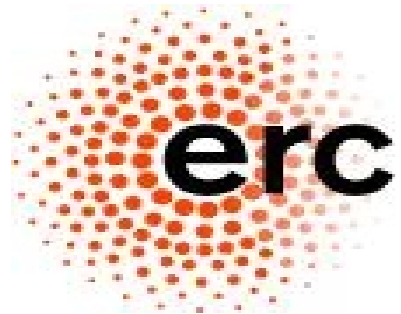


# Azimuthal angular correlations between heavy flavour decay electrons and charged hadrons in proton-proton collisions at $\sqrt{s} = 7$ TeV using the ALICE detector

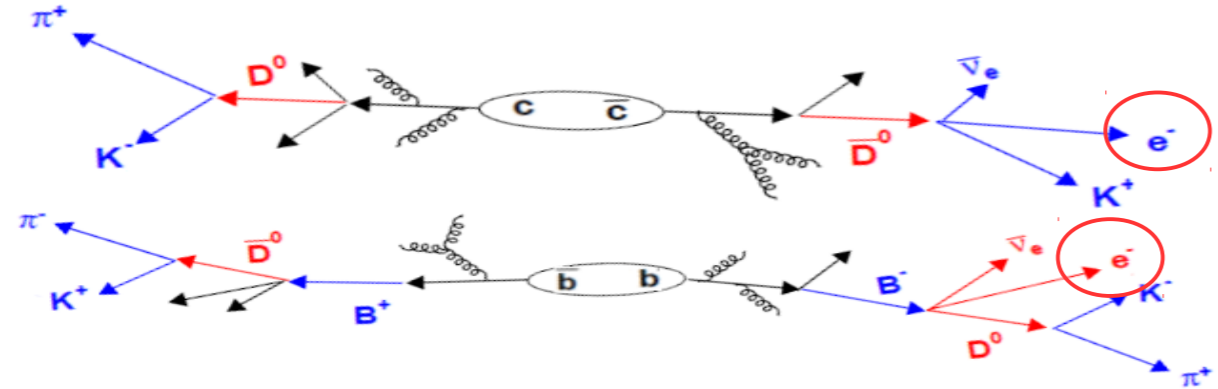


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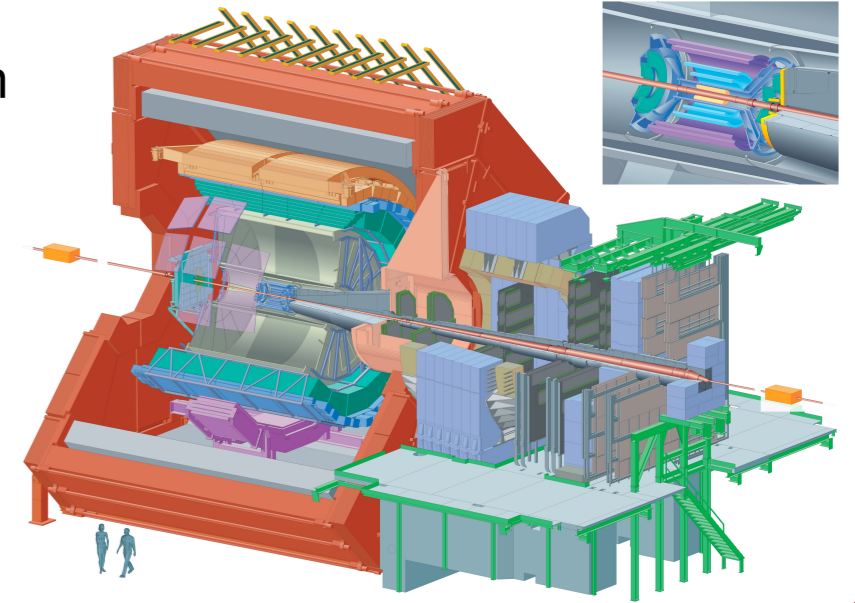
## 1. Motivation

