DeadCone Searches with Jet-Trees

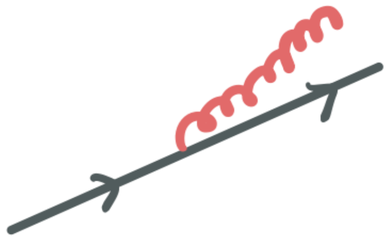
Davide Napoletano, DIS 2023, 30/03/2023

Introduction

- Suppressed region of gluon radiation off heavy quark, fundamental property of QCD in vacuum

Introduction

- Emission off a massless quark:

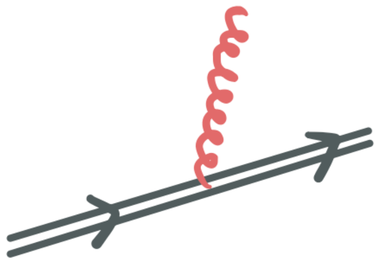


$\Rightarrow$

$$P \sim \frac{dk_\perp^2}{k_\perp^2}$$

Introduction

- **Emission off a massive quark:**



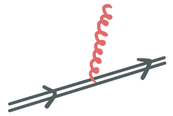
$\Rightarrow$

$$P \sim \frac{dk_\perp^2}{k_\perp^2 + z^2 m^2}$$

Introduction

[Nature 605 (2022) 440-446]

- **Recent measurement by ALICE at the LHC**



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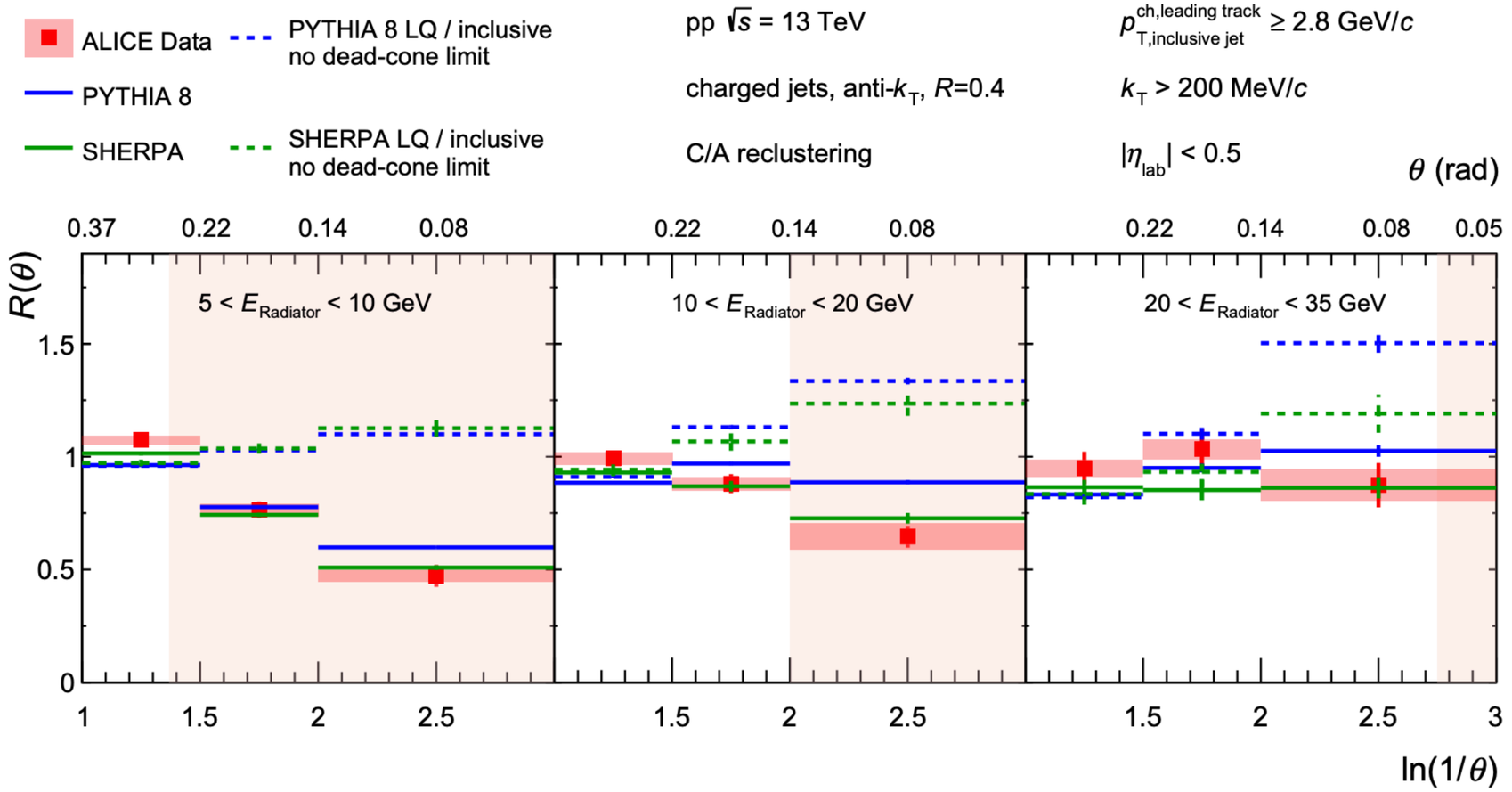

