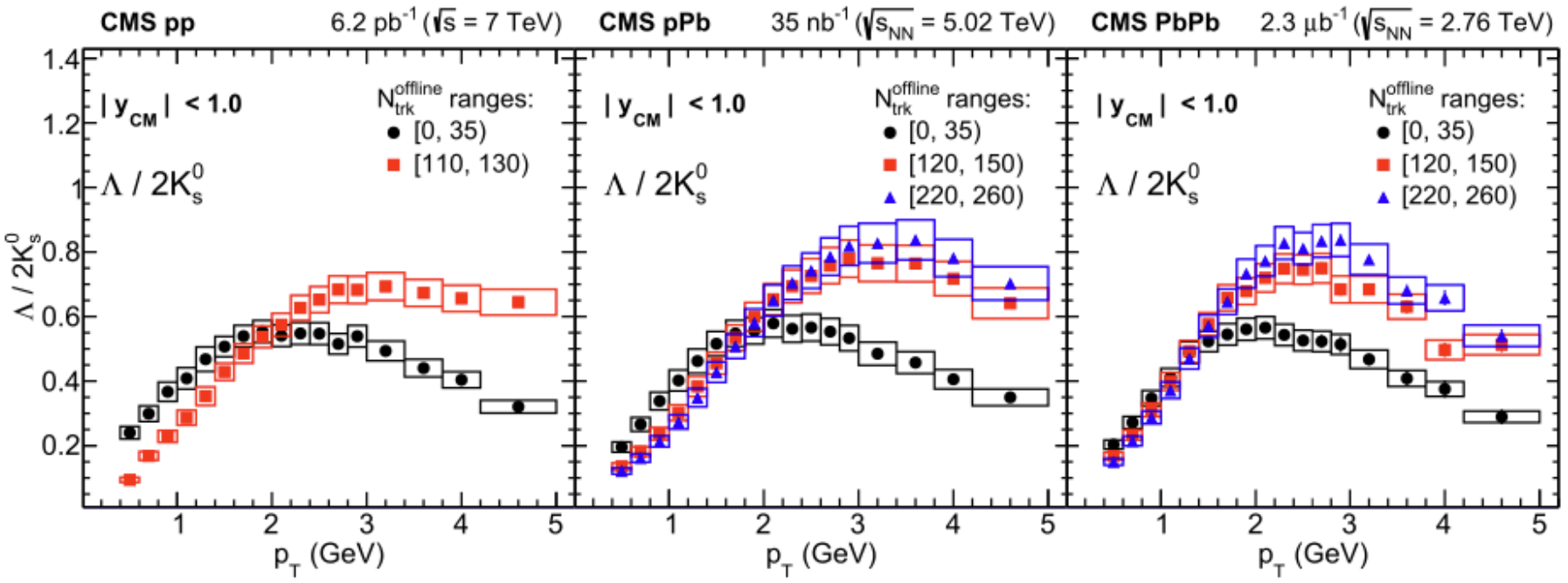
In-jet heavy Flavor Bayron-to-Meson yield ratios in p+p and Pb+Pb

代巍 中国地质大学 （武汉）

合作者：徐子璇 刘云帆 赵佳星 张本威

Motivation



Even

Vaccum hadronization

In-medium hadronization

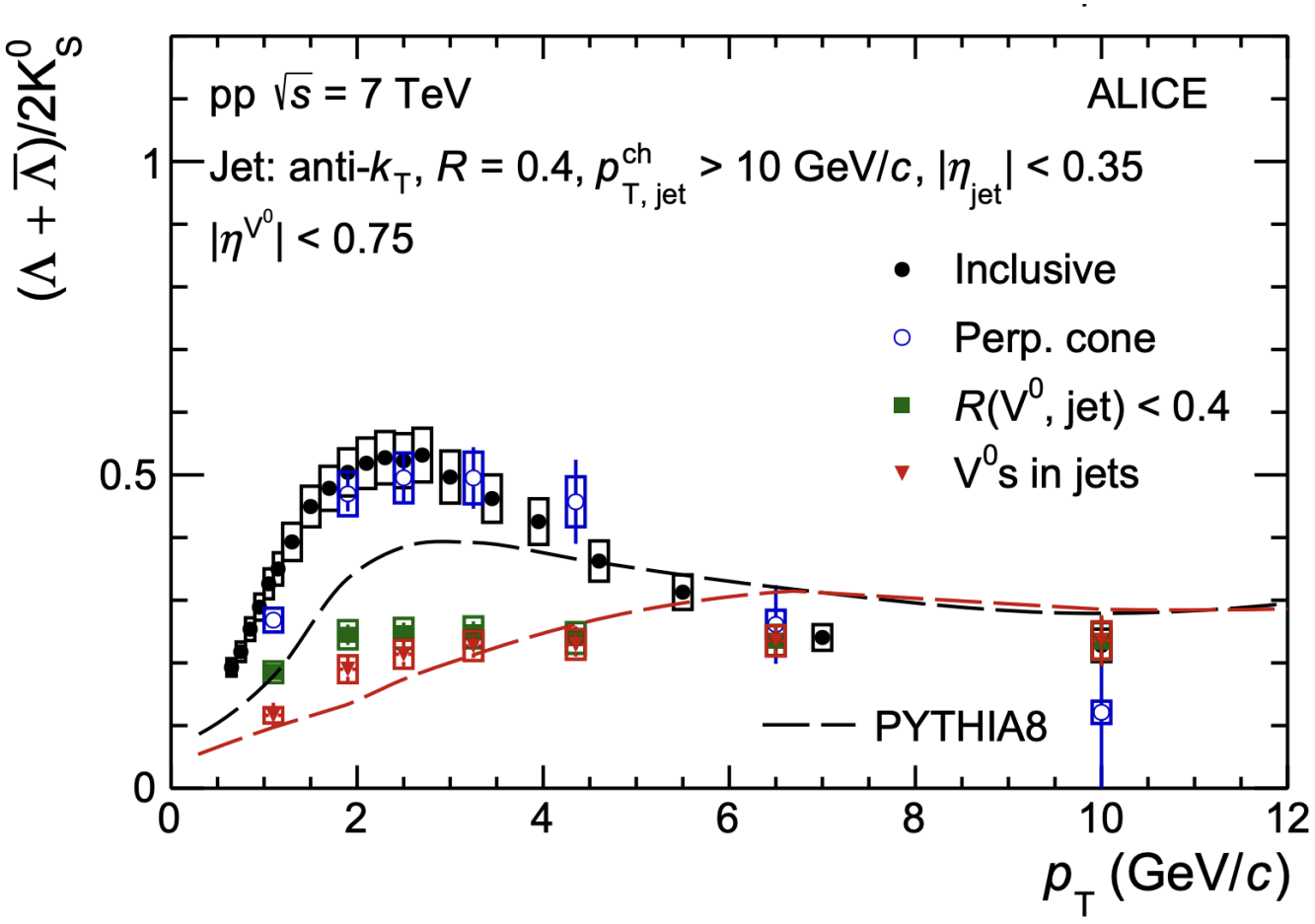
are still open questions

An enhancement of baryon-to-meson ratio at intermediate transverse momentum p_T has been extensively observed in high multiplicity **pp**, **pA**, and **AA** collisions.

The reasons behind them are complex: hadronization, underlying events, in-medium hadronization

Motivation

ALICE Phys.Lett.B 827 (2022)



In-jet production is a useful tool for separating the contribution from the **hard processes** and the **underlying events**.

Light Flavor case : Λ/K_S^0 ratio within jets (hard) shows NO characteristic enhancement of baryons at the intermediate p_T.

Heavy Flavor case: Heavy quarks are produced in the initial hard process, BUT there are still enhancements in pp, pA, and AA.

Opportunity to investigate hadronization !

