

# Session: Particle production & freezeout

## Topic that I would like to discuss: Multiplicity dependent particle production mechanism

Particle production & freeze-out

T2

- Does strangeness enhancement come from canonical suppression, strings or something else? Can we find an observable for this?
- Do we have a common or flavour-dependent freeze-out in small systems? What could be a reasonable check for this?
- How reasonable are fits from models (with freeze-out) to small systems?

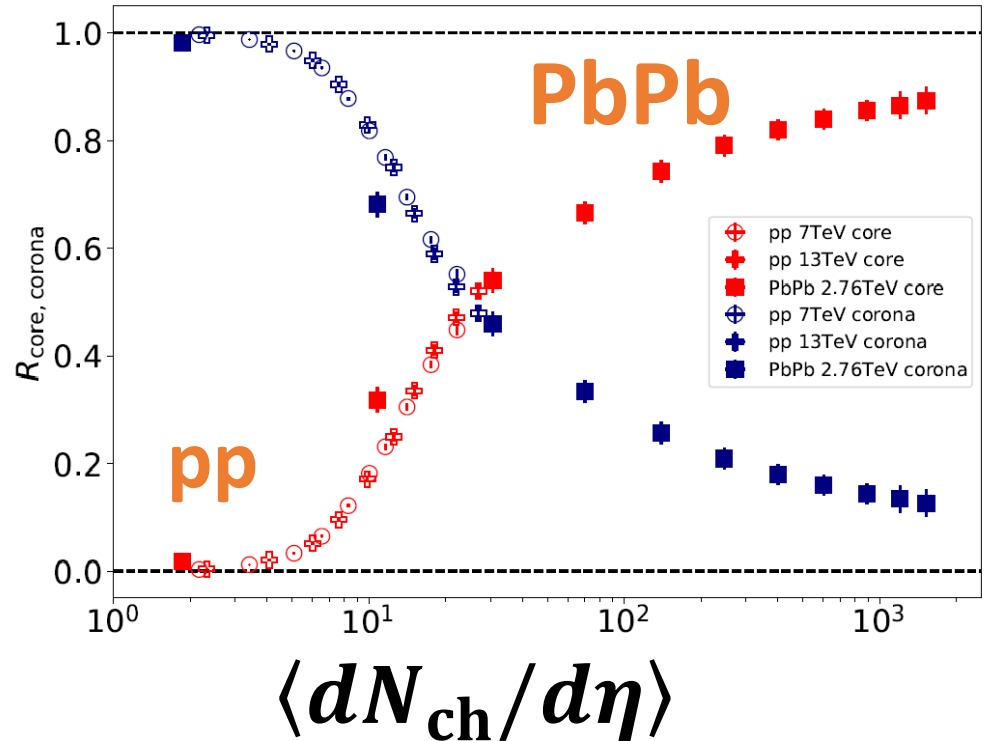


~~Do we have equilibrated matter (QGP) in small systems?~~

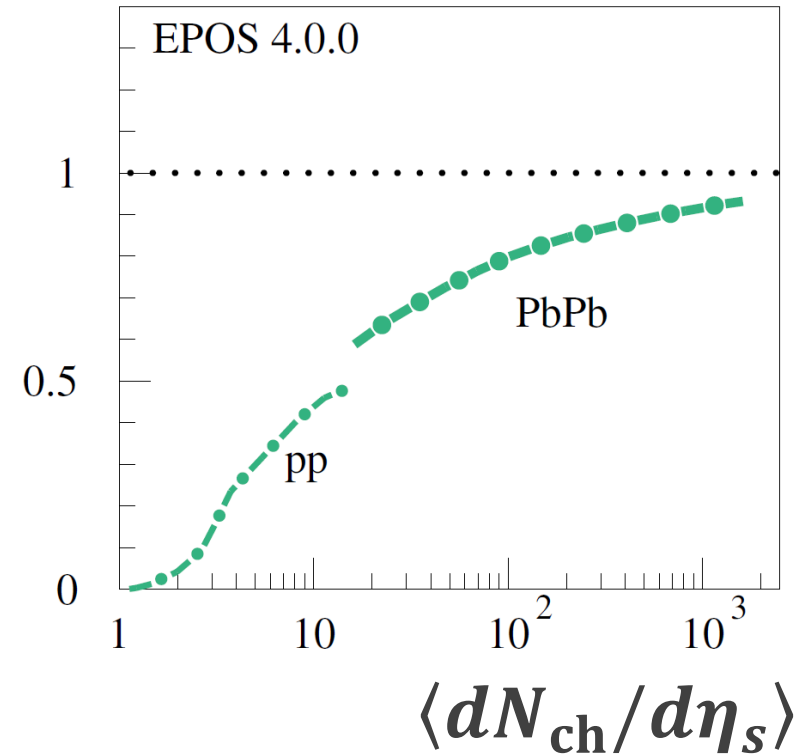
Is it equilibrium (QGP) or far-from equilibrium (string)?  
... or both?

# Particle production is from both equilibrated and non-equilibrated systems!

Y. Kanakubo *et al.*, Phys. Rev. C 106 (2022) 5, 054908  
Y. Kanakubo *et al.*, Phys. Rev. C 105 (2022) 2, 024905



2301.12517



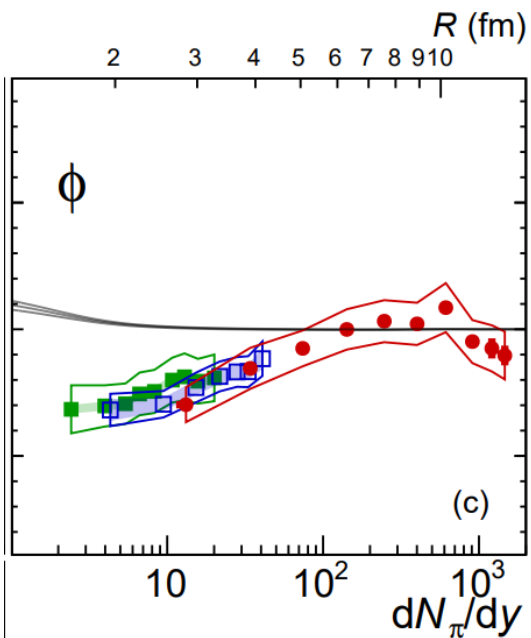
Separation of core-corona with conservation of incoming energy-momentum