- Heavy flavour (HF) quarks are produced in hard scattering processes
- HF quarks are a sensitive probe of the QCD matter that is produced in heavy ion collisions
- In pp collisions:
  - Test for perturbative QCD calculations
  - Baseline for heavy ion measurements
- HF quarks can be studied by using electrons from semi-leptonic decays of heavy flavour hadrons
- Separation of electrons from B and D decays necessary for testing perturbative QCD calculations



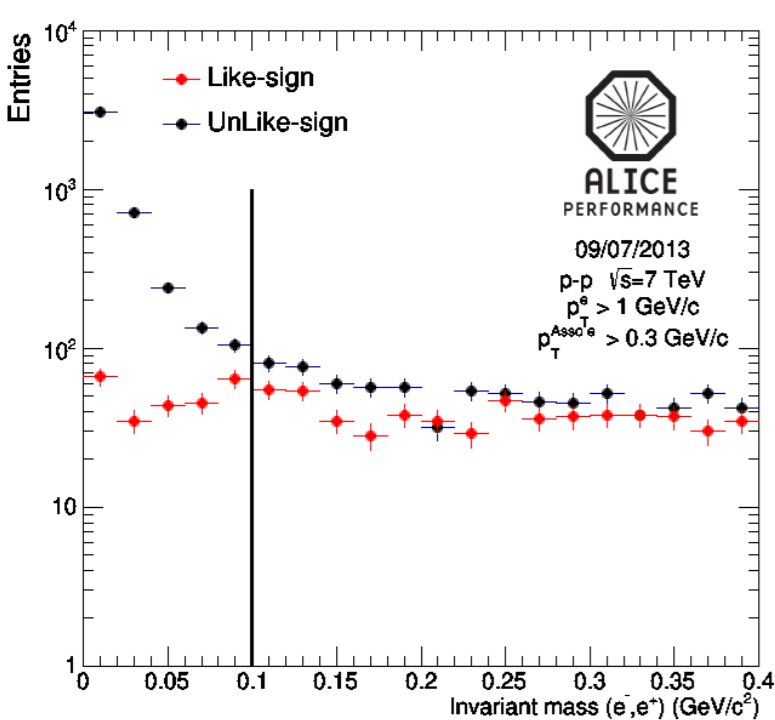
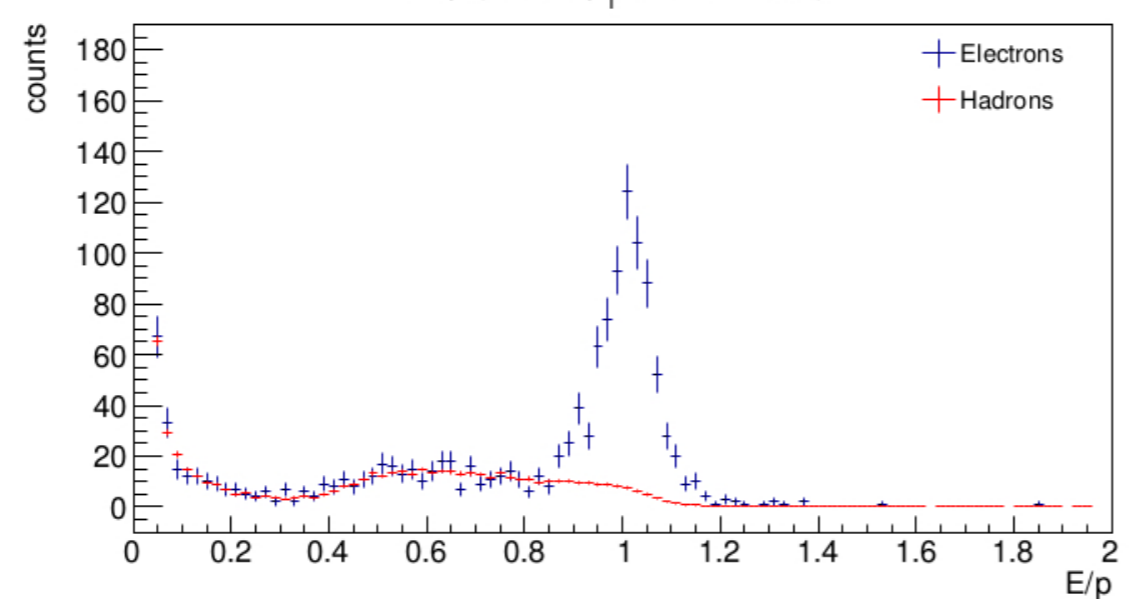
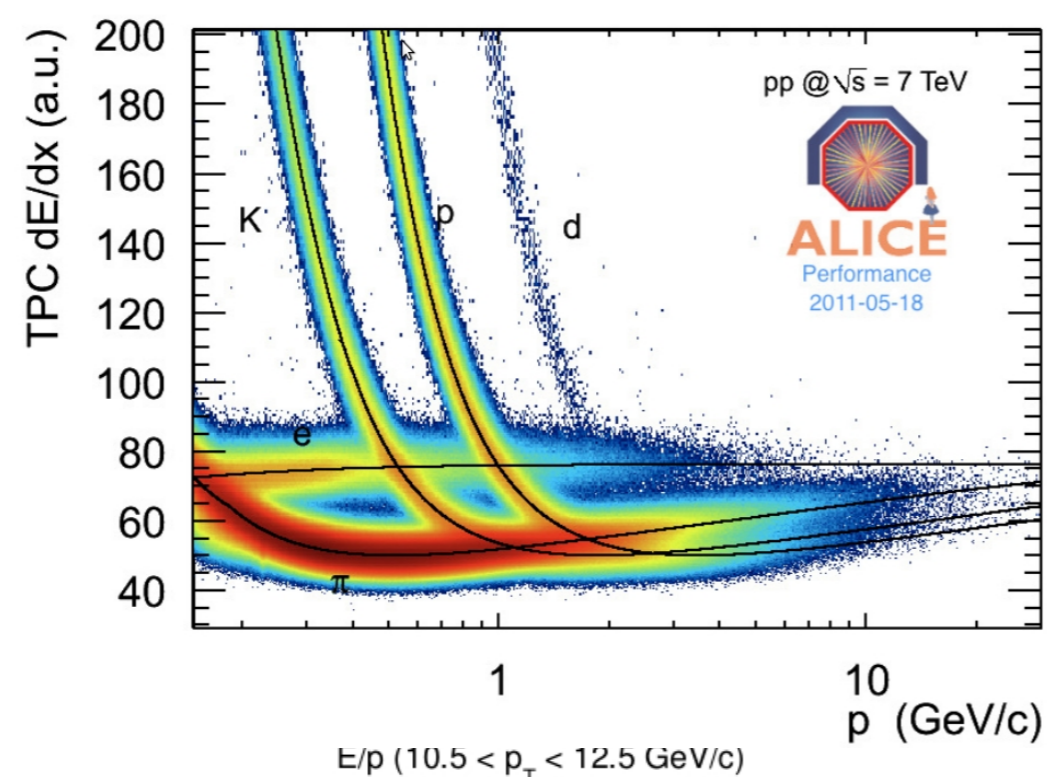
## 2. Method and data sample

