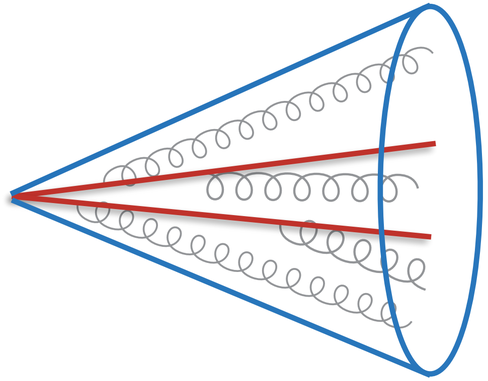
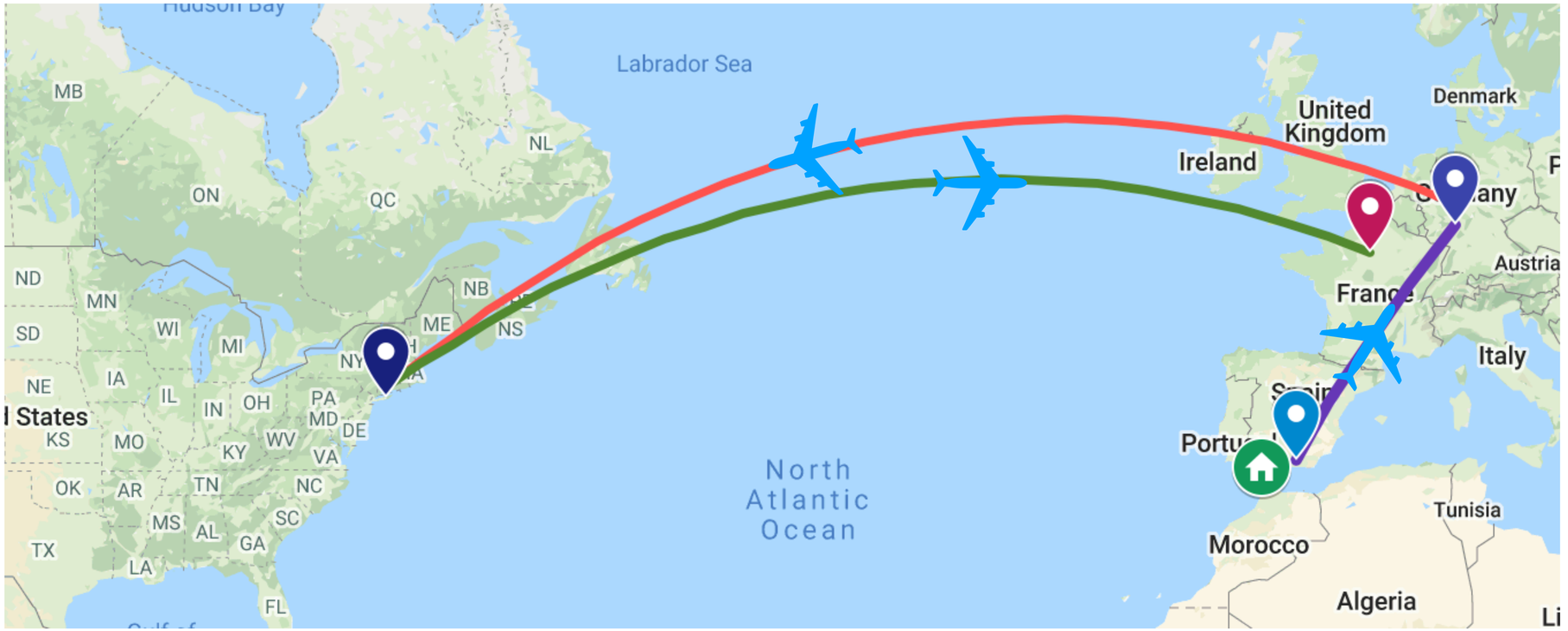
DYNAMICALLY GROOMED JET RADIUS AS A TEST FOR COLOR COHERENCE IN HEAVY-ION COLLISIONS



Alba Soto-Ontoso + Paul Caucal, Adam Takacs

Assemblée Générale du GDR QCD
Remote, 9th March, 2021

My research worldline



- **PhD thesis:** “Initial state structures and final state correlations in heavy-ion collisions”
  w/ Javier Albacete (Universidad de Granada) and Hannah Elfner (Goethe University)
- **1st PostDoc:** Brookhaven National Laboratory w/ Yacine Mehtar-Tani

