Identified Particle Production in O + O collisions at $\sqrt{s_{NN}}$ = 200 GeV using EPOS4

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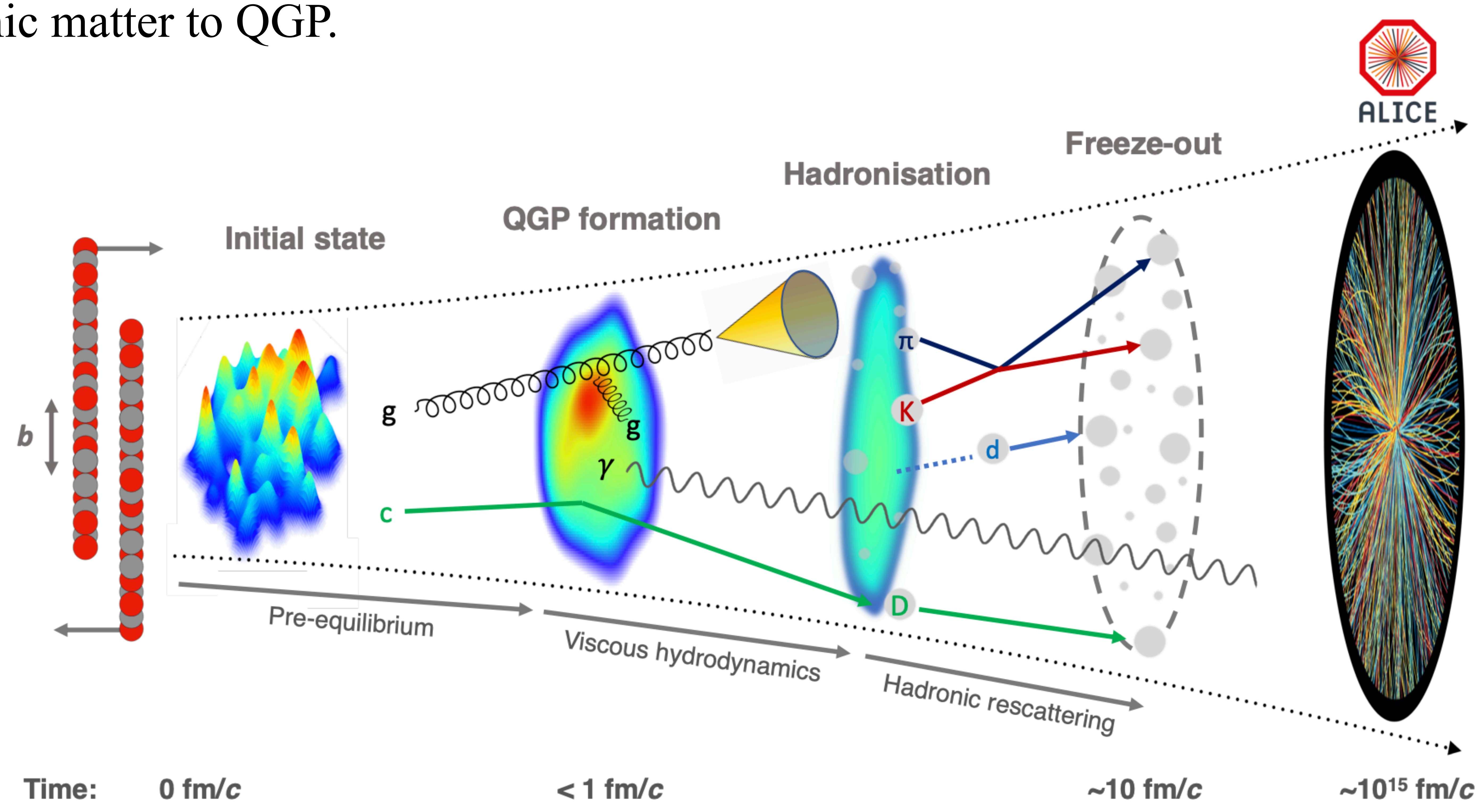
Outline

- Introduction: Heavy-Ion Collisions
- Motivation
- Results:
    - Charge Particle Multiplicity
    - p_{T}-Spectra
    - Integrated Yield (dN/dy) and $\langle p_T \rangle$
    - Ratios
- Summary

Introduction: Heavy Ion Collisions

- ***What are Heavy-Ion Collisions?***
  High-energy collisions between nuclei to create conditions similar to those just after the Big Bang.
- ***Objective***: To study the Quark-Gluon Plasma (QGP), a state of matter where quarks and gluons are deconfined.
- ***Importance***: Helps understand the strong interaction (QCD) and the phase transition from hadronic matter to QGP.

