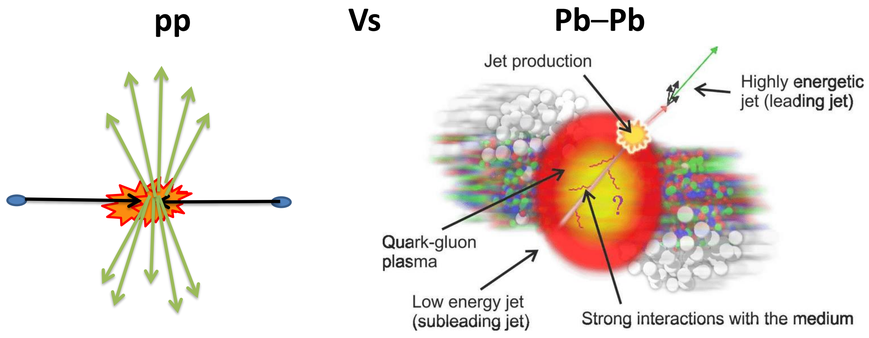
Particle-yield modification in jet-like azimuthal V^0–hadron correlations in Pb–Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV with ALICE at the LHC

Mustafa Anaam on behalf of the ALICE Collaboration

Motivation

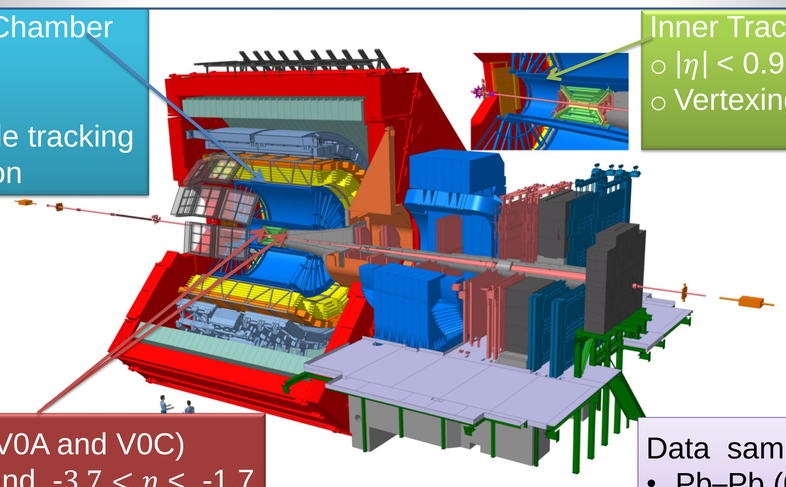


- One of the important goals of the heavy-ion physics program is to understand the mechanisms of energy loss that a parton traversing the quark–gluon plasma undergoes
- Two-particle angular correlations are a powerful tool to study jet quenching in a p_{T} region inaccessible by direct jet identification
- Interaction of quark and gluon jets with the medium can be studied via correlations using $\mathrm{K}^0_{\mathrm{s}}$ and Λ, considering that their relative production differs in quark and gluon jets

ALICE detector

Time Projection Chamber (TPC)
- $|\eta| < 0.9$
- Charged-particle tracking and identification

Inner Tracking System (ITS)
- $|\eta| < 0.9$
- Vertexing, triggering

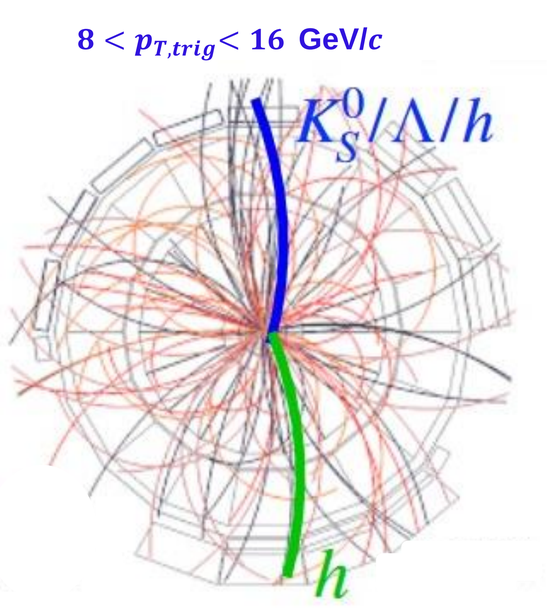


V0 scintillators (V0A and V0C)
- $2.8 < \eta < 5.1$ and $-3.7 < \eta < -1.7$
- Triggering, multiplicity and centrality determination

