Two-particle correlations in p–Pb collisions: the double ridge and the jet-like structures

Two-particle correlations:
- Trigger particle with a transverse momentum $p_{T\text{, trig}} > p_{T\text{, trig, min}}$
- Associated particles within $p_{T\text{, assoc, min}} < p_{T\text{, assoc}} < p_{T\text{, trig}}$

Per-trigger yield:

$$\frac{1}{N_{\text{trig}}} \frac{d^2N_{\text{assoc}}}{d\eta d\phi}$$  \hspace{1cm} (1)

Multiplicities from jet on top of a double ridge[1,2] structure.

Ridge subtraction
Near-side long-range (black) symmetrized around π/2 (green) subtracted from short-range (blue)

<table>
<thead>
<tr>
<th>Near-side yield (0.7 &lt; $p_{T\text{, trig}}$ &lt; 1.2 GeV/c)</th>
<th>$N_{\text{assoc, nearside}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before Double Ridge Subtraction</td>
<td>After Double Ridge Subtraction</td>
</tr>
<tr>
<td>Contribution odd components (dashed curve) added in the systematic uncertainties.</td>
<td></td>
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</tbody>
</table>

Per-trigger yields

$\langle N_{\text{assoc, nearside}} \rangle = \text{integral of the near-side above the combinatorial background}$

$\langle N_{\text{assoc, awayside}} \rangle = \text{integral of the away-side above the combinatorial background}$

**NEAR-SIDE and AWAY-SIDE**

- Per-trigger yields nearly constant apart from low multiplicity
- Number of hard processes (contributing to trigger and associated particles) and soft particles (contributing to trigger particles) exhibit the same evolution with multiplicity
- Plateau observed only after subtraction of long-range correlations
- Minijets and ridge structures are additive in two-particle correlations
- Consistent with a picture where minijet-associated yields originate from the incoherent fragmentation of multiple nucleon-nucleon collisions

**EFFECT OF SUBTRACTION**

Uncorrelated seeds: the link to MPIs

Uncorrelated seeds: independent sources of particle production (linearly correlated to multiparton interactions (MPIs) in Pythia[3]),

$$\langle N_{\text{uncorrelated}} \rangle = \frac{\langle N_{\text{trig}} \rangle}{\langle N_{\text{trig, correlated}} \rangle} = \frac{\langle N_{\text{trig}} \rangle}{1 + \langle N_{\text{assoc, nearside}} \rangle + \langle N_{\text{assoc, awayside}} \rangle}$$  \hspace{1cm} (2)

- Number of uncorrelated seeds increases linearly with multiplicity at midrapidity
- Linear trend is broken at low multiplicity
- Number of uncorrelated seeds scales with $N_{\text{all}}$ from Glauber Monte-Carlo calculations only in the intermediate multiplicity region
  → in high- and low-multiplicity events the number of semi-hard scatterings estimated with Glauber has a bias

Summary

- Number of hard processes and soft particles exhibit the same evolution with multiplicity
- Minijet and ridge structures are additive
- Minijets arise from incoherent fragmentation of multiple nucleon-nucleon collisions
- Number of uncorrelated seeds increases linearly with multiplicity at midrapidity
- The number of semi-hard scatterings from Glauber Monte-Carlo calculations in low and high multiplicity events is biased

References