Research interests

Small-x regime

Hints of saturation at LHC energies and cosmic rays

1505.06583

Hadronic structure

Proton/nuclear structure pheno impact at colliders

1605.09176
1612.06274
1707.05592
1908.10231

QCD

Jets in p+p & A+A

Jet substructure modifications in the QGP

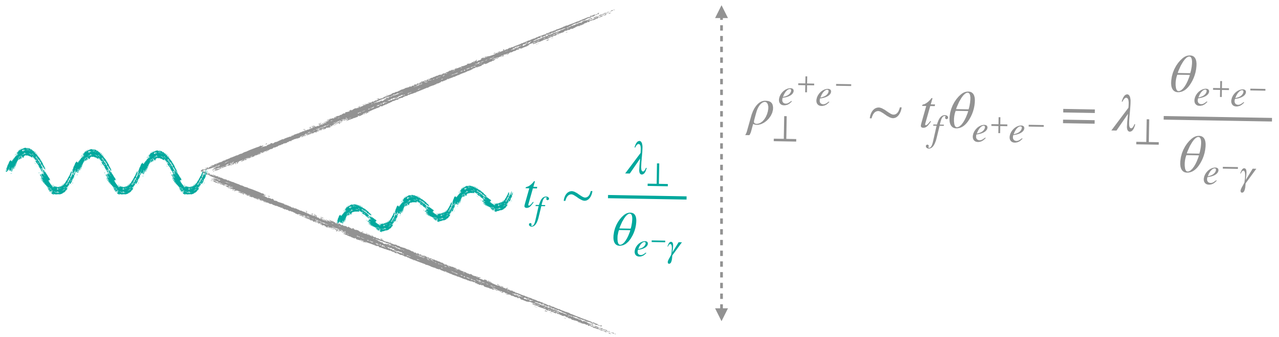
1904.12185
1911.00375
2005.07584
2009.13667

Parton showers

NEW: PanScales project

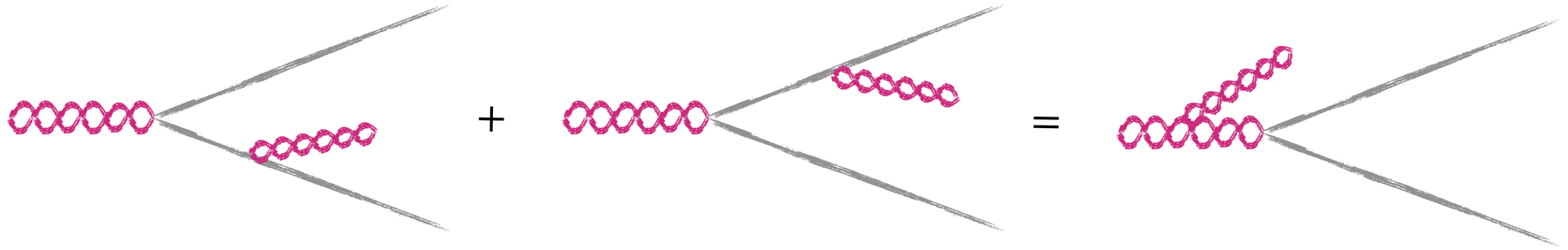
Color coherence in vacuum jets [Dokshitzer et al. 'Basics of pQCD']

Radiation pattern of soft photons in $e^+ + e^-$



Emitted photon cannot resolve the e^+e^- pair when $\theta_{e^-\gamma} > \theta_{e^+e^-}$,
i.e. $\lambda_\perp > \rho_\perp^{e^+e^-}$ ⇨ suppression

Similarly, in QCD wide-angle, soft radiation is sensitive to the parent color charge

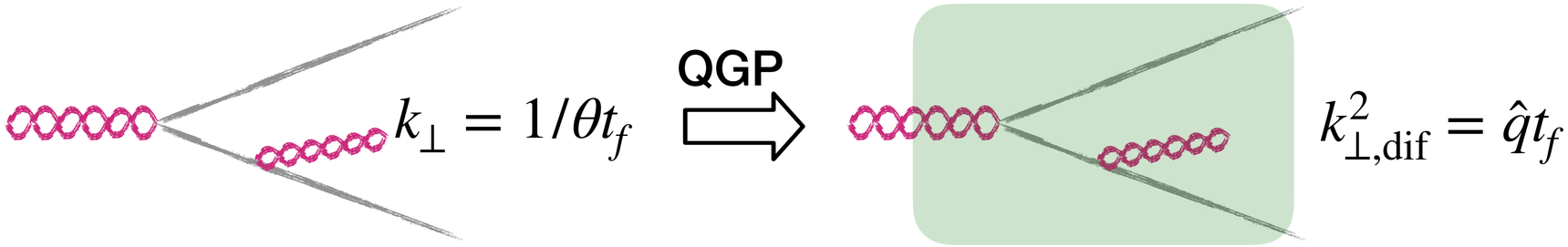


Color coherence leads to angular ordering in QCD showers

Color (de)coherence in medium jets

[Casalderrey, Mehtar-Tani, Tywoniuk, Salgado'12]
[Mehtar-Tani, Tywoniuk, Salgado'11]

New phenomena enter into play when embedding QCD jets in a QGP



Decoherence time: vacuum like splittings vs. medium-dominated regime

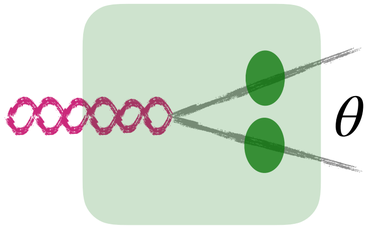
$$k^2_{\perp,\mathrm{dif}} = k^2_\perp \Longrightarrow \boxed{t_D \sim (\hat{q}\theta^2)^{-1/3}}$$

Minimal decoherence angle: scale at which the medium resolves the splitting

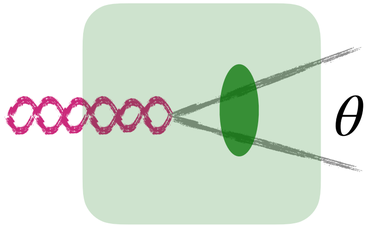
$$t_f = t_D = L \Longrightarrow \boxed{\theta_c = (\hat{q}L^3)^{-1/2}}$$

Can we measure the QGP resolution angle θ_c ?

