Angular Correlations in AMPT

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Zimanyi School, 2017

Motivation

- **Analysis in ALICE Experiment[1]:**
  - Study jets using correlations
  - With unidentified particles

[1] [Adam, Jaroslav and others; Phys.Rev. C96 (2017), 034904]

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  - Central collisions in **low** p_T
    $\rightarrow$ the peaks are **wider**, **asymmetry** between $\Delta\varphi$ and $\Delta\eta$
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- **Our goal:**
  - Simulate heavy-ion collisions with **AMPT**
  - Identified trigger particles
  - Which particles show **similar** properties?

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A Multi-Phase Transport Model (AMPT)

- **Developed to simulate heavy-ion collisions**
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- **Collective effects:**
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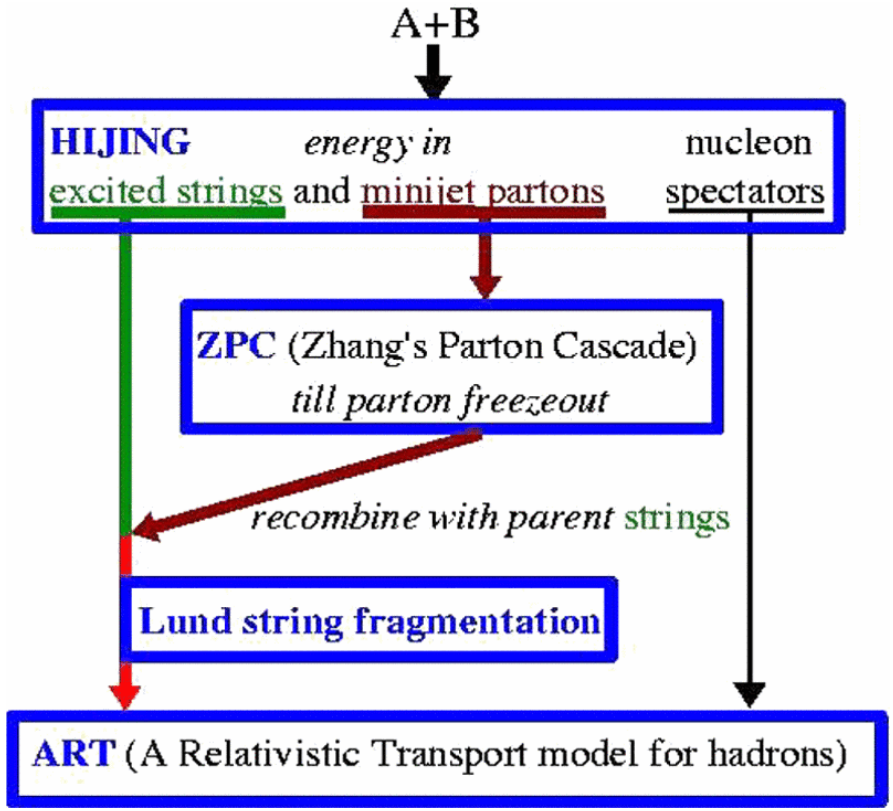
- **Two main settings:**
  - **Default and String Melting**

