Dijet Invariant Mass with ALICE at the LHC

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Introduction

- **Long term goal:** Study the properties of **quark gluon plasma (QGP)** by measuring the centrality dependence of dijet mass distribution in Pb–Pb collisions.
  - High energy jets are quenched in QGP.
  - In a dijet system both jets lose energy, interesting constrain on the geometry.
  - → Comparing to a single jet, a dijet may, on the average, traverse a longer distance inside the strongly interacting medium.
- **Intermediate goal:** Study the properties of **cold nuclear matter effects**, by comparing p–Pb to pp collisions results.
- **In this poster:** ALICE Monte Carlo simulations for pp collisions.
- CMS [1] and ATLAS [2] have measured dijet invatiant mass distribution in pp collisions in order to search resonances at $M_{jj} > 200$ GeV$/c^2$.

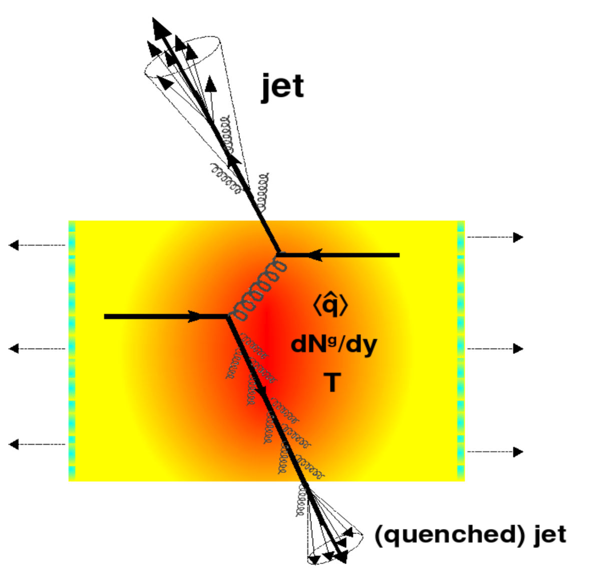

Figure 1: Schematic representation of a hard interaction, with jets born from the outgoing partons. Source: [3]

Tracks and jets

- **Charged tracks** with $p_T > 150$ MeV$/c$ in range $|\eta_{track}| < 0.9$.
- Jets are reconstructed with FASTJET package [4], using anti-k_T algorithm and jet resolution parameter $\mathbf{R = 0.4}$.
- Jets with $|\eta_{jet}| < 0.9 - R$ are accepted.
- p_T scheme is used for combining the tracks into jets.

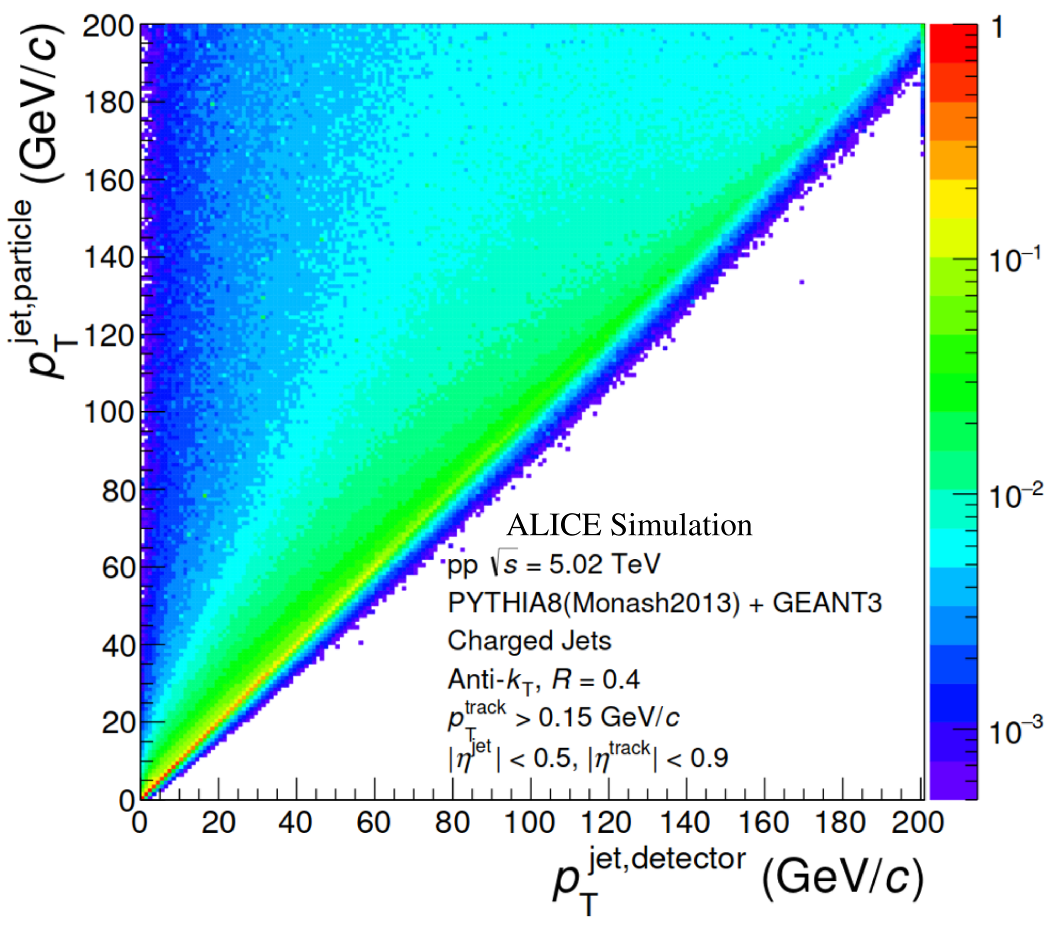

Figure 2: Unfolding matrix of a published ALICE jet p_T analysis [5] in pp collisions at $\sqrt{s} = 5.02$ TeV.

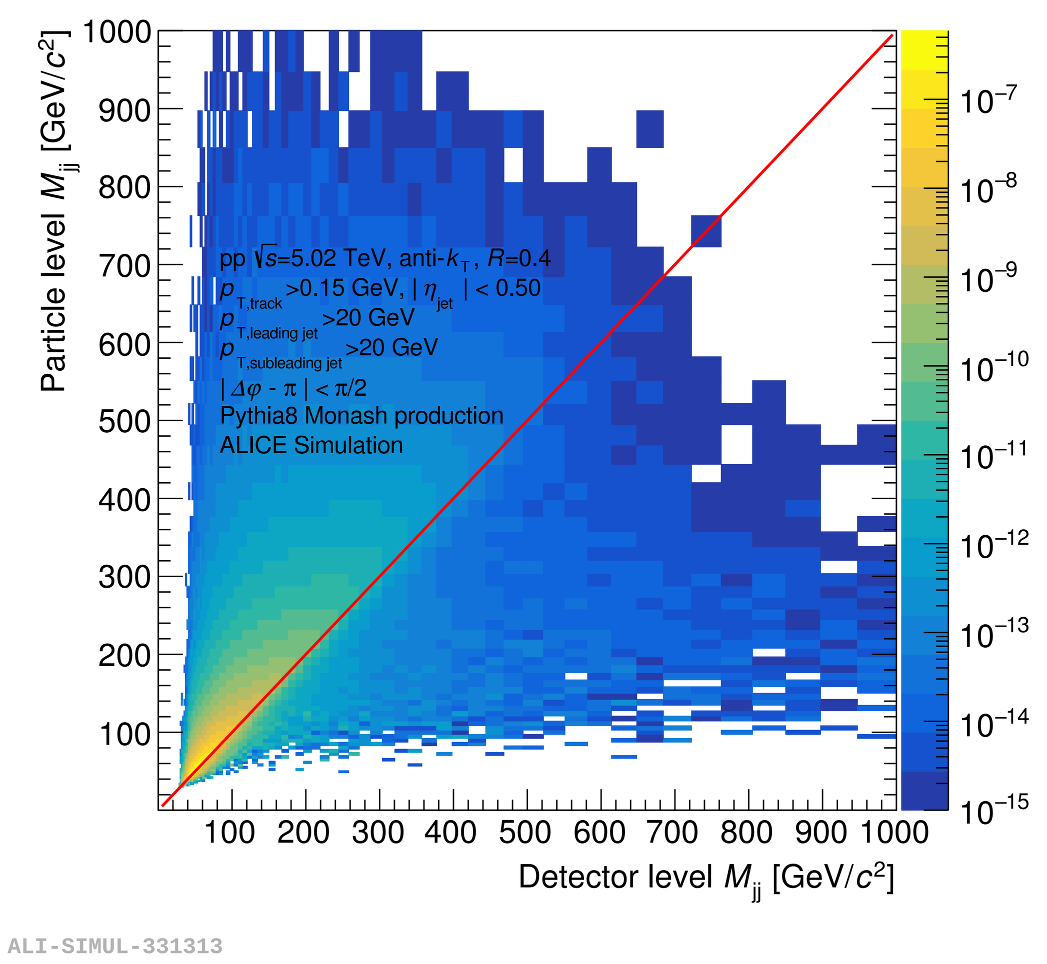

Figure 3: Unfolding matrix for dijet invariant mass spectrum in pp collisions at $\sqrt{s} = 5.02$ TeV.

Dijets

- Leading and subleading jet $p_{T,jet} > 20$ GeV$/c$.
- $|\Delta\varphi - \pi| < \pi/2$ between dijet candidates.
- The invariant mass of the dijet system:

$$\begin{aligned} M_{jj}^2 &= (p_1 + p_2)^2 \\ &= m_1^2 + m_2^2 + 2\left(m_{T,1}m_{T,2}\cosh(\Delta y) - p_{T,1}p_{T,2}\cos(\Delta\varphi)\right) \\ &\approx 2p_{T,1}p_{T,2}\left(\cosh(\Delta\eta) - \cos(\Delta\varphi)\right), \end{aligned}$$

  where $\Delta y = y_1 - y_2$, $\Delta\eta = \eta_1 - \eta_2$ and $\Delta\varphi = \varphi_1 - \varphi_2$.
- In p_T scheme used here, jets are massless and the last equation is exact.