Hints of color coherence in data



$\theta > \theta_c \Rightarrow \langle \varepsilon_{\text{loss}} \rangle \propto C_A + C_i$



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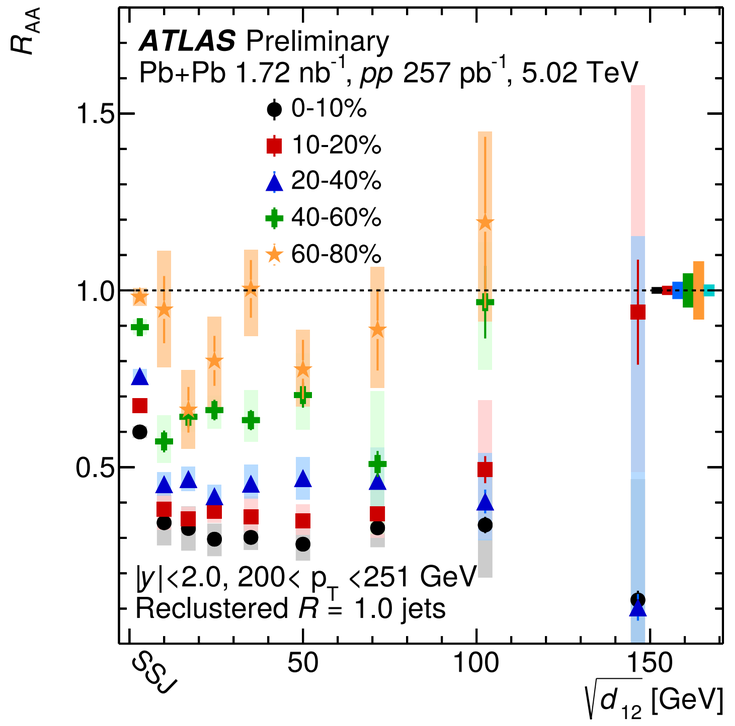
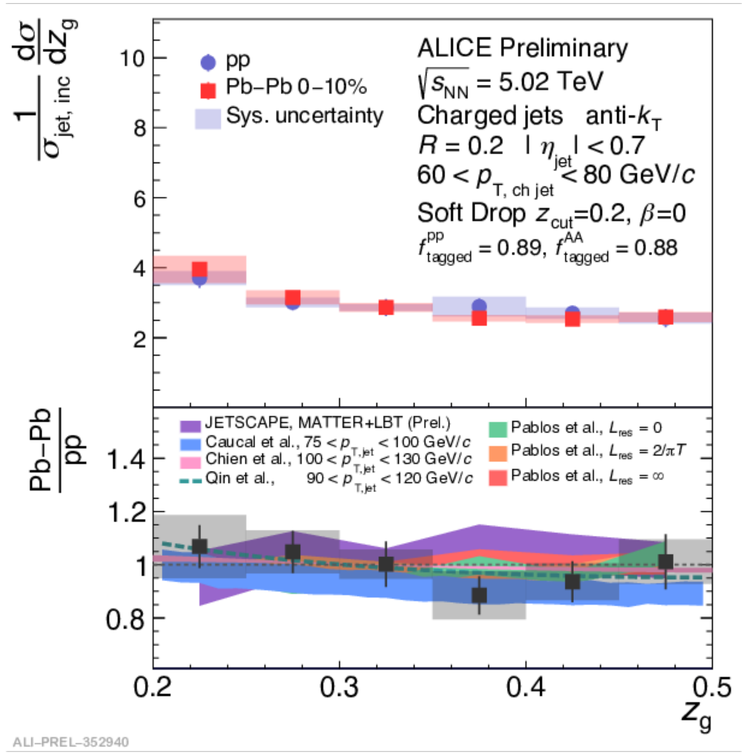
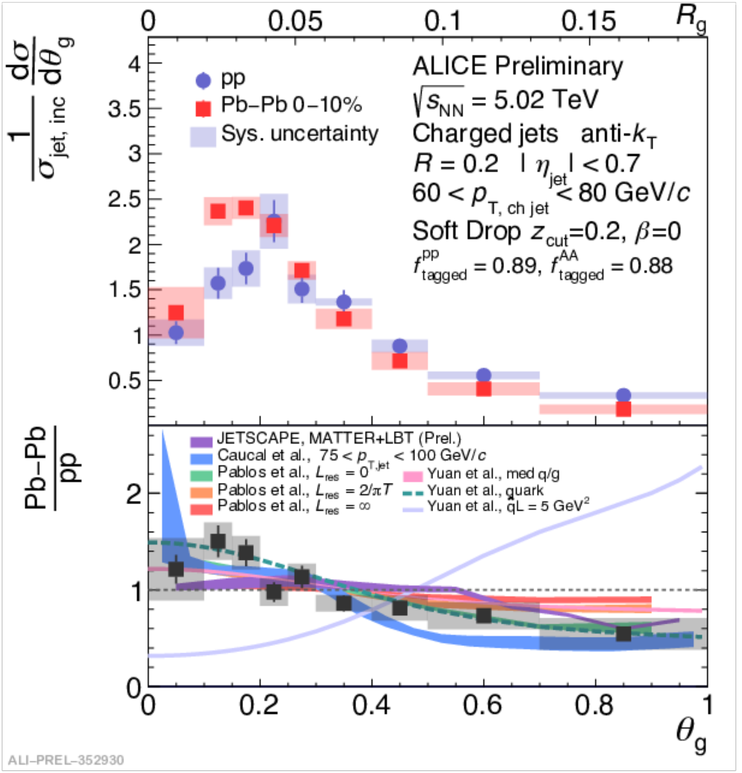




