Elliptic flow of heavy-flavour decay electrons at $\sqrt{s_{NN}}$ = 2.76 TeV with the ALICE detector

Andrea Dubla for the ALICE collaboration

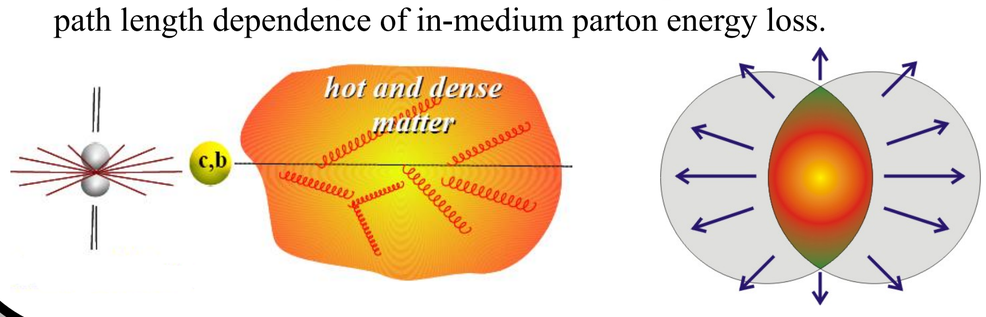
Institute of Subatomic Physics

Utrecht University, The Netherlands

Email : andrea.dubla@cern.ch

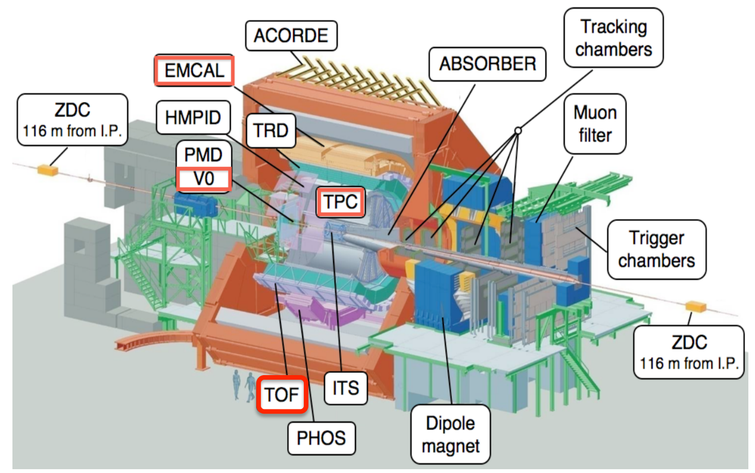
Motivation

- Heavy-quarks are produced in the early stages of heavy-ion collisions, carrying information on the full evolution of the hot and dense plasma of quarks and gluons (QGP) created in such collisions.
- Because of their large masses ,they are expected to lose less energy than light quarks and gluons. They thus provide a unique test of parton energy loss models.
- At low p_T , the elliptic flow of the heavy-flavour decay electrons is sensitive to the degree of thermalization of charm and beauty quarks in the medium. At higher p_T , the measurement of v_2 carries information on the path length dependence of in-medium parton energy loss.

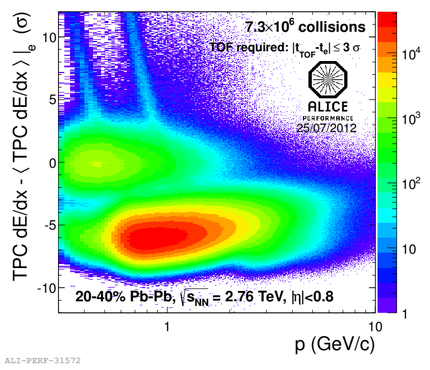


ALICE detector

- Electron identification:
- TPC • EMCal • TOF
- Centrality:
- VZERO Multiplicity
- 20-40% central Pb-Pb
- Event Plane reconstruction
- TPC • VZERO
- Event Selection:
- MB trigger (2010)
  2.8×10^6 events
  only TPC+TOF PID
- Semi-Central trigger (2011)
  8×10^6 events
- Single-shower trigger (EMCal trigger)
  1.3×10^6 events