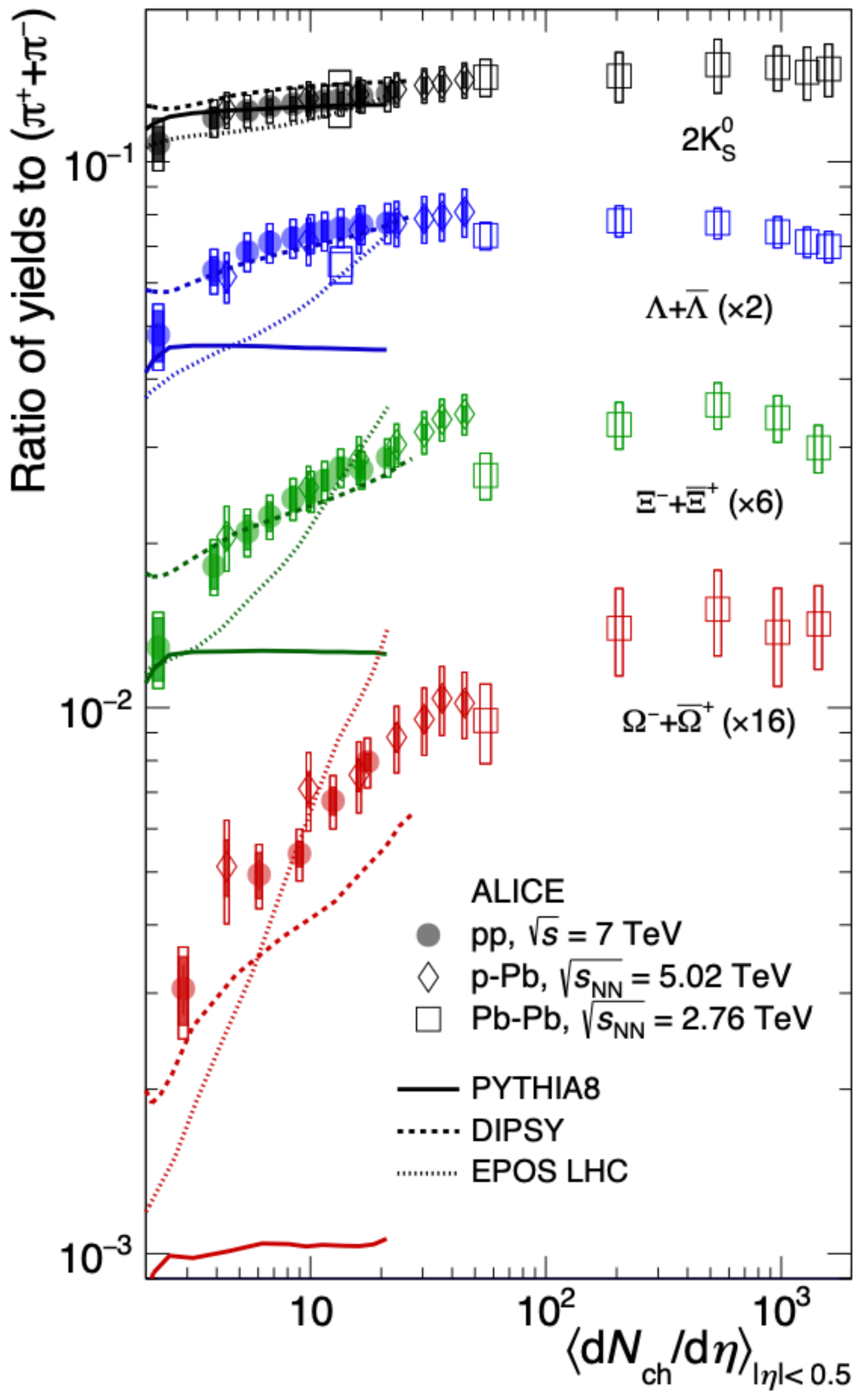


The evolution of a heavy-ion collision at LHC energies

S. Acharya et al., ALICE, Eur. Phys. J. C 84 (2024)

Motivation

- A smooth increase in the ratio of strange hadron production to the pion yield as a function of multiplicity has been found in various collision systems (p+p, p+A, A+A).