- Electrons are identified using the particle identification capabilities of the ALICE detector (section 3)
- Azimuthal angular correlation between HF decay electrons and hadrons is calculated
- Using the correlation distribution we can extract:
  - Relative beauty contribution to the HF decay electron yield, using the difference of decay kinematics of B and D hadrons by fitting Monte Carlo templates to the correlation distribution on the near side (section 4)
  - Yield per trigger, by fitting the near-side correlation peak with a Gaussian. This measurement forms a baseline for heavy ion collisions (section 5)
- Data sample:
  - Electromagnetic Calorimeter (EMCal) triggered events at  $\sqrt{s} = 7$  TeV
  - Detectors: Inner Tracking System ( $|\eta| < 0.9$ ), Time Projection Chamber ( $|\eta| < 0.9$ ) and EMCal ( $|\eta| < 0.7$ ,  $80 < \phi < 180^\circ$ )
  - Statistics:  $6.3 \times 10^6$  events



## 3. HF-decay electron identification

- Electron identification using TPC and EMCal information
- Track selection:
  - $-1 < \frac{(dE/dx) - (dE/dx)_e}{\sigma_e} < 3$
  - $0.8 < E/p < 1.2$
- Non-heavy flavour electrons
  - Main sources:  $\gamma$  conversions and  $\pi^0$ ,  $\eta$  Dalitz decays
  - Identified using  $e^+e^-$  invariant mass distribution
  - Invariant mass cut of  $100 \text{ MeV}/c^2$
  - Reconstruction efficiency around 70%



- Azimuthal angular correlation between HF electrons and charged hadrons is calculated using the inclusive electrons, the reconstructed non-HF electrons and the non-reconstructed non-HF electrons (using the reconstruction efficiency):

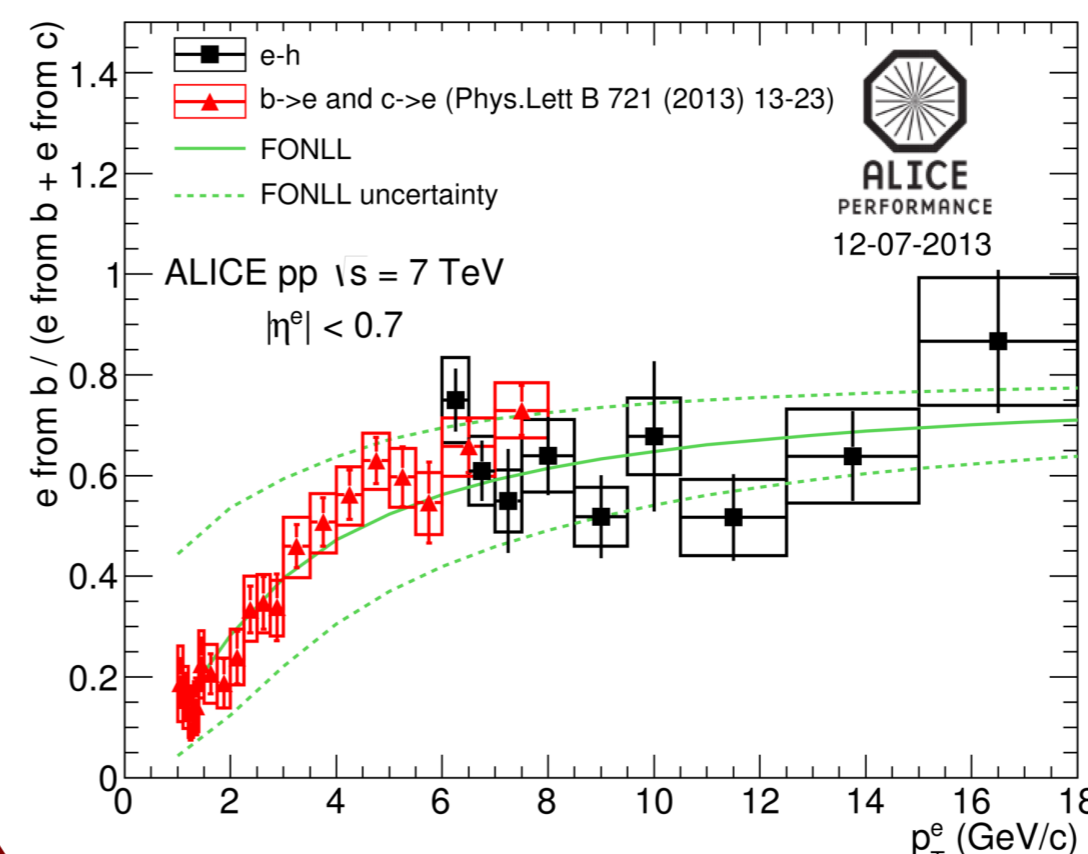
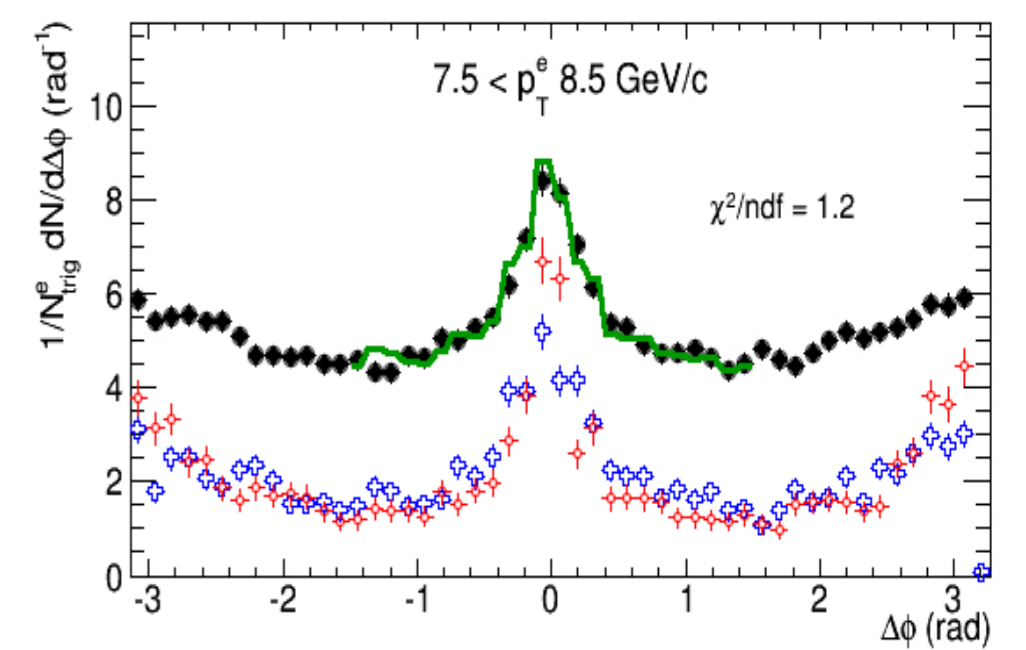
$$\frac{dN^{\text{HFE}}}{d\phi} = \frac{dN^{\text{incl E}}}{d\phi} - \frac{dN^{\text{reco NHFE}}}{d\phi} - \left(\frac{1}{\epsilon} - 1\right) \frac{dN^{\text{NHFE}}}{d\phi}$$