# Purely thermal or thermal + non-thermal

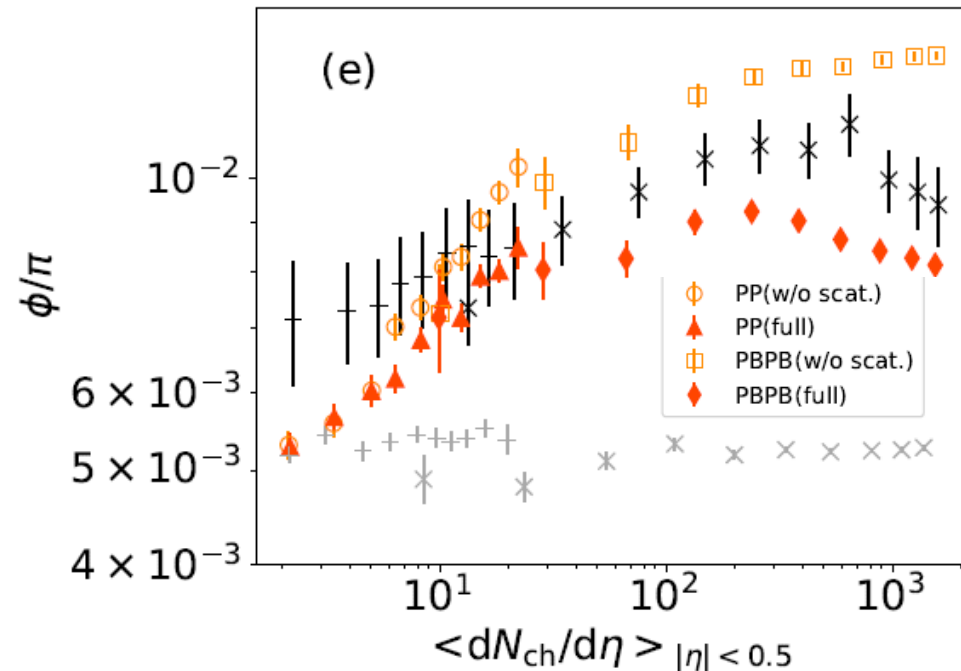
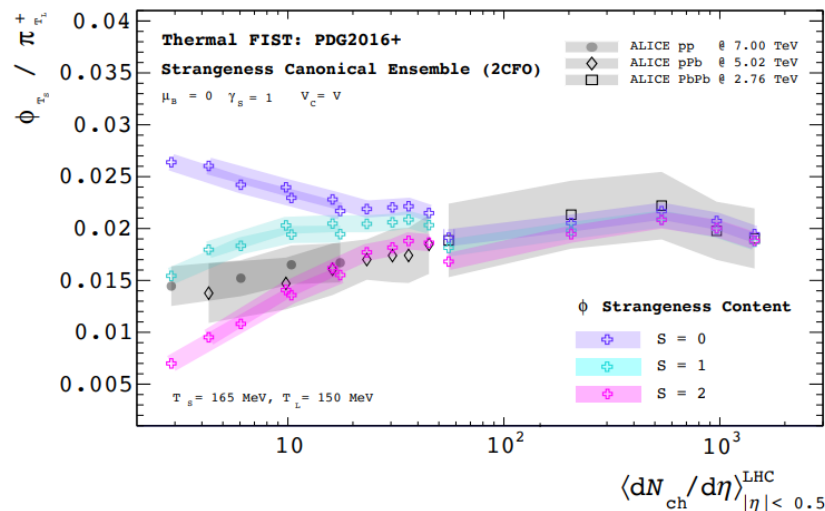
1807.11321