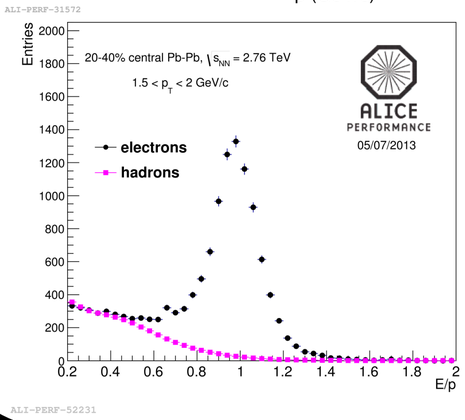


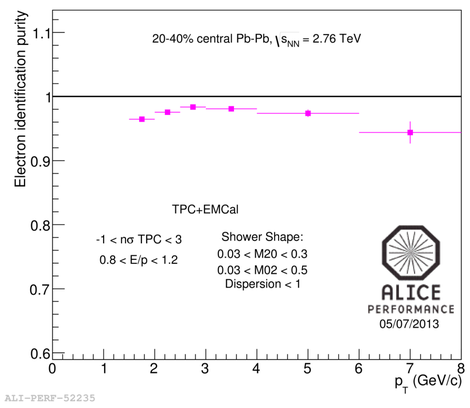
Electron identification



Different PID strategies were used to select the electron candidates.

- TPC + TOF
  - $1.5 < p_T < 6$ GeV/c
  - $-3 < n\sigma$ TOF < 3; $-1 < n\sigma$ TPC < 3
- TPC + EMCal
  - $1.5 < p_T < 13$ GeV/c
  - $-1 < n\sigma$ TPC < 3 ; $0.8 < E/p < 1.2$

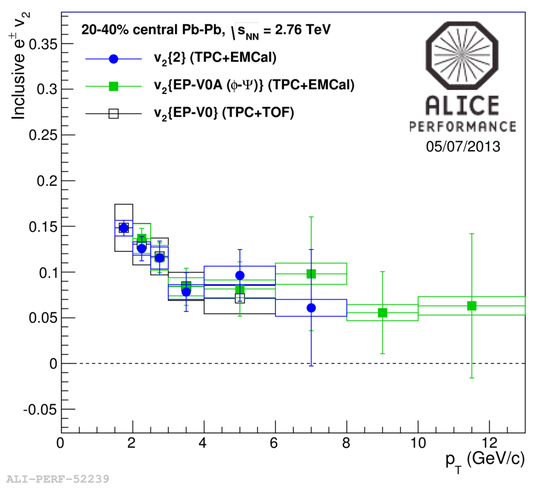


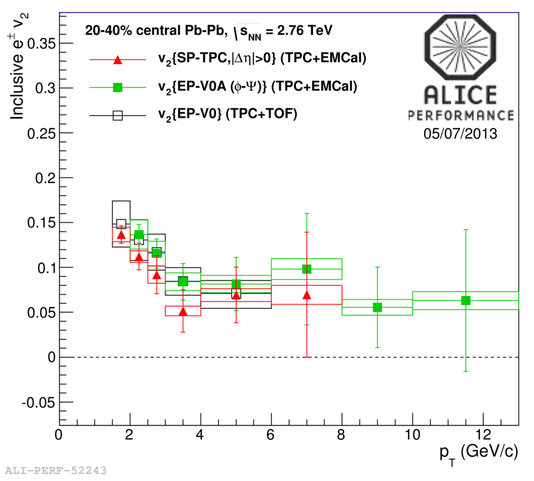


Inclusive electron v_2

$$E\frac{d^3N}{d^3p} = \frac{d^3N}{p_t dp_t dy d[\phi - \Psi_n]} = \frac{1}{2\pi}\frac{d^2N}{p_t dp_t dy}\left(1 + \sum_{n=1}^{\infty} 2v_n(p_t, y)\cos[n(\phi - \Psi_n)]\right)$$

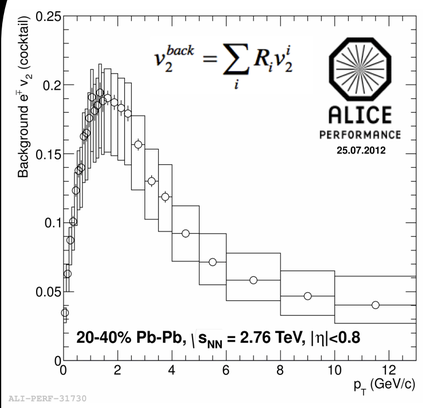
The elliptic flow is the second Fourier coefficient of the azimuthal distribution of particle momenta in the transverse plane with respect to the symmetry plane Ψ_n.