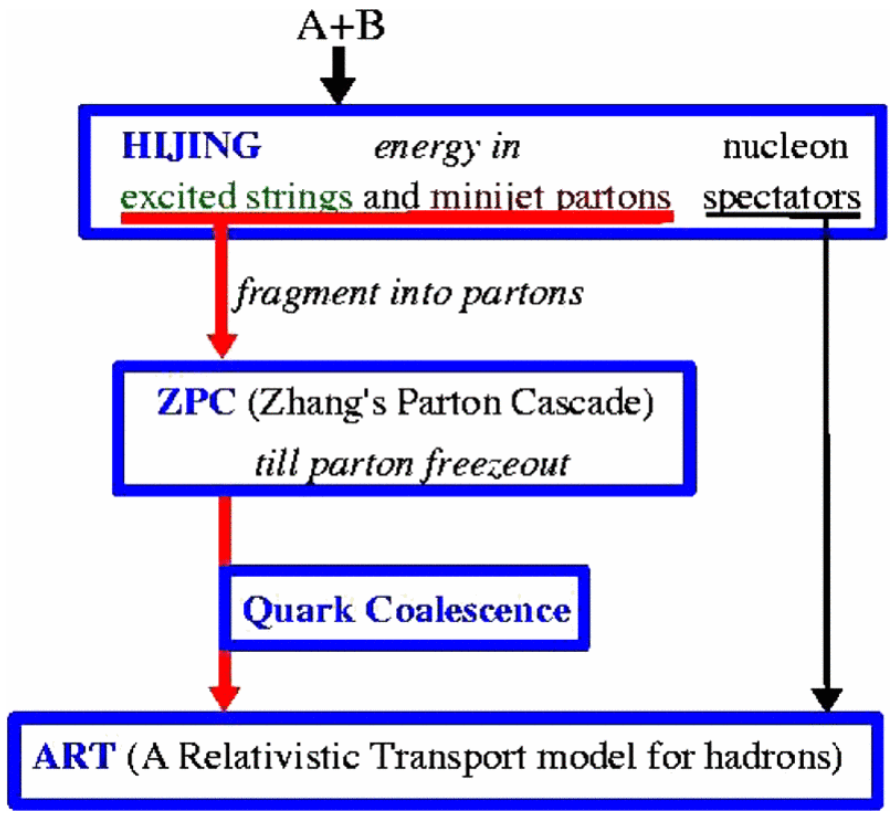
Default AMPT model

- Initial distributions imported from HIJING (Glauber model)
- Partonic scattering modelled with elastic scattering cross section
- The Freeze-out modelled by symmetric fragmentation function
- Hadronic two-particle scatterings modelled via ART



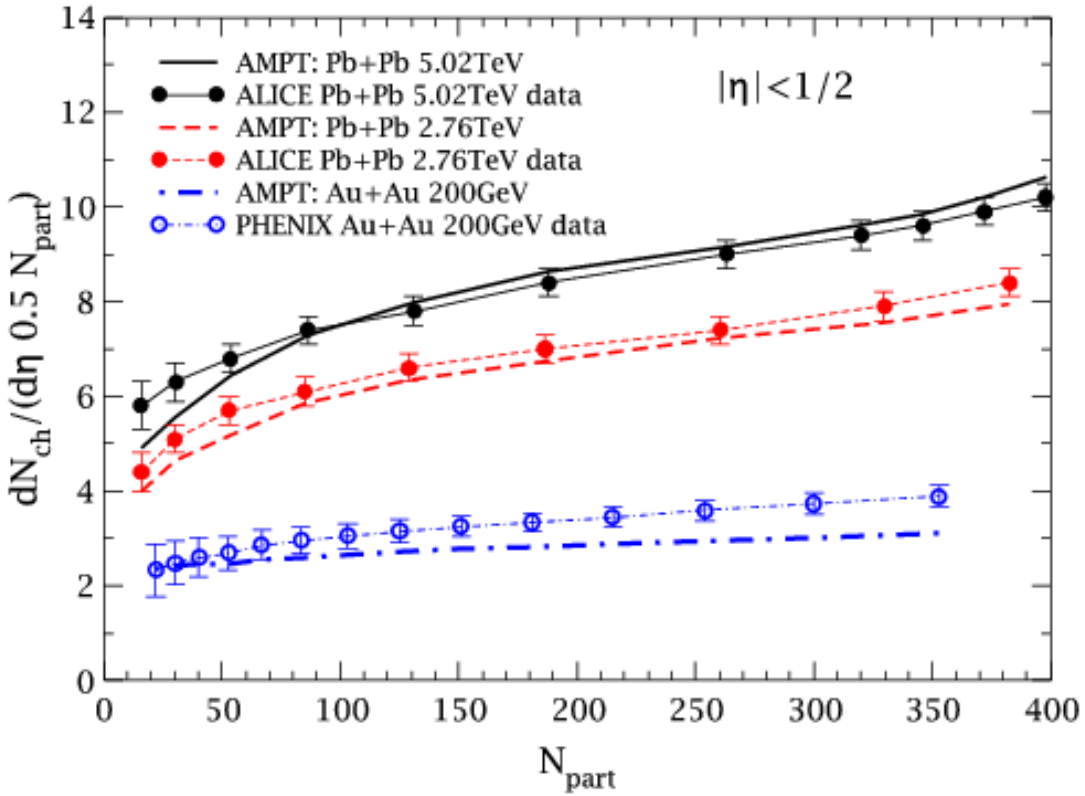
String Melting AMPT model

- Converts excited strings into (anti)quarks
- Partonic Scatterings treated via ZPC
- Quark Coalescence model:
  - Nearest quark-antiquark pair $\rightarrow$ **meson**
  - Nearest three quark $\rightarrow$ **baryon**
- Hadronic two-particle scatterings modelled via ART