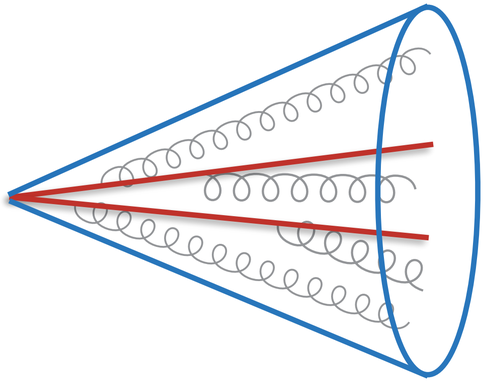


No conclusive evidence so far

Dynamical grooming [Mehtar-Tani, ASO, Tywoniuk PRD'20]

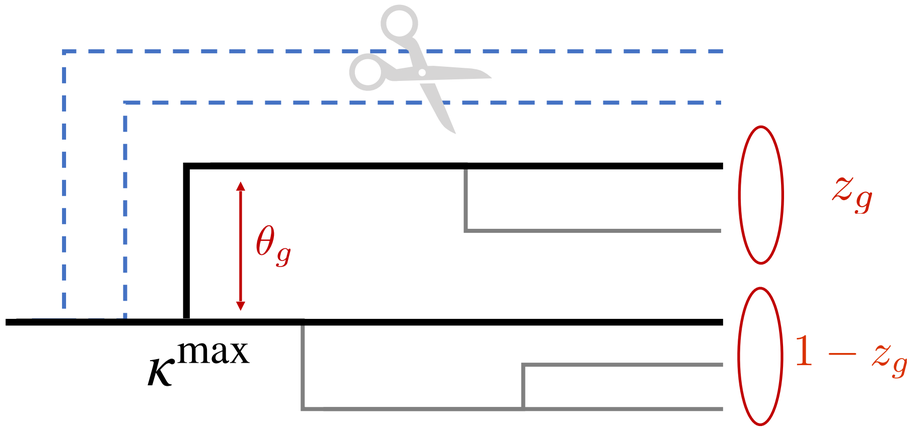
1) Find **hardest** branch in the C/A sequence, i.e.

$$\kappa^{(a)} = \frac{1}{p_T} \max_{i \in \text{C/A}} z_i(1-z_i) p_{T,i} (\theta_i/R)^a$$

