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ALICE

Strange and non-strange light-flavour hadron production in Pb-Pb and p-Pb collisions at LHC energies with ALICE

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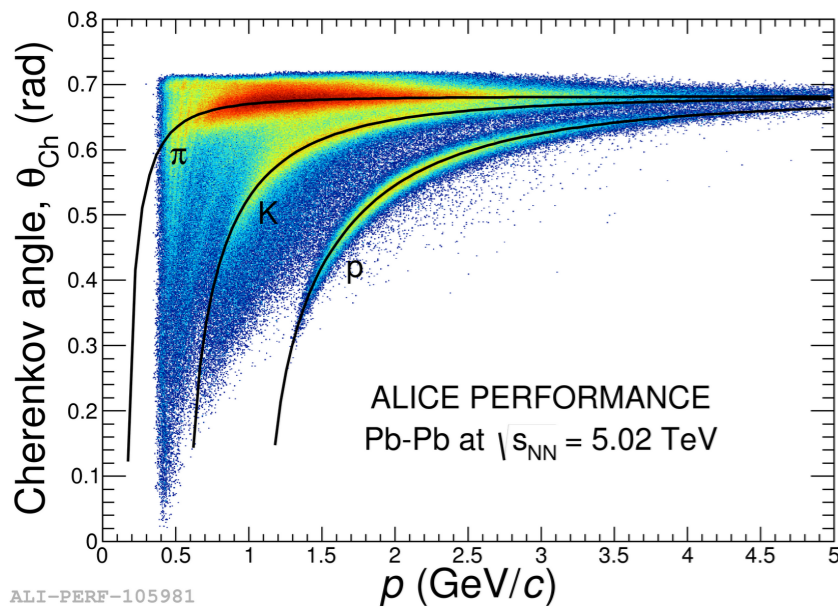
on behalf of the ALICE Collaboration



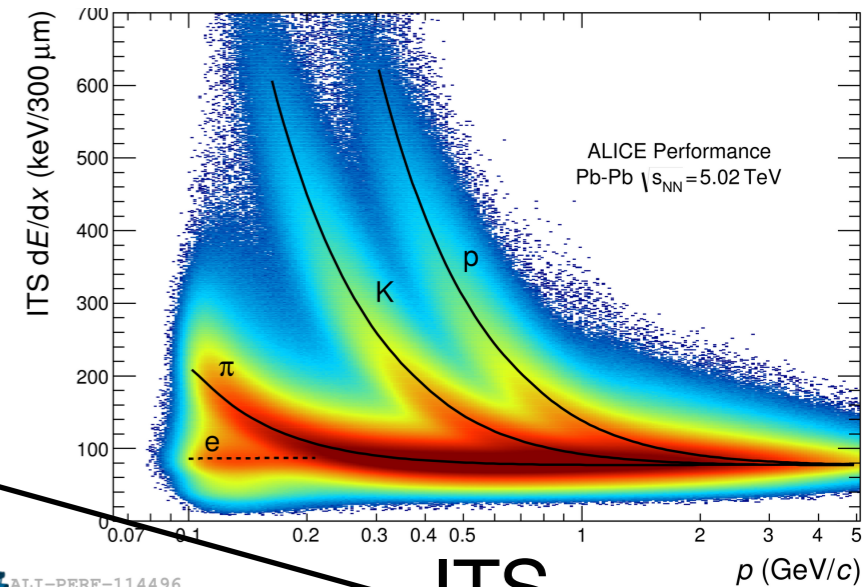
Introduction and motivation

- Measurement of light flavour hadron observables provides important information about the colliding system:
 - Radial flow -> comparison of p_T spectra to hydrodynamic models.
 - Kinetic freeze-out -> Blast-wave model fit.
 - Energy loss in the medium -> nuclear modification factors.
 - Chemical freeze-out -> thermal model fit to particle yields.
 - Strangeness enhancement -> comparison of particle yields in different multiplicities.

The ALICE detector



- ITS primary vertex resolution: $\sim 10\mu\text{m}$.



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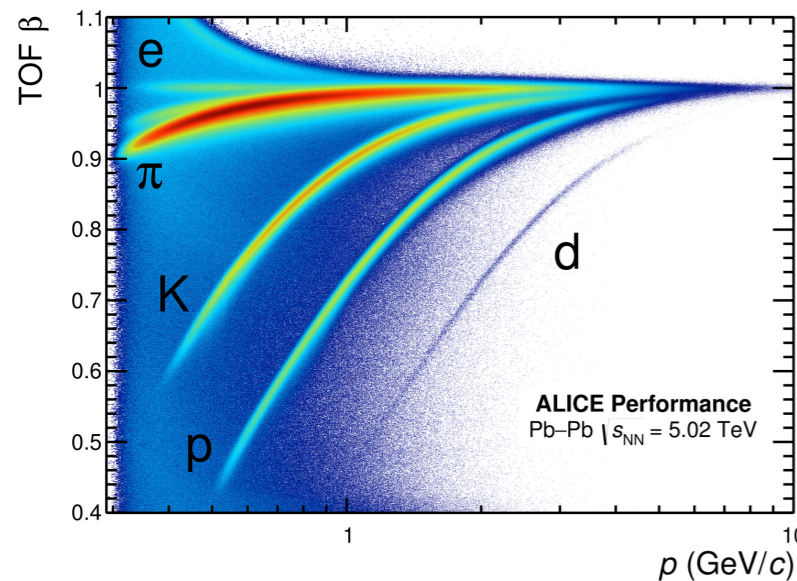
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HMPID
(high p_T PID)

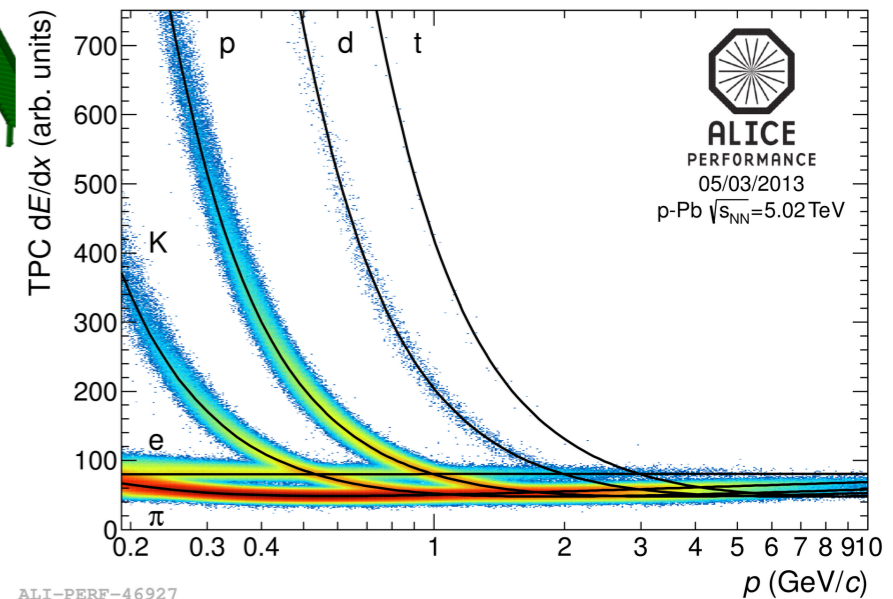
ITS
(vertexing,
tracking, PID)

(PID)
TOF

(tracking, PID)
TPC

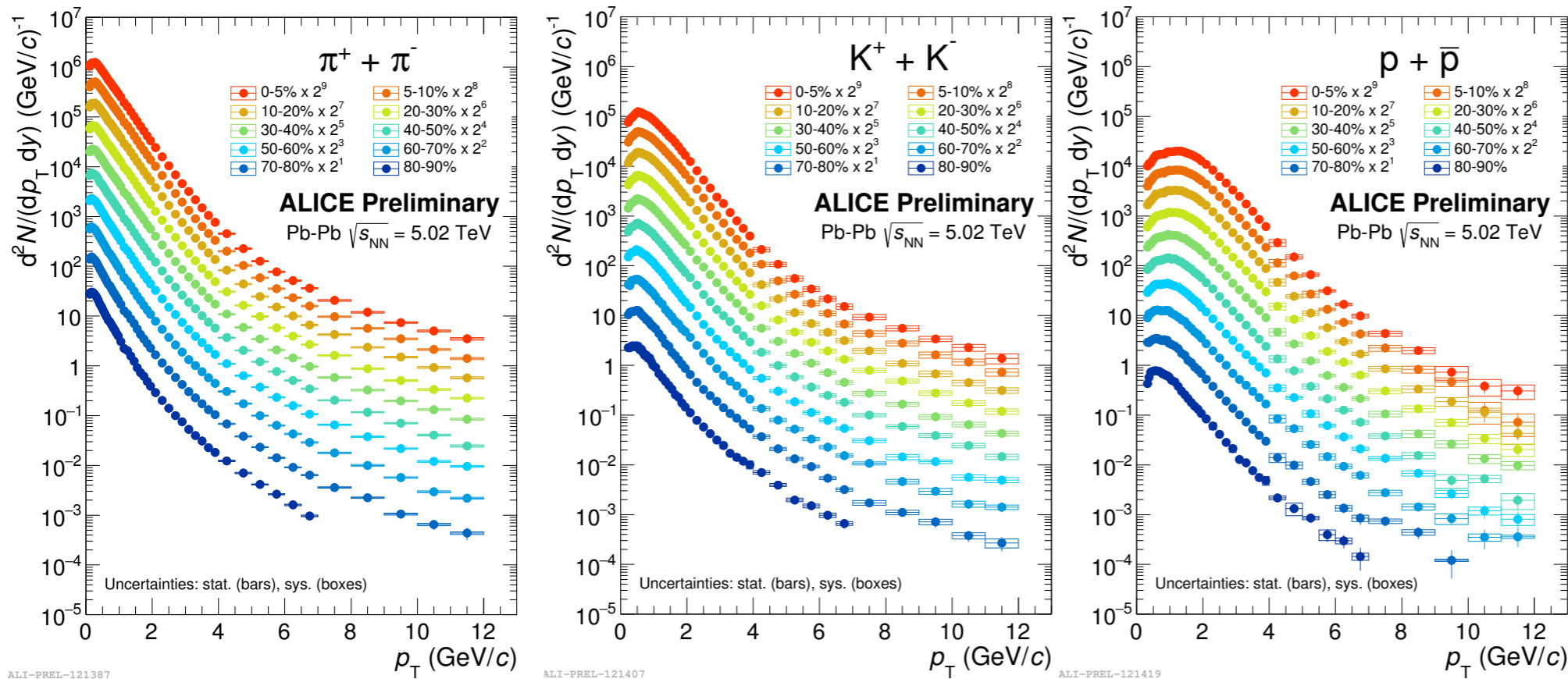
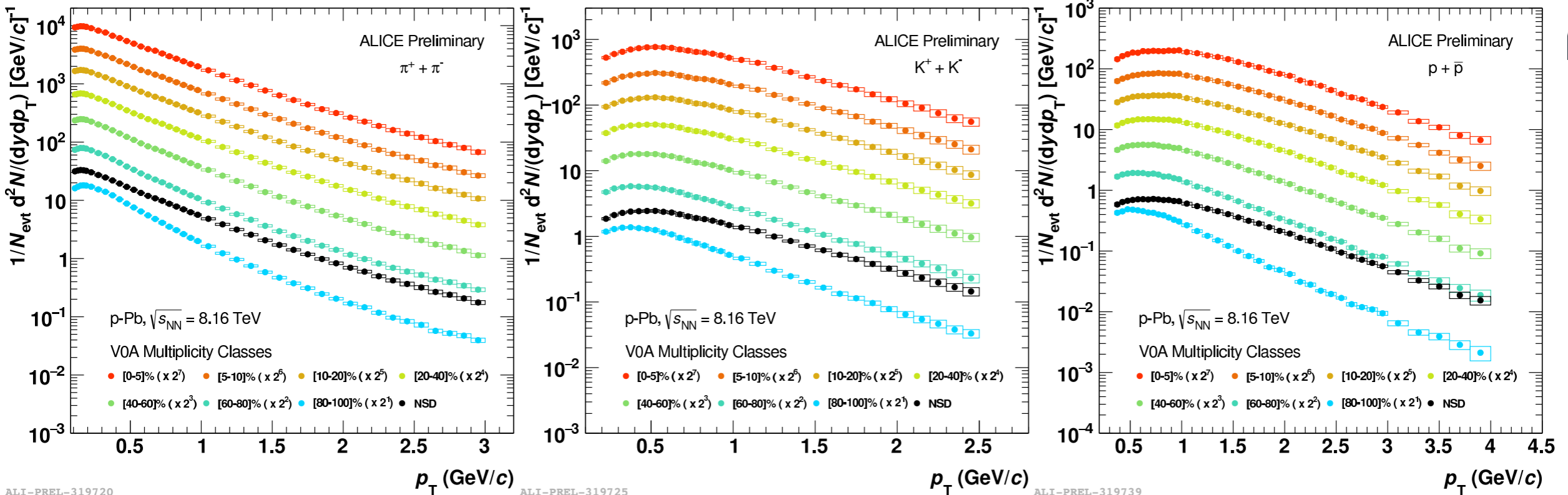


- TPC particle ionisation measurement resolution: $\sim 5\%$.
- TOF time measurement resolution: $\sim 80\text{ps}$.



