

Dynamically groomed jet radius in heavy-ion collisions

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[arXiv:2103.06566](https://arxiv.org/abs/2103.06566) and [arXiv:2111.14768](https://arxiv.org/abs/2111.14768)

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Supported by the Trond Mohn Foundation BFS2018REK01

and MCnetITN3 H2020 Marie Curie Initial Training Network 722104



Tagging splittings in jets

The Lund plane: phase space of emissions

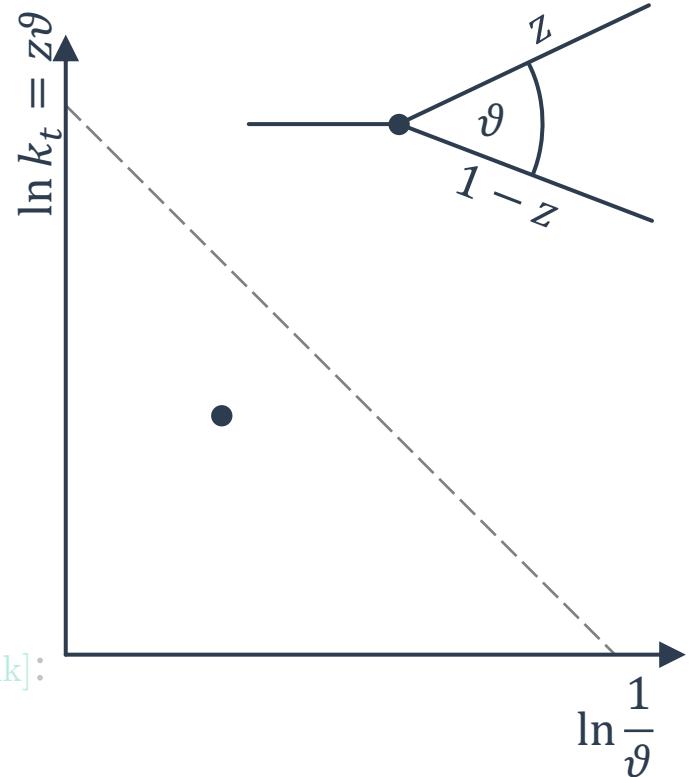
1. Find a jet
2. Decluster with C/A (widest angle first)
3. Follow the hardest branch ($z_i > \frac{1}{2}$)

Soft Drop tagged splitting [Larkovski, Marzani, Soyez, Thaler]:

4. Stop if $z_i > z_{cut} \vartheta_i^\beta$ (with the widest angle)
 - Free parameters z_{cut} and β .

Dynamically tagged splitting [Mehtar-Tani, Soto-Ontoso, Tywoniuk]:

4. Find the hardest $\max_i(z_i \vartheta_i^a)$
 - No cuts, autogenerated jet-by-jet
 - Clear physical meaning: maximum k_t ($a = 1$), or maximum m^2 ($a = 2$)



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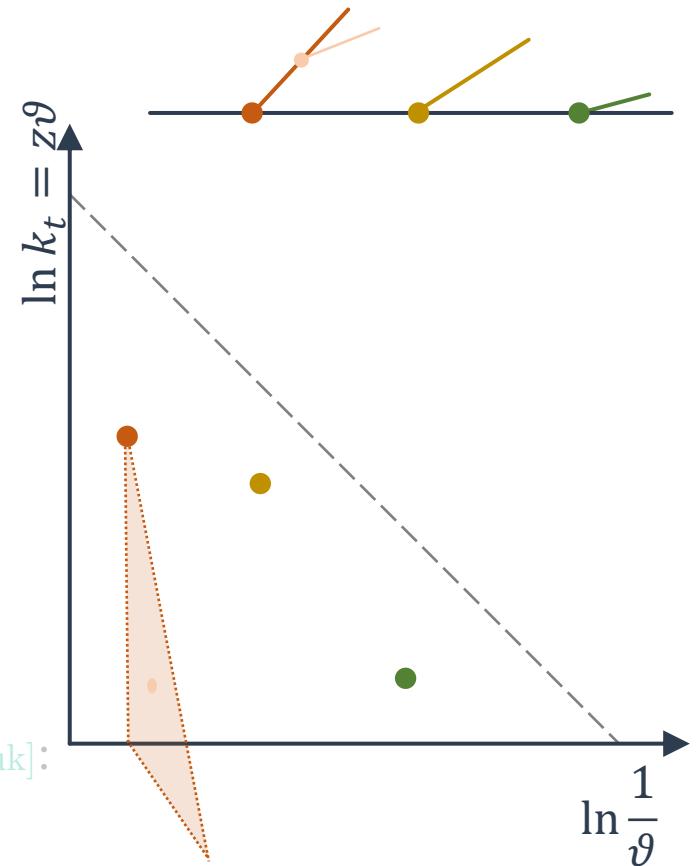
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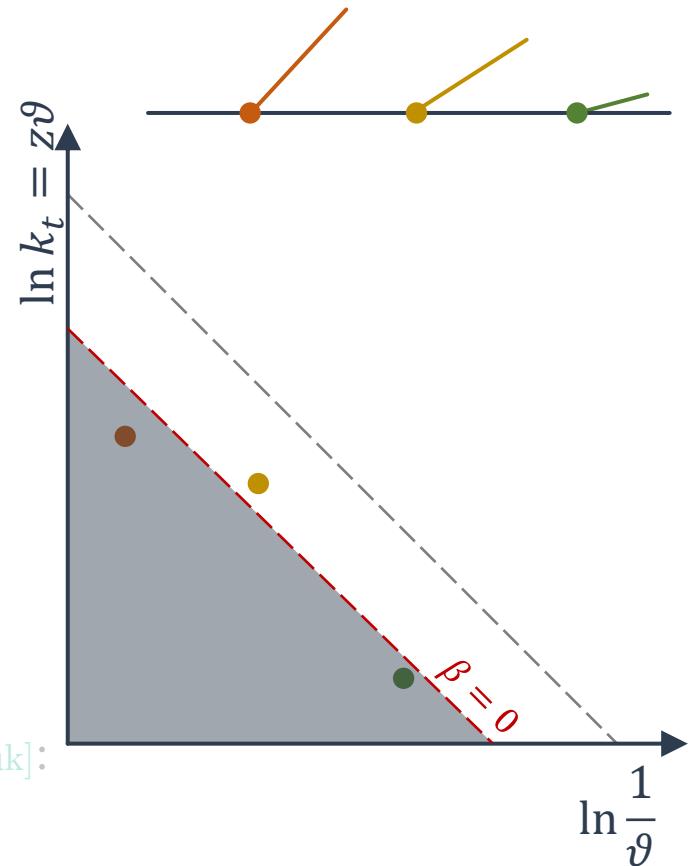
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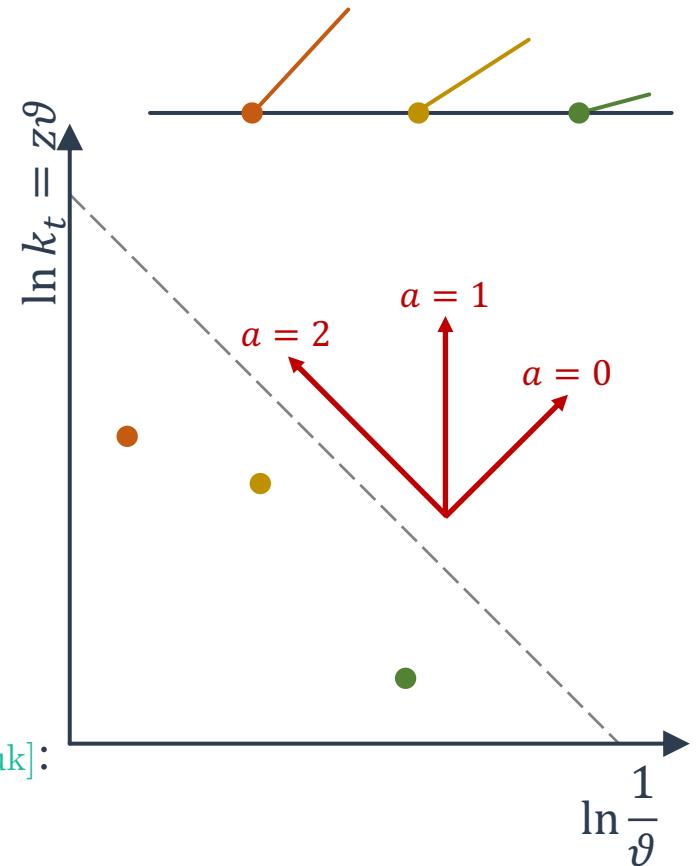
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Proton-Proton Collisions

