Strangeness in ALICE

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BIRMINGHAM SQM 2013

ALICE

UNIVERSITY OF BIRMINGHAM

Outline

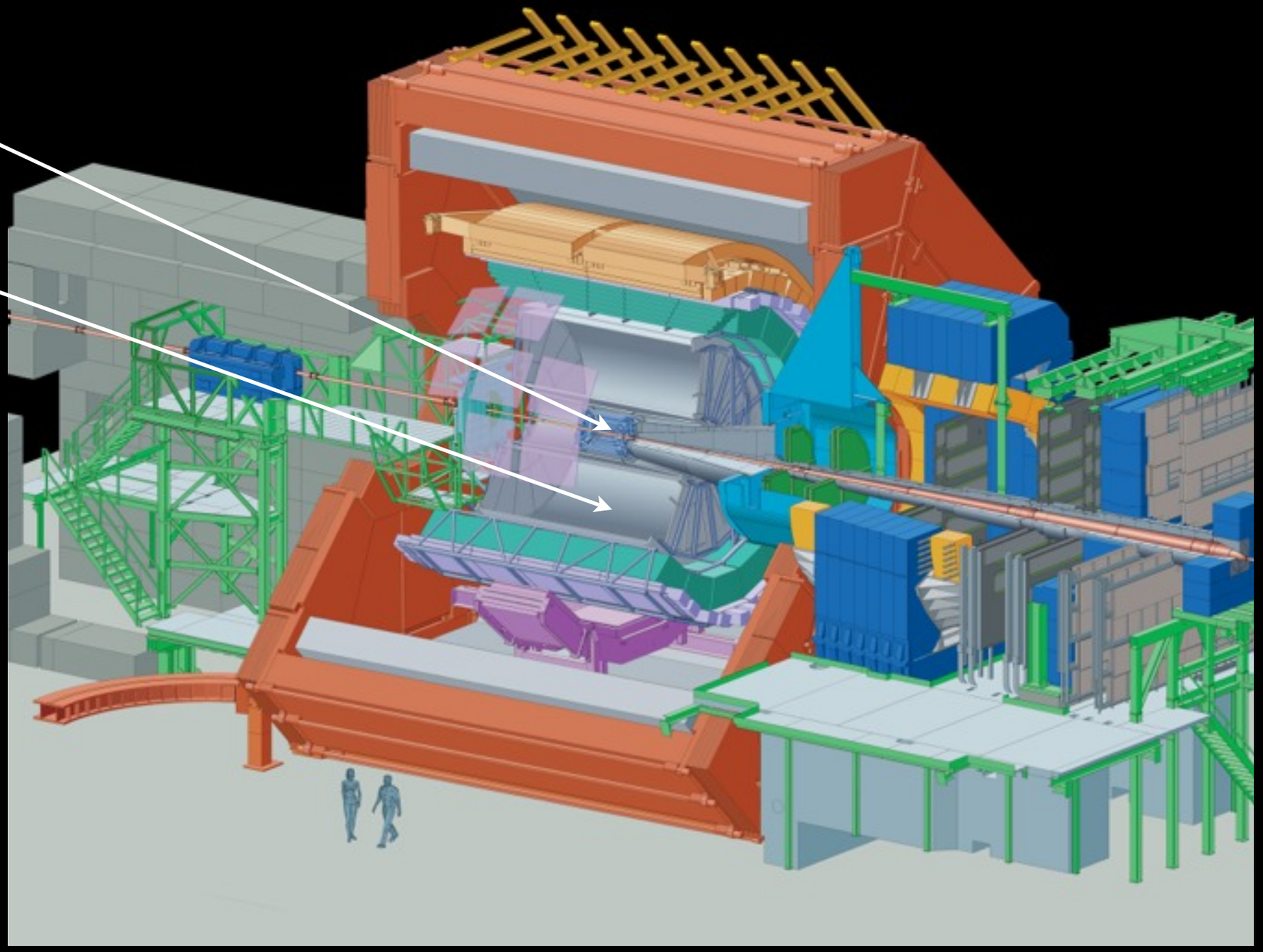
- Motivation
- ALICExperiment
- Strangeness enhancement
- Statistical Model fit
- Limits on exotic states
- Resonances
- Nuclear modification factor
- Conclusion

Motivation

- Characterisation of the integrated yields of particle species
  - described in a common framework?
  - differences due to light (u,d) and strange constituents?
- Description of the p_T spectra and links to the hadronisation process
- Does the suppression of particles at high p_T show any dependence on the species
  - strange or non-strange, baryon or meson?
  - constraints on models of parton energy loss?