Motivation

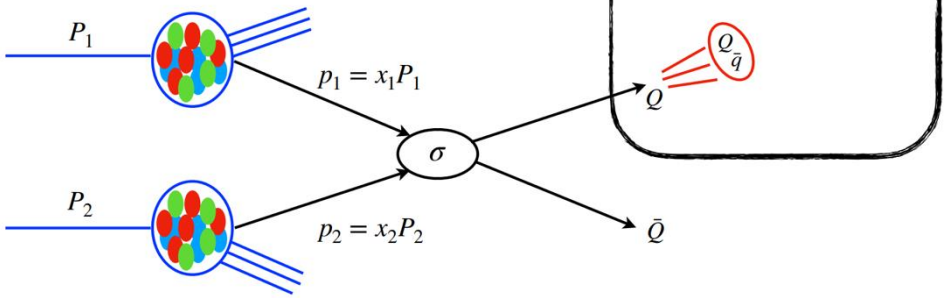
Hadronization mechanism in vacuum

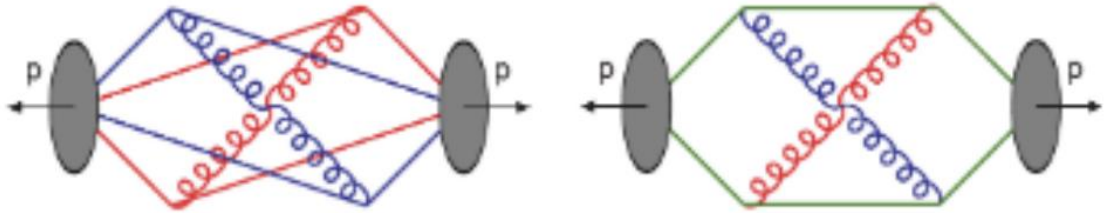
$$\sigma_H \propto f_i^A(x_1,\mu_F) f_j^B(x_2,\mu_F) \otimes \sigma_{ij\to Q\bar{Q}+X} \otimes \mathcal{D}_{Q\to H}$$

Parton distribution (PDFs)

Hard scattering (pQCD)

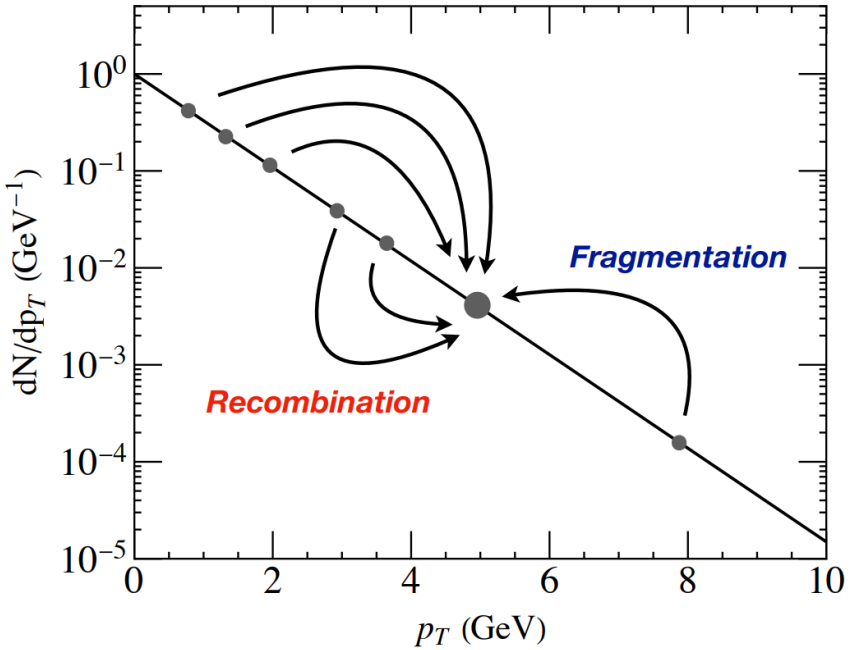
Fragmentation function



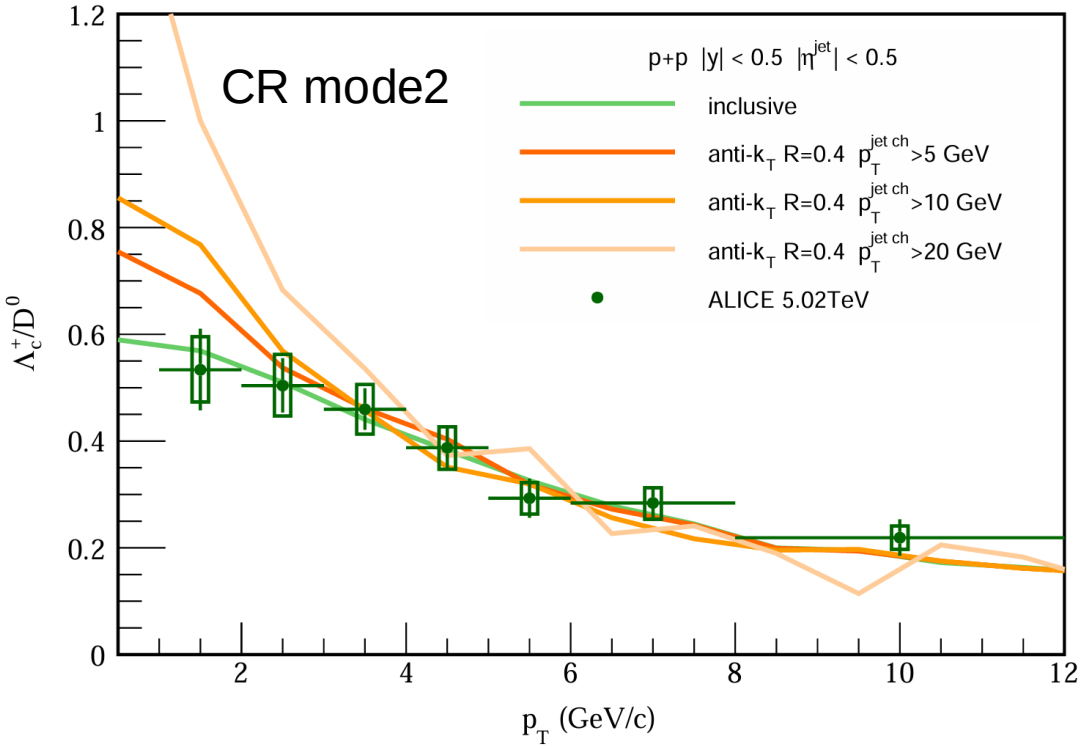


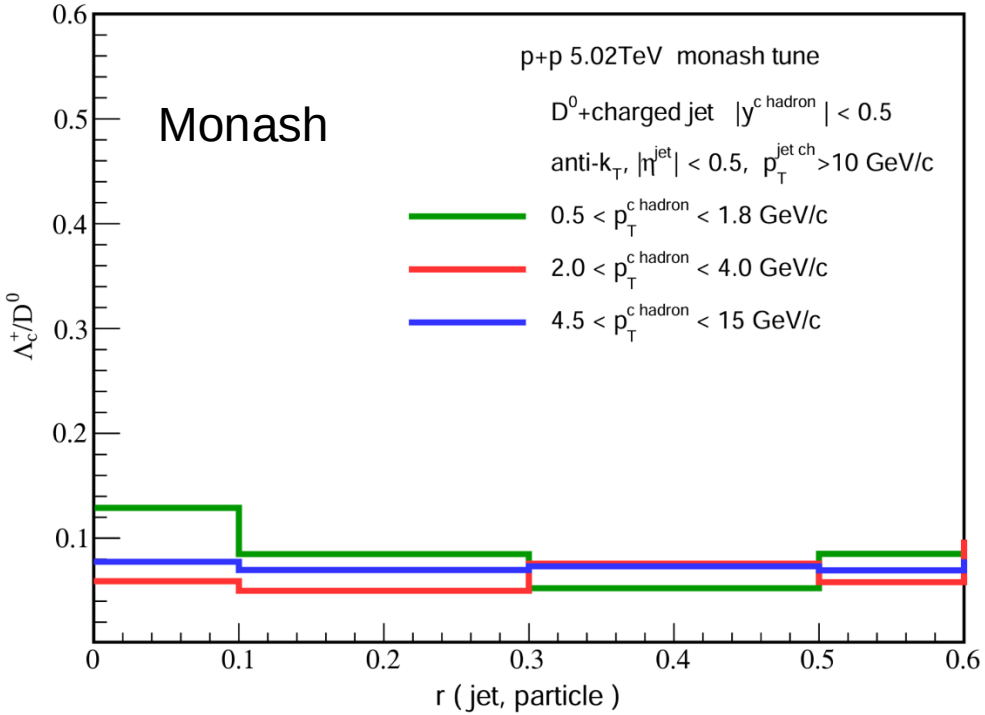
color reconnection mechanism

Hadronization mechanism in medium



Vacuum hadronization: In-jet Λ_c^+/D^0





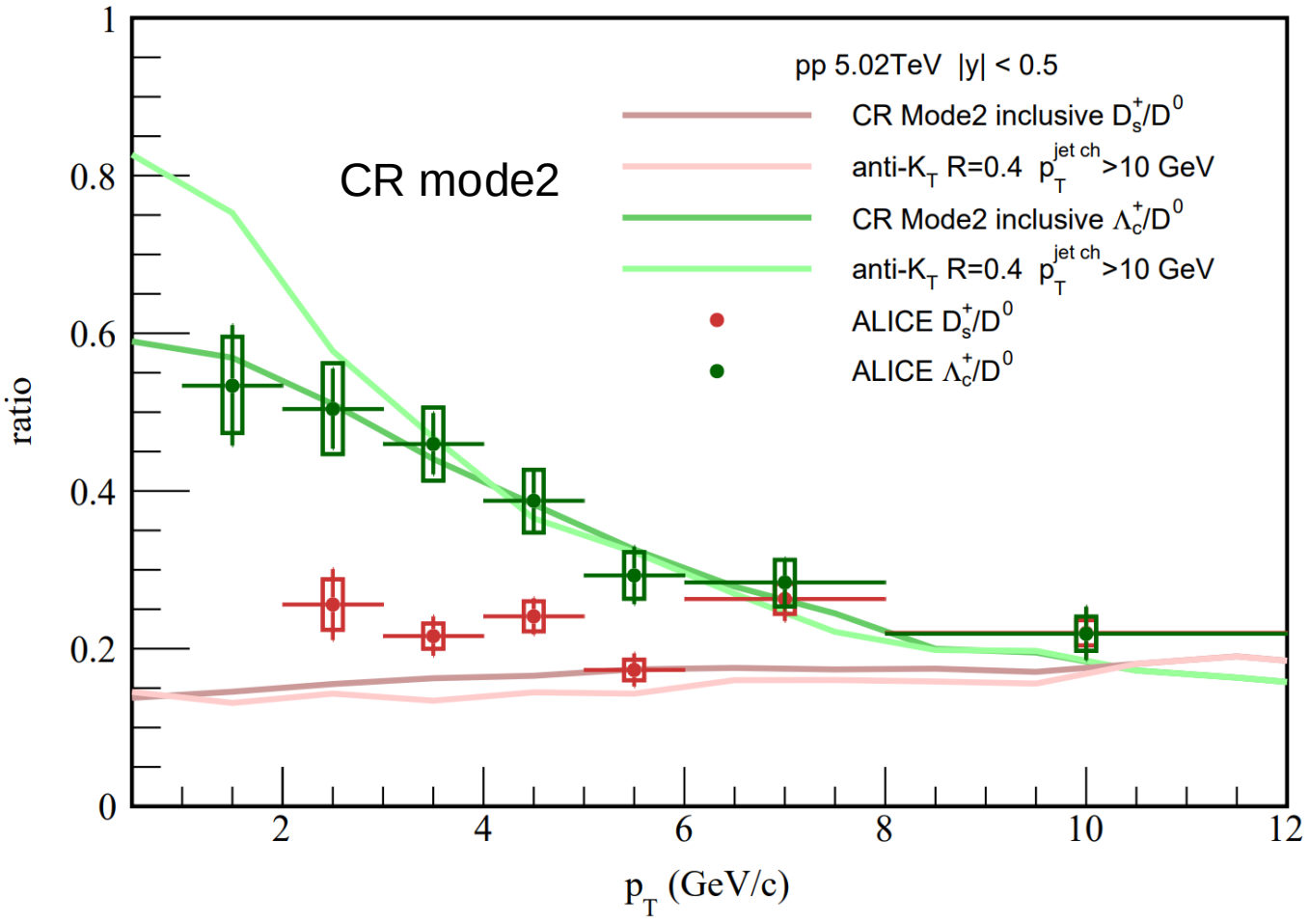
In-jet requirement leads to enhancement for heavy flavor baryon-to-meson ratio.

IF

color reconnection mechanism is used to describe hadronization.

Jet p_T increasing, stronger enhancement (R and η^{jet} has no noticeable impact)

Vacuum hadronization: In-jet Λ_c^+/D^0



Heavy flavor sector:

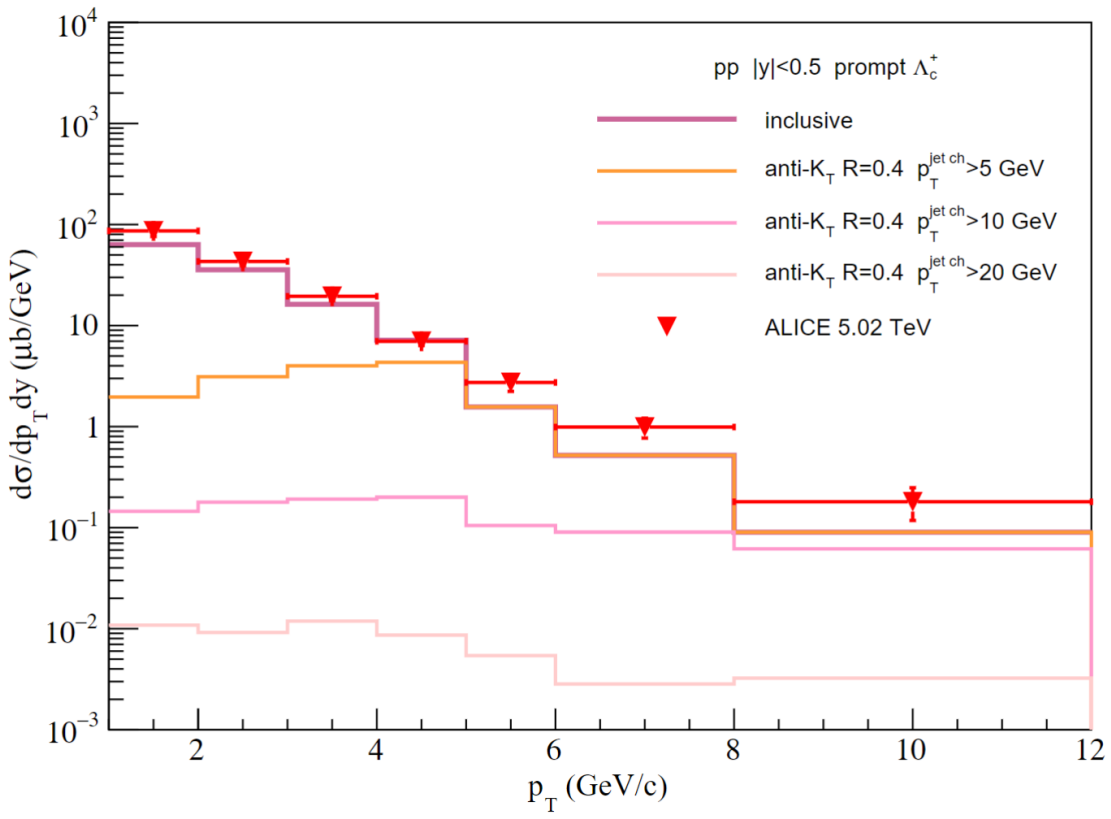
the hard process contribution alone will lead to an enhancement of the baryon-to-meson ratio

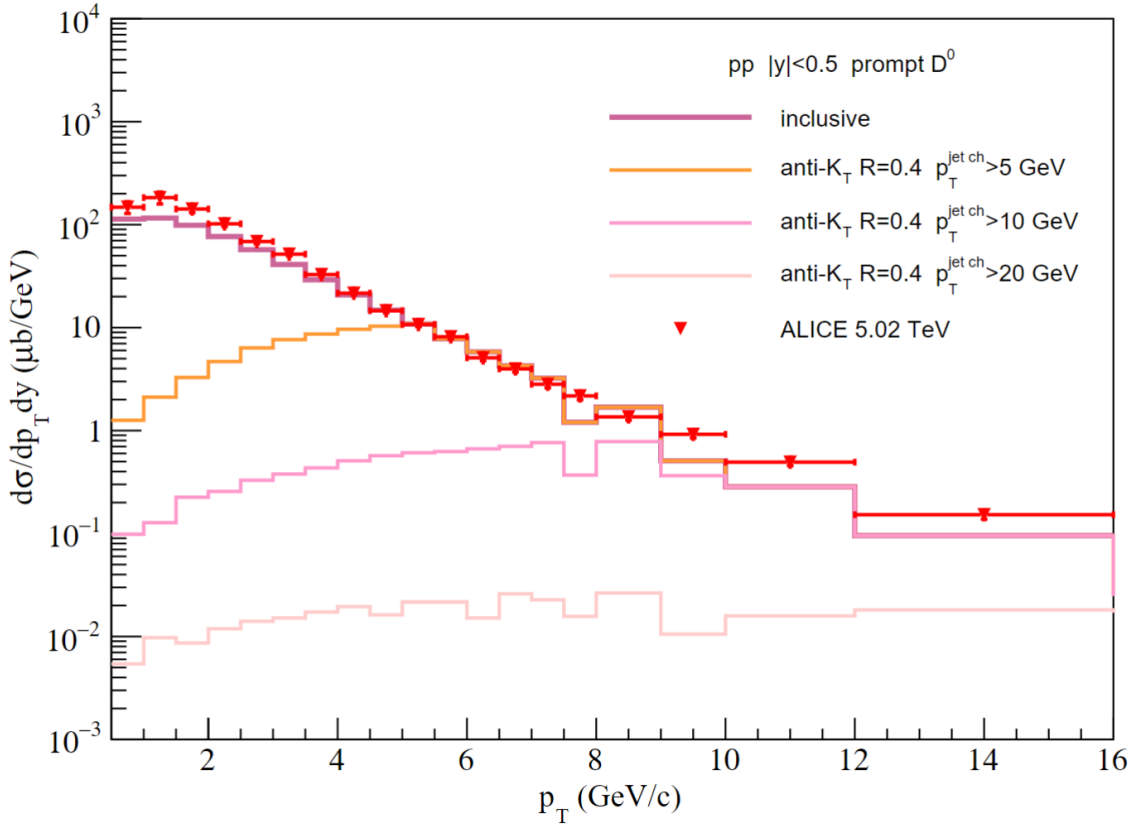
If the color reconnection mechanism is used to describe hadronization.

Light flavor sector:

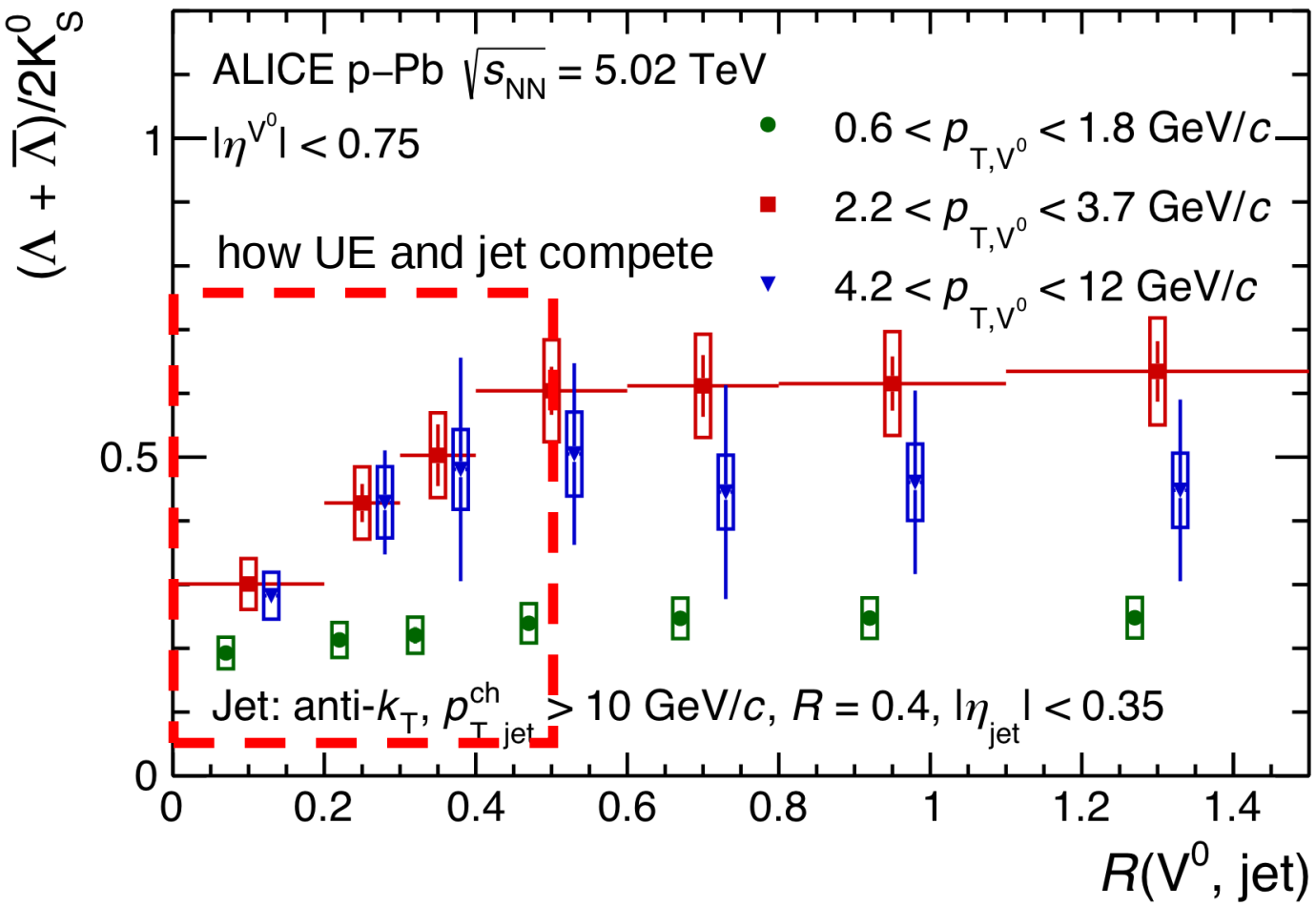
indicates it is mainly coming from underlying events

Spectrum in jets



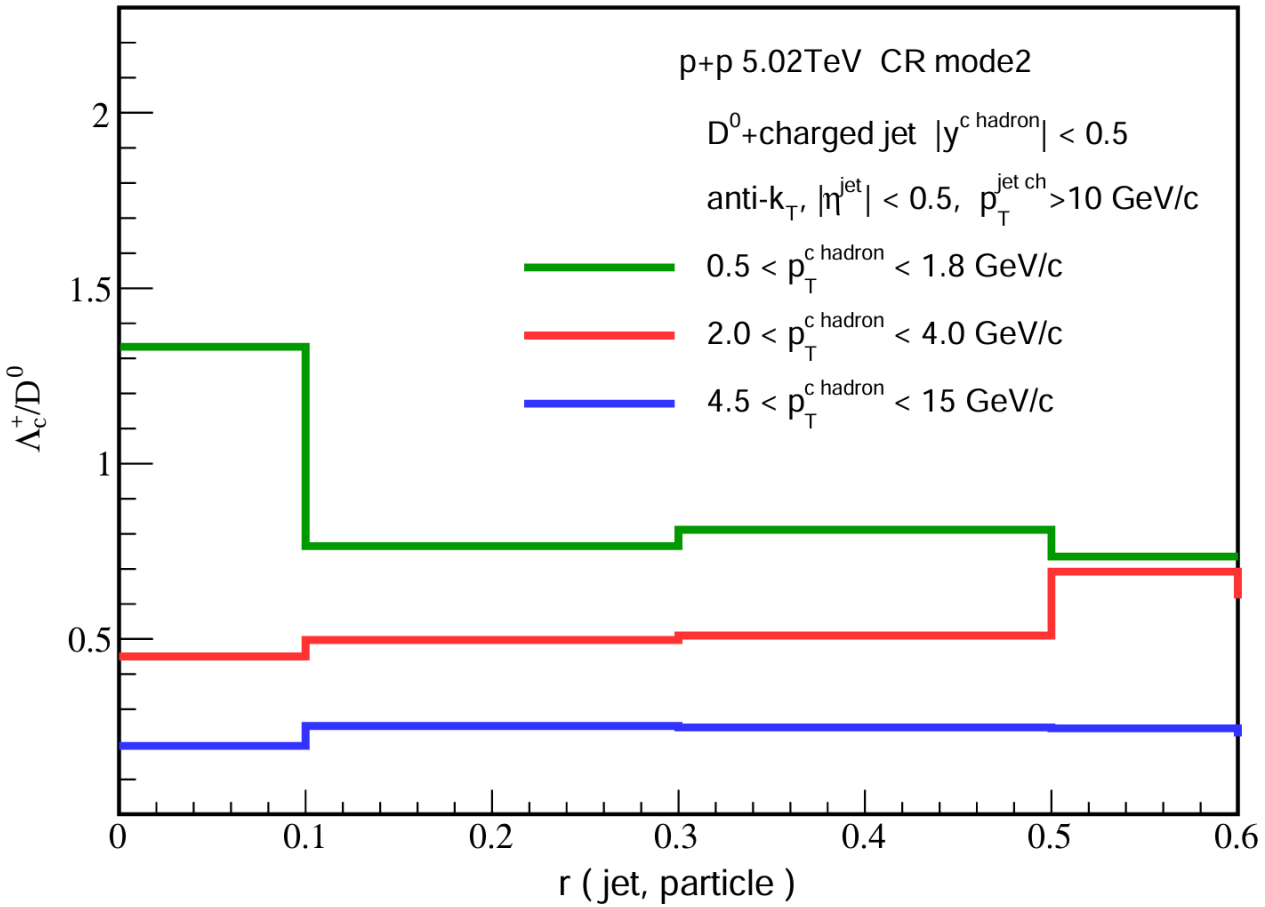


p+p collisions with PYTHIA : In-jet $(\Lambda + \bar{\Lambda})/2K^0_s$



The lack of enhancement close to the jet axis indicates that the enhanced ratio is NOT associated with jets.

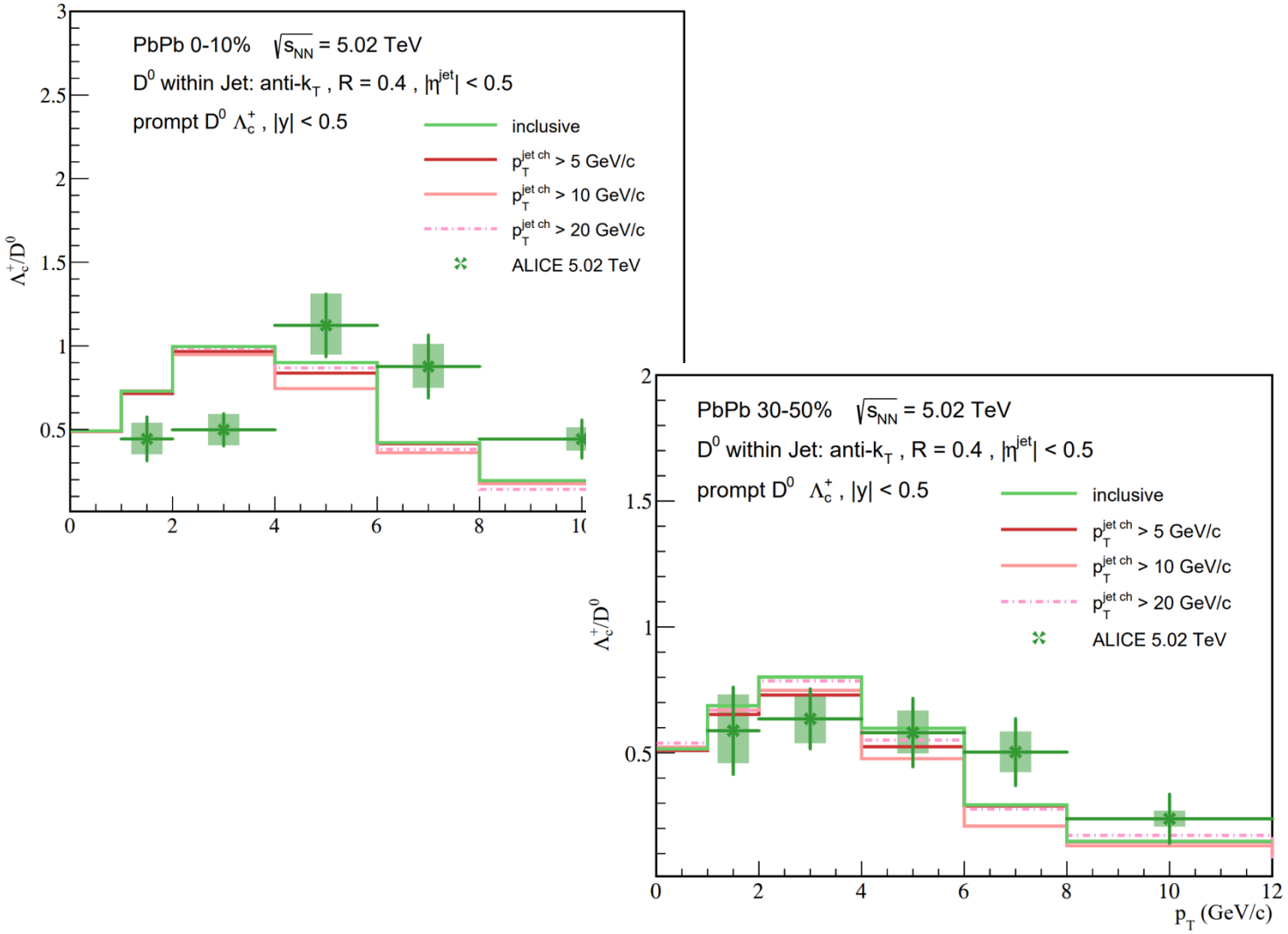
In-jet Λ_c^+/D^0 distribution in pp



Lower the p_T , closer to the jet axis, more enhancement will be observed.

------- Color Reconnection

In-medium hadronization: In jet Λ_c^+/D^0



For Pb+Pb collisions:

✓Cold nuclear effect

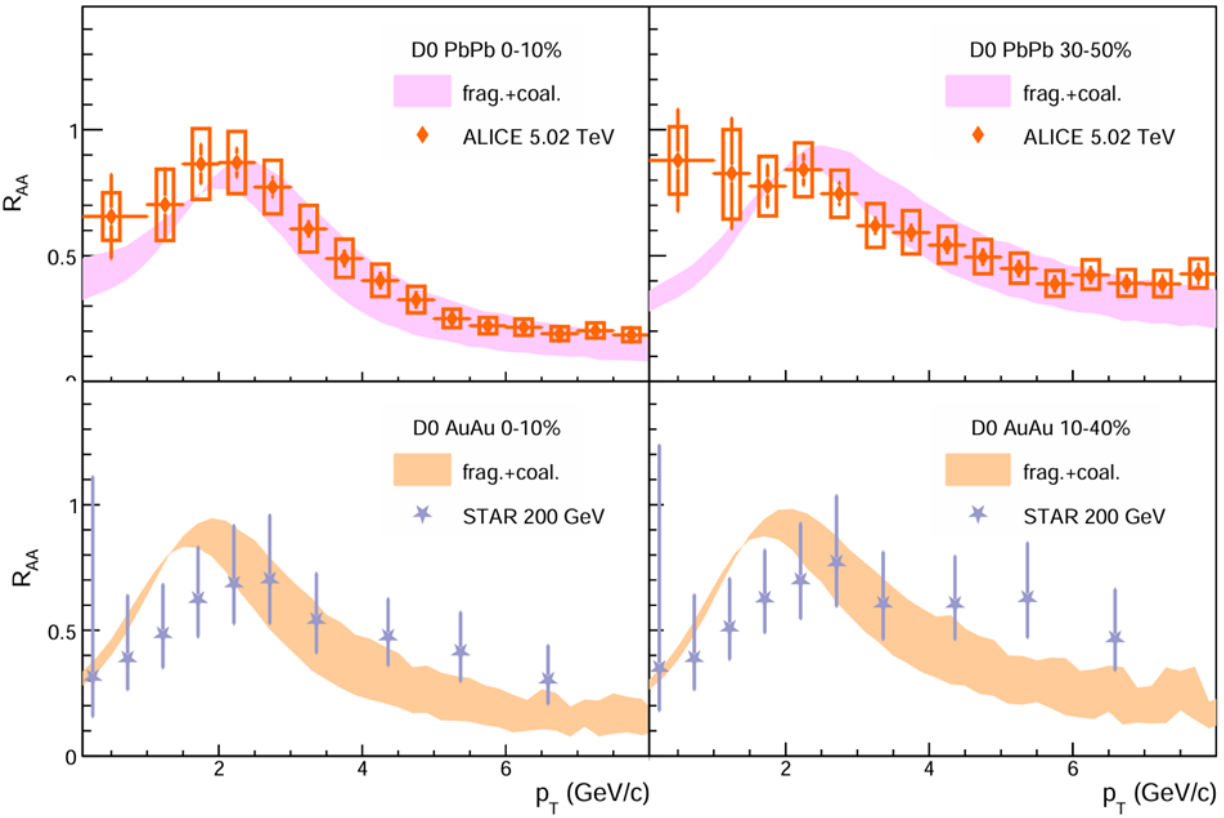
✓In-medium energy loss (SHELL: collisional+radiative)

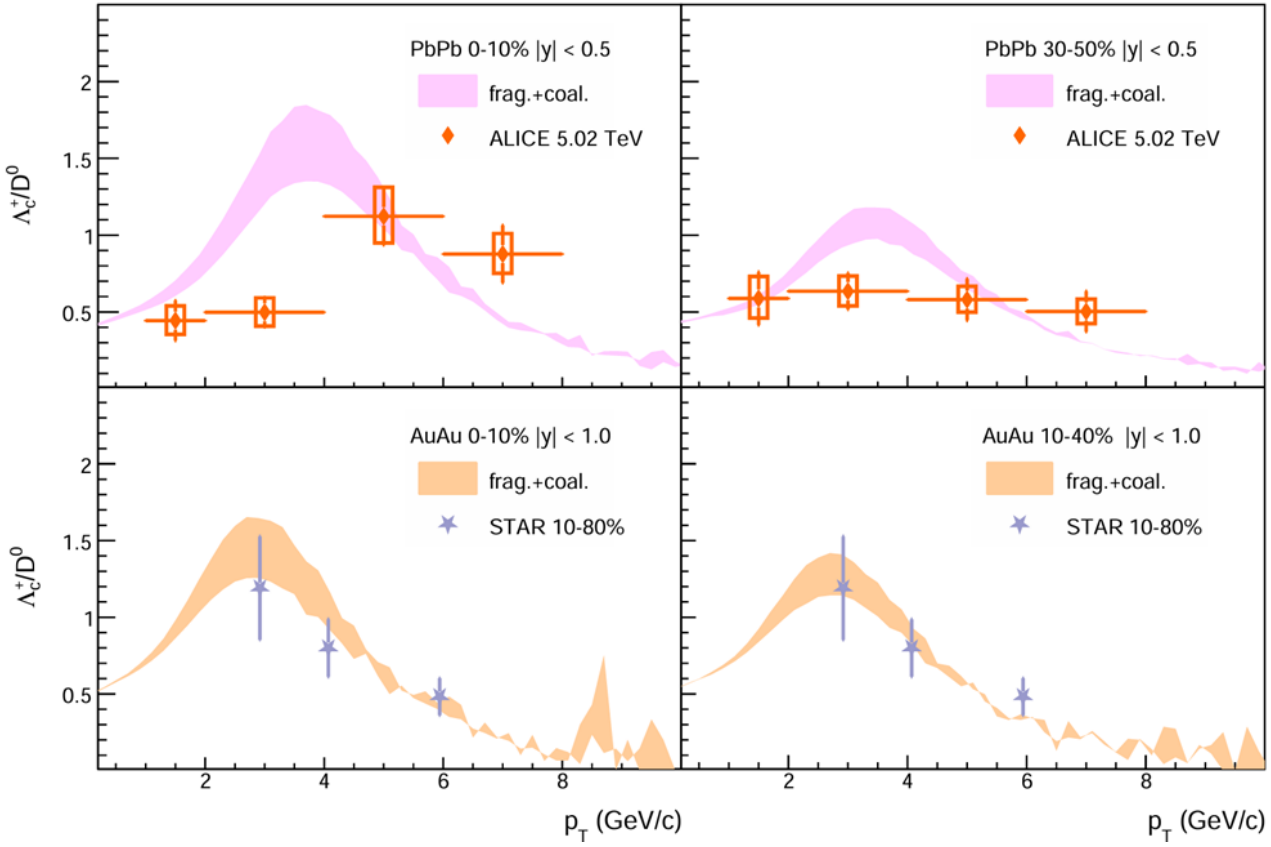
✓Coalescence and fragmentation hybrid description for hadronization

Chin.Phys.C 44 (2020) 8, 084101

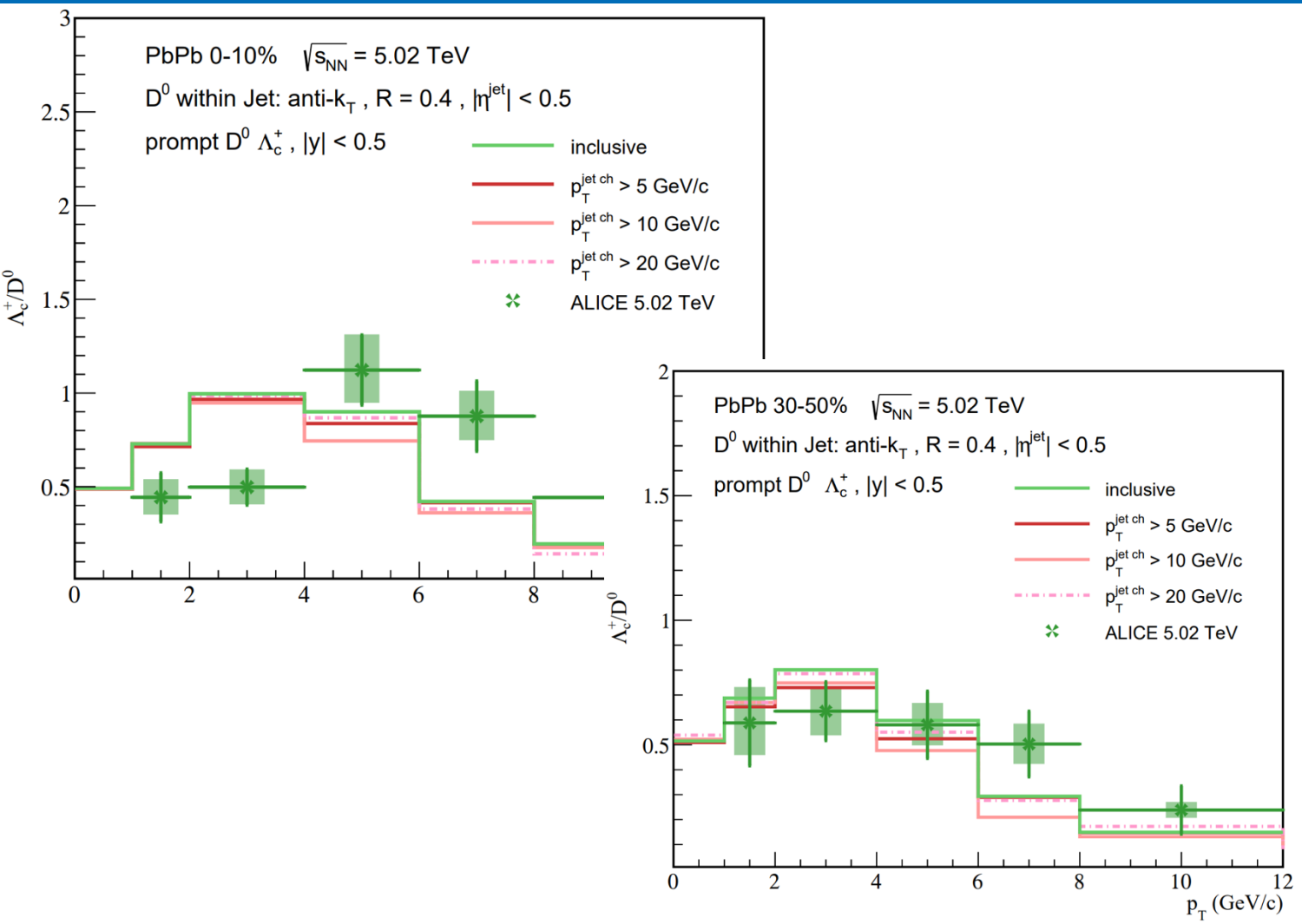
Shuzhe Shi, Jiaxing Zhao and Pengfei Zhuang

In-medium hadronization: model verification





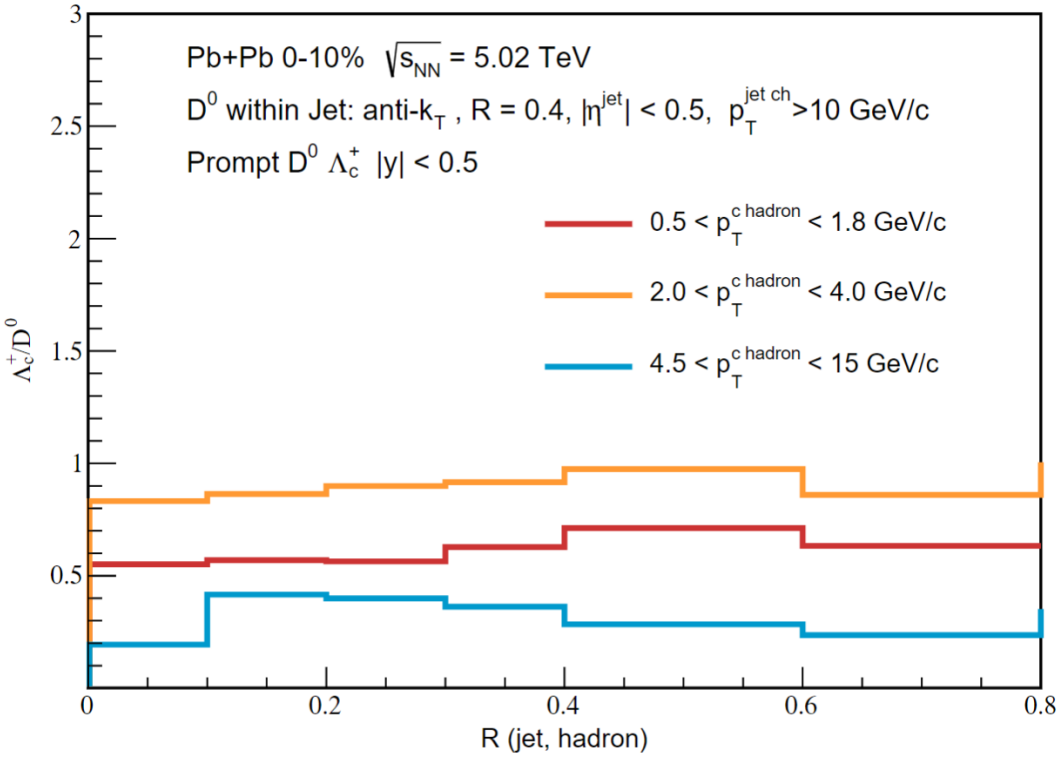
In-medium hadronization-- Coalescence type:

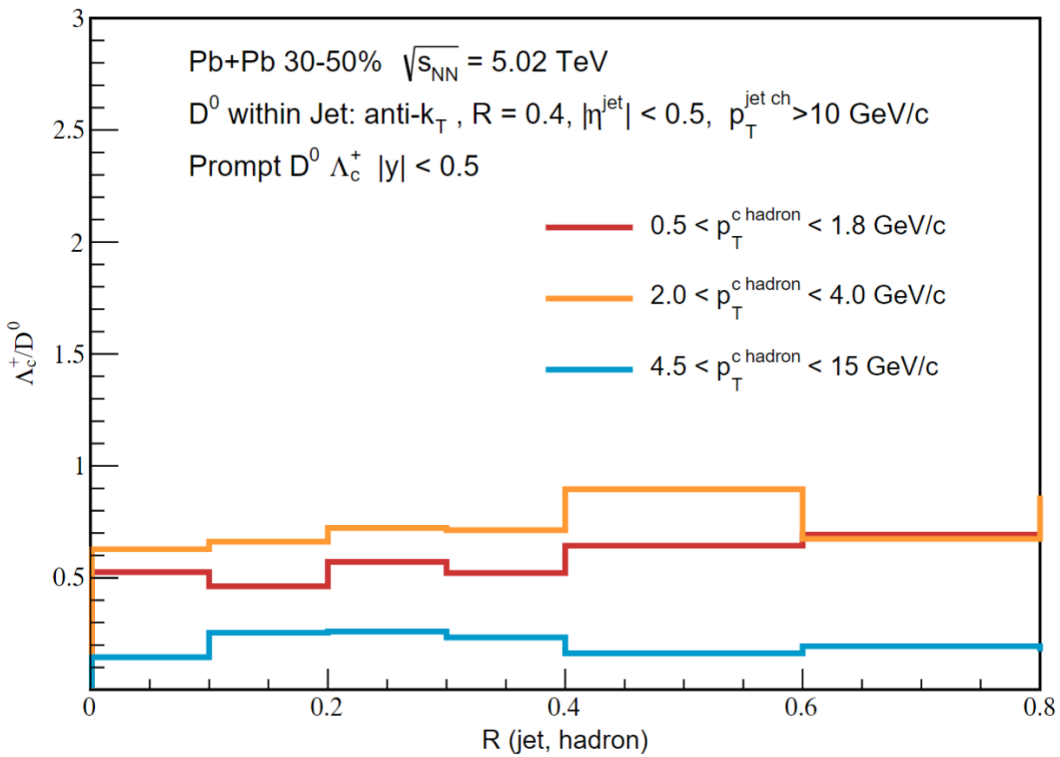


In-jet requirement leads to slight suppression for heavy flavor baryon-to-meson ratio in A+A.

---- Coalescence and fragmentation hybrid

In-medium hadronization-- Coalescence type:

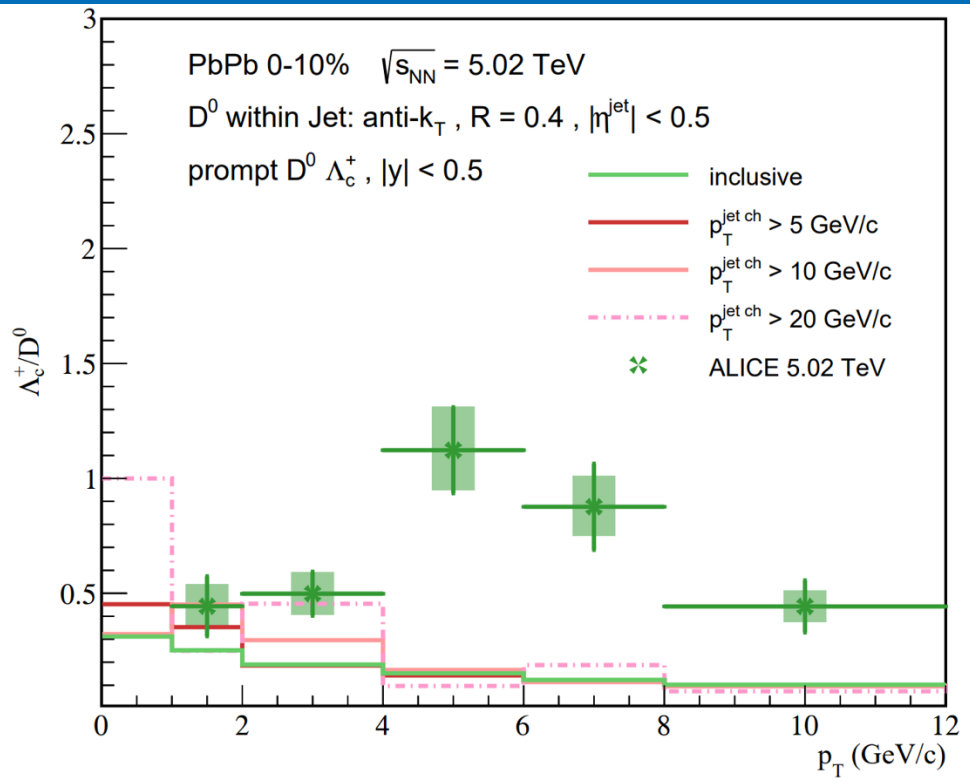


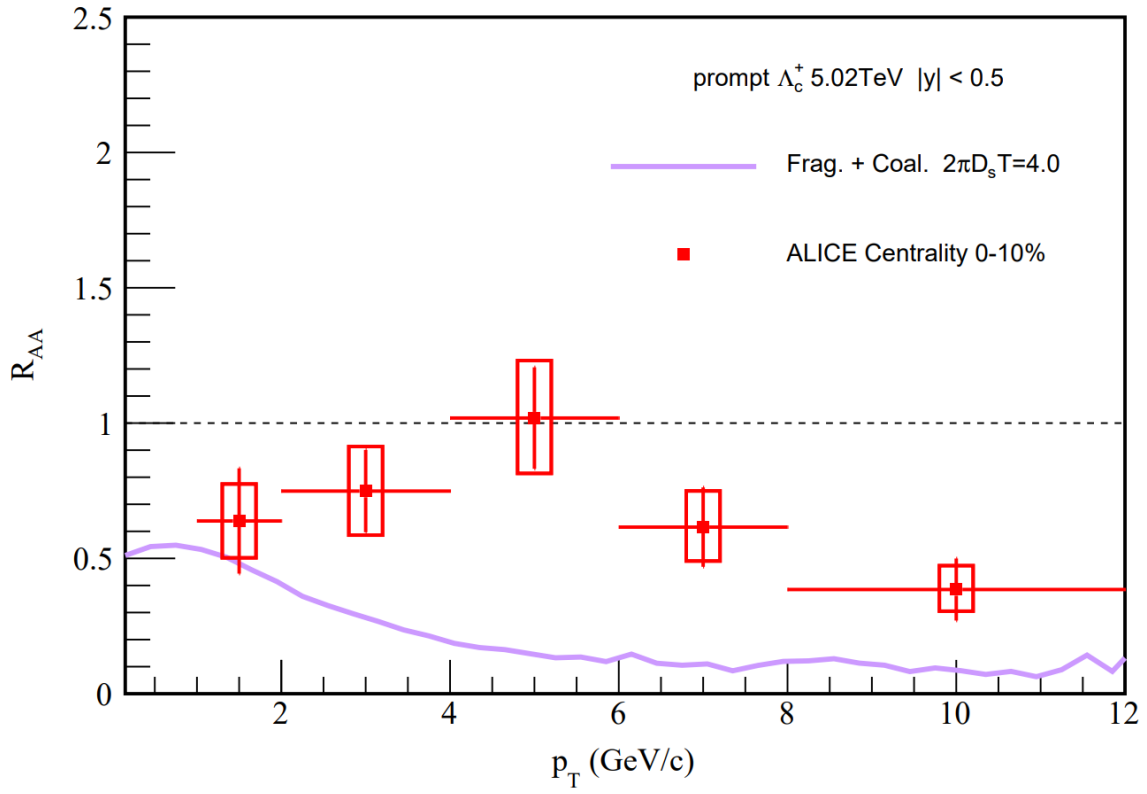


Coalescence kind of mechanism will also lead to enhancement of Λ_c^+/D^0 ratios within jets.