[arXiv:2103.06566](https://arxiv.org/abs/2103.06566)



Analytic properties

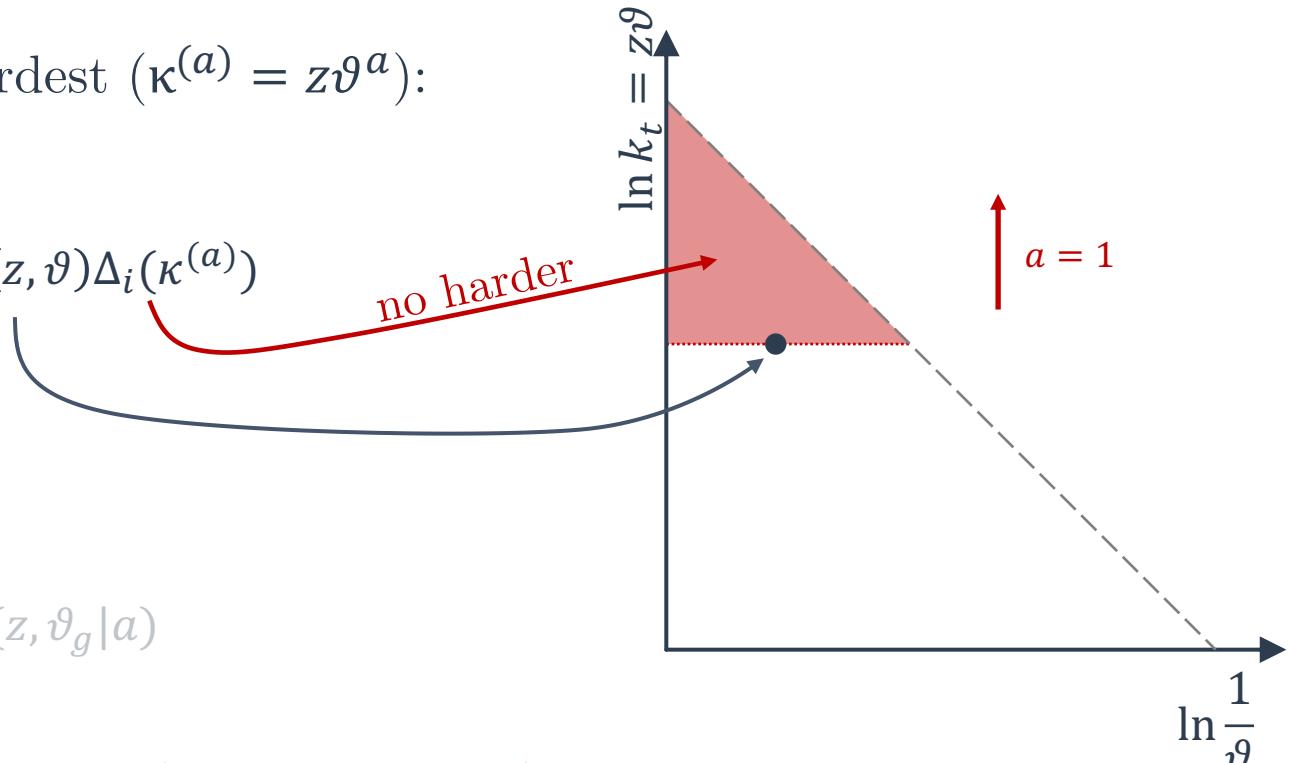
Probability of (z, ϑ) is the hardest ($\kappa^{(a)} = z\vartheta^a$):

$$\frac{d^2 \mathcal{P}_i(z, \vartheta | a)}{d\vartheta dz} = P_i(z, \vartheta) \Delta_i(\kappa^{(a)})$$

Measuring ϑ_g :

$$\left. \frac{1}{\sigma} \frac{d\sigma}{d\vartheta_g} \right|_a = \int_0^1 dz \mathcal{P}_i(z, \vartheta_g | a)$$

The Sudakov regulates the integral (there is no z_{cut})!