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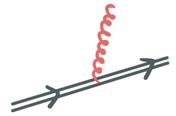

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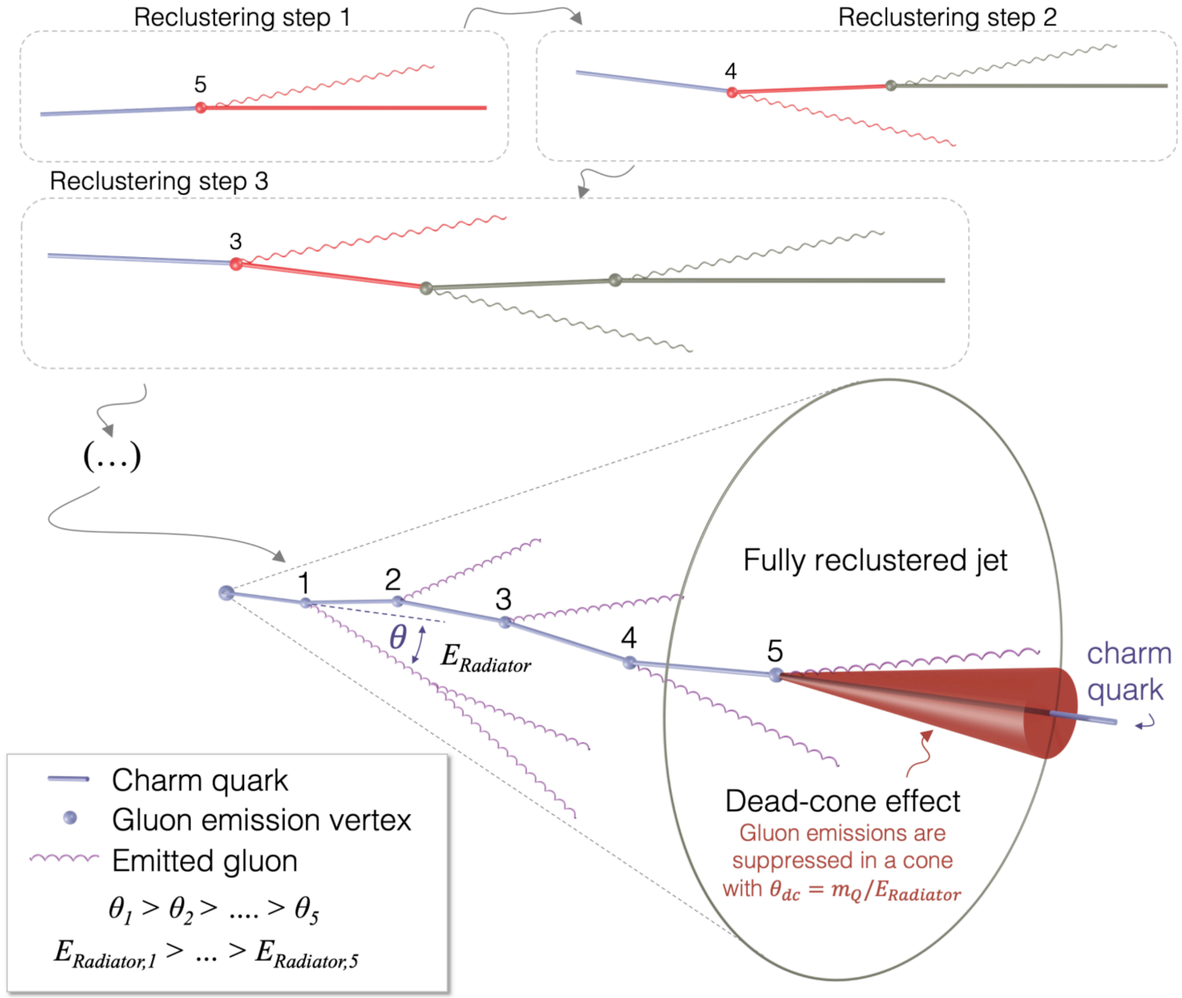