Unfolding

- Detector effects are corrected via a 2D Bayesian unfolding [6]. Response matrix for dijet invariant mass can be seen in figure 3.
  - A side by side comparison with jet p_T response matrix in pp collisions at $\sqrt{s} = 5.02$ TeV from a published ALICE analysis [5] is provided in figure 2.

Results

In Figure 4 I show the dijet invariant mass spectrum of PYTHIA [7] Monash and 4C tunes in pp collisions at $\sqrt{s} = 5.02$ TeV.

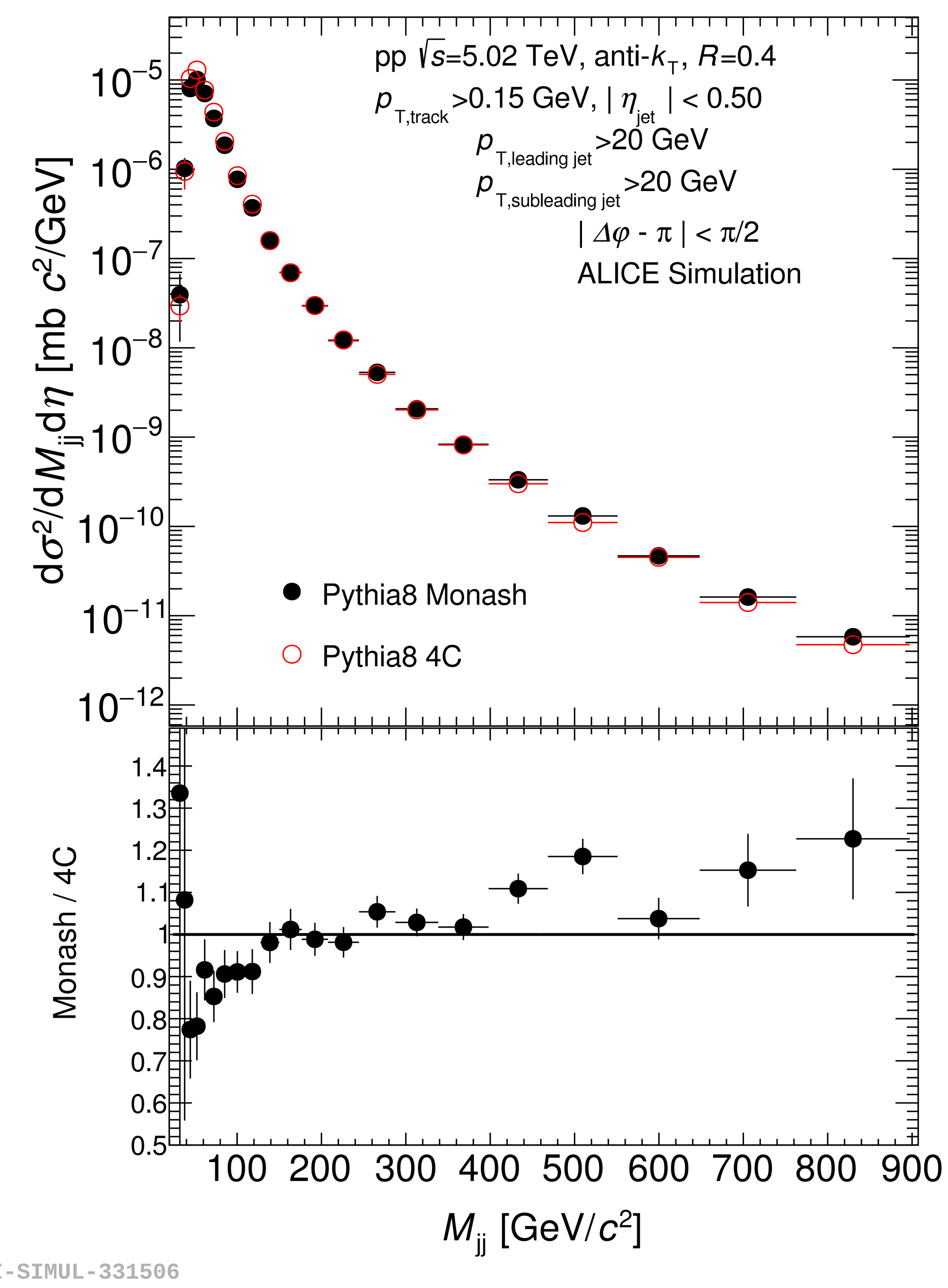

Figure 4: Dijet invariant mass spectrum comparison of PYTHIA Monash and 4C tunes in pp collisions at $\sqrt{s} = 5.02$ TeV.

Conclusions and outlook

- PYTHIA Monash and 4C tunes mostly agree within statistical uncertainties. PYTHIA 4C tune seems to estimate dijet mass higher on lower masses.
- **Next:** Analysis of ALICE $\sqrt{s} = 5.02$ TeV pp and p–Pb collision data for the study of cold nuclear matter effects and small colliding systems modifications.

References

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