Nature Phys **13**, 535–539, ALICE, 2017

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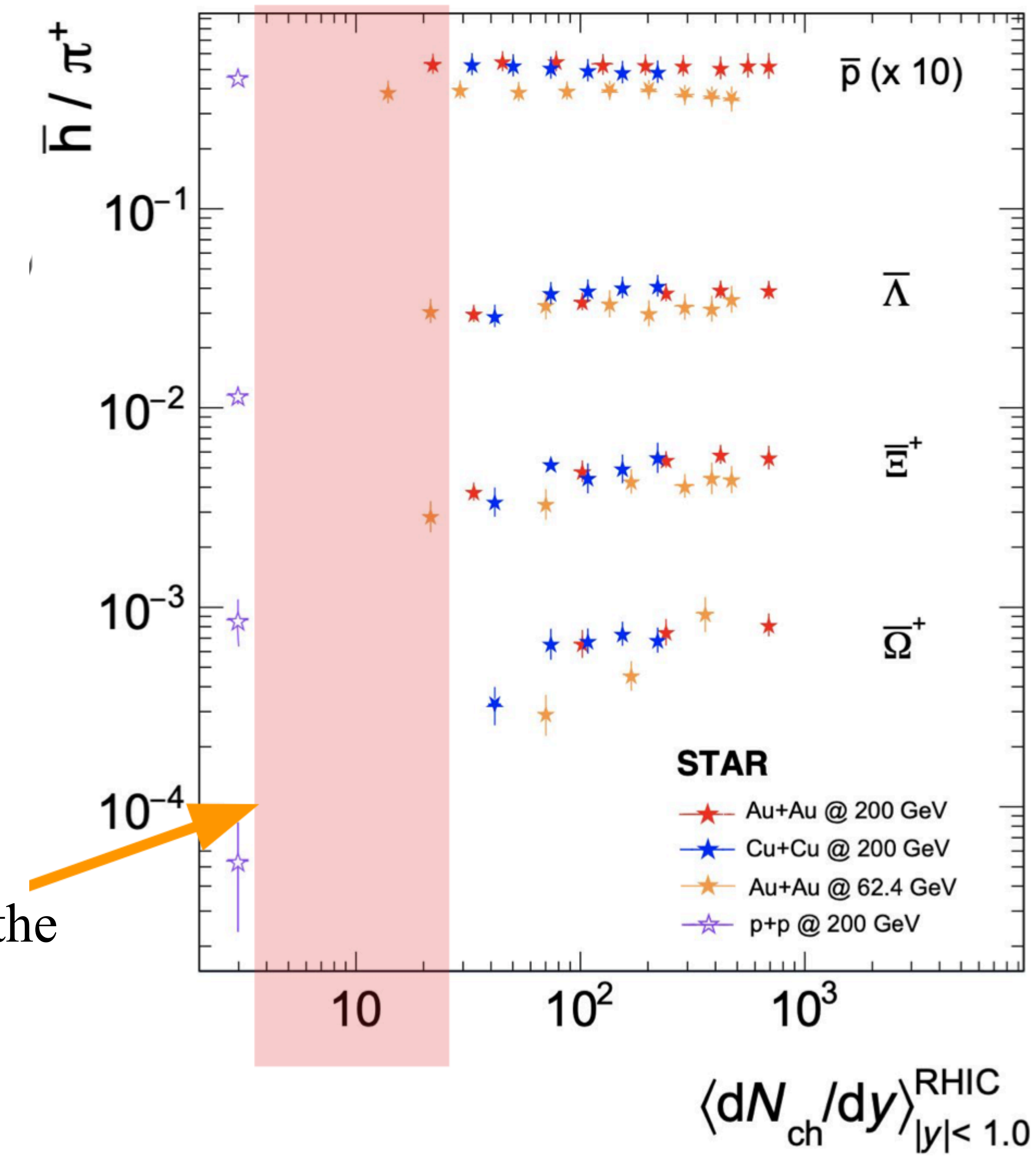
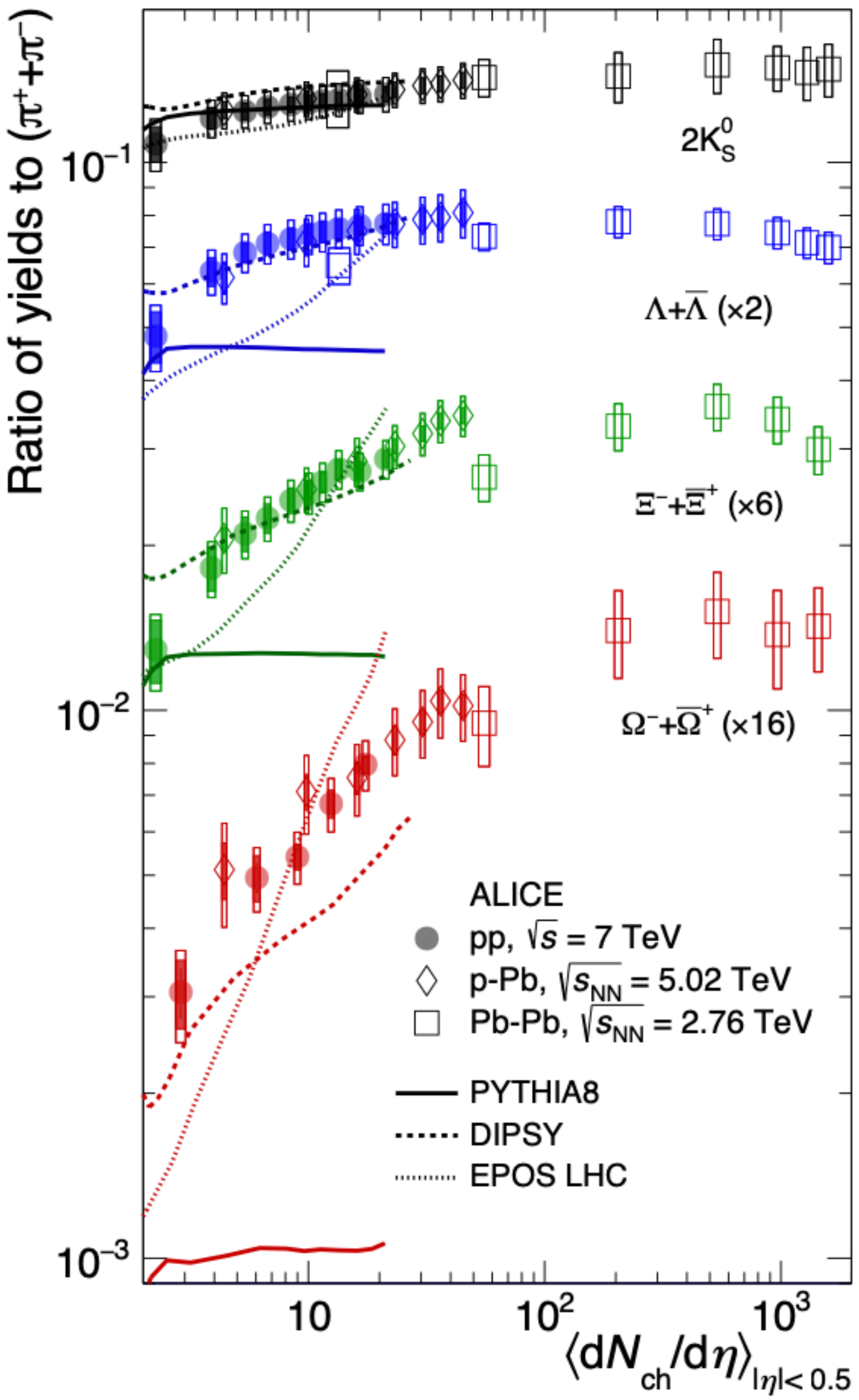
  - STAR has reproduced these ratios.





- However, there is a notable data gap in the low multiplicity region