Introduction

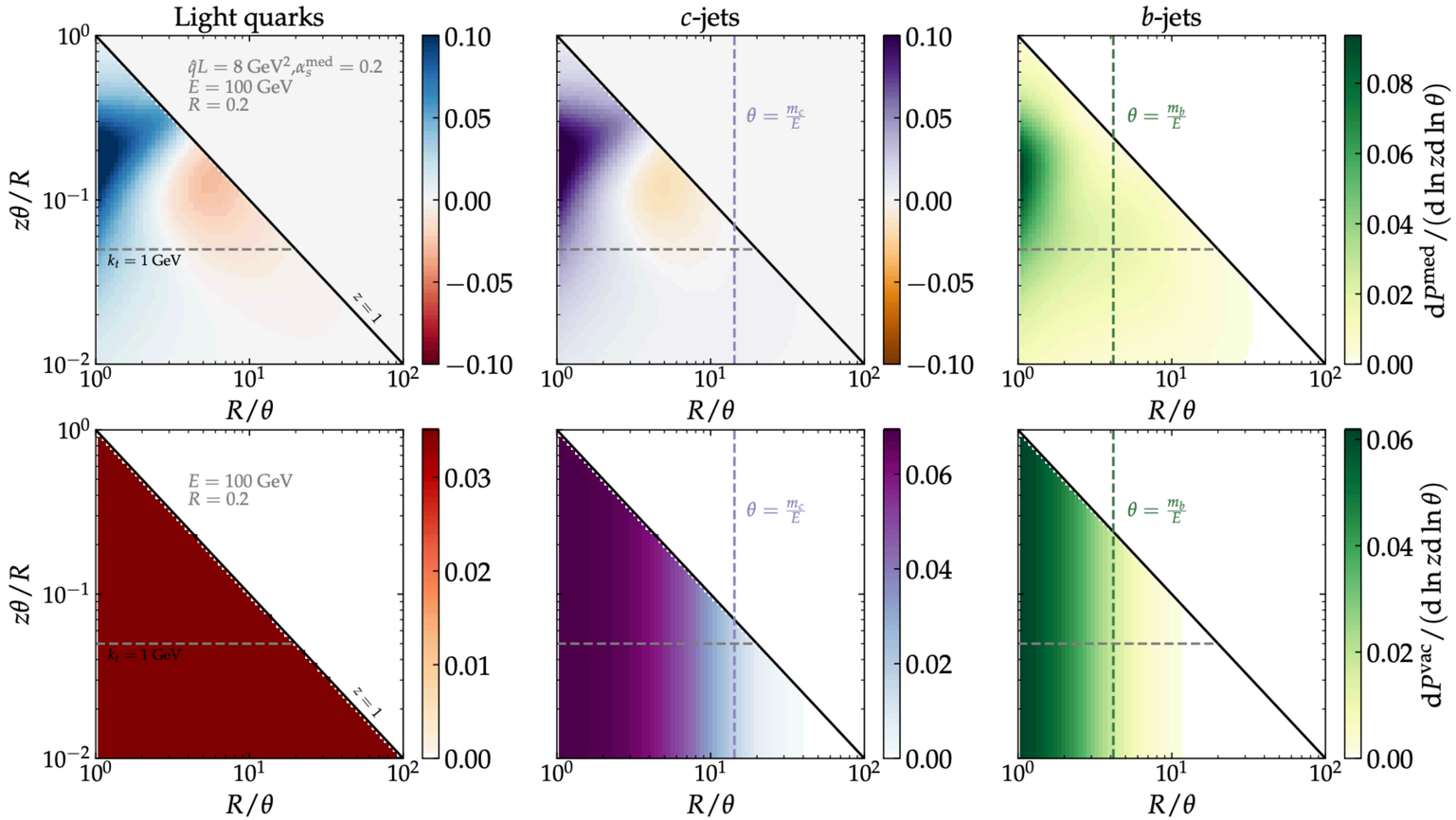
- Three key aspects that made this measurement possible:

1. Ability to penetrate jet-tree down to small angles
2. Suppress NP effects which can fill the deadcone
3. The ability to fully reconstruct heavy hadrons

Introduction

[ArXiv 2211.11789]

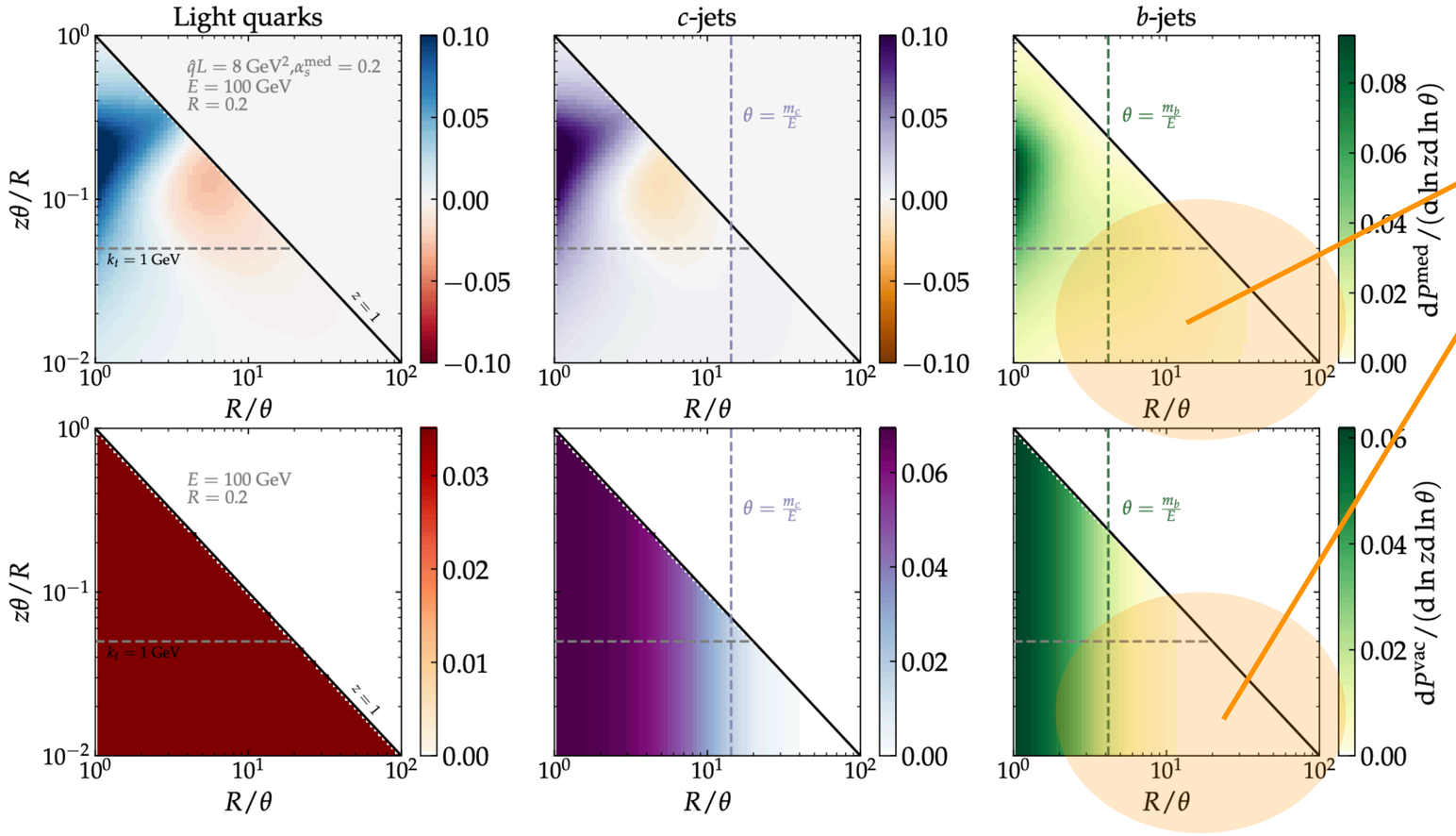
- In medium QCD shows different behaviour



