Study of Angular Correlations in Monte Carlo Simulations

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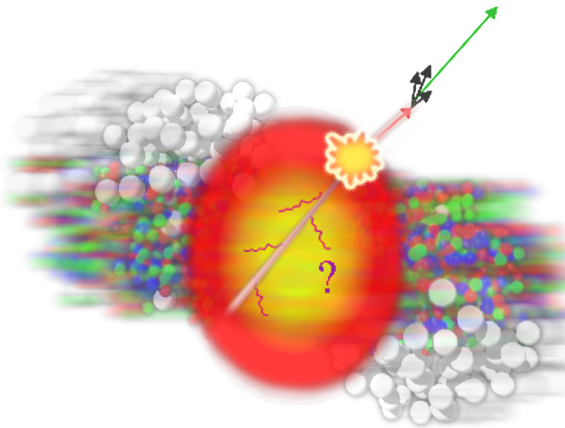
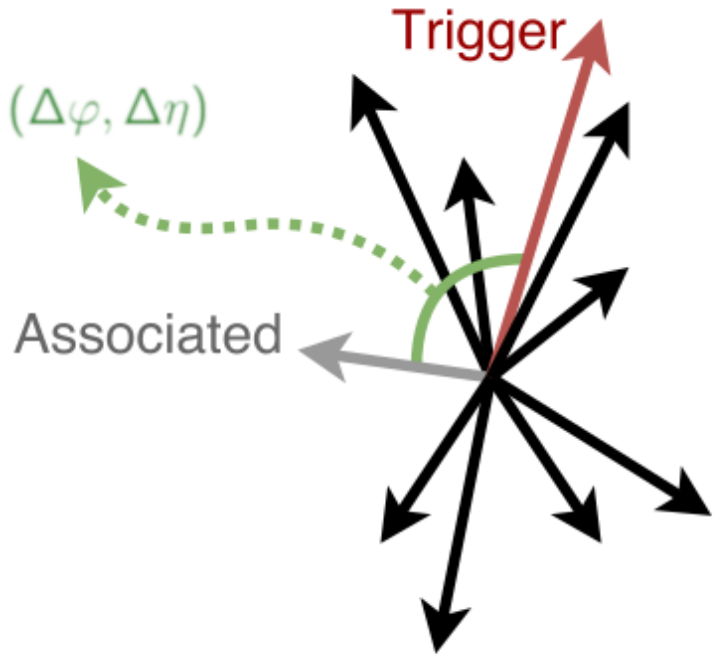
Physics Motivation

- Heavy-Ion Collision
- Goal: study interaction of jets with medium
- Angular Correlations represent a powerful tool to study jets
  - where jet quenching effects expected to be large
  - in an energy region where jets cannot be identified event-by-event
- ALICE results: jet broadening, depletion
- MC Simulations with different physical background



Analysis

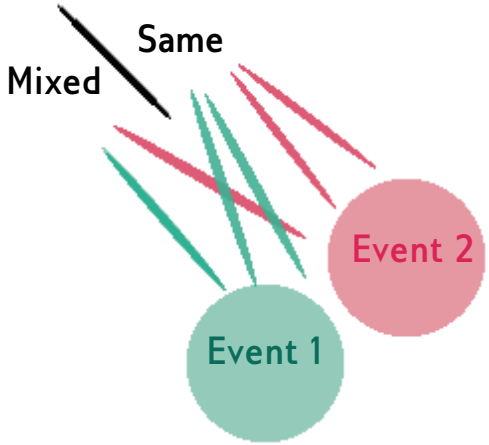
- The direction of the produced particles are correlated
- Trigger and associated particles
- Particle momenta represented by
  - Pseudorapidity (η)
  - Azimuth angle (φ)
- ($\Delta\varphi$) and ($\Delta\eta$) differences
- Associated yield per trigger:
- $$\frac{1}{N_{trigger}} \frac{d^2 N_{assoc}}{d\Delta\varphi d\Delta\eta}$$