Compared with Experimental Data

- **The simulated data compared with experimental data from LHC and RHIC**



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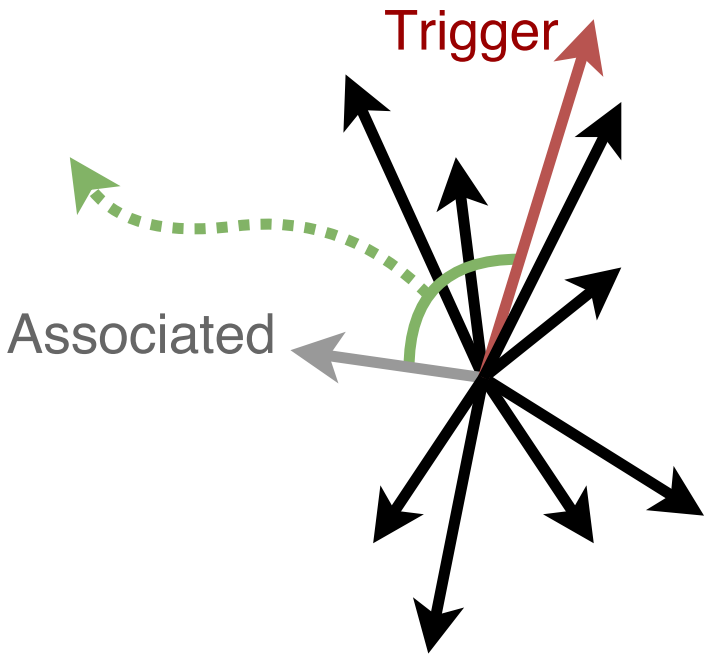
Angular correlation powerful tool to study:

- High and low p_T region

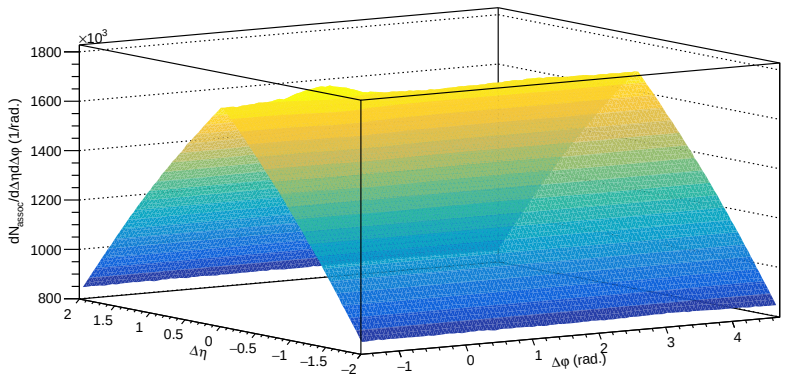
Method

- Trigger and associated particle $(\Delta\varphi, \Delta\eta)$
- Identified trigger (π^+)
- Particle's momentum represent by:
  - pseudorapidity (η)
  - azimuthal angle (φ)
- $(\Delta\varphi)$ and $(\Delta\eta)$ differences
- Associated yield per trigger:
- $$\frac{1}{N_{trigger}} \frac{d^2 N_{assoc}}{d\Delta\varphi d\Delta\eta} = \frac{S(\Delta\varphi;\Delta\eta)}{M(\Delta\varphi;\Delta\eta)}$$



Same and Mixed Event

- $\Delta\varphi - \Delta\eta$ distribution calculated when:
  - Trigger and associated from same event
  - Associated from an another event
- Division removes acceptance effects and detector efficiency effects



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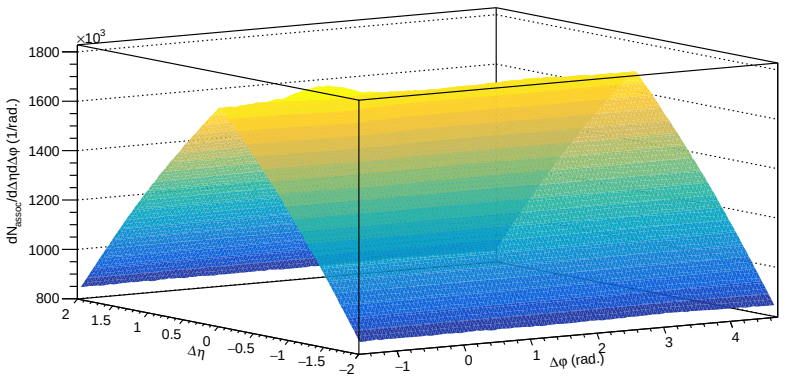