- Filling of deadcone region in medium relative to vacuum

Introduction

- In medium QCD shows different behaviour



- Filling of deadcone region in medium relative to vacuum

Introduction

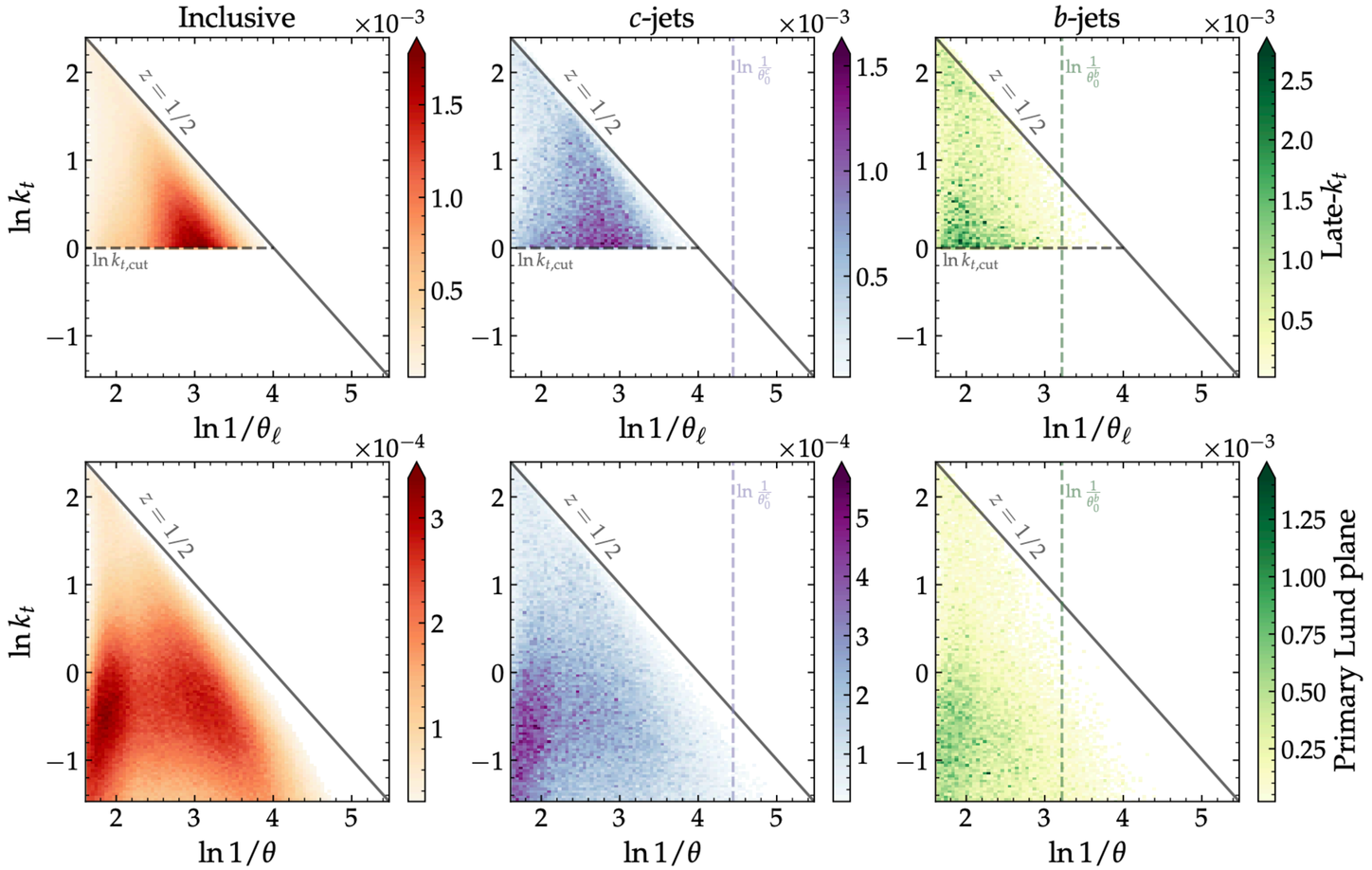
- In medium QCD collinear singularity shielded by LPM interference
  - Filling of deadcone region in medium relative to vacuum
  - Shorter formation time