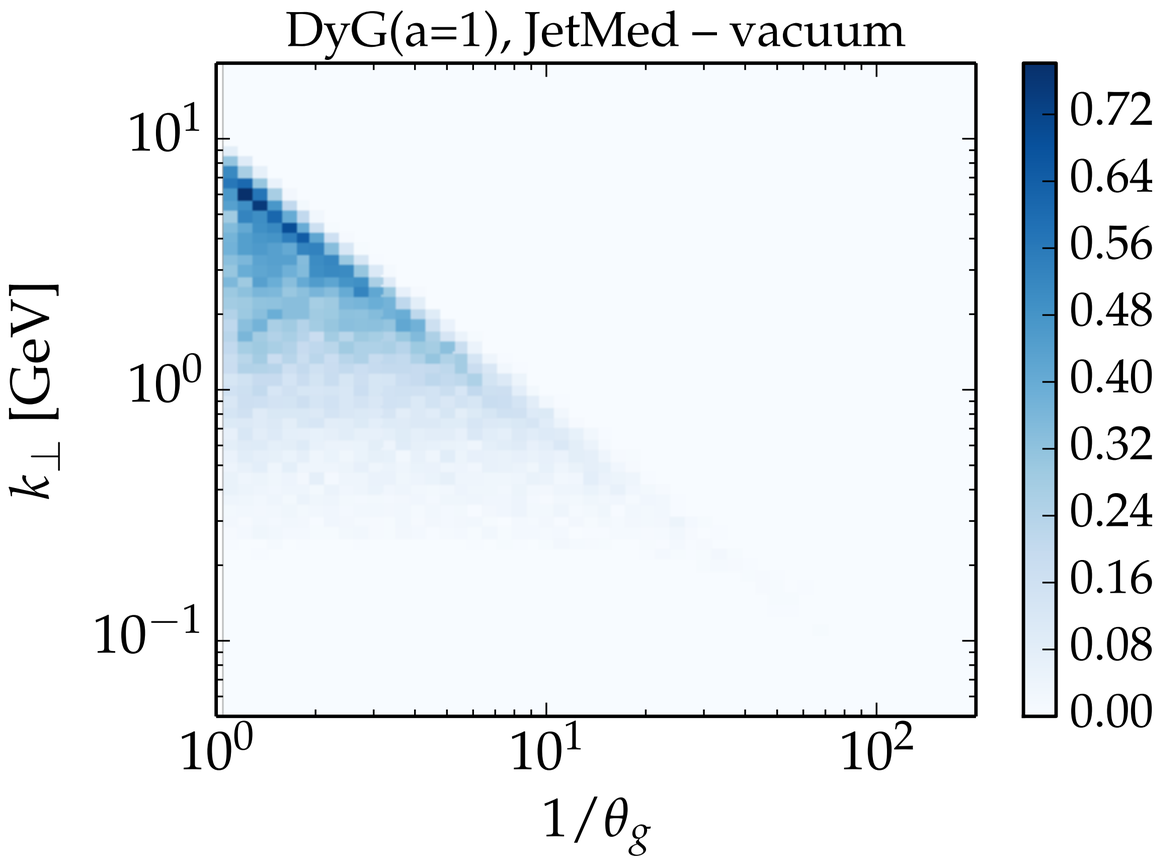


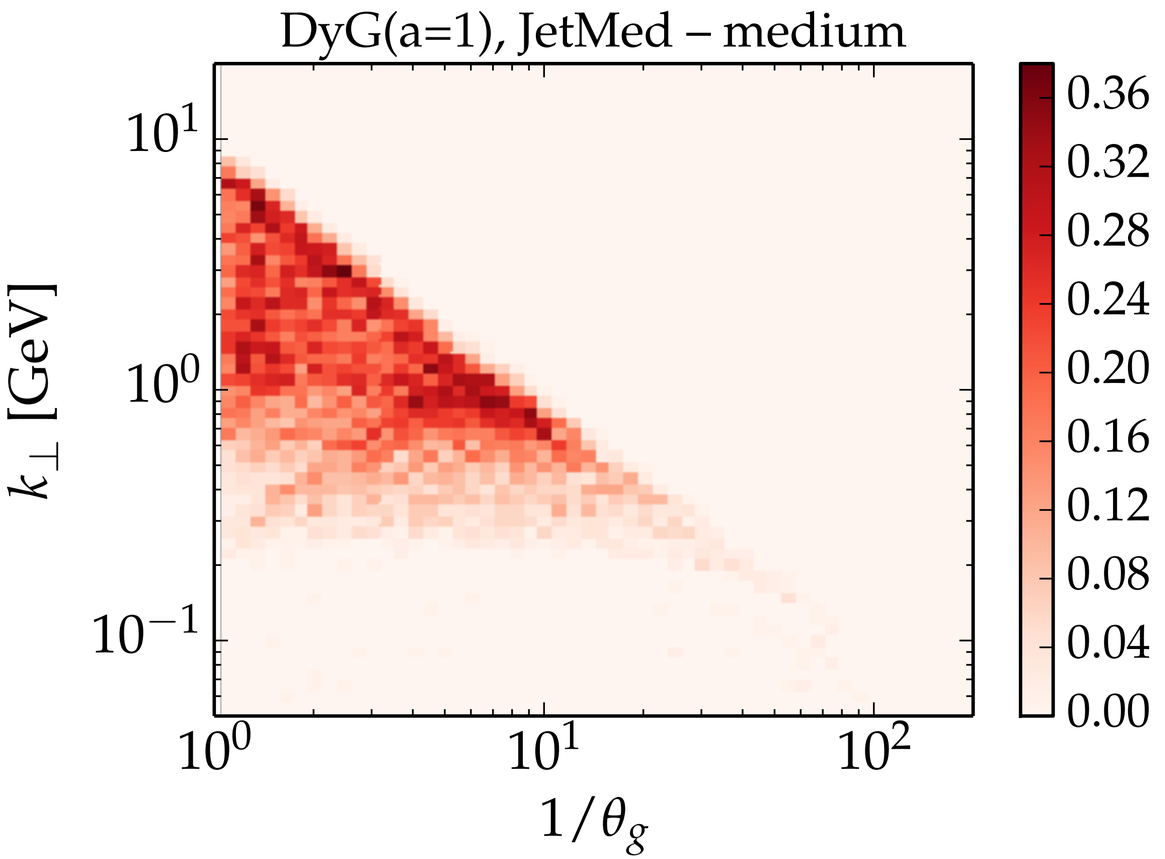
Physical interpretation: • a=2: $\kappa \sim m^2$ • a=1: $\kappa \sim k_t$ • a~0: $\kappa \sim z$