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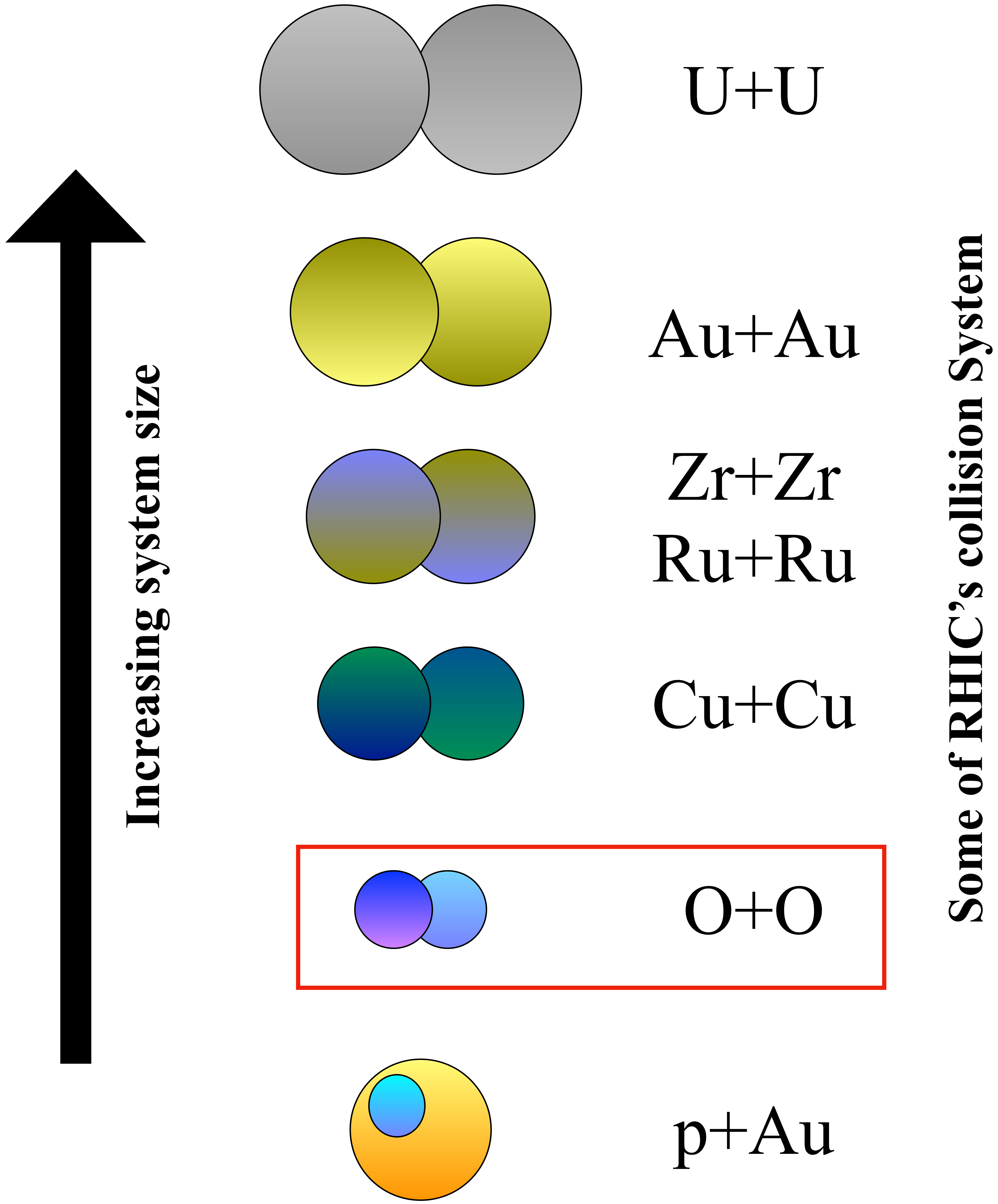
- Oxygen is one of the smallest ions used at RHIC.
  - Fill in the hyperon to pion ratio in the low multiplicity gap
  - Allows a more straightforward geometry mapping with centrality than those asymmetric small system collisions like He+Au, or d+Au