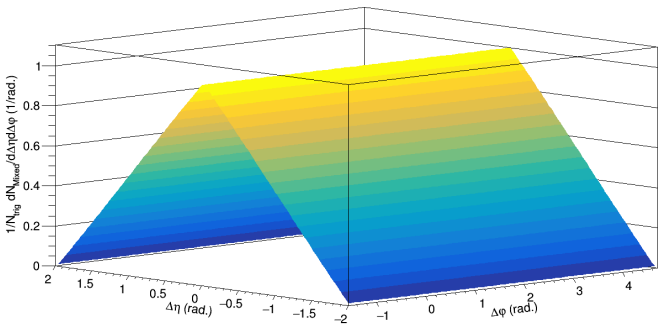

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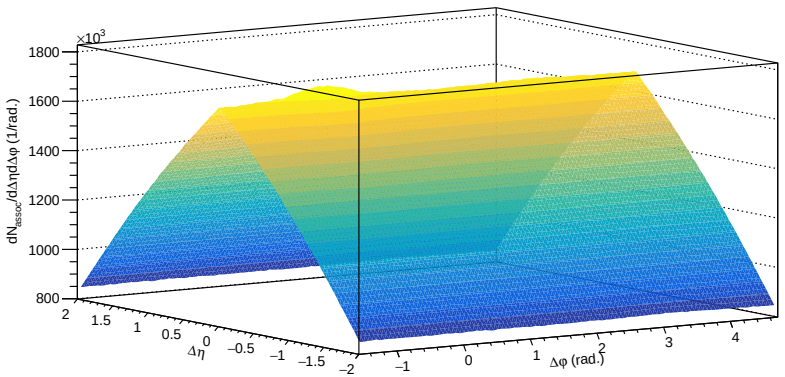

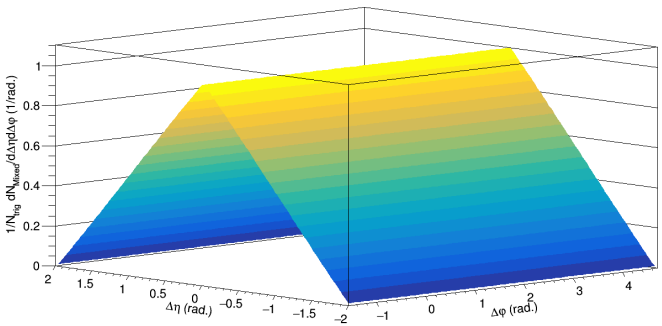

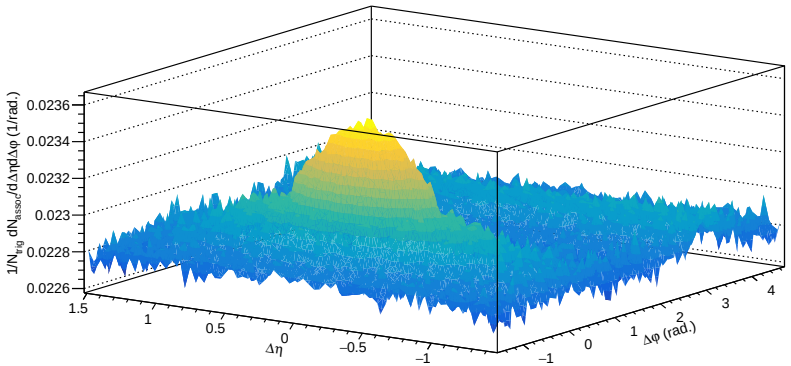

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- Large transverse momentum quarks and gluons
- Produced in QGP hard scattering process
- We only detect colorless hadrons:
  - fragmentation of **partons** $\rightarrow$ detected **hadrons**
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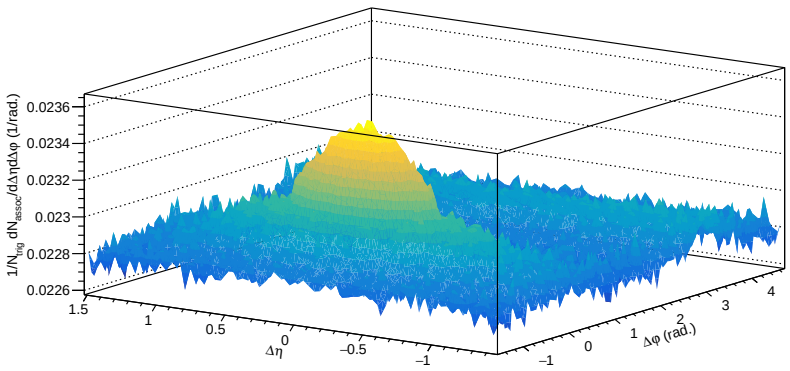

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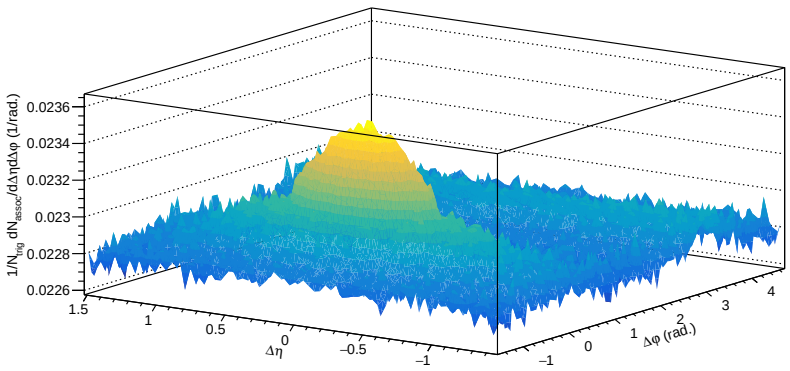