2) Drop all branches at larger angles, i.e. $\theta_i > \theta_g$



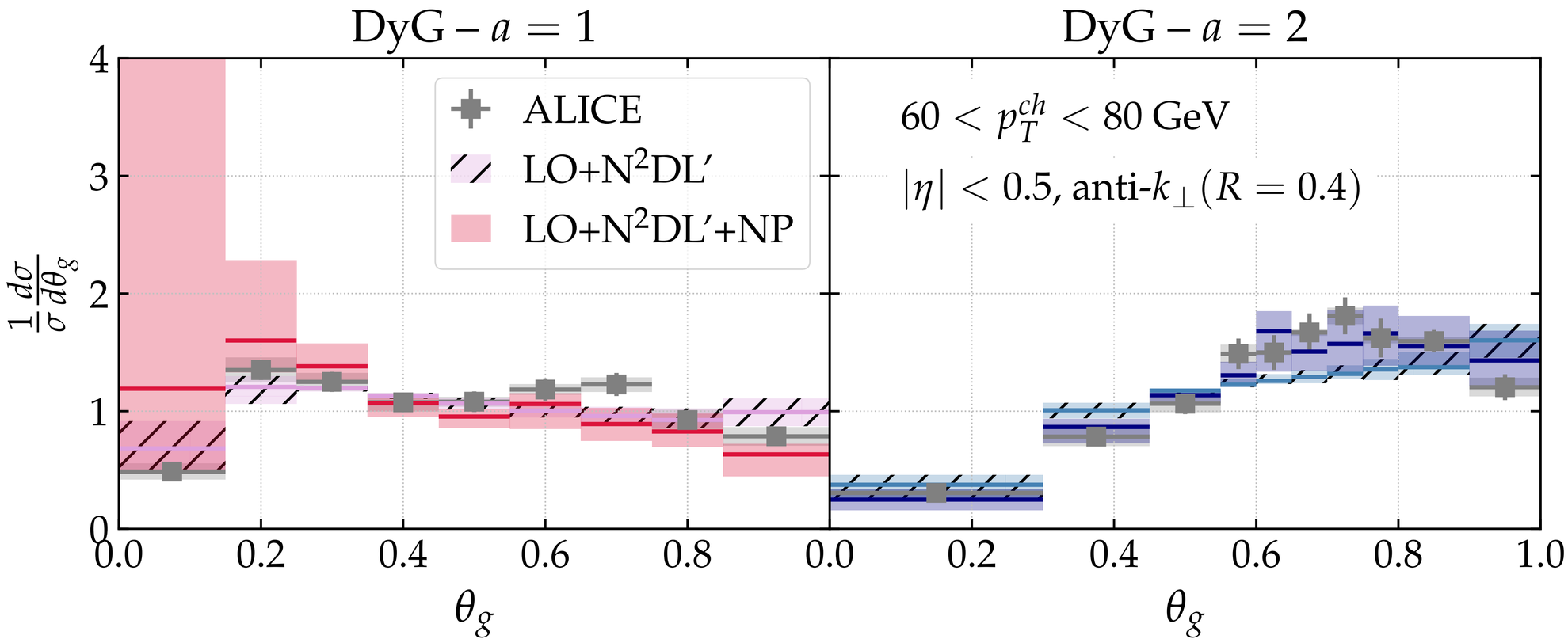
Dynamically groomed Lund planes





Multiple regions of radiation in the medium are probed by DyG

Dynamically groomed jet radius: vacuum baseline [Caucal, ASO, Takacs to appear]

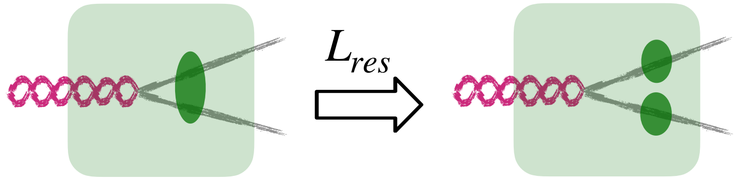


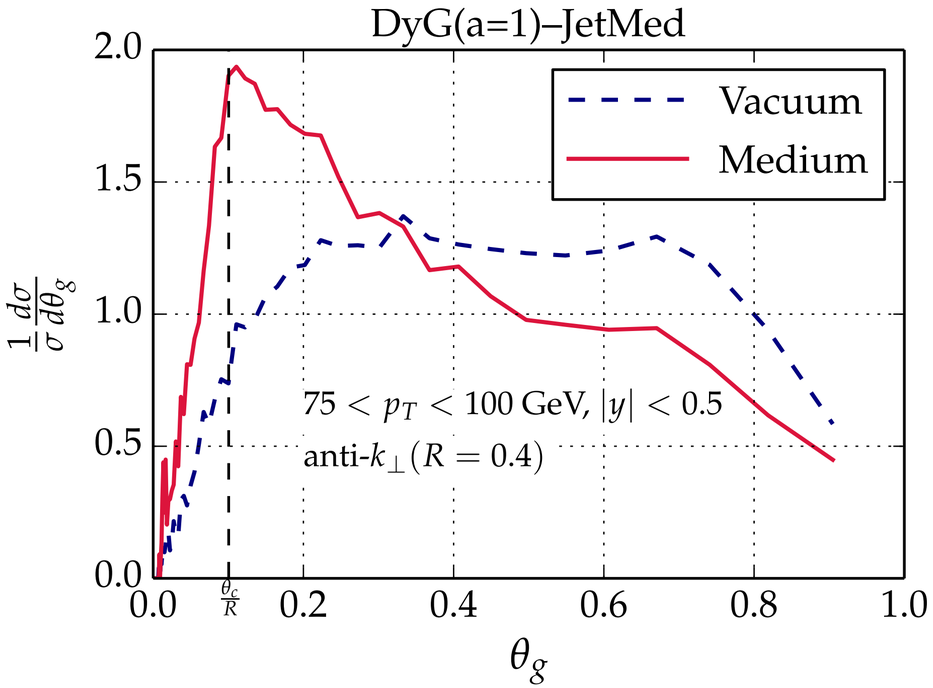
Theoretical uncertainties on the vacuum benchmark under control