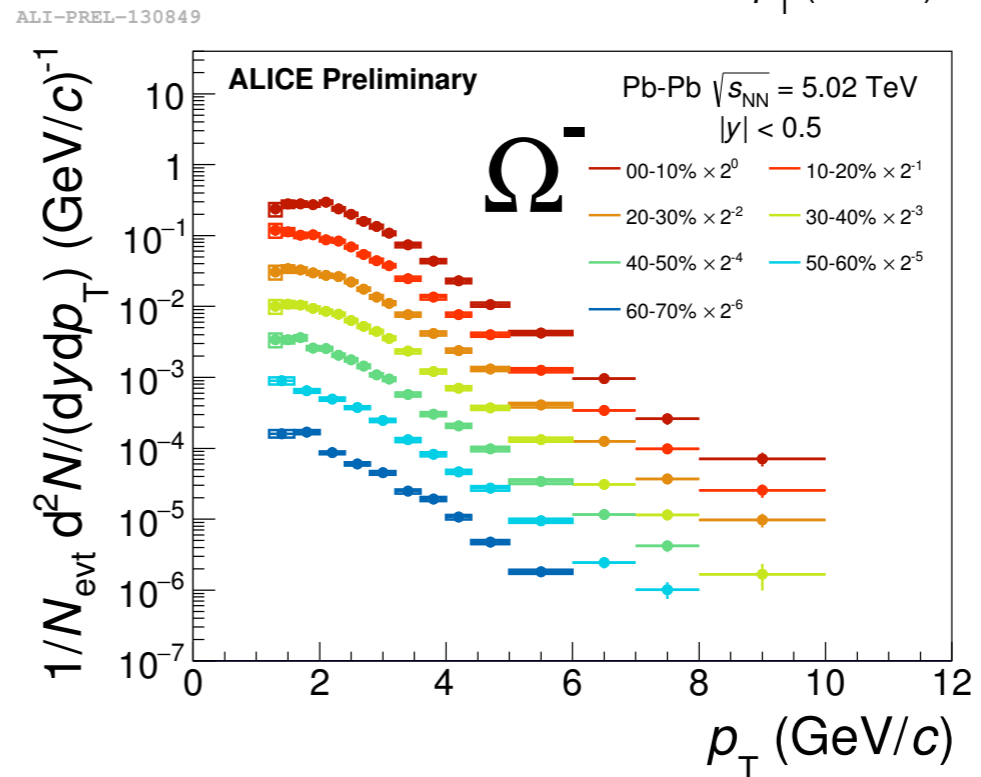
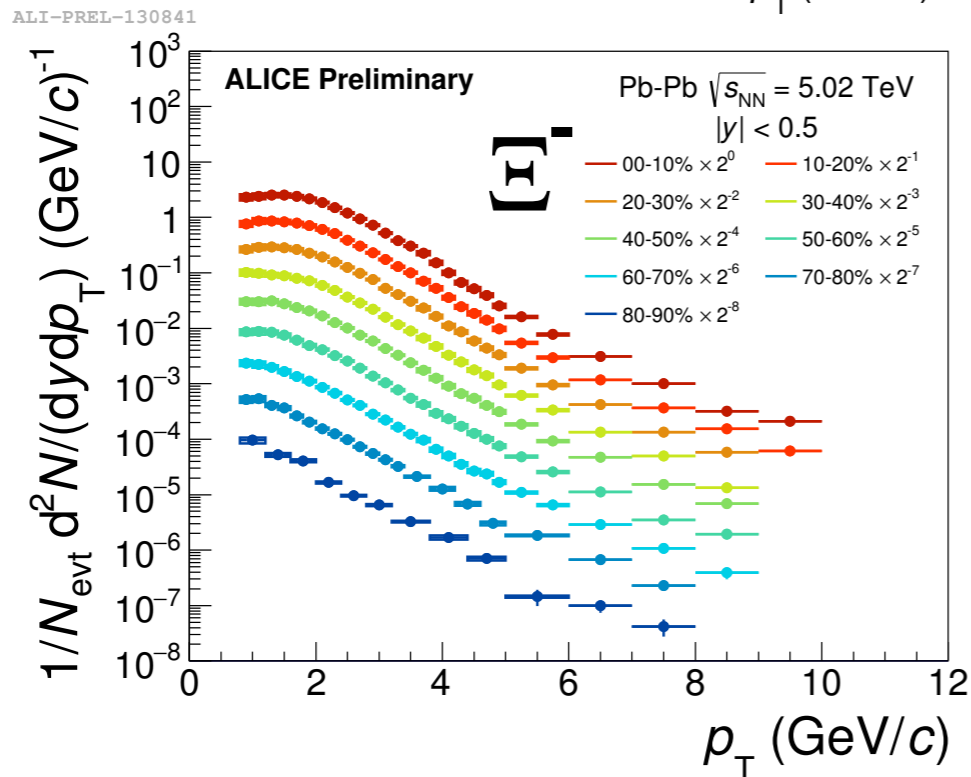
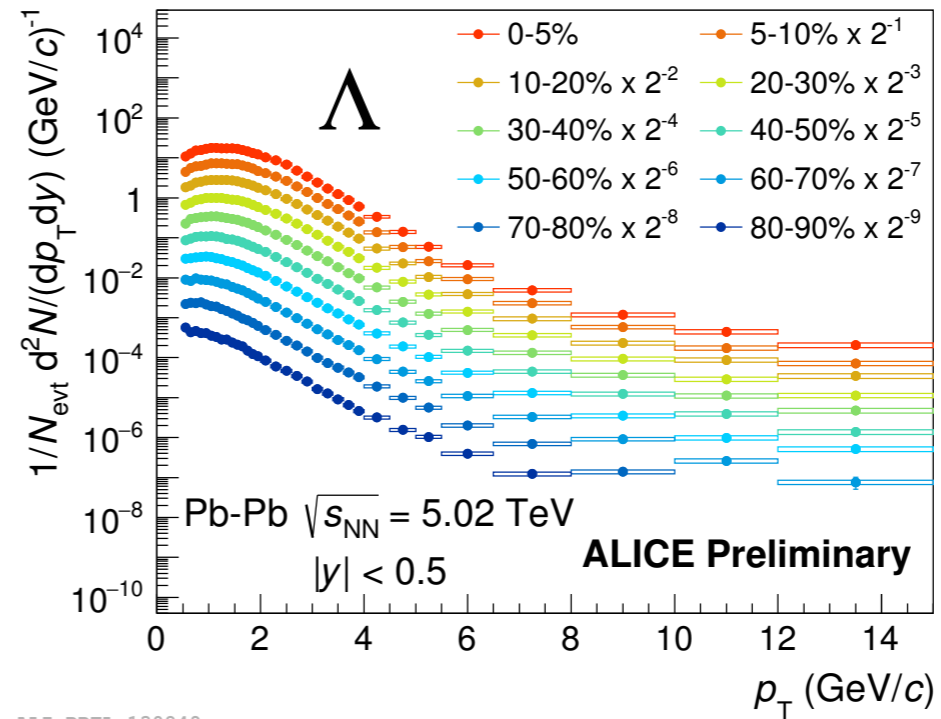
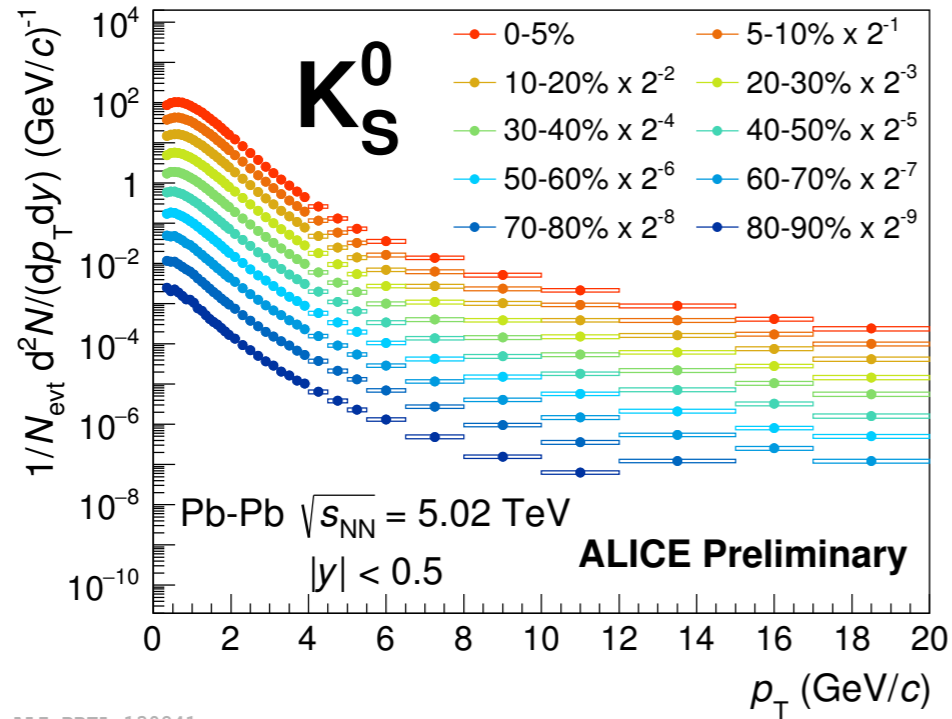
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Transverse momentum spectra



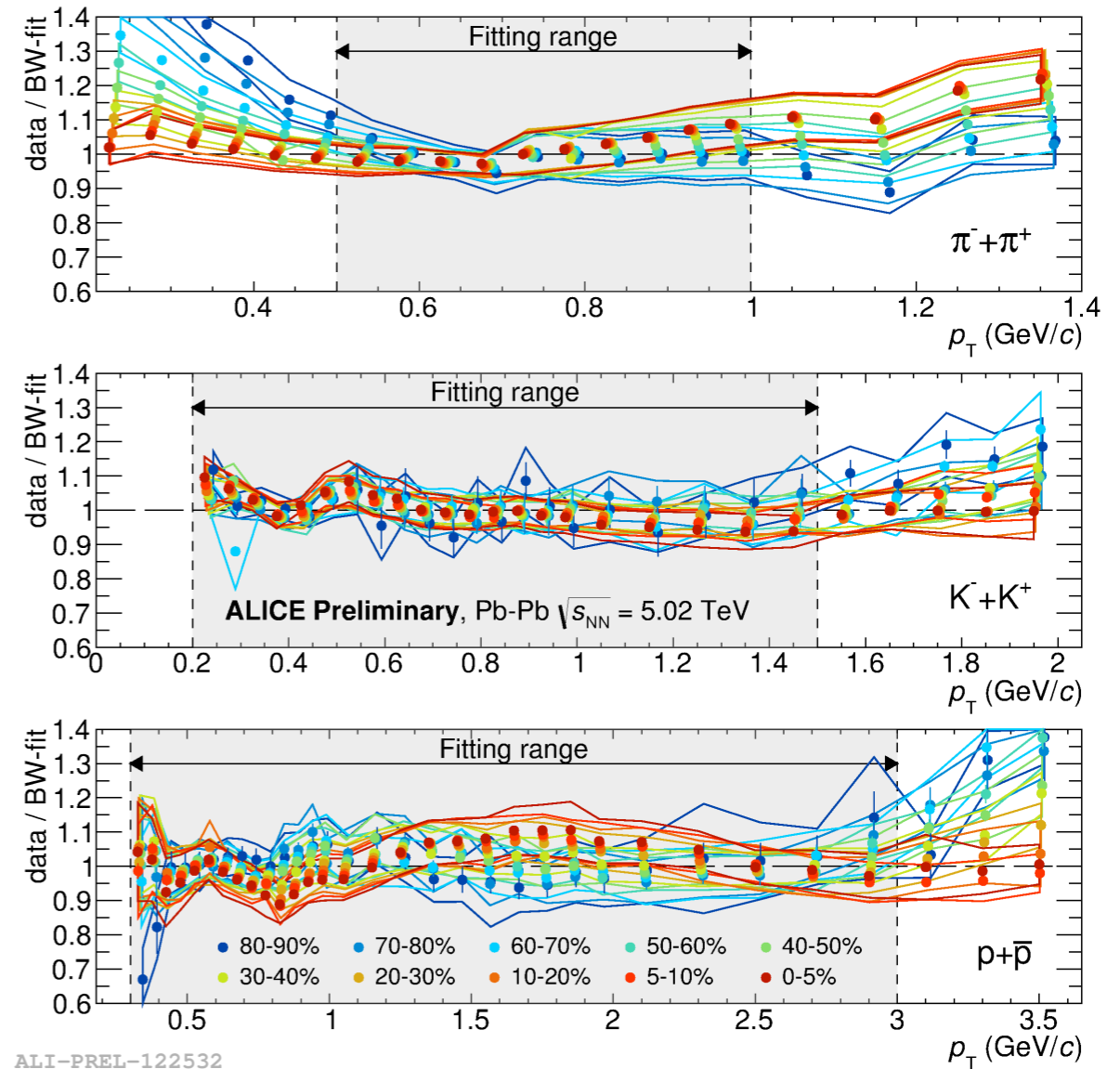
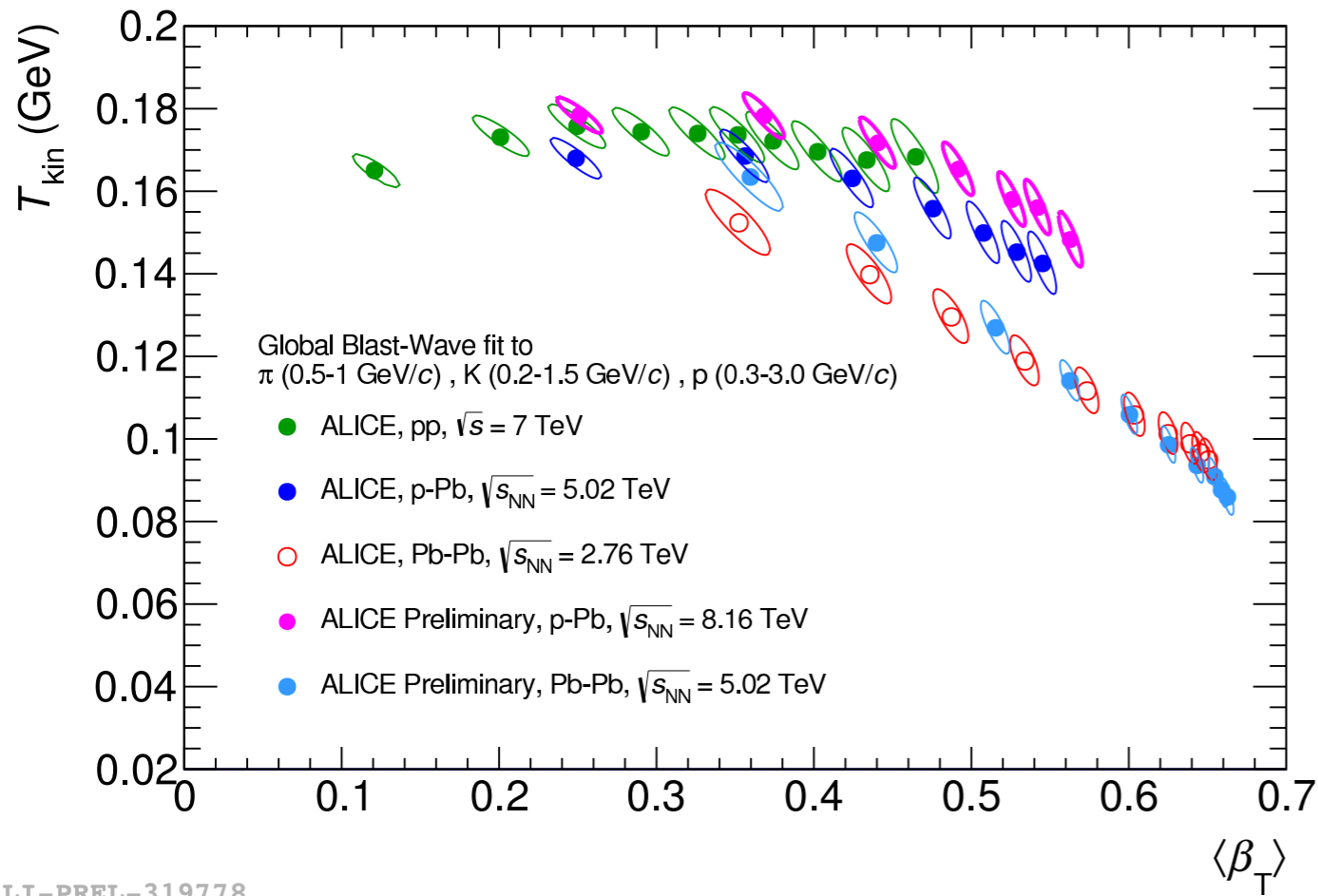
- Particle and antiparticle spectra are summed because they are compatible.
- Mass dependent flattening of spectra with centrality at low p_T \rightarrow expected as consequence of radial flow.
- Power-law shape at high p_T .