$$t_f^{\text{massive}} \equiv \frac{2}{\omega(\theta^2+\theta_0^2)} < \frac{2}{\omega\theta^2} \equiv t_f^{\text{massless}}$$

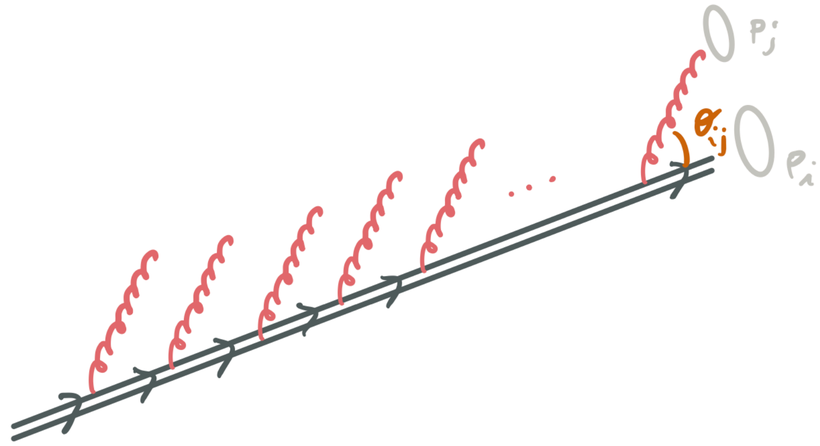
- Reduction of LPM Interference

⇒ Isolate Medium only dynamics

Late-kt



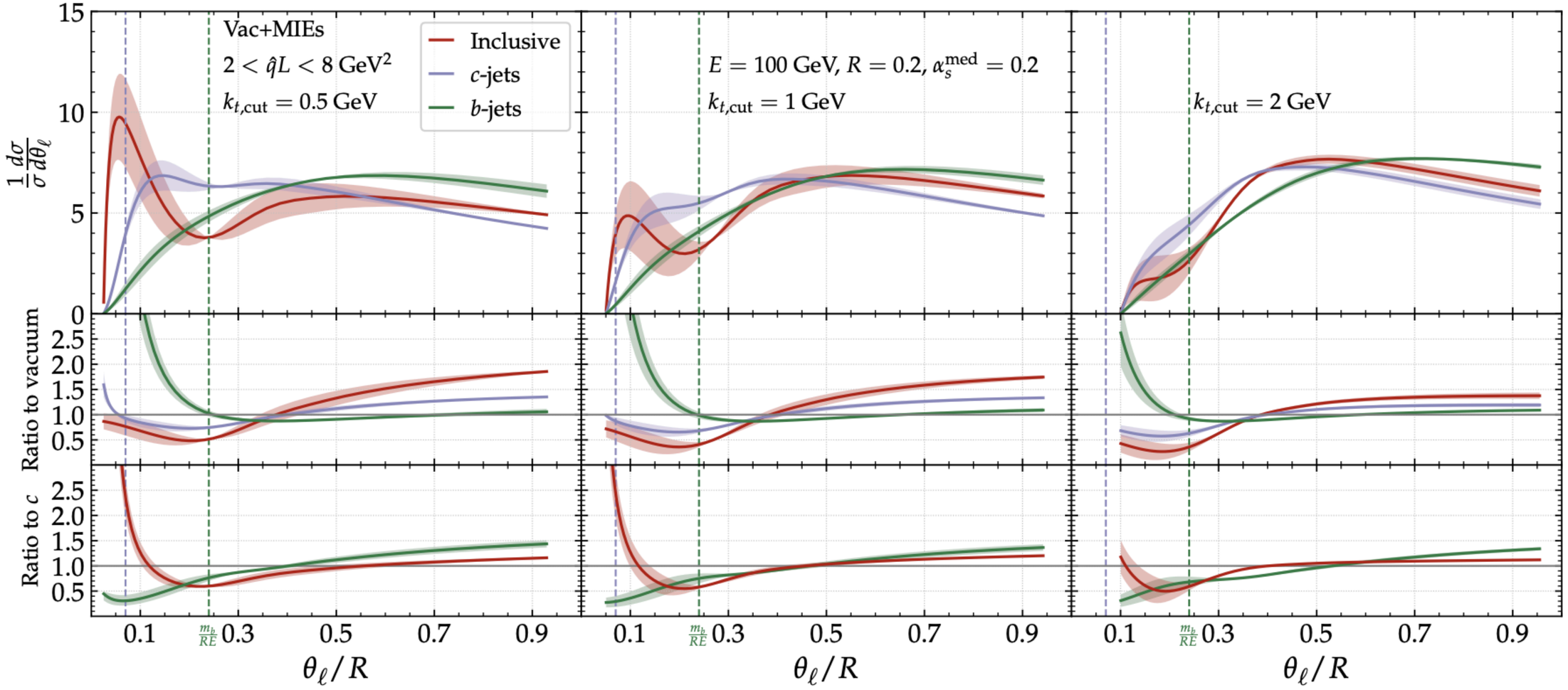
1.



