Angular correlations of heavy-flavour hadron decay electrons with charged particles in p-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV with the ALICE detector

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1 Motivation

- Baseline: p-Pb collisions are used to understand the medium formed in Pb-Pb collisions: jet properties, cold nuclear matter effects and collective behavior
- A double ridge (Figure 1) was observed in Pb-Pb and in high-multiplicity pp and p-Pb collisions [1-4].
- Although in Pb-Pb collisions it is due to collective motion, the origin of this phenomenon is still in debate, specially regarding the role of hydrodynamics and initial conditions

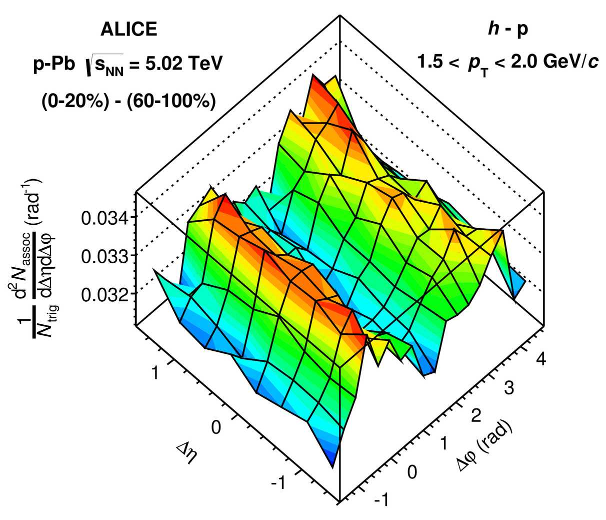

Figure 1: Jet subtracted h-p correlations in p-Pb collisions[1]

2 Heavy quarks

- Angular correlations of heavy quarks with charged particles access heavy quark fragmentation and jet properties and possible double ridge effect in small systems
- Charm and beauty hadrons can be identified using their semi-leptonic decay into electrons (Figure 2, branching fraction ~10% [5])

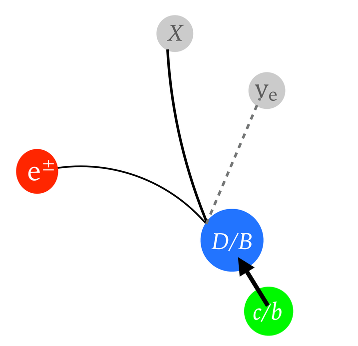

Figure 2: Heavy-quark decay into electron

3 ALICE Experiment

Detectors used in the analysis:

- Tracking: Inner Tracking System (ITS) and Time Projection Chamber (TPC)
- Particle identification: TPC and Time of Flight (TOF)
- Event trigger and centrality selection: Zero Degree Calorimeters (ZDCs) and V0s

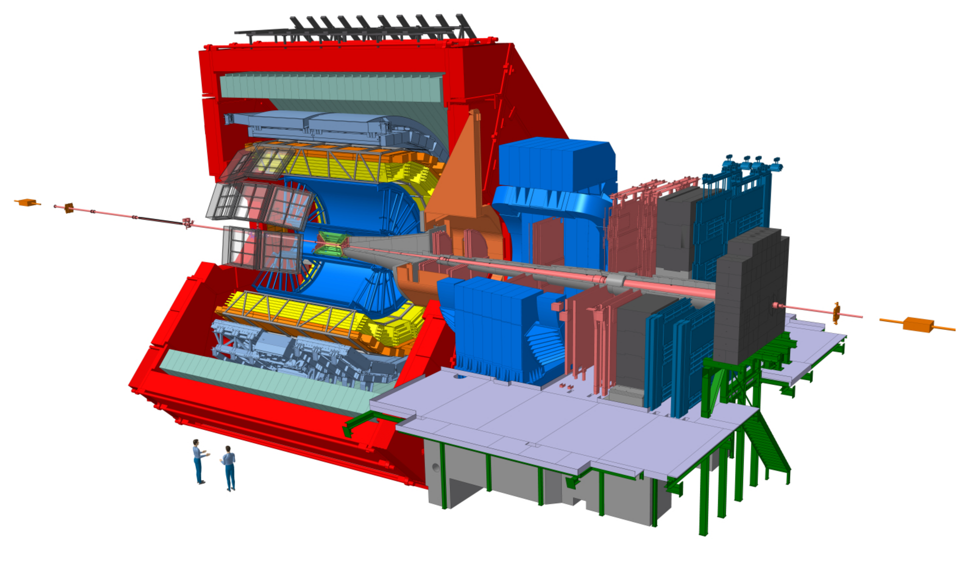

Figure 3: ALICE Schematics as during Run 2

4 Procedure

Dataset: p-Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV recorded in 2016, ~610M events