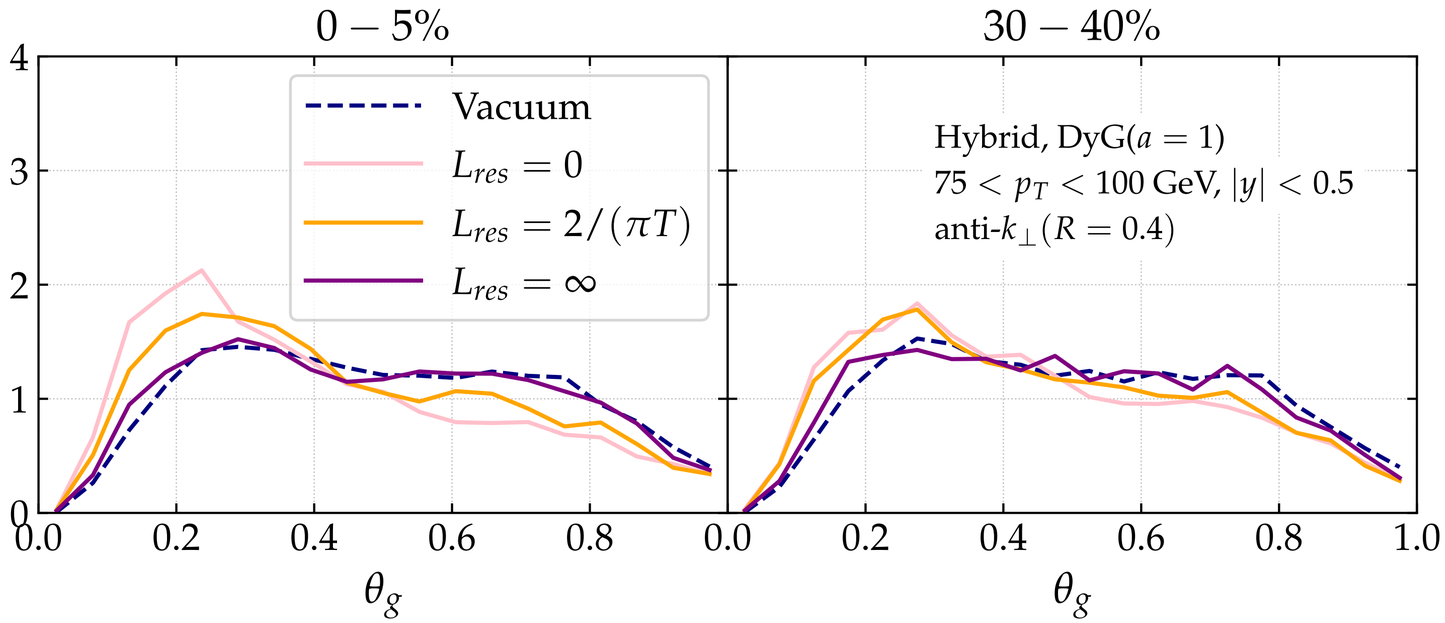
Dynamically groomed jet radius: quenched MCs [Caucal, ASO, Takacs to appear]

[JetMed: P.Caucal et al. 2018-2021]

[Hybrid: D.Pablos et al. 2014-2021]