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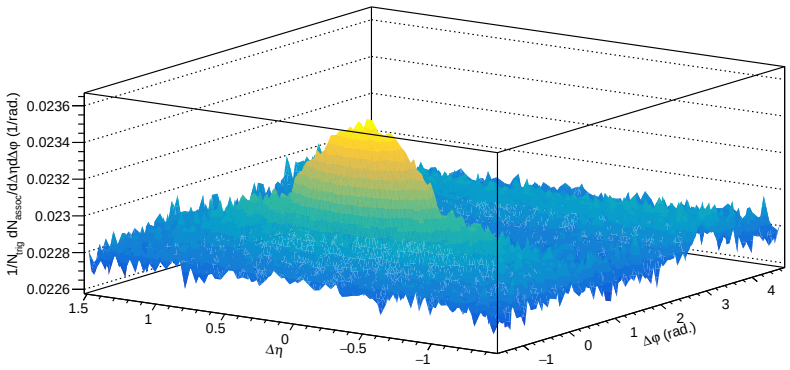

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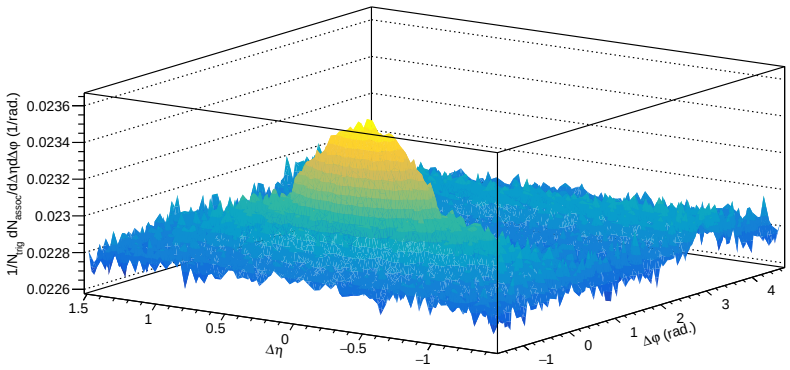

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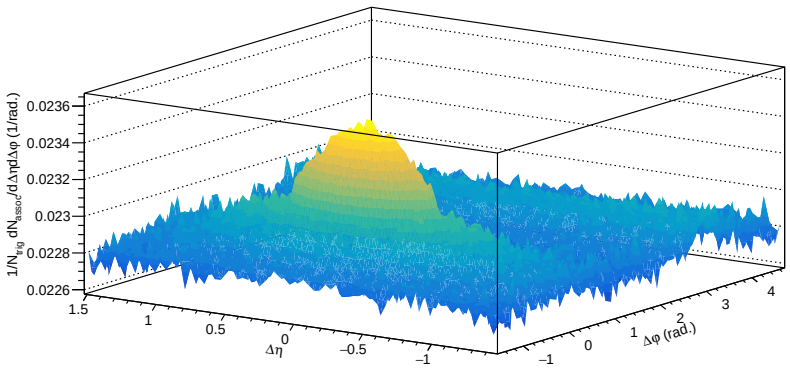

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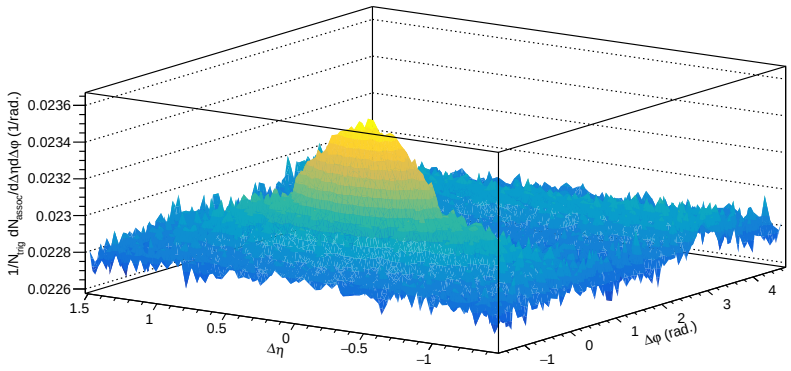
  - to consider the jet shape centrality and p_T dependence
  - **Flow is a background for jet studies**

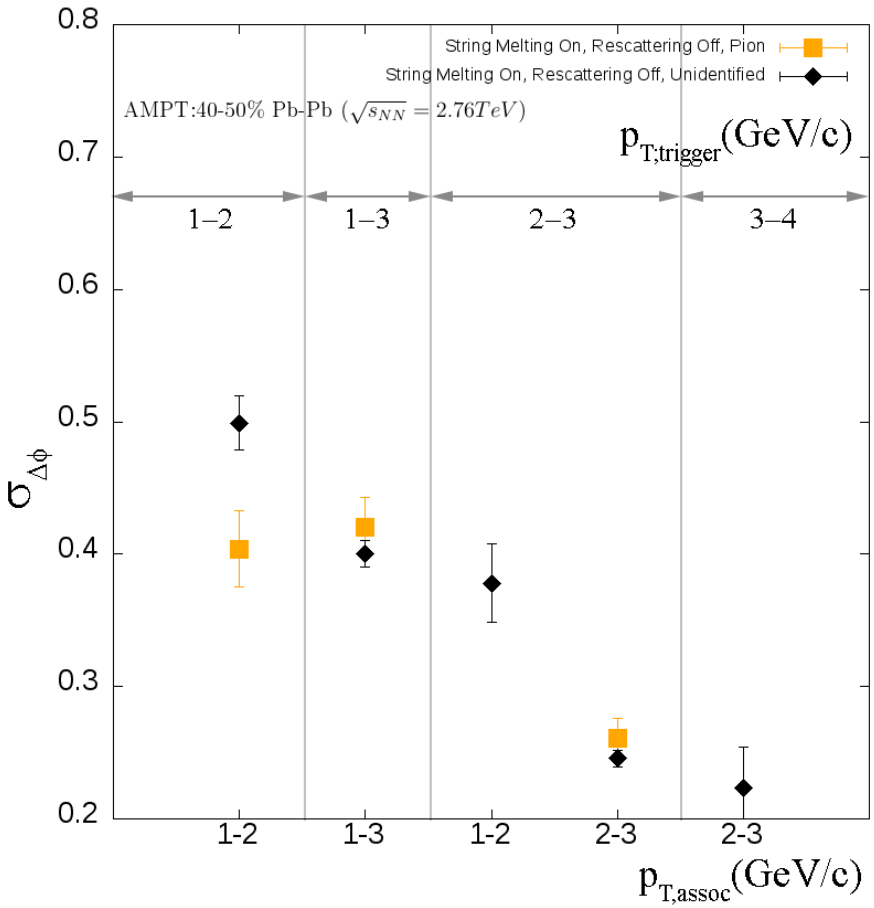
Fitting methods

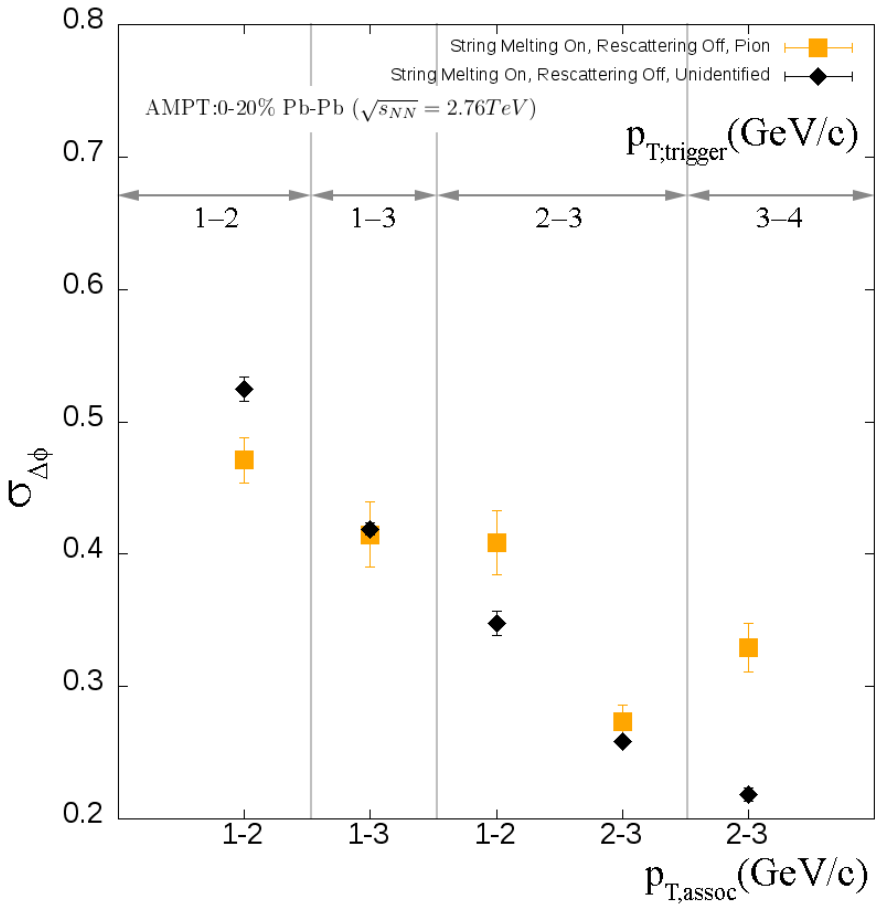
- Fit the jet with a **Generalised Gaussian:**



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

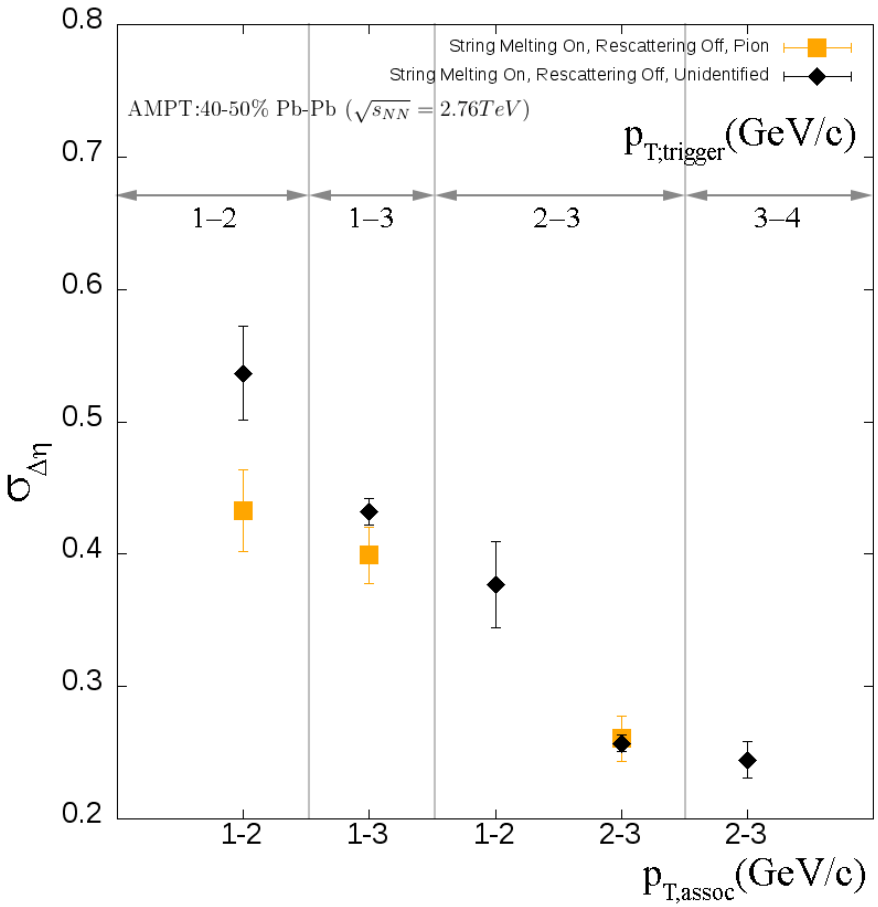
Results: $\Delta\phi$ variances

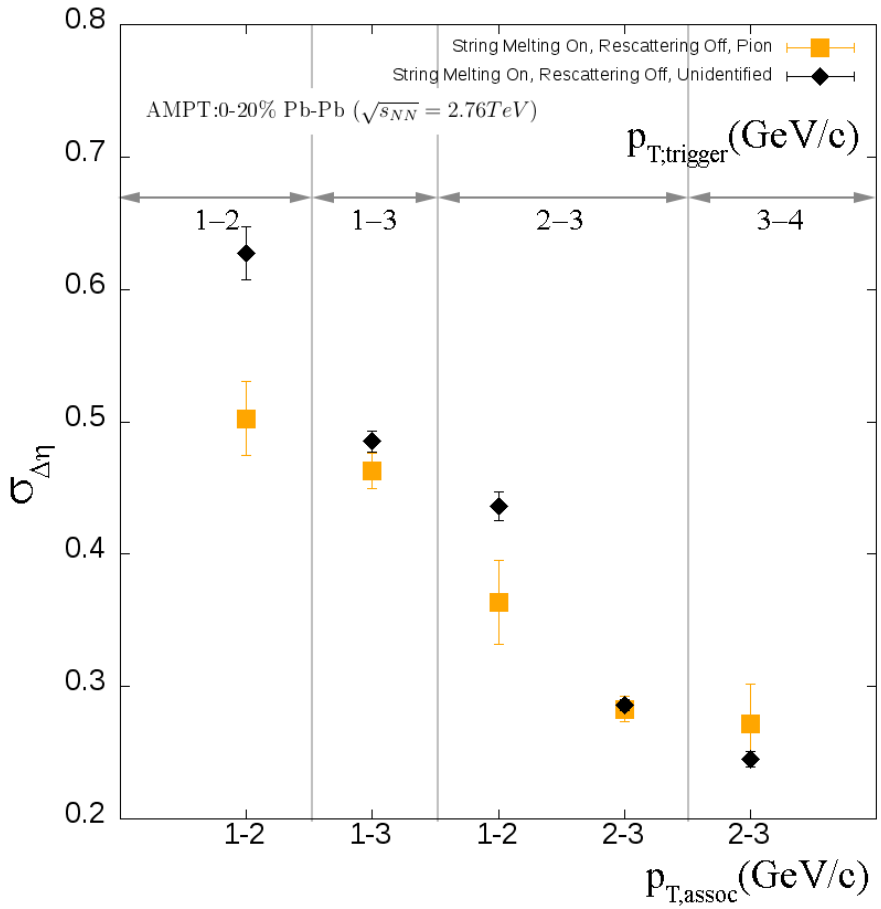




- Hint of species dependence at **low** p_T (below 2 GeV/c) and at asymmetric trigger and associated p_T

Results: $\Delta\eta$ variances





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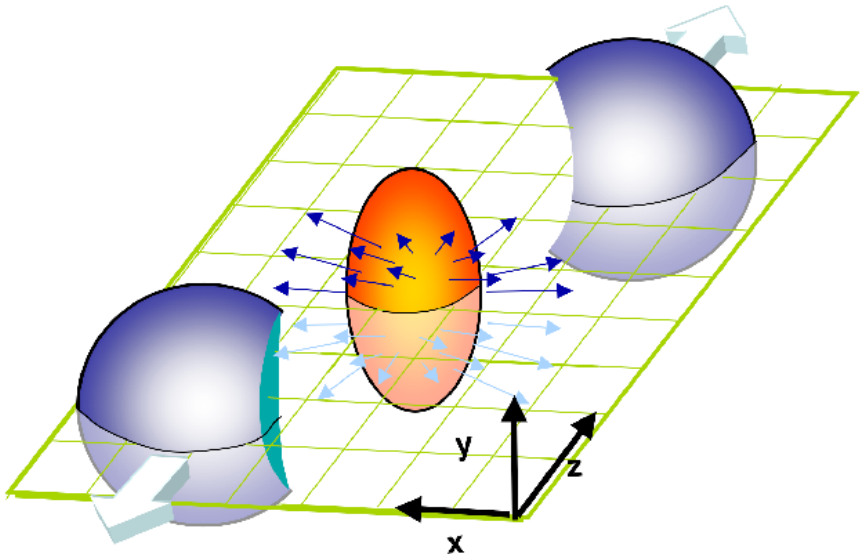
Summary

- **AMPT:**
  - Four **main components:** initial conditions, parton level, hadronozation, hadron cascade
  - **Default** and **Melting model**
  - Collective effects
- **Angular Correlation:**
  - Trigger and associated particles
  - **Identified** trigger particles (π^+)
  - Distribution of $\Delta\varphi$ and $\Delta\eta$