However, intermediate p_T , closer to the jet axis, will lead to the enhancement. ------ Coalescence

In-medium hadronization-- CR type:

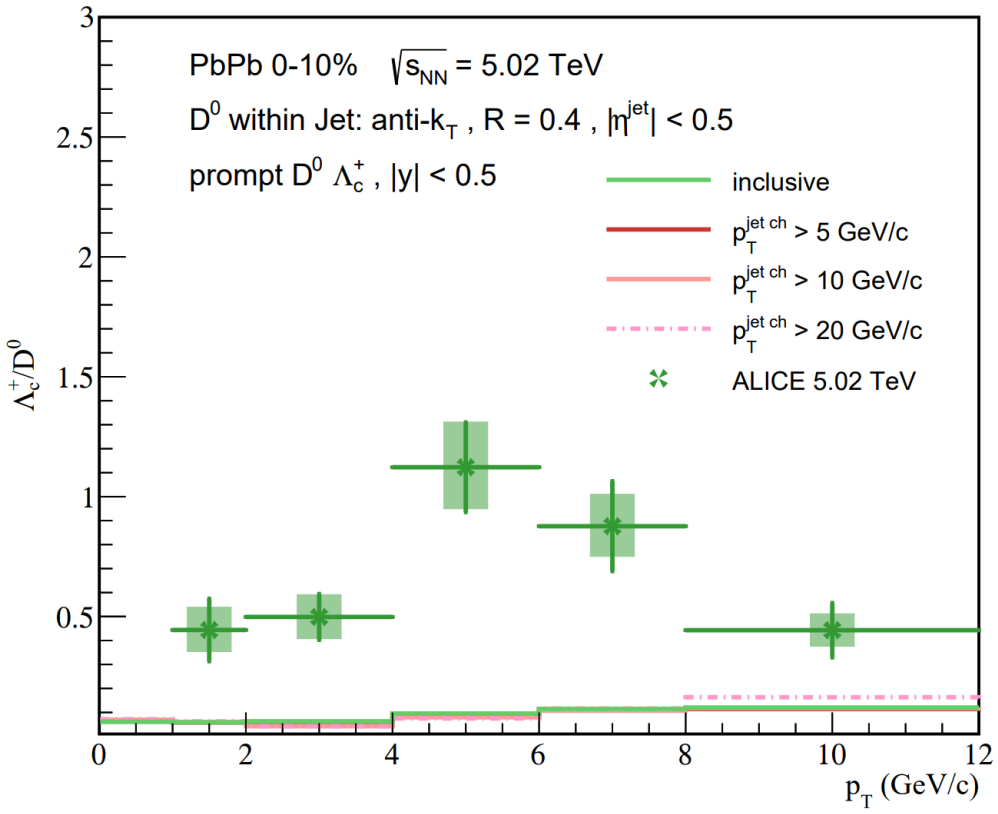


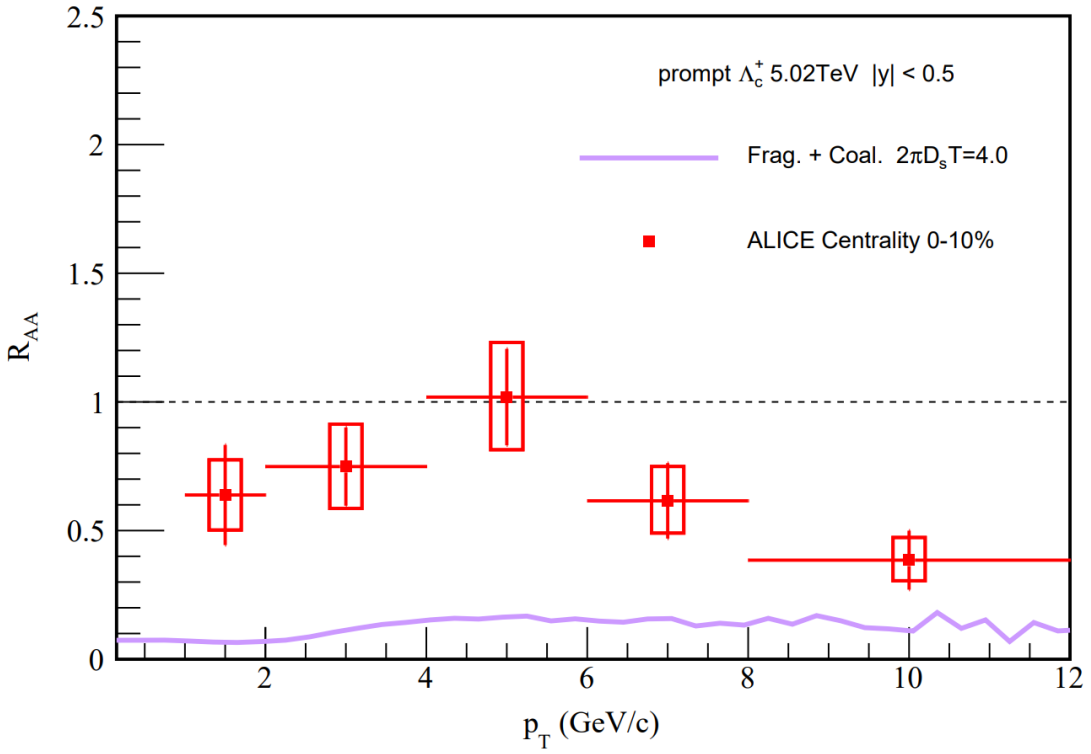


The CR hadronization after energy loss will also lead to an enhancement due to jet requirements.

Even CR hadronization can not describe the production in A+A

In-medium hadronization-- fragmentation type:





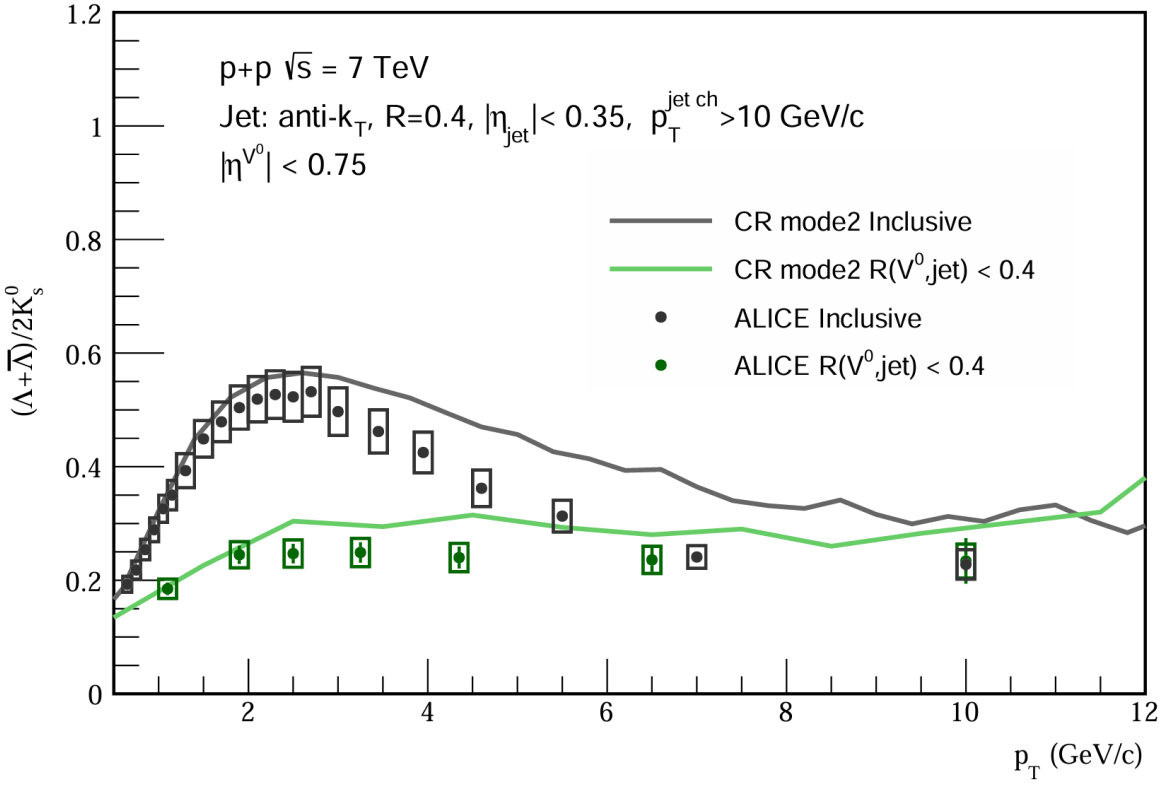
The string fragmentation hadronization after energy loss will lead to suppression due to jet requirements same as in p+p.

Try to Conclude:

- The enhancement in inclusive heavy flavor baryon-to-meson ratio is mainly coming from the hard process while the light case is mainly from underlying events.
- Color reconnection and coalescence can both describe the enhancement at lower p_T .
- For color reconnection description of hadronization both in p+p and A+A, the in-jet requirement will lead to an enhancement of $\boldsymbol{\Lambda_c^+/D^0}$ ratio lower p_T .
- For coalescence type of hadronization, the in-jet requirement will lead to an suppression of $\boldsymbol{\Lambda_c^+/D^0}$ ratio lower p_T .
- Further In jet $\boldsymbol{\Lambda_c^+/D^0}$ ratio can be useful tool to probe the hadronization mechanism since there are argument that hot and dense medium created in small system.

Backup:

★ What if Colour reconnection apply for light case?



★ What if fragmentation mechanism apply for heavy case?