Elliptic flow of electrons from heavy-flavour hadron decays in Pb-Pb collisions 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 (HFE) 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.

Electron identification
Different PID strategies were used to select the electron candidates.
- \( \text{ITS} + \text{TOF} + \text{TPC} \)
- \( 0.5 < p_T < 3 \) GeV/c
- \( \text{TPC} + \text{TOF} \) (20-40% centrality class)
- \( 1.5 < p_T < 6 \) GeV/c
- \( \text{TPC} + \text{EMCal} \)
- \( 1.5 < p_T < 13 \) GeV/c

Similar purity evaluated using ITS+TOF+TPC and TPC+EMCal PID for \( p_T > 3 \) GeV/c.

Background: photonic electrons
- Main background sources: \( \gamma \) conversion, \( m^+ \) and \( \eta \) decay.
- The \( v_2 \) signal and the background ratio (R_{\text{bg}}) were estimated with two methods.
- Cocktail simulation: based on the measured elliptic flow and \( p_T \) distributions of charged pions and direct \( \gamma \) in ALICE (cocktail \( v_2 \) is used for \( p_T > 1.5 \) GeV/c).
- Invariant mass: based on the reconstruction of ee\' pairs (ULS) from photon conversions and Dalitz decays with small invariant mass. Like sign pairs (LS) are used to estimate the combinatorial background to the ULS pairs.

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

\[
\frac{dN}{dp_T} = \frac{1}{2}\cos[2(\phi - \Phi_{\text{AP}})]
\]

Inclusive electron \( v_2 \)
The elliptic flow is the second Fourier coefficient of the azimuthal distribution of particle momenta in the transverse plane with respect to the reaction plane \( \Phi_{\text{AP}} \).

Inclusive electron \( v_2 \) is evaluated in different centrality classes:
- Event plane (estimator of the reaction plane) method.
- Smooth transition of electron \( v_2 \) in \( p_T \) using different PID strategies.
- Clear centrality dependence of the \( v_2 \) coefficient.

Conclusions
- Good agreement is observed among the different electron identification strategies.
- Consistent results between the invariant mass and the cocktail methods.
- Centrality dependence observed for the heavy-flavour decay electron \( v_2 \).
- Non zero \( v_2 \) of heavy-flavour decay electrons was observed in Pb-Pb collisions at \( \sqrt{s_{NN}} = 2.76 \) TeV → indicates strong re-interaction of heavy quarks in the created hot and dense partonic medium.