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- Oxygen is one of the smallest ions used at RHIC.
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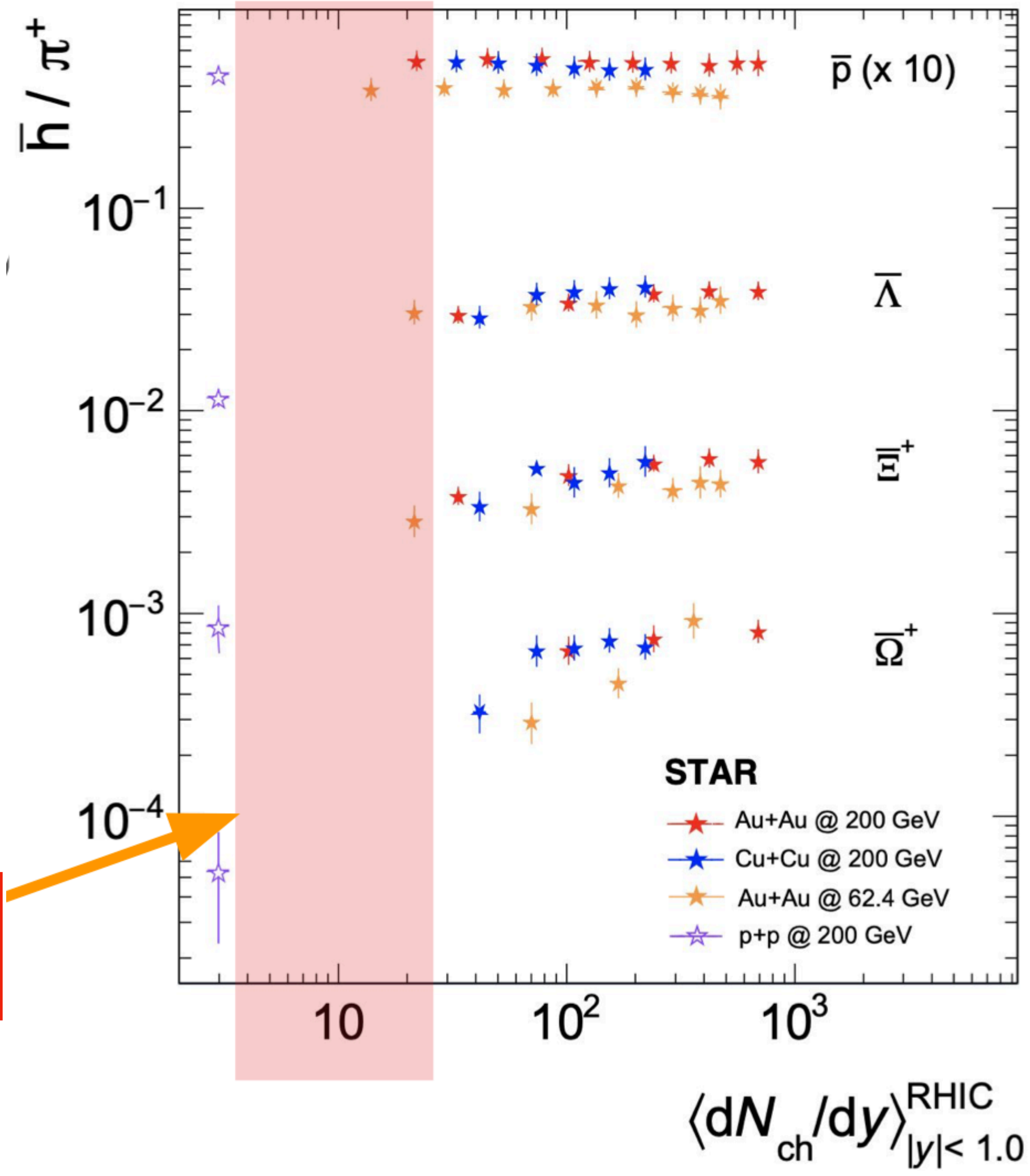
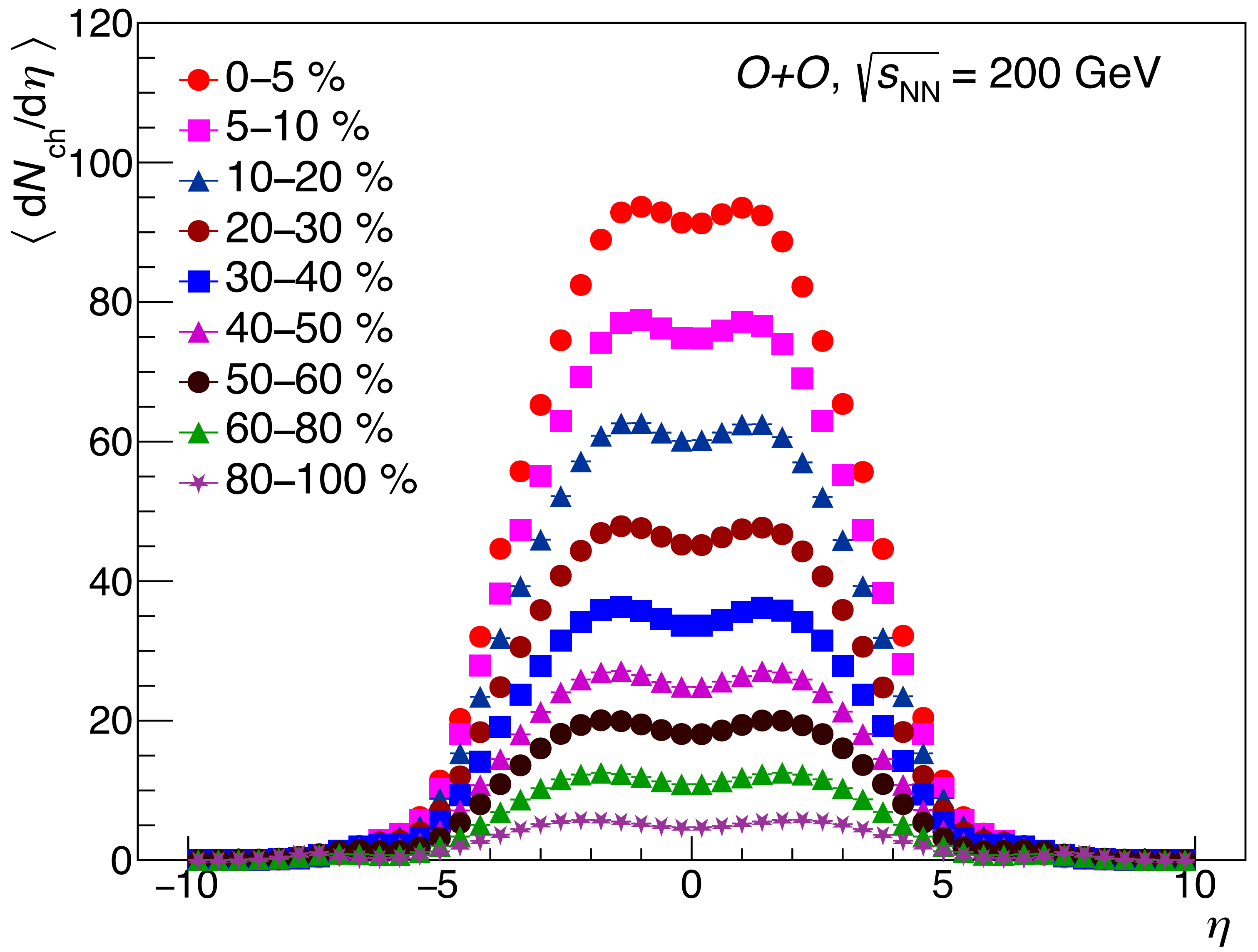
  - O+O multiplicity can extend to this un explored region