## 4. Fraction of beauty-decay electrons in pp collisions

- Measured azimuthal angular correlation of HF electrons is shown, together with the MC templates for beauty and charm decays
- The relative beauty contribution to the HF decay electron yield is calculated by fitting the function

$$\left(\frac{dN}{d\phi}\right)_{\text{data}} = c + r_B \left(\frac{dN}{d\phi}\right)_B + (1 - r_B) \left(\frac{dN}{d\phi}\right)_D$$

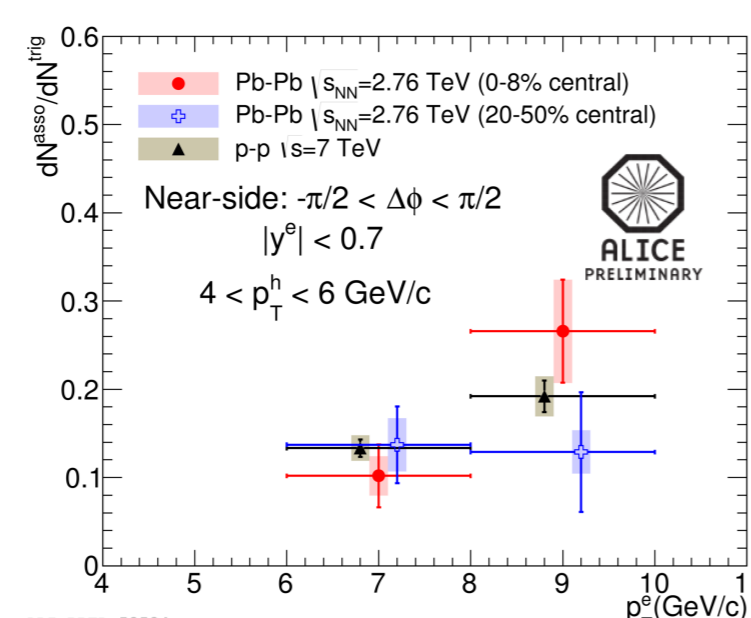
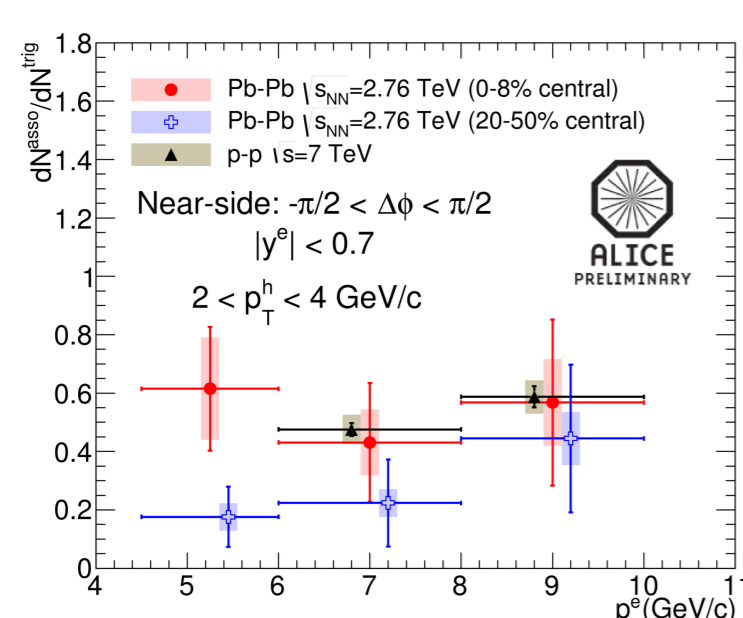
with  $r_B = \frac{N_B}{N_B + N_D}$  and  $c$  a constant corresponding to the uncorrelated background



- Relative beauty fraction as function of  $p_T^e$
- Measurement has a higher momentum range (16 GeV/c) compared to the cross section measurement that uses the impact parameter<sup>1</sup> (8 GeV/c)
- In agreement with each other in the overlapping region
- In agreement with First Order Next to Leading Log (FONLL) calculations<sup>2</sup>

## 5. Near-side yield comparison with Pb-Pb at $\sqrt{s}_{NN} = 2.76$ TeV

- Azimuthal correlation distribution also measured in central (0-8%) and semi-central (20-50%) Pb-Pb collisions at  $\sqrt{s}_{NN} = 2.76$  TeV
- In each analysis: near side correlation peak fitted with Gaussian
- Comparison of electron yield per trigger in two hadron momentum ranges:  $2 < p_T^h < 4$  GeV/c and  $4 < p_T^h < 6$  GeV/c



- Yields are the same within the large uncertainties, no modification observed
- High uncertainties on the Pb-Pb data points due to the statistic of the sample

## 6. Conclusions

- The azimuthal angular correlation distribution between heavy flavour electrons and charged hadrons was measured in pp collisions at  $\sqrt{s} = 7$  TeV with the ALICE detector.
- Using the different decay kinematics of electrons from B and D, the relative contribution of beauty to the heavy flavour decay electron yield was measured.
- An agreement was found between this measurement and previous measurements using the impact parameter method.
- FONLL perturbative QCD calculations are also in agreement within the uncertainties.
- In addition, the near side yield was measured in pp collisions and (semi-)central Pb-Pb collisions at  $\sqrt{s}_{NN} = 2.76$  TeV.
- The observed yields of the different colliding systems are the same within the statistical and systematic uncertainties.
- No modification observed, however this analysis is limited by the statistic of the Pb-Pb data sample.

References:  
<sup>1</sup>ALICE Collaboration, Phys. Lett. B 721, 13 (2013).  
<sup>2</sup>M. Cacciari et al, JHEP 1210, 137 (2012).