ALICE

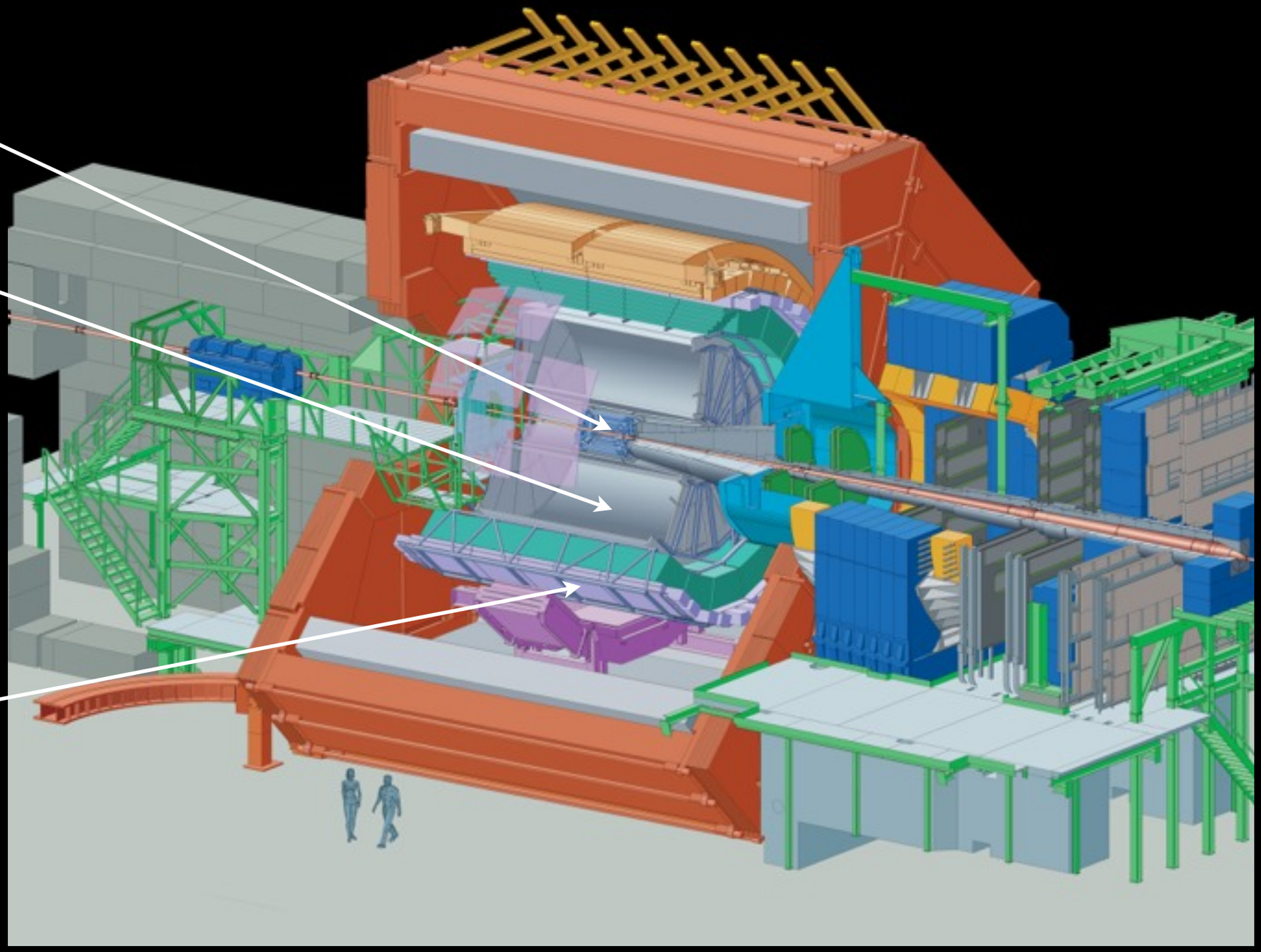
TPC and ITS
for tracking



ALICE

TPC and ITS
for tracking

TPC, ITS and
TOF for PID

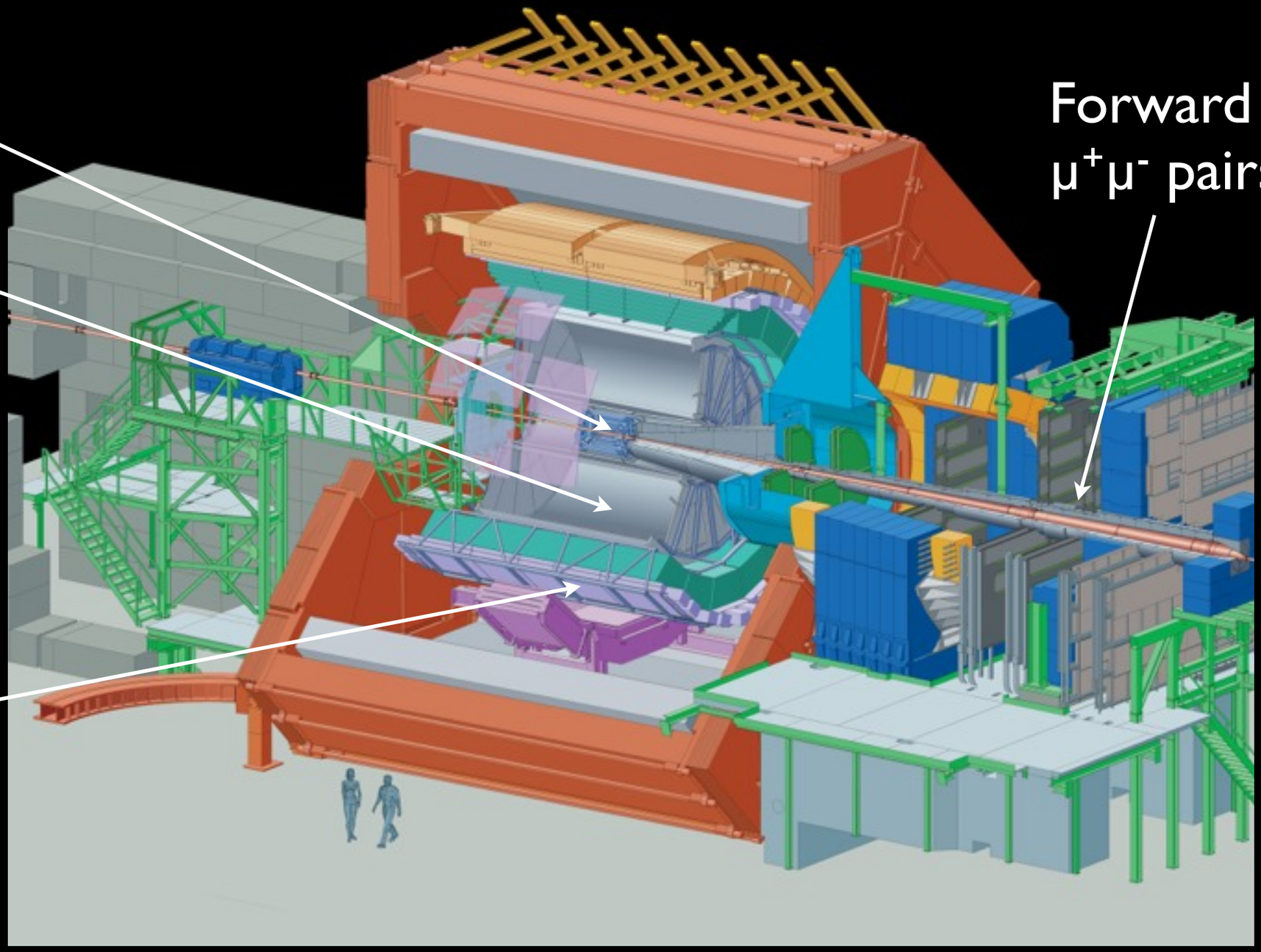


ALICE

TPC and ITS
for tracking

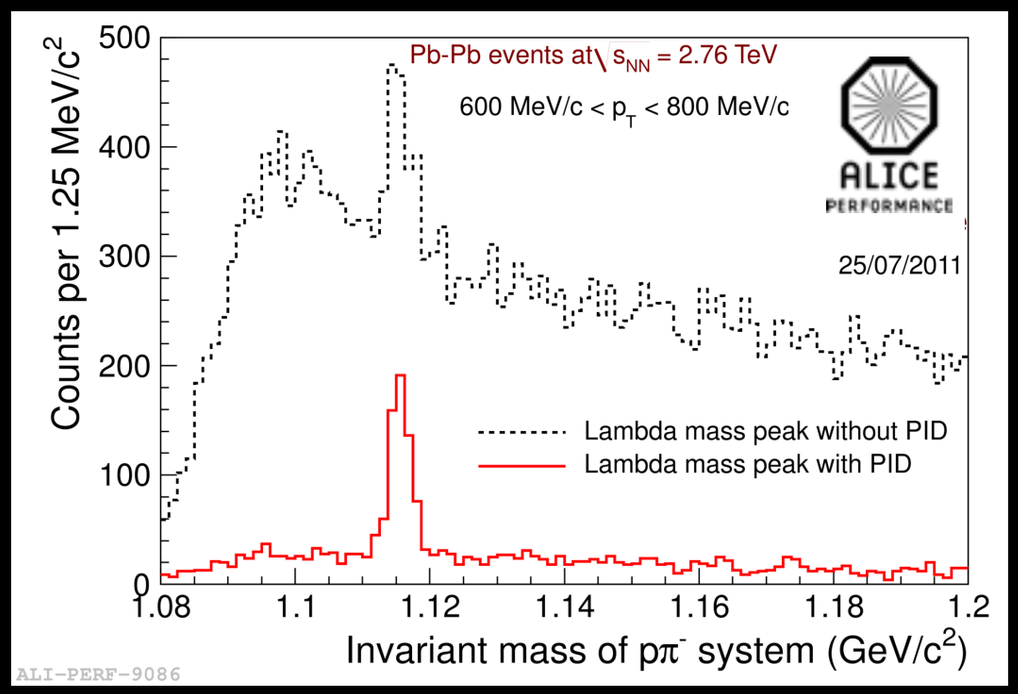
Forward
$\mu^+\mu^-$ pairs

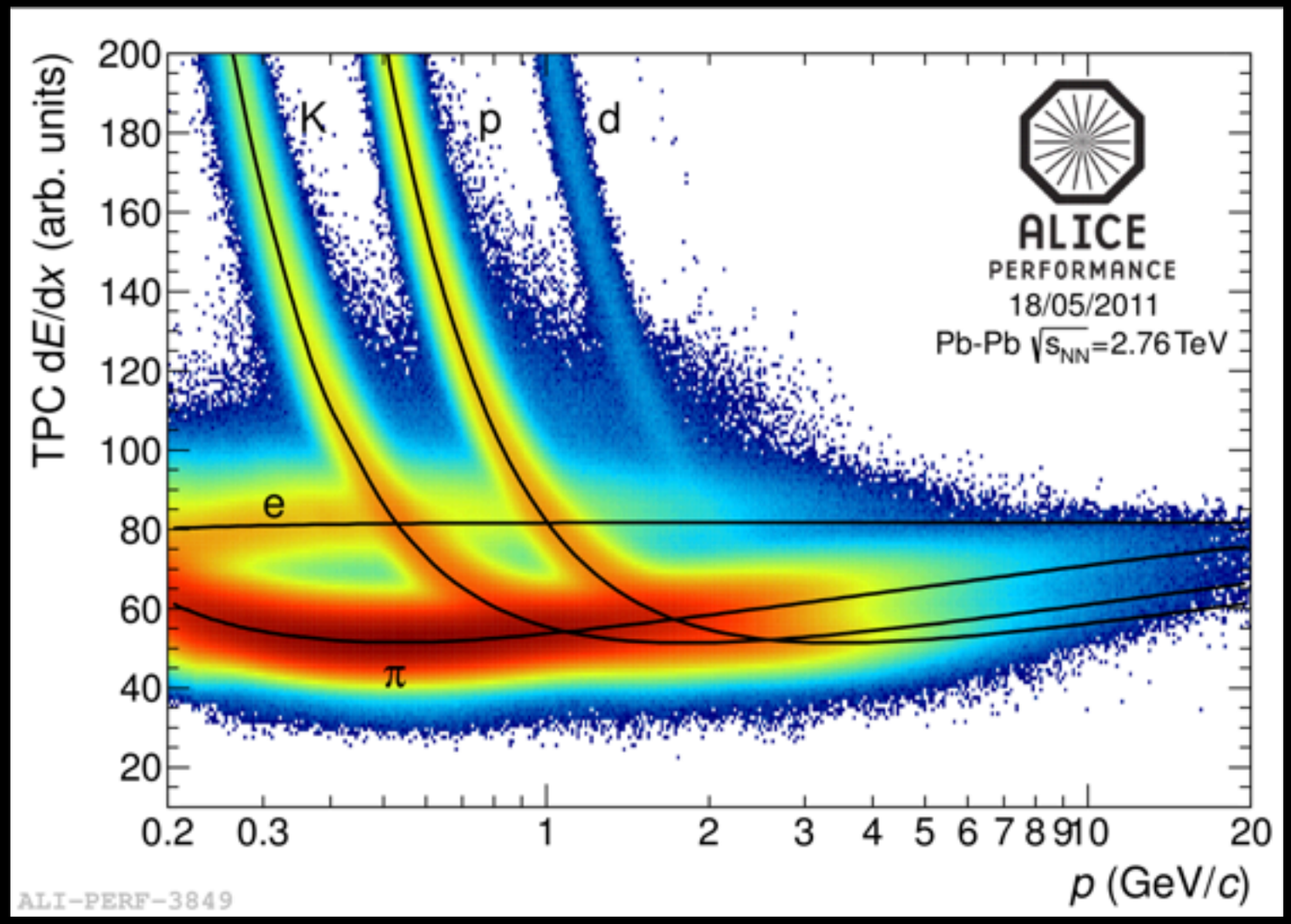
TPC, ITS and
TOF for PID



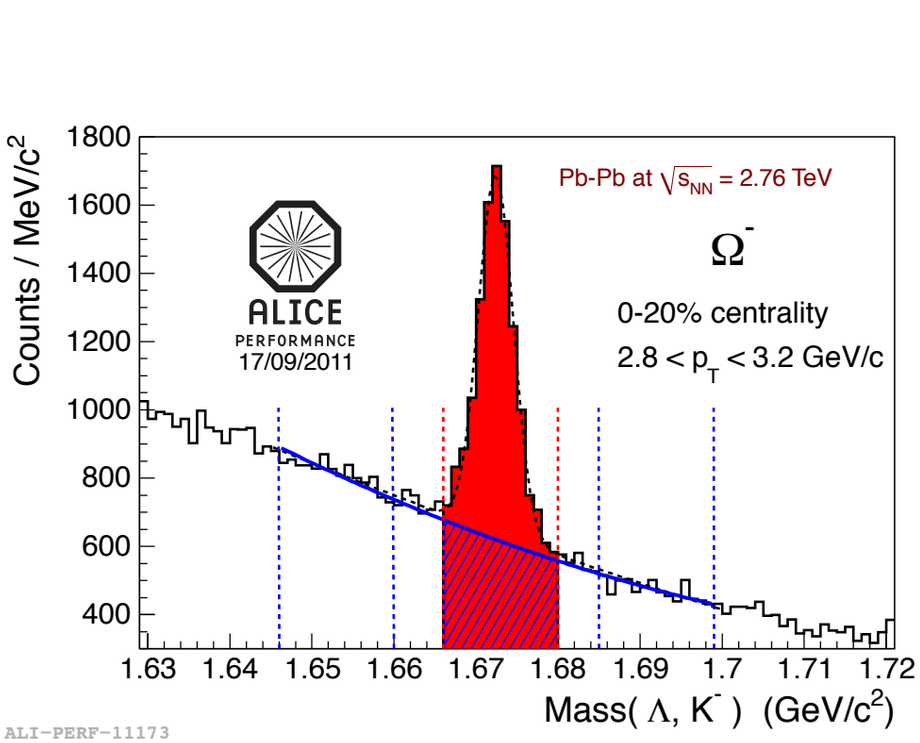
PID

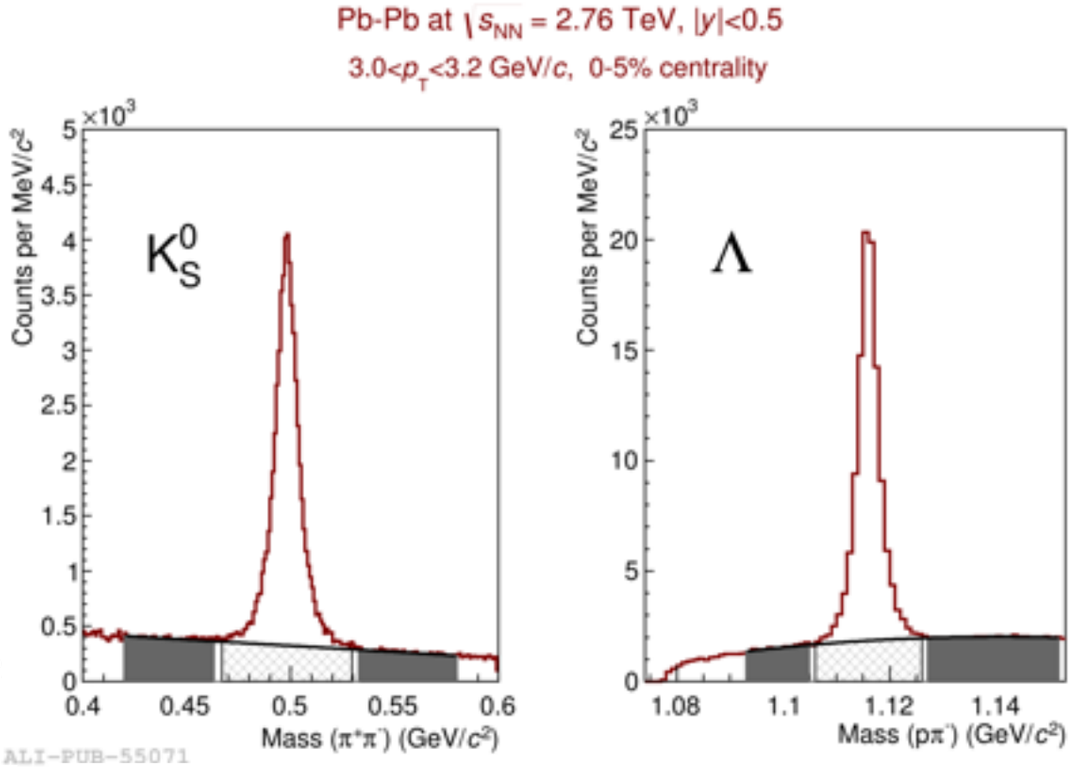
- E.g. TPC d*E*/d*x* essential for good strangeness measurements