Track acceptance: $|\eta_{lab}| < 0.8$

ZNA classes: 0-20%, 20-60%, 60-100%

Analysis steps:

- Electron identification and hadron contamination subtraction
- Background electrons identification and correction using simulations for the non-identified background
- Event mixing correction for limited acceptance and detector inhomogeneity

5 Electron identification

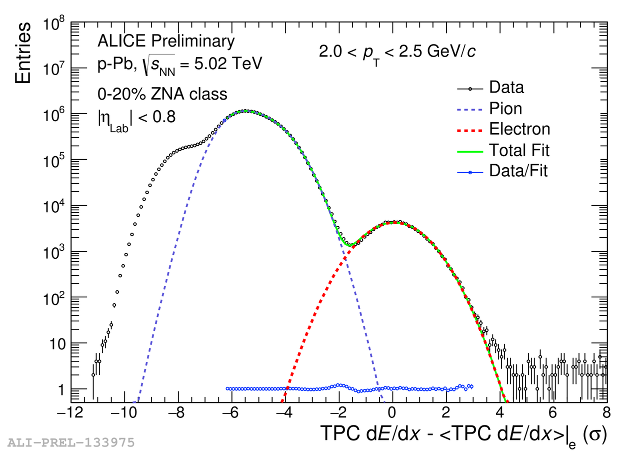

Figure 4: TPC $n\sigma^e_{TPC}$ after TOF cut

- Energy loss in the TPC (dE/dx): $-1 < n\sigma^e_{TPC} < 3$
- Time of flight: $|n\sigma^e_{TOF}| < 3$
- Contamination estimated using TPC $n\sigma^e_{TPC}$ fits shown in Figure 4
- Remaining contamination (< 1% for $p_T < 4$ GeV/c and < 10% for $4 < p_T < 6$ GeV/c) is subtracted using scaled hadron -hadron correlations

6 Event mixing

- The event-mixed distribution is obtained combining electrons with charged particles from different events with similar multiplicity and primary vertex position to correct for the pair acceptance and detector inhomogeneity. It is normalized to 1 at $\Delta\varphi = \Delta\eta = 0$
- The same event distribution (Figure 5) is divided by the mixed-event distribution (Figure 6) . The corrected result is shown on Figure 7.

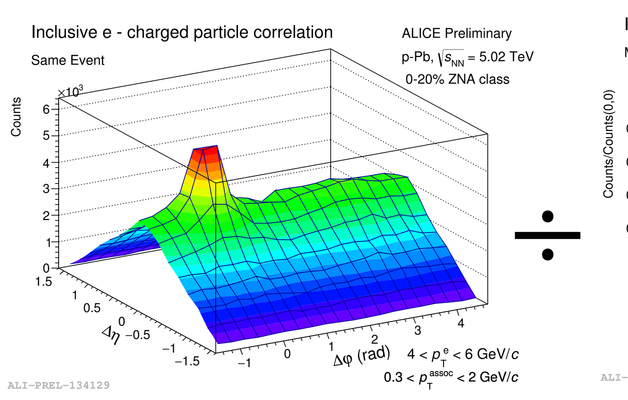

Figure 5: Inclusive electron same event distributions

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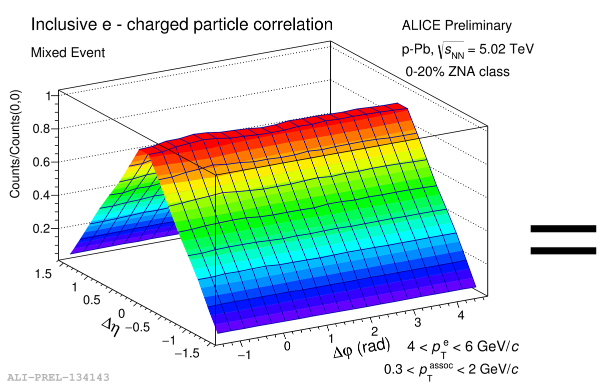

