Study On The Flow Of The Identified Particles In p-Pb Collisions At $\sqrt{s_{NN}}$ = 5.02 TeV

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2022 koALICE workshop

Outline

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   b. Two-particle correlations in small systems
2. **Analysis Method**
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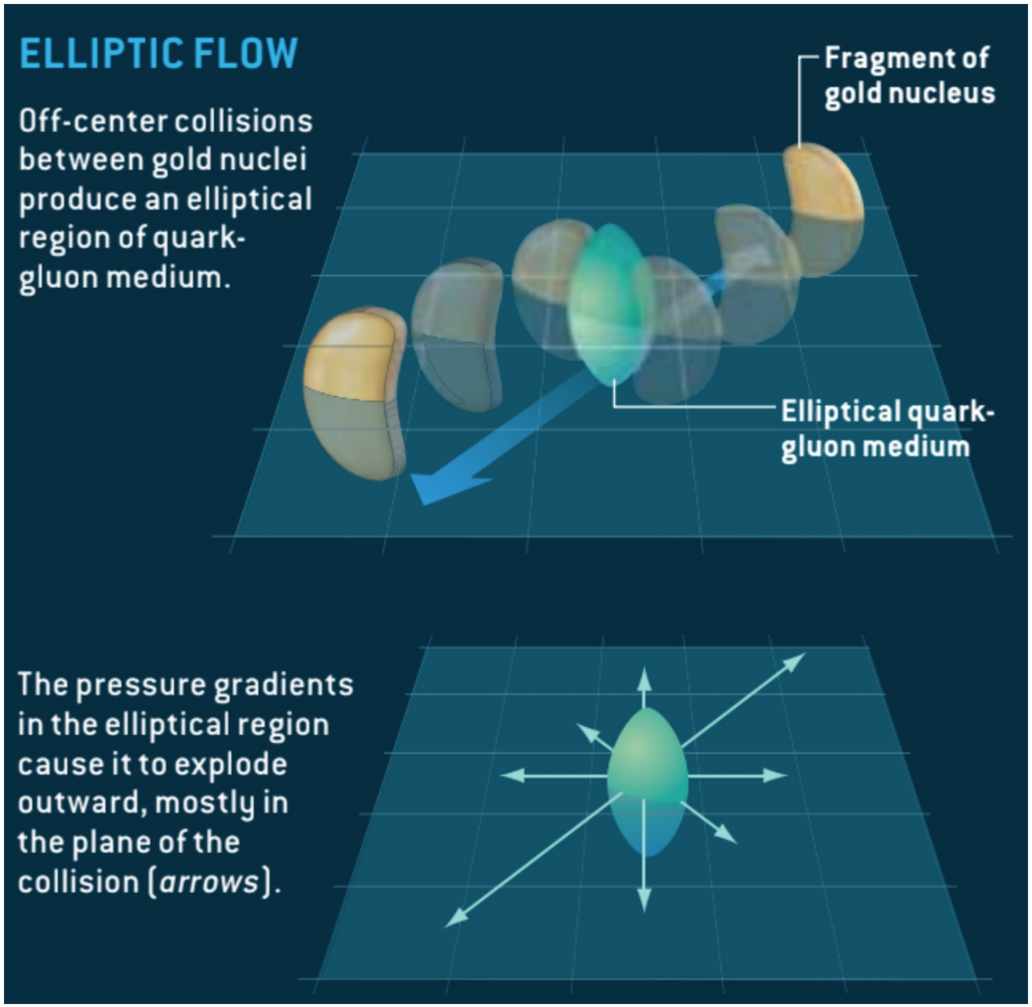
   b. Correlation function
   c. Template fit method
3. **Results**
   a. v_2 , v_3 vs p_T (centrality)
   b. Discussion
4. **Summary & Plan**

1-a. Introduction Particle correlations in heavy ion collisions

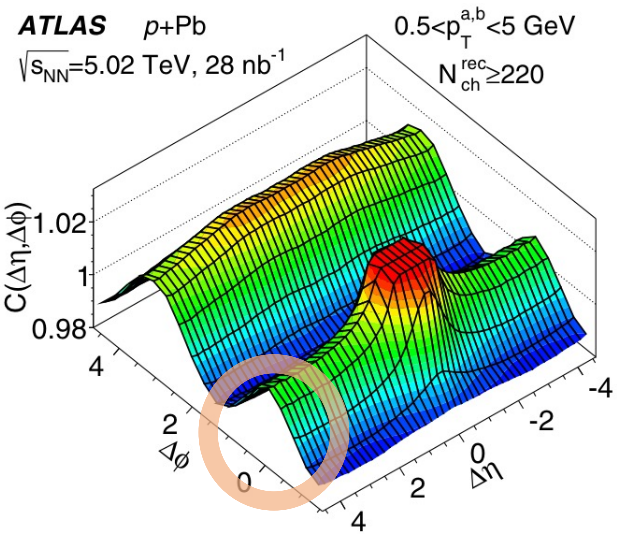


- Almond shape of QGP is formed in off-centre heavy-ion collision due to the the initial collision geometry
- More energetic hadrons squirt out in the plane of the interaction causing that emerge reach the detector in an elliptical distribution

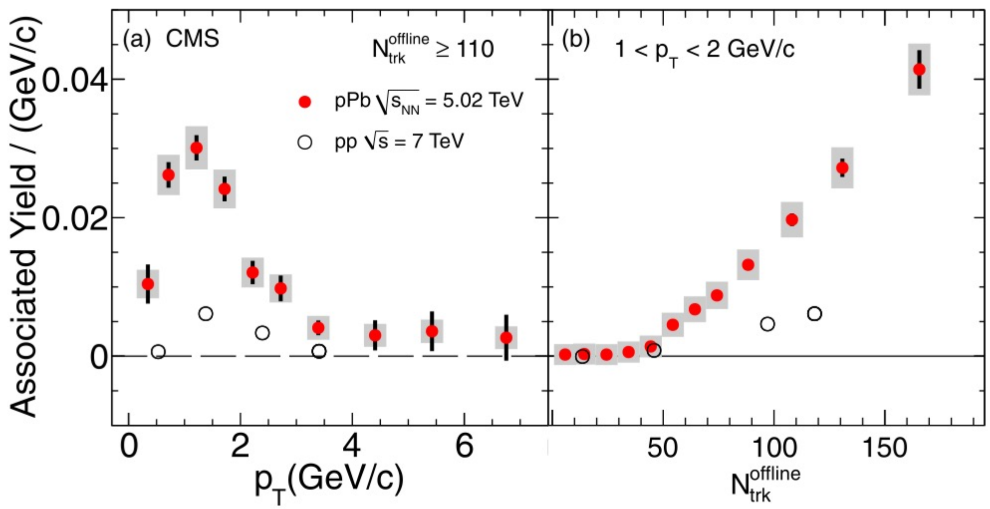
-> Angular correlation of the particles is seen

