Prospects for measuring angular correlations between heavy-flavour hadron decay electrons and jets with the ALICE detector

A. Rossi, CERN for the ALICE Collaboration

PHYSICS GOALS

Address charm and beauty interaction with the medium studying modification to heavy-flavour jet production and properties in Pb-Pb collisions with respect to pp and p-Pb collisions

- In-medium energy loss, both radiative and collisional, predicted to be smaller for heavy quarks with respect to light quarks and gluons.
- Mass dependence stronger at low pt.
- With jets: probe energy loss and angular distribution of the radiated energy.
- Possible medium modification to heavy-flavour parton shower properties.

With heavy-flavour hadron decay electron – jet azimuthal correlations:

- Probe energy loss, quantifying the away-side jet pt-spectrum modification with respect to pp and p-Pb.
- “Surface bias”: trigger-particle parent quark produced closer to the surface, going outward.
- Sensitivity to energy loss dependence on path length, expected L (L=) for collisional (radiative) energy loss.

EXPLOITING EMICAL TRIGGER

EMICAL \((\Delta \eta \Delta \phi = 1.4 \times 1.87, 4.35 < r < 7.7, \) tower size: \(\Delta \eta \Delta \phi = 0.014 \times 0.014\) can provide L0 and L1 trigger with centrality dependent thresholds for L1.

- Select at trigger level events with high-p_T electrons

Trigger topology and energy thresholds (typical values used during pp run in 2013):
L0: 4x4 towers, \(E > 2 \text{ GeV/c}\)
L1: Single Shower patch: 4x4 towers, \(E > 10.2 \text{ GeV/c}\).
L2-Jet Patch: 32x32 towers, \(E > 15.7 \text{ GeV/c}\).

ANALYSIS STRATEGY

- Electron identification.
- Reject photonic electrons by requiring a point in the innermost ITS layer and by rejecting electrons that, when paired with an opposite-sign track of the event, give rise to a \(e^+e^-\) pair with an invariant mass \(M > 0.1 \text{ GeV/c}^2\).
- Correlate selected electrons with reconstructed charged jets.
  - In Pb-Pb case: jet energy correction to remove the contribution of background (with density \(p_T\), event-by-event, \(p_T^{\text{jet}} = p_T^{\text{jet}} - p_T^{\text{background}}\)).
  - Subtract contamination of residual hadron-jet azimuthal correlations.
  - Correction for electron selection efficiency and residual contamination of background electrons.
- Unfolding of the away-side jet pt spectrum to account for detector effects and, in Pb-Pb, background fluctuations.
- In Pb-Pb collisions (before unfolding): subtract the spectrum obtained with low pt trigger electrons to that obtained from electrons in a higher pt range to decrease the relevance of background fluctuations.
- Obtain the corrected “per-trigger” jet pt-spectrum in the away-side.

OUTLOOK

Away-side b-jet pt spectrum (Pythia) + FONLL prediction of beauty decay electron cross-section + 30% electron efficiency (independent in p_T) used to estimate the statistical uncertainty on the recoil jet pt spectrum for an integrated luminosity of \(L_{\text{int}} = 1 \text{ pb}^{-1}\) for pp collisions at \(\sqrt{s} = 8 \text{ TeV}\).

Analysis ongoing with pp, p-Pb and Pb-Pb data from Run 1 at LHC.