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 θ_g.
  - Good pQCD control.
  - Sensitivity to the coherence angle of the medium θ_c.
- Based on JHEP 2021 (7), 1-48 and arXiv:2111.14768.

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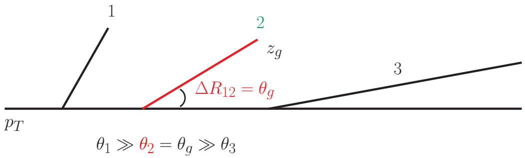
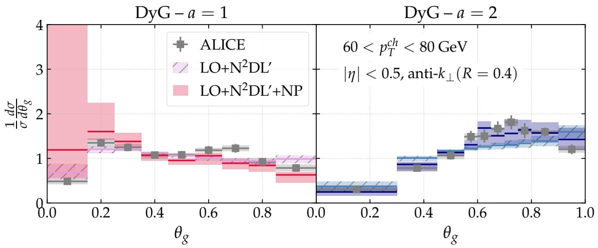
Definition and predictions in *pp* collisions

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

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





- Band: theoretical uncertainties, perturbative control.
- Overall good agreement with ALICE data. 2009.07712, 2009.12247
- Small a: larger NP corrections.

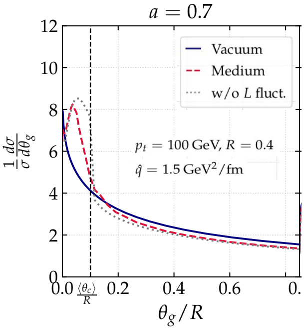
Probing coherence effects in heavy-ion collisions

- Coherence angle measures resolution power of the medium.
- Scales like

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

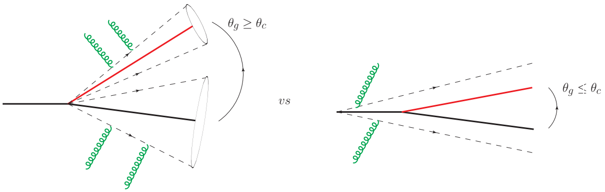
Mehtar-Tani, Salgado, Tywoniuk, 2011 - Casalderrey-Solana, Iancu, 2011

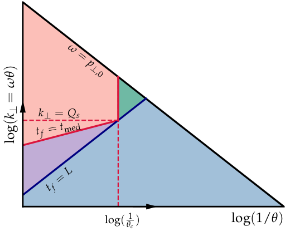
- Jets with $\theta_g \geq \theta_c$ lose more energy.



Analytic "toy" calculation

including energy loss, MIEs and L fluctuations

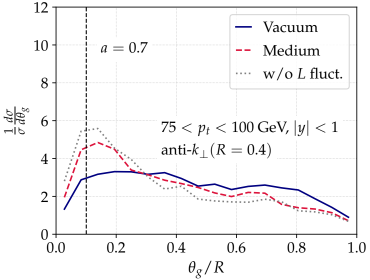




Dependence upon jet quenching model

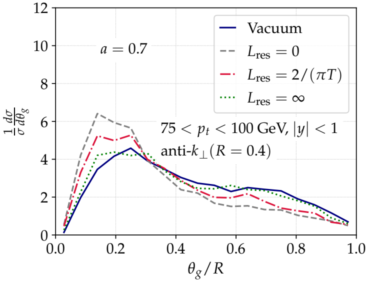
- Many jet quenching models have a notion of "resolution scale" incorporated.
- Example: L_{res} parameter in the Hybrid strong-weak coupling model.

  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

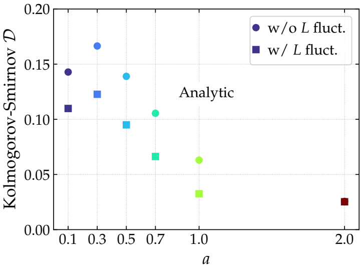


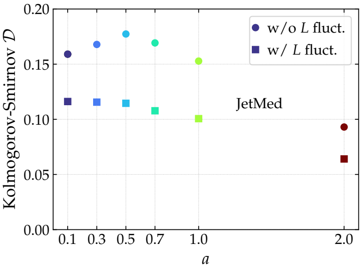
MC Hybrid model (hybrid strong/weak coupling picture)