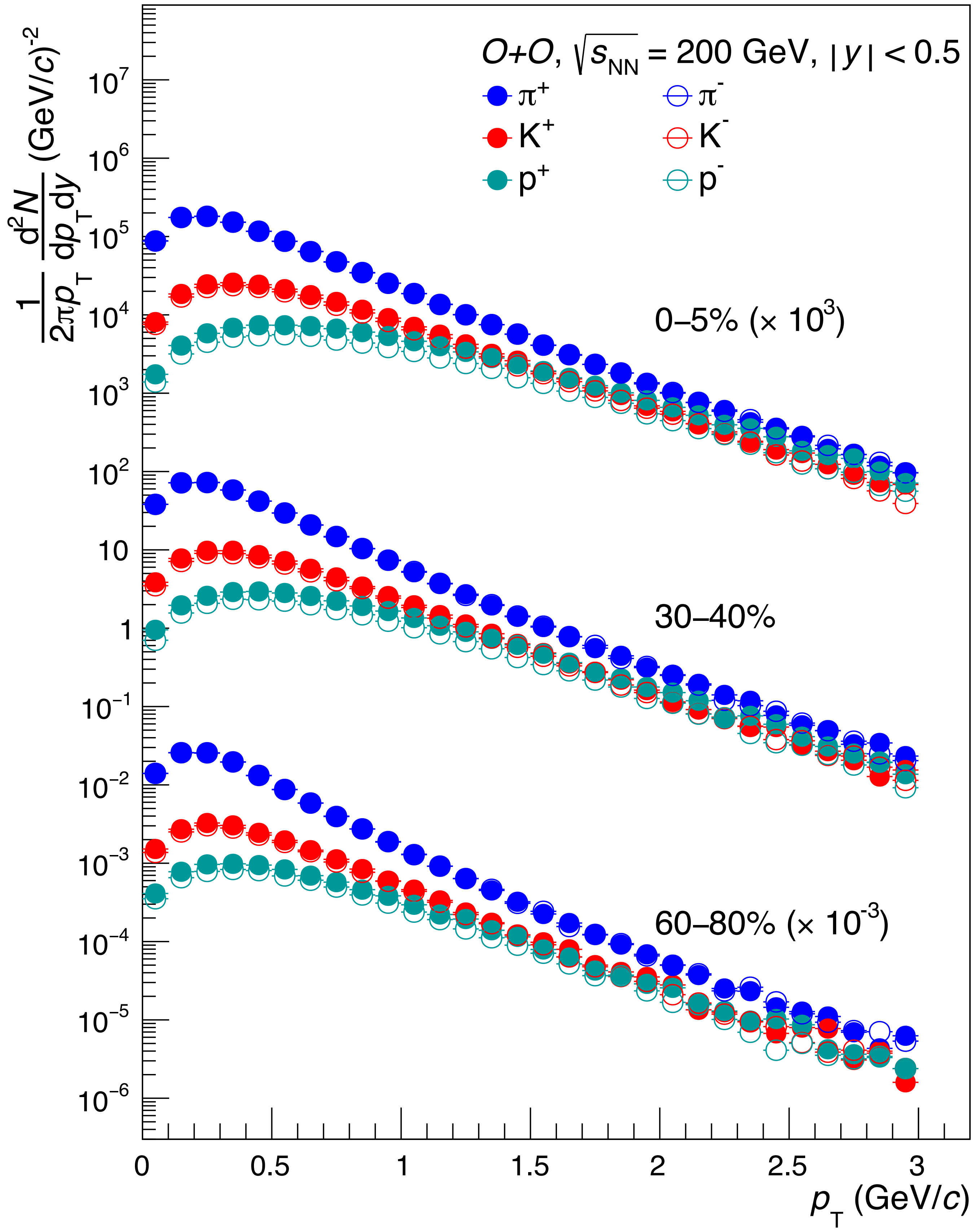


Results

Multiplicity distributions and p_T-Spectra



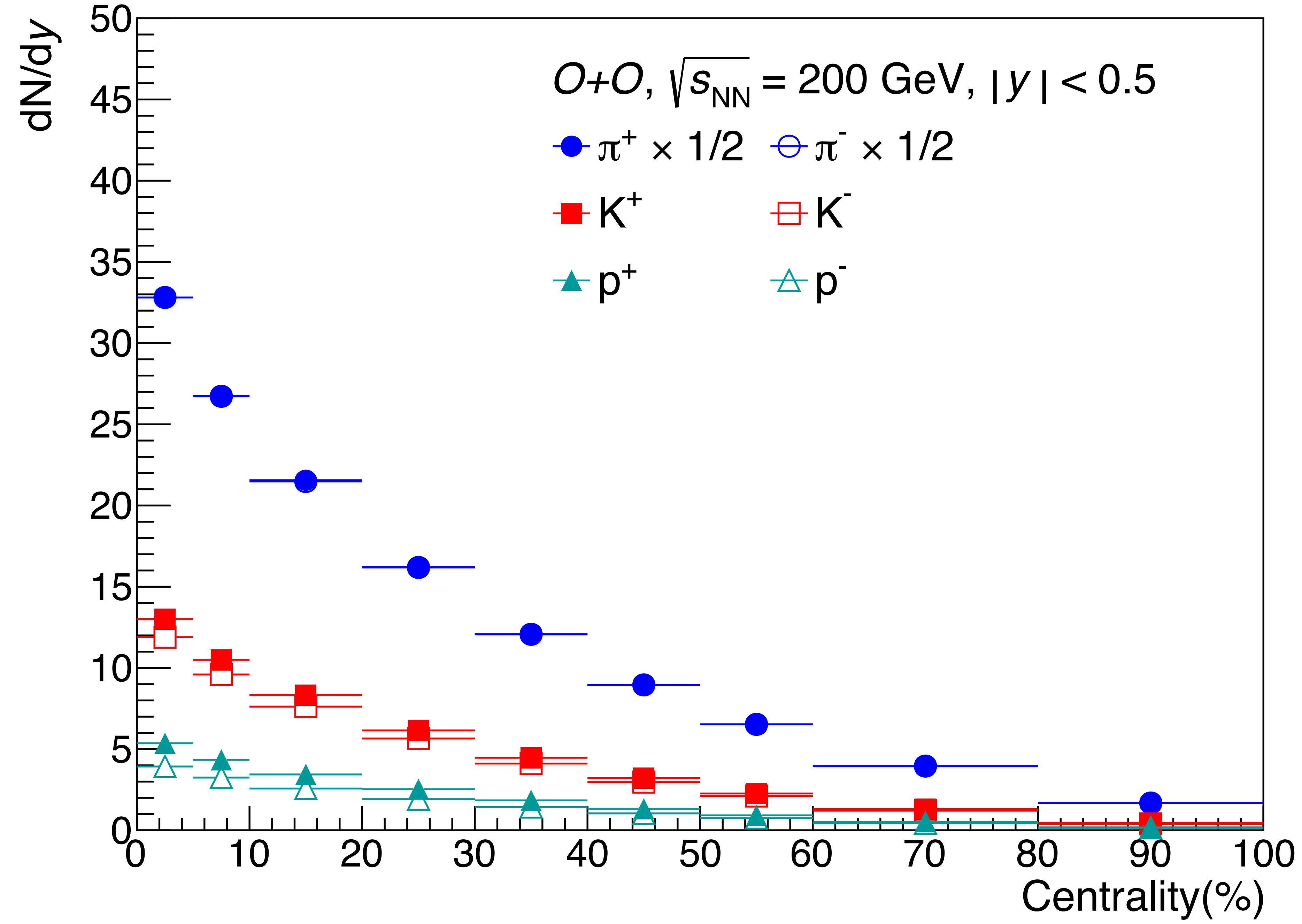
- Pions: lightest hadrons - most abundance
- Low-p_T : Mass-dependent behavior (identified)
- Intermediate-p_T: Spectra converges; due to radial flow effects
- Steeper slope: heavy particles