SHM

Core-corona 2108.07943

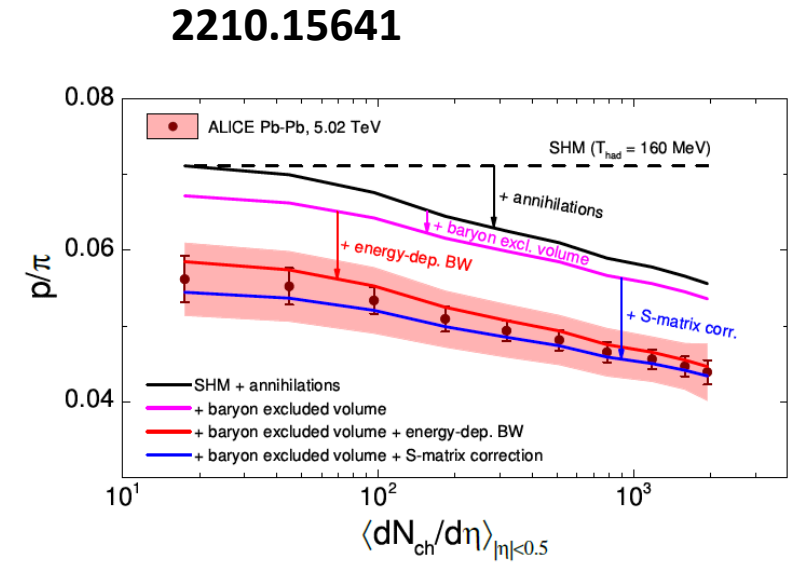
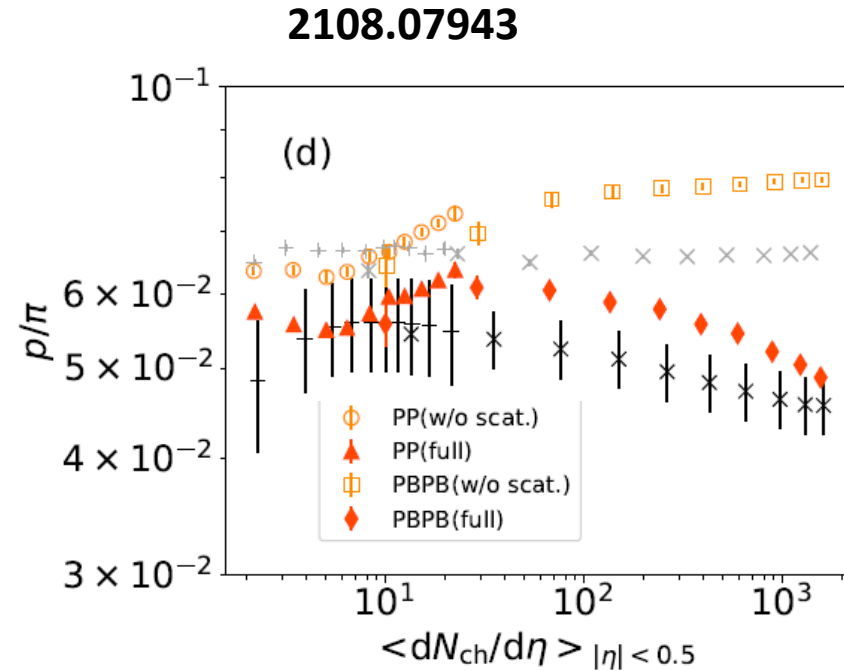
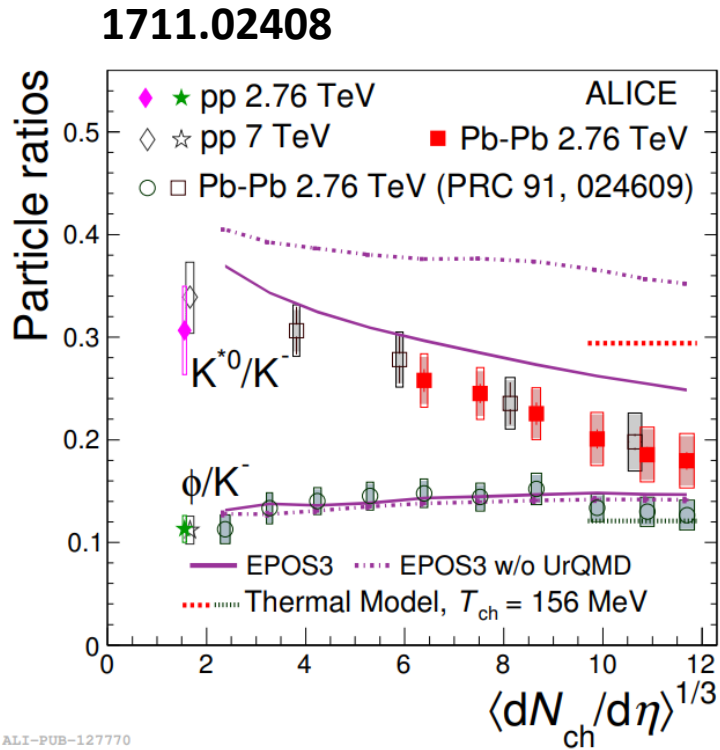


2109.09843



Is volume dependent freeze-out temperature enough, or do we still need far-from non-equilibrium components?