Best experimental set-up

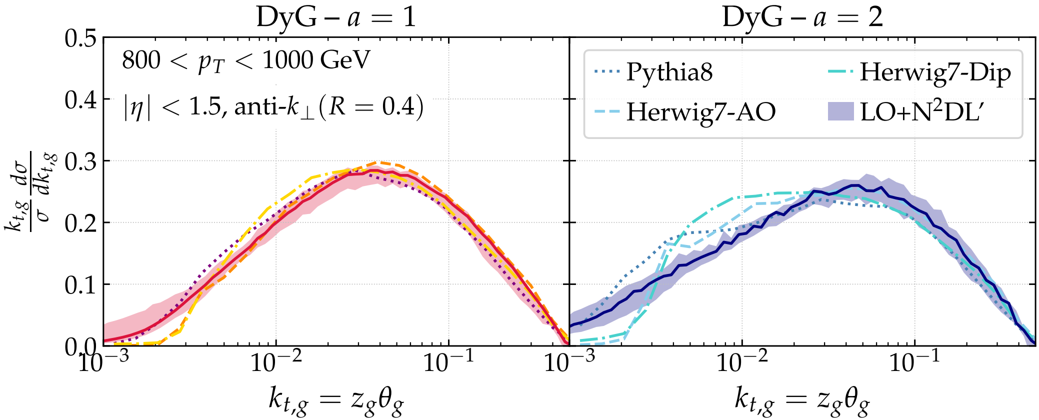
- Kolmogorov-Smirnov distance measures the difference between the medium and vacuum baseline. $KS = \max|\Sigma_{\rm PbPb}(\theta_g) - \Sigma_{\rm pp}(\theta_g)|$
- Analytic results confirm our numerical findings.
- "Ideal" set-up:

$$0.5 \lesssim a \lesssim 1 \quad \text{and} \quad \underbrace{R = 0.2}_{\text{reduce medium response and background effects}}$$