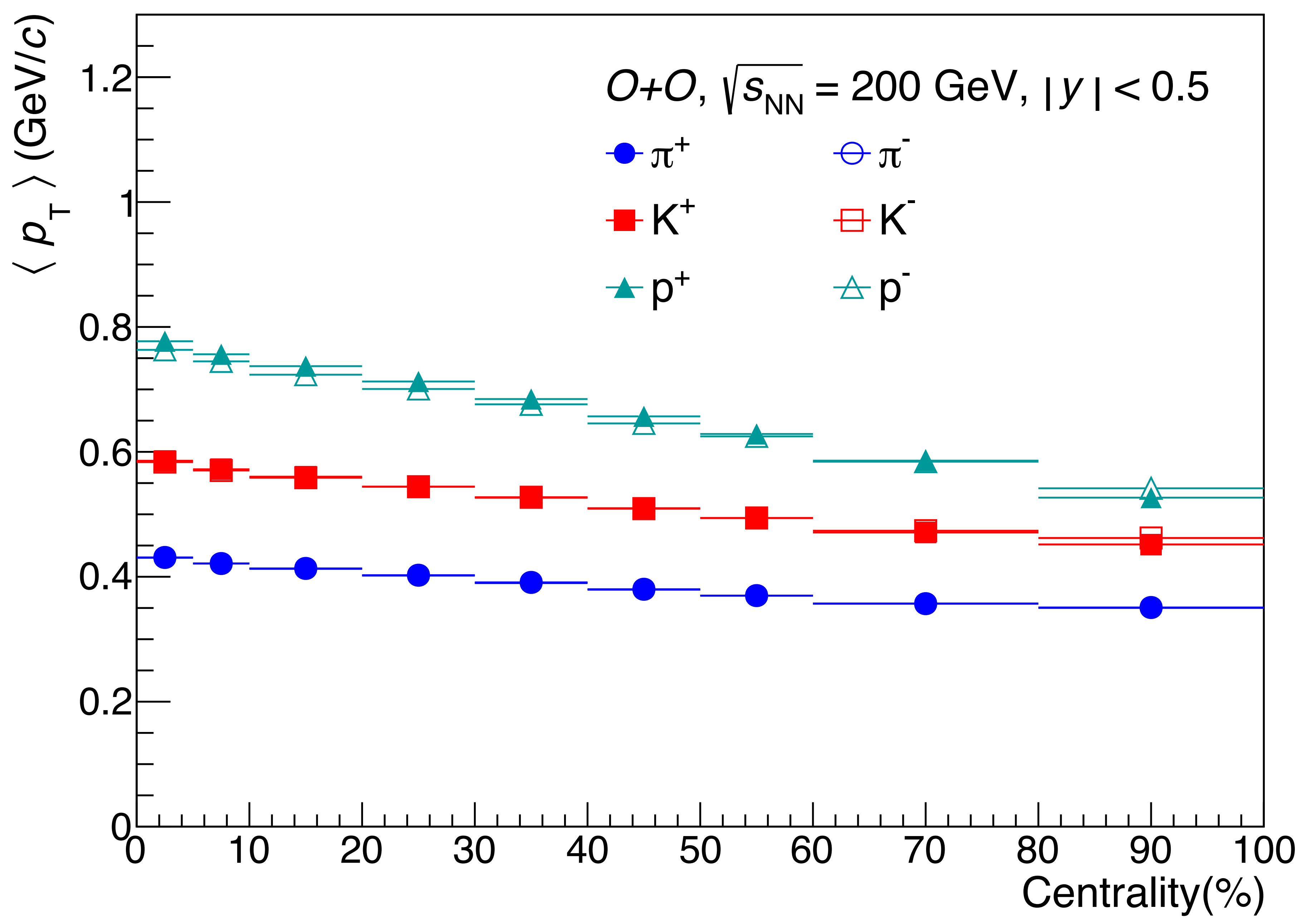


- Pseudorapidity distributions
- Centrality classes: Reference multiplicity ($|\eta| < 0.5$)

Centrality (%)	$\langle dN_{ch}/d\eta \rangle$	$\langle N_{part} \rangle \pm$ rms	$\langle N_{coll} \rangle \pm$ rms
0 – 5	91.44 ± 0.14	24.86 ± 2.18	31.89 ± 9.32
5 – 10	74.801 ± 0.13	21.05 ± 2.33	25.77 ± 8.79
10 – 20	60.437 ± 0.08	18.44 ± 3.15	19.35 ± 7.88
20 – 30	45.863 ± 0.07	14.87 ± 3.12	13.84 ± 5.65
30 – 40	33.027 ± 0.06	10.44 ± 2.56	9.35 ± 4.11
40 – 50	24.037 ± 0.05	8.60 ± 2.52	6.16 ± 3.24
50 – 60	18.146 ± 0.06	5.98 ± 2.3	4.94 ± 2.54
60 – 80	10.889 ± 0.02	3.49 ± 1.96	2.31 ± 1.84
80 – 100	4.127 ± 0.01	1.84 ± 1.53	1.13 ± 1.06