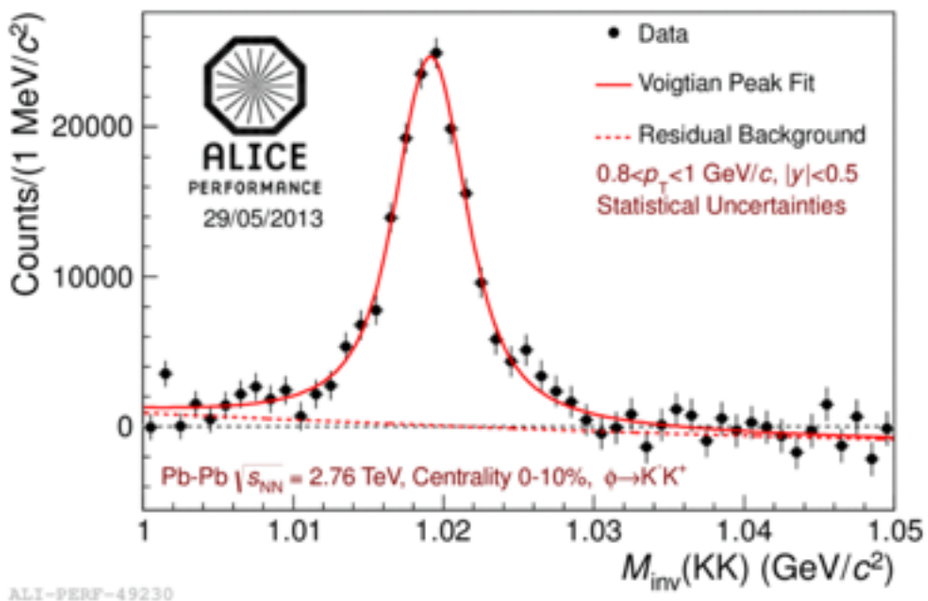


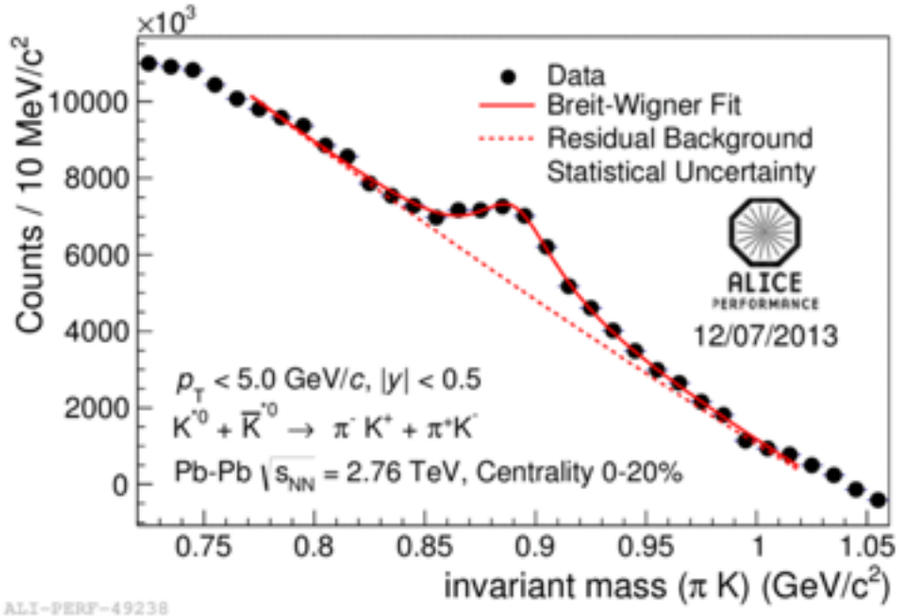


Invariant mass









Topological identification of weak decays

Invariant mass with statistical background subtracted

Strangeness Enhancement

See talk of D. Colella

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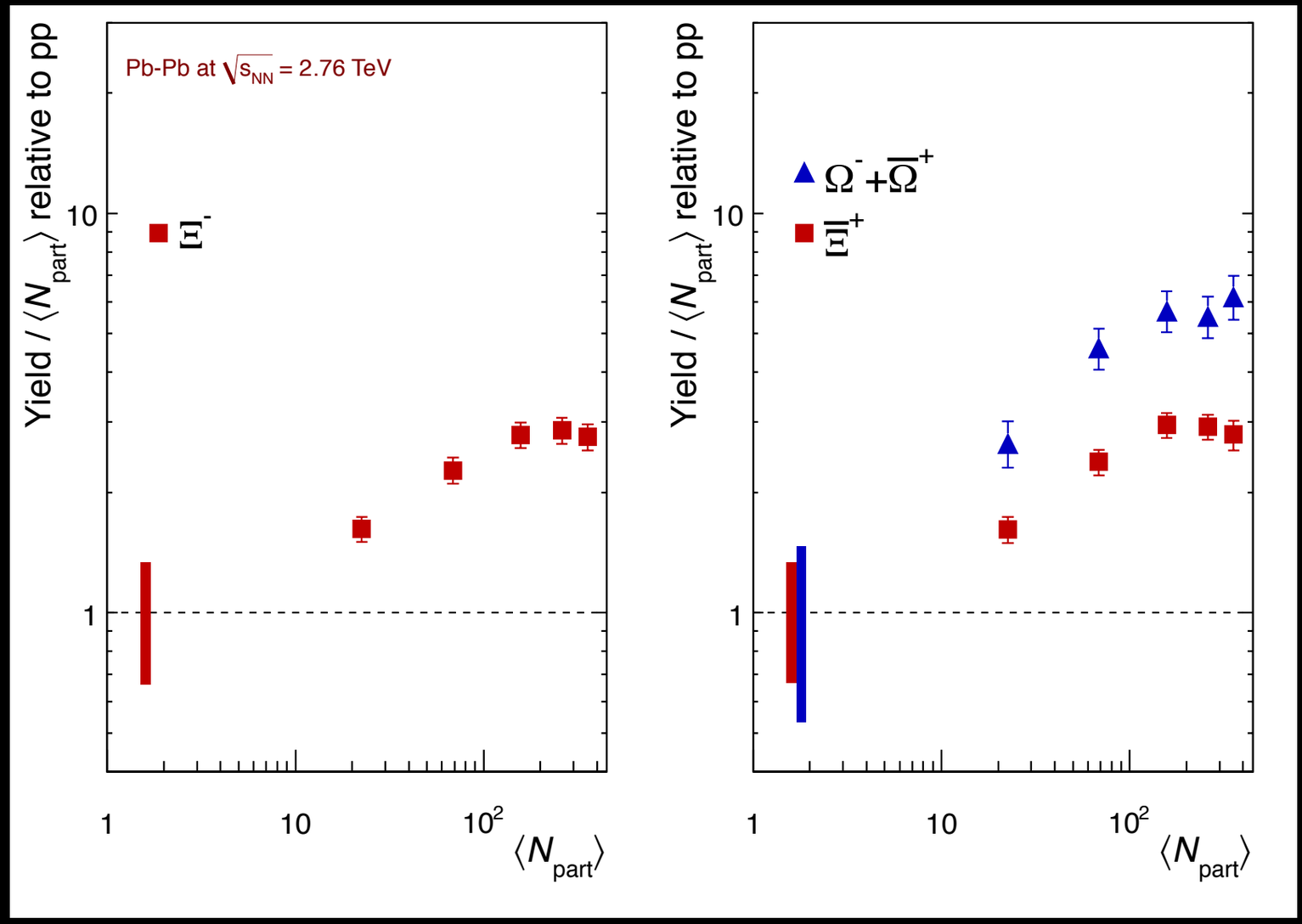
$$E = \frac{\frac{dN}{dy}_{PbPb} / N_{part}}{\frac{dN}{dy}_{pp} / 2}$$

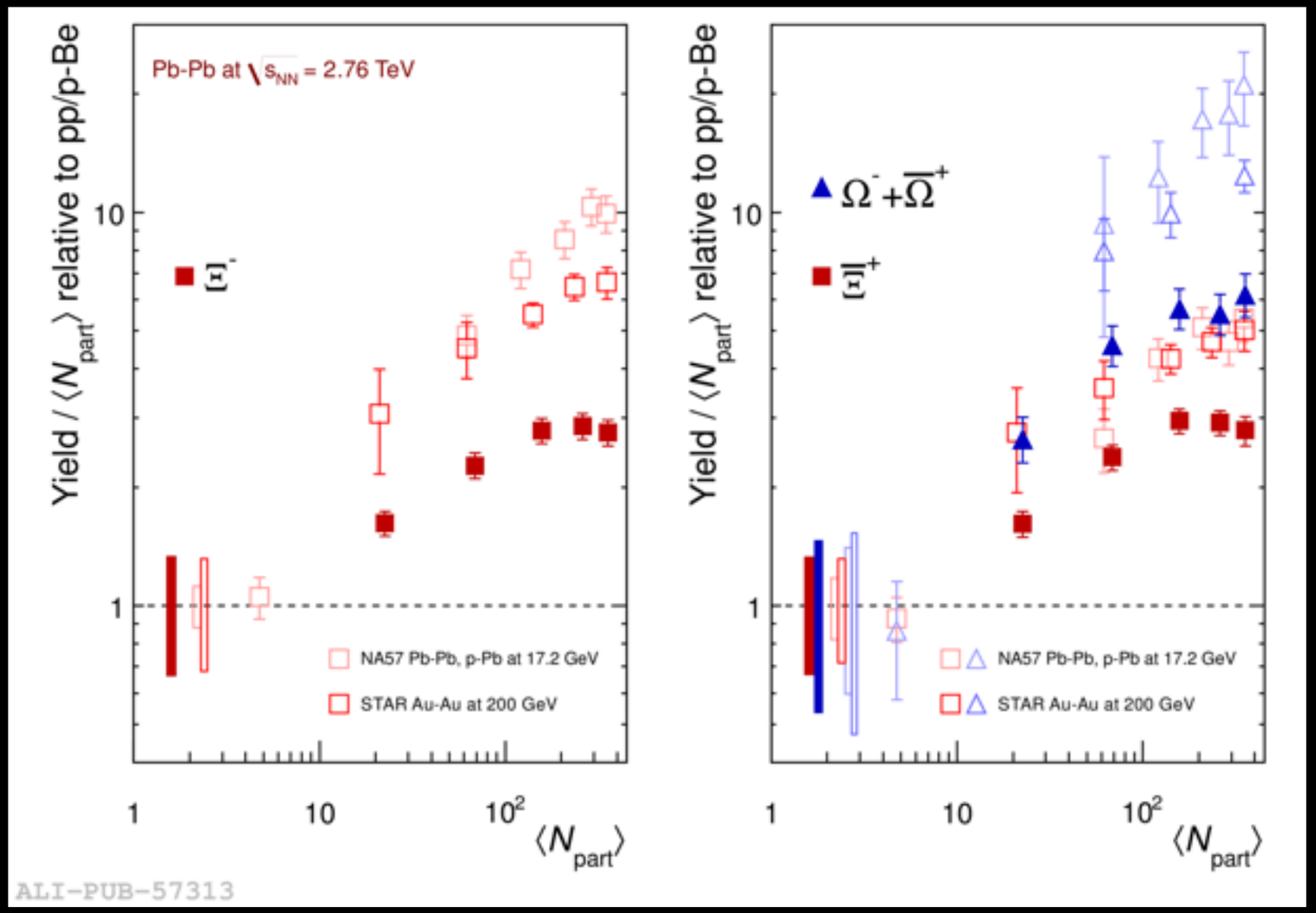
- *Participant-scaled* yield relative to pp collisions
- Hierarchy based on strangeness content
- E(S=3) > E(S=2)



Strangeness Enhancement

$$E = \frac{\frac{dN}{dy}_{PbPb}/N_{part}}{\frac{dN}{dy}_{pp}/2}$$

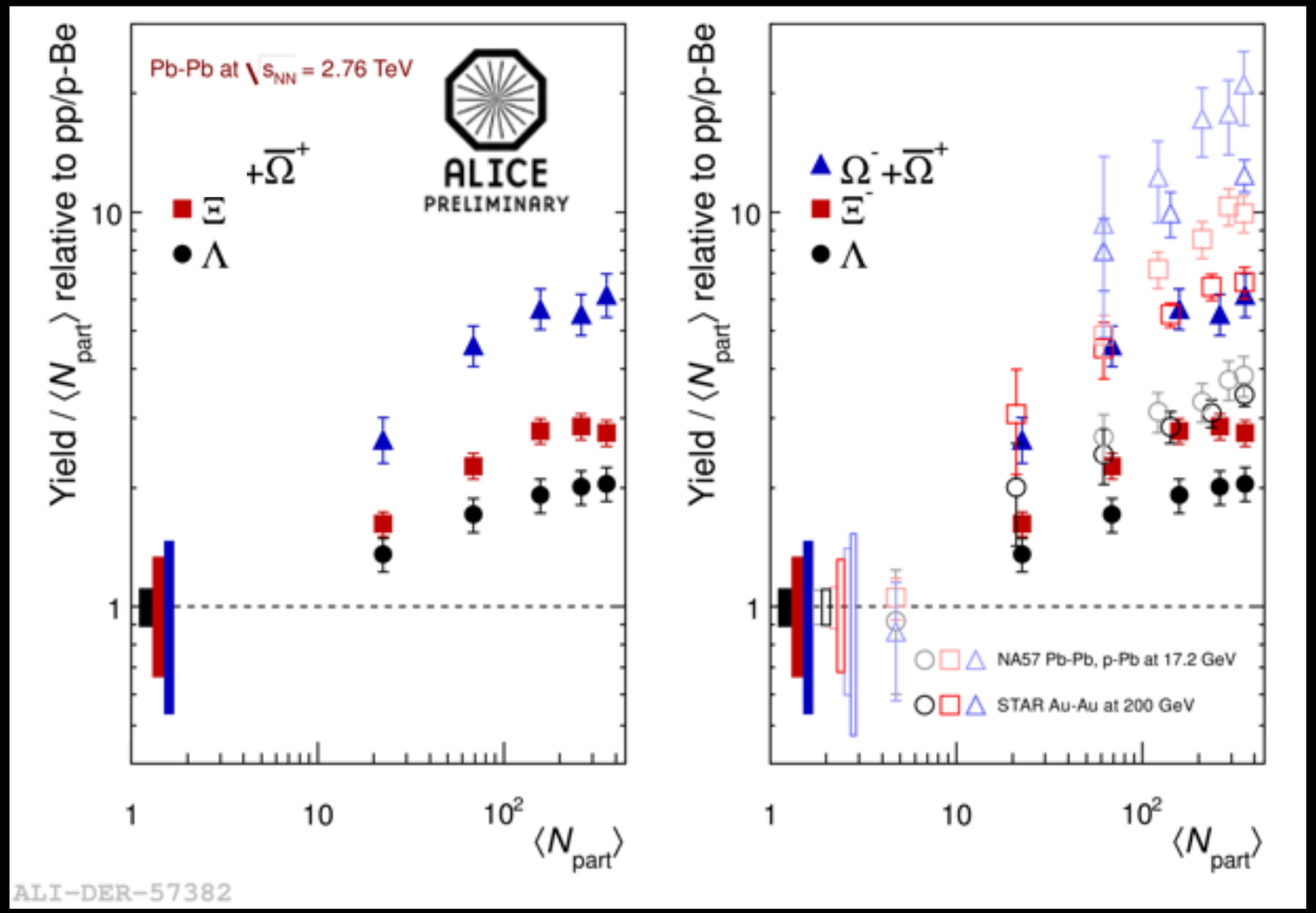
- Larger enhancement at lower $\sqrt{s}$
- E(SPS) > E(RHIC) > E(LHC)



Strangeness Enhancement

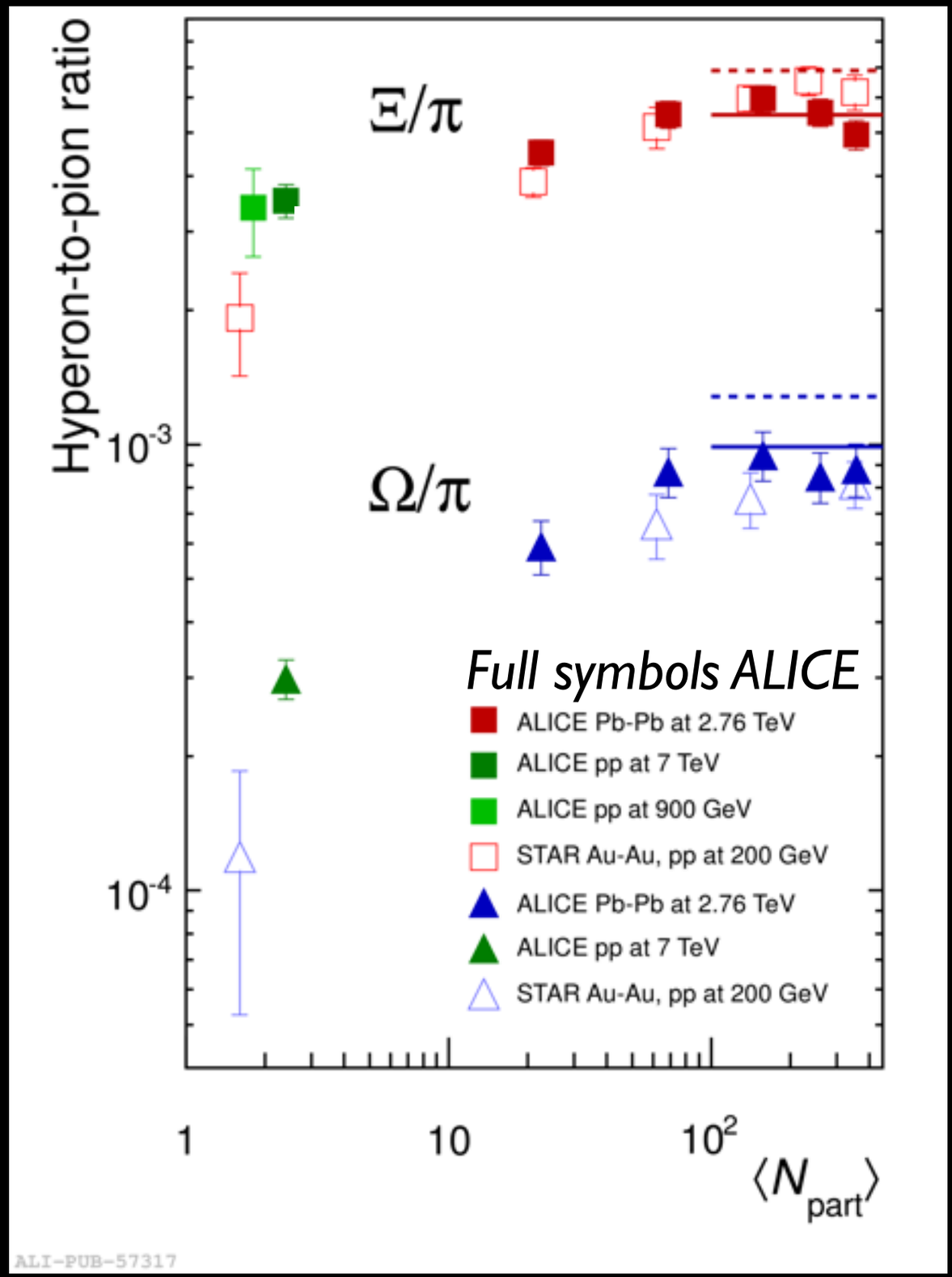
$$E = \frac{\frac{dN}{dy}_{PbPb}/N_{part}}{\frac{dN}{dy}_{pp}/2}$$

- Including also Λ
- E(S=3) > E(S=2) > E(S=1)



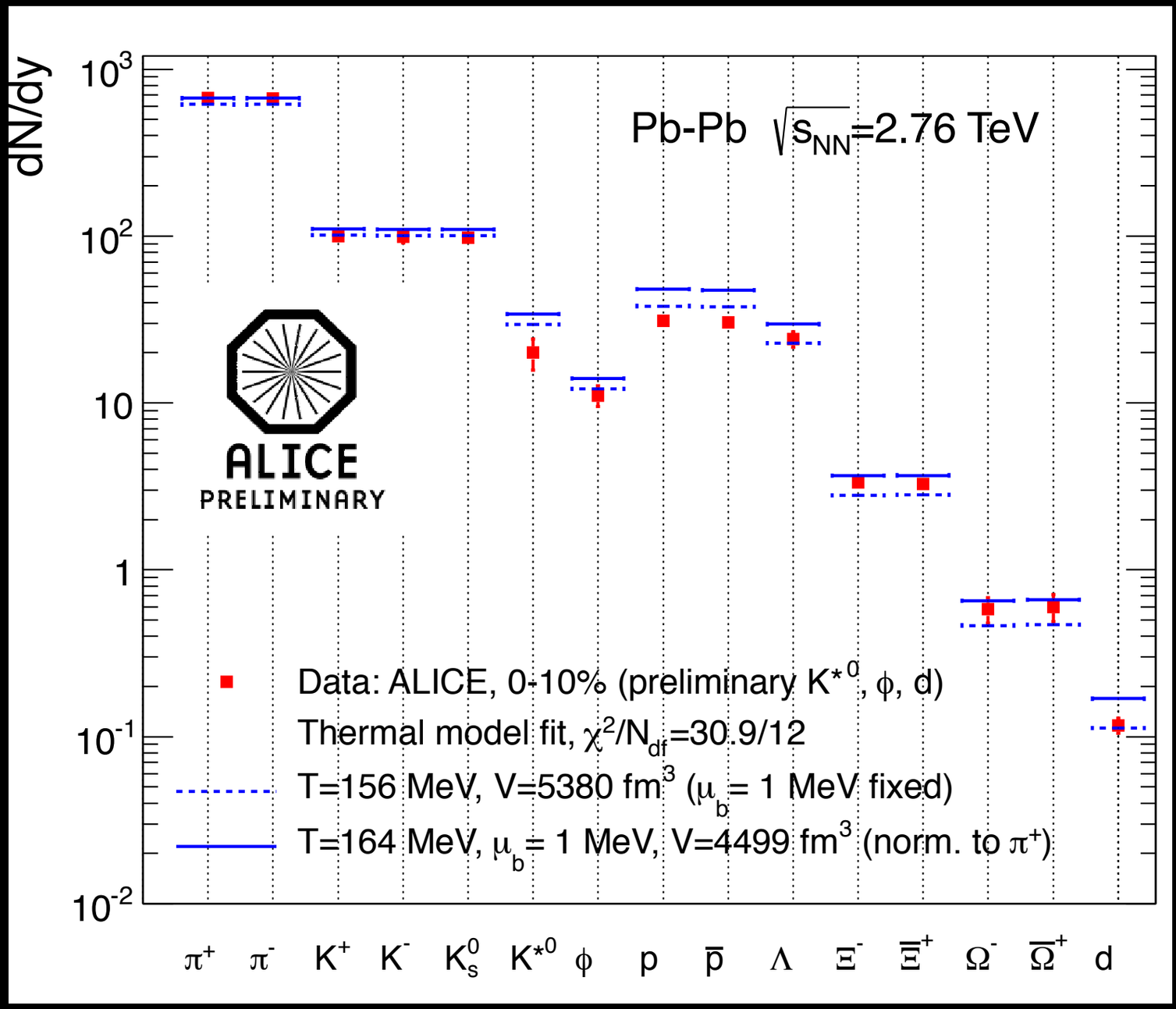
Multi-strange $\sqrt{s}$ dependence

- Compare the baseline production in pp
  - normalise to π
- As $\sqrt{s}$ increases the Ω/π and Ξ/π ratios in pp approach their values in AA collisions



Statistical Model Fit

- Final dN/dy values for π, K, p, Λ, Ξ and Ω
- *Equilibrium* thermal model fit to ALICE measurements
- Clearly prefers a lower T value of 156 MeV compared to expected 164 MeV
- Tension between species



K* not included in fit

Dibaryons

See talk of B. Doenigus

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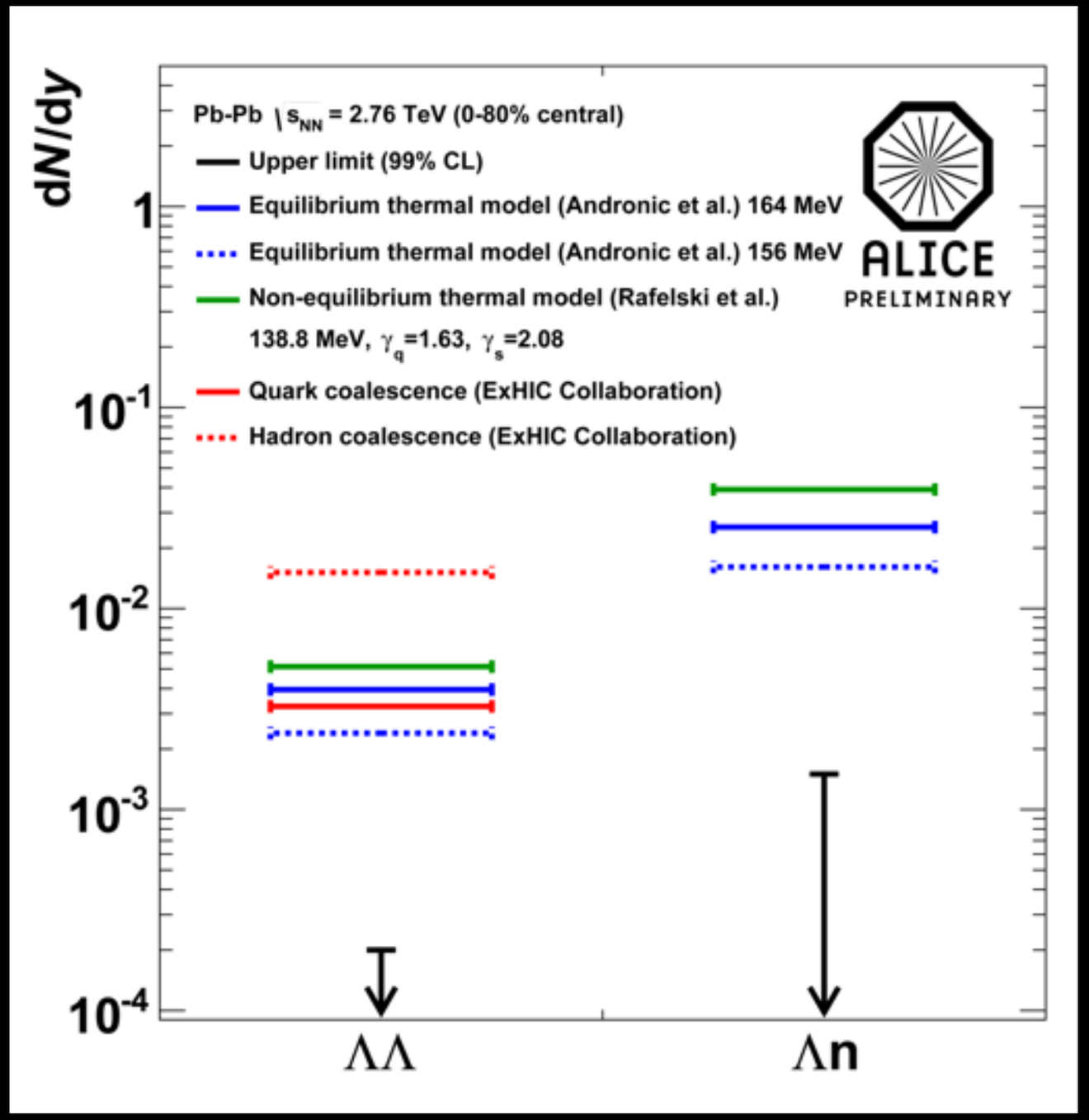
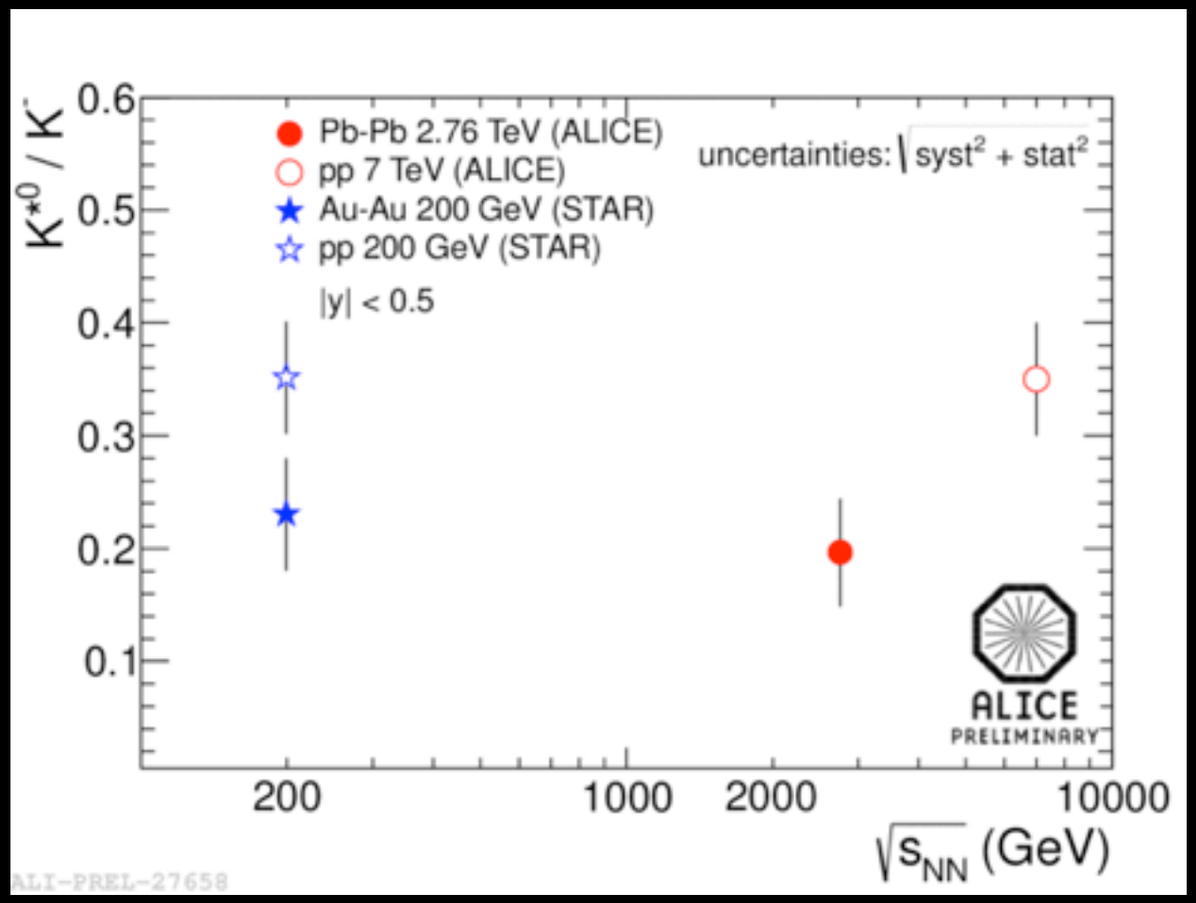
- Upper limits set on production of ΛΛ (H-dibaryon) and Λn states
- Limits physically interesting w.r.t. model expectations

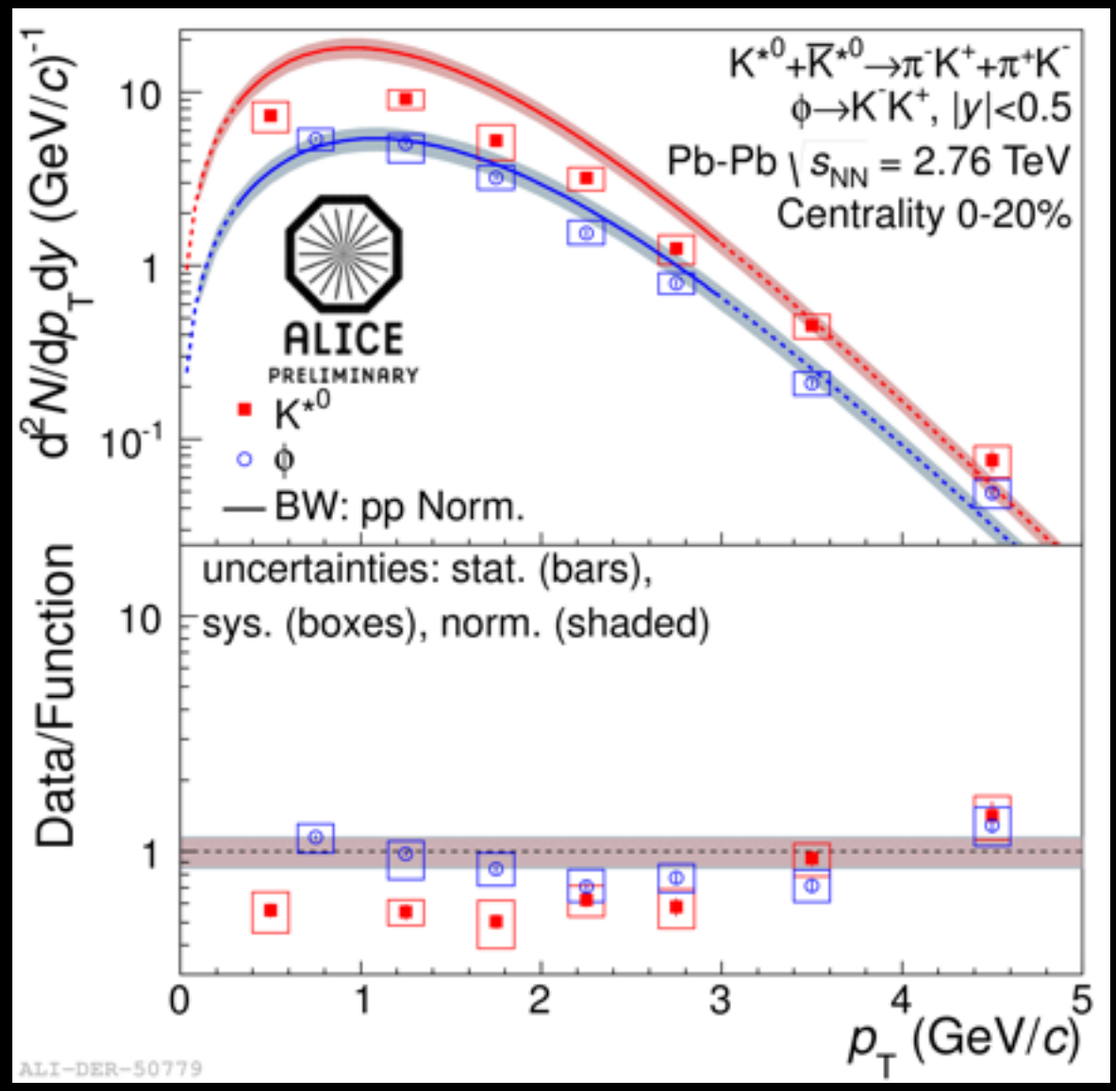


Resonances

See talk of A. Knospe



- K*/K ratio lower in Pb-Pb than pp
- Comparison of spectra to blast-wave expectation
  - fixed to π, K, p



Constant in p_T below 3 GeV/c

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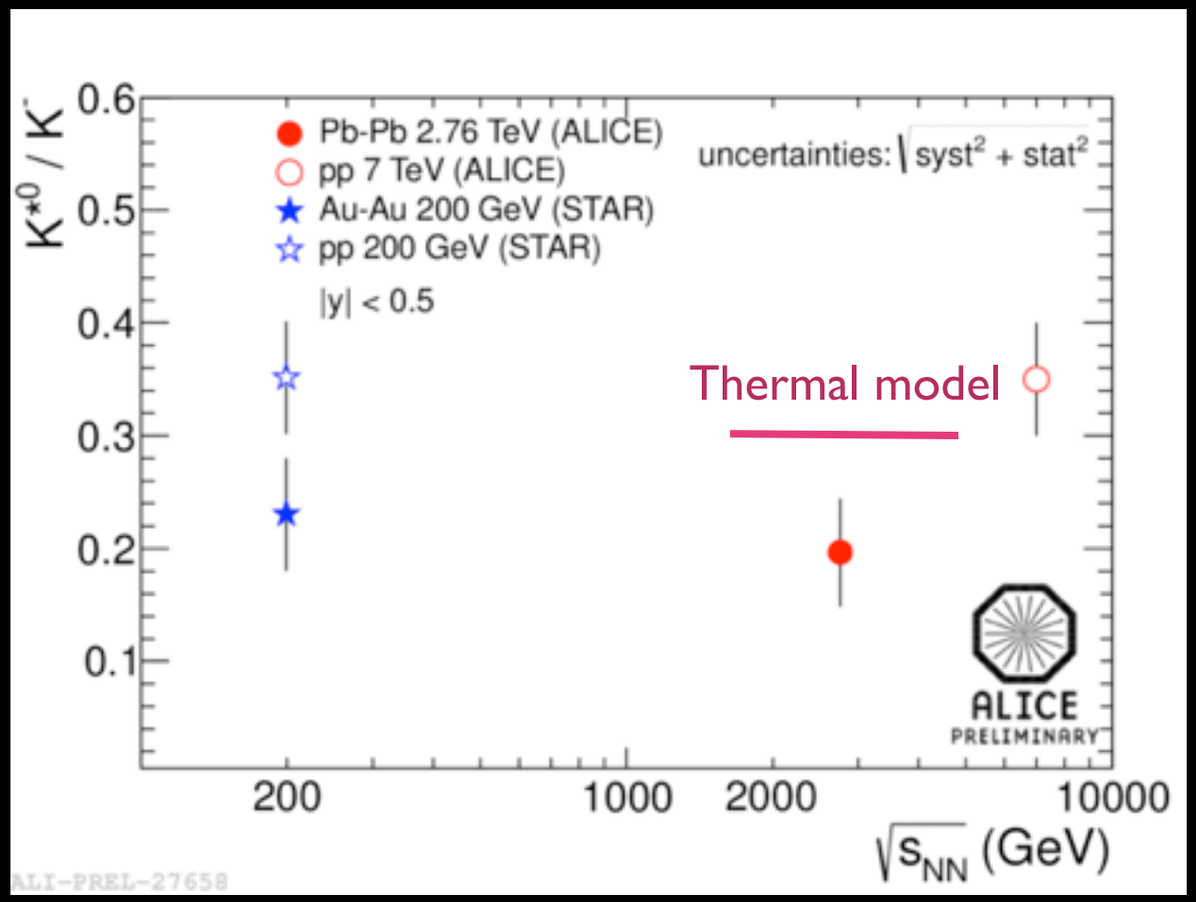

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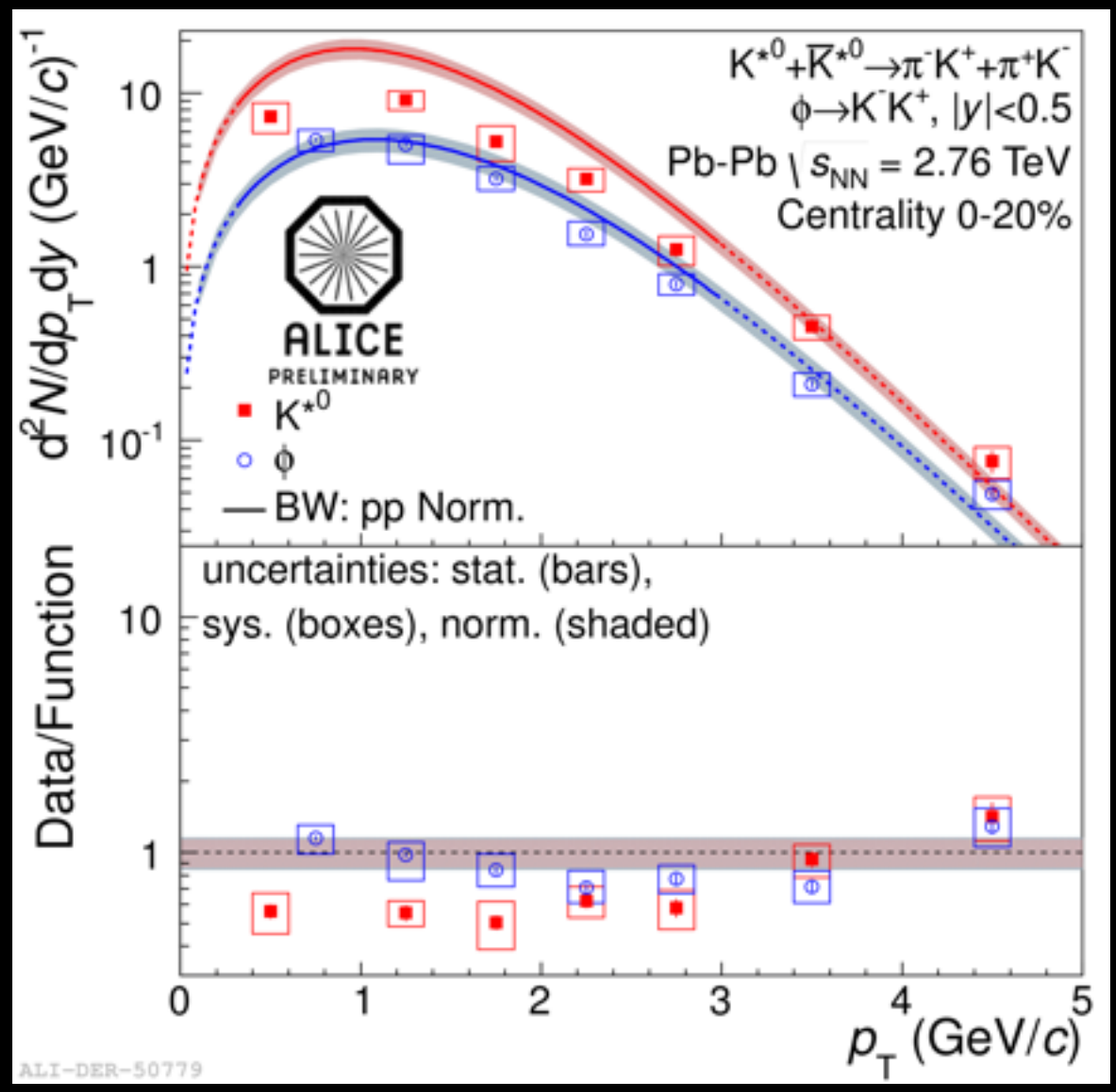
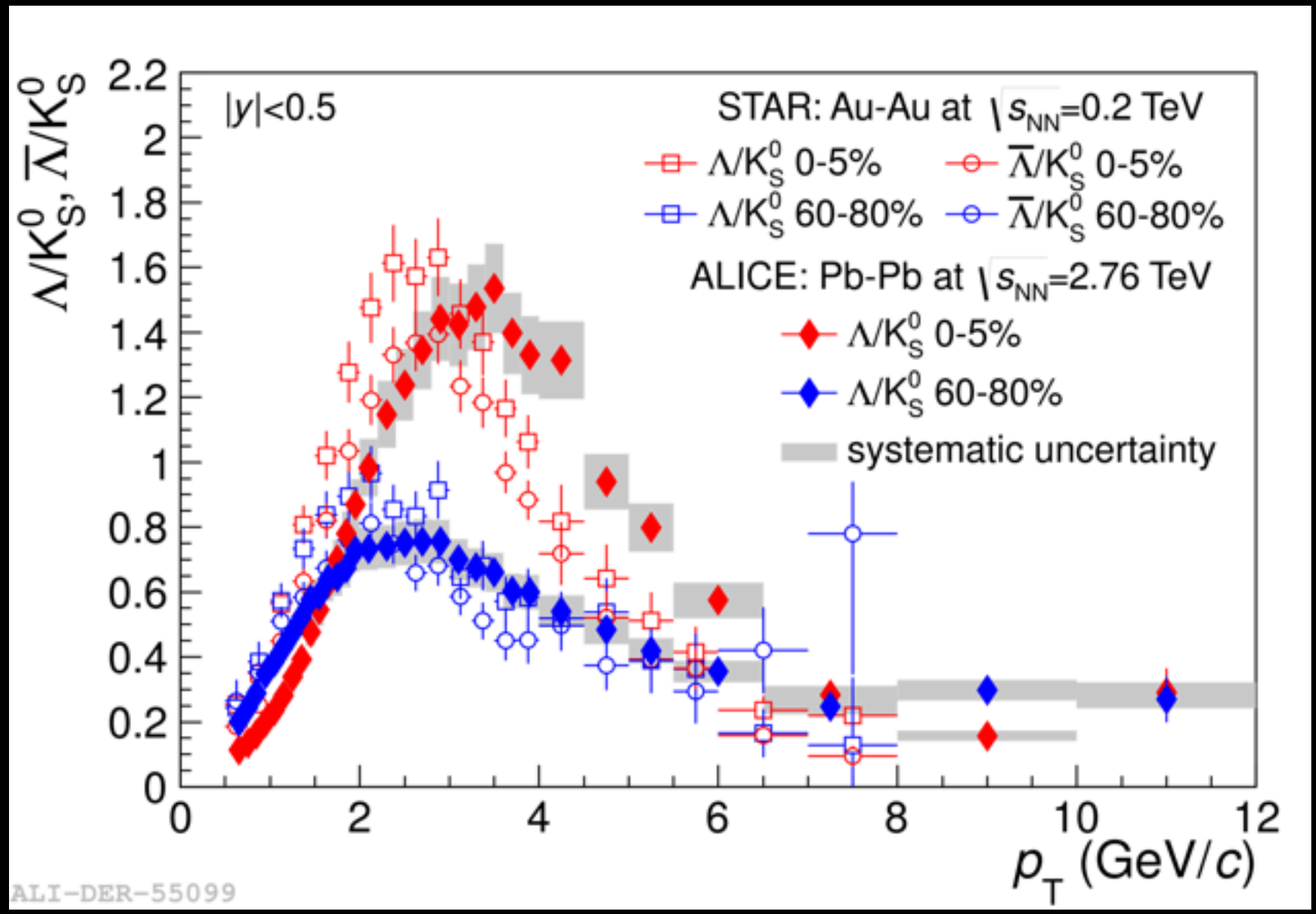


Constant in p_T below 3 GeV/c

Intermediate p_T

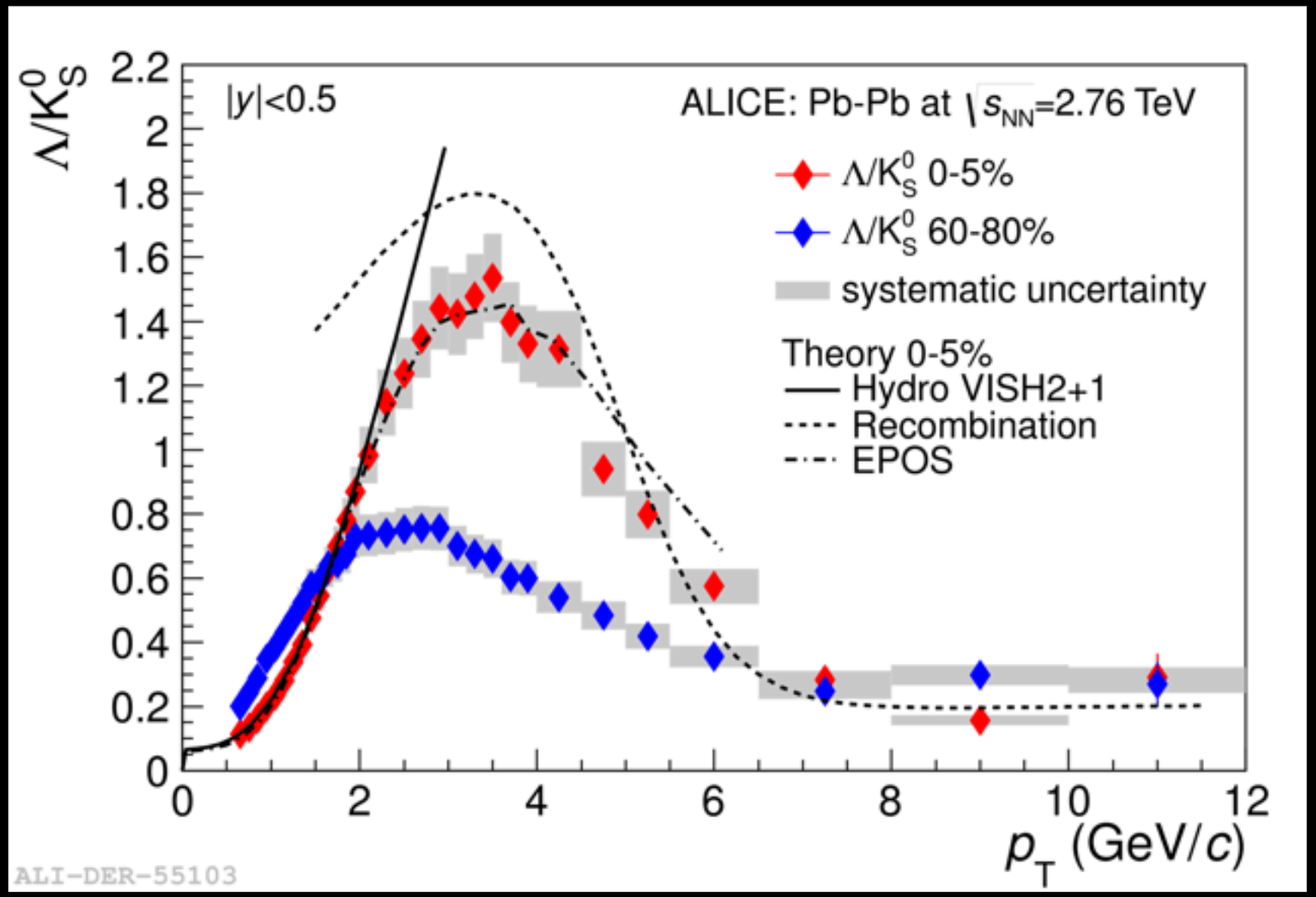
See talk of L. Hanratty

- Baryon/meson ratio: Λ/K^0
- Striking maximum
  - very similar maximum value to STAR
  - occurs at larger a p_T
- Excess in central w.r.t peripheral persists to higher p_T



Theory comparison

- Hydro model works well at low p_T
- Recombination calculation gets correct shape
- EPOS successfully describing transition



p-Pb ratio result

See talk of J.Anielski

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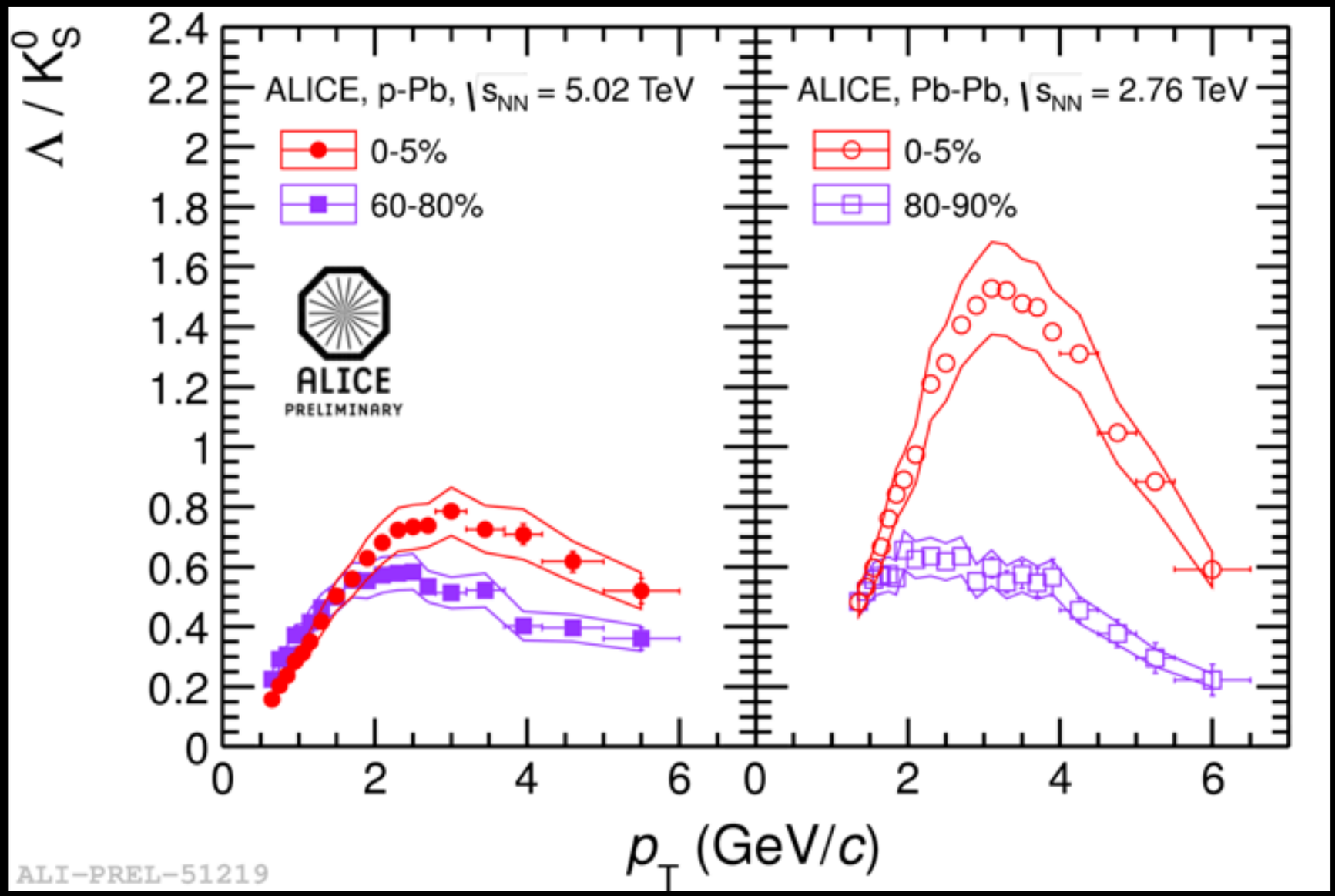
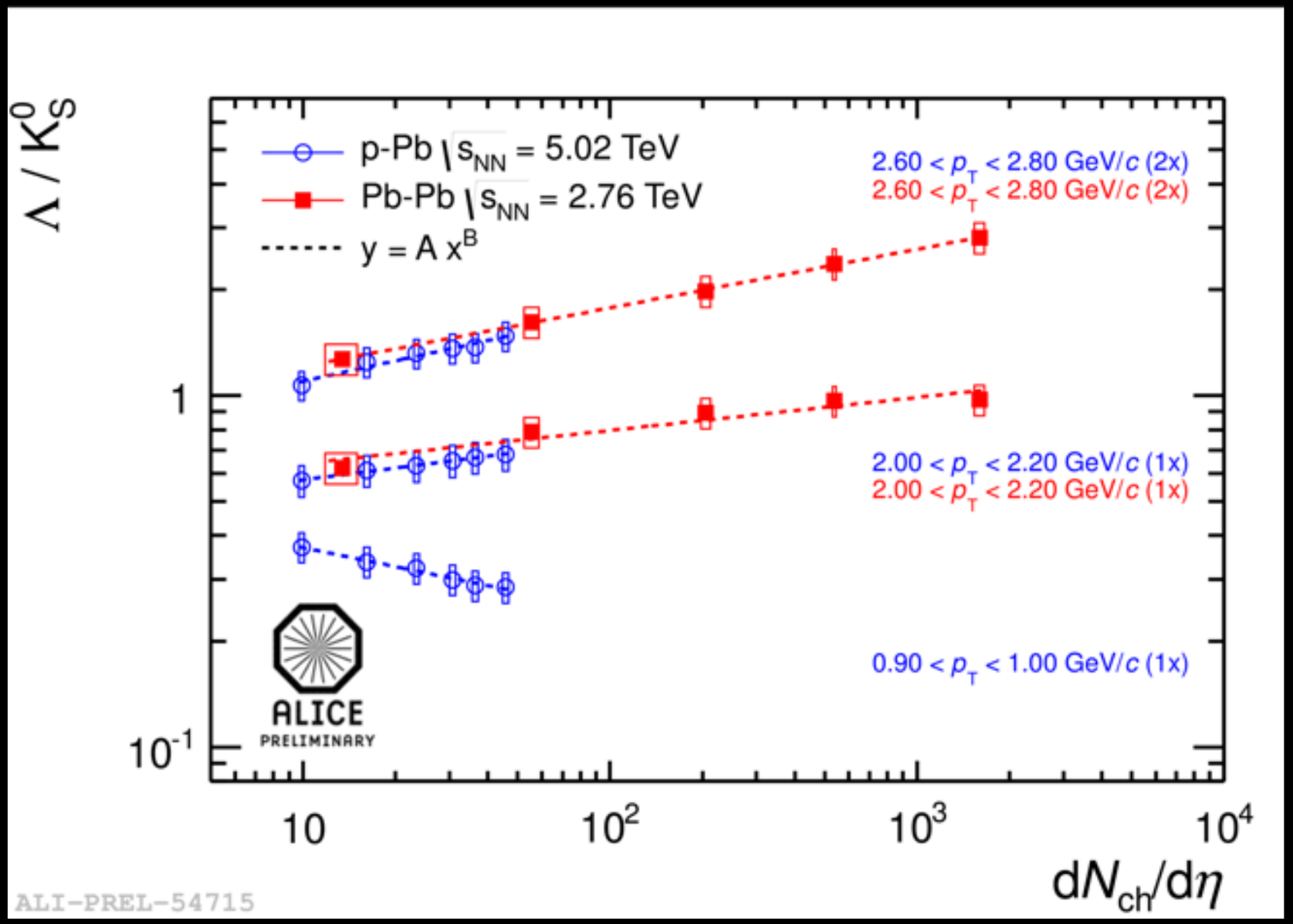
- Show similar centrality dependence to Pb-Pb
- Try to relate increase in Λ/K ratio to increase in dN/dη



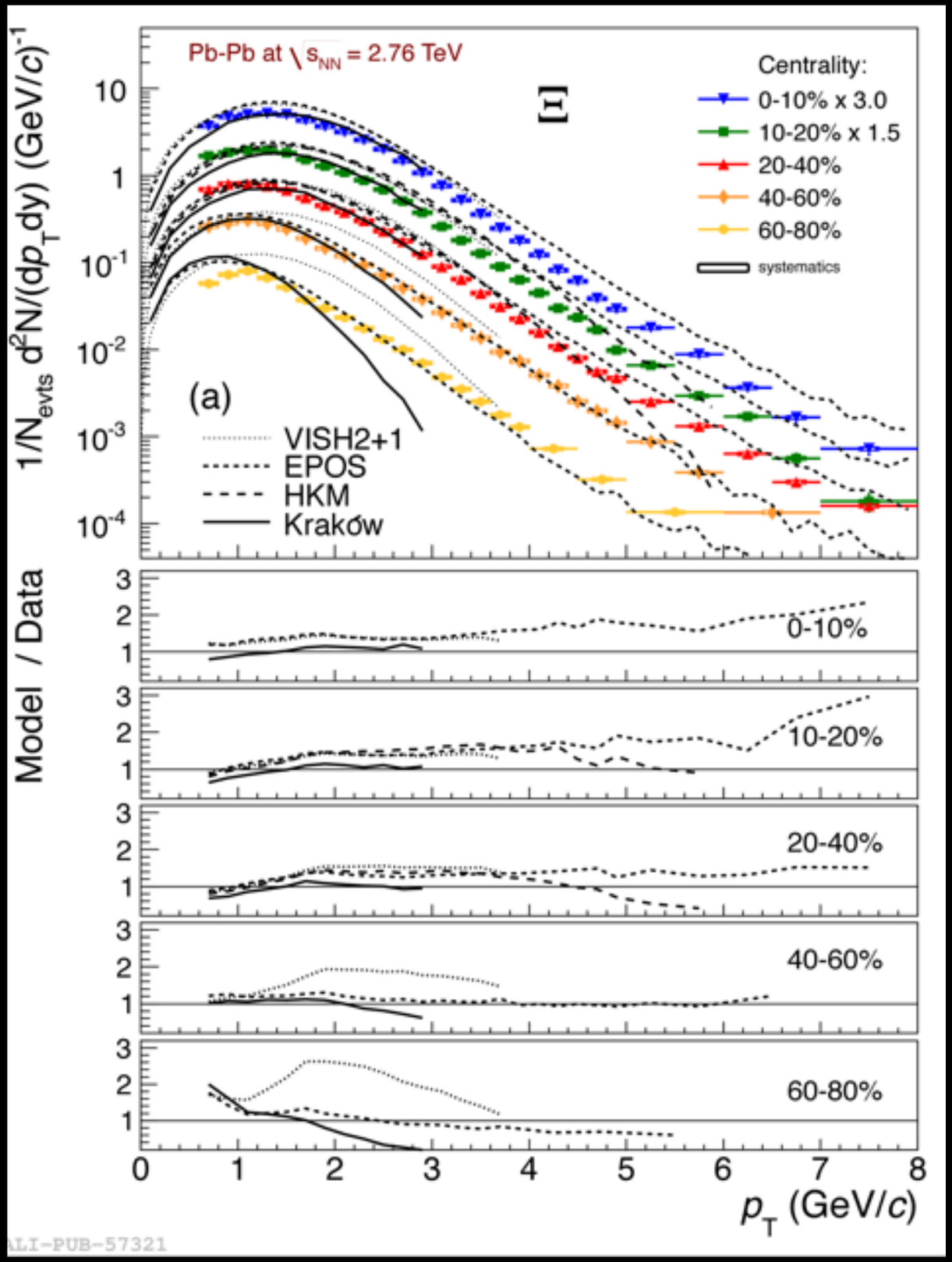
p-Pb scaling

- Fit $y=Ax^B$ for each p_T interval
- Shows same power law scaling for Pb-Pb and p-Pb



Multi-strange p_T spectra

- Kraków model best for yields
- EPOS applicable over widest p_T range

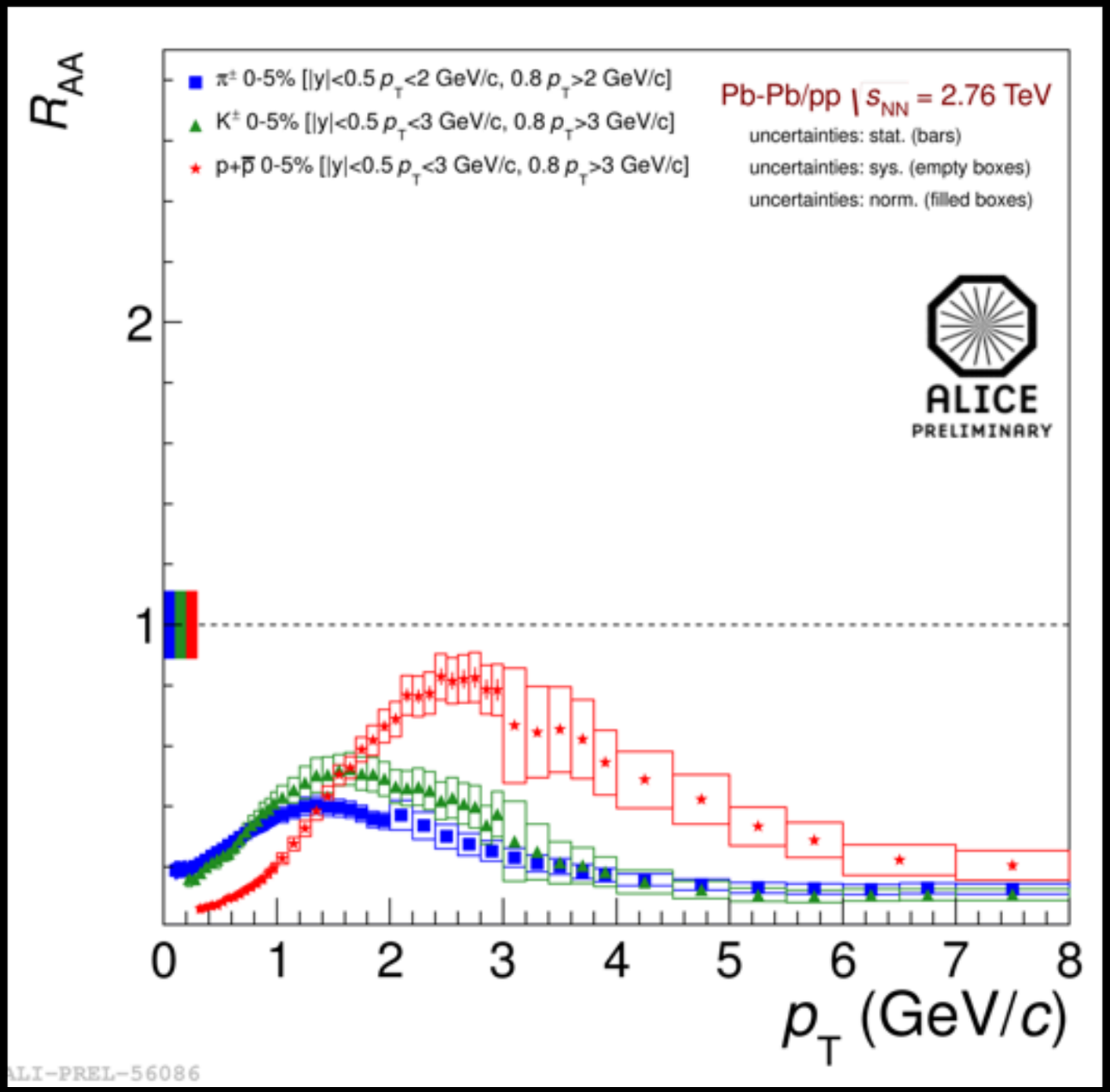


Nuclear Modification Factor

See talk of M. Chojnacki

ALICE

- All species show large suppression
  - Ξ compatible with p at 7 GeV/*c*
  - Ω is an exception
- Progenitor partons of these baryons show similar energy loss
- They are the same kind of partons (e.g. g) *or* the parton types have the same energy loss



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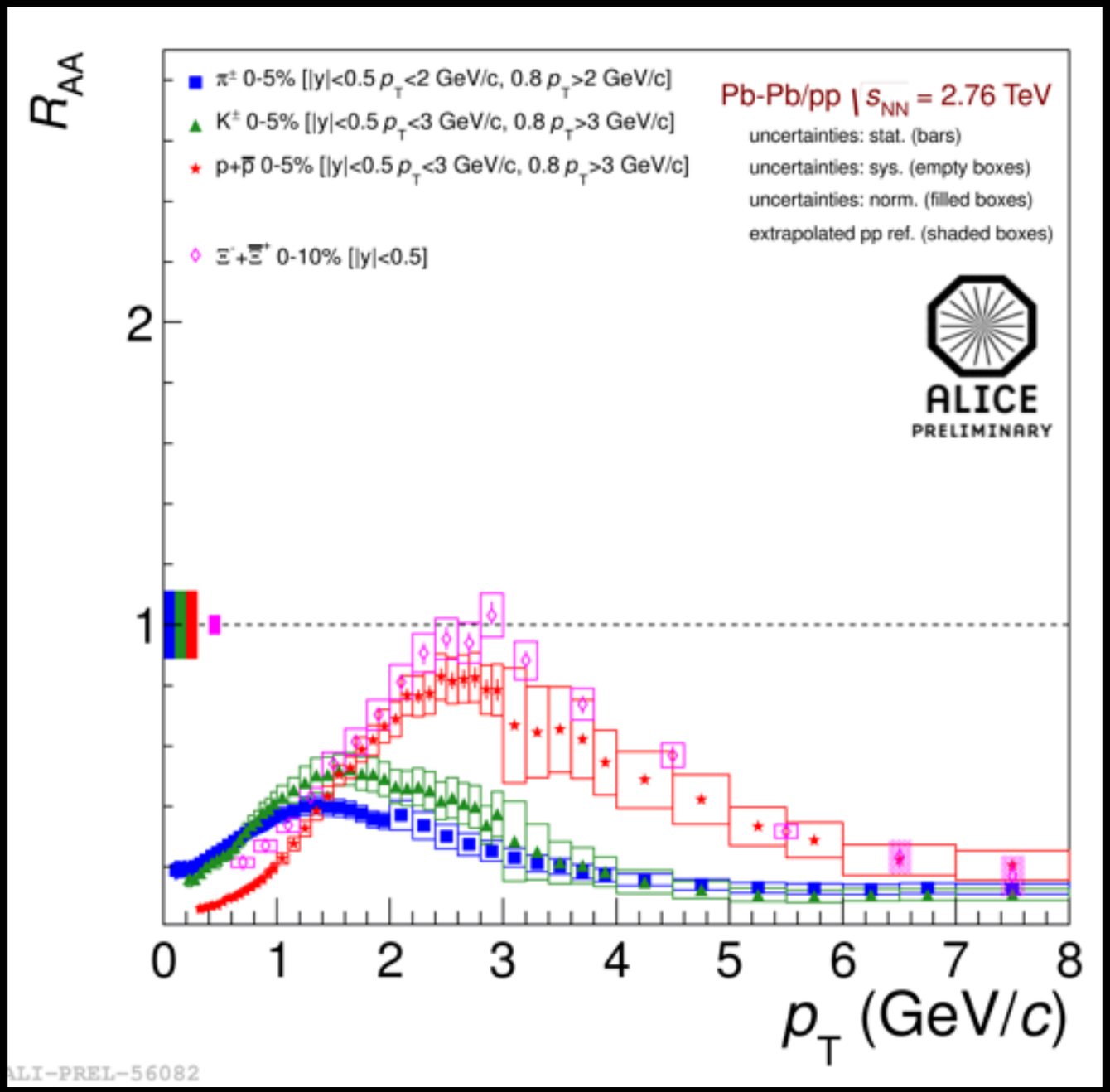

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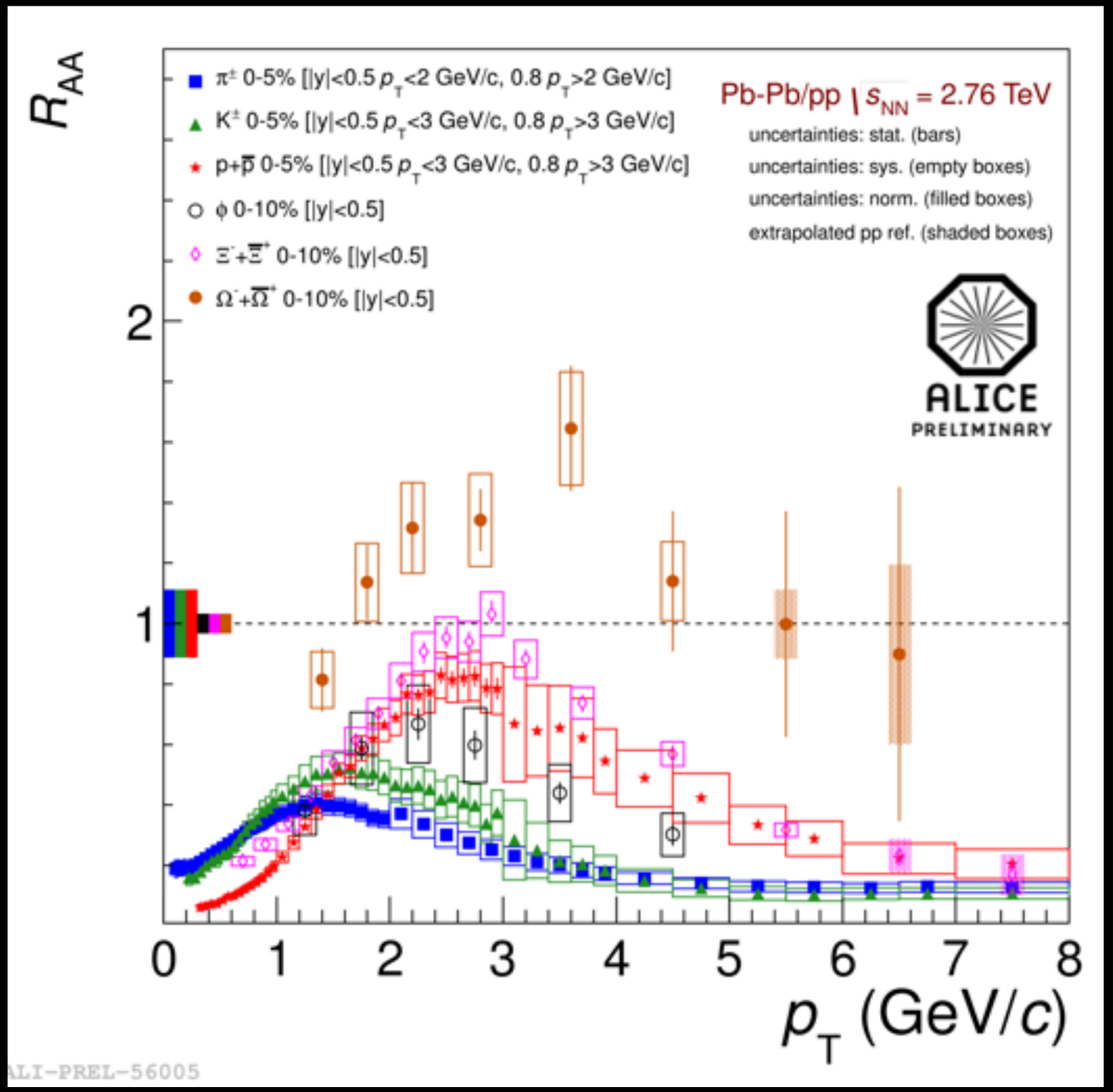

Conclusions

- Strangeness enhancement controlled by suppression in pp
- Thermal fits yield a lower than expected T of 156 MeV
- Intermediate p_T region is still a fertile ground for developing hadronisation models
- Common scaling of ratios in p-Pb and Pb-Pb
- Energy loss models should not show differential suppression for light species around 7 GeV/*c*

Backup slides

Pb-Pb Results

- Identified charged particles arXiv
  - http://arxiv.org/abs/1303.0737
- Λ and K^0_S arXiv submission
  - arXiv submit/0764109
- Multi-strange baryons arXiv submission
  - arXiv submit/0764130
- Preliminary