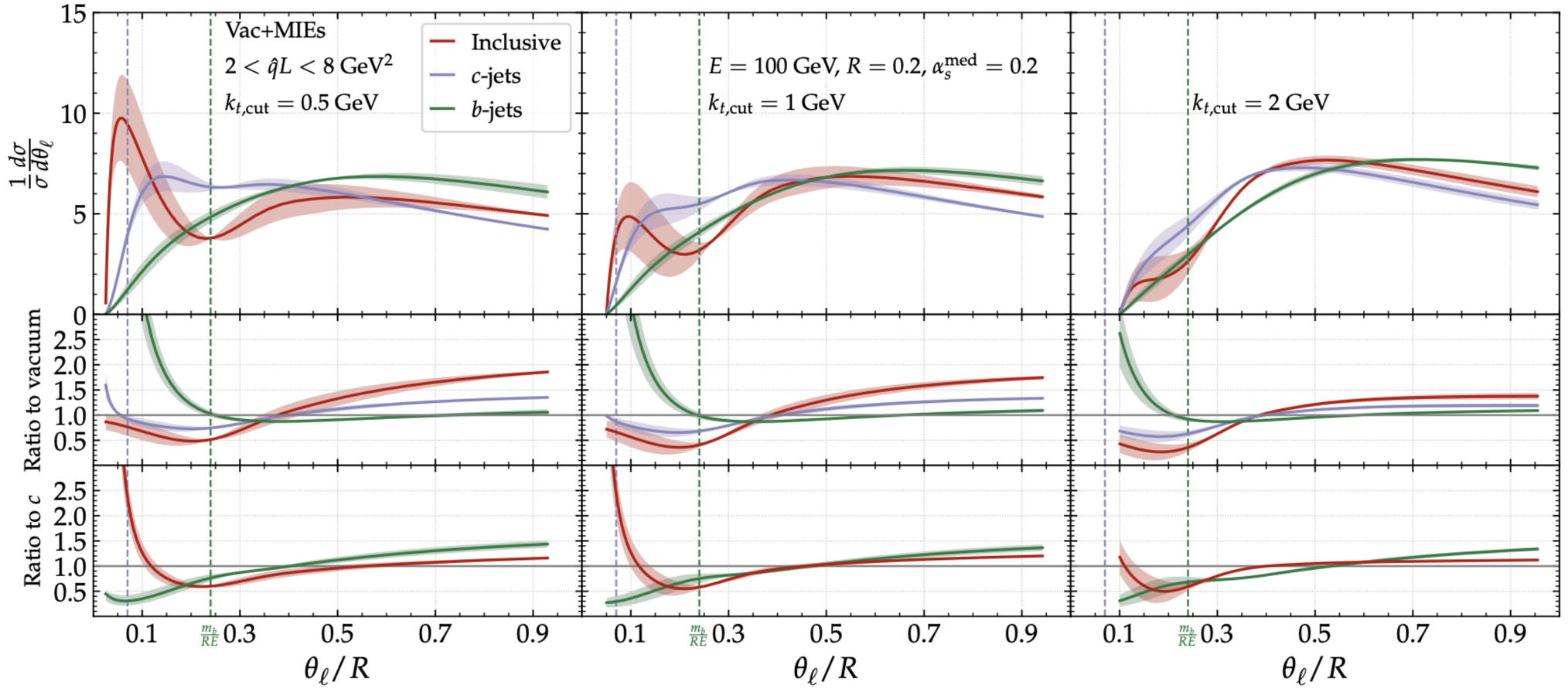
2. If $k_t(i,j) > k_t^{cut}$ store θ_{ij} → 1.