Transverse momentum spectra



- Particle and antiparticle spectra compatible
- Mass dependent hardening of the spectra with centrality (confirmed by increasing measured mean transverse momenta with centrality).

Blast-Wave model

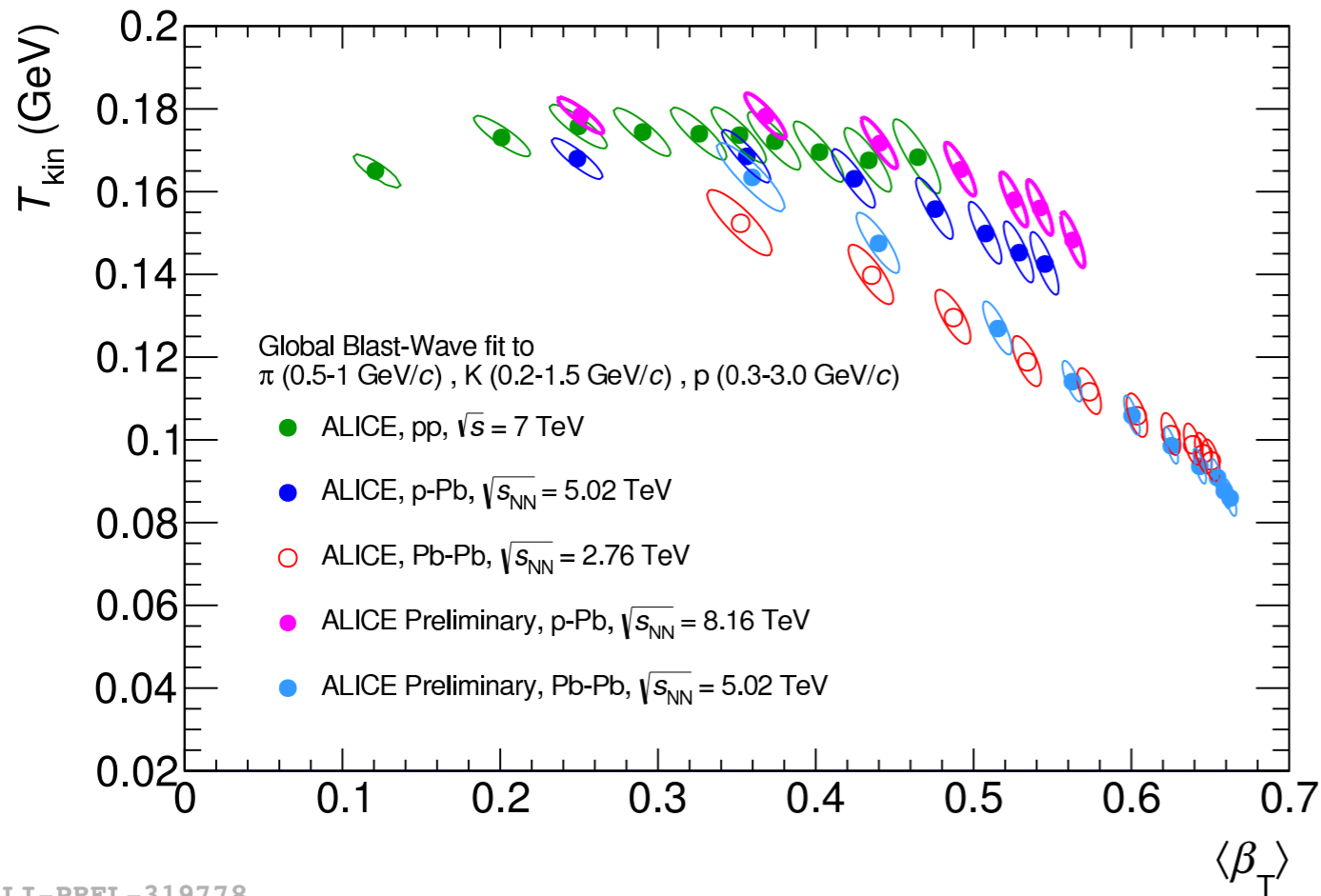


- Combined Blast-Wave[1] fit to π , K and p
- Pb-Pb at **5.02 TeV** follows a similar trend than for **2.76 TeV**, with increase in expansion velocity in most central collisions.
- In p-Pb, we observe higher T_{kin} for **8.16 TeV** than for **5.02 TeV**.

- π , K and p spectra are **fitted** in *shaded* p_T intervals.

[1] E. Schnedermann et al., Phys. Rev. C 48, 2462 (1993)