Figure 6: Inclusive electron mixed event distributions

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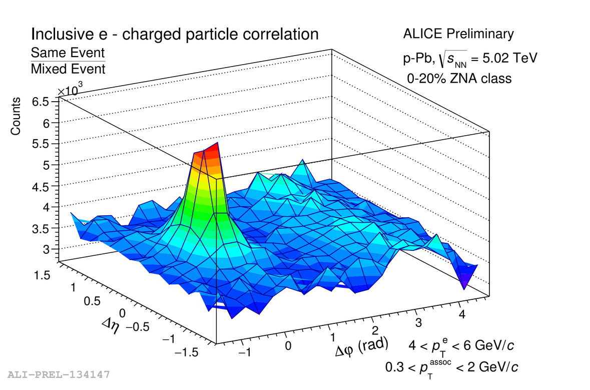

Figure 7: Corrected inclusive electron distributions

7 Photonic-electron tagging

- Main background sources are electrons from γ conversions and Dalitz decays of π^0 and η
- Photonic-electron tagging method[6]: unlike-sign pairs with invariant mass $m_{ee} < 140$ MeV/c^2 are selected
- The like-sign pairs are used to subtract the combinatorial background (Figure 8)

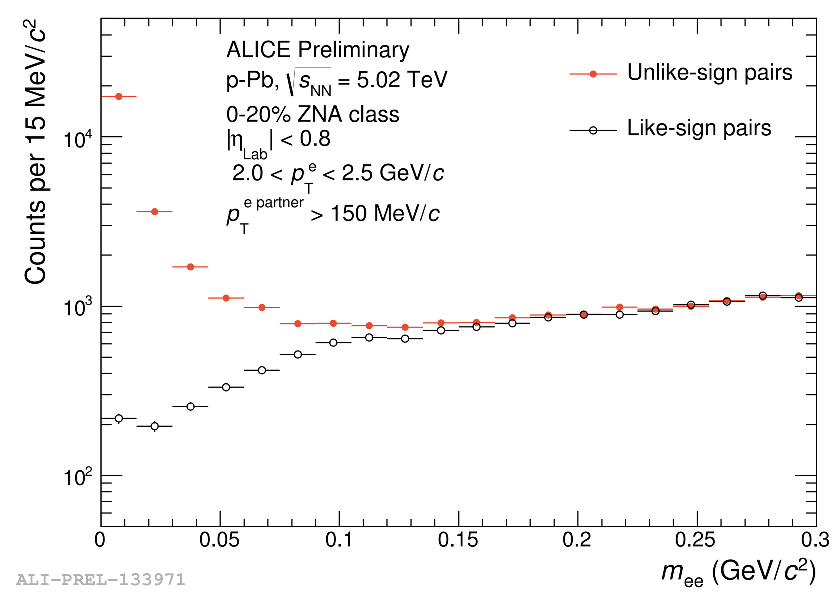

Figure 8: Invariant mass distribution for unlike-sign and like-sign pairs used for the background tagging

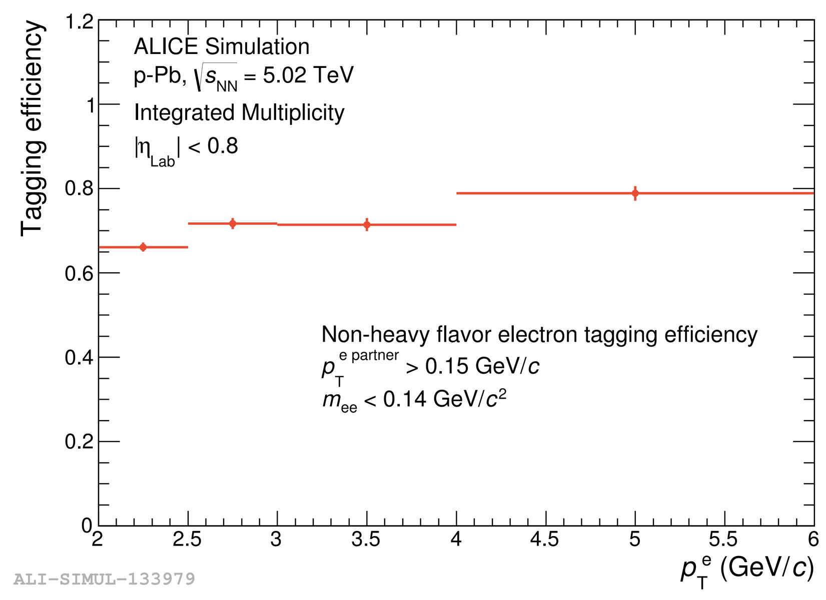

Figure 9: Tagging efficiency for photonic electrons obtained with HIJING Simulation

