Search for jet quenching effects in high-multiplicity proton-proton collisions at $\sqrt{s} = 13$ TeV

Quark-gluon plasma formation in small collision systems?

Collective flow

- Minimum bias events
- High-multiplicity events

Jet quenching in high particle multiplicity pp collisions

- $R_{AA}$ measurements $\rightarrow$ undefined Glauber scaling
- Semi-inclusive observables $\rightarrow$ increase of hadron-jet system acoplanarity

Parton propagation through medium

Pb-Pb $\sqrt{s}_{NN} = 2.76$ TeV

CMS, arXiv:1305.0609v3

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Kotliarov A.

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Proton-proton data

- Data from 2016 - 2018
- Online triggers based on V0 arrays:
  - Minimum bias (MB): 0.098 pb$^{-1}$
  - High-multiplicity (HM): 13 pb$^{-1}$
- Offline event activity (EA) selection:
  \[ V0M = V0A + V0C \rightarrow \text{sum of signals} \]
- Scaled multiplicity $V0M/\langle V0M\rangle$ 
  $\langle V0M\rangle$ - mean of MB distribution

Minimum bias distribution →

V0A: $2.8 < \eta < 5.1$

V0C: $-3.7 < \eta < -1.7$
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Acoplanarity versus event activity: raw data and PYTHIA 8

**Semi-inclusive recoil jet analysis**
- Anti-$k_t$ charged-track jets recoiling from a high-$p_T$ trigger track
- Jet $p_T$ corrected for underlying event density $\rho$
- Data-driven approach to remove uncorrelated background yield

**Raw data**
- Estimated uncertainty from tracking efficiency
- Significant suppression and broadening of HM data w.r.t. MB

**PYTHIA data**
- Does not account for jet quenching
- Exhibit qualitatively similar suppression effect as raw data

\[ \Delta \text{recoil} = \frac{1}{N_{\text{jet}}} \frac{dN_{\text{jet}}}{dp_{T,\text{jet}}} \text{TT}[20,30] - \frac{1}{N_{\text{jet}}} \frac{dN_{\text{jet}}}{dp_{T,\text{jet}}} \text{TT}[6,7] \]

$\text{TT}(x,y) \rightarrow$ trigger track with $p_T \in (x,y)$ GeV/c
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**PYTHIA 8 simulations**

Recoil jet pseudorapidity distribution vs. event activity

- **Increase of event activity bias enhances probability** to find a high-$p_T$ recoil jet in V0
- **HM events → suppressed probability to have 1 hard recoil jet in ALICE central barrel w.r.t. MB**
- **HM trigger → bias towards multi-jet final states**

Lower enhancement in V0A is caused by asymmetric coverage of V0 arrays

Multi-jet bias must be taken into account when imposing HM bias in small collision systems

★ VOM is defined as the number of charged, final state particles within V0A & V0C acceptances

Number of high-$p_T$ recoil jet vs. event activity

Enhancement of multi-jet events

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