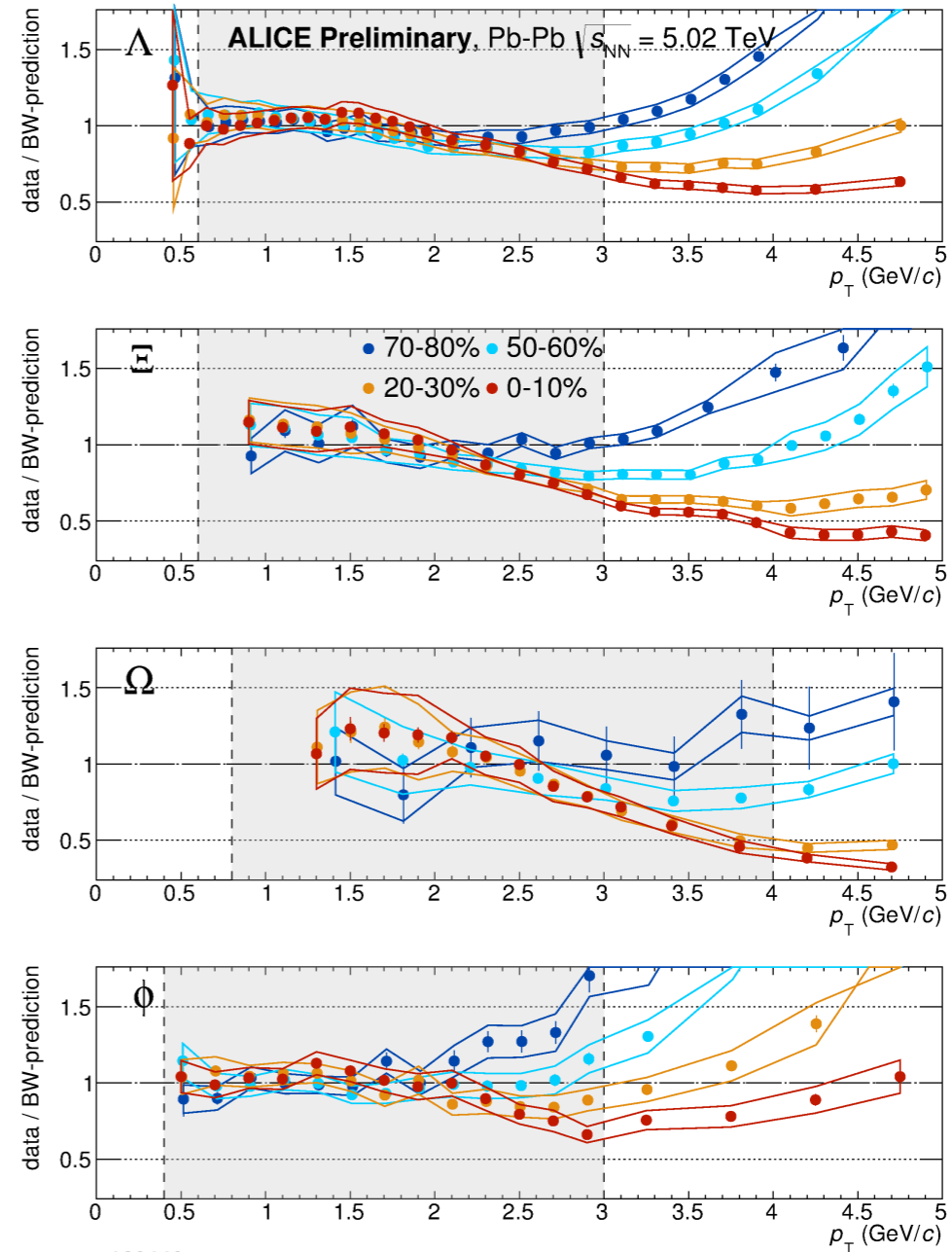
Blast-Wave model



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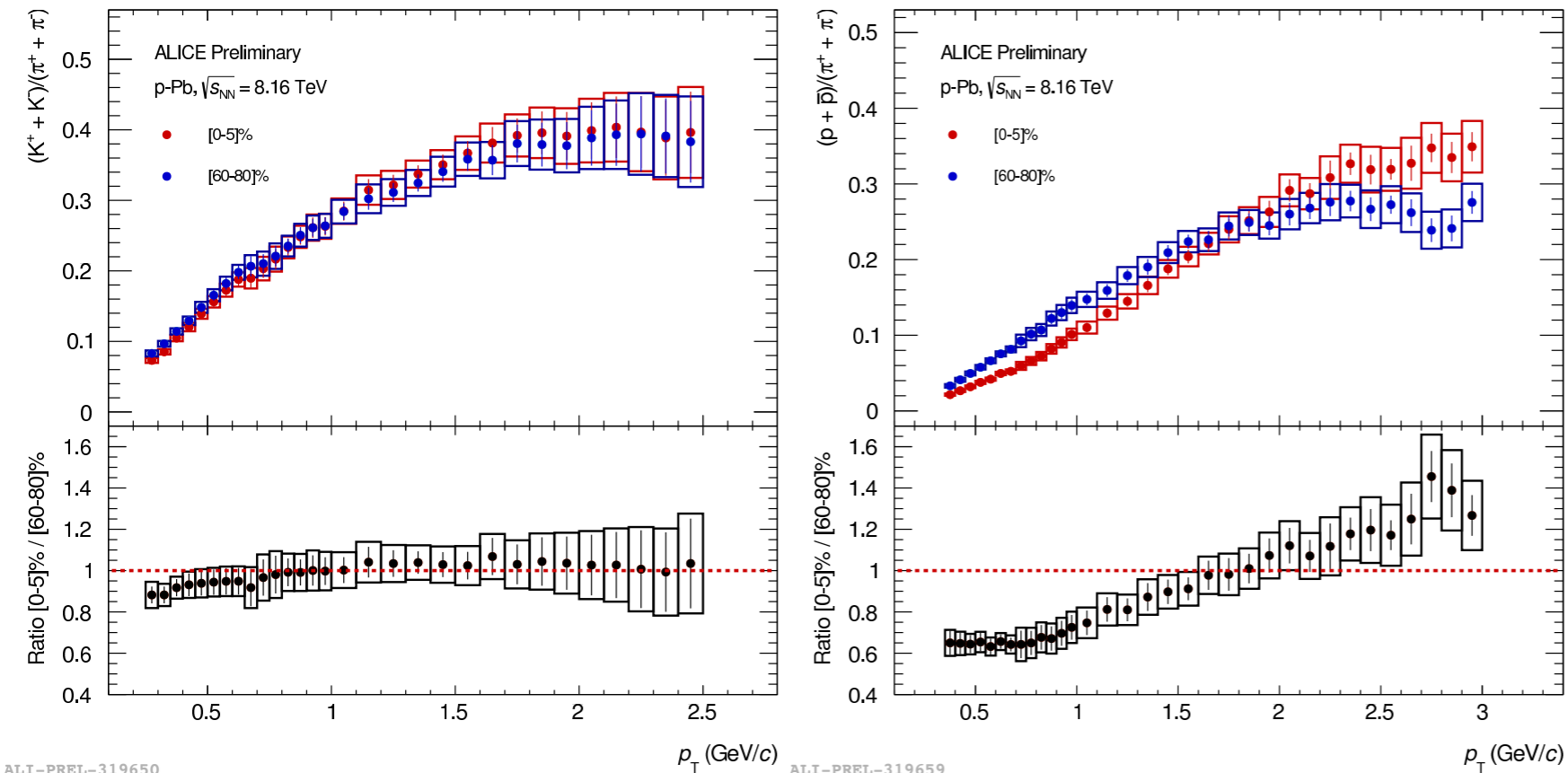
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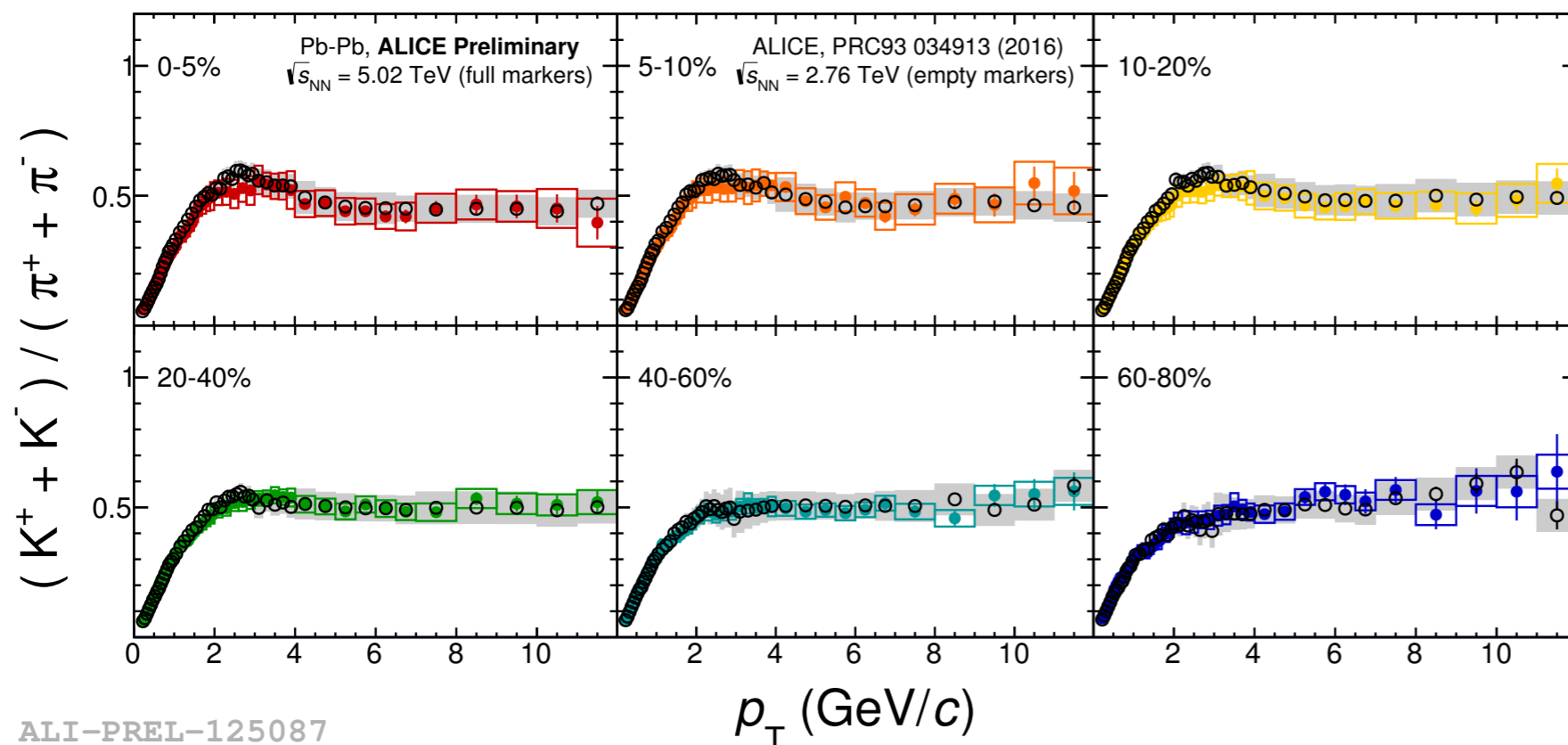


- **Prediction** of the Blast-Wave fit for strange particles.
- In pp, they follow the prediction in *shaded* p_T intervals.

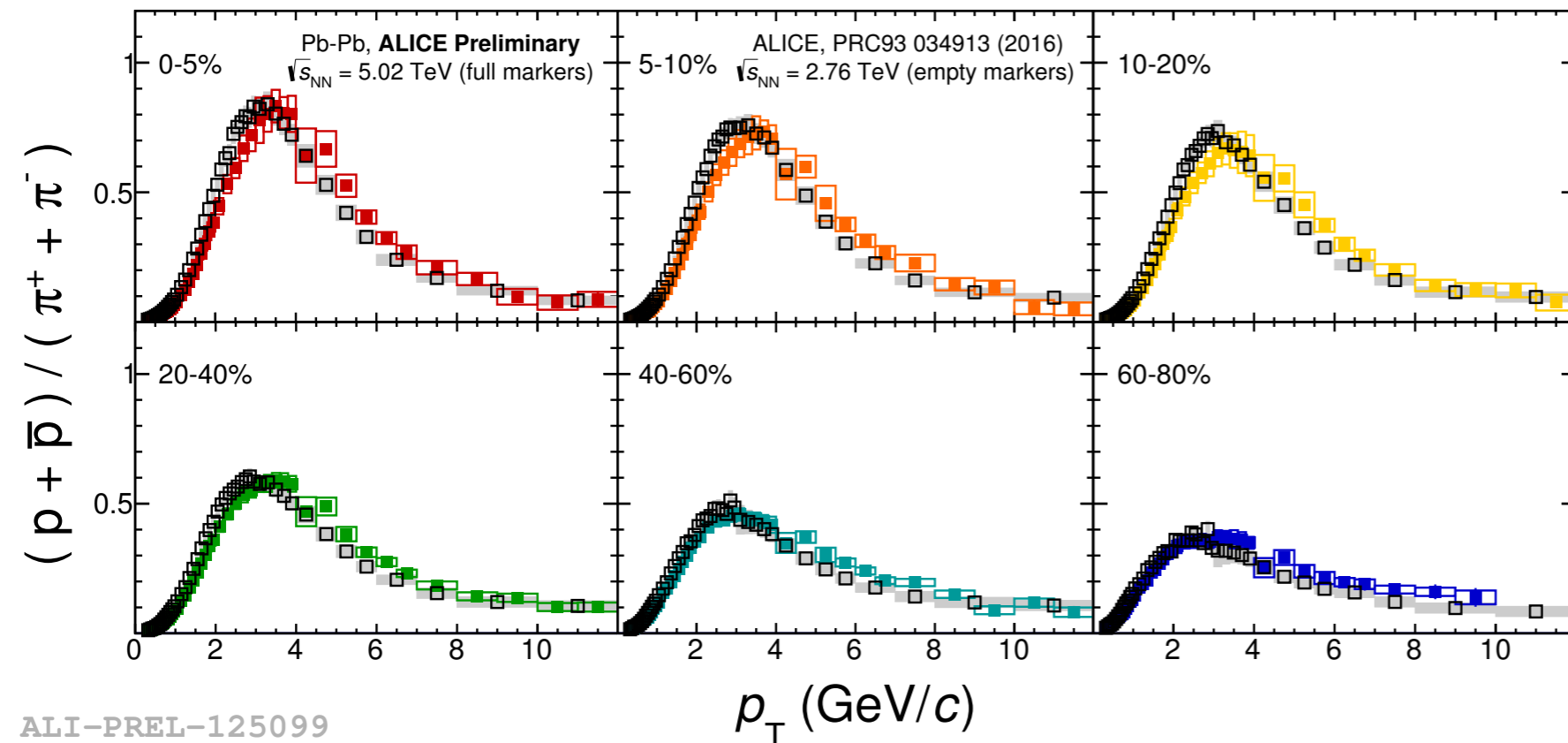
Spectra ratios



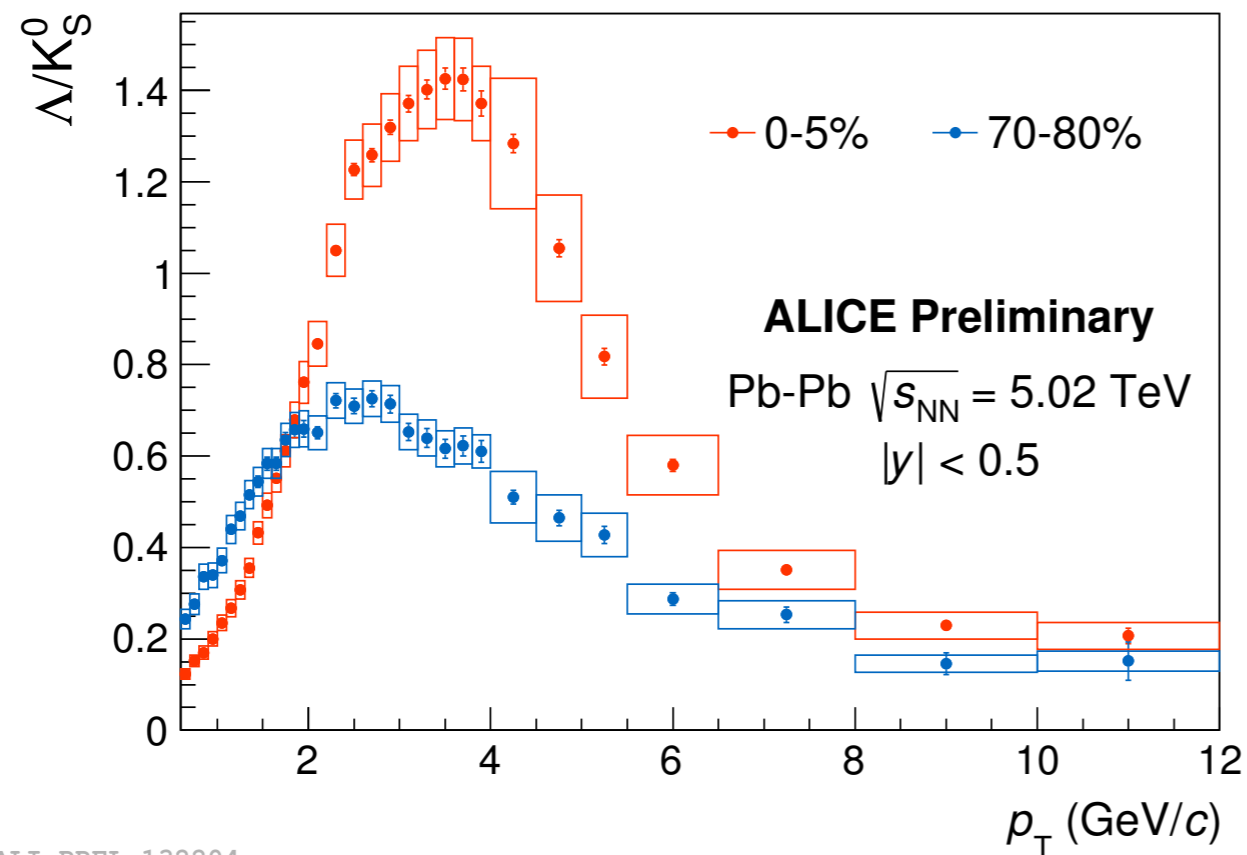
- **Low p_T** (0-2.5 GeV/c): steep increase.
- **High p_T** (> 10 GeV/c): little or no p_T or multiplicity dependence -> suggesting production via jet fragmentation.
- ρ/π ratio in central Pb-Pb collisions exhibits a **pronounced enhancement** w.r.t. peripheral Pb-Pb collisions.
- Smaller enhancement in the K/π w.r.t. ρ/π ratio -> expected as consequence of **radial flow**.
- Λ/K^0_s ratio has the **same qualitative behaviour** as ρ/π .
- The position of the maximum shifts towards higher p_T with increasing energy -> in qualitative agreement with increasing radial flow.



Spectra ratios

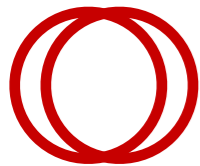
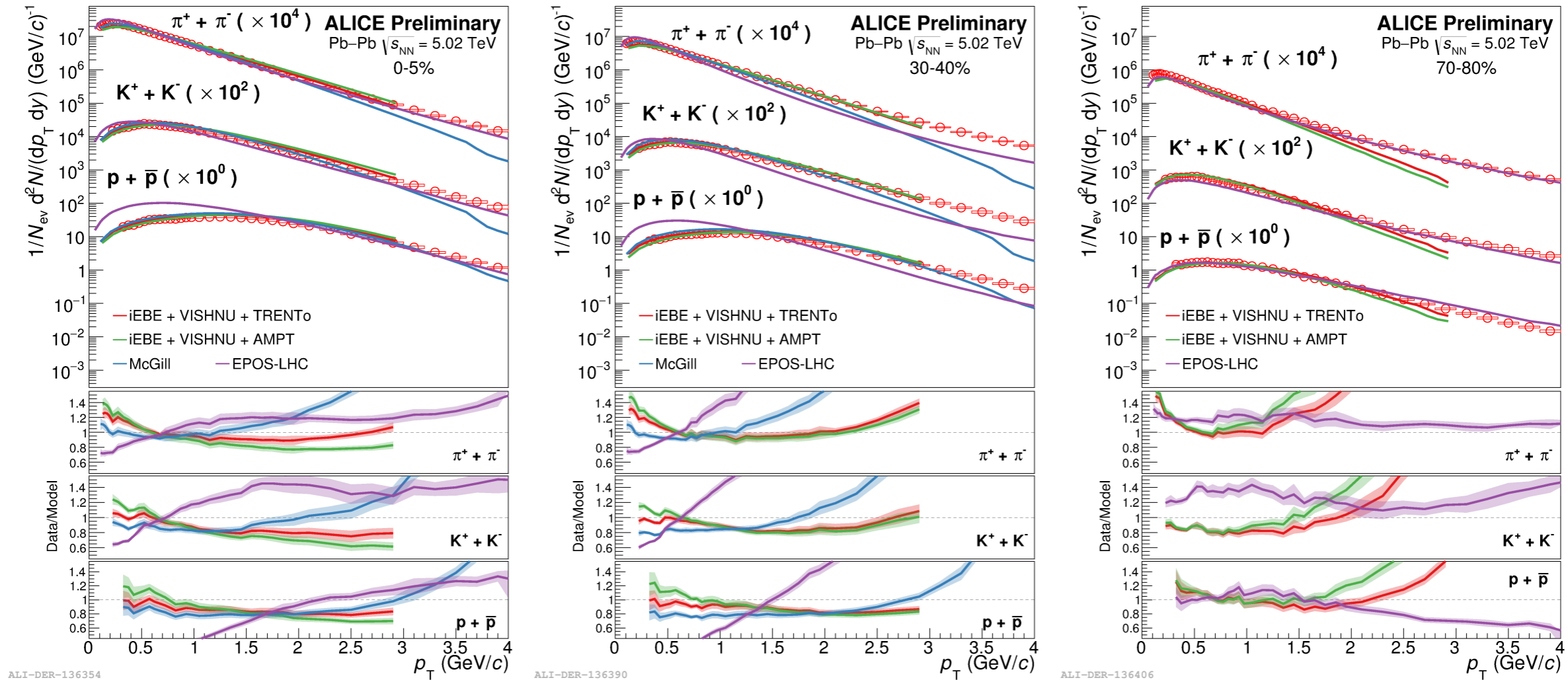


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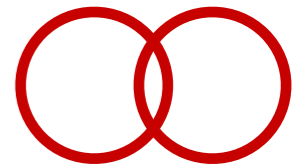


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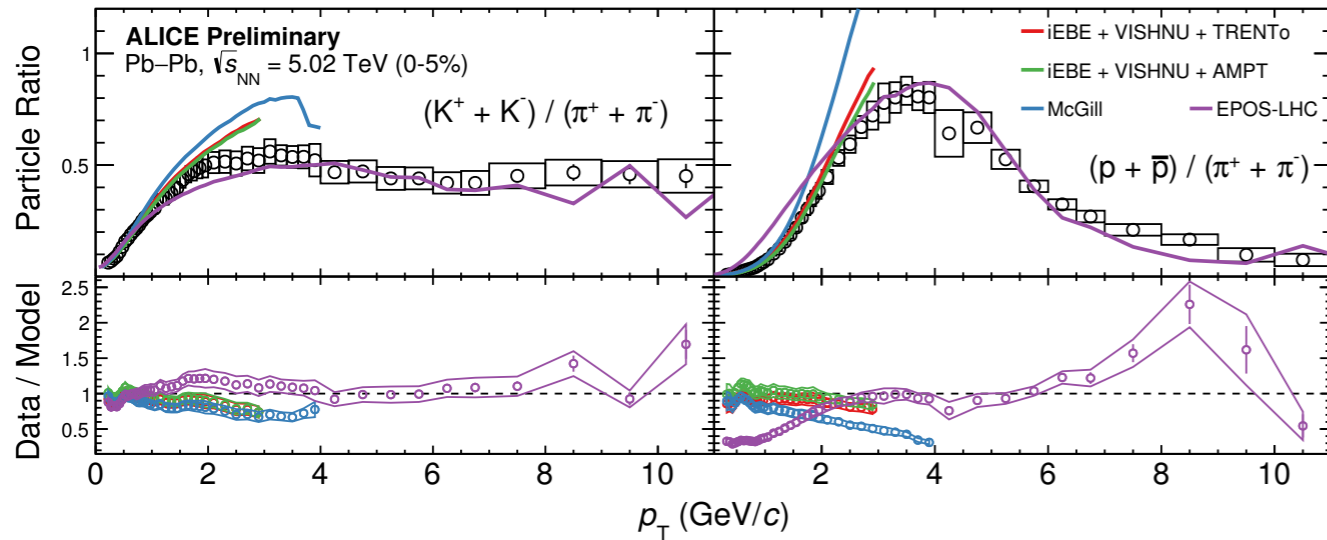
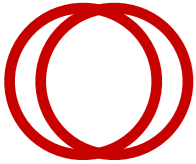
Comparison to hydrodynamic models



- Hydrodynamic model elements:
 - Initial state model provides a starting point for hydrodynamic calculation.
 - Chemical freeze-out occurs at a constant temperature hyper-surface.
 - Local particle production modelled with a statistical thermal model.
 - Hadronic system is allowed to re-interact.
- Protons described over the broadest p_T range.
- Central collisions are described over broader p_T range than peripheral collisions.

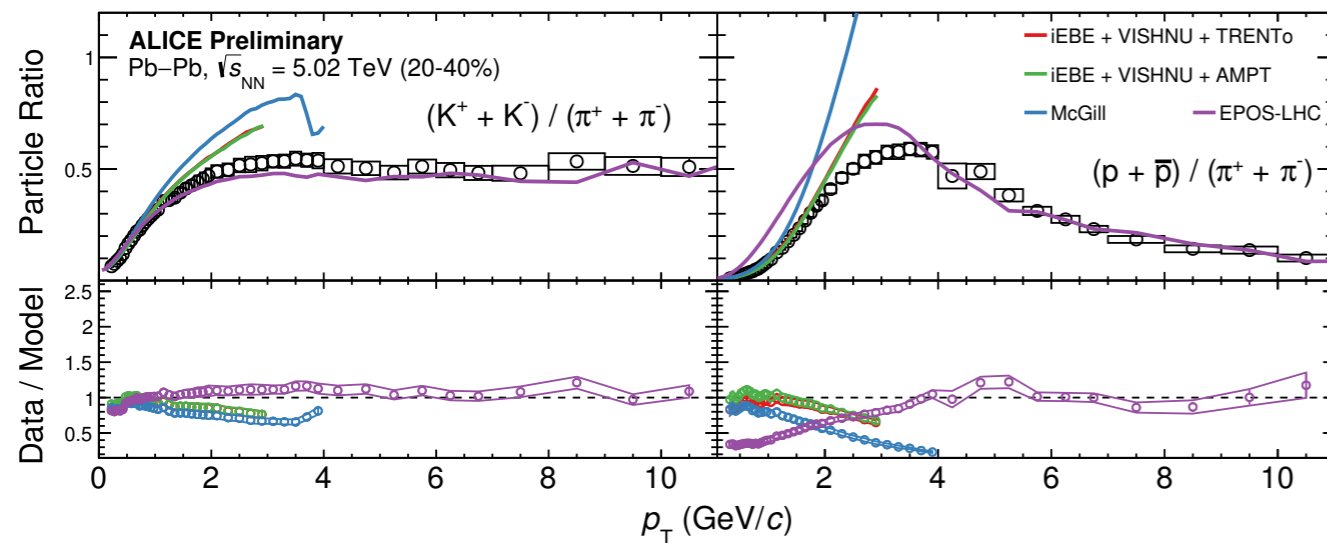


Comparison to hydrodynamic models

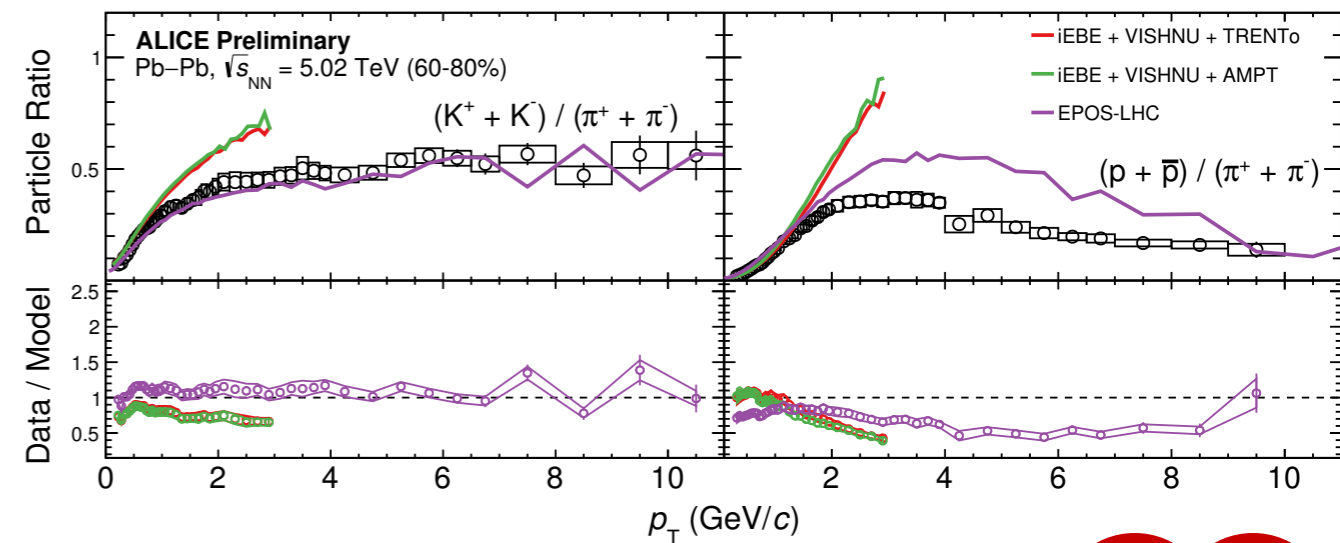


- Better description of spectra ratios than of individual spectra.
- **EPOS-LHC** prediction is significantly better for spectra ratios.

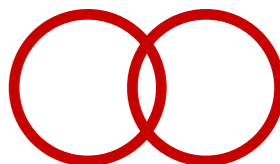
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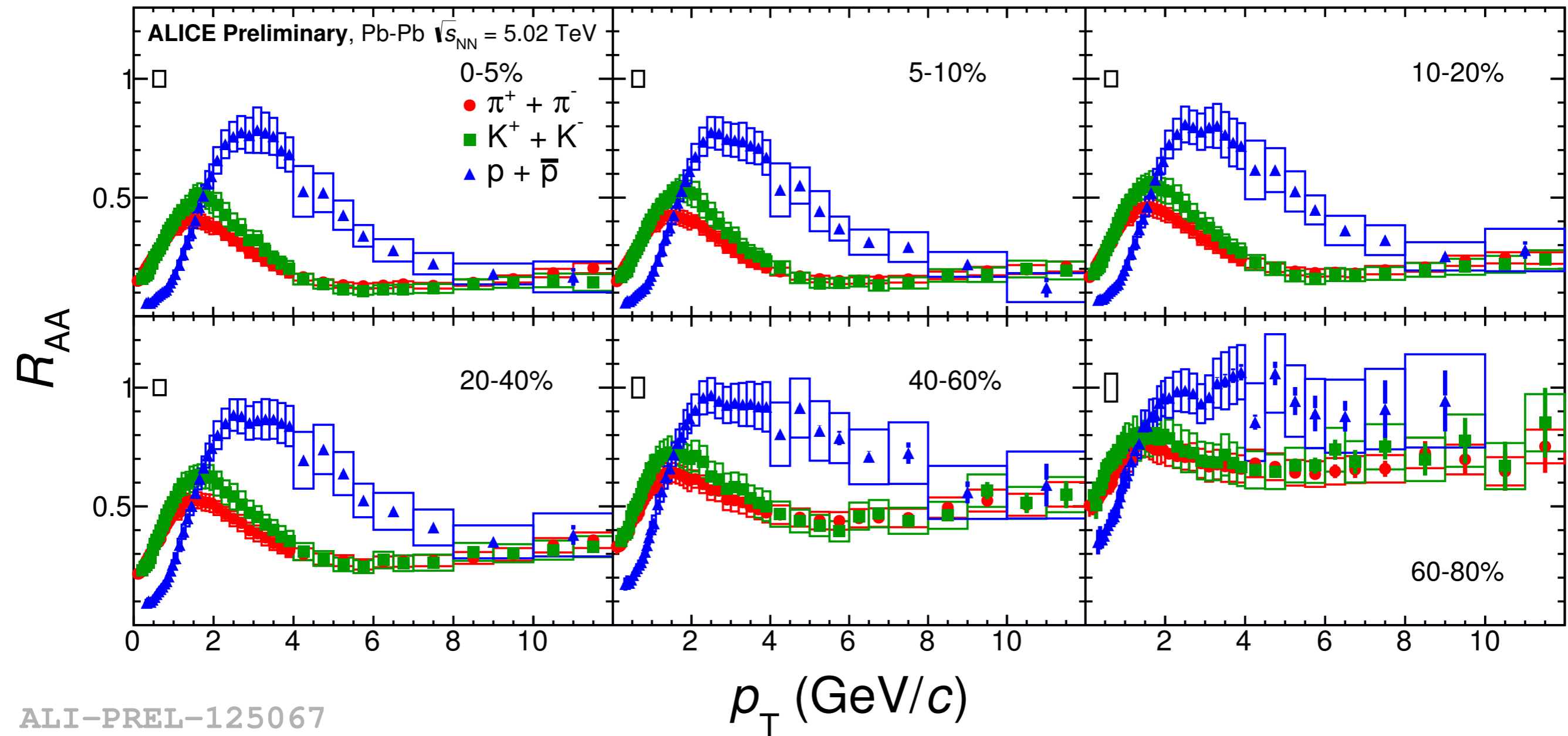
ALI-DER-136542