- Non-identified background ($h^{not\ ID}_{NHFe}$) is subtracted using the tagged background (ULS-LS), removing the identified partner from the correlation ($h^{id\ NoP}_{NHFe}$) and the tagging efficiency (ε_{tag}) obtained from HIJING simulation (Figure 9)

$$h_{HFe} = h_{Inc.} - h^{id}_{NHFe} - \left(\frac{1}{\varepsilon_{tag}} - 1\right) h^{id\ NoP}_{NHFe}$$

- Corrections for electron and charged-particle reconstruction efficiencies, and contamination of secondary particles

8 Results

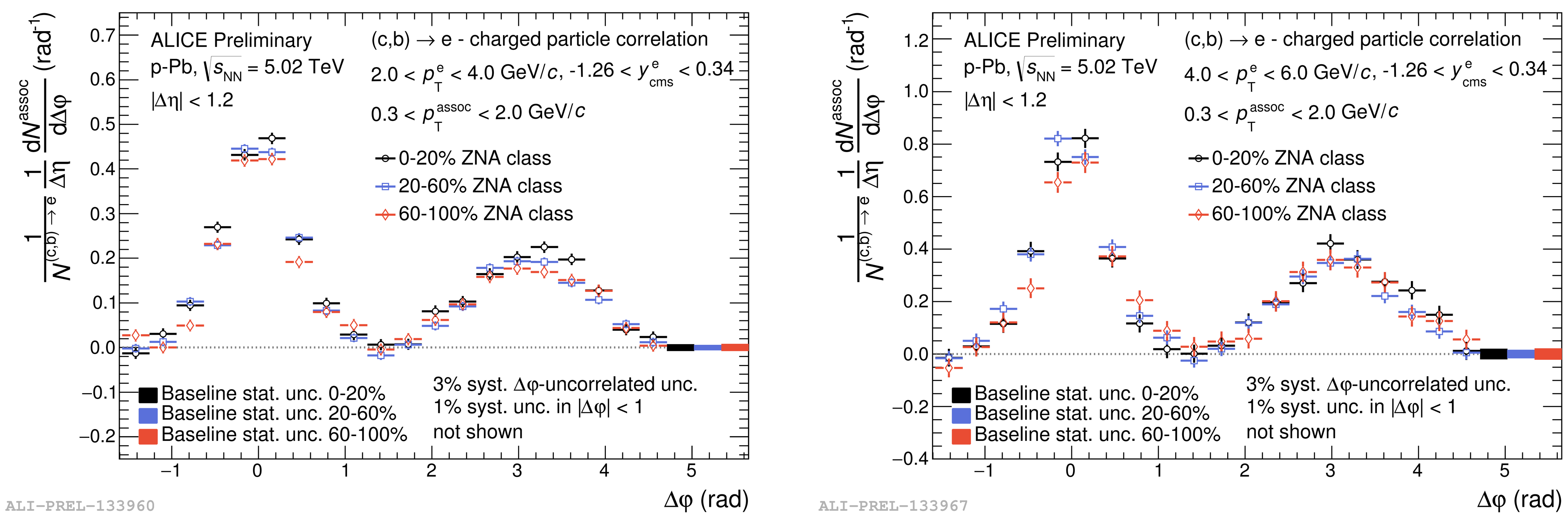

Figure 10: Azimuthal correlations of heavy-flavour decay electrons with charged particles in different ZNA classes

- Azimuthal correlations of heavy-flavour decay electrons with charged particles measured for p-Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV in ZNA classes 0-20%, 20-60% and 60-100% is shown in Figure 10
- Flat baseline assumed for subtraction
- The systematic uncertainties from charged-particles tracking and secondary-particles contamination are dominant

9 Conclusion and Outlook

- With the current precision we have the opportunity to investigate whether there is an modification of the correlation functions with multiplicity, that could be induced also by collective effect
- Extend the measurement to lower electron p_T and explore different charged-particle p_T intervals to investigate better possible modifications of the correlation function in central collisions

References

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[2] The CMS collaboration, Observation of long-range, near-side angular correlations in proton-proton collisions at the LHC. JHEP 1009 (2010) 091
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