Analytic properties

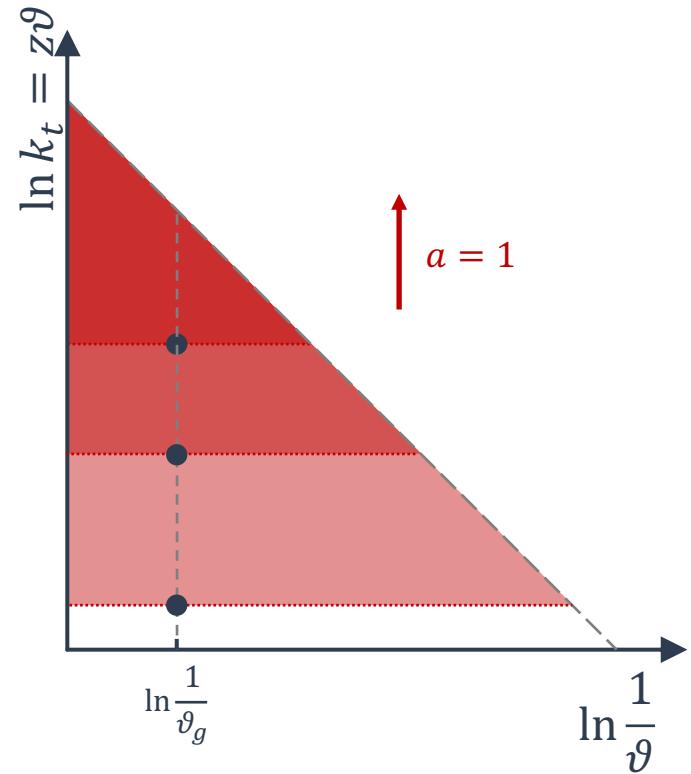
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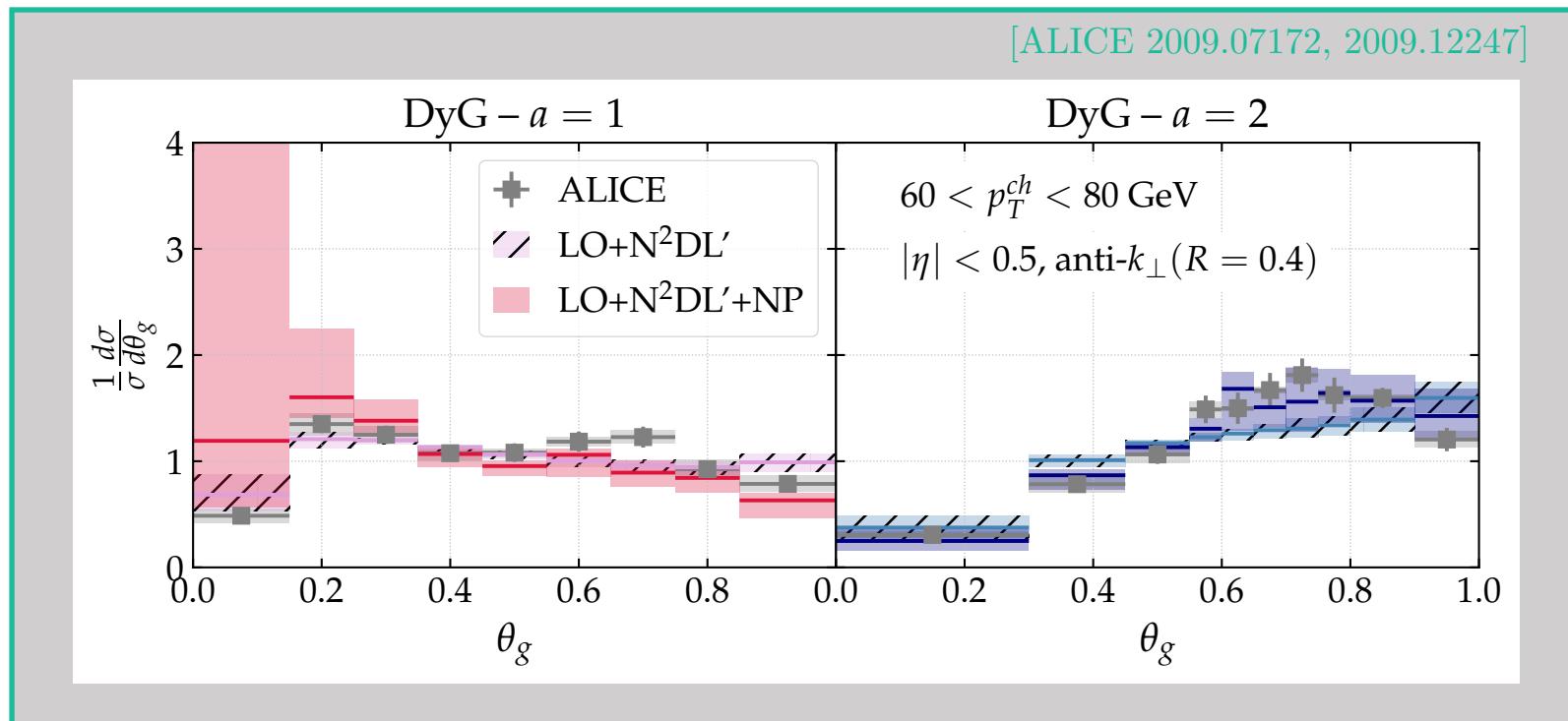
Results

Targeted accuracy is N^2DL :

- Splitting function at 2-loop
- Running coupling at 2-loop
- Non-global contributions (at large N_c)
 - There is no clustering log
 - Boundary logs present
- No multiple emission contribution
- Small-R jets
- Matching to NLO MadGraph5
- Hadronization and non-perturbative correction



Results - Comparison to ALICE preliminary



Heavy-Ion Collision

[arXiv:2111.14768](https://arxiv.org/abs/2111.14768)



Analytic properties

In-medium Lund plane regions:

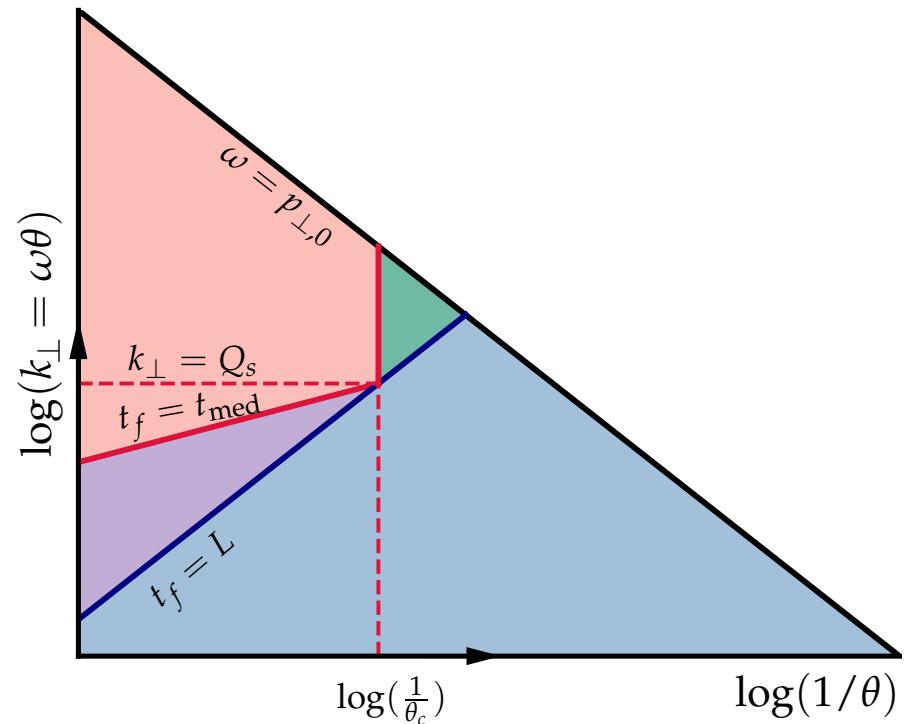
- $t_f > L$: Out of the medium
vacuum emissions
- $t_f < t_{\text{med}}$: Inside and resolved
vacuum+medium emissions
energy loss

Vacuum-like emissions:

$$\frac{d^2 \mathcal{P}_i^{vle}(z, \vartheta | a)}{d\vartheta dz} = P_i(z, \vartheta) \theta_{\notin \text{veto}} \Delta_i^{vle}(\kappa^{(a)})$$

Medium induced emissions:

$$\frac{d^2 \mathcal{P}_i^{mie}(z, \vartheta | a)}{d\vartheta dz} = P_i(z, \vartheta) \Delta_i^{mie}(\kappa^{(a)})$$



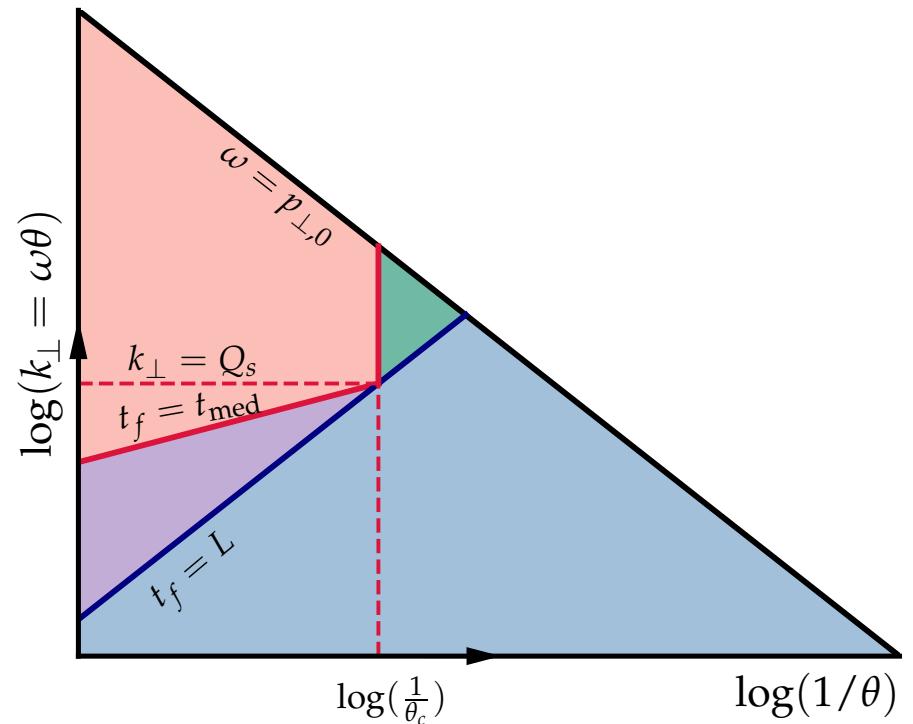
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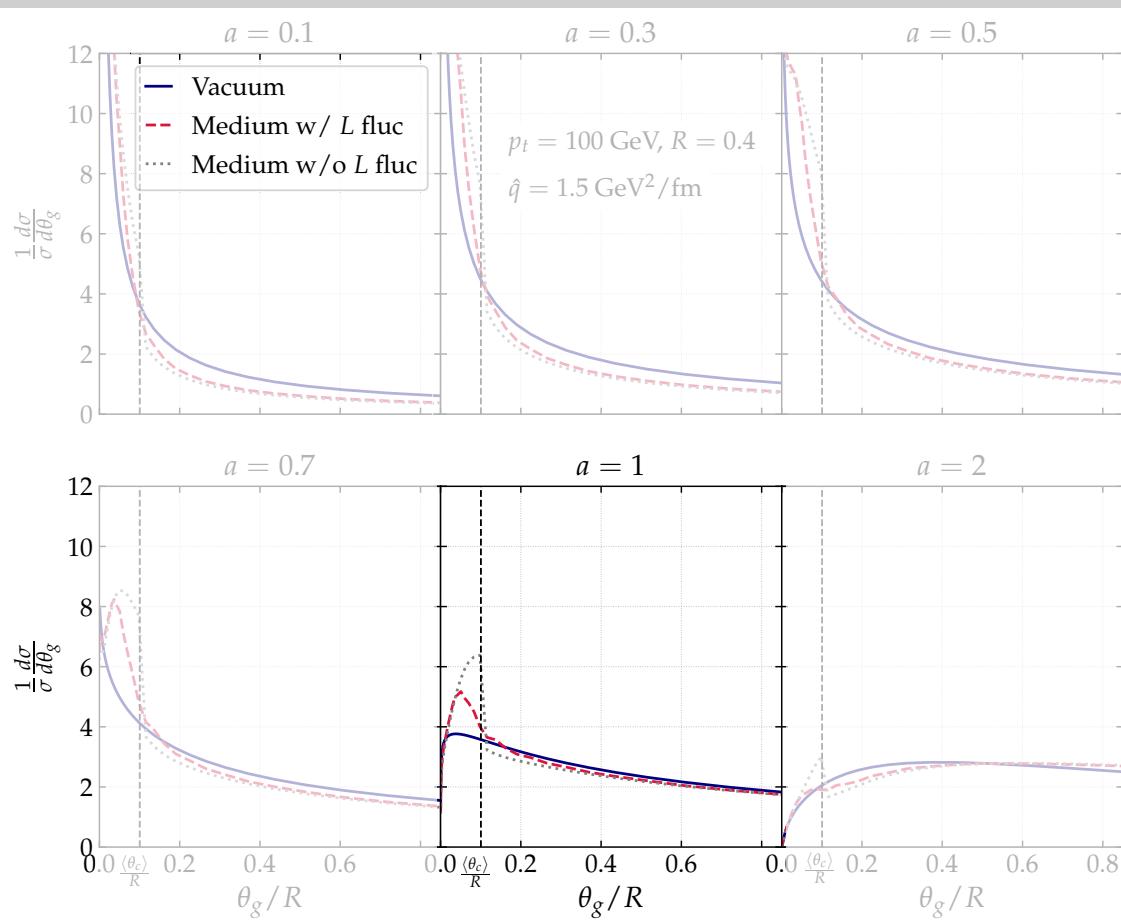
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Energy-loss:

$$\begin{aligned} \frac{1}{\sigma} \frac{d\sigma}{d\vartheta_g} \\ = \frac{1}{N} \int d\varepsilon \sum_i \frac{d\sigma_i}{d(p_t + \varepsilon)} \\ \times \int dz \mathcal{P}_i^{\text{med}}(z, \vartheta_g) \mathcal{E}_{i,p_t,R}(\varepsilon | z, \vartheta_g) \end{aligned}$$

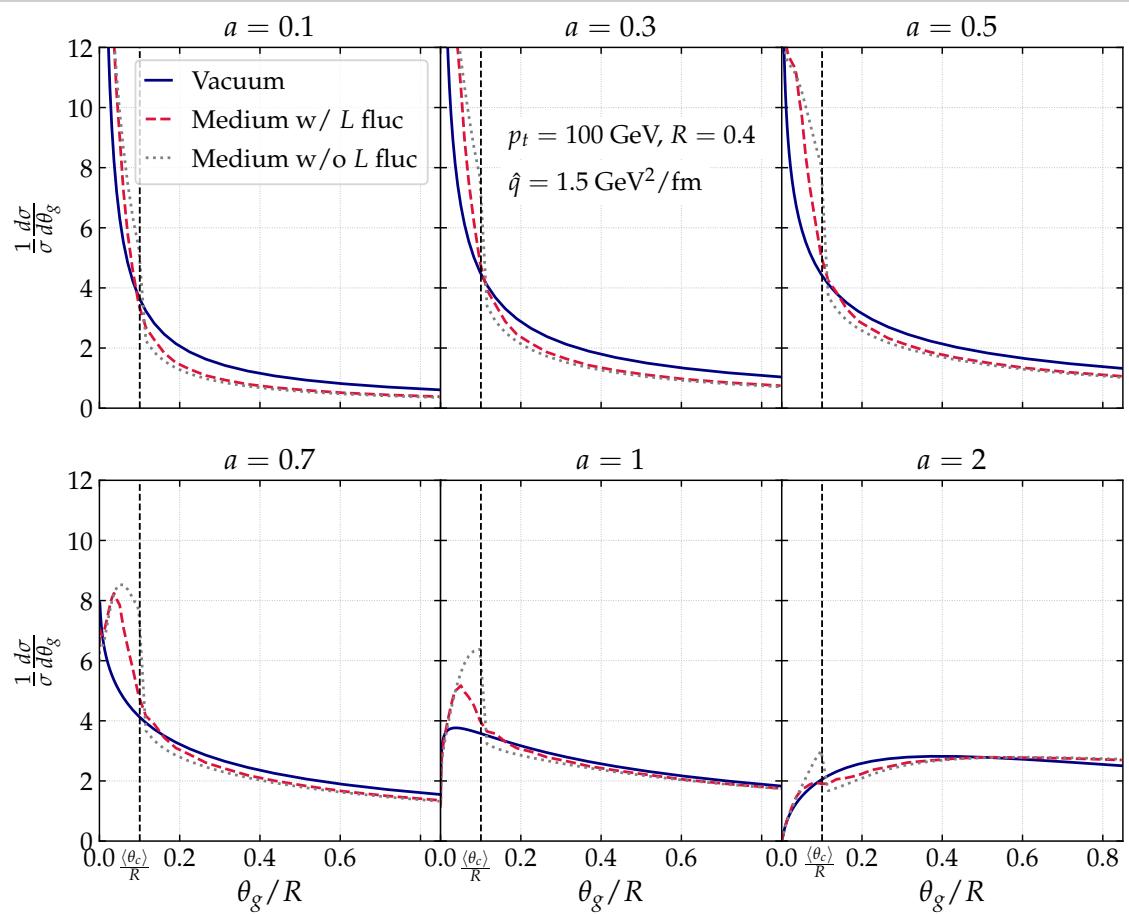


Our analytic Toy Model

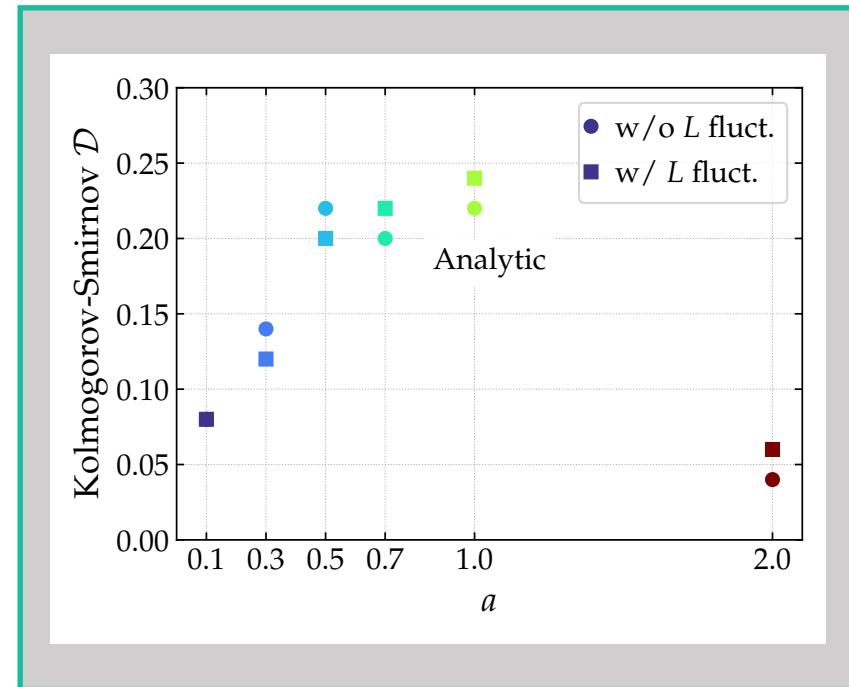


Huge jump around ϑ_c !

Our analytic Toy Model



Which a is the best?

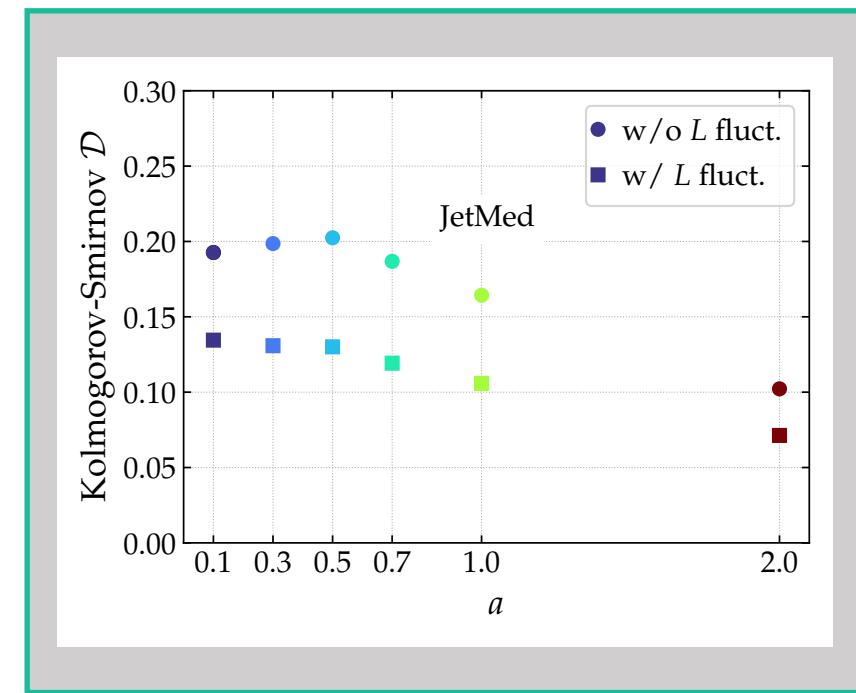
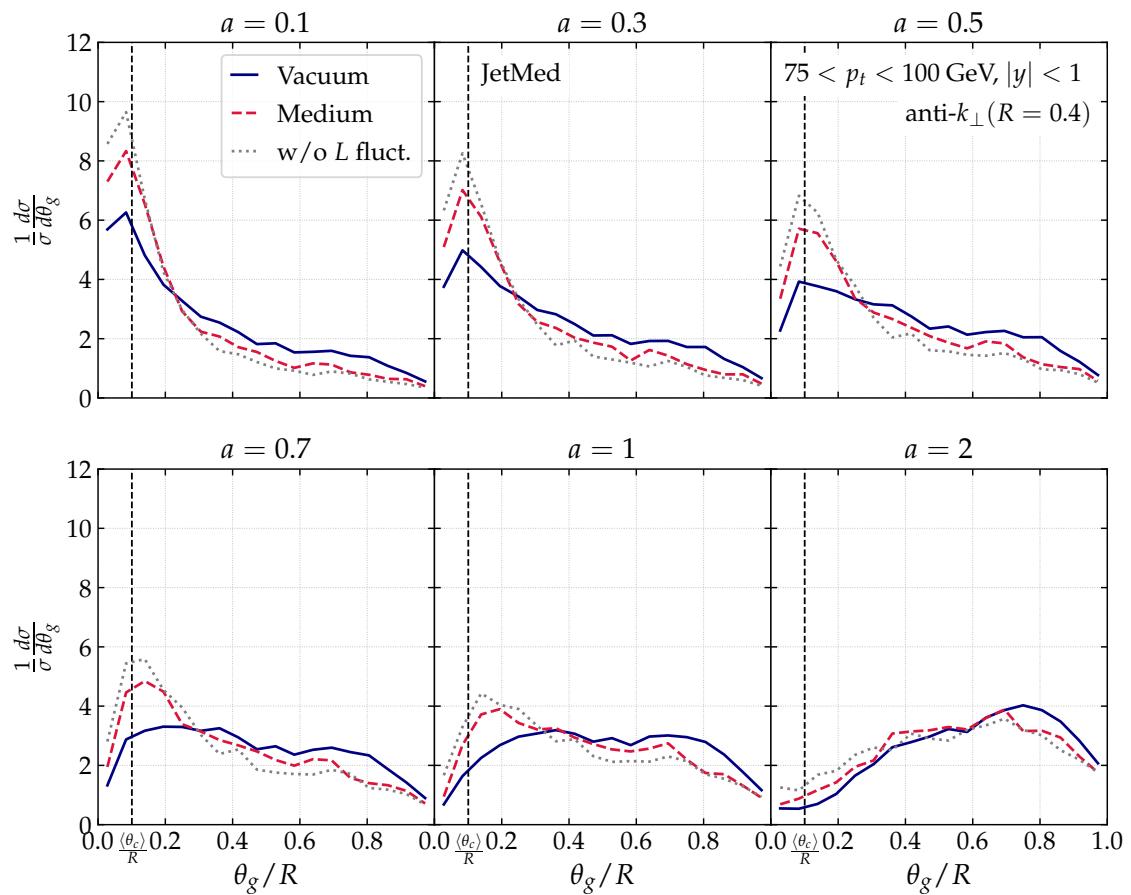


Is ϑ_c really measurable?