3. Find last θ_{ij} | $k_t(i,j) > k_t^{cut}$ ⇒ θ_ℓ

Late-kt

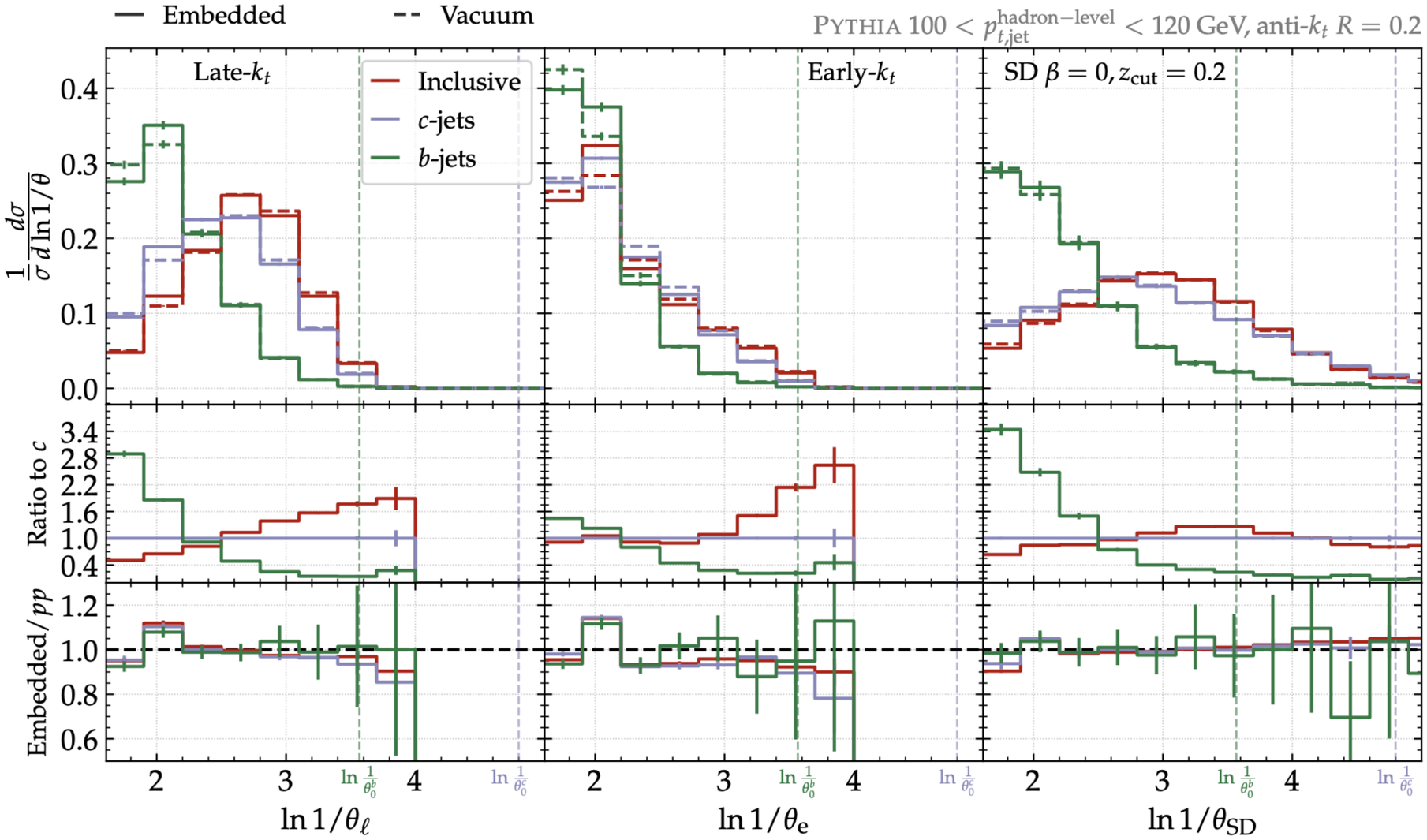

Vac+MIEs
$2 < \hat{q}L < 8$ GeV^2
$k_{t,\mathrm{cut}} = 0.5$ GeV
Inclusive
c-jets
b-jets
$E = 100$ GeV, $R = 0.2$, $\alpha_s^{\mathrm{med}} = 0.2$
$k_{t,\mathrm{cut}} = 1$ GeV
$k_{t,\mathrm{cut}} = 2$ GeV
$\frac{1}{\sigma}\frac{d\sigma}{d\theta_\ell}$
Ratio to vacuum
Ratio to c
$\frac{m_b}{RE}$
θ_ℓ / R