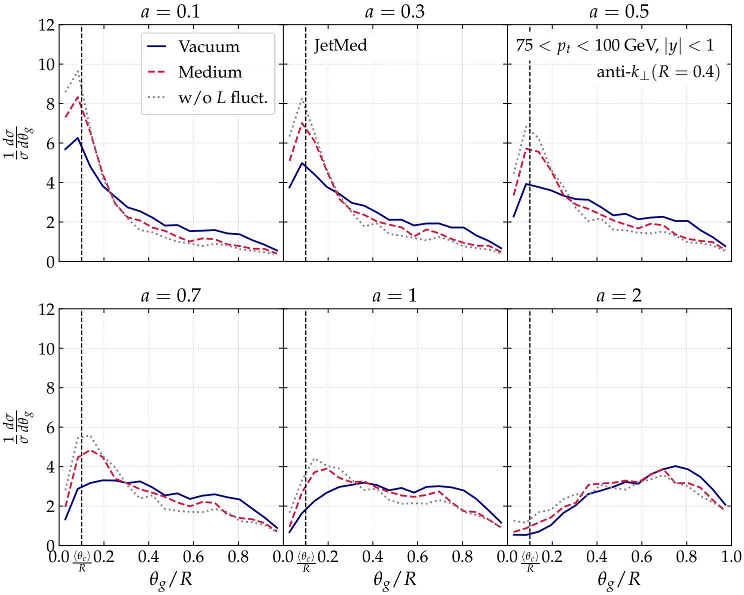




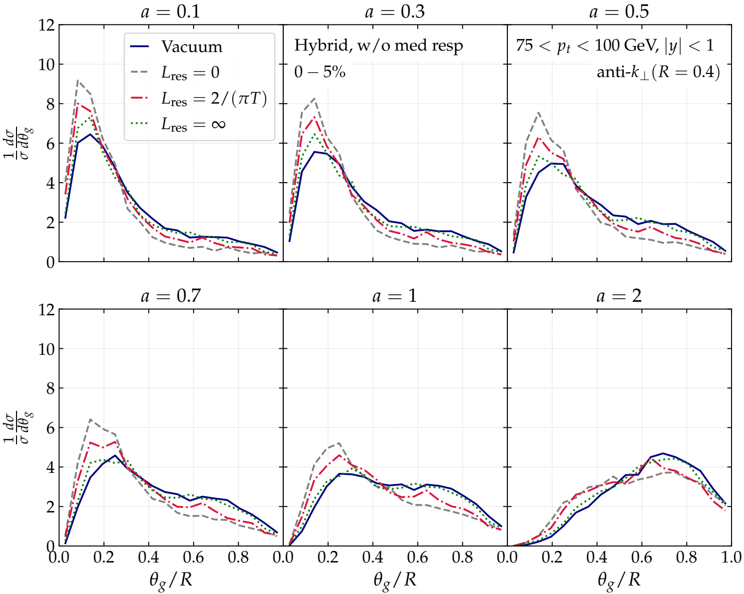
Back-up



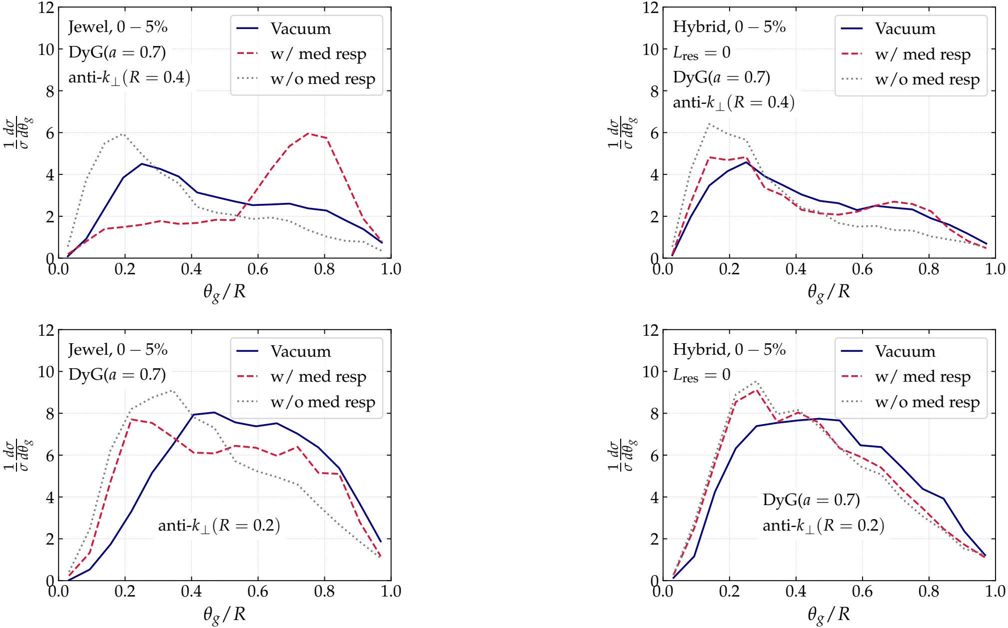
DyG – $a = 1$
DyG – $a = 2$
$800 < p_T < 1000$ GeV
$|\eta| < 1.5$, anti-$k_\perp (R = 0.4)$
Pythia8
Herwig7-Dip
Herwig7-AO
LO+N^{2}DL′
$\frac{k_{t,g}}{\sigma}\frac{d\sigma}{dk_{t,g}}$
0.0
0.1
0.2
0.3
0.4
0.5
10^{-3}
10^{-2}
10^{-1}
$k_{t,g} = z_g\theta_g$



$a = 0.1$
$a = 0.3$
$a = 0.5$
$a = 0.7$
$a = 1$
$a = 2$
Vacuum
Medium
w/o L fluct.
JetMed
$75 < p_t < 100$ GeV, $|y| < 1$
anti-$k_\perp (R = 0.4)$
$\frac{1}{\sigma}\frac{d\sigma}{d\theta_g}$
$\frac{\langle\theta_c\rangle}{R}$
θ_g/R
0 2 4 6 8 10 12
0.0 0.2 0.4 0.6 0.8 1.0



$a = 0.1$
$a = 0.3$
$a = 0.5$
$a = 0.7$
$a = 1$
$a = 2$
Vacuum
$L_{res} = 0$
$L_{res} = 2/(\pi T)$
$L_{res} = \infty$
Hybrid, w/o med resp
$0 - 5\%$
$75 < p_t < 100$ GeV, $|y| < 1$
anti-$k_\perp (R = 0.4)$
$\frac{1}{\sigma}\frac{d\sigma}{d\theta_g}$
θ_g / R


Jewel, 0 − 5%
DyG(a = 0.7)
anti-k⊥(R = 0.4)
Vacuum
w/ med resp
w/o med resp
Hybrid, 0 − 5%
L_res = 0
DyG(a = 0.7)
anti-k⊥(R = 0.4)
Jewel, 0 − 5%
DyG(a = 0.7)
anti-k⊥(R = 0.2)
Hybrid, 0 − 5%
L_res = 0
DyG(a = 0.7)
anti-k⊥(R = 0.2)
1/σ dσ/dθ_g
θ_g/R
0.0
0.2
0.4
0.6
0.8
1.0
0
2
4
6
8
10
12