1-b. Introduction   Two-particle correlations in small systems

Phys. Rev. C. 96, 024908 (2017)



Phys. Lett. B. 718 (2013) 795-814

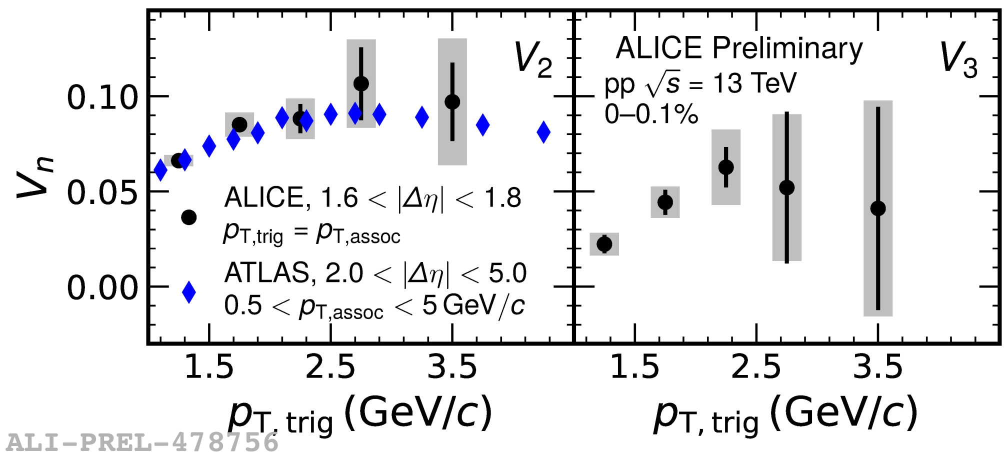


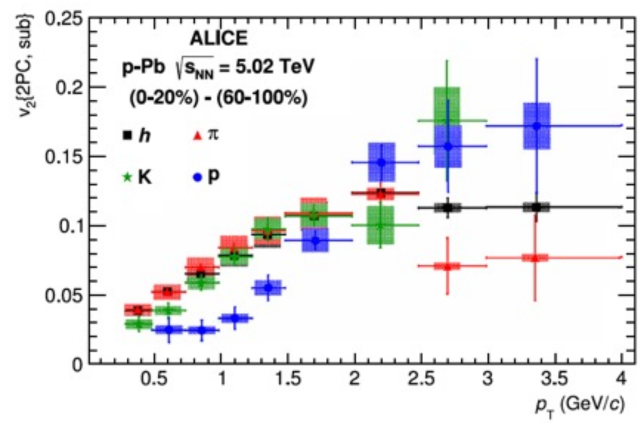
- Long-range azimuthal correlations has been studied in small collision systems.
- The origin of such collective behaviour in small systems is not clear yet.

  => More experimental measurements for different particles and/or collision systems can help to improve the current understanding.

1-b. Introduction Two-particle correlations in small systems

Phys. Lett. B 726 (2013) 164-177

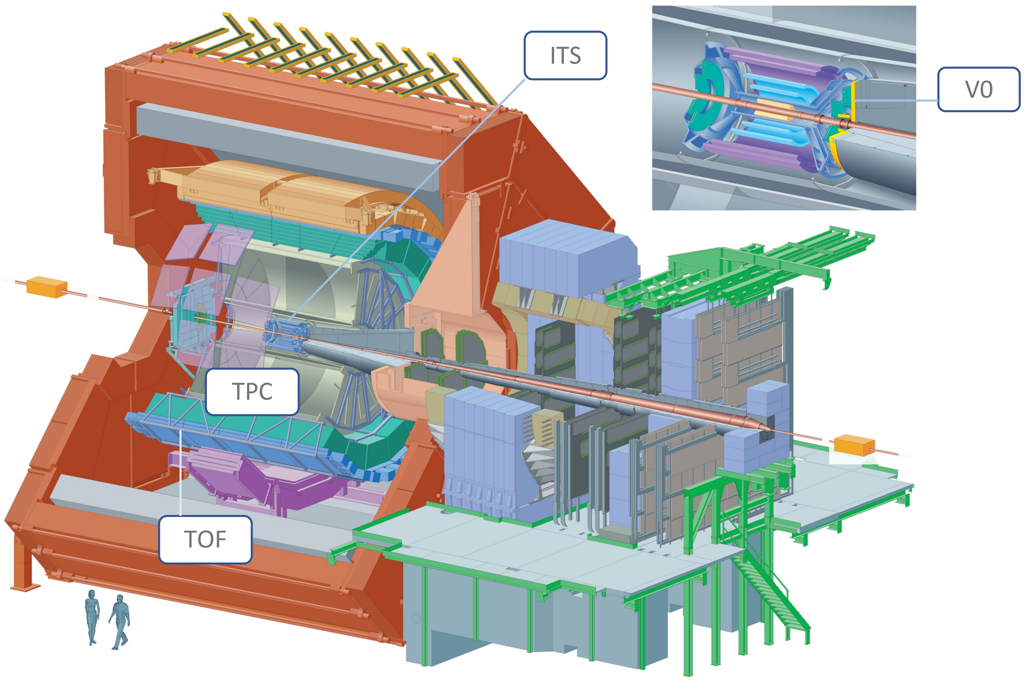




- v_2 and v_3 were measured using the template fit method in 0-0.1% pp collisions(left) in ALICE.
- We would like to apply the template fit method to measure v_n of the identified particles in p-Pb collisions with Run2 data (about 700M events were used).