# Is hadronic rescattering crucial picture?



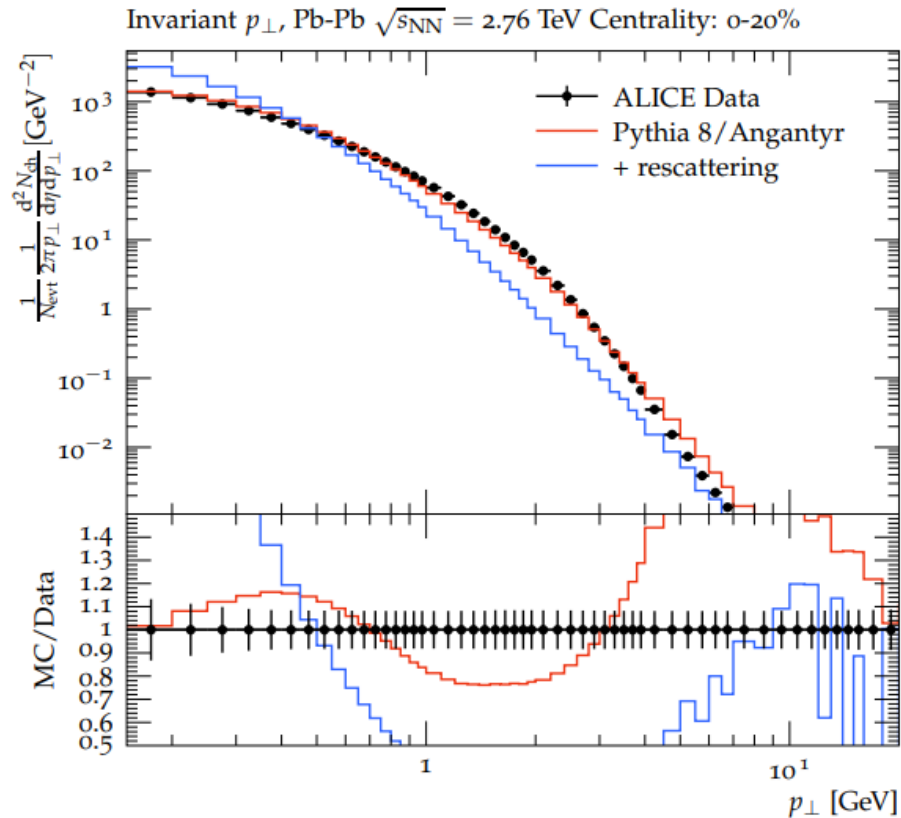
ALI-PUB-127770



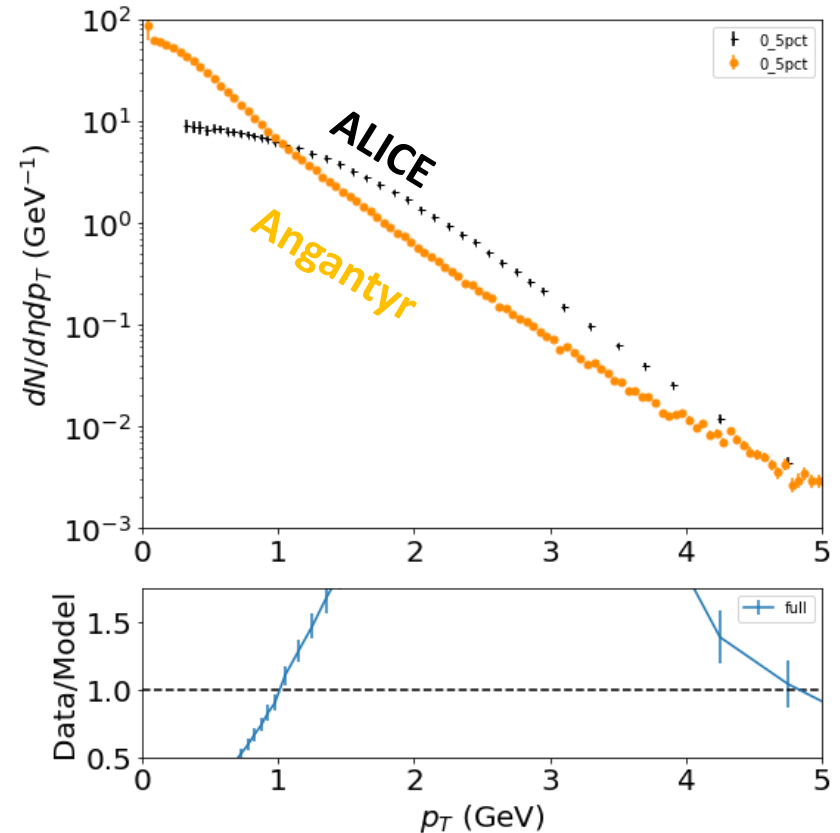
Do we agree that final particle ratios (slightly) deviates from statistical value?

# Thermal spectra from string fragmentation?

2103.09665  
Charged particle



Proton and anti-proton

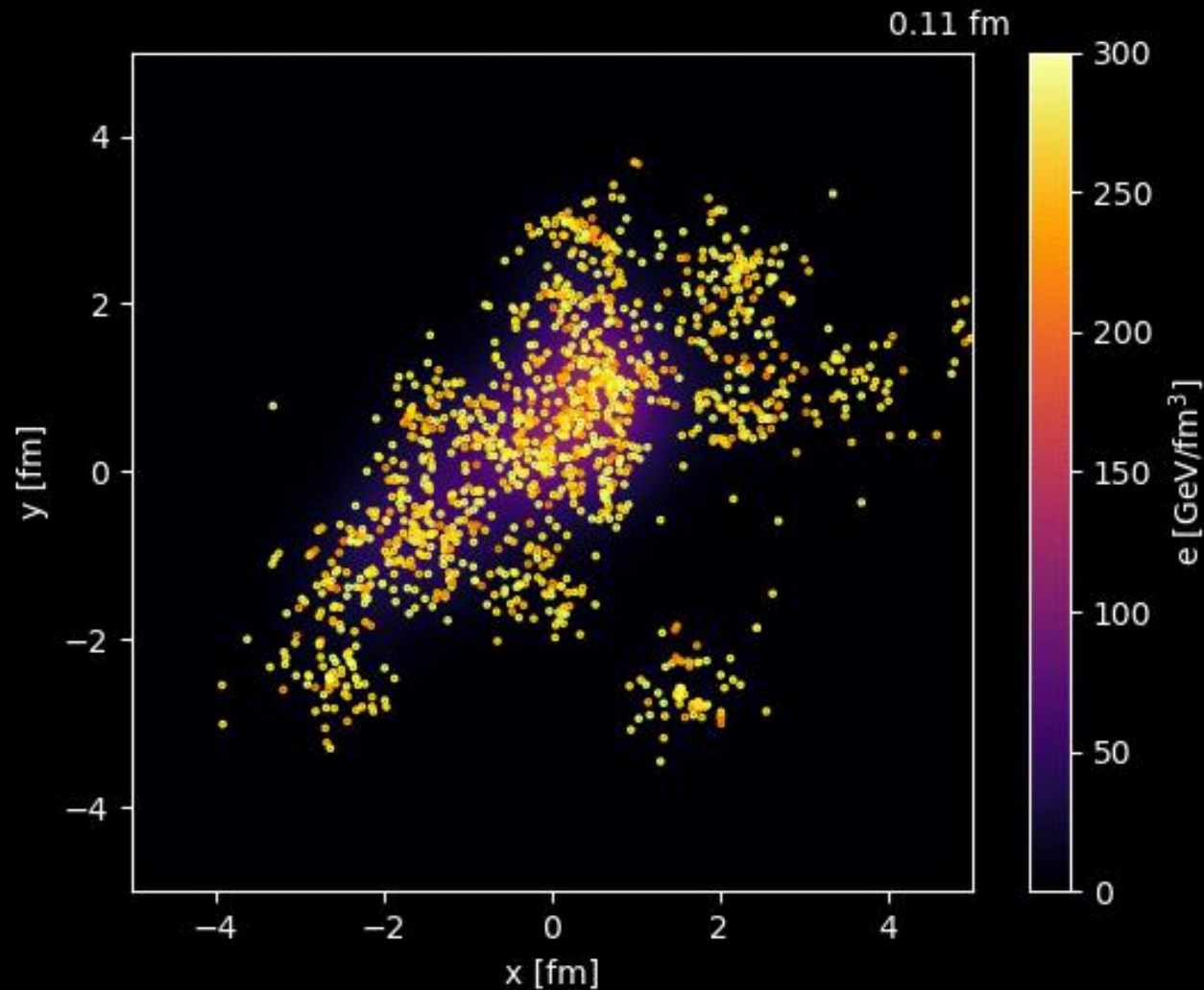


Particle production in heavy-ion collisions  
should be thermal

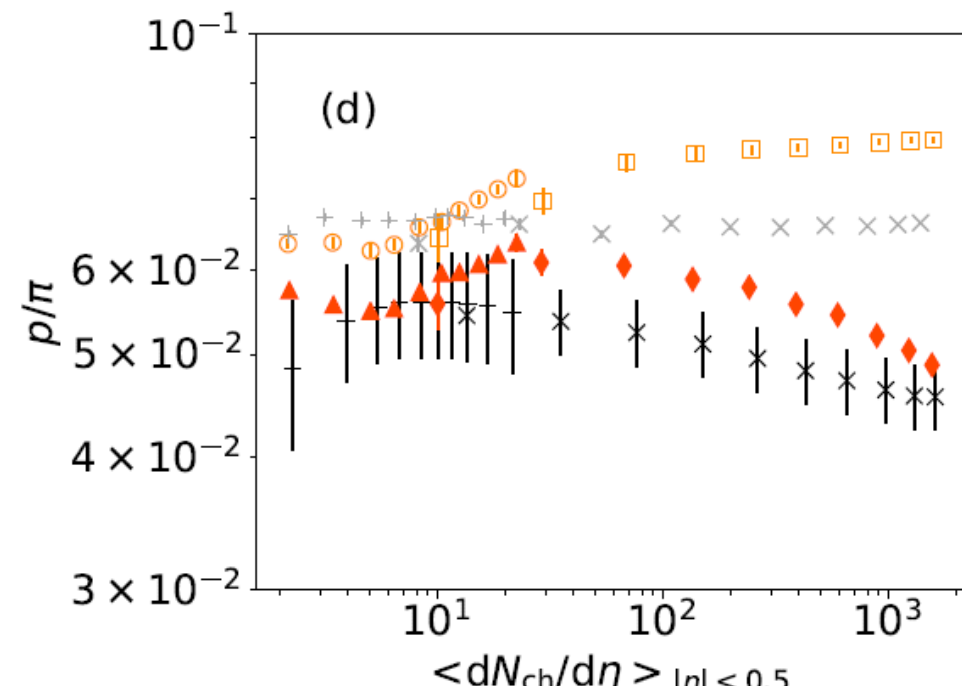
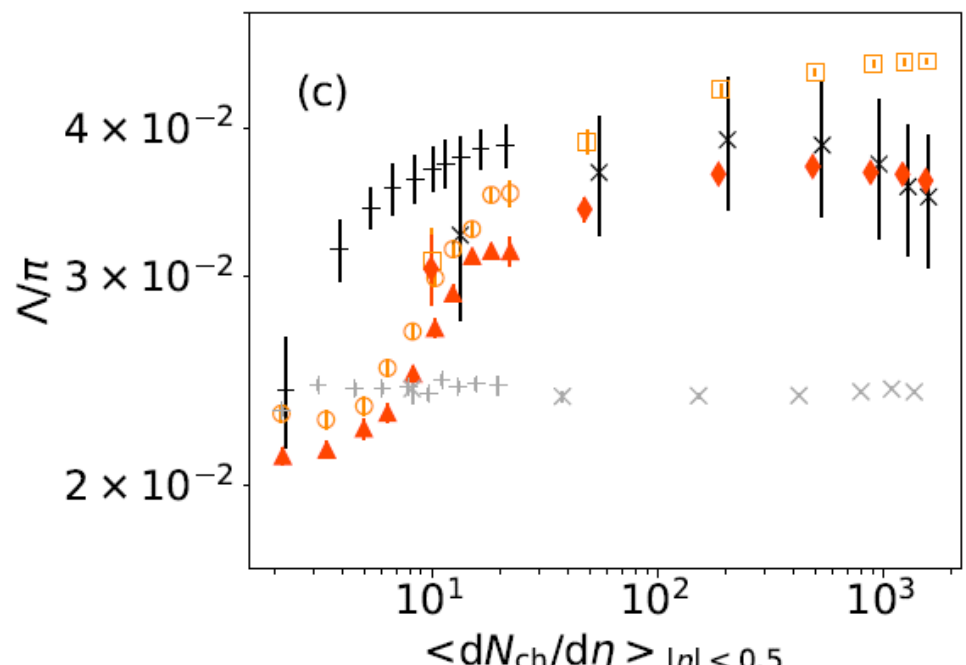
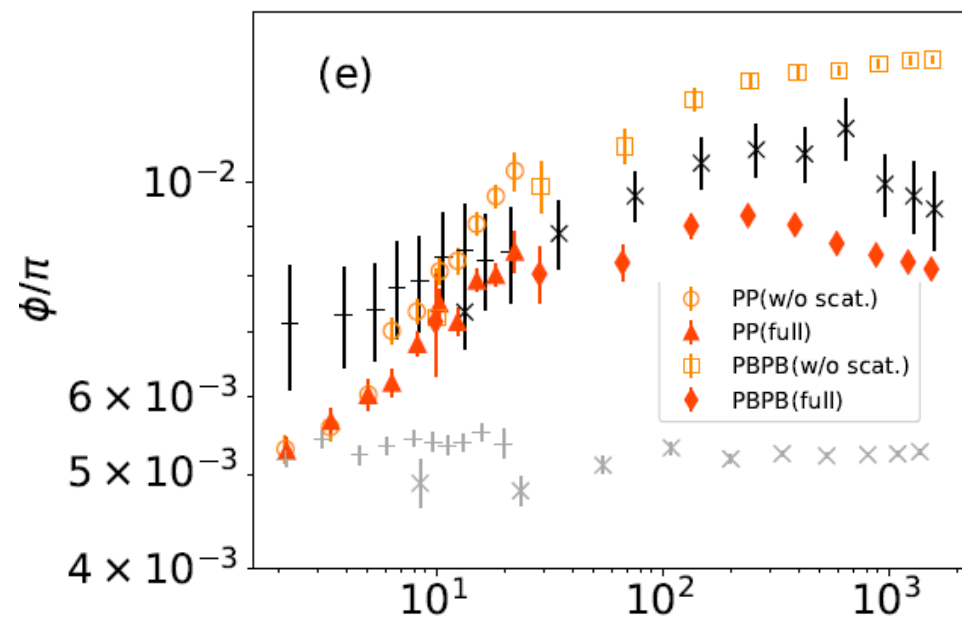
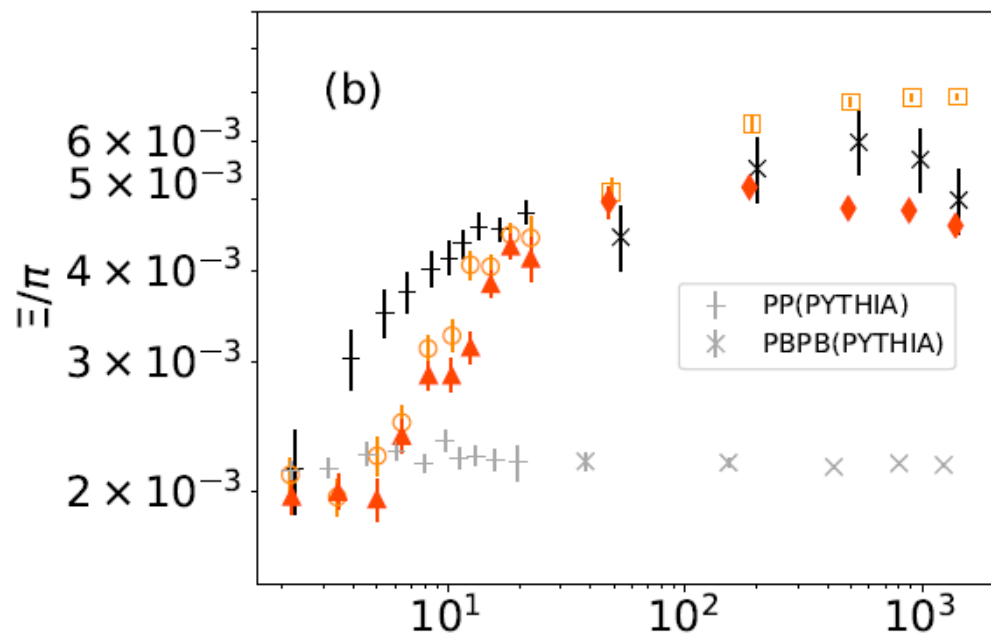
**Backup**