Integrated Yield (dN/dy) and $\langle p_T \rangle$

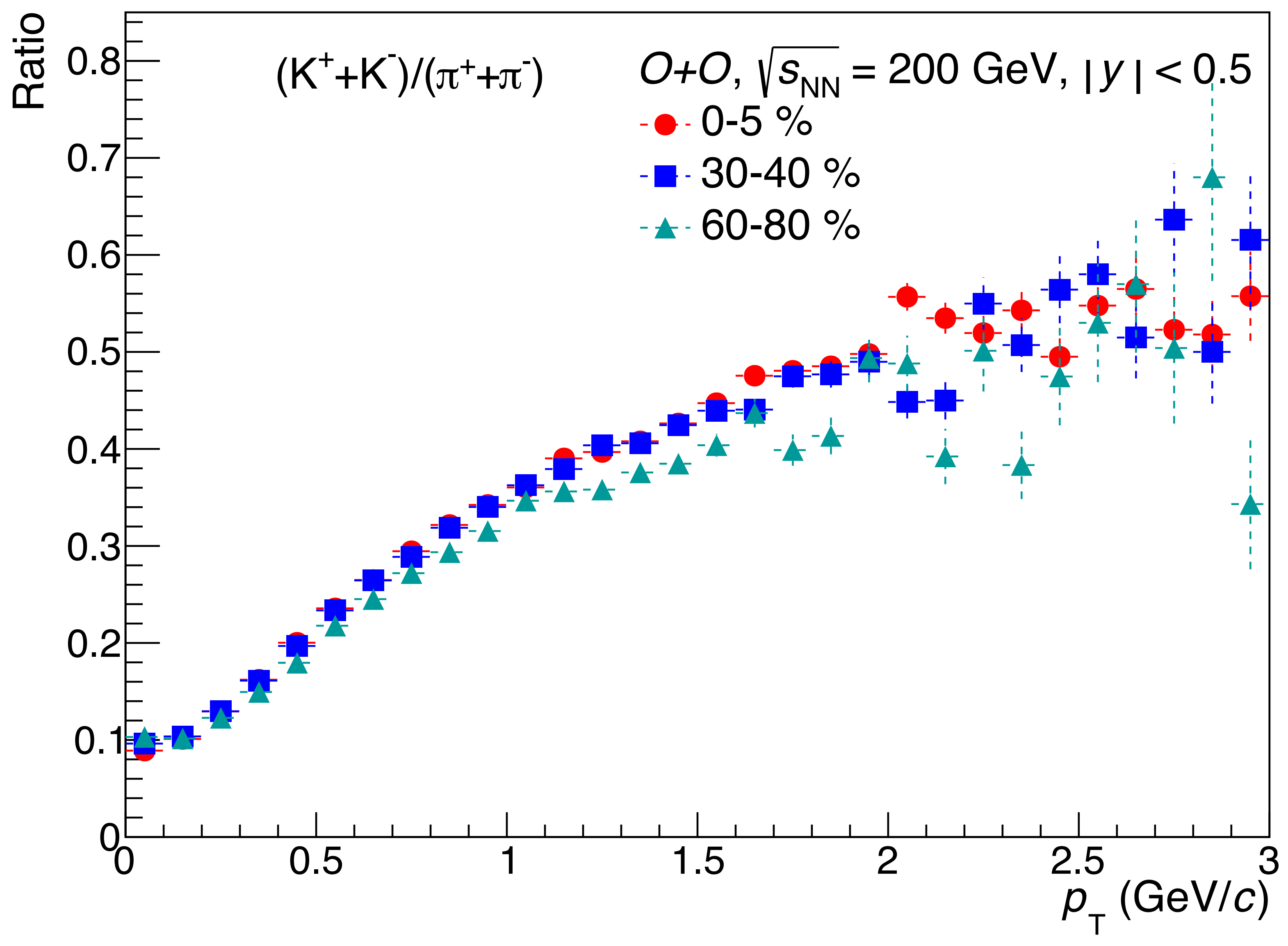


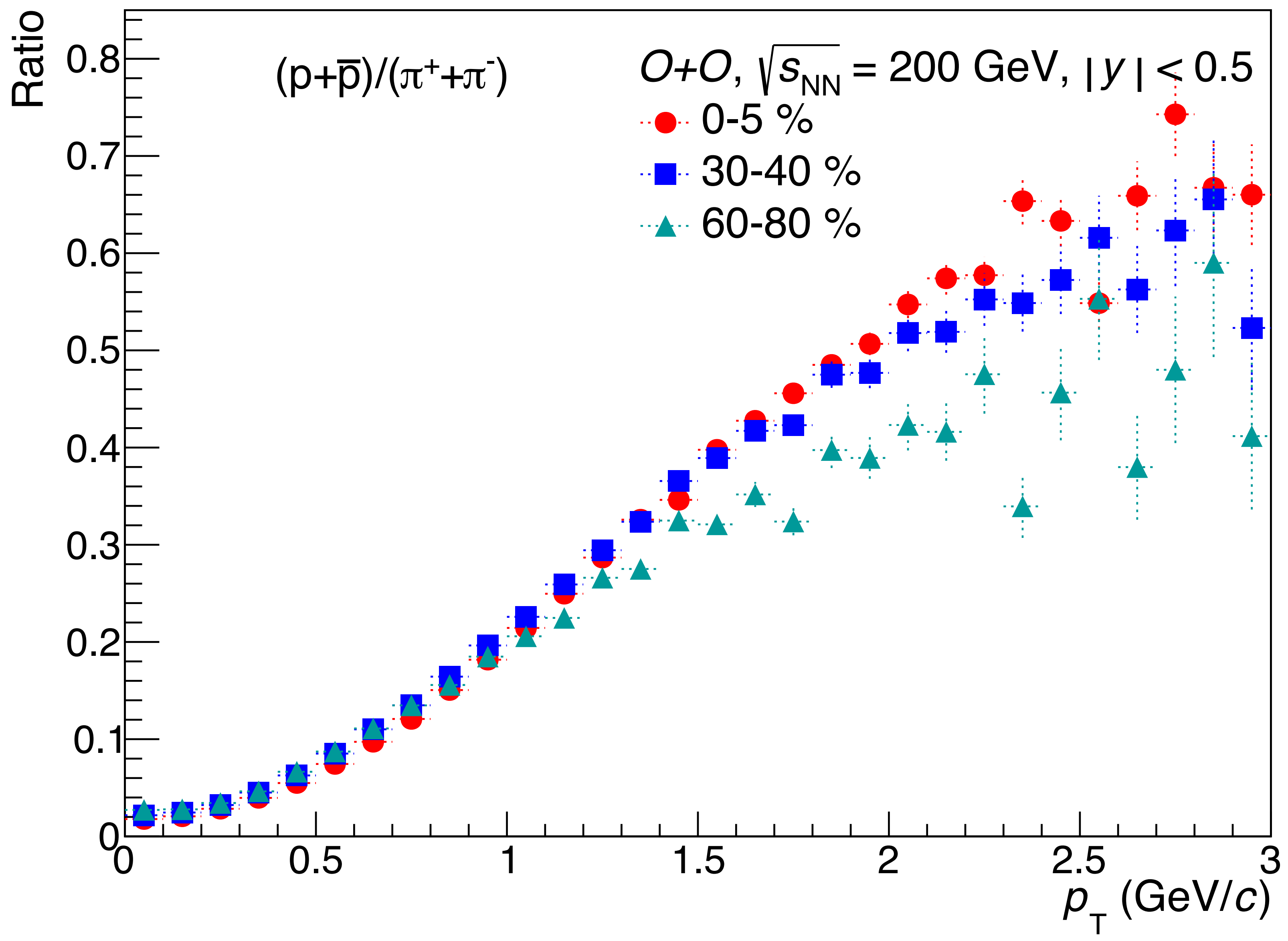


- Integrated Yield (dN/dy): centrality decreases (towards more central collisions), the particle production increases, indicating higher multiplicity in central collisions
- Abundance of Pions: This reflects the typical hierarchy in particle production in heavy-ion collisions, where lighter particles like pions dominate

- A general trend of increasing $\langle p_T \rangle$ with centrality is evident, indicating higher transverse momentum for more central collisions
- Heavier particles such as protons (p) show higher $\langle p_T \rangle$ compared to lighter particles like pions

Particle Ratios (on going)





- higher in more central collisions compared to peripheral
- $p_T < 1 \rightarrow$ Ratio: No strong centrality dependent

Summary

- We present predictions of various observables for identified (π, K, p) in O + O collisions at $\sqrt{s_{NN}}$ = 200 GeV using the recently updated hydrodynamics-based EPOS4.
- Yield of identified hadrons increase with collision centrality.
- $\langle p_T \rangle$ increases from peripheral to central collisions:
  - More radial flow in central collisions.
- p_T-integrated ratios:
  - higher in more central collisions compared to peripheral
  - $p_{\mathrm{T}} < 1 \rightarrow$ Ratio: No strong centrality dependent
- It would be interesting to investigate this study with the experimental data when available

Thank you for your attention!!

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