2-a. Analysis Method Data set, event selection

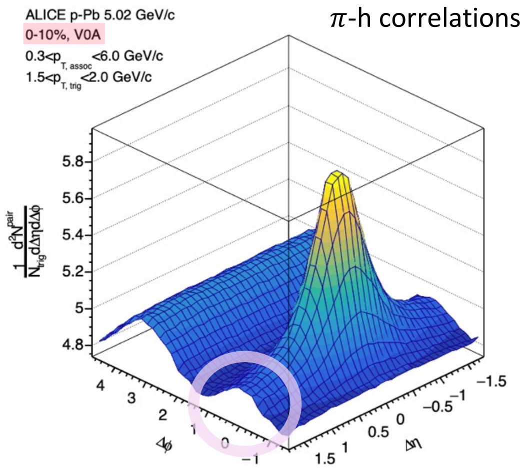
ALICE Run2 Detector

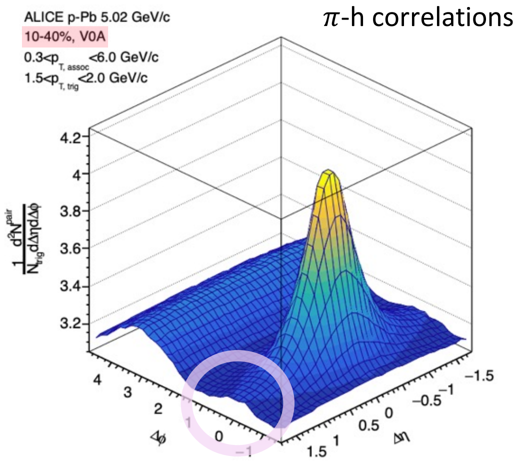


- Data set
  - 2016 p-Pb $\sqrt{s_{NN}}$ = 5.02 TeV
- Event Selection
  - Trigger selection : min-bias trigger
  - $|z_{vtx}| < 10$ cm
  - V0A Centrality
- Particle Identification
  - $\sqrt{N^2_{\sigma,PID}} = \sqrt{N^2_{\sigma,TPC} + N^2_{\sigma,TOF}} < 3$
  - Smaller $N_{\sigma,PID}$ is chosen when $N_{\sigma,PID}$ for two or more species are less than 3

2-a. Analysis Method

Correlation function ($|\eta|$<0.9, V0A (2.8<η<5.1))



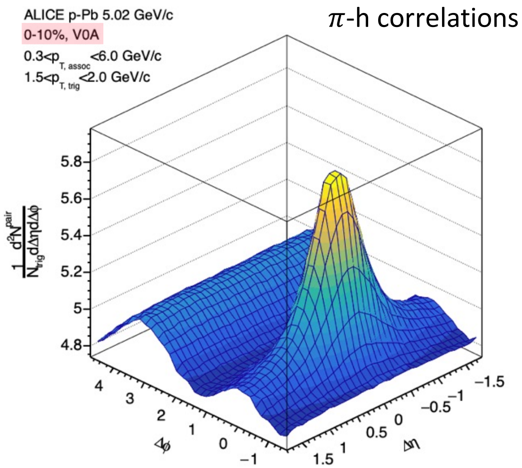


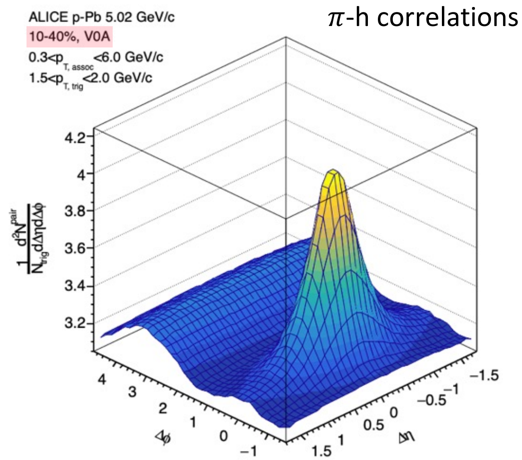
$$\frac{1}{N_{trig}}\frac{d^2N^{pair}}{d\Delta\eta d\Delta\phi} = B(0,0)\frac{S(\Delta\eta,\Delta\phi)}{B(\Delta\eta,\Delta\phi)}$$

- $0.3 < p_{T,\ assoc} < 6.0$ GeV/c,
  $0.5 < p_{T,\ trig} < 6.0$ GeV/c .
- Efficiency corrected
- High multiplicity
  : Centrality 0-10%, 10-40%
- Low multiplicity
  : Centrality 60-100%

2-b. Analysis Method

Template fit method ($|\eta|<0.9$, V0A ($2.8<\eta<5.1$))

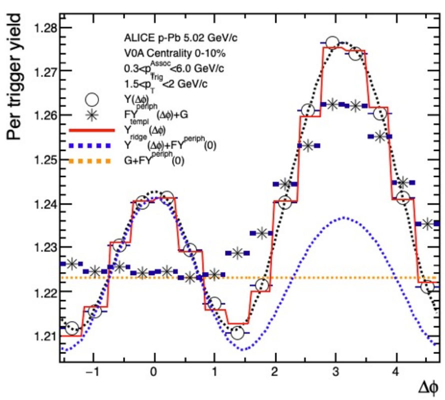


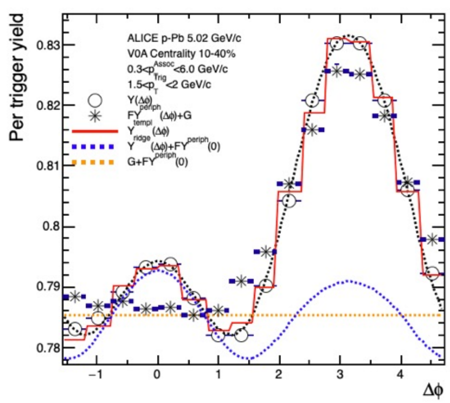


$$\frac{1}{N_{trig}}\frac{d^2N^{pair}}{d\Delta\eta d\Delta\phi} = B(0,0)\frac{S(\Delta\eta,\Delta\phi)}{B(\Delta\eta,\Delta\phi)}$$

- $Y^{templ}(\Delta\phi)$
  $= Y^{ridge}(\Delta\phi) + FY^{periph}(\Delta\phi)$
- $Y^{ridge}(\Delta\phi)$
  $= G\left(1 + \sum_{n=2}^{4} 2v_{n,n}\cos(n\Delta\phi)\right)$

- 1D Projection to $\Delta\phi$ direction in long-range ($1.0<|\Delta\eta|<1.8$)
- Template fitting to subtract the non-flow yield