Late-kt

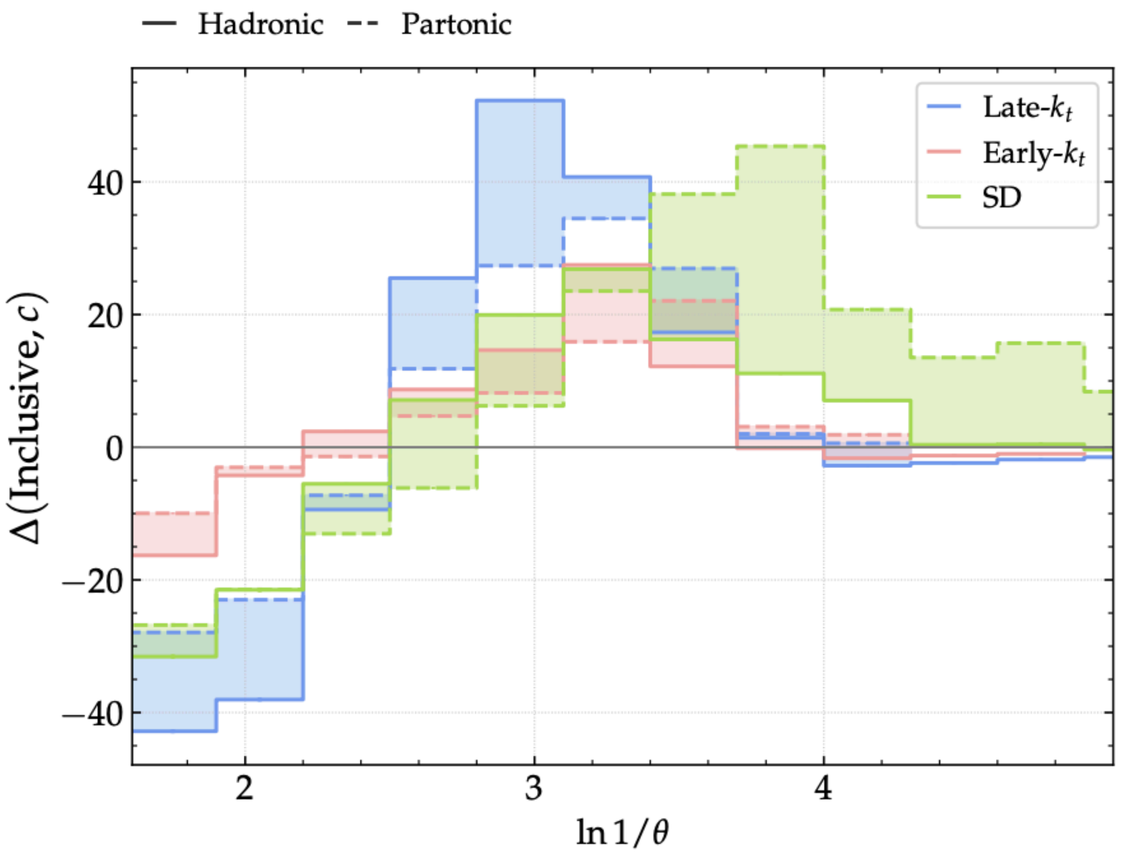


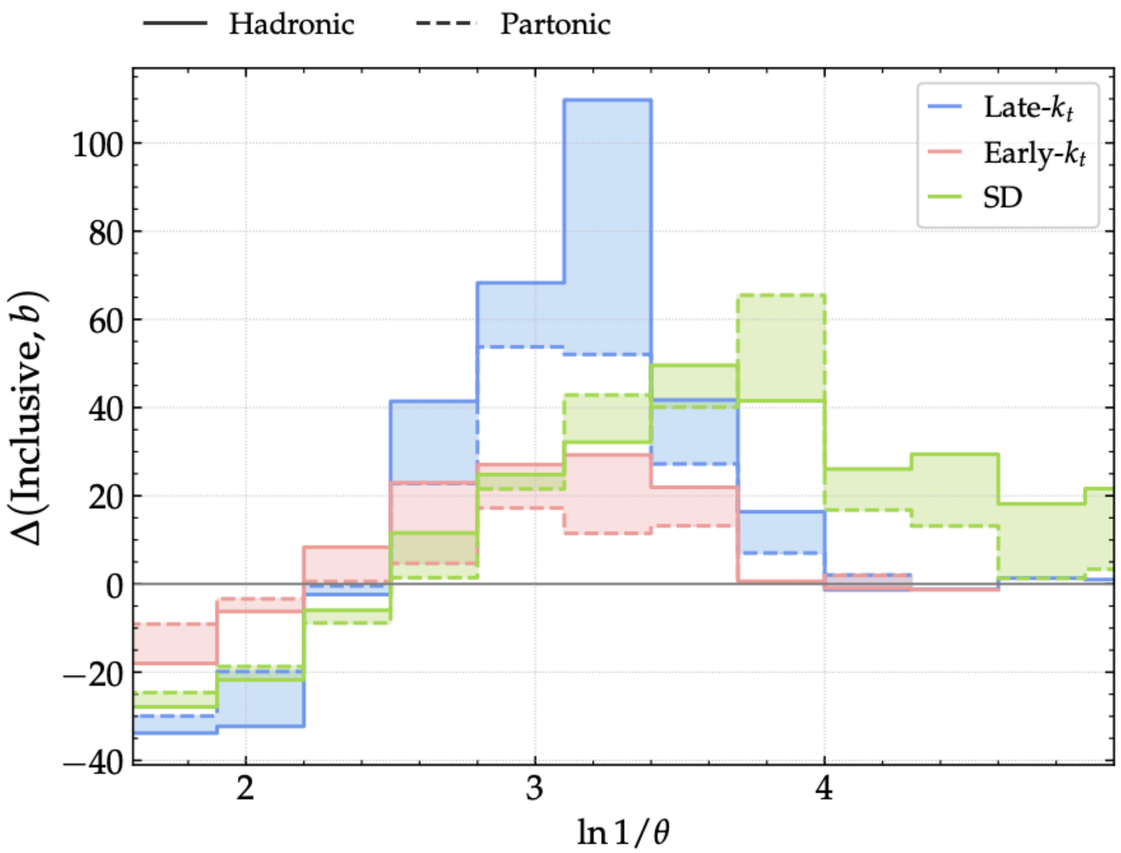
- **NonTrivial interplay between ktcut and mass**

Groomer comparison



Groomer Comparison





$$\Delta(x,y) = \frac{x-y}{\sqrt{\sigma_x^2 + \sigma_y^2}}$$

Conclusions

- Deadcone measure in HI collision can lead to important info about QGP
- (Now) Active field of resummation for HQ
- The measure seems feasible: