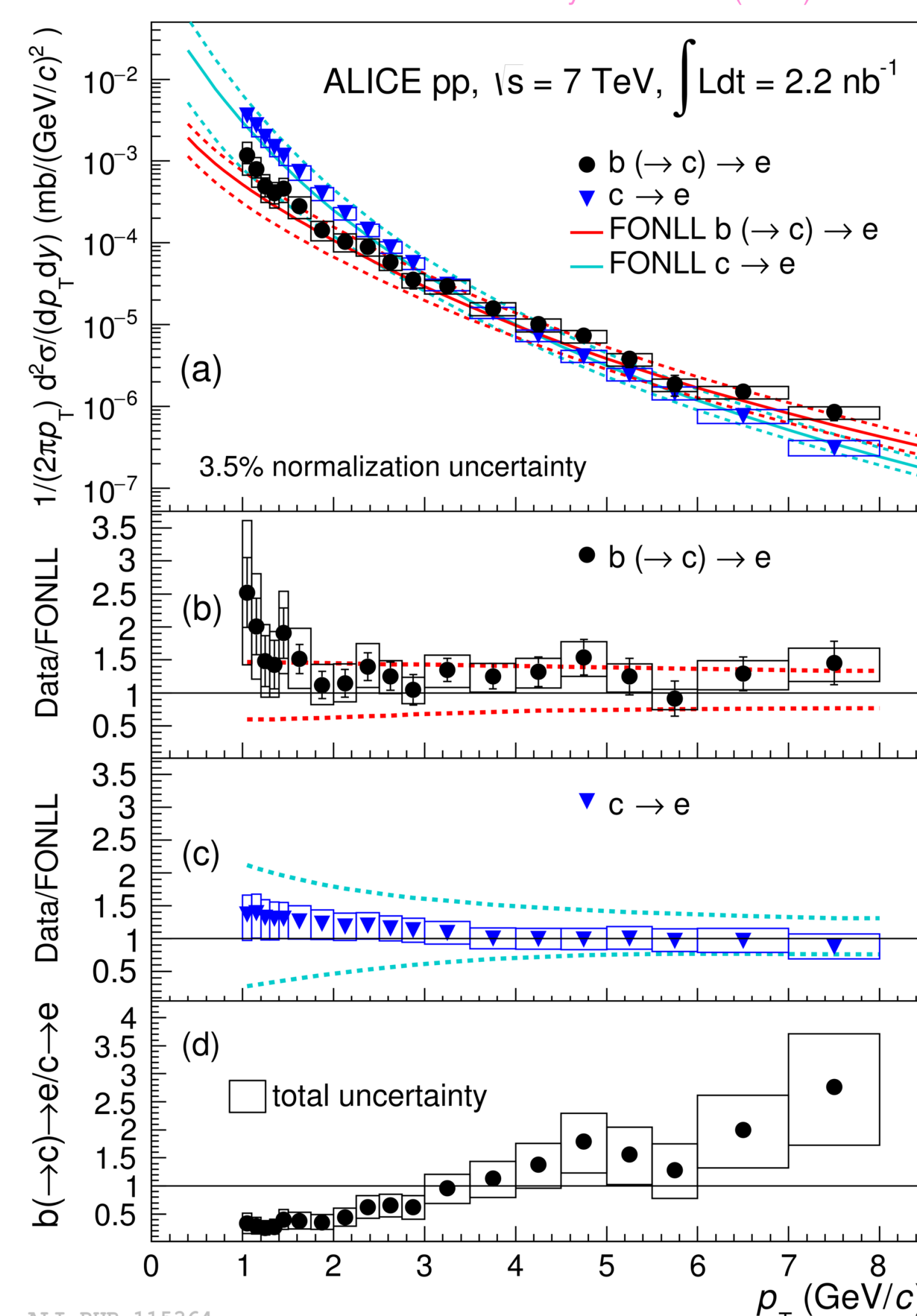
- Maximum likelihood-based approach
- Take into account finite statistics of MC templates.
- Assume unknown expectation value of MC templates in each bin (additional free parameters).

## Transverse momentum dependent differential cross section in pp collisions

- Transverse momentum dependent differential cross section of electrons from semi-leptonic decays of beauty hadrons was reported at  $\sqrt{s} = 2.76$  TeV and 7 TeV in pp collisions. Phys.Lett. B763 (2016) 507-509 Phys.Lett. B763 (2016) 507
- Impact parameter cut method was used for both cases.
- The results are compared to pQCD calculations and the theory agrees with data within uncertainties.
- These results provide a crucial reference for the study of beauty-quark production in Pb-Pb collisions at the LHC.

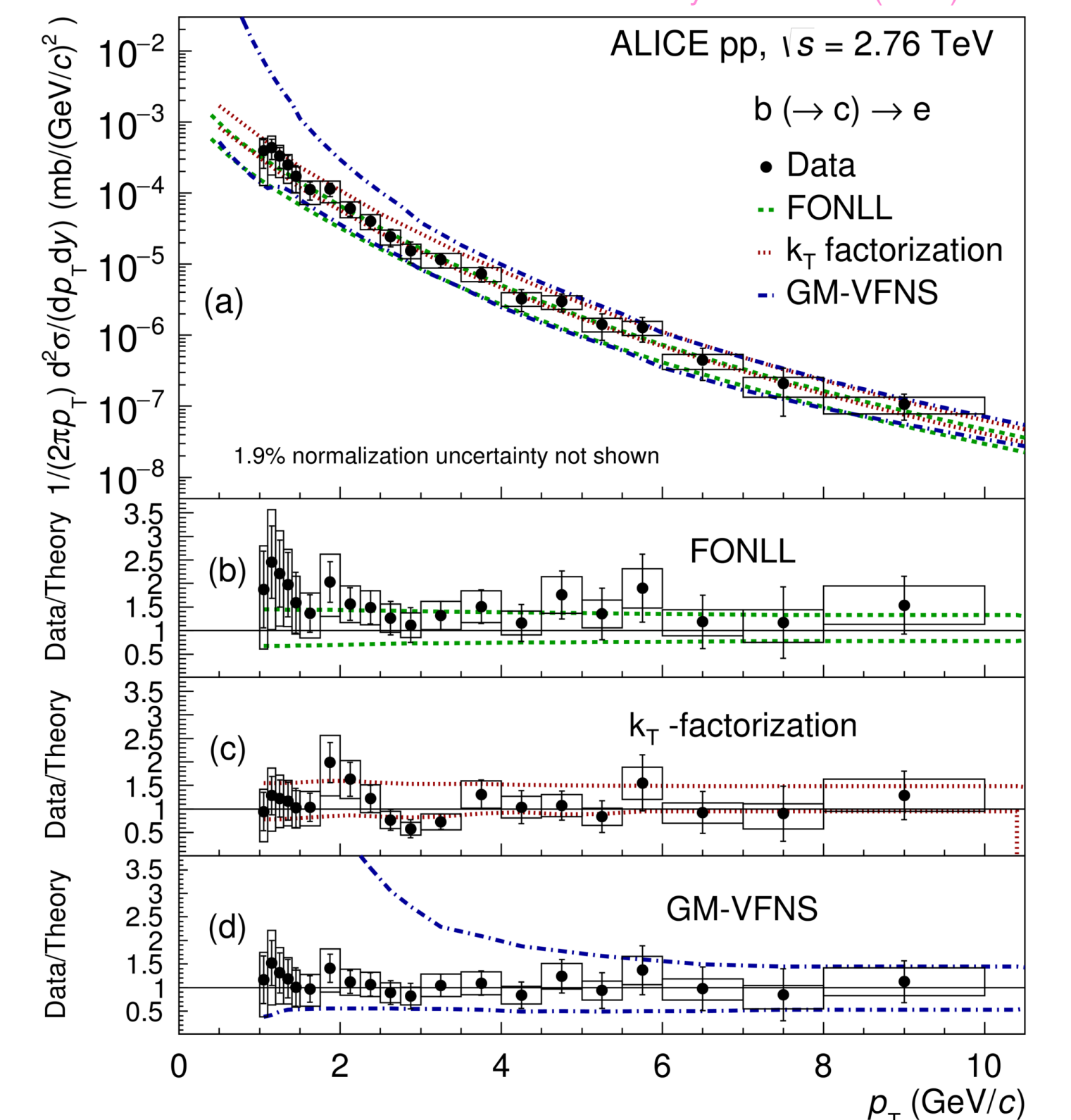
### pp at 7 TeV

Phys.Lett. B763 (2016) 507-509



### pp at 2.76 TeV

Phys.Lett. B763 (2016) 507



- Beauty production in pp collisions at  $\sqrt{s} = 13$  TeV is being studied using impact parameter fit method. Correction for background templates is ongoing.

## Summary and outlook

- Beauty production is studied via measurement of electrons from beauty-hadron decays in pp collisions at the LHC with ALICE.
- Electrons from beauty-hadron decays are measured via impact parameter using two methods: cut method and fit method.
- Transverse momentum dependent differential cross section of electrons from semi-leptonic decays of beauty hadrons is measured in pp collisions at  $\sqrt{s} = 2.76$  TeV and 7 TeV using impact parameter cut method.
- The measurements are described by pQCD-based calculations within uncertainties.
- Beauty production in pp collisions at  $\sqrt{s} = 13$  TeV is studied using impact parameter fit method.