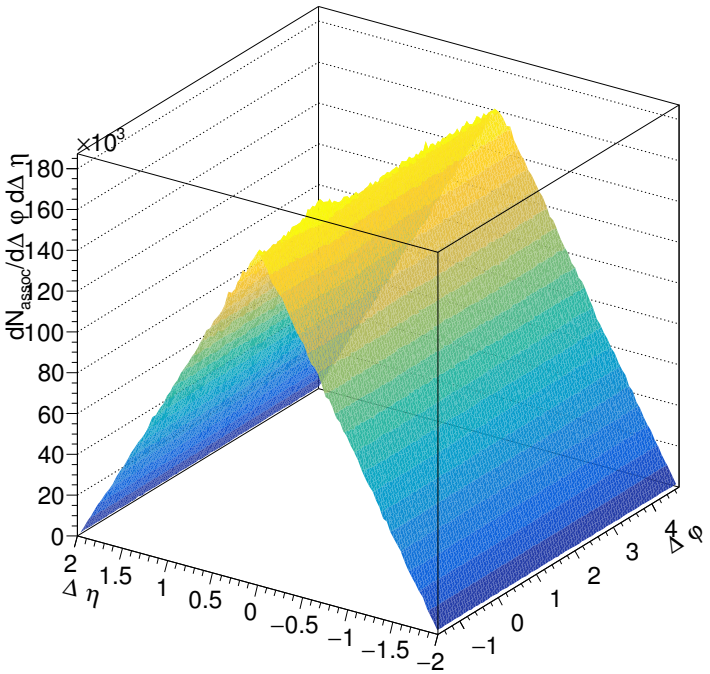


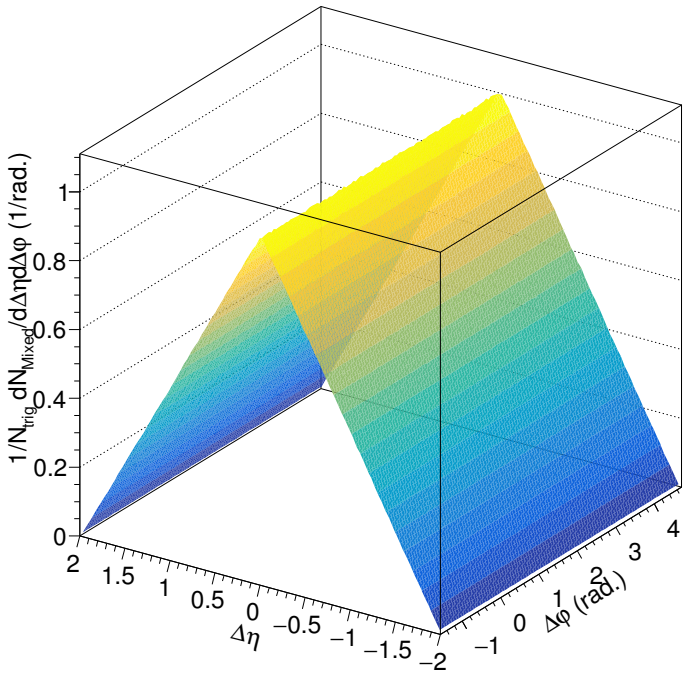
  - (identified)hadron-(identified)hadron, jet-hadron, hadron-jet, lepton-hadron, etc.

Same and Mixed event

- The associated yield per trigger is expressed in terms of the ratio of the same and mixed event
- In the ratio the detector acceptance effects disappear

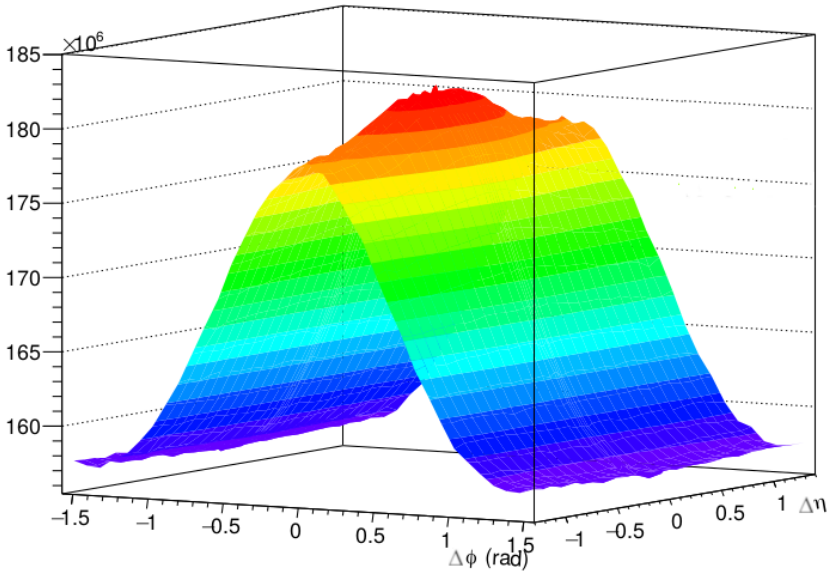






Associated yield per trigger

- Associated yield per trigger:
- $$\frac{1}{N_{trigger}} \frac{d^2 N_{assoc}}{d\Delta\varphi d\Delta\eta} = \frac{S(\Delta\varphi;\Delta\eta)}{M(\Delta\varphi;\Delta\eta)}$$



- Useful tool
  - to study flow and jets
  - to study soft and hard process

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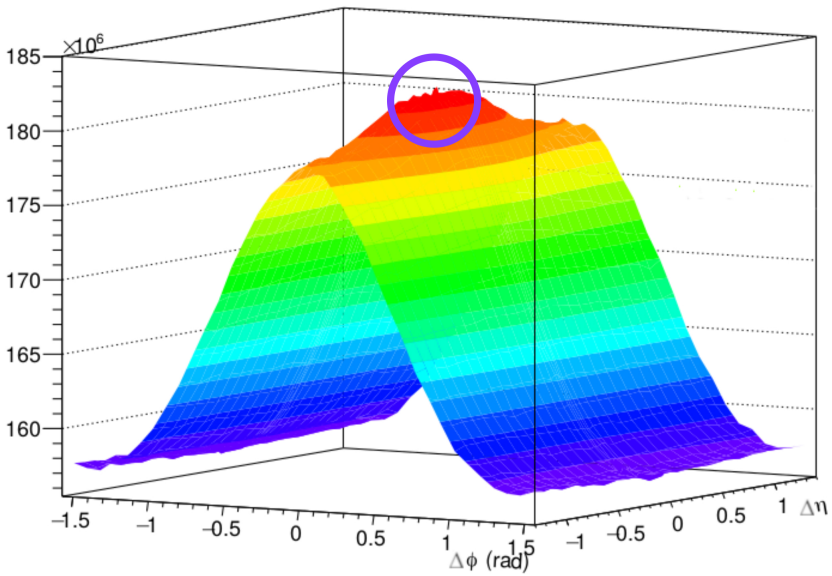

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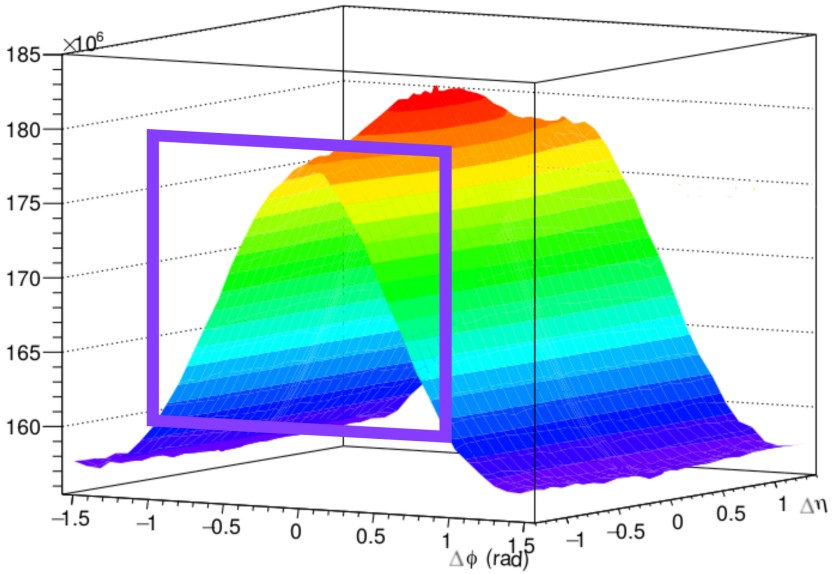

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  - to study flow and jets
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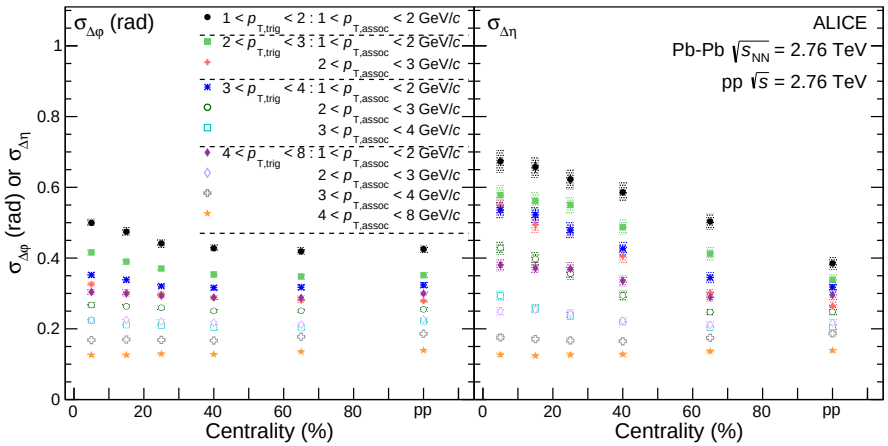
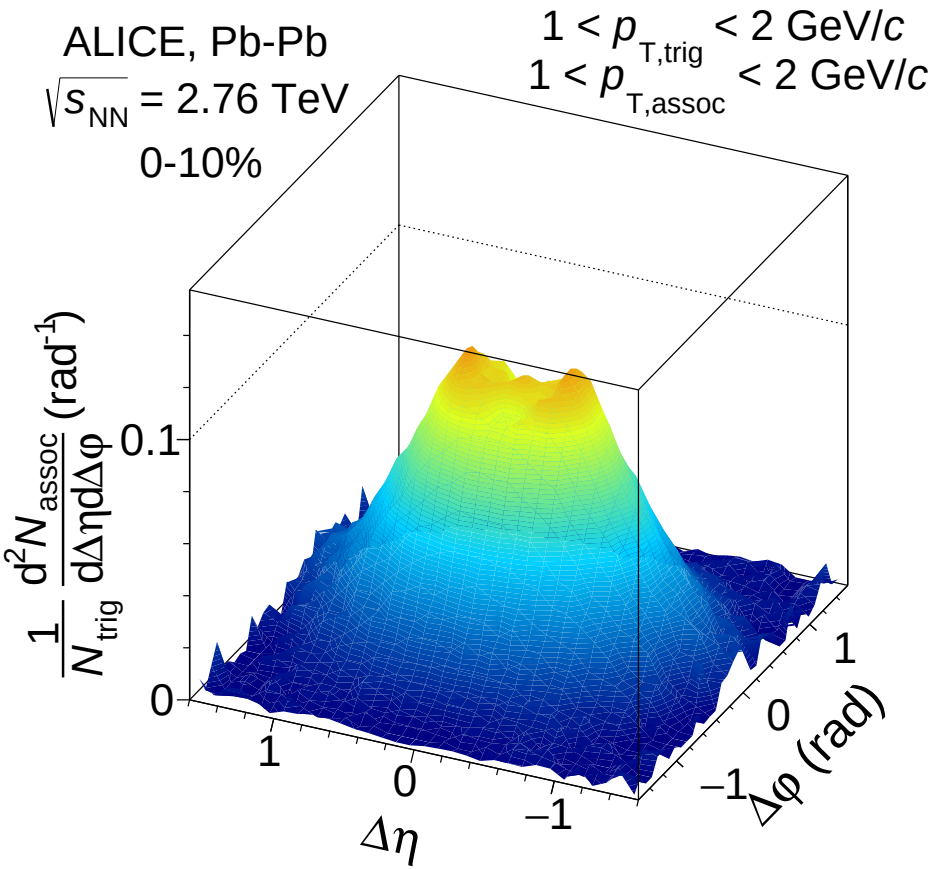
ALICE Results[1]

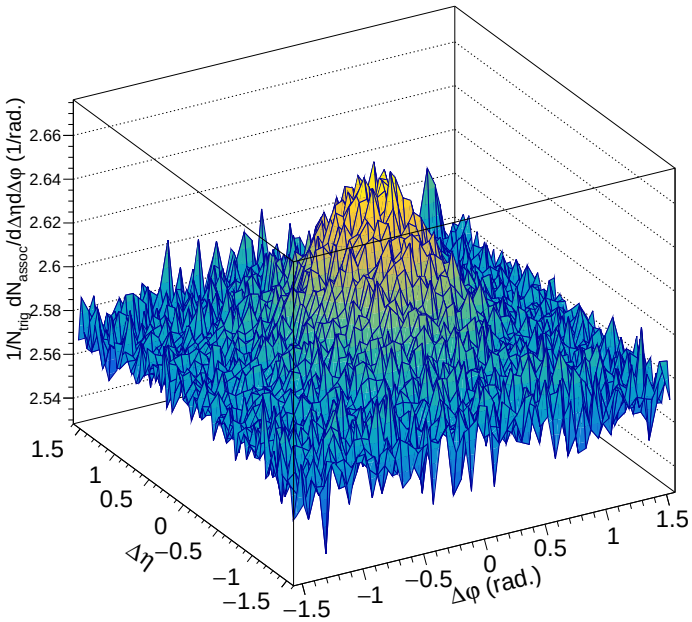


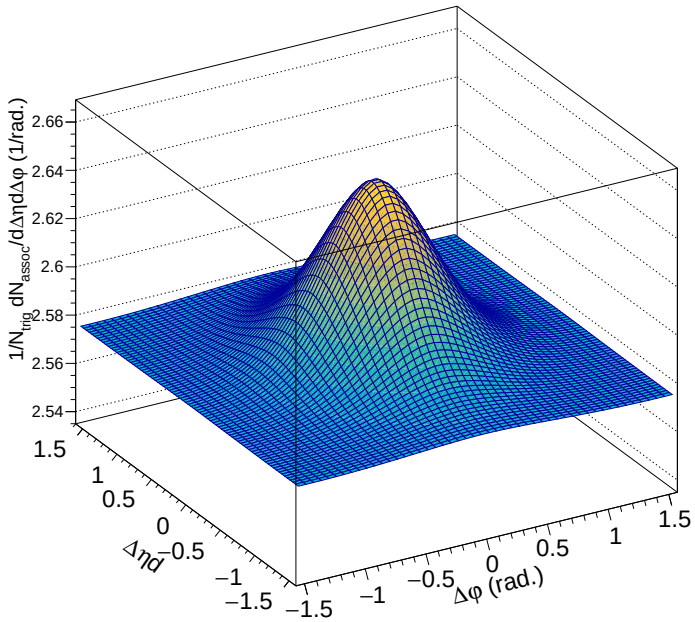


[1] [The ALICE Collaboration; Phys.Rev.Lett. 119. (2017)]

Fitting methods

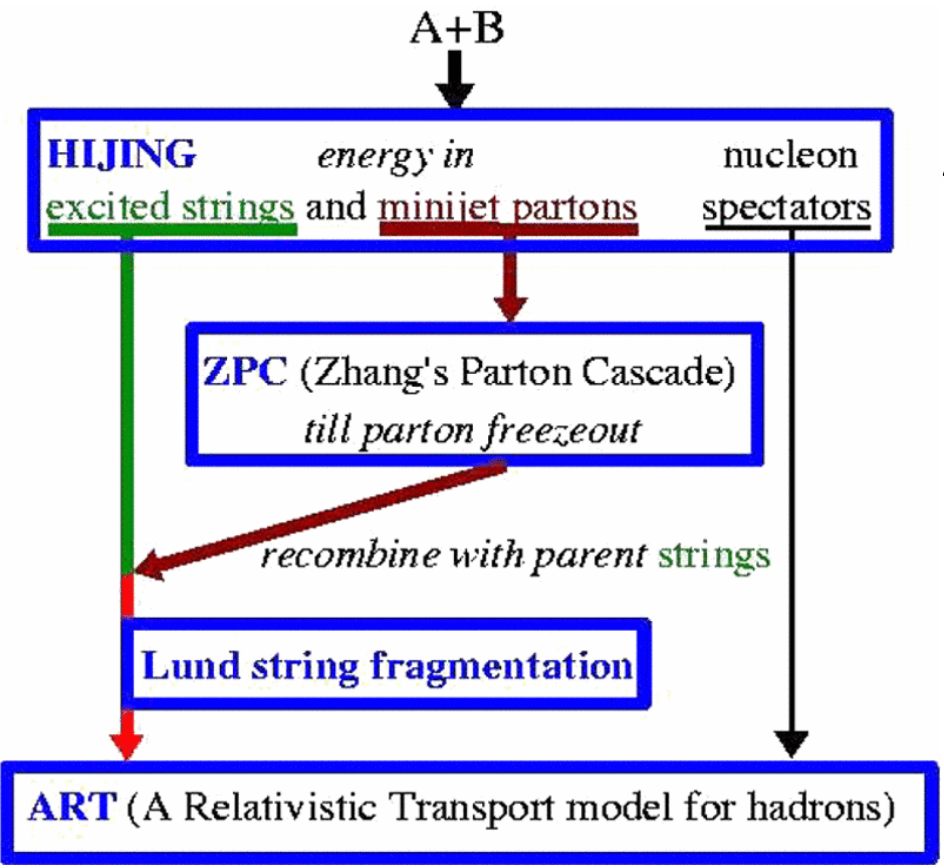
Fit the jet shape with a **Generalised Gaussian:**





- $G_{\gamma_x,\omega_x}(x) = \frac{\gamma_x}{2\omega_x\Gamma(1/\gamma_x)} exp\left[- \left(\frac{|x|}{\omega_x} \right)^{\gamma_x} \right]$
- The $\sigma_{\Delta\varphi}$ and $\sigma_{\Delta\eta}$ variance values characterise the jet shape

Monte Carlo Simulation

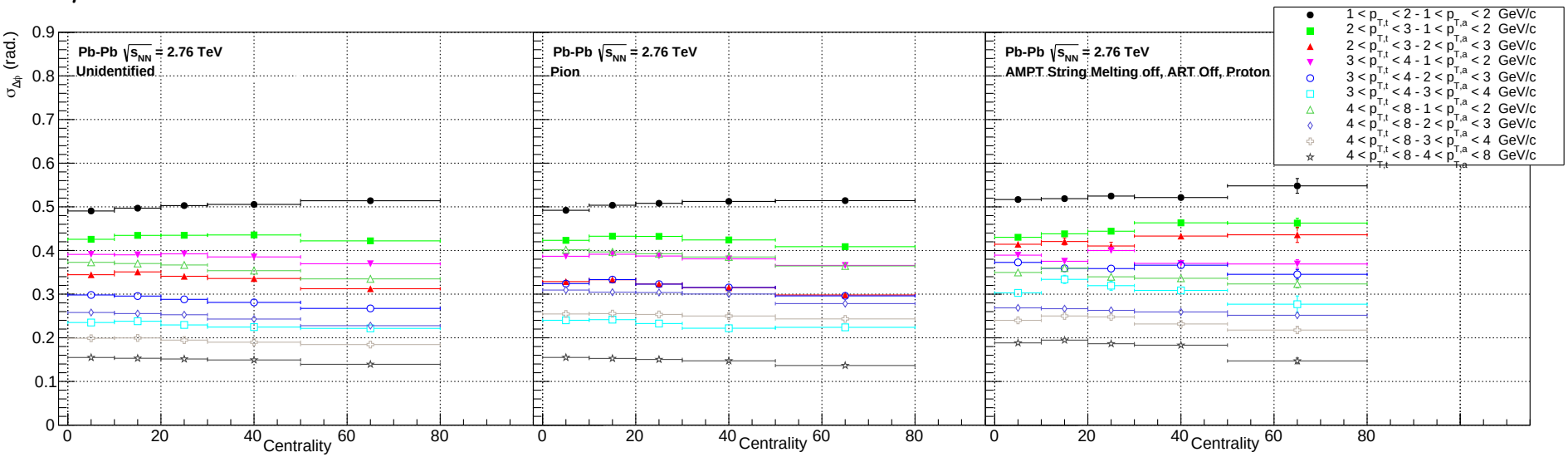


AMPT

- Developed for heavy-ion collisions
- Based on Hijing
- Collective effects, ZPC
- String Melting and Default mode
- Cluster-, and string hadronization
- Language: fortran77

AMPT String Melting Off, ART Off

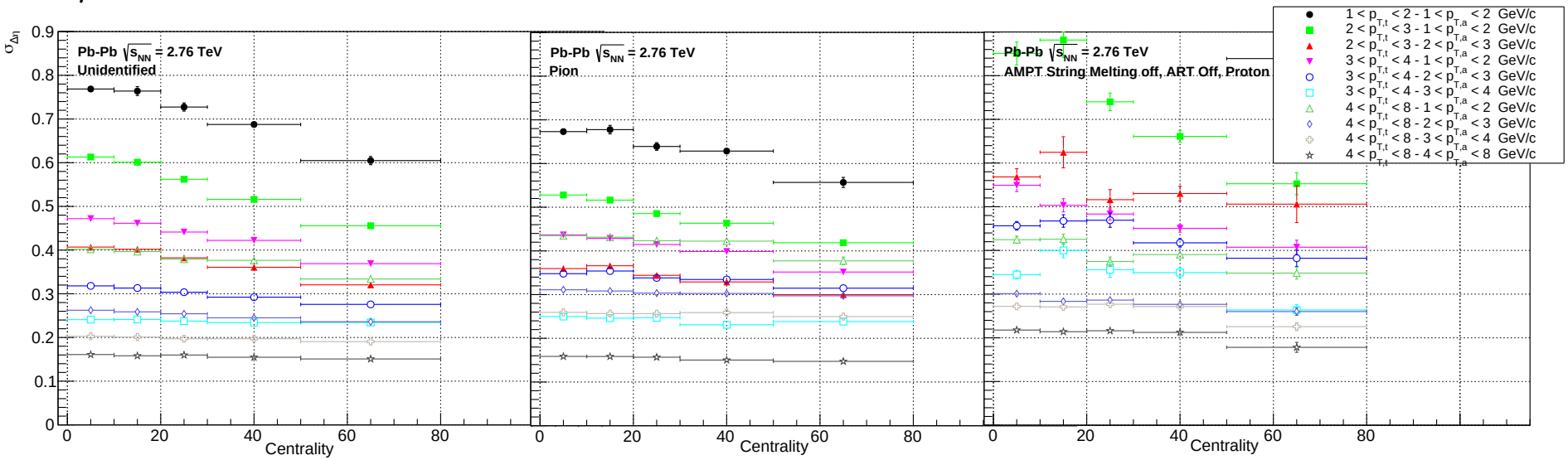
$\sigma_{\Delta\varphi}$ variances:



No centrality dependence in $\Delta\varphi$, no particle species dependence

AMPT String Melting Off, ART Off II.

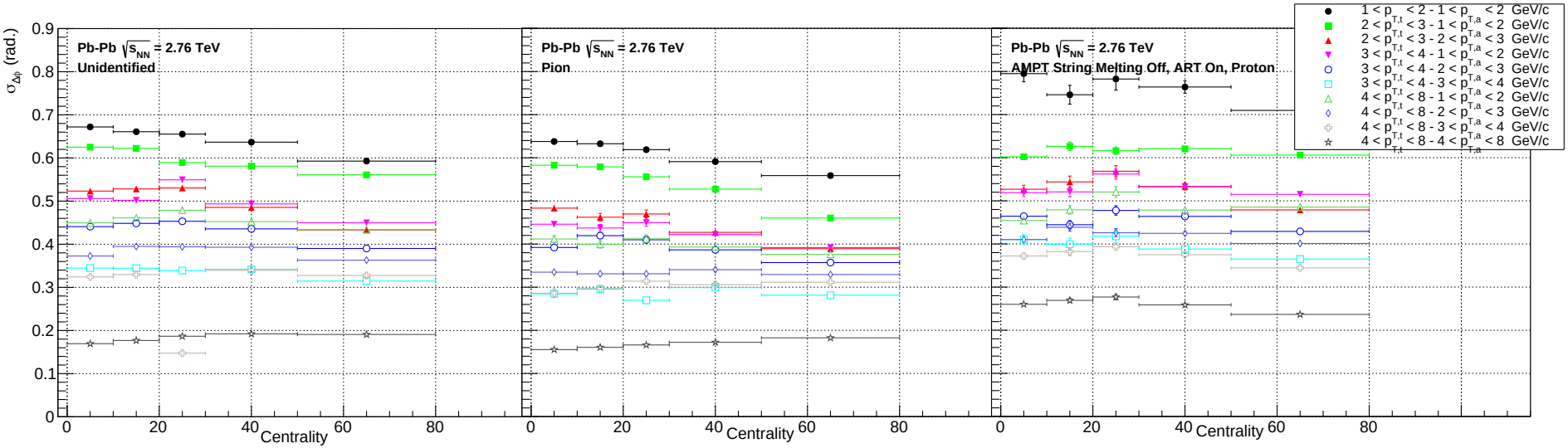
$\sigma_{\Delta\eta}$ variances:



Strong centrality dependence in $\Delta\eta$, and strong particle species dependence

AMPT String Melting Off, ART On

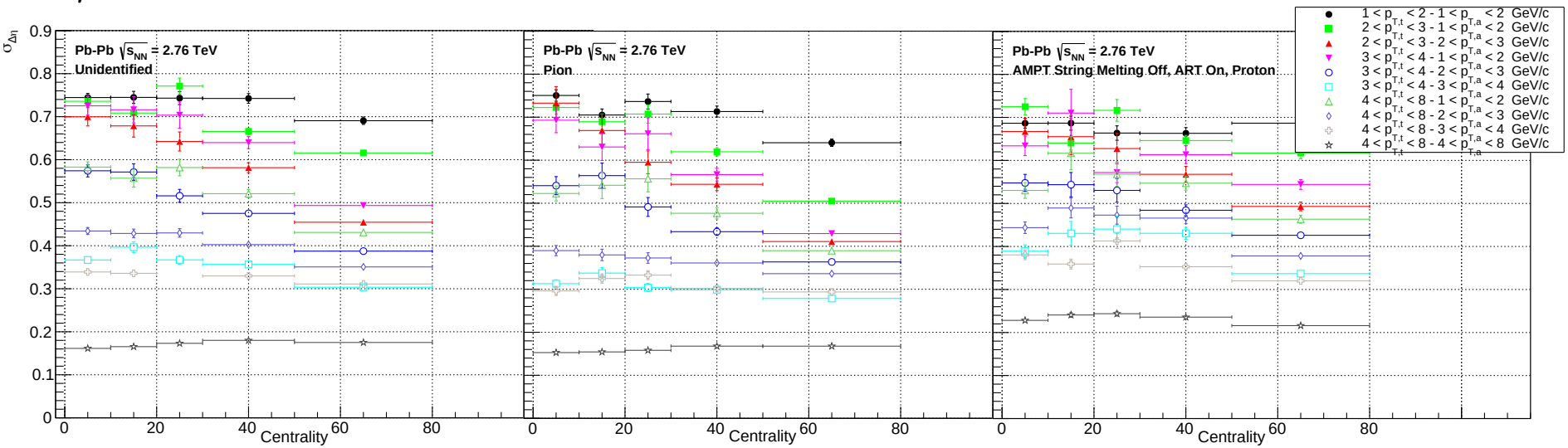
$\sigma_{\Delta\varphi}$ variances:



There is a centrality and species dependence in $\Delta\varphi$

AMPT String Melting Off, ART On II.

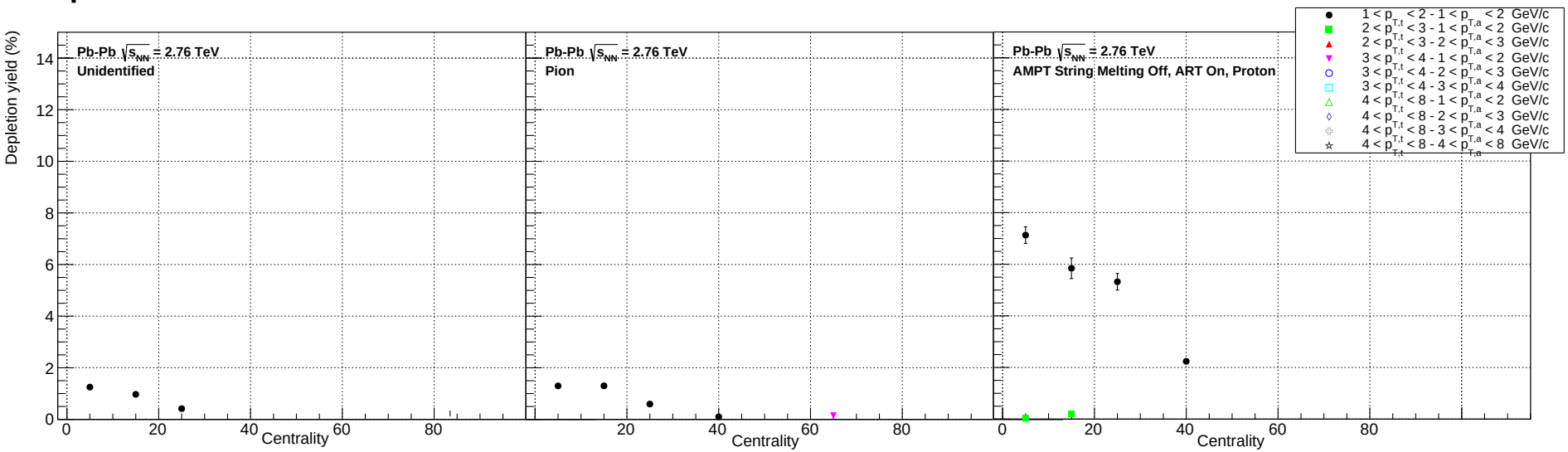
$\sigma_{\Delta\eta}$ variances:



Centrality dependence in $\Delta\eta$, and a hint of particle species dependence

AMPT String Melting Off, ART On III.

Depletion Yield:



Strong centrality and dependence species dependence in the Depletion Yield

Summary

To summarise:

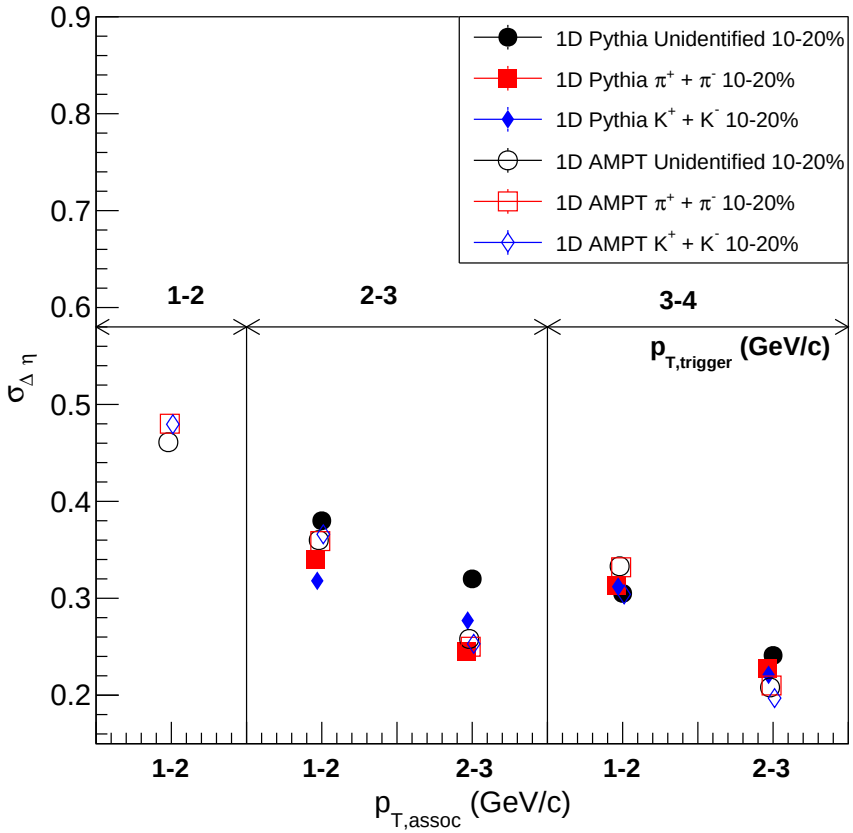
- Angular correlations are useful tool to study jets and flow.
- Fit the jet shape with a Generalised Gaussian
- No depletion yield without hadronic rescatterings
- Strong centrality dependence in both case
- A particle dependence in both case

Future plans:

- Different MC simulations: JetScape, Hijing++, EPOS 3.216
- Data and Monte-Carlo Simulation Comparison

Thank you for the Attention!

AMPT-Pythia


1D Pythia Unidentified 10-20%
1D Pythia π+ + π- 10-20%
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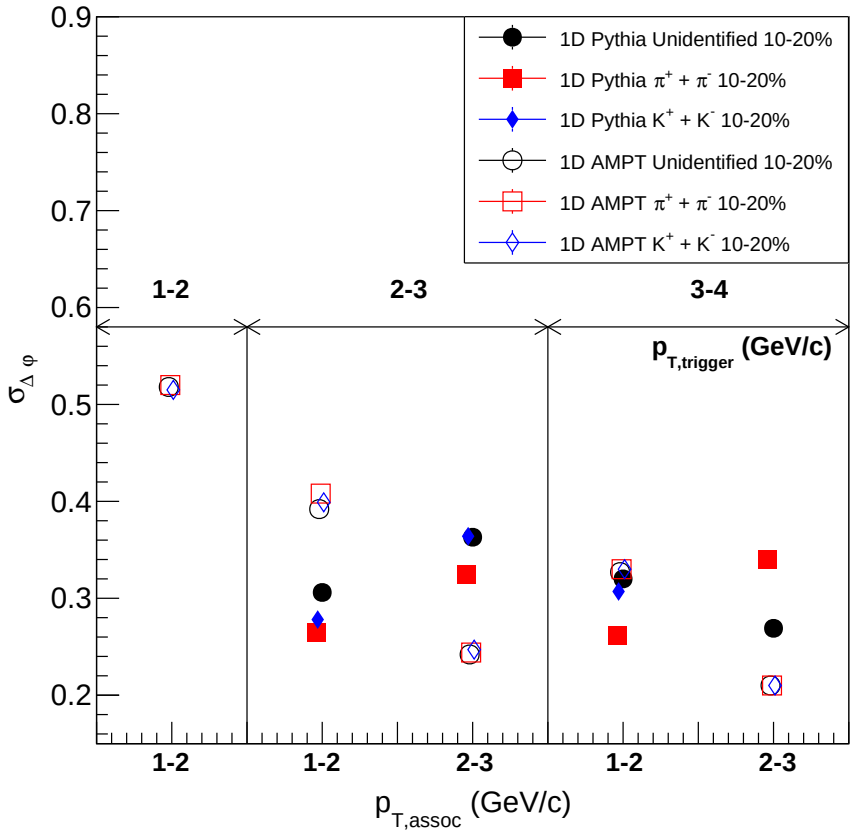
1D AMPT K+ + K- 10-20%
1-2
2-3
3-4
p_T,trigger (GeV/c)
σ_Δη
p_T,assoc (GeV/c)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