Data samples:
- Pb–Pb (0–10%) $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV
- pp $\sqrt{s} = 5.02$ TeV

Strange-hadron correlations

$8 < p_{T,trig} < 16$ GeV/c



$1 < p_{T,assoc} < 8$ GeV/c

1. Agular correlation is mesured

$$C(\Delta\varphi,\Delta\eta) = \frac{1}{N_{\mathrm{trig}}}\frac{d^2N_{\mathrm{assoc}}}{\mathrm{d}\Delta\varphi\mathrm{d}\Delta\eta} = \frac{\mathrm{S}(\Delta\varphi,\Delta\eta)}{\mathrm{M}(\Delta\varphi,\Delta\eta)}$$

$$\Delta\varphi = \varphi_{\mathrm{trig}} - \varphi_{\mathrm{assoc}}\,,\ \Delta\eta = \eta_{\mathrm{trig}} - \eta_{\mathrm{assoc}}$$

2. Background contribution is estimated

$$B(\Delta\varphi) = B_0\left(1 + 2\sum_n V_n\cos(n\Delta\varphi)\right)$$

$$V_n \approx v_n^{\mathrm{trig}}.v_n^{\mathrm{assoc}},\ n = 2,3$$

3. Jet is calculated

$$J(\Delta\varphi) = C(\Delta\varphi) - B(\Delta\varphi)$$

4. Associated yield is obtained

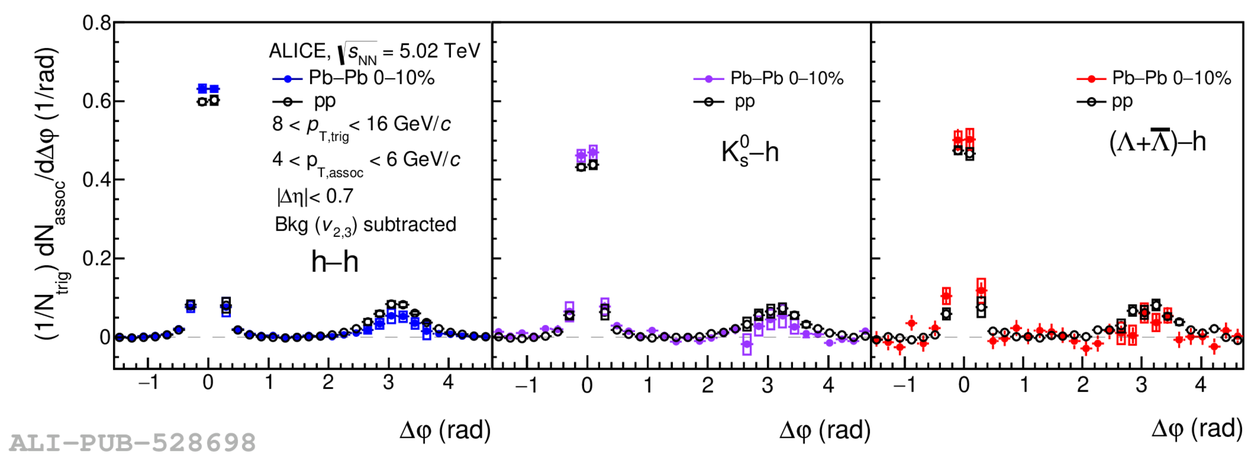
$$Y_{\Delta\varphi} = \int_X J(\Delta\varphi)\mathrm{d}\Delta\varphi$$

5. The yield ratio is taken

$$I_{AA}\frac{Y^{\mathrm{Pb-Pb}}_{\Delta\varphi}}{Y^{\mathrm{pp}}_{\Delta\varphi}}$$

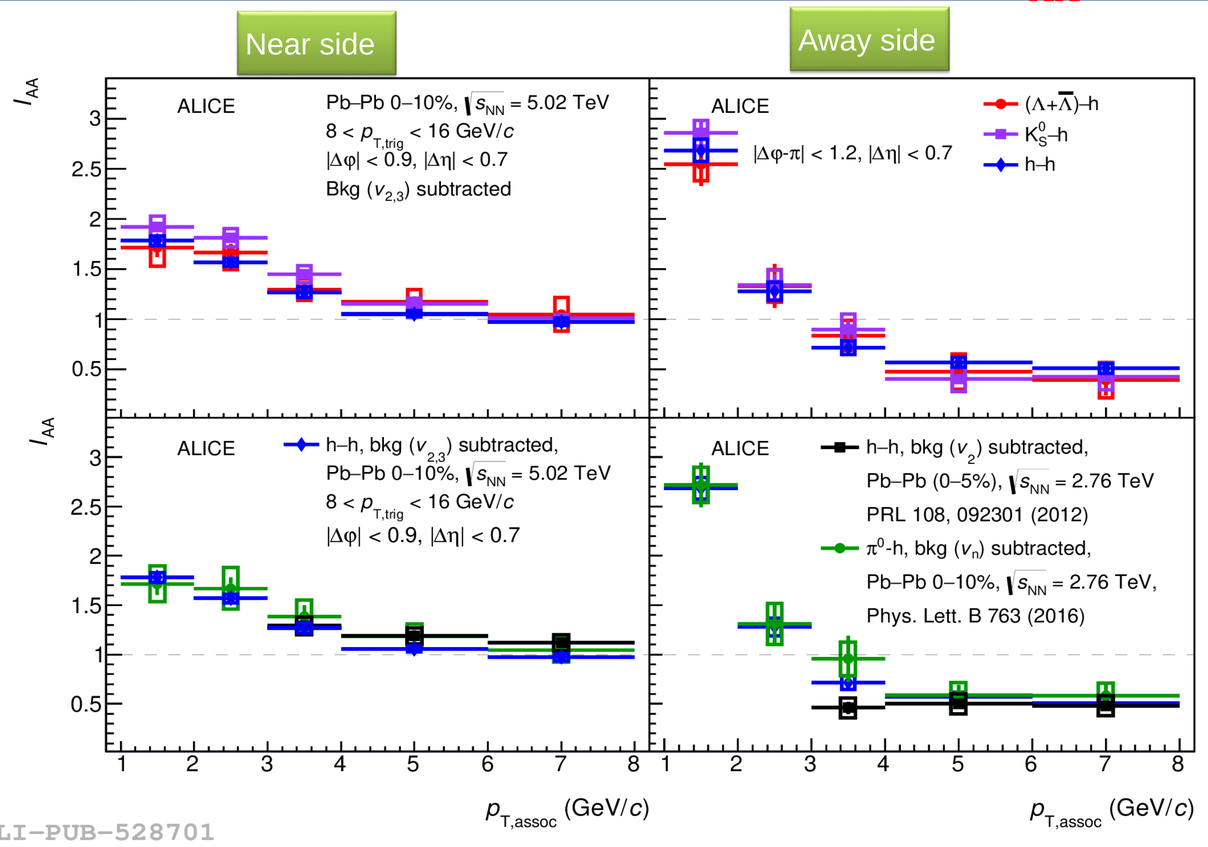
where X denotes either the near-side $|\Delta\varphi| < 0.9$ or the away-side $|\Delta\varphi - \pi| < 1.2$ region to be integrated

Results: $\Delta\varphi$ projections



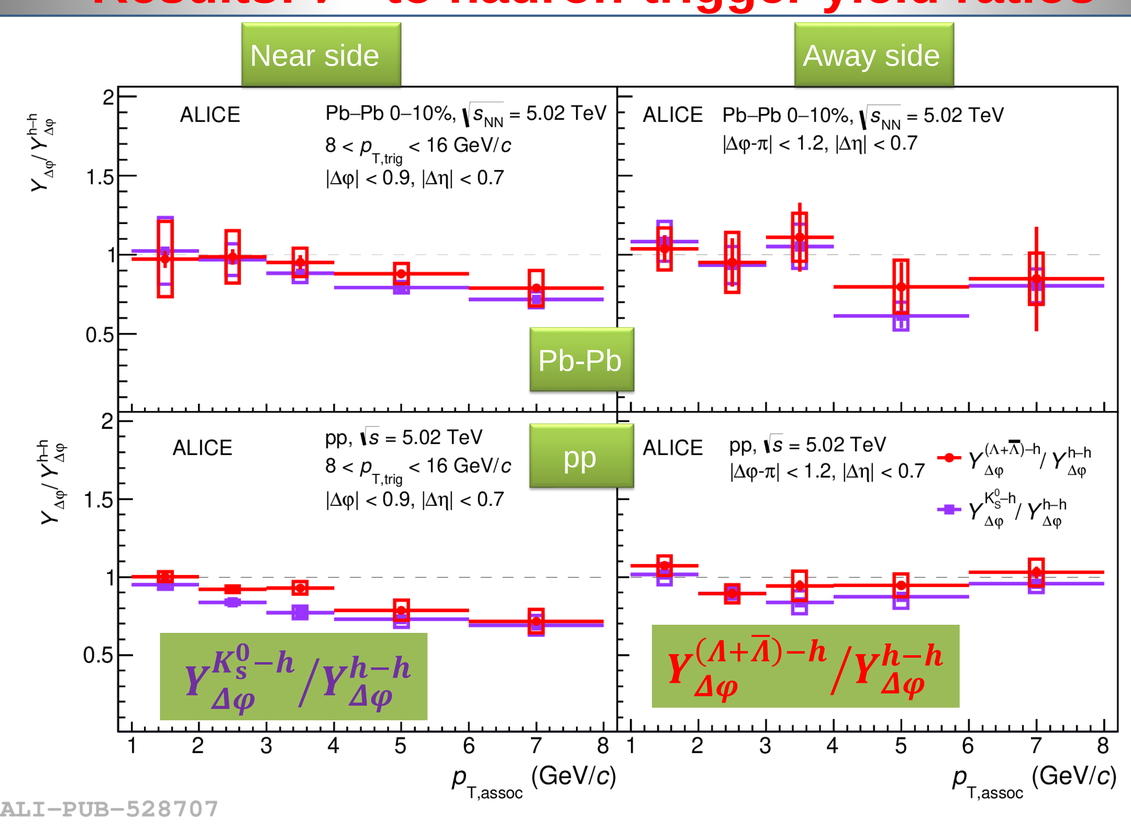
- The comparisons of $C(\Delta\varphi)$ distributions show a less pronounced away-side peak in central Pb–Pb collisions compared to pp collisions for three trigger-particle species

Results: Nuclear modification factor I_{AA}



- Away-side: a suppression of per-trigger yields in central Pb-Pb collisions for $p_{\mathrm{T,assoc}} > 3$ GeV/c is observed, while an enhancement of I_{AA} is present at low $p_{\mathrm{T,assoc}}$
- Near-side: strong enhancement at low $p_{\mathrm{T,assoc}}$, and no modifications at high $p_{\mathrm{T,assoc}}$
- No significant dependence of I_{AA} on particle species within uncertainties
- New measurement consistent with previous one at $\sqrt{s_{\mathrm{NN}}} = 2.76$ TeV [1][2]

Results: V^0 to hadron-trigger yield ratios



- A decreasing trend of the ratio with increasing $p_{\mathrm{T,assoc}}$ is observed on the near side for both Pb–Pb and pp collisions
- No difference between trigger $\mathrm{K}^0_{\mathrm{s}}$ and $(\Lambda + \bar{\Lambda})$ is observed except for a mild difference at mid $p_{\mathrm{T,assoc}}$ in near-side of pp collisions[3]

Summary

- Suppression of I_{AA} on the away side at high $p_{\mathrm{T,assoc}}$: consistent with energy loss of energetic partons in the medium
- No modification of I_{AA} on the near side at high $p_{\mathrm{T,assoc}}$: consistent with trigger particles predominantly coming from the vacuum-like fragmentation of hard partons
- Enhancement of I_{AA} on the away side at low $p_{\mathrm{T,assoc}}$: expected based on energy conservation"
- Enhancement of I_{AA} on the near side at low $p_{\mathrm{T,assoc}}$: near-side parton is also subject to medium effects
- No dependence of I_{AA} on the trigger-particle species
  - consistent with measurements of the nuclear modification factor R_{AA} of different hadron species for the considered $p_{\mathrm{T,trig}}$ range[4]

Mustafa.naji.anaam@cern.ch

References

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3. ALICE Collaboration, B. B. Abelev et al., Eur. Phys. J. C 81 no. 10, (2021) 945
4. ALICE Collaboration, B. B. Abelev et al., Phys. Lett. B 736 (2014) 196–207