ALI-DER-136350



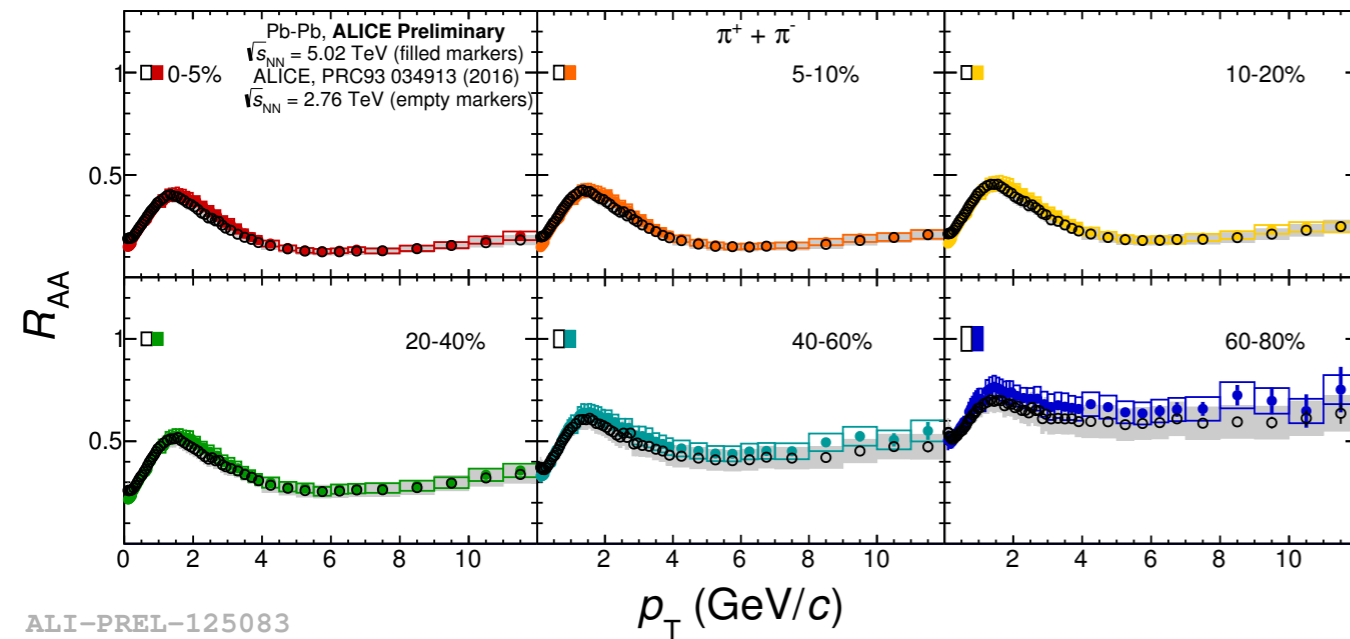
Nuclear modification factors



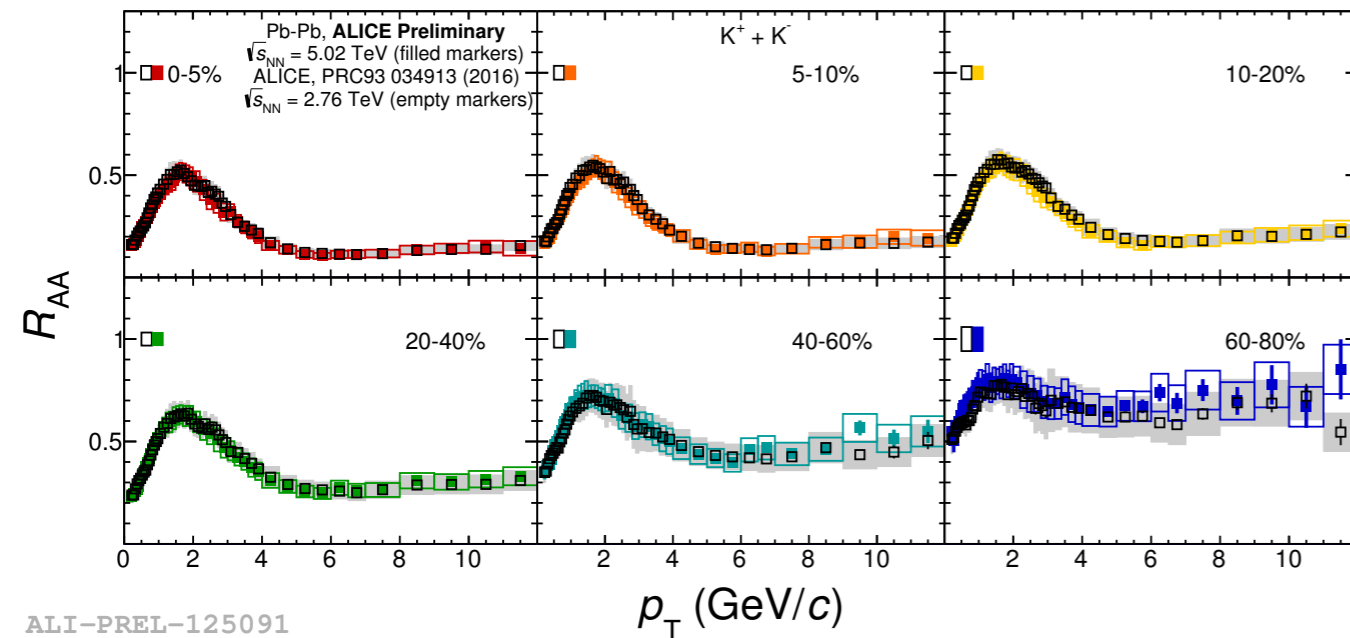
- At high p_T , all particle species are equally suppressed \rightarrow suggests jet quenching does not affect particle composition.

Nuclear modification factors

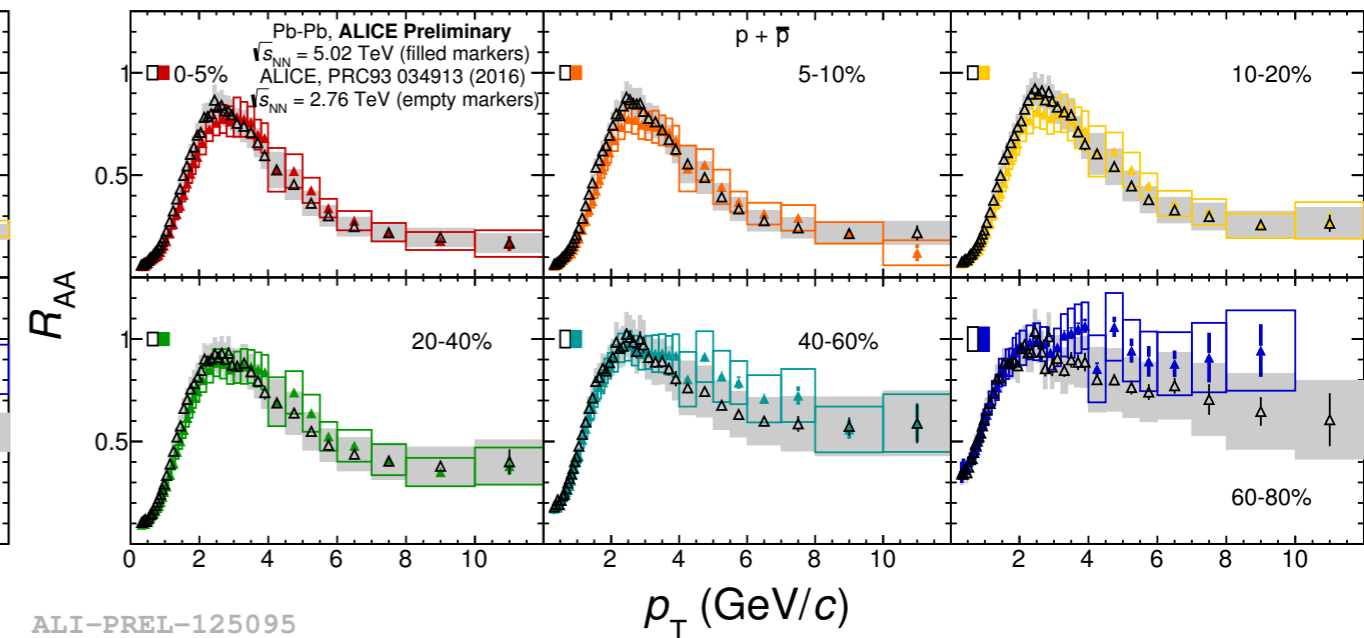
- No significant dependence on collisional energy, although the spectra are significantly harder in 5.02 TeV w.r.t. 2.76 TeV in both pp and Pb-Pb.



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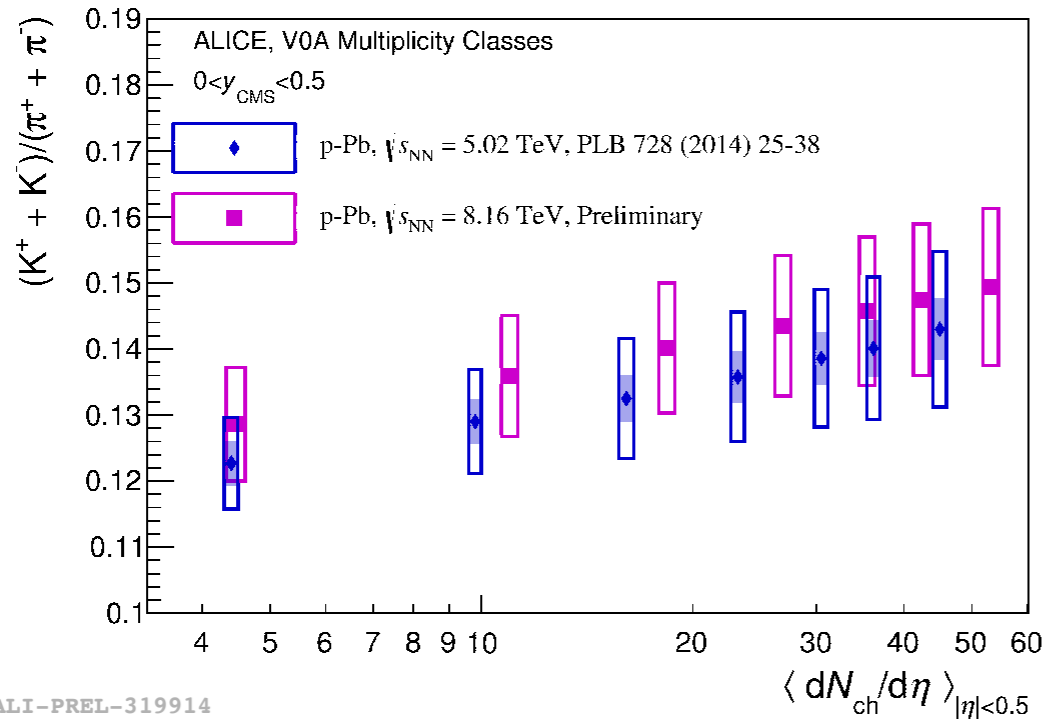


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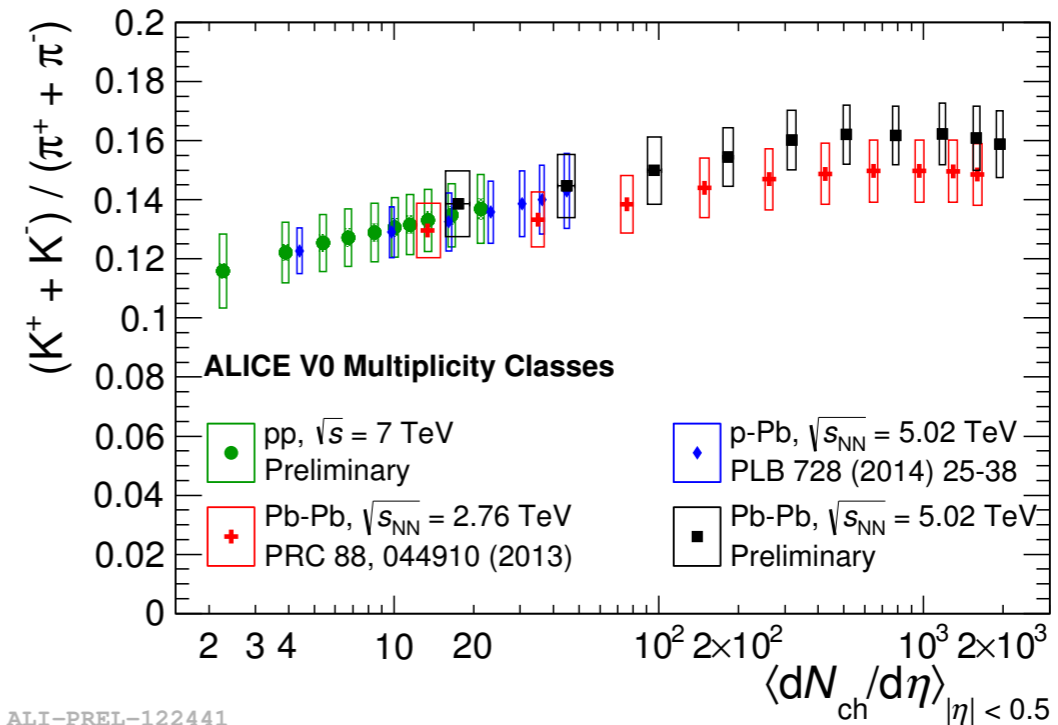