# Dynamical initialisation based on core-corona

Y. Kanakubo *et al.*, *Phys. Rev. C* 105 (2022) 2, 024905 Y. Kanakubo *et al.*, *Phys. Rev. C* 106 (2022) 5, 054908

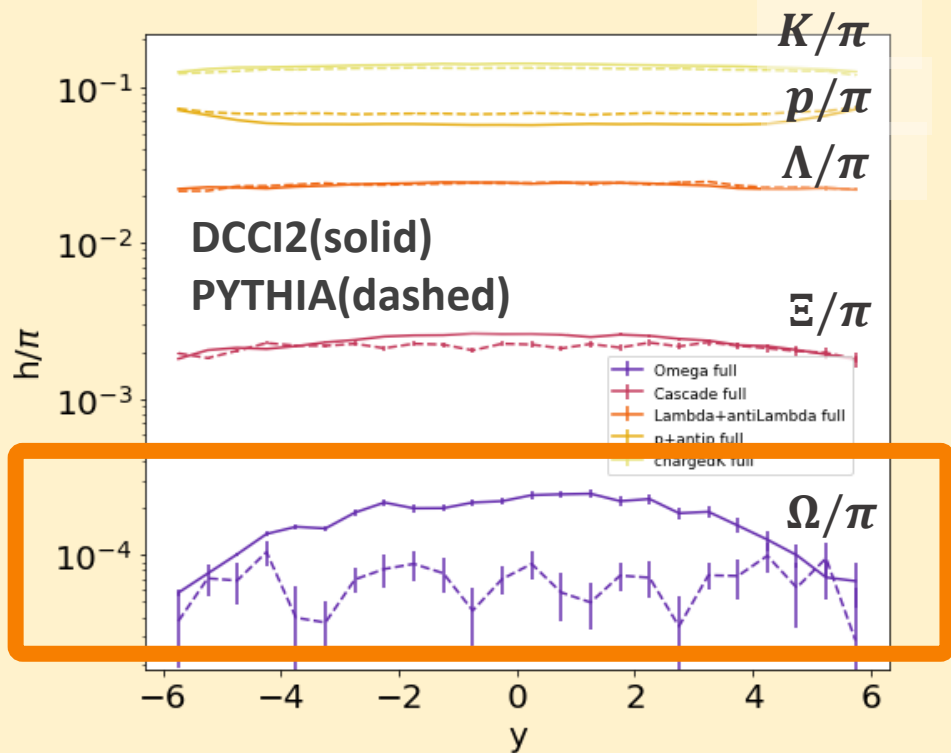


**Core: hydro, Corona: PYTHIA (Angantyr)**



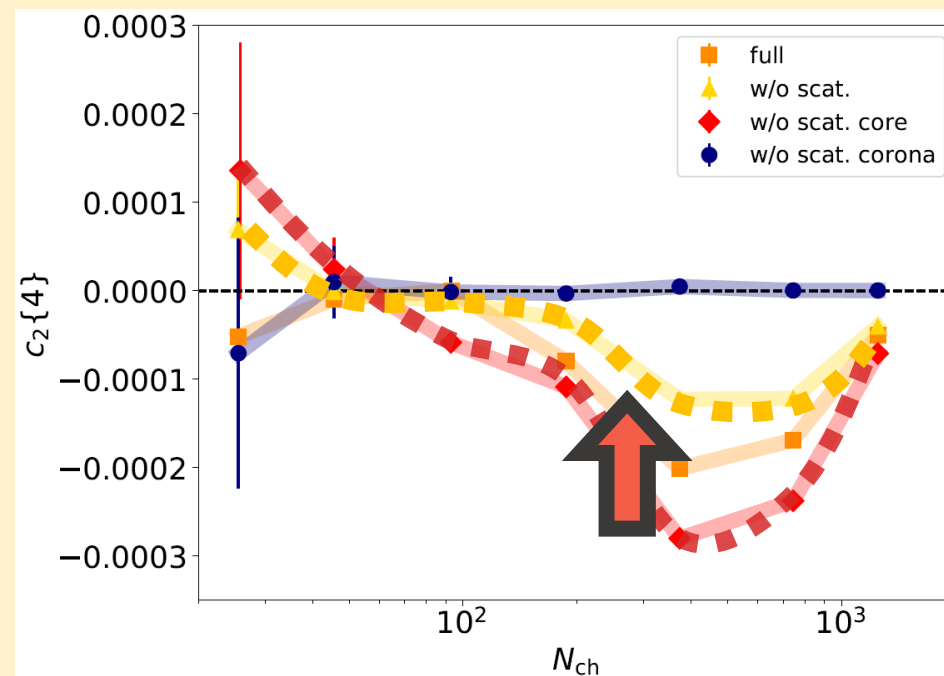


## $\Omega/\pi$ enhancement in MB pp



3-4 times larger in mid than forward rapidity

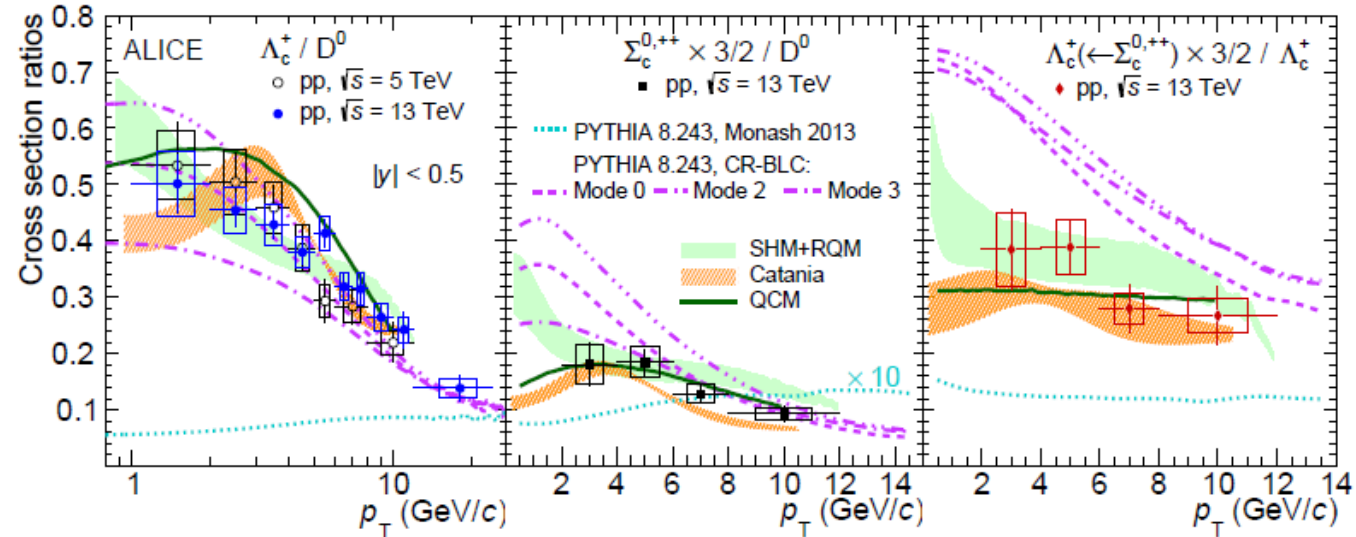
## Corona correction on $c_2\{4\}$ in PbPb



$$c_2\{4\}_{\text{core}} \neq c_2\{4\}_{\text{tot}}$$

→ Flow from hydro calc. should never be compared to exp. data as long as corona exists

# What I want to know about SHM



2106.08278

How general can SHM describe experimental data in small systems? (light flavor  $p_T$  spectra etc.)

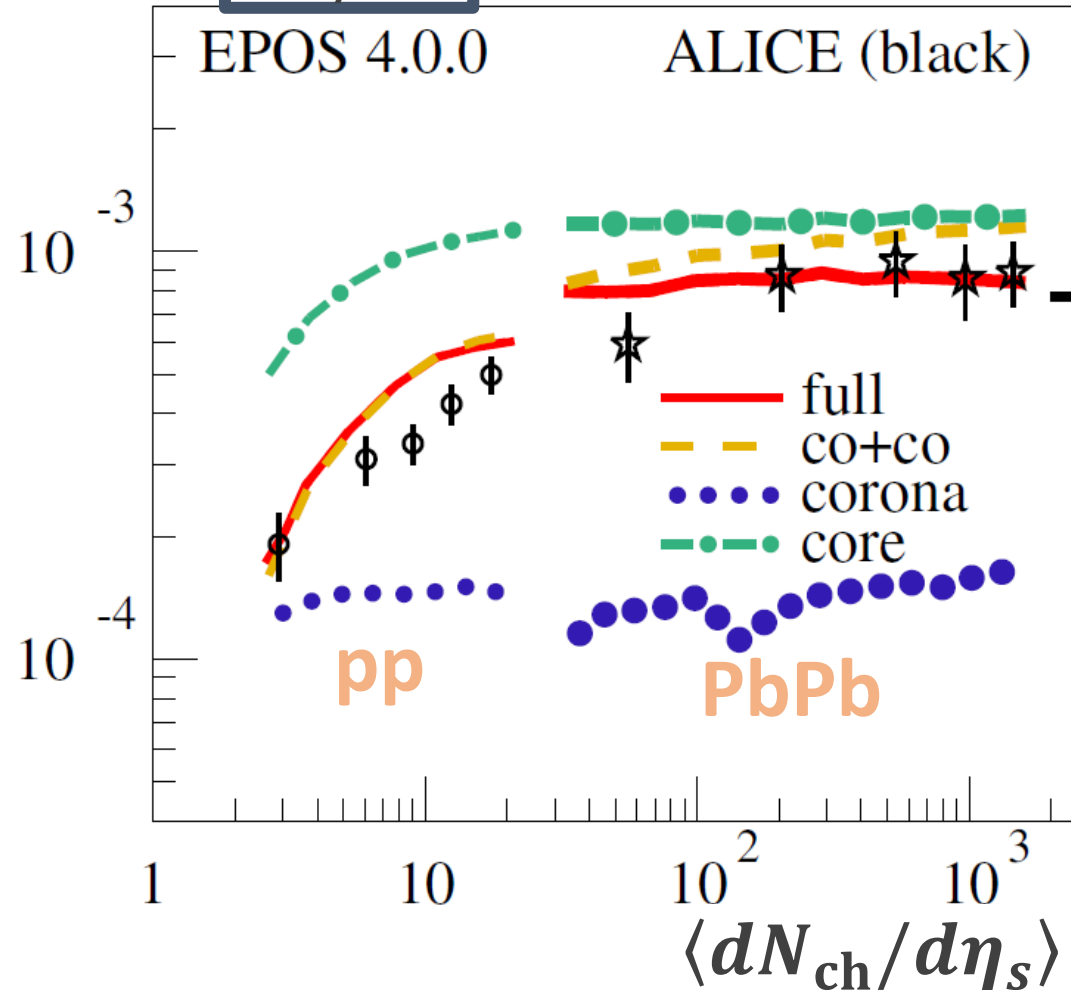
If one can describe pp with SHM, what does it tell?