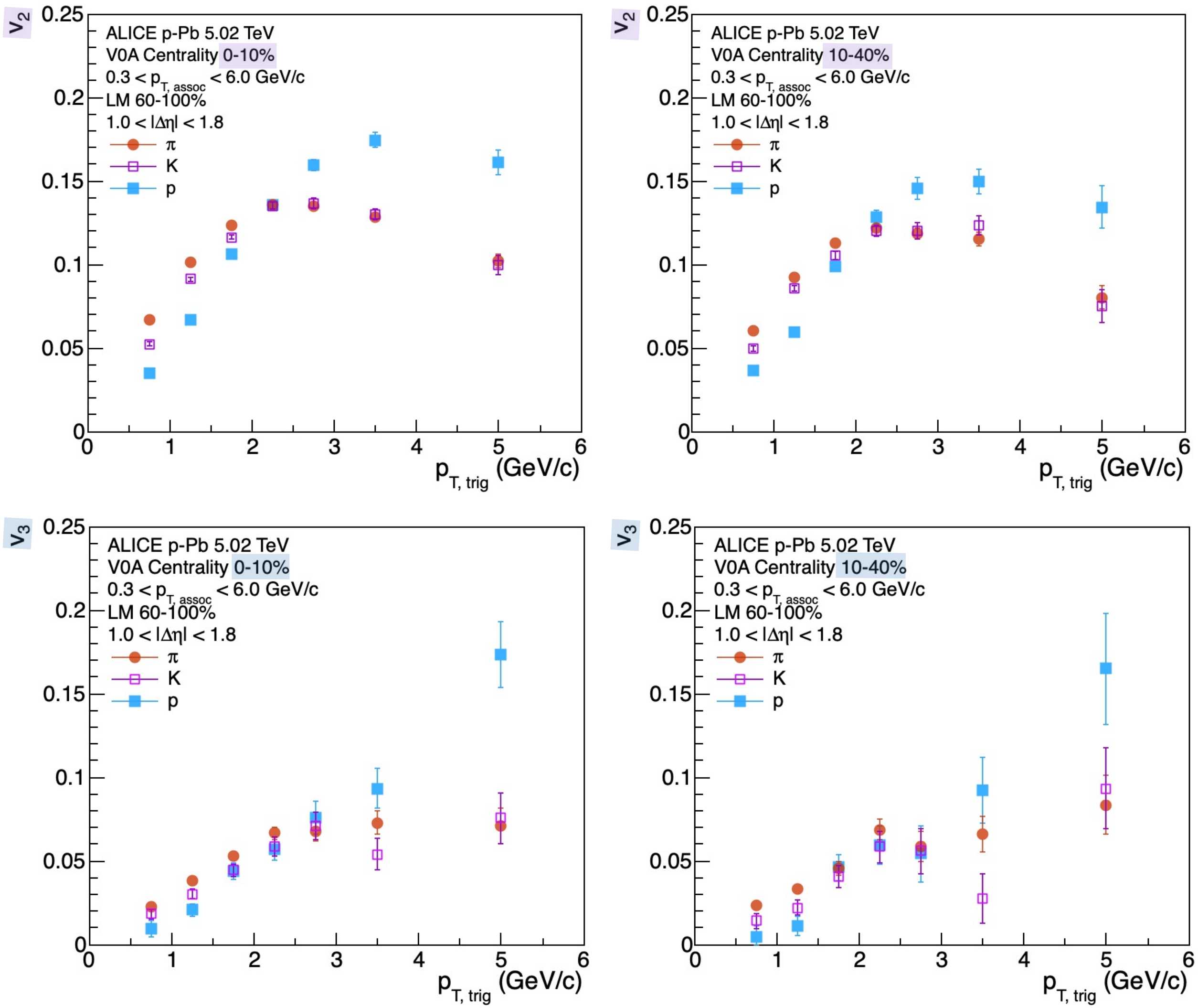




0-10%, V0A π-h correlations 10-40%, V0A

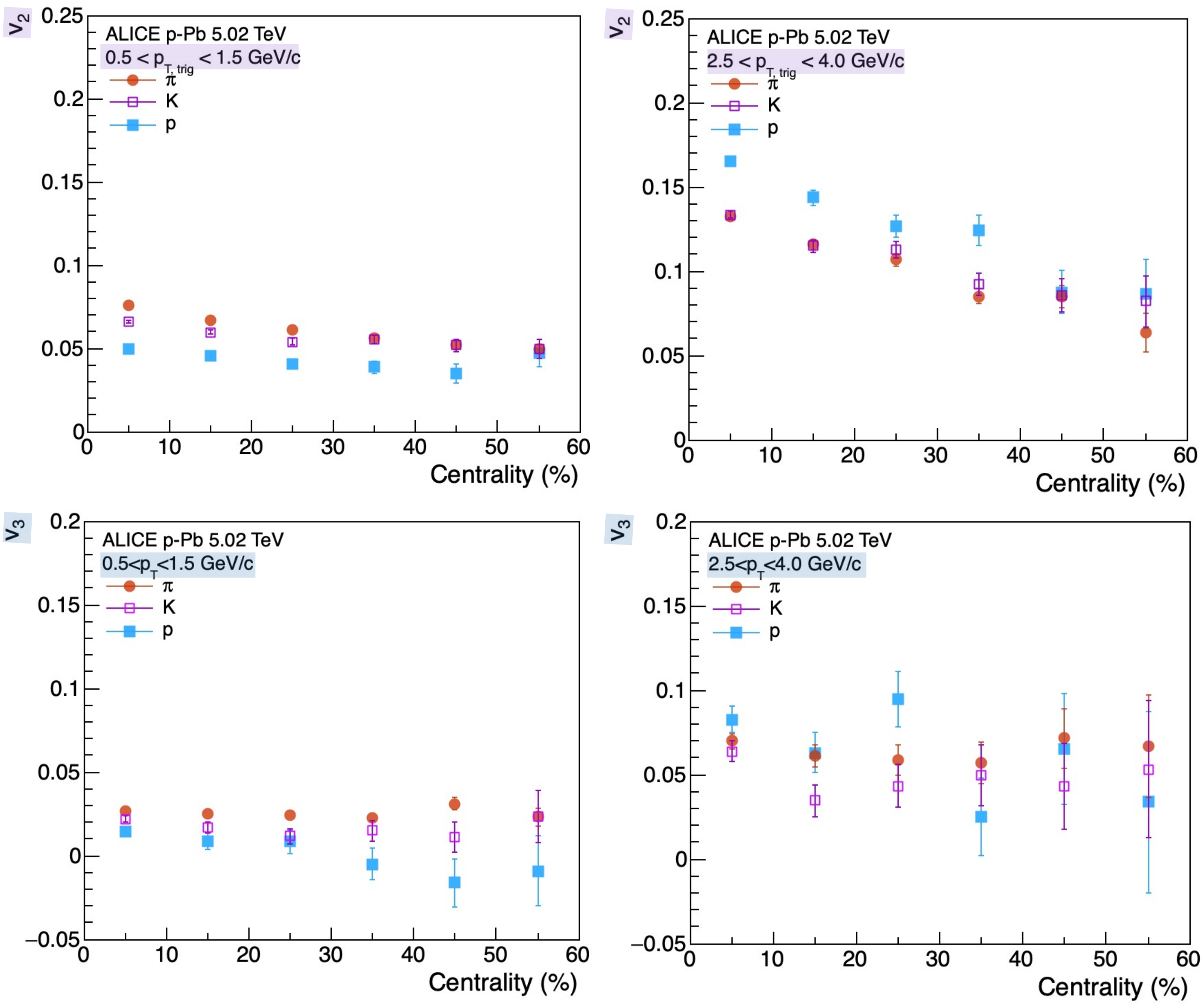
- $v_{n,n}^{\pi-h} = v_n^{\pi} \times v_n^{h}$
- $v_{n,n}^{h-h} = v_n^{h} \times v_n^{h} = \left(v_n^{h}\right)^2$
- $v_n^{\pi} = v_{n,n}^{\pi-h} / \sqrt{v_{n,n}^{h-h}}$