- HI Event generator study:
 - JetMed** [Caucal, Iancu, Soyez]
 - Jewel** [Zapp, Krauss, Wiedemann]
 - Hybrid** [Casalderrey-Solana, Milhano, Pablos, Rajagopal]
- Different energy-loss models
- Fluctuations: geometry, path length
- Embedded hydro/kinetic theory
- Medium response
- Hadronization
- Statistical tool: Kolmogorov-Smirnov Distance

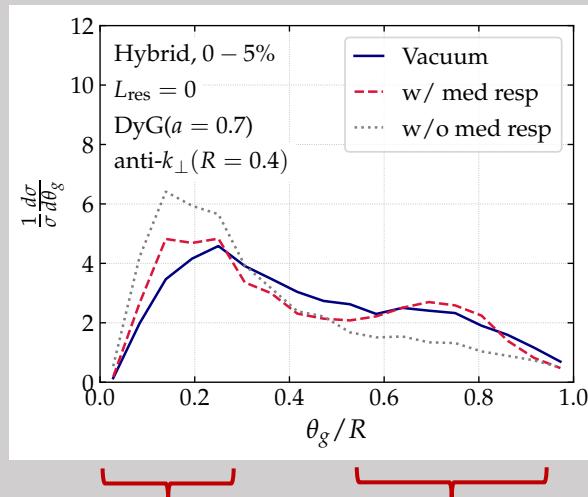


JetMed simulation

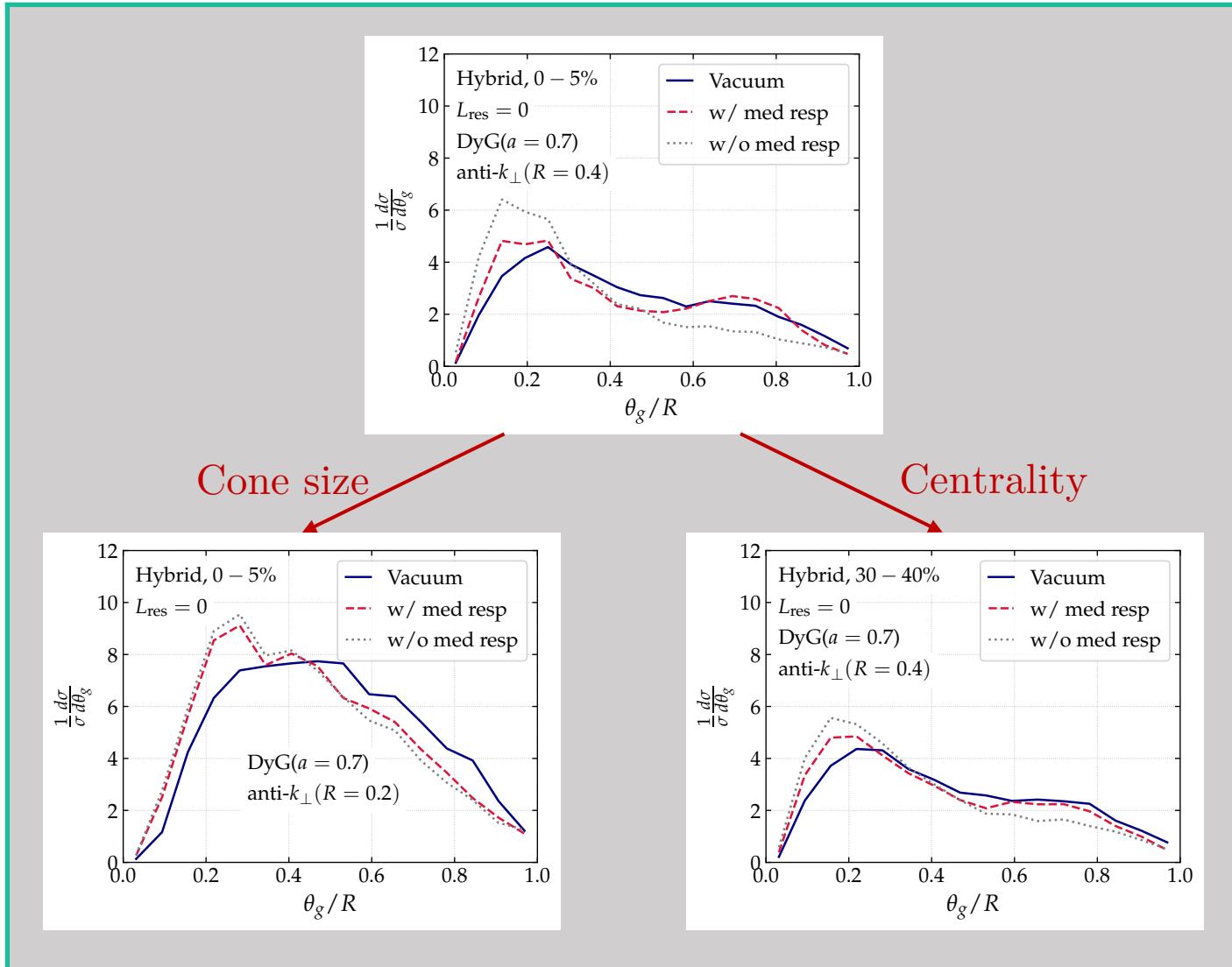


similar for Jewel and Hybrid...

