



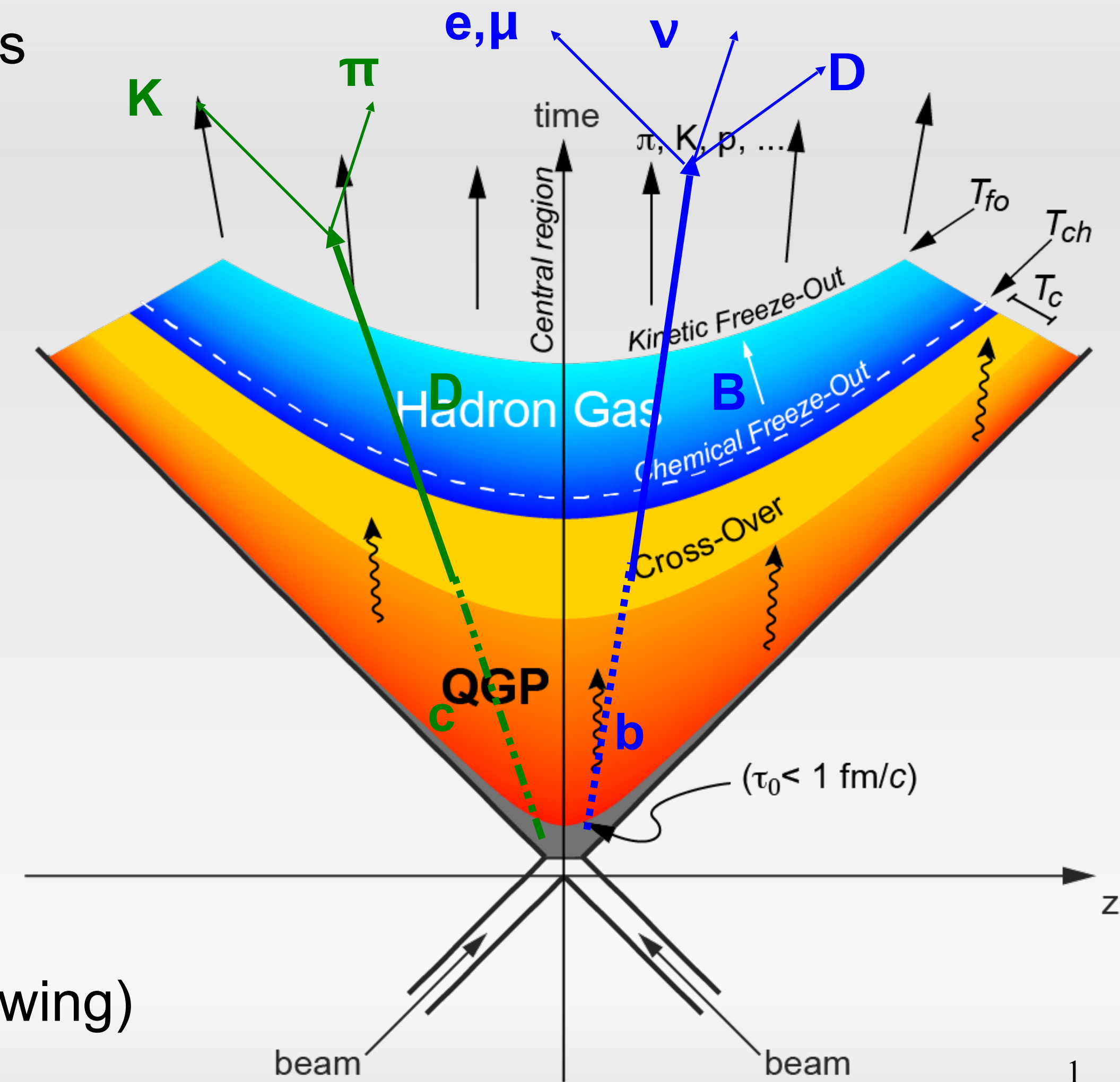
QM highlights heavy flavour

Andrea Dubla

02/12/19

Why heavy quarks?

- ⇒ **Charm and beauty** quarks are produced in the initial stages of the collisions via hard scattering processes
- ⇒ They experience the full evolution of the system → sensitive probes of the properties of the QGP
- ⇒ Expected to **lose energy**
- ⇒ **Collective expansion**
- ⇒ **Hadronization**: fragmentation vs coalescence
- ⇒ **Cold Nuclear Matter effect**: modification of nPDF (shadowing)



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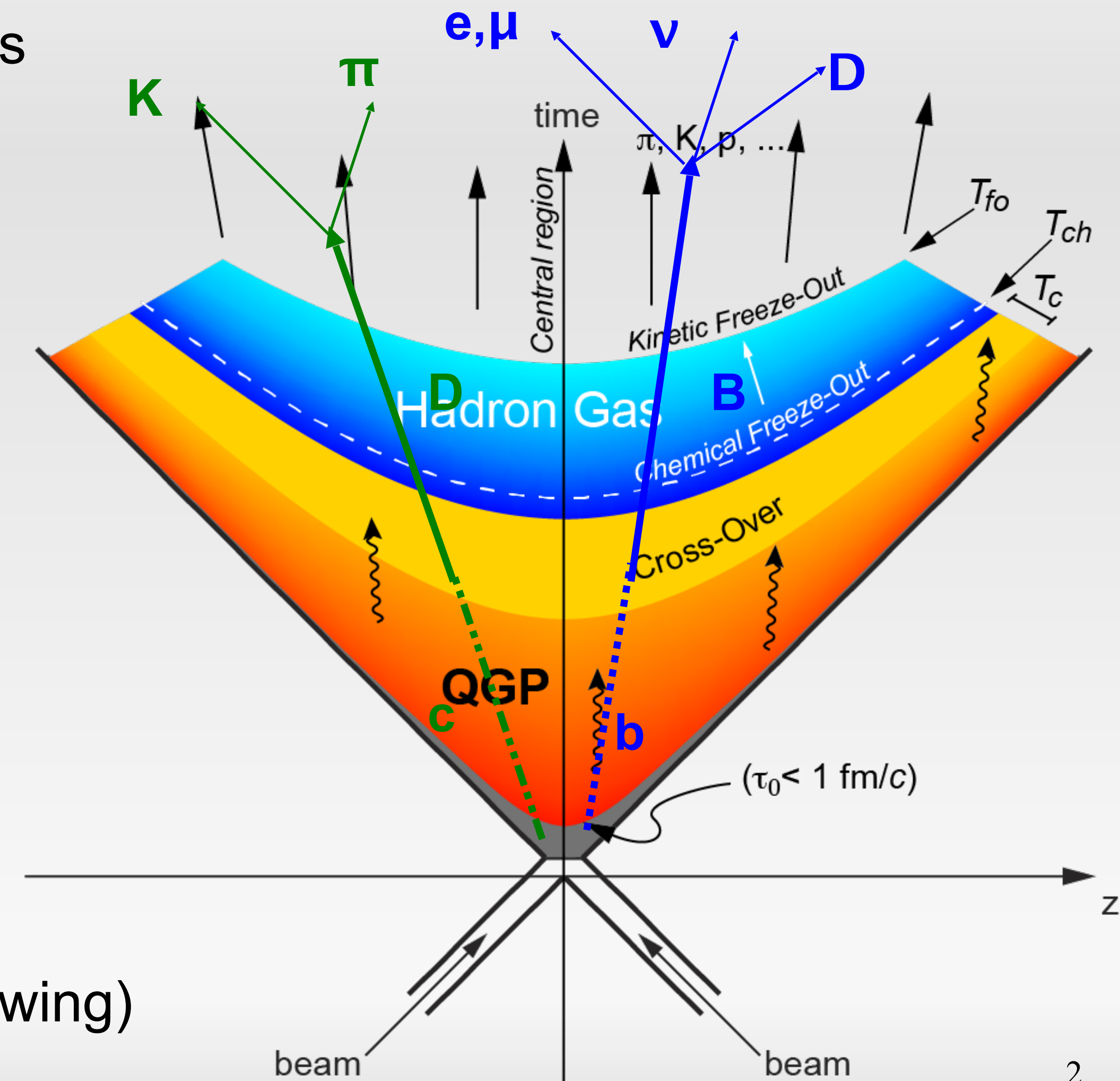
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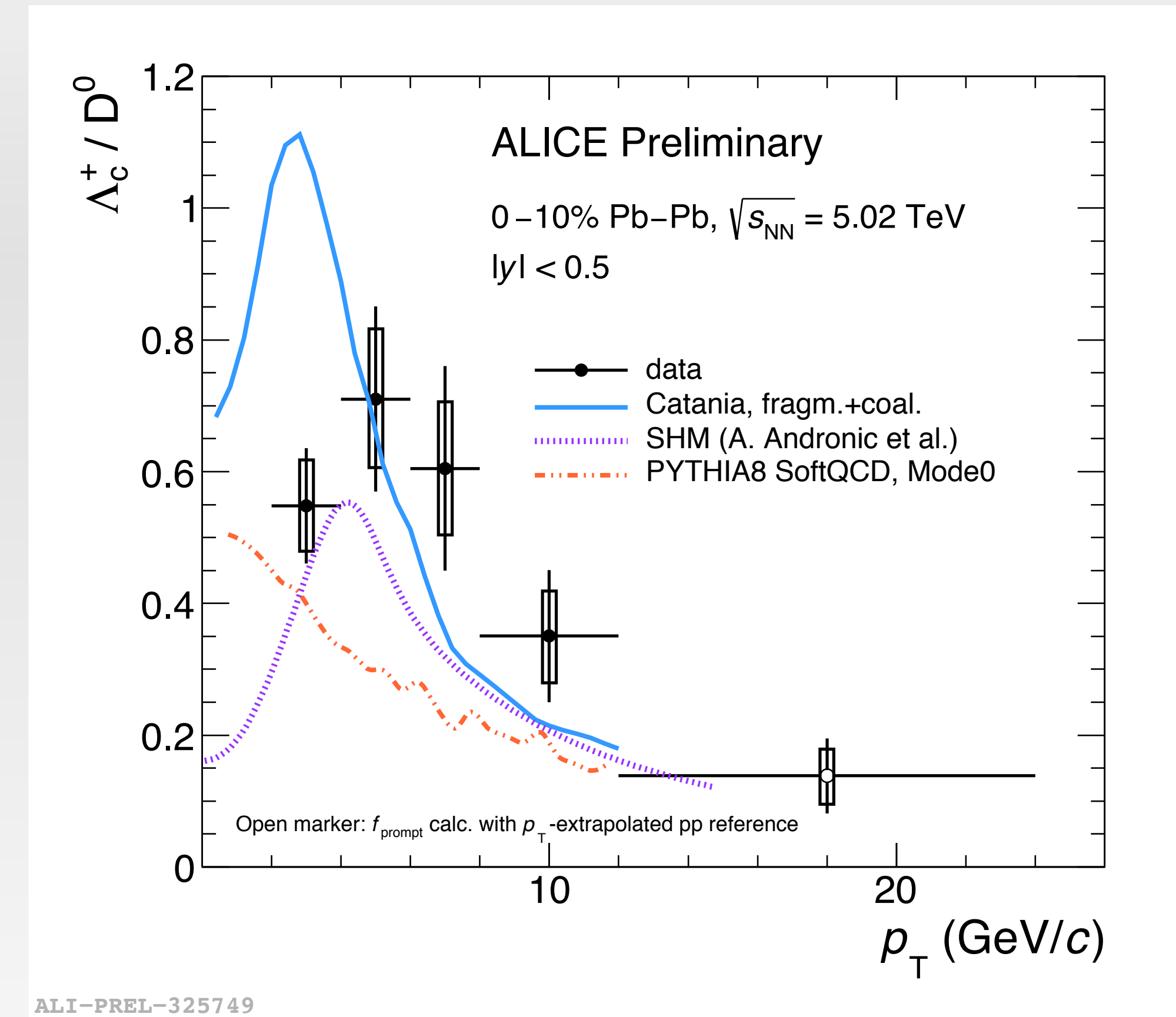
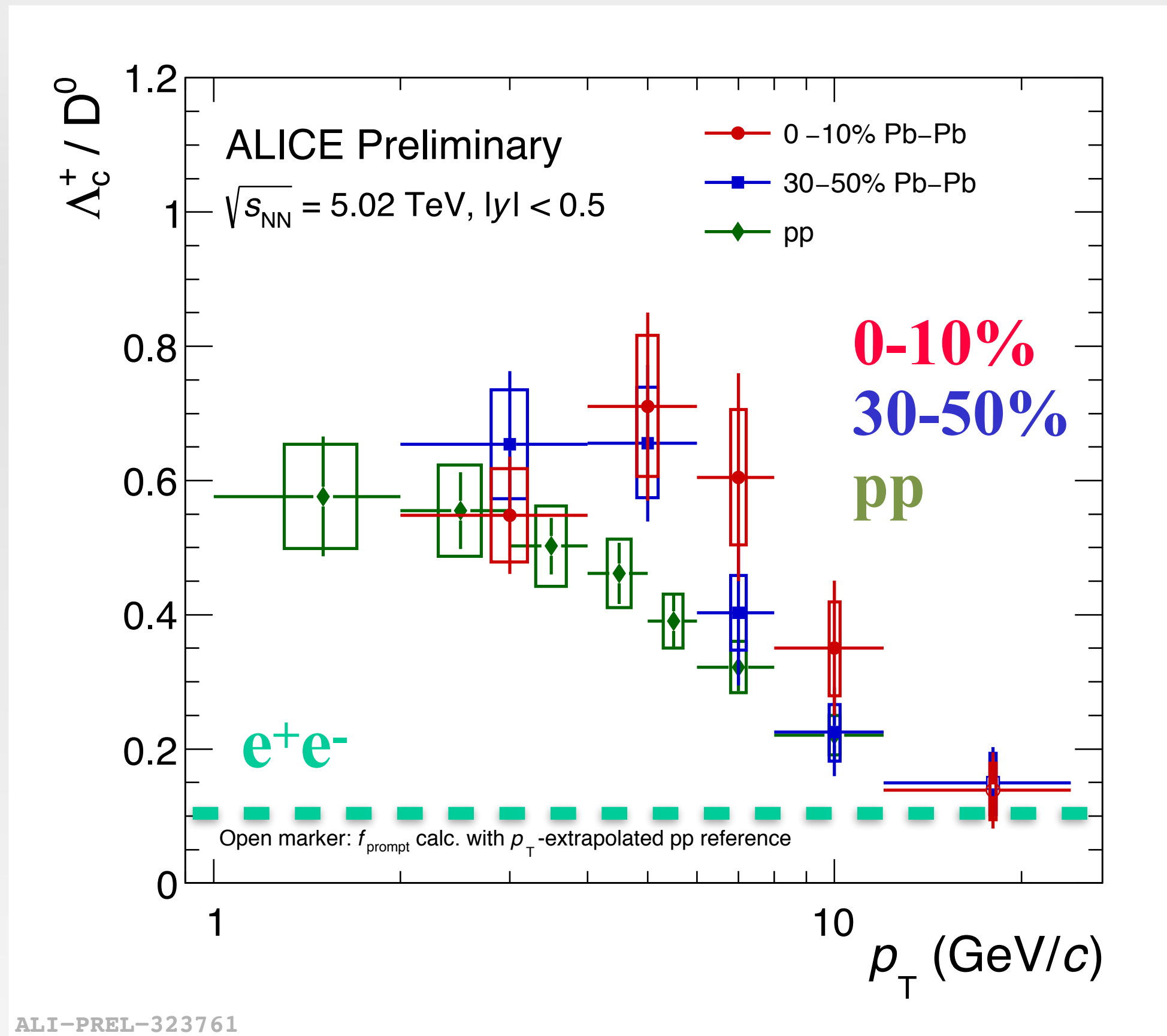
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⇒ **Hadronization**: fragmentation vs coalescence

⇒ **Cold Nuclear Matter effect**: modification of nPDF (shadowing)



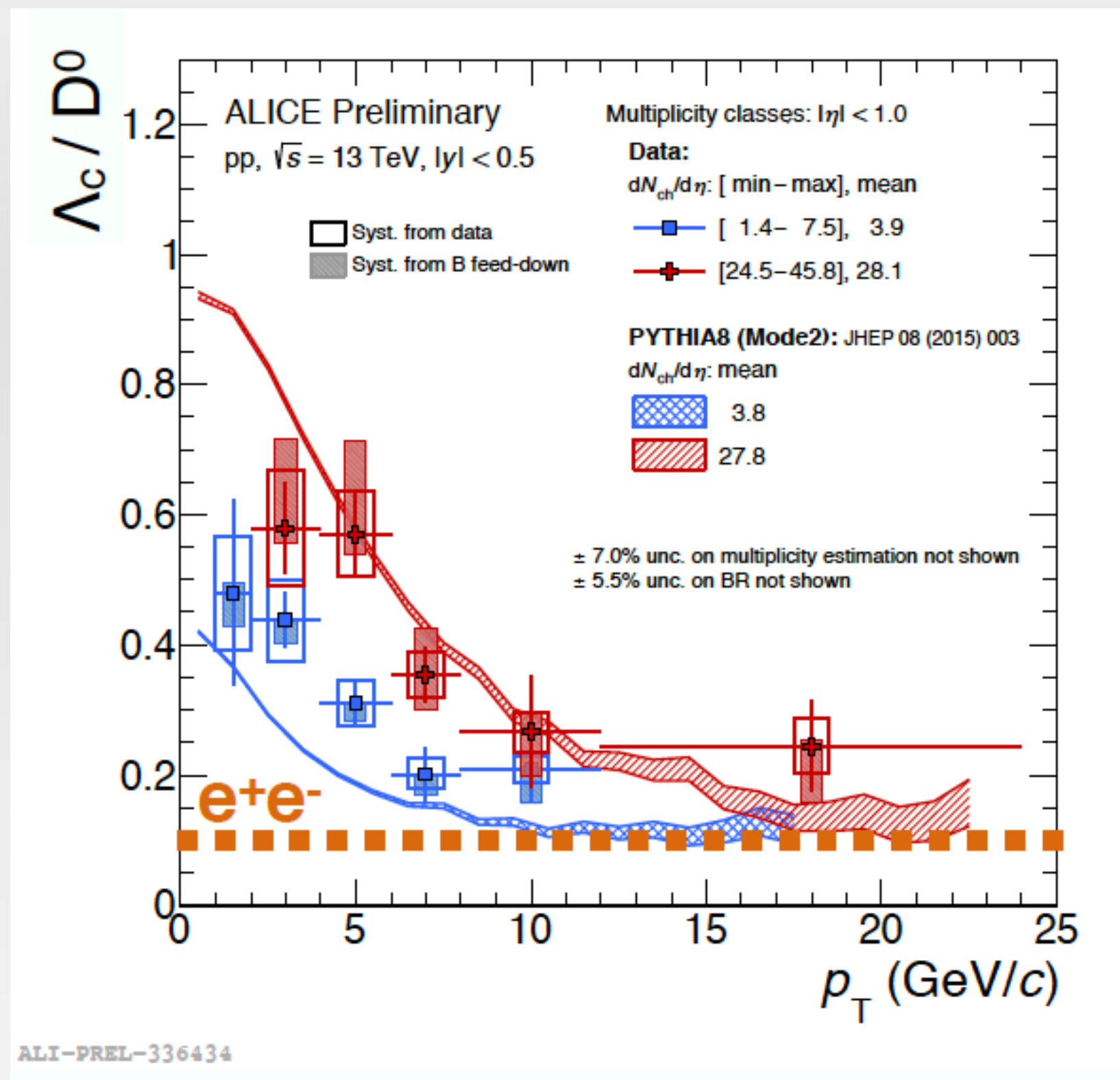
Charm baryons: a tool to study hadronisation



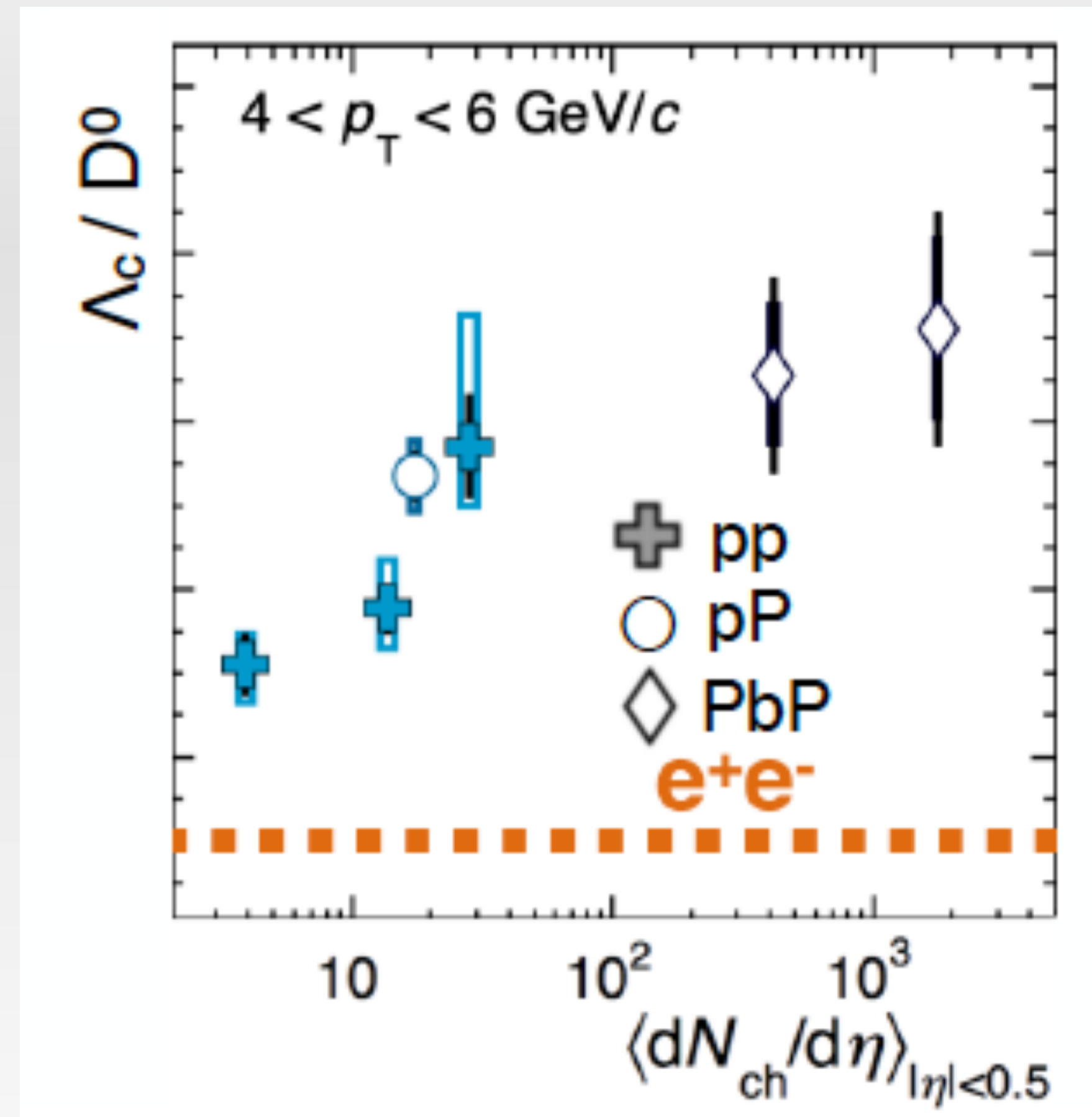
→ Moderate enhancement from pp to Pb-Pb collisions at intermediate p_T within the uncertainties

- Compatible with model that include coalescence
- Statistical hadronization accounts for the peak

Charm baryons: a tool to study hadronisation



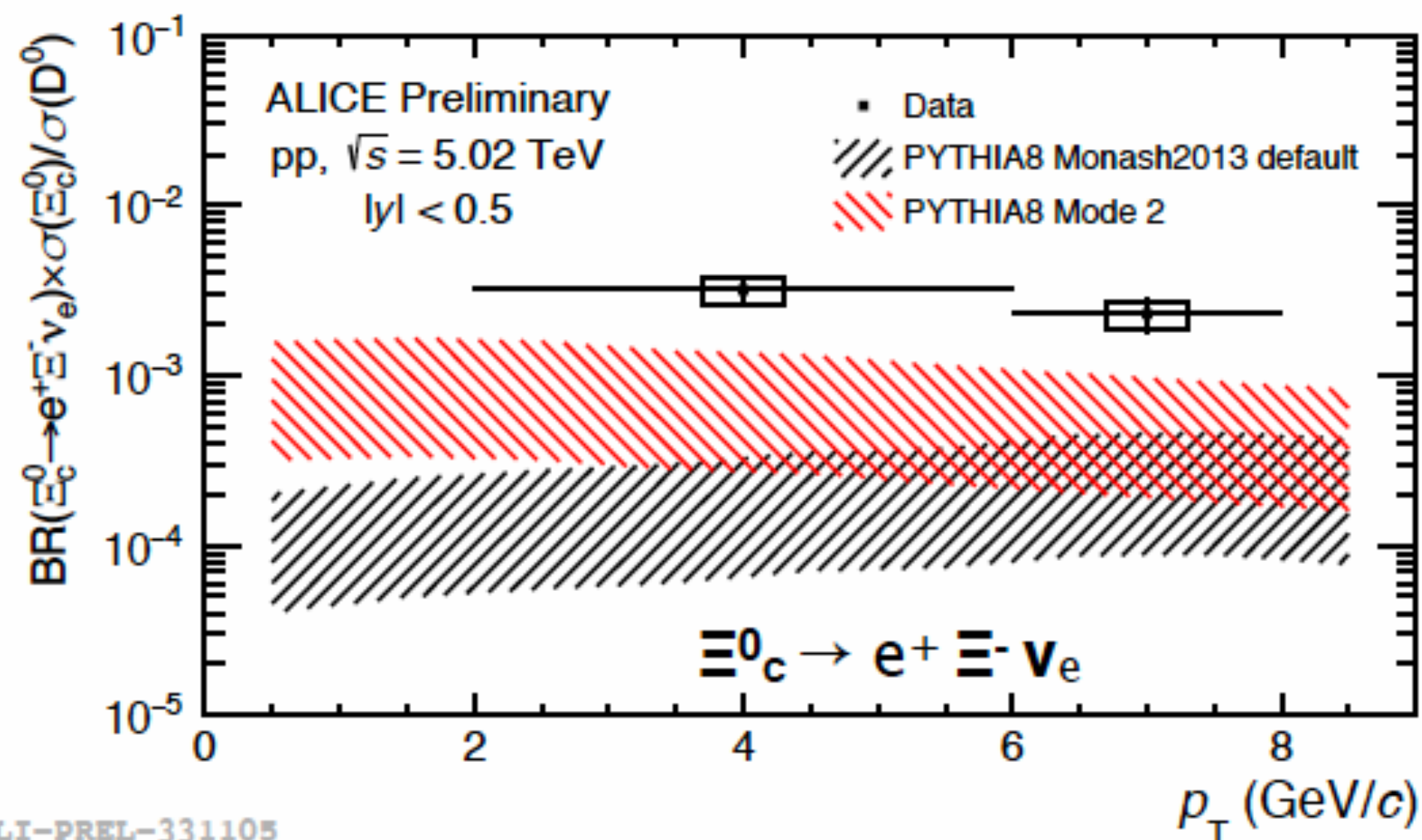
- Λ_c/D^0 shows a significant increase from **low multiplicity to high multiplicity**
- Alternative description that does not require the presence of a equilibrated medium
- But challenge our interpretation of recombination!



- **large increase from e^+e^- to pp**
- tiny increase from pp to central PbP
- **Local recombination?!**

Charm baryons: a tool to study hadronisation

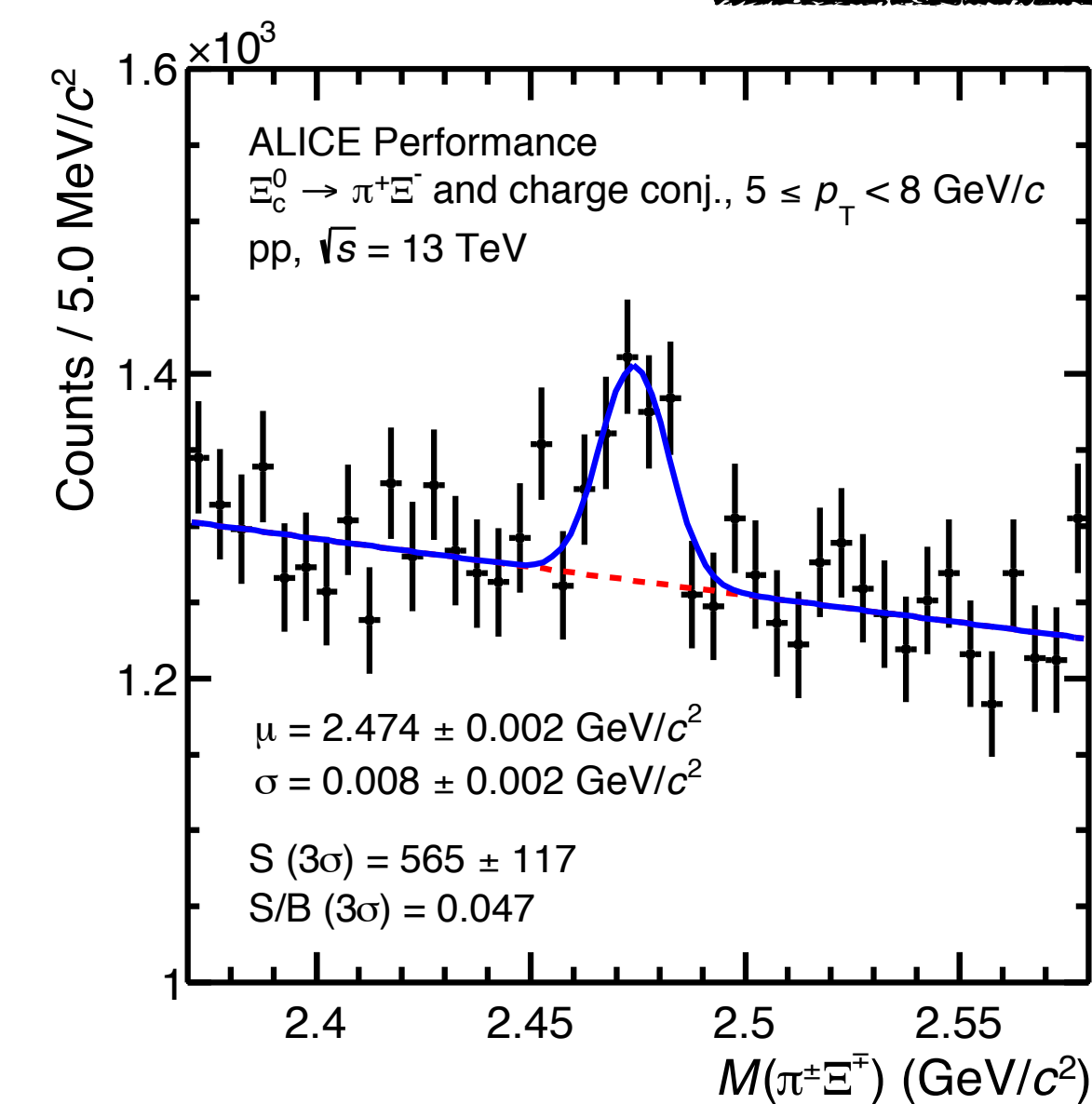
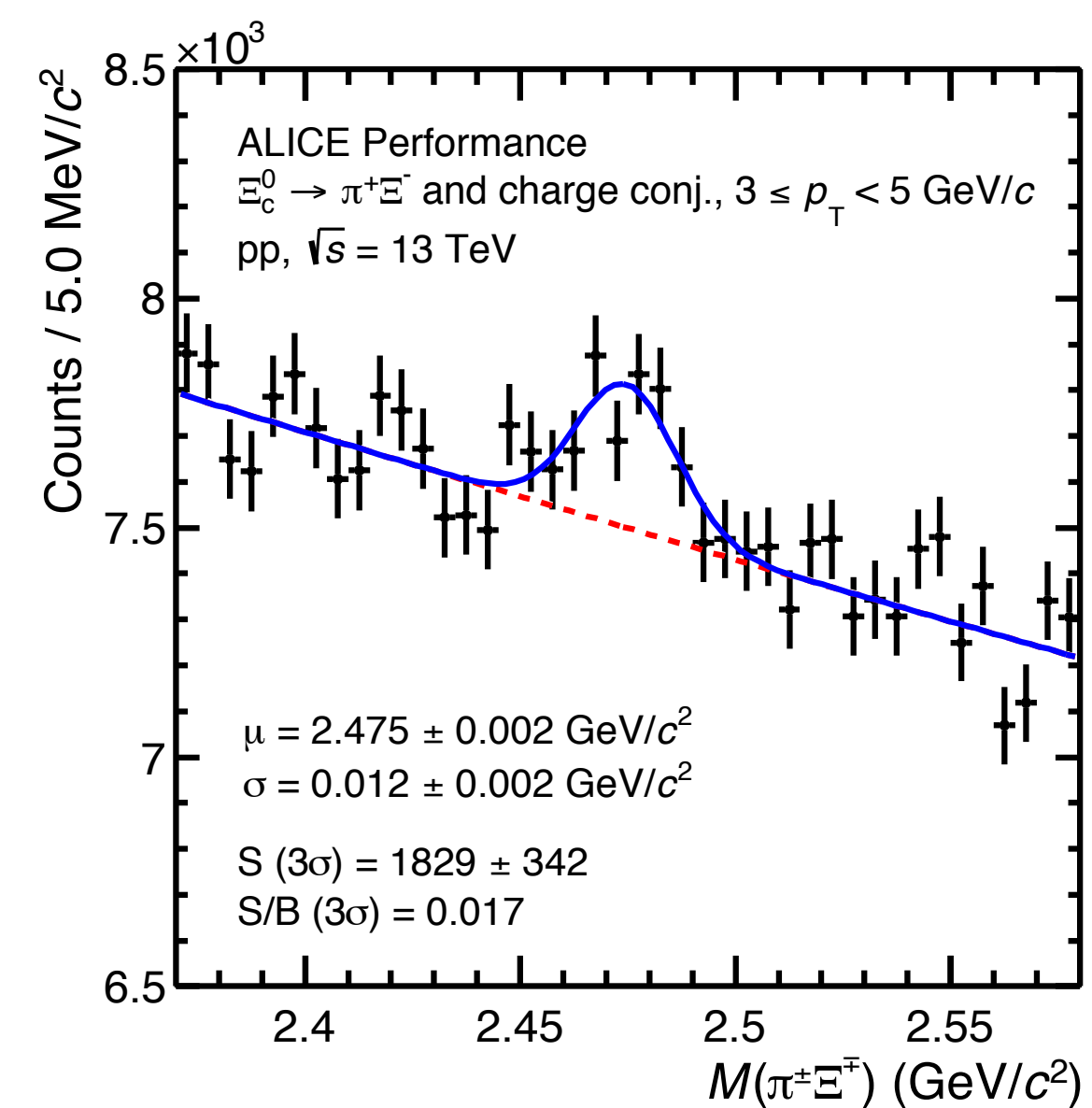
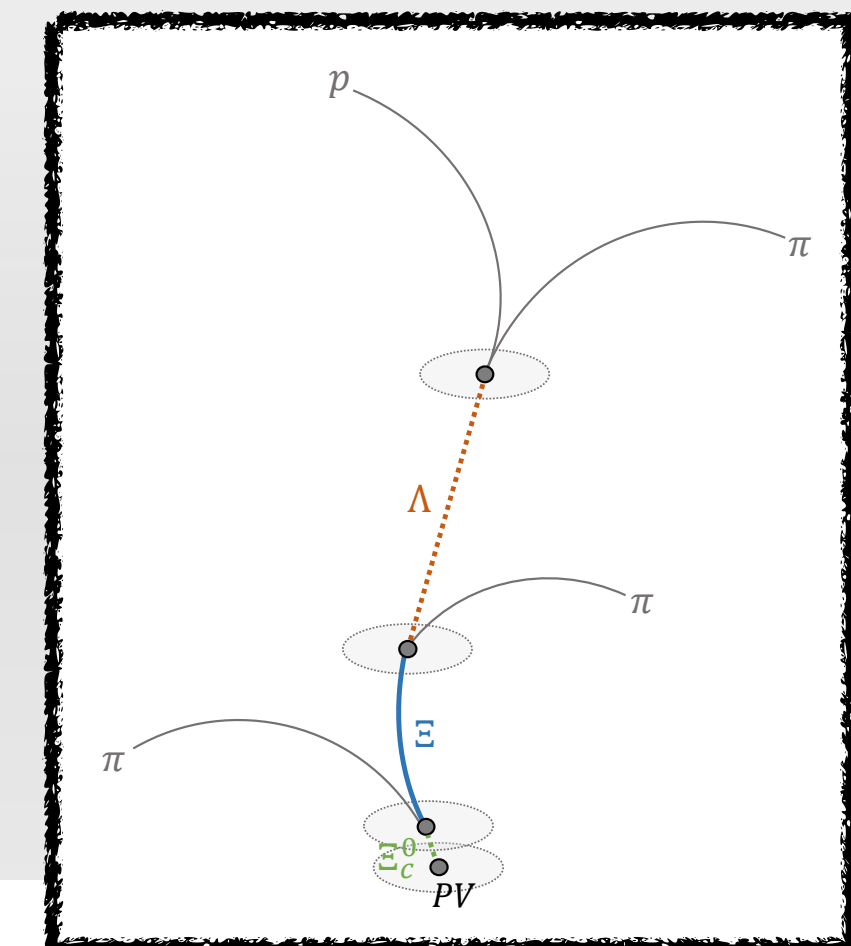
Another player in this game



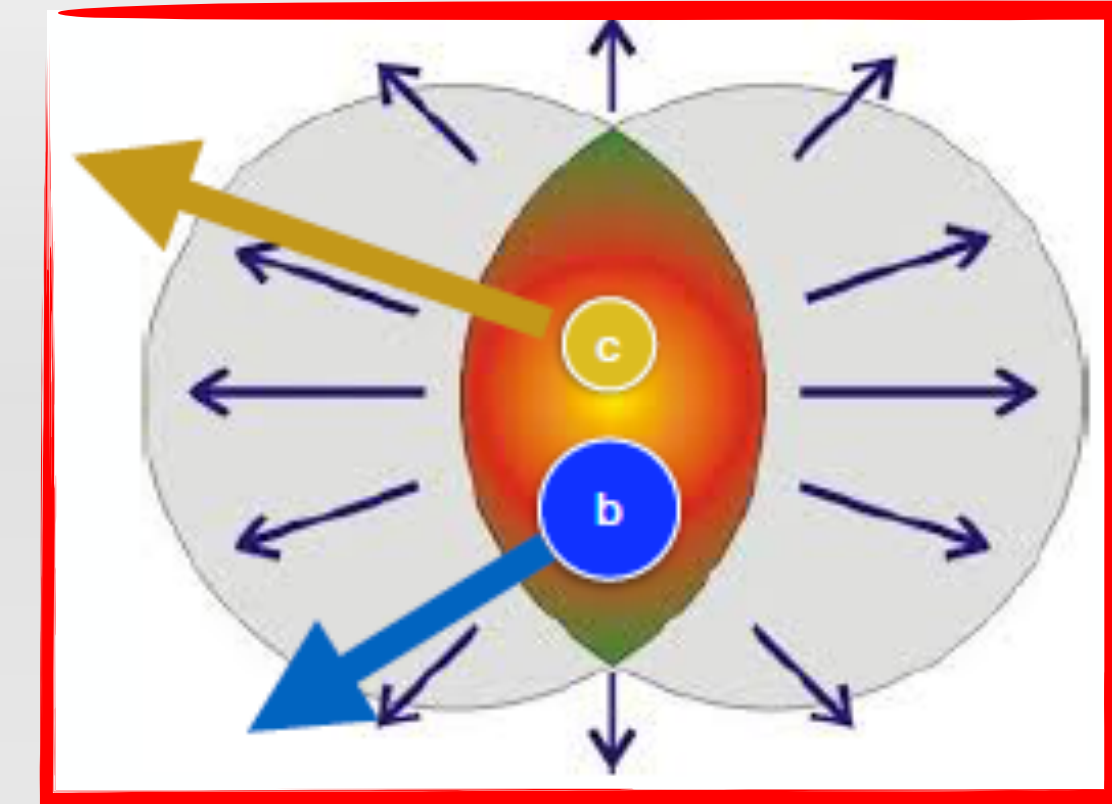
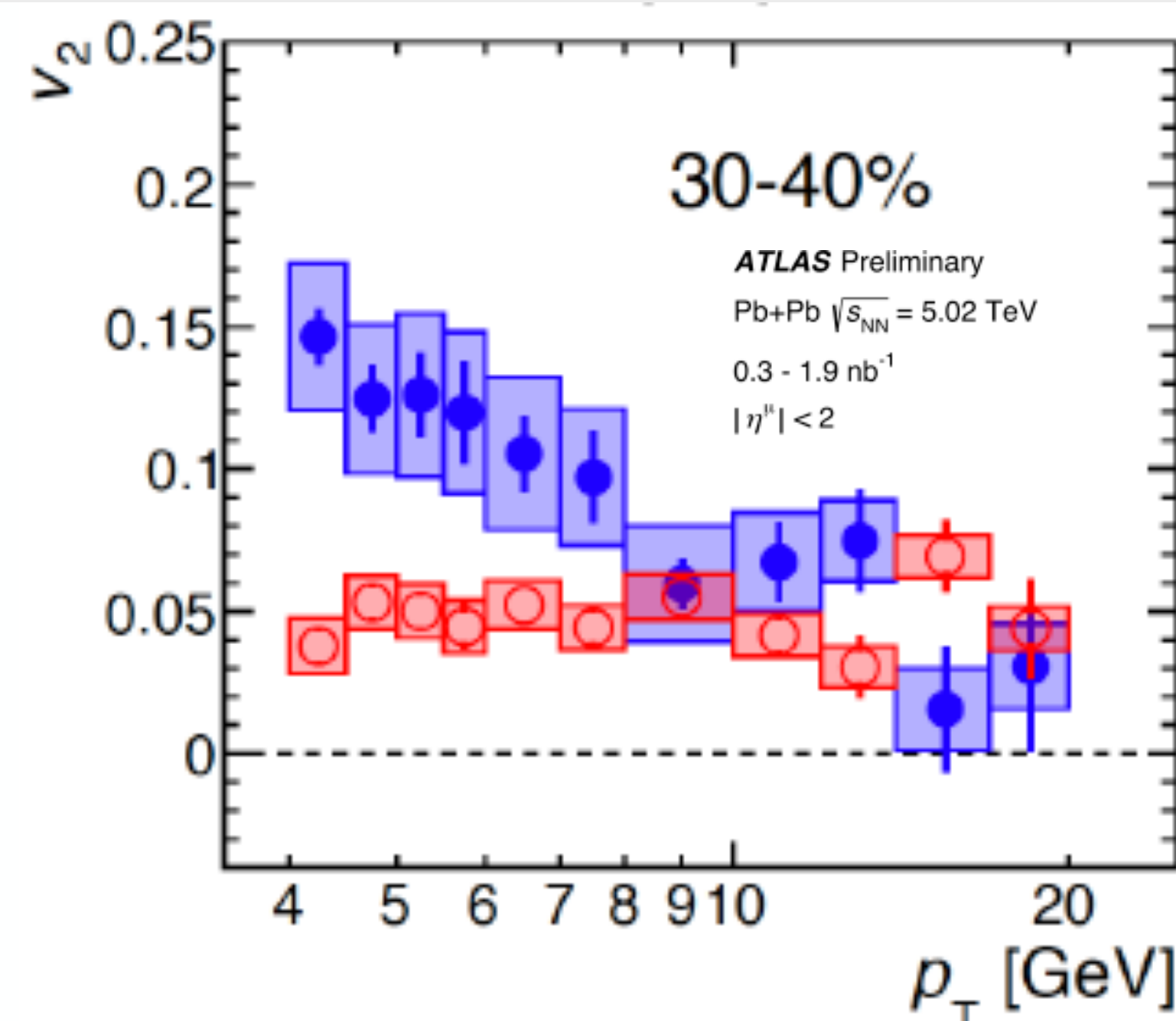
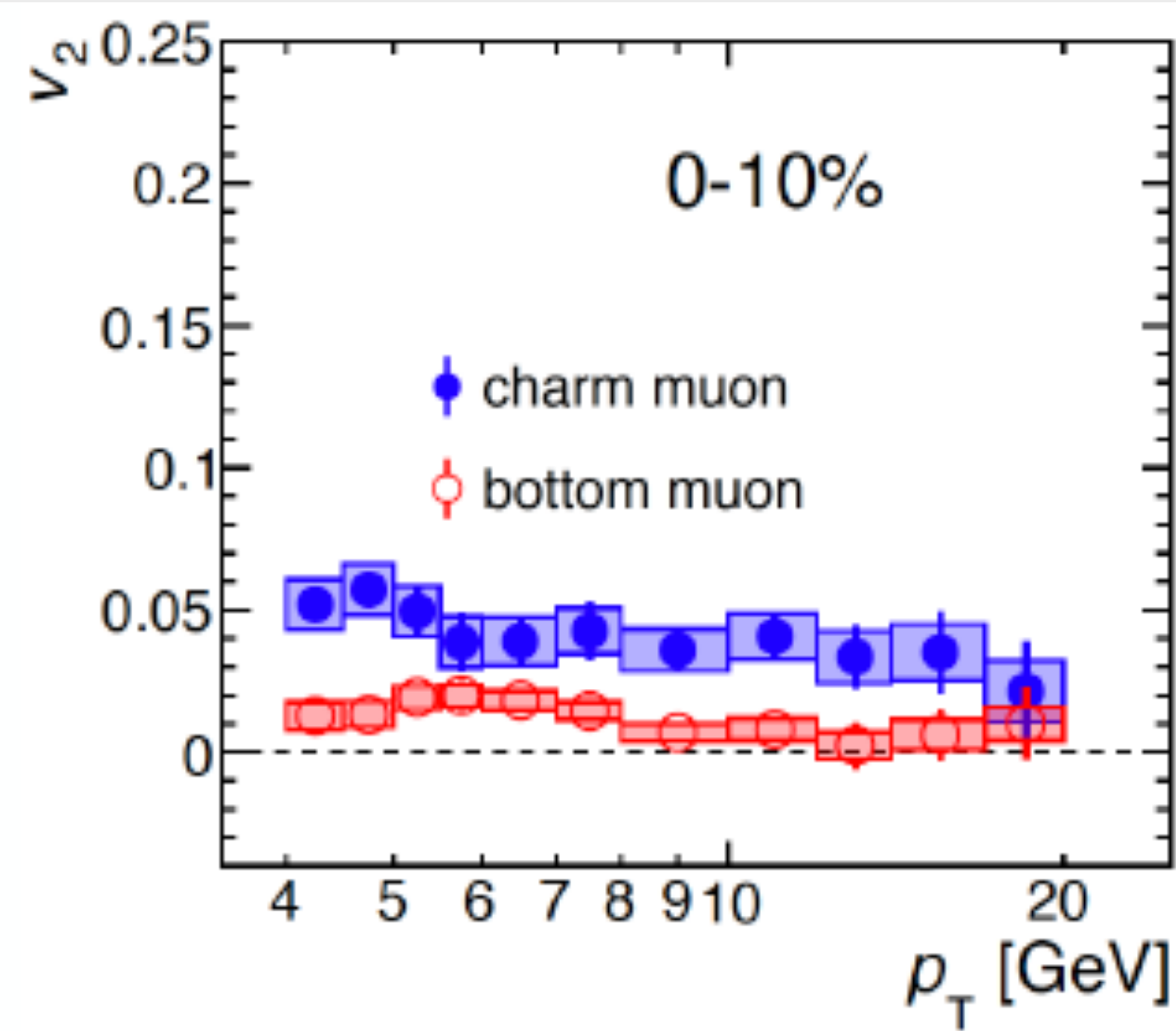
→ Ratio with heavier baryons Ξ_c^0 :
- expected larger enhancement

→ First attempt to fully reconstruct the Ξ_c^0 in hadronic decay via $\Xi\pi$ decay

→ Clear and significant peaks in the p_T interval 3-8 GeV/c

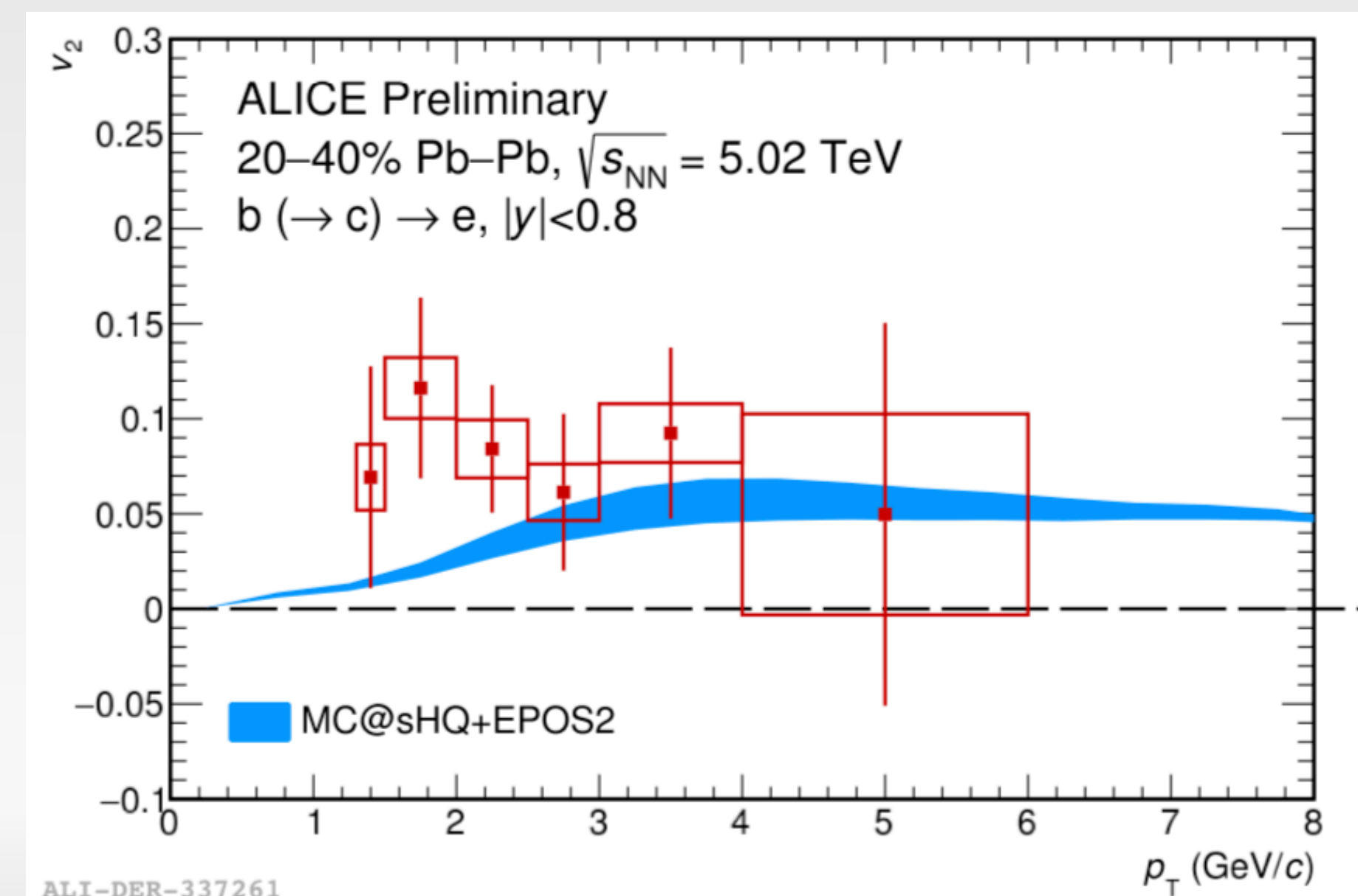
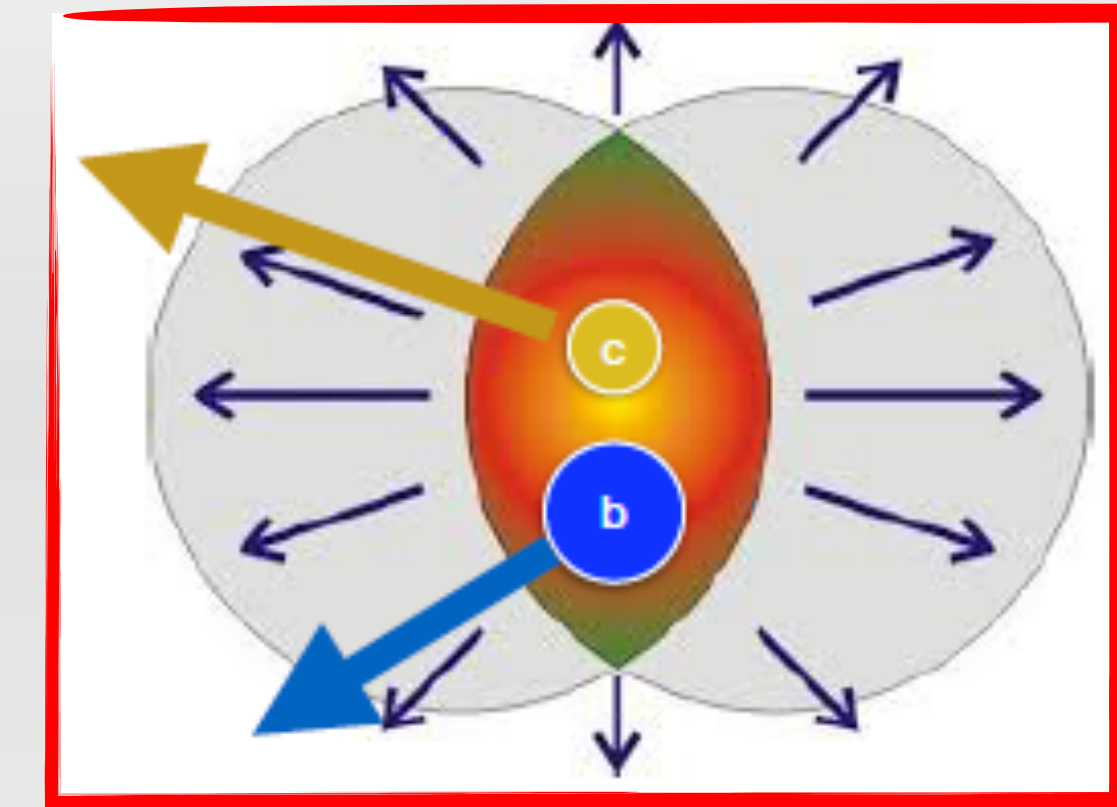
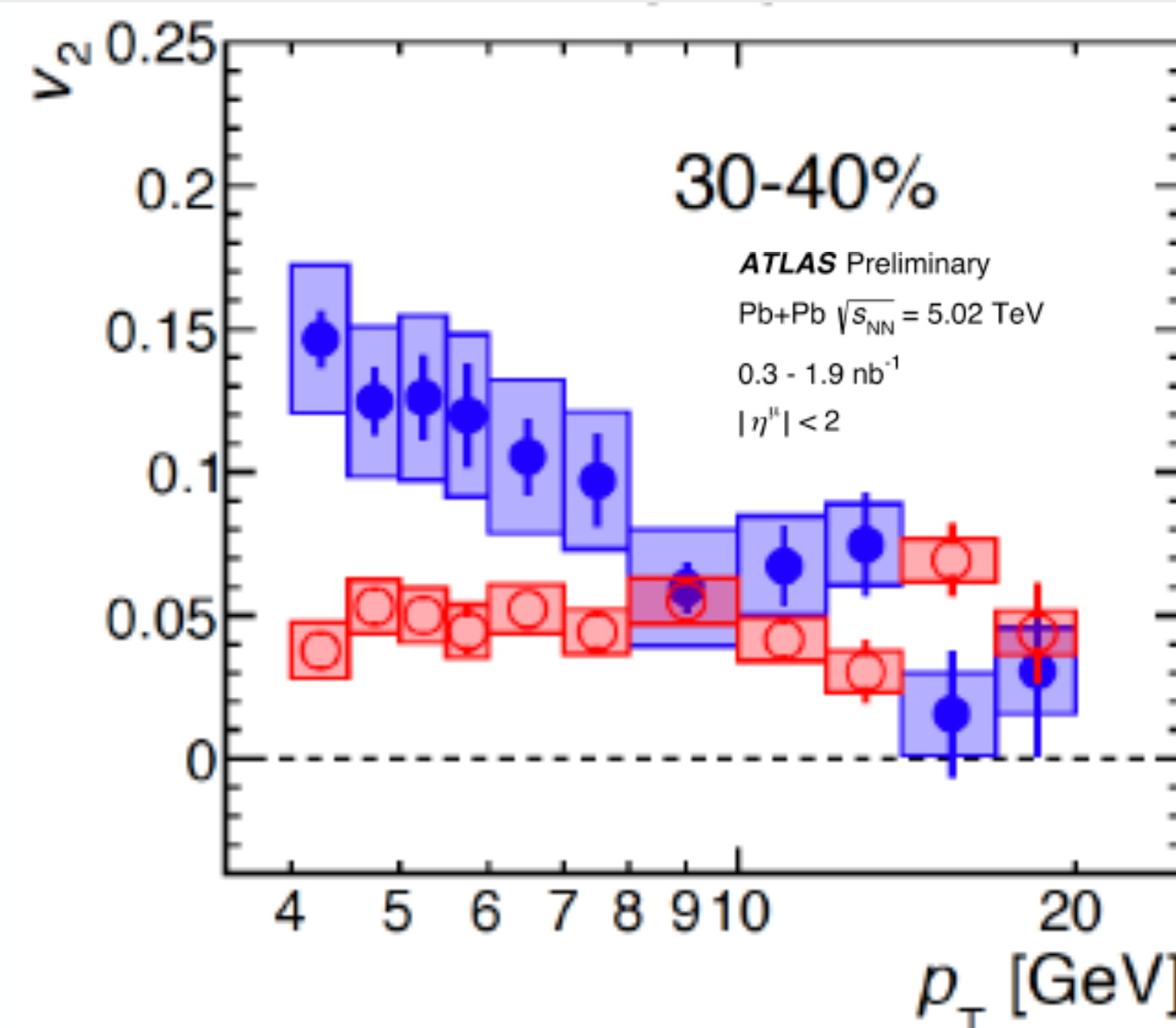
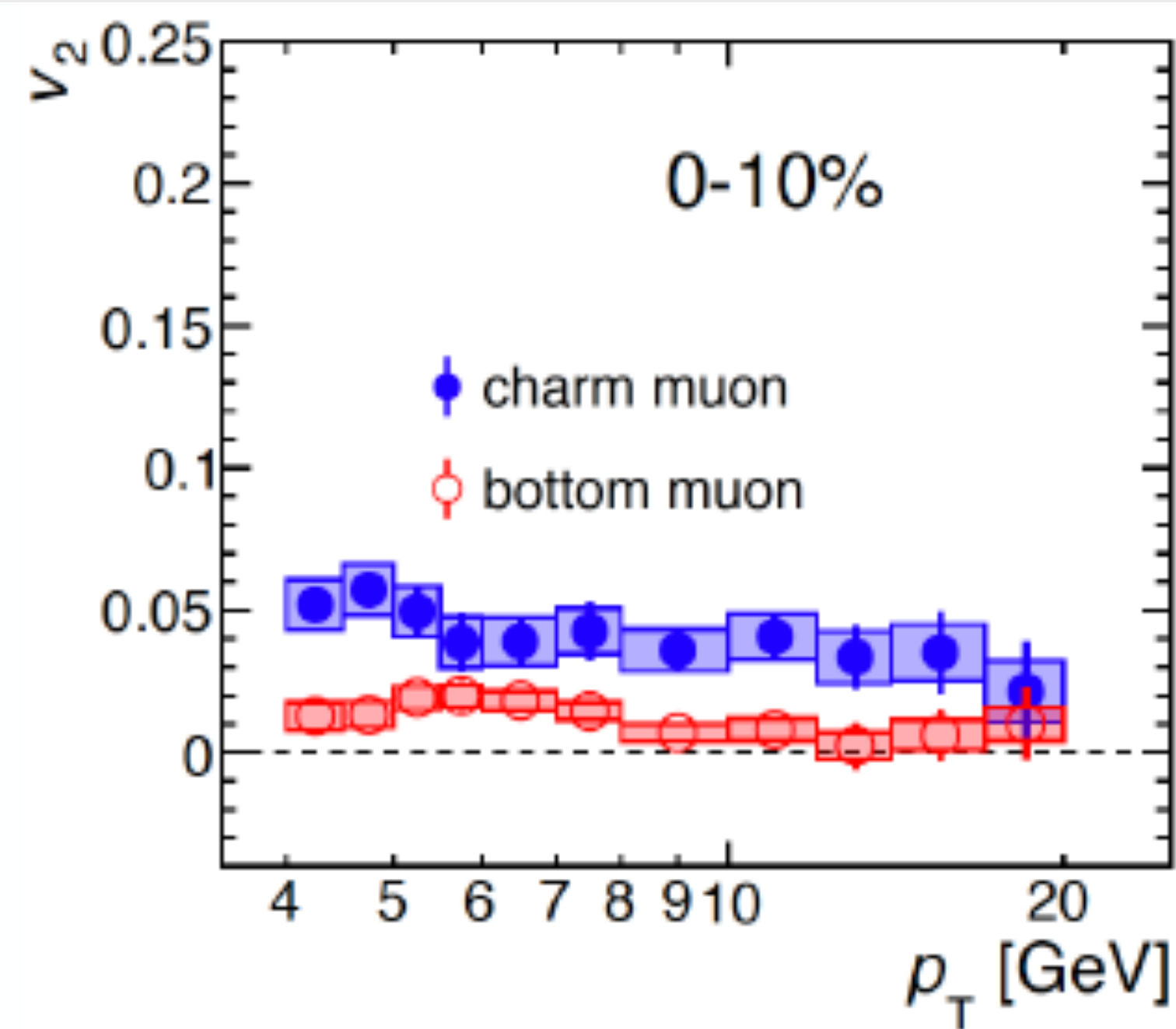


Collectivity



- Both **charm** and **beauty** flow in AA!

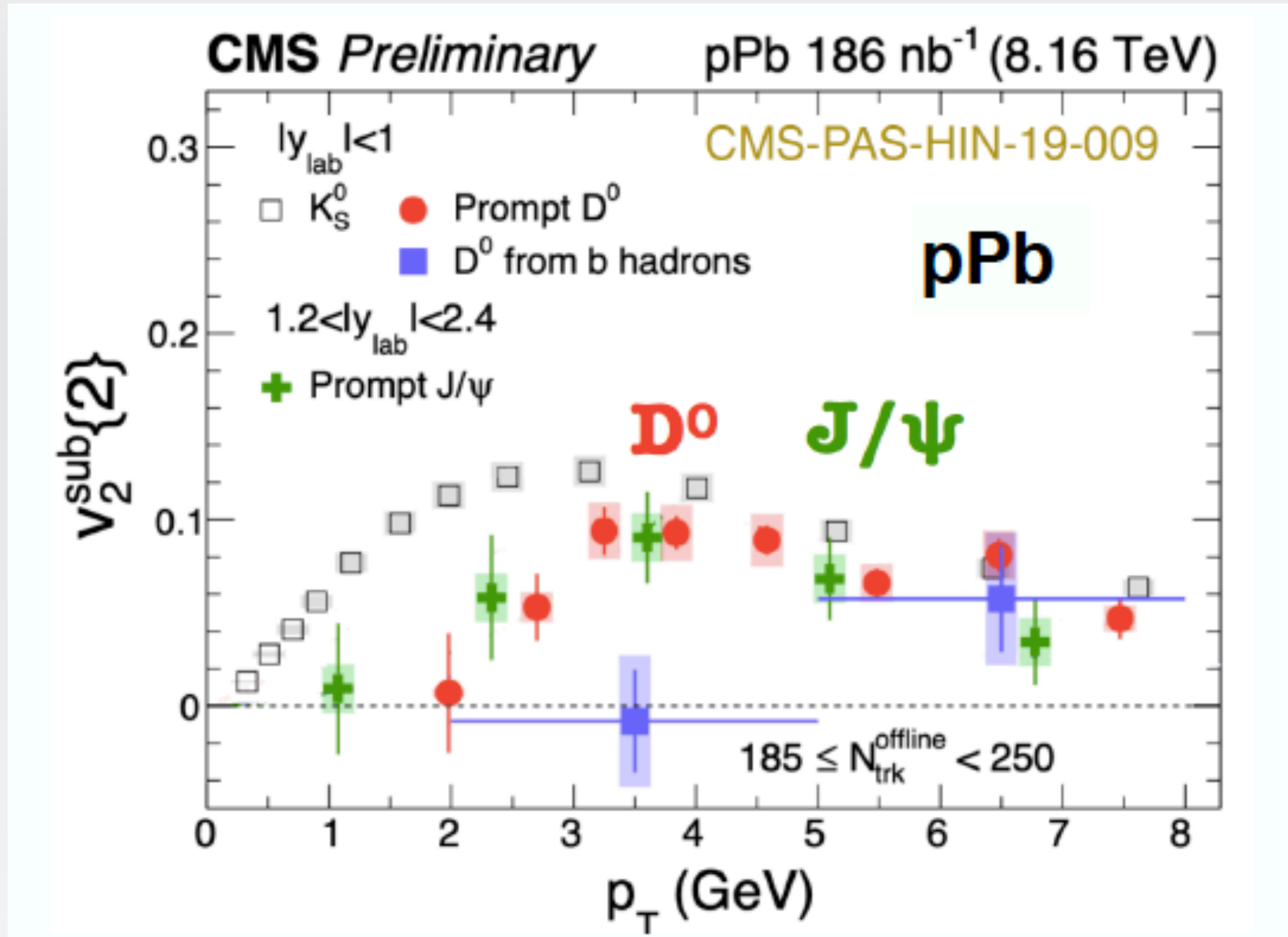
Collectivity



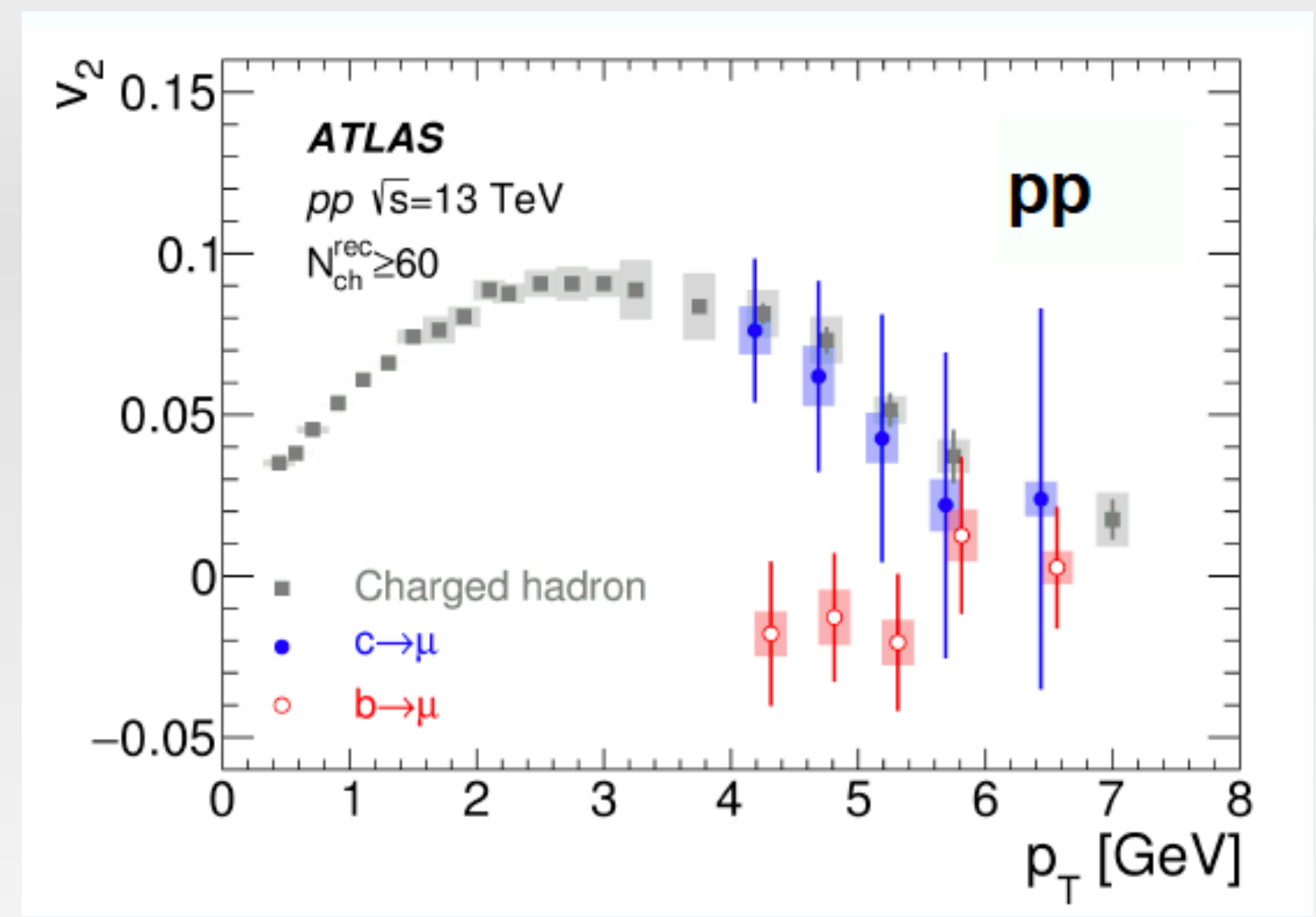
ALI-DER-337261

- Both **charm** and **beauty** flow in AA!
- Consistent with beauty HF electrons from ALICE

Collectivity - small systems



- **Charm** flows in high multiplicity pPb events
- **Beauty**: precision to be improved and need measurements at higher p_T

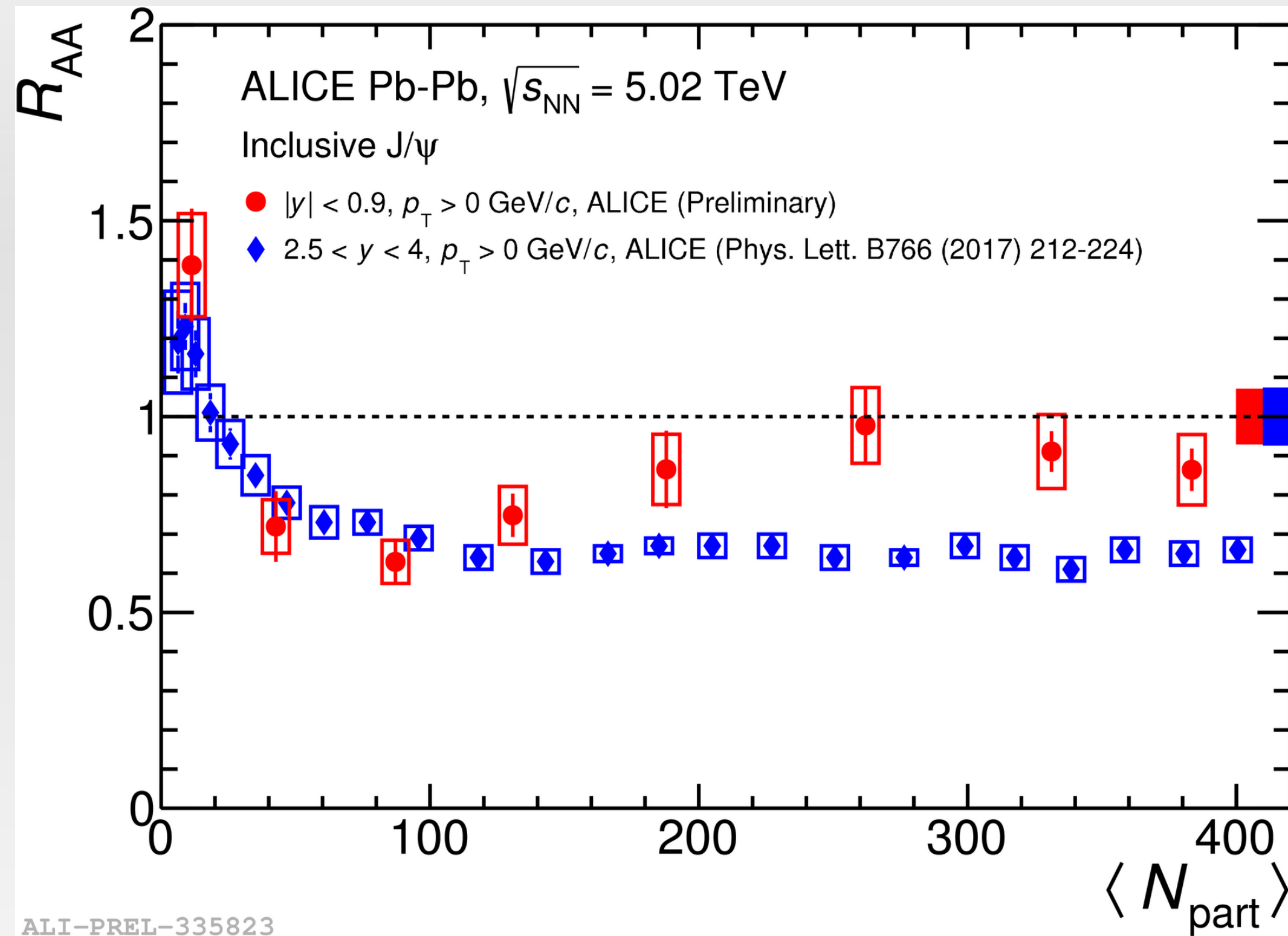


- **Charm** flows also in pp collisions at high mult
- **Beauty**: precision to be improved and need measurements at higher p_T

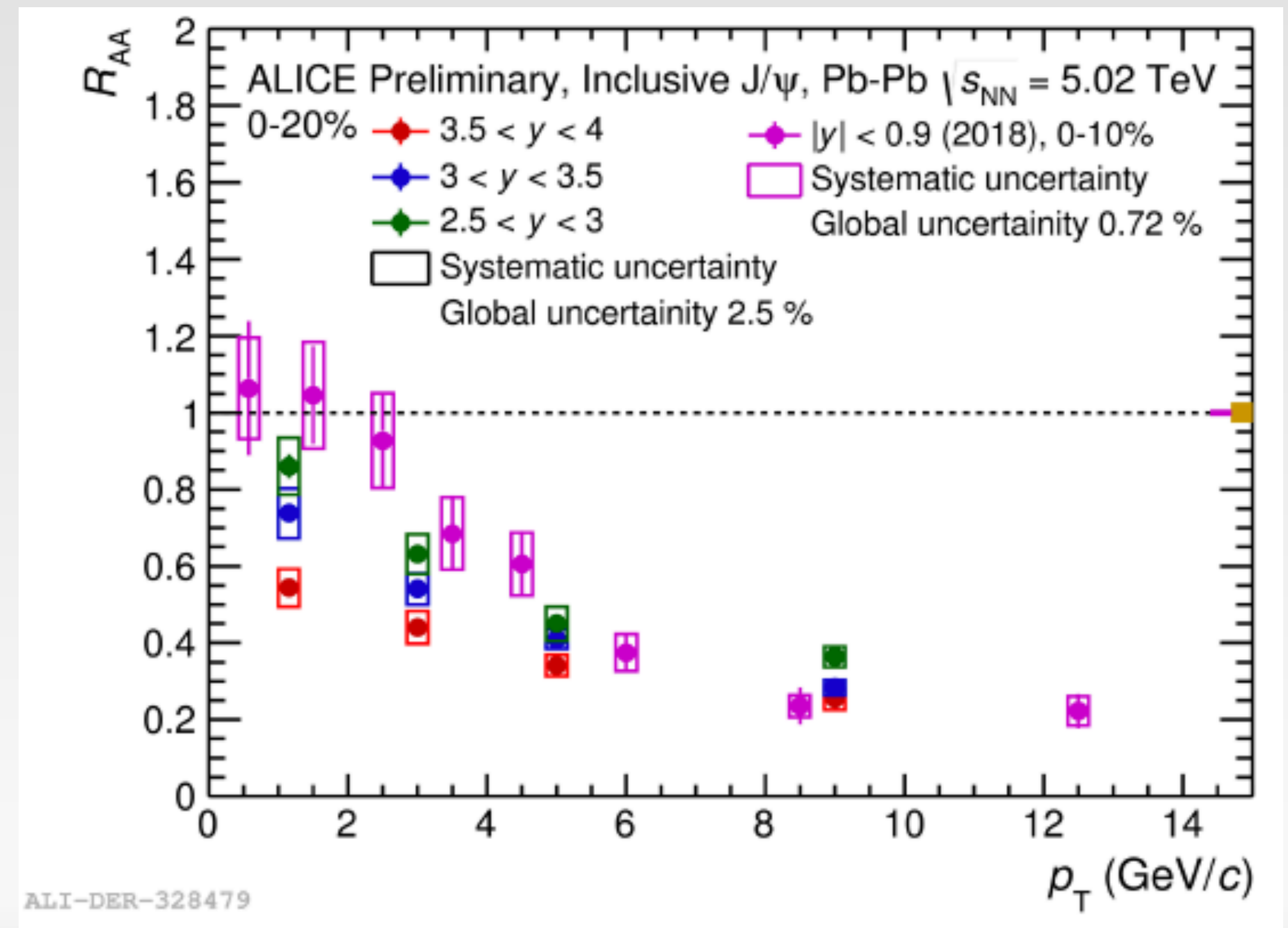
Quarkonia



ALICE



smaller suppression at **mid rapidity** w.r.t. **forward rapidity** — further support for (re)generation scenario!



Idea proposed before LHC started:

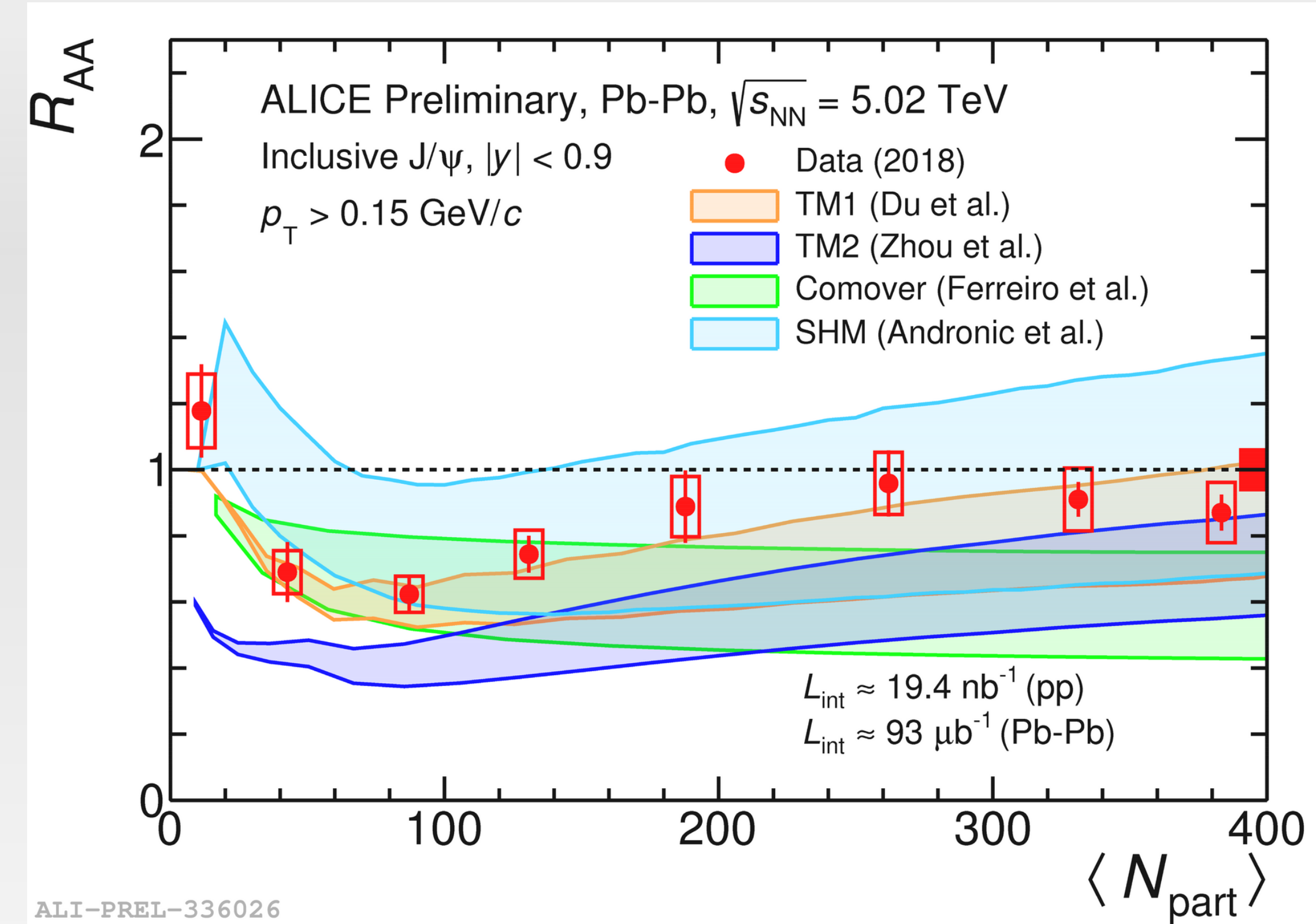
- (re)generation of charmonia
- requires abundance of charm quarks and deconfinement!

Braun-Munzinger, Stachel, Nature 448 (2007) 302-309

Quarkonia

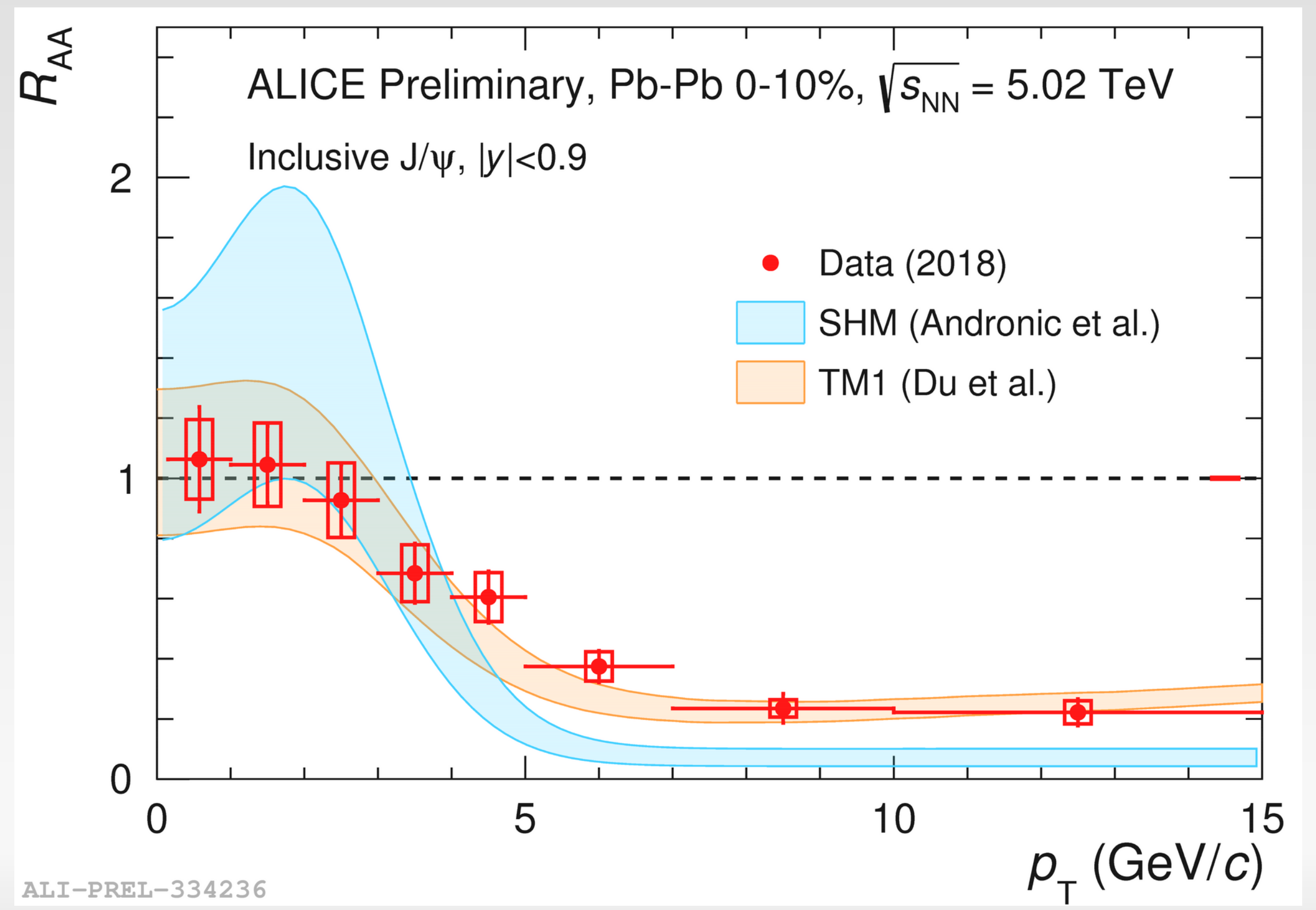


ALICE



- Large model uncertainties: shadowing, open charm cross section
- Progress on theory (and also experiment) needed for further conclusion

- Suppression at high p_T but not at low p_T
 - expected from (re)generation scenario
 - captured by models implementing dissociation and (re)generation



Conclusion

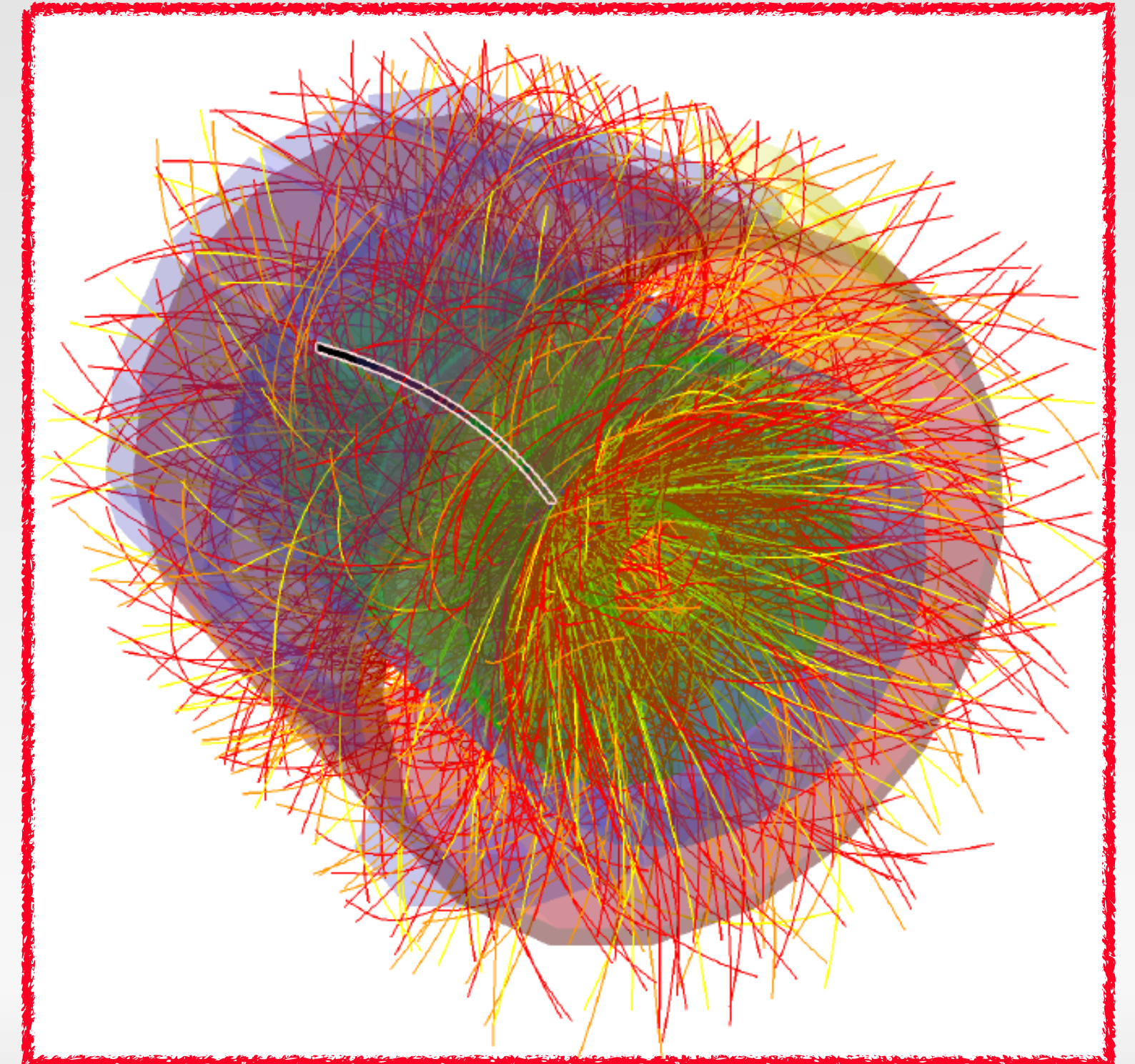


- Charm quarks help in investigating **different hadronization scenario**
- **First measurements with good precision about beauty flow in large and small systems**
- **Regeneration** important to explain $J/\Psi R_{AA}$

Conclusion

- Charm quarks help in investigating **different hadronization scenario**
- **First measurements with good precision about beauty flow in large and small systems**
- **Regeneration** important to explain $J/\Psi R_{AA}$

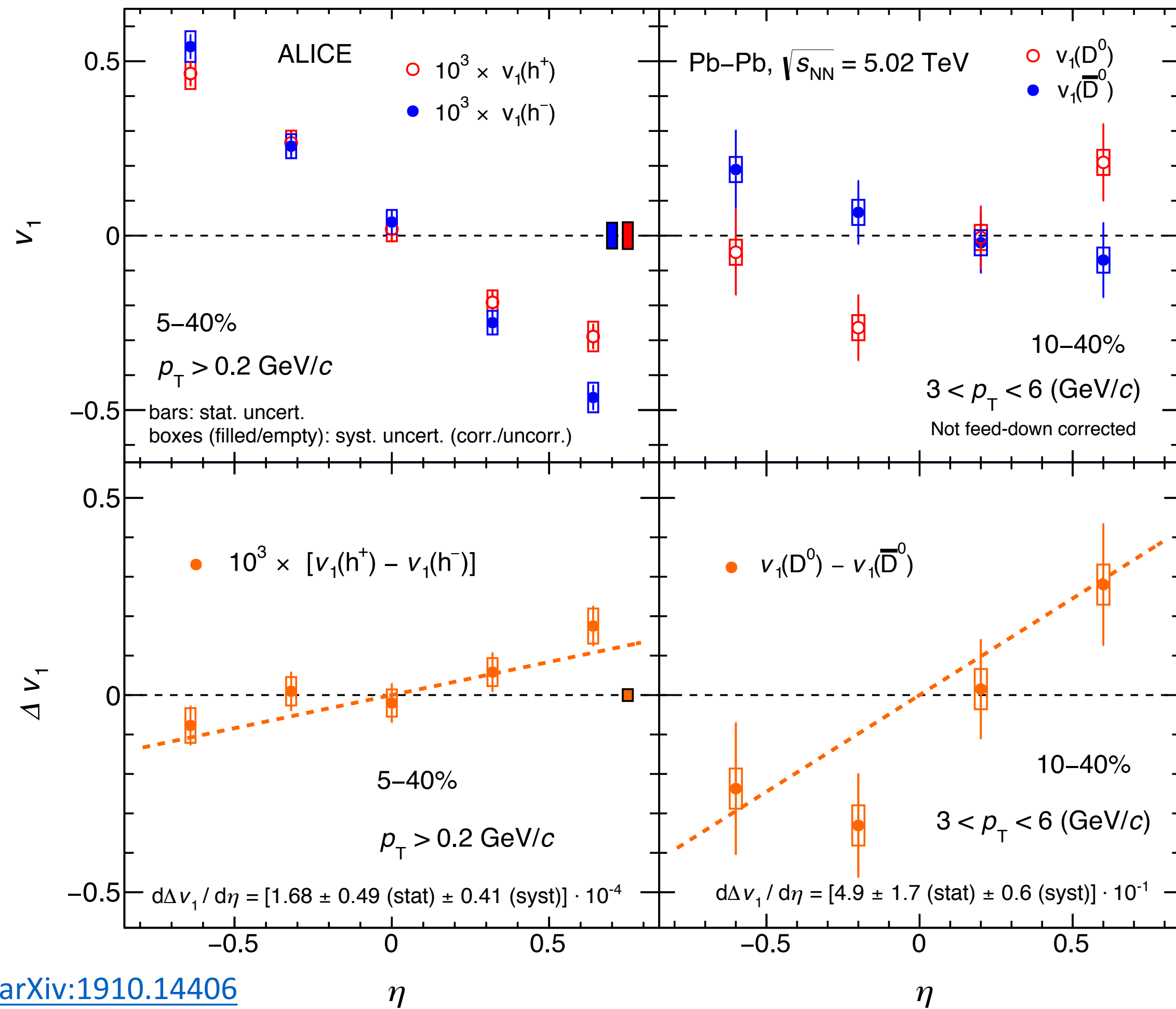
Thank you for your attention





Backup

Heavy flavour: a tool to study electromagnetic fields



[arXiv:1910.14406](https://arxiv.org/abs/1910.14406)

→ First measurements of charge dependent directed flow of light and heavy-flavour particles

- **3 orders of magnitude difference** between charged particles and heavy flavours predicted by theory are also experimentally accessible

- **effect of the early time magnetic field** and it will constrain fundamental and unexplored properties of the QGP (e.g. conductivity)