3-a. Results v_2, v_3 (vs p_T)



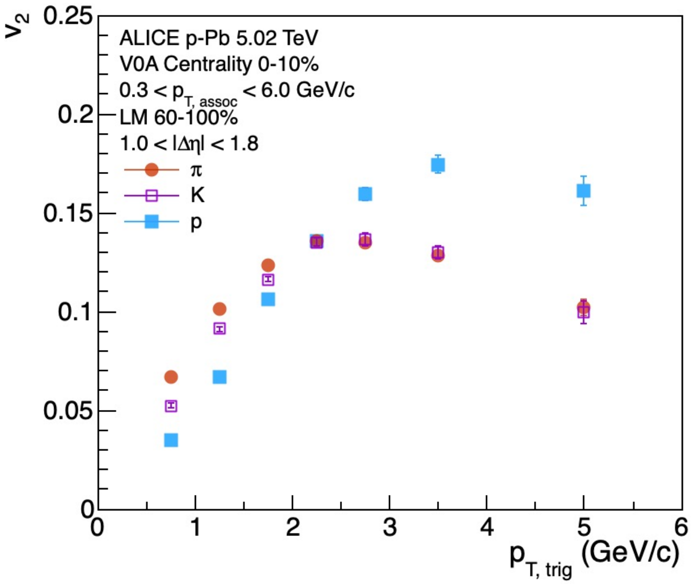
- v_2 and v_3 as function of p_T in two different multiplicity bins.
- Clear mass ordering is seen for v_2 in both multiplicity bins.
- $v_2^p < v_2^\pi$ (p_T < 2.5 GeV/c),
  $v_2^\pi < v_2^p$ (p_T > 2.5 GeV/c).
- Unlike v_2 as function of p_T, Similar p_T dependence is seen in two different multiplicity bins.
- Large statistical uncertainties are seen for v_3.

3-a. Results v_2, v_3 (vs multiplicity)



- v_2 and v_3 as function of centrality in two different p_T bins.
- $v_2^p < v_2^\pi$ (p_T < 2.5 GeV/c), $v_2^\pi < v_2^p$ (p_T > 2.5 GeV/c).
- $v_3^p < v_3^\pi$ (p_T < 2.5 GeV/c), the uncertainties in p_T > 2.5 GeV/c are too large.

3-b. Results Discussion



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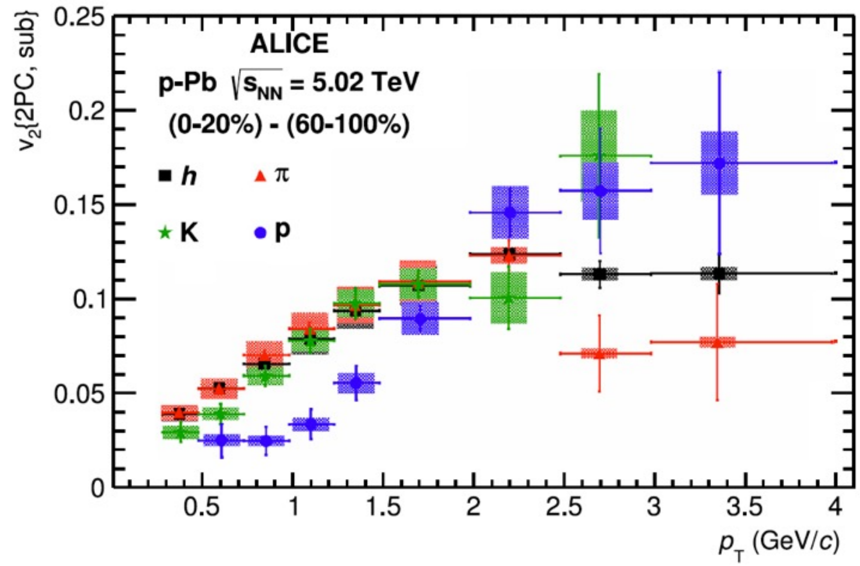
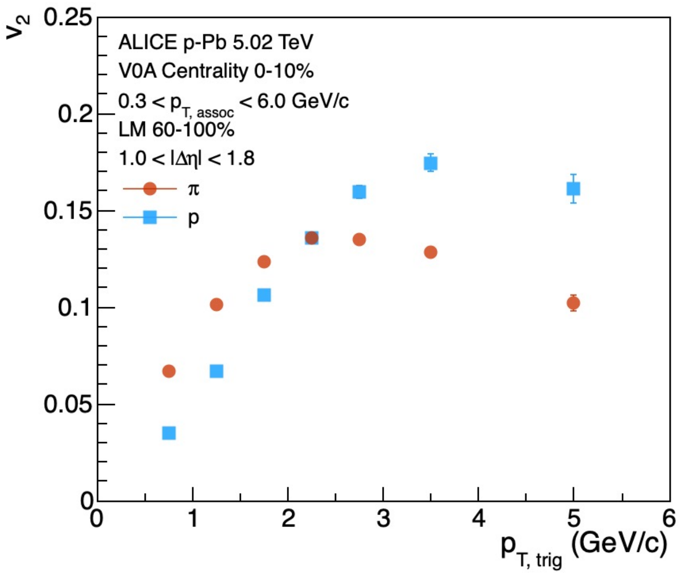
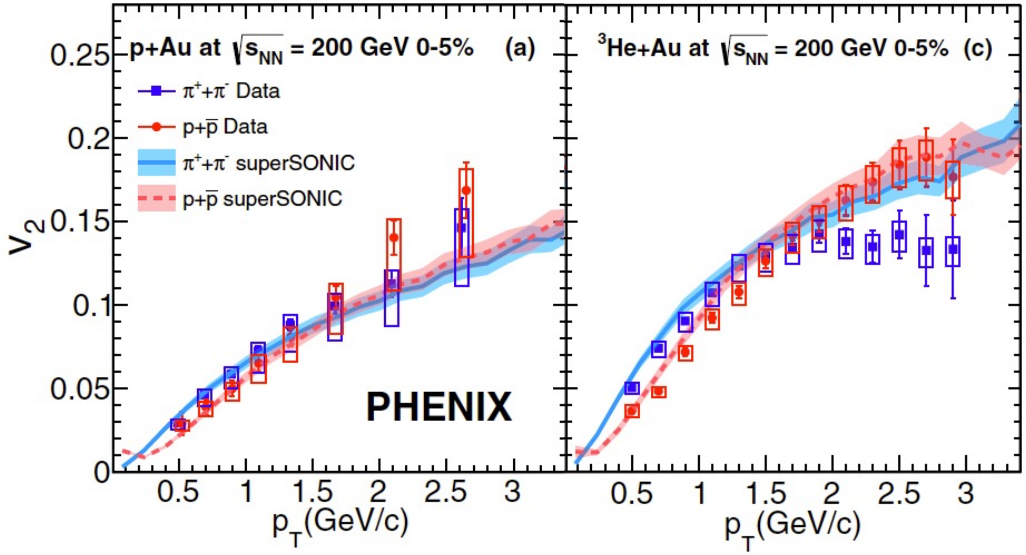


- v_2 of pion, kaon and proton using the template fit method are compared with the ones using the peripheral subtraction method.
- Consistent v_2 for pion and kaon is observed whilst slightly different v_2 for proton is seen in $p_T < 1.5$ GeV/c.

3-b. Results Discussion

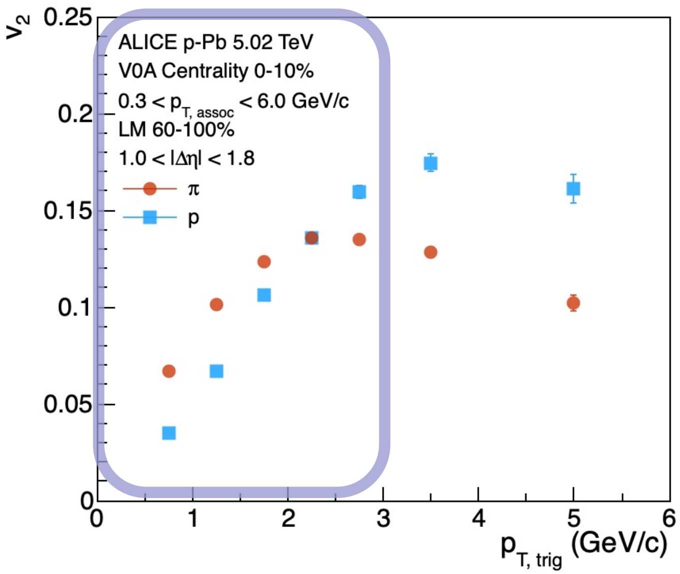
PRC **97**, 064904 (2018)



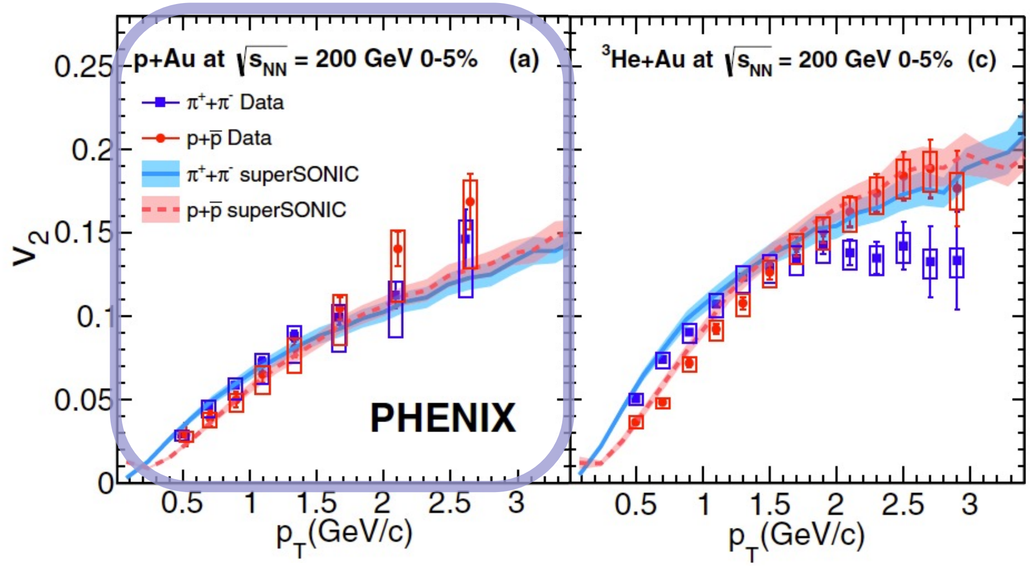


- v_2 of pion and proton in p-Pb 5.02 TeV are compared with the PHENIX p+Au and ^{3}He+Au 200 GeV results.
- The PHENIX results show the mass splitting in p_T ~ 1.5 GeV/c, whilst The ALICE results is in p_T ~ 2.5 GeV/c.

3-b. Results Discussion



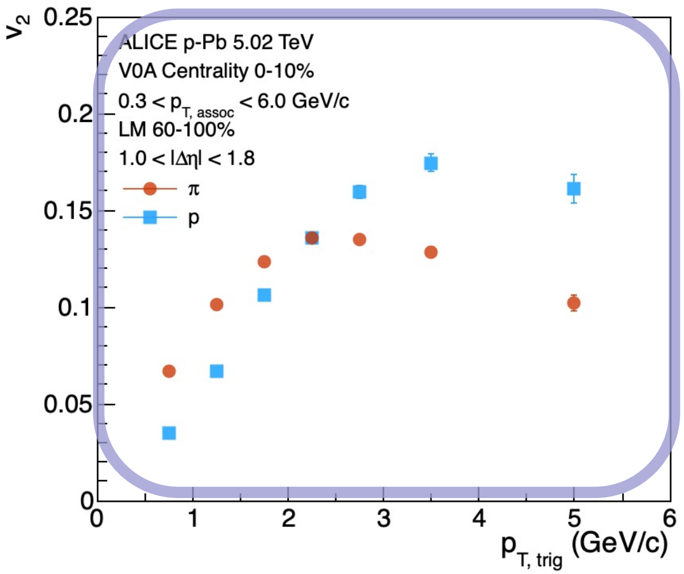
PRC **97**, 064904 (2018)

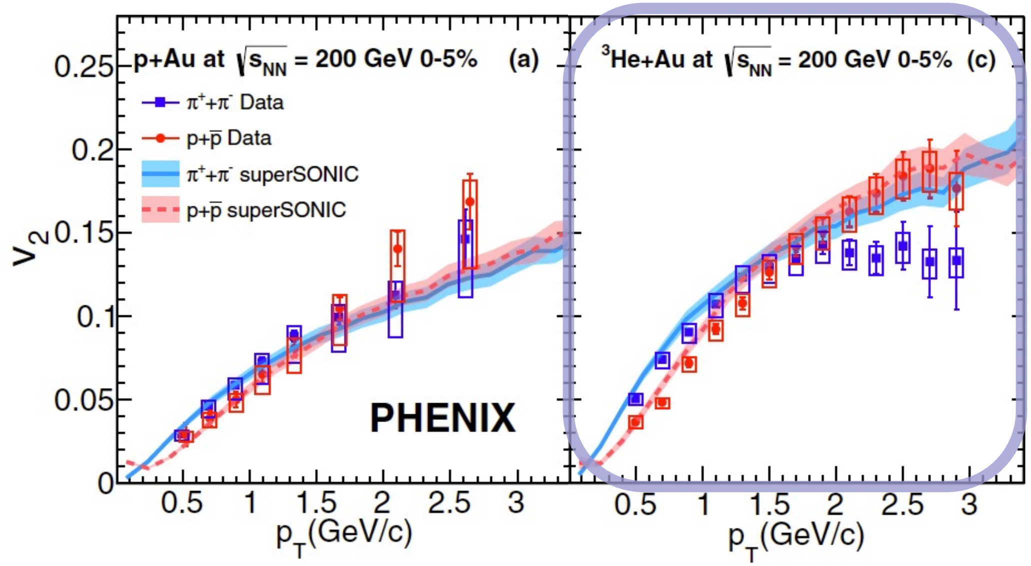


- v_2 of pion and proton in p-Pb 5.02 TeV are compared with the PHENIX p+Au and ^{3}He+Au 200 GeV results.
- The PHENIX results show the mass splitting in p_T ~ 1.5 GeV/c, whilst The ALICE results is in p_T ~ 2.5 GeV/c.
- In terms of the value of v_2, the ALICE results looks similar with the PHENIX p+Au results.

3-b. Results Discussion

PRC **97**, 064904 (2018)

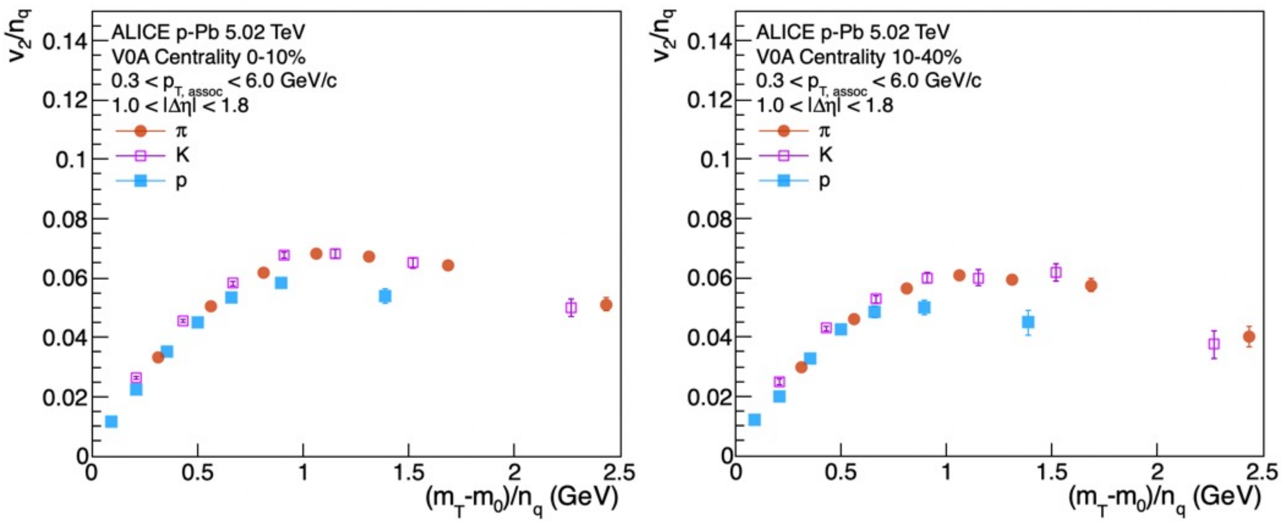


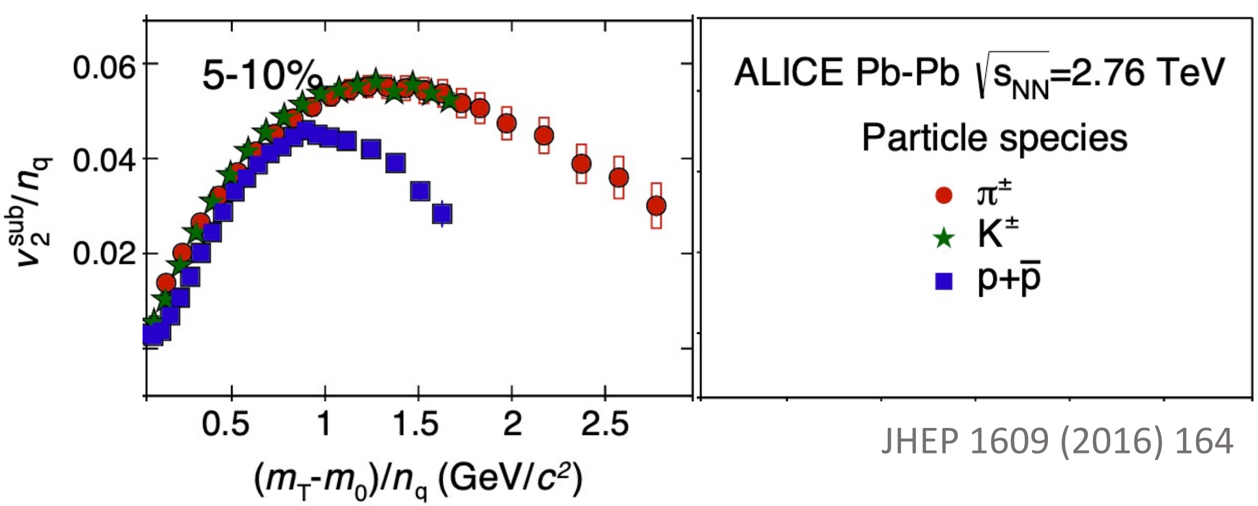


- v_2 of pion and proton in p-Pb 5.02 TeV are compared with the PHENIX p+Au and ^{3}He+Au 200 GeV results.
- The PHENIX results show the mass splitting in p_T ~ 1.5 GeV/c, whilst The ALICE results is in p_T ~ 2.5 GeV/c.
- In terms of the trend of v_2 , the ALICE results looks similar with the PHENIX ^{3}He+Au results.

3-b. Results

n_q scaled v_2 (vs KE_T)





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- n_q scaled v_2 as function of transverse kinetic energy.
- Quite Identical trend is observed for all particles under 1 GeV, however proton shows different trend in over 1 GeV.

4. Summary

- Initial look on v_2 , v_3 as function of p_T (centrality) of identified particles using template fit method using ALICE p-Pb 5.02 TeV data in long-range.
- $v_2^p < v_2^\pi$ (p_T < 2.5 GeV/c), $v_2^\pi < v_2^p$ (p_T > 2.5 GeV/c).
- v_2 shows decreasing trend with the decreasing centrality.
- The trend of v_2 seems similar to the previous ALICE and PHENIX analyses.

5. Plan

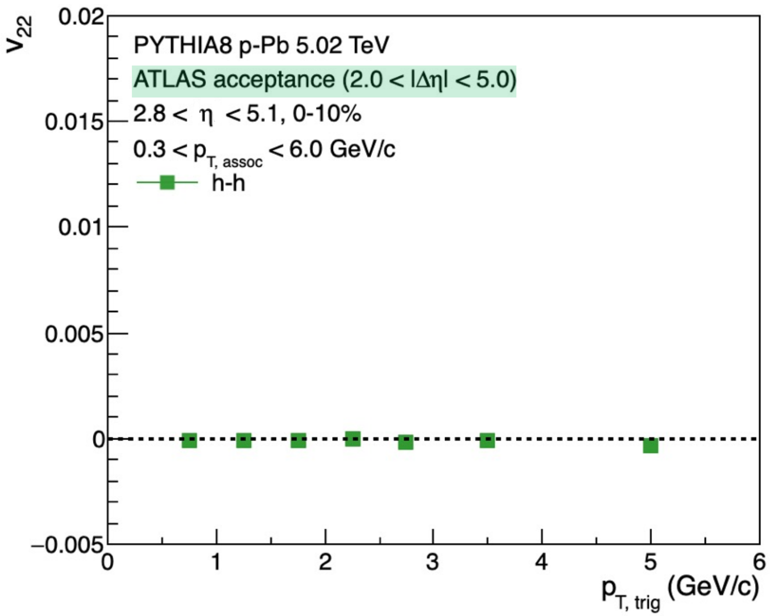
- Analysing pass2 data
- Using Bayesian approach for the particle identification

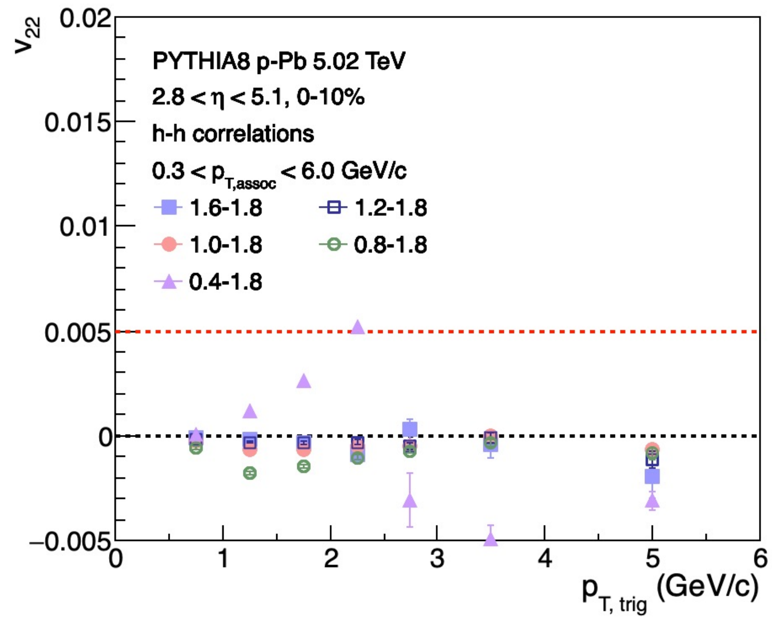
Thank you!

Back-up

2-b. Analysis Method

Template fit method (V0A (2.8<η<5.1))





~ 7% of v_2

- Closure test is done using p-Pb $\sqrt{s_{NN}}$ = 5.02 TeV PYTHIA8 events in long-range. ATALS acceptance (left), ALICE acceptance(right).
- v_{22} is close to zero in all p_T bins in both ATLAS and ALICE acceptance apart from when the long-range is 0.8 <$|\Delta\eta|$< 1.8 and 0.4 <$|\Delta\eta|$< 1.8.
- This can be understood that the template fit method works in the long-range of 1.0<$|\Delta\eta|$<1.8.