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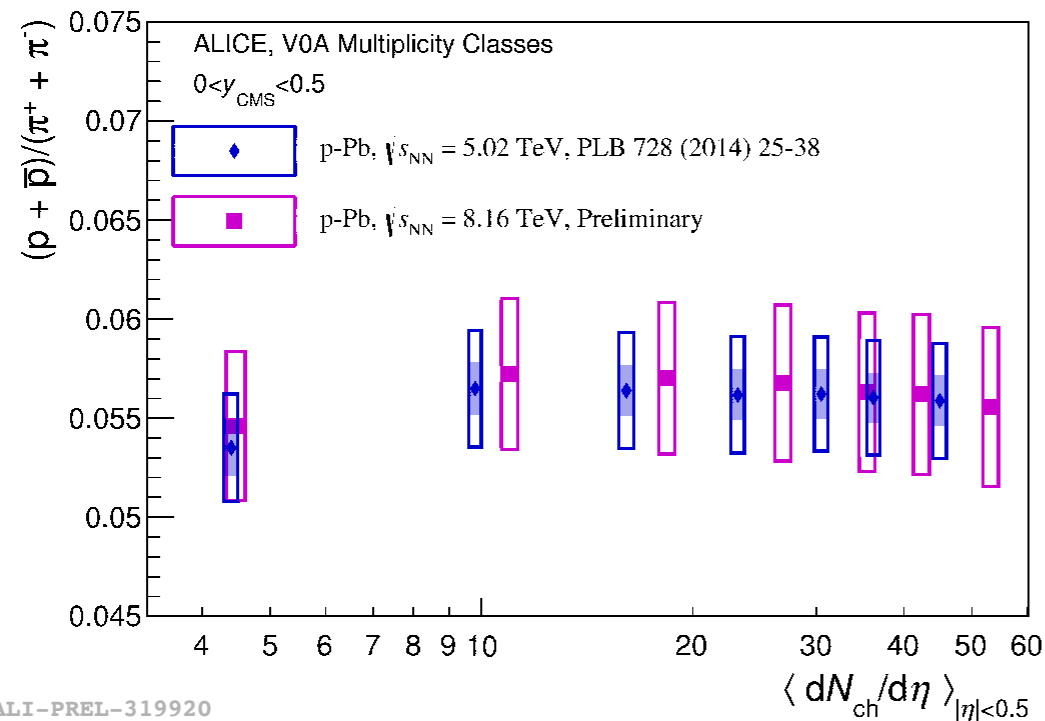
Yield ratios to pions



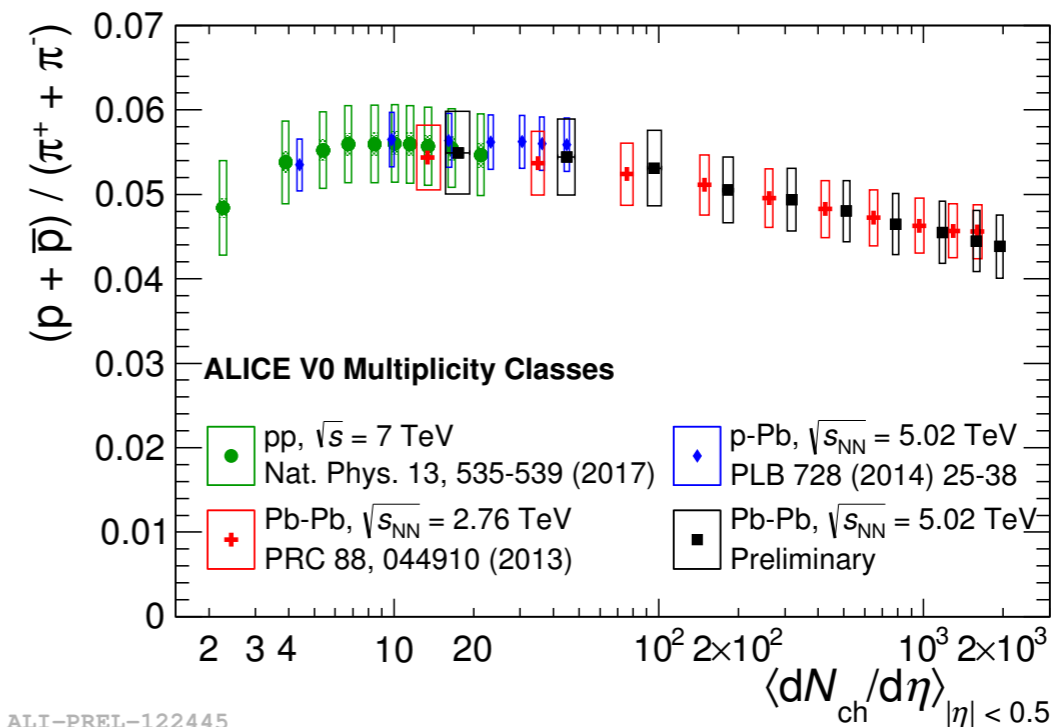
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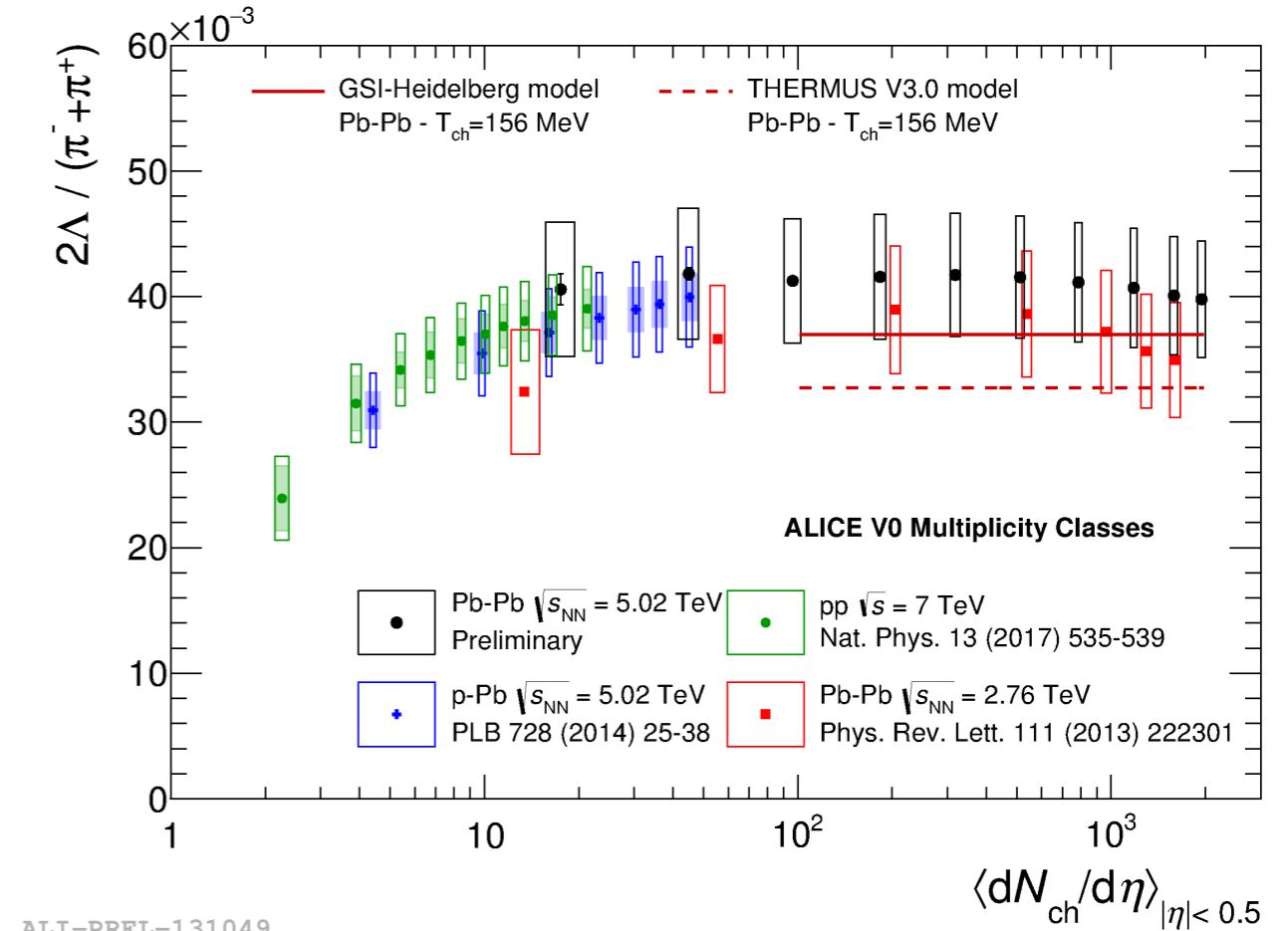
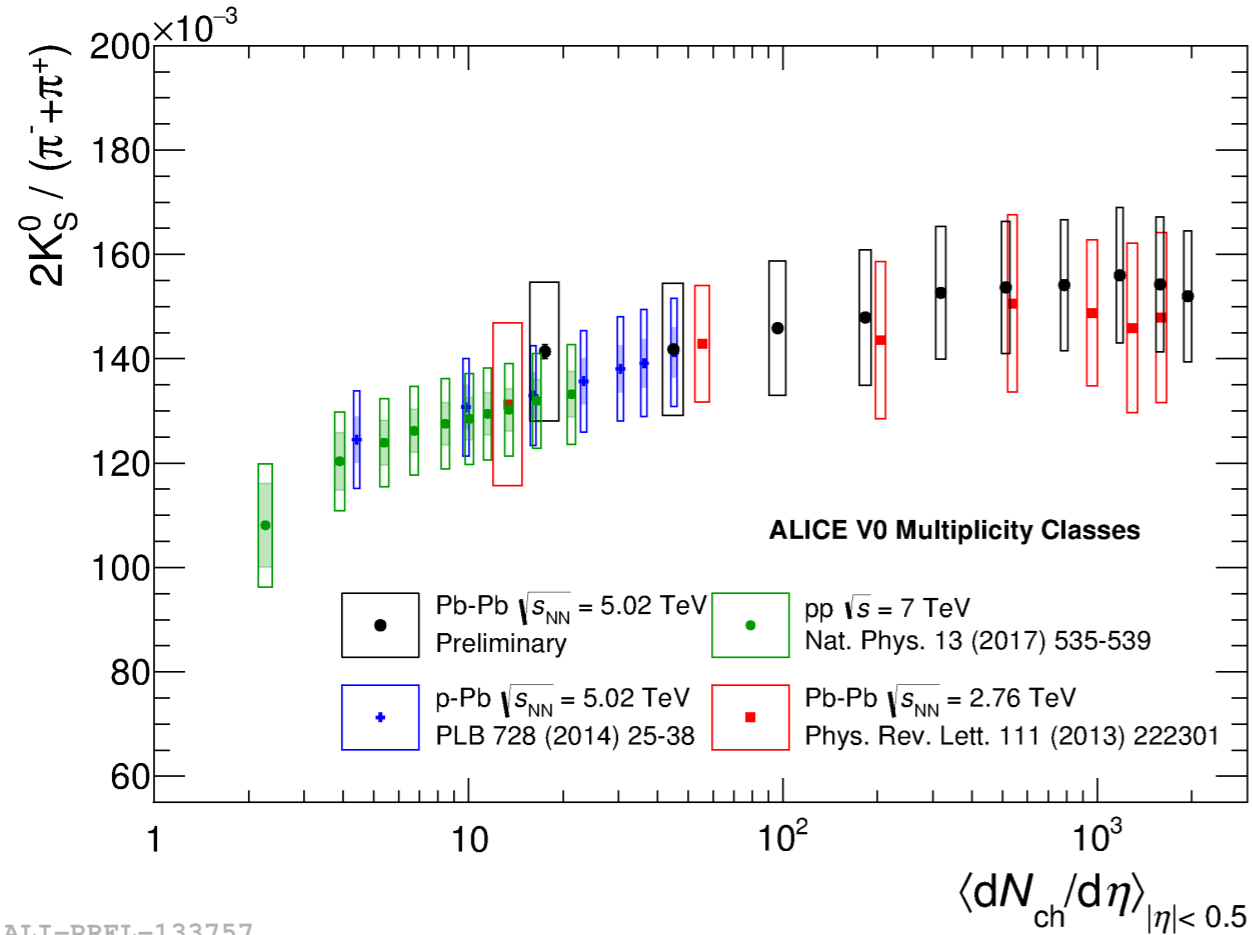
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ALI-PREL-122445