Medium response



Medium response



Summary

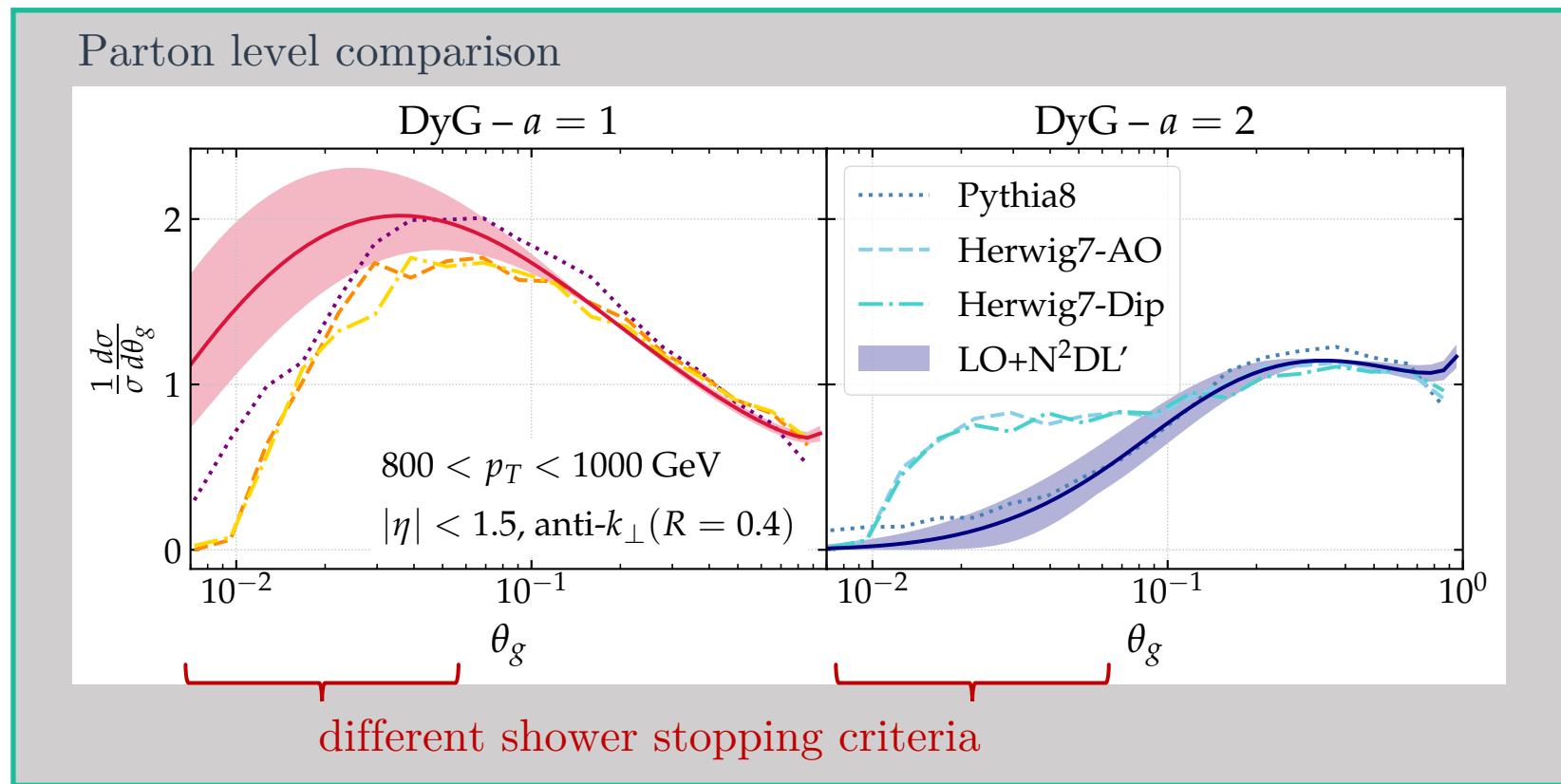
- p-p collisions:
 - Dynamical tagging at N²DL
 - Good agreement with ALICE preliminary
- Heavy-Ion collisions:
 - analytical understanding, **enhancement around ϑ_c**
 - MCs to test ϑ_c : JetMed, Jewel, Hybrid
 - Statistical analysis for measuring ϑ_c
 - Studied: energy-loss, fluctuations, medium response, hadronization
 - Best parameter: **$0.5 < a < 1$ and $R \sim 0.2$**



Thank you for the attention!



Results - Comparison to MC



Analytic properties

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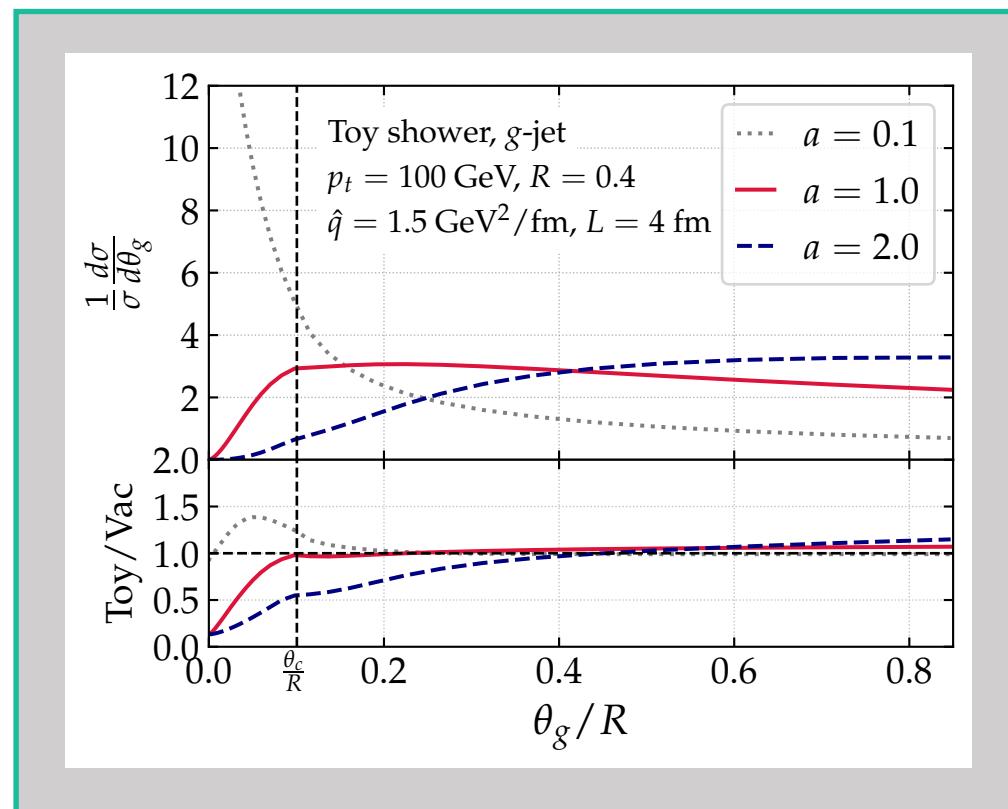
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