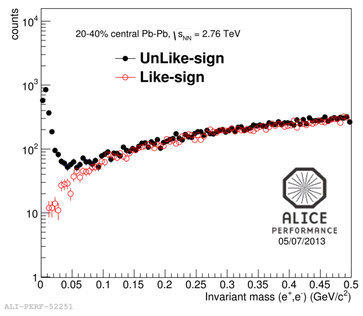


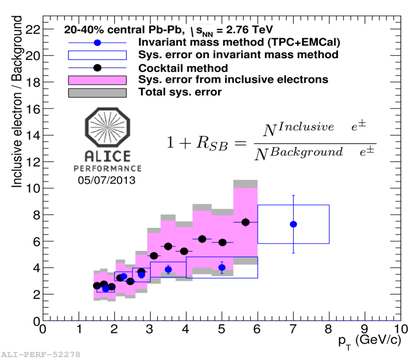
- Different approaches to evaluate v_2:
  - Event plane (estimator of the symmetry plane) method.
  - Multiparticle correlation methods Q-Cumulants and Scalar Product.
- Agreement among the different methods and different PID procedures is observed.

Background: non heavy-flavour decay electron



- Main background sources: π^0, η and γ conversion
- The v_2^{back} and the signal over background ratio (R_{SB}) were estimated using Monte Carlo simulation (cocktail) and invariant mass method.
- **Cocktail simulation:** based on the measured elliptic flow and p_T distributions of hadrons
- **Invariant mass**: based on the reconstruction of e^+e^- (ULS) pairs from photonic conversions and Dalitz decays by selecting on their invariant mass. Like sign pairs (LS) are used to estimate the combinatorial background to the ULS pairs.



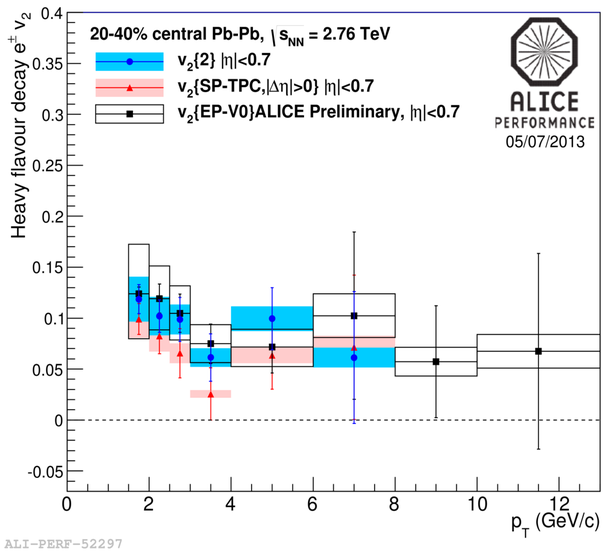


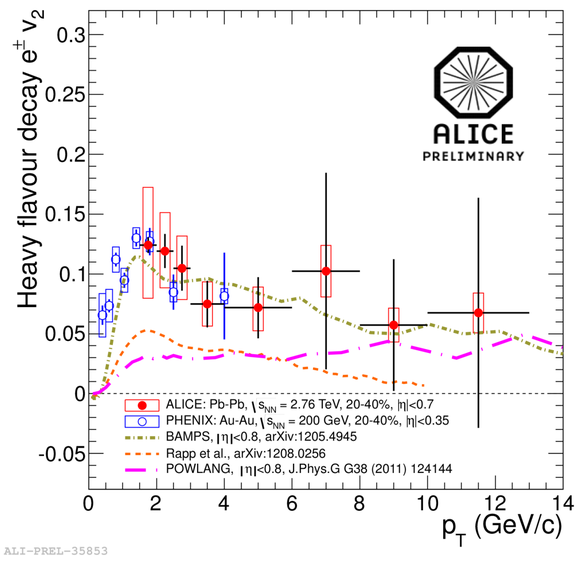
- $\mathbf{v_2^{back}}$**:** from cocktail.
- $\mathbf{R_{SB}}$ **:**
  → SP & QC : from invariant mass method.
  → EP : from cocktail.

Heavy-flavour decay electron v_2

The heavy-flavour electron v_2 is extracted form the inclusive one after subtracting the background contribution according to the equation:

$$v_2^{HFE} = \frac{(1+R_{SB})v_2^{incl} - v_2^{back}}{R_{SB}}$$





- $v_2 > 0$ → 3σ effect at low p_T
- Different methods to extract v_2 produce comparable results within uncertainties.
- Results were compared to measurements at lower energy by PHENIX at RHIC ($\sqrt{s_{NN}}$ = 200 GeV) and with theoretical models.

Conclusions

- Good agreement is observed among the different analysis methods and electron PID selections used to evaluate the elliptic flow of electrons from heavy-flavour hadron decays.
- The invariant mass method provides compatible results with respect to the cocktail simulation within the systematic error bars.
- Non-zero v_2 of heavy-flavour decay electrons was observed in 20- 40% Pb-Pb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV.
- $v_2 > 0$ at low p_T (3σ effect has been observed) indicates strong re-interaction of heavy quarks in the created hot and dense partonic medium.