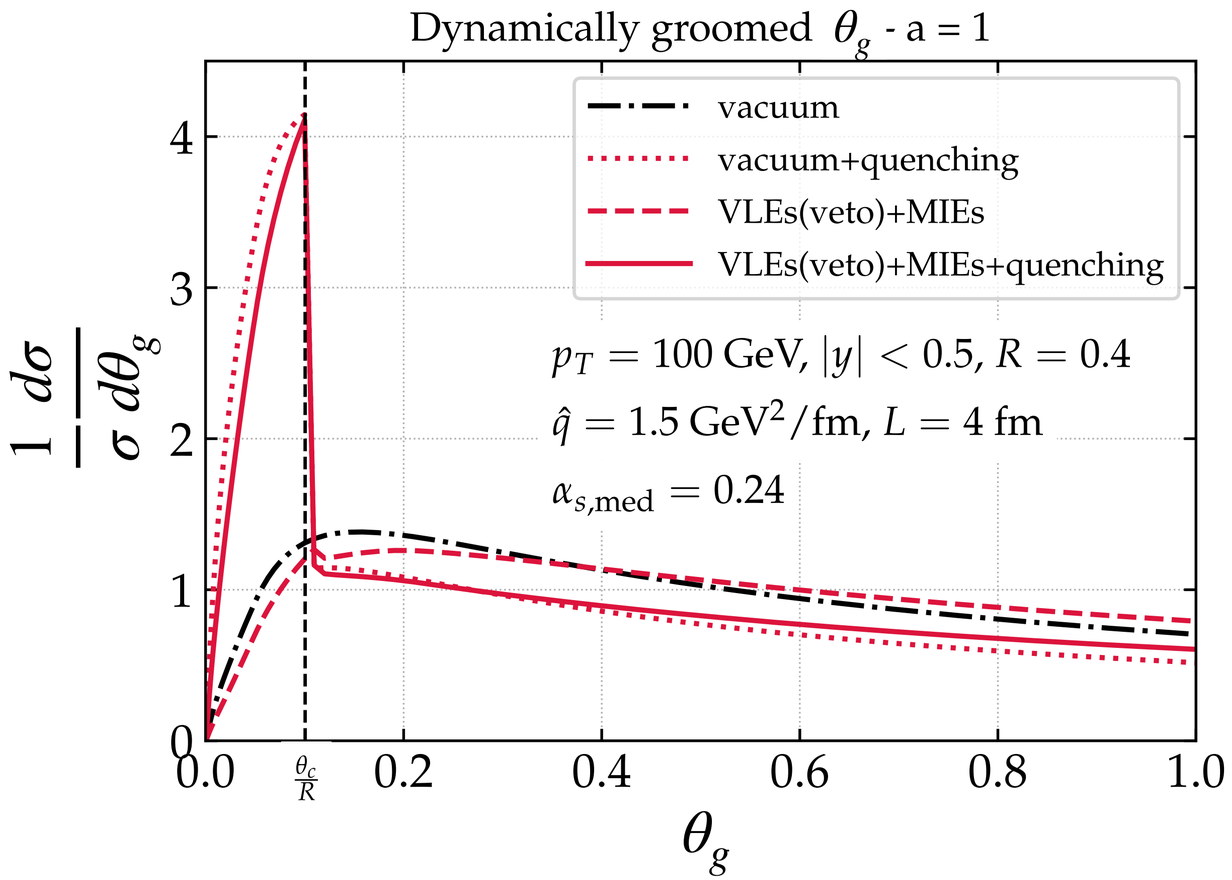


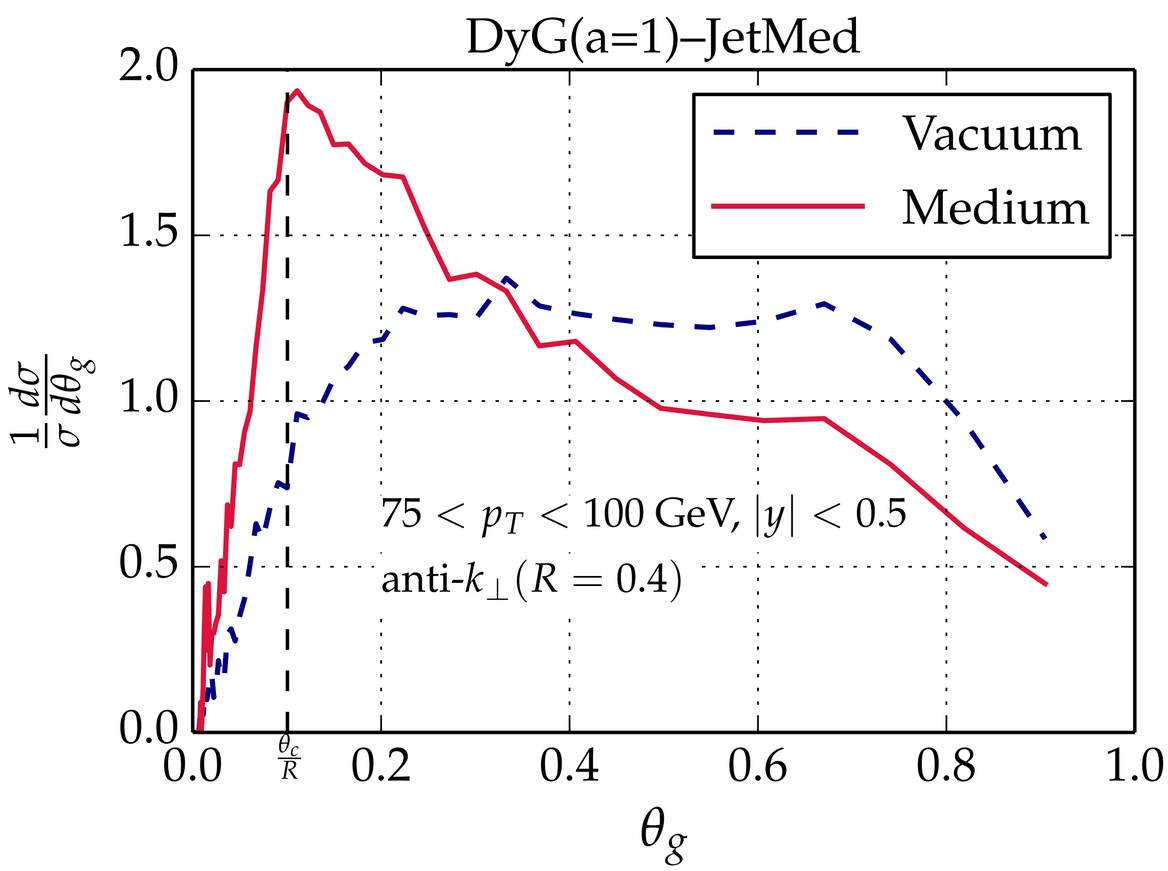


Sharp contrast between vacuum and medium distributions

New window into color decoherence with jet substructure observables

Dynamically groomed jet radius: analytical insight





Convergence of several dynamical processes in the medium at $\theta_g = \theta_c$