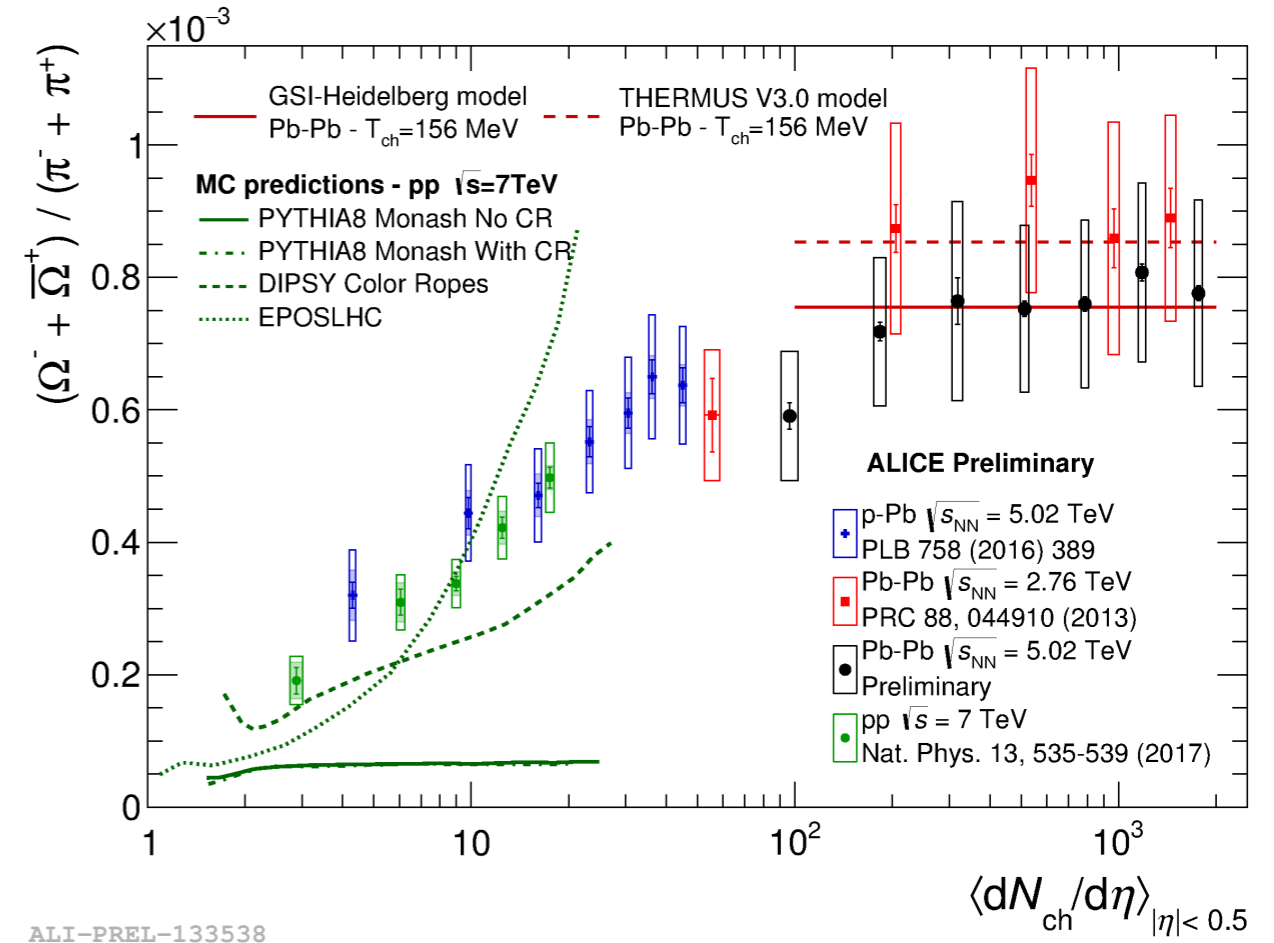
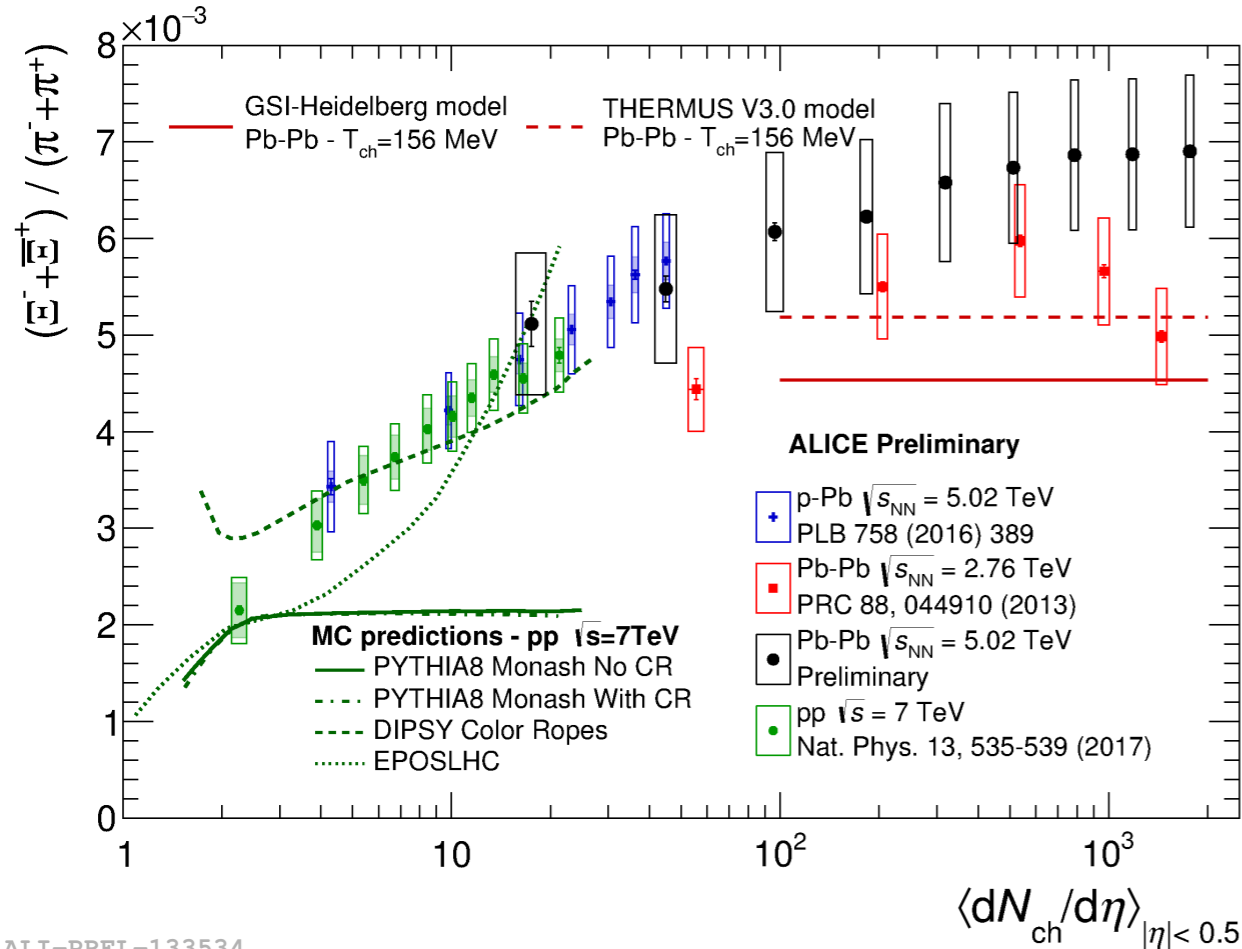
- No significant dependence on energy.
- K/ π ratio increase with multiplicity visible in p-Pb data.
- p/ π shows a hint of decrease with multiplicity in central and semi-central Pb-Pb data.

Yield ratios to pions



- Common trend for different systems and energies.
- Increase with multiplicity in small systems, saturation at high multiplicities.
- Steeper increase for particles with greater strangeness content.

Yield ratios to pions



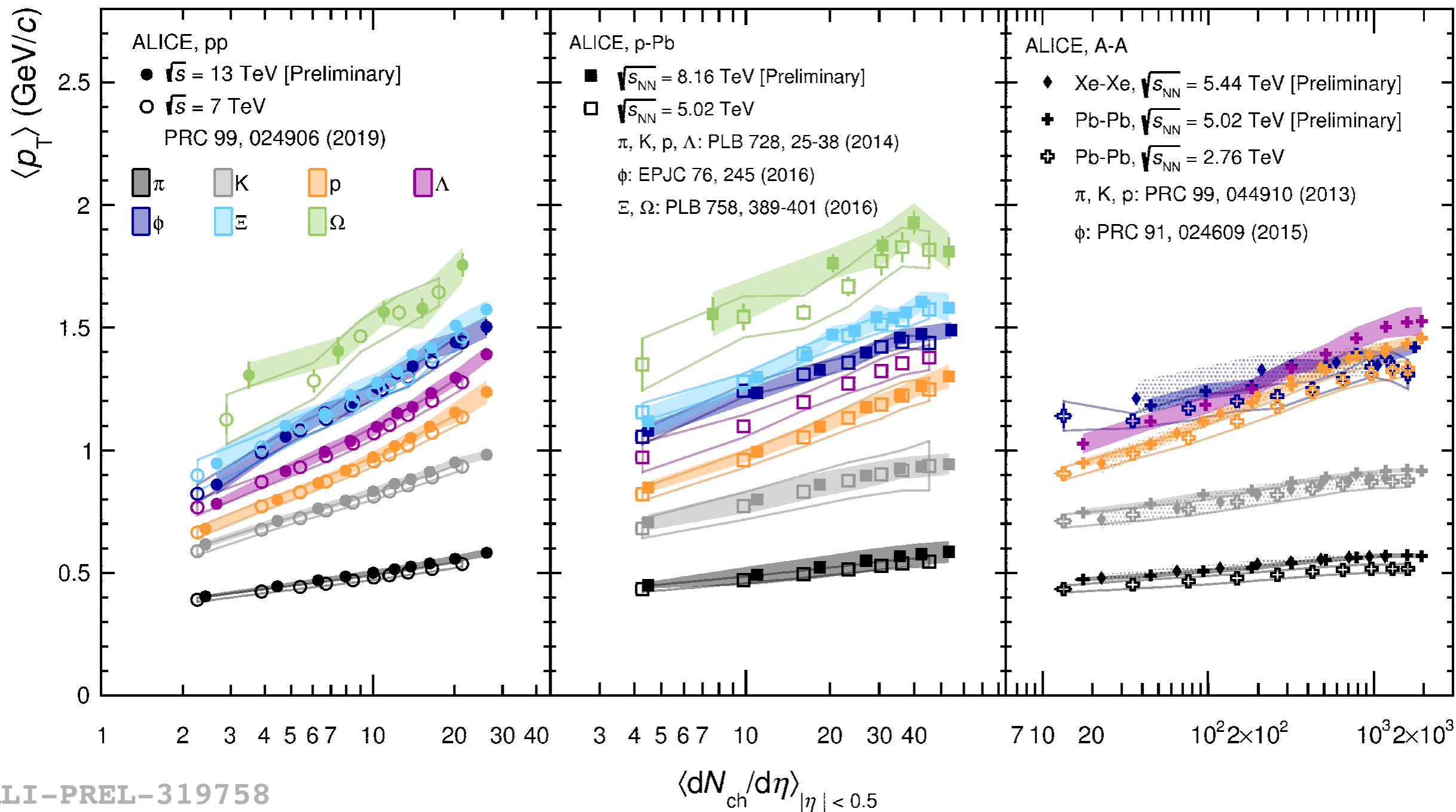
- Common trend for different systems and energies.
- Increase with multiplicity in small systems, saturation at high multiplicities.
- Steeper increase for particles with greater strangeness content.

Summary

- **Transverse momentum spectra:** mass dependent hardening with centrality, as expected from radial flow.
- **p_T -dependent spectra ratios:**
 - Distinctive peak at around 3 GeV/c in central Pb-Pb collisions.
 - Peak position moves slightly towards higher p_T with energy.
- **Nuclear modification factor:** no change with energy, although the spectra are significantly harder in 5.02 TeV w.r.t. 2.76 TeV in both pp and Pb-Pb.
- **Integrated yield of hadrons w.r.t. pion yields:**
 - Common trend for different systems and energies.
 - The enhancement from low to high multiplicities shows a dependence on particle strangeness content.

backup

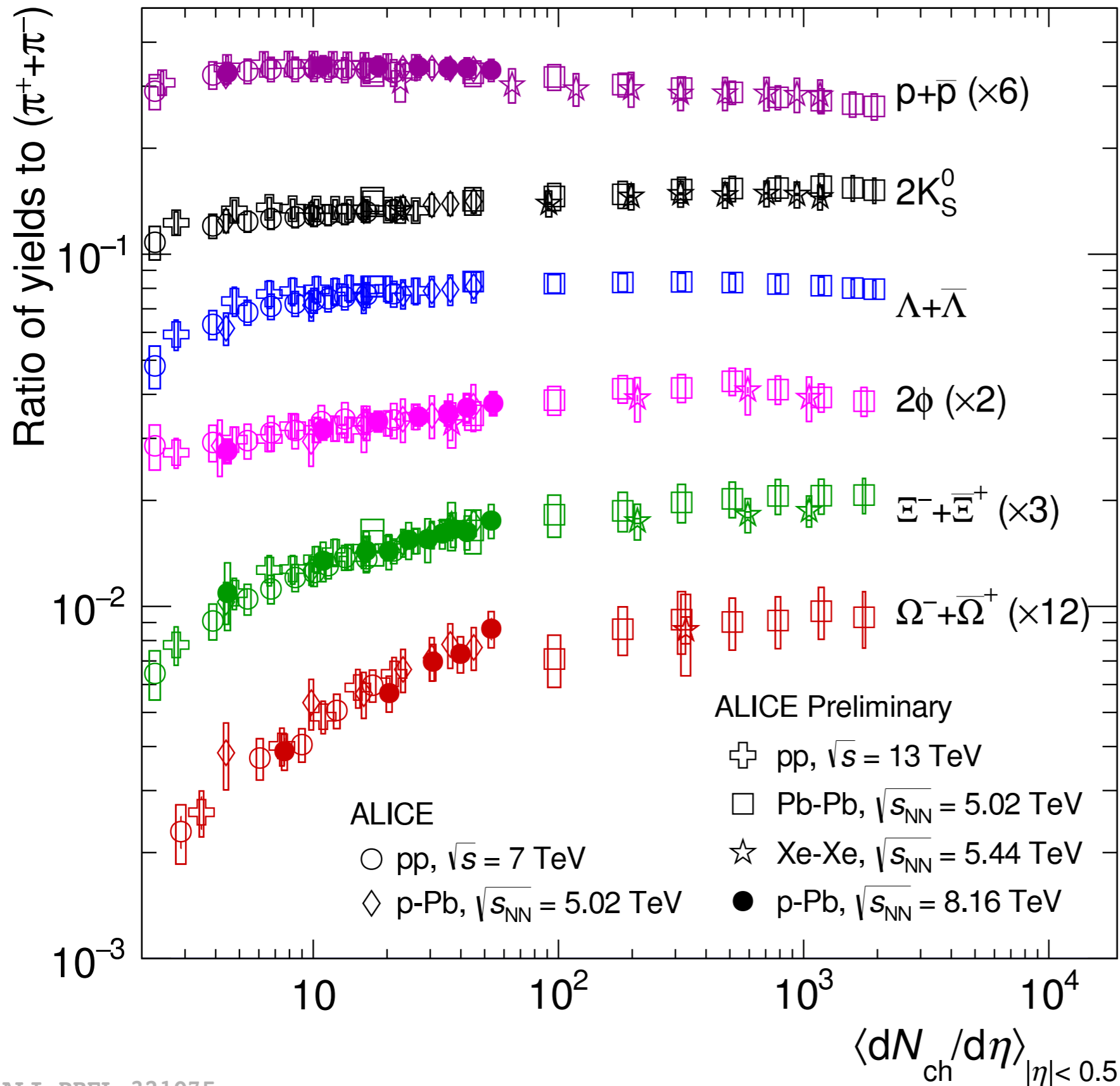
Mean transverse momentum



ALI-PREL-319758

- Mean p_T increases with multiplicity.
- Mass ordering.
- Slight energy increase.

Yield ratios to pions



- Common trend for different systems and energies.
- Increase with multiplicity in small systems, saturation at high multiplicities.
- Steeper increase for particles with greater strangeness content.