$$T_H? \gamma_{s/c}? V?$$

# Core-corona picture

$\Omega/\pi$

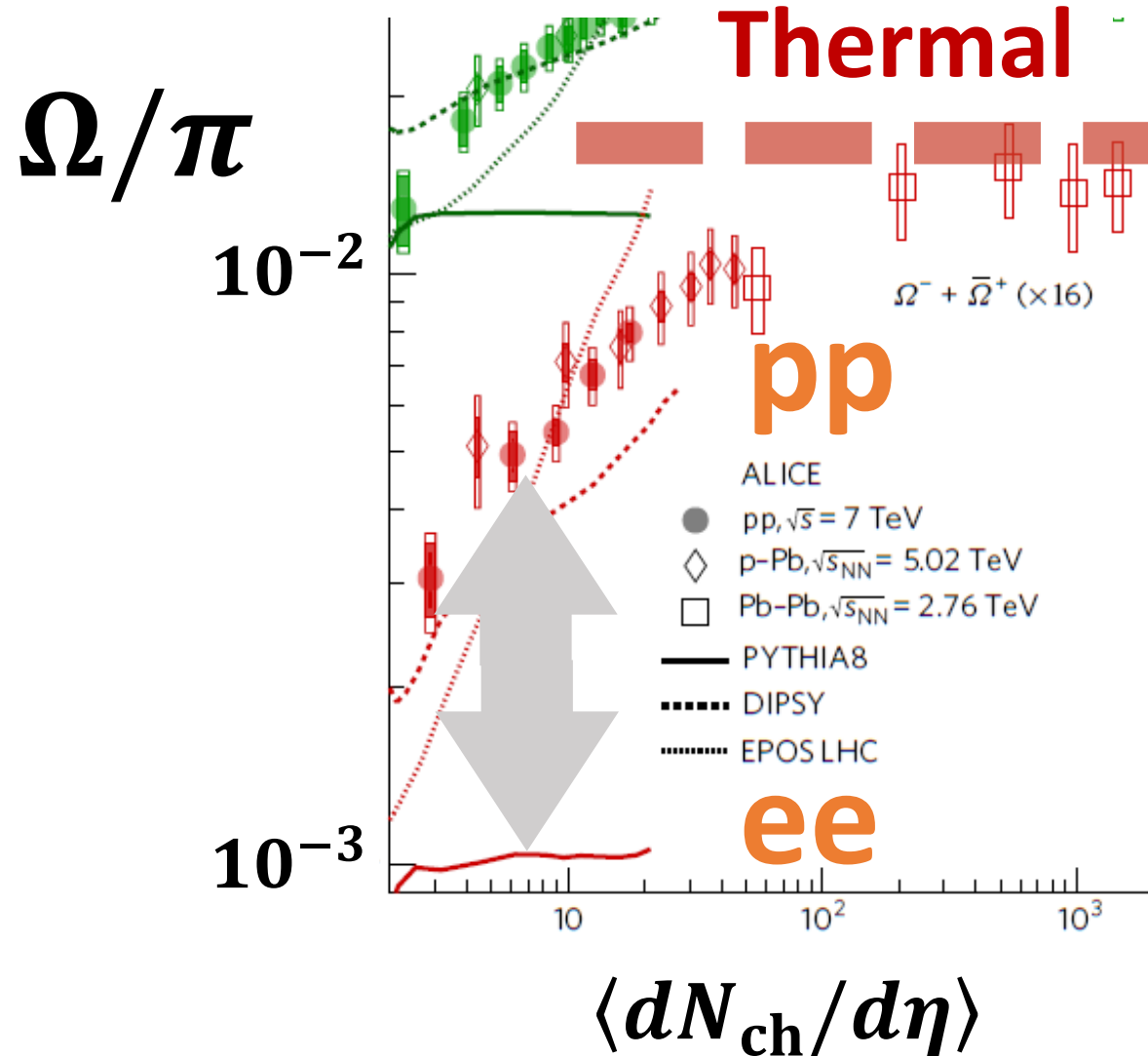
K. Werner, arXiv: 2301.12517 [hep-ph]



Strangeness enhancement

→ Multiplicity dependent  
QGP formation in initial stage

# What kind of particle production mechanism is in small systems?



- Particle productions are not purely from thermal in pp even in high multiplicity events