  - AMPT simulations hint species **dependence at low** P_T
- **Plans for the future:**
  - Simulation with other settings
  - Other triggers (π^-, p^+)
  - Comparing results with experimental data

Thank You!

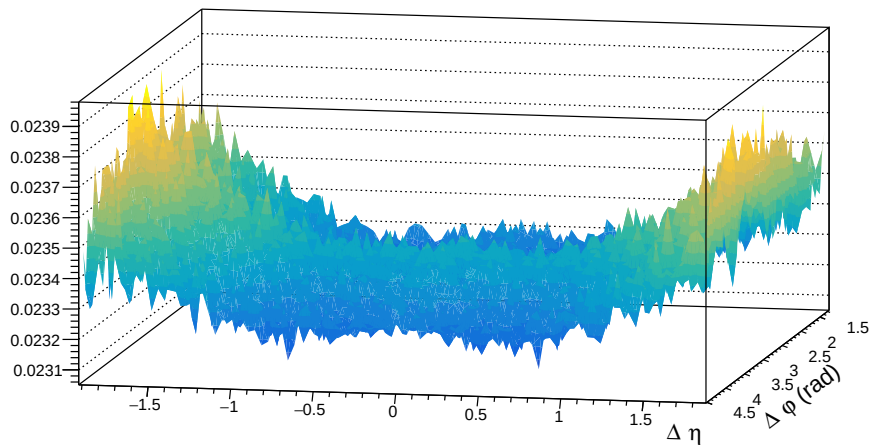
Flow

- QGP strongly interacting almost **perfect fluid**
- From initial spatial **asymmetry** $\rightarrow$ **asymmetry** in particle distribution
- Flow is a background for jet studies
- Can be subtracted on a statistical basis



$\Delta\eta$ independent structure

- **Parabola structure in $\Delta\eta$**
- **This structure comes from:**
  - **$\Delta\eta$ dependence of particle generation**
  - **centrality bin size isn't infinitesimal**
  - **$\Delta\eta$ dependence of flow**



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