Dynamically groomed jet radius in heavy-ion collisions
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- Jet substructure in heavy-ion collisions
  - Vacuum baseline under pQCD control
  - Tuned to be sensitive to specific medium effects.

- In this poster: dynamically groomed angle $\theta_g$.
  - Good pQCD control.
  - Sensitivity to the coherence angle of the medium $\theta_c$.

- Based on JHEP 2021 (7), 1-48 and arXiv:2111.14768.
Definition and predictions in $pp$ collisions

Definition  Mehtar-Tani, Soto-Ontoso, Tywoniuk, 1911.00375

- Tag the hardest declustering in all the C/A sequence, with hardness measure $\kappa^{(a)} = z(1-z)p_t(\Delta R/R)^a$.

- Then measure the $\theta_g = \Delta R$ of this branching.

- Band: theoretical uncertainties, perturbative control.

- Overall good agreement with ALICE data.

- Small $a$: larger NP corrections.

\begin{align*}
\Delta R_{12} &= \theta_g \\
\theta_1 &\gg \theta_2 = \theta_0 \gg \theta_3
\end{align*}
Probing coherence effects in heavy-ion collisions

- Coherence angle measures resolution power of the medium.

- Scales like

\[ \theta_c = \frac{2}{\sqrt{\hat{q}L^3}} \]


- Jets with \( \theta_g \geq \theta_c \) lose more energy.

Analytic "toy" calculation including energy loss, MIEs and L fluctuations
Dependence upon jet quenching model

- Many jet quenching models have a notion of "resolution scale" incorporated.
- Example: $L_{\text{res}}$ parameter in the Hybrid strong-weak coupling model.
  
  Casalderrey-Solana, Gulhan, Hulcher, Milhano, Pablos, Rajagopal, 2015-17

- Need for an "orthogonal" observable to discriminate between models.

MC JetMed (weak coupling picture)
PC, Iancu, Mueller, Soyez, 2018

MC Hybrid model (hybrid strong/weak coupling picture)
Best experimental set-up

- Kolmogorov-Smirnov distance measures the difference between the medium and vacuum baseline. \( KS = \max |\Sigma_{\text{PbPb}}(\theta_g) - \Sigma_{\text{pp}}(\theta_g)| \)

- Analytic results confirm our numerical findings.

- "Ideal" set-up:

  \[ 0.5 \lesssim a \lesssim 1 \quad \text{and} \quad R = 0.2 \]

  reduce medium response and background effects
Back-up
\[ k_{t,g} = z_g \theta_g \]

### DyG – \( a = 1 \)

- \( 800 < p_T < 1000 \text{ GeV} \)
- \( |\eta| < 1.5, \text{ anti-} k_{\perp} (R = 0.4) \)

### DyG – \( a = 2 \)

- \( \frac{k_{t,g}}{\sigma} \frac{d\sigma}{dk_{t,g}} \)
- \( \text{Pythia8, Herwig7-AO, Herwig7-Dip, LO+N^2DL'} \)
$a = 0.1$

Vacuum

Medium

w/o L fluct.

JetMed

$75 < p_t < 100\text{ GeV}, |y| < 1$

anti-$k_\perp (R = 0.4)$

$\langle \theta_c \rangle$

$R$

$a = 0.3$

$\langle \theta_c \rangle$

$R$

$a = 0.5$

$\langle \theta_c \rangle$

$R$

$a = 0.7$

$\langle \theta_c \rangle$

$R$

$a = 1$

$\langle \theta_c \rangle$

$R$

$a = 2$

$\langle \theta_c \rangle$

$R$
\(a = 0.1\)

- Vacuum
- \(L_{\text{res}} = 0\)
- \(L_{\text{res}} = 2/(\pi T)\)
- \(L_{\text{res}} = \infty\)

Hybrid, w/o med resp

0 - 5%

75 < \(p_t\) < 100 GeV, |\(y\)| < 1

anti-\(k_{\perp}\) (\(R = 0.4\))

\(a = 0.3\)

\(a = 0.5\)

\(a = 0.7\)

\(a = 1\)

\(a = 2\)

\(\theta_g/R\)

\(\theta_g/R\)

\(\theta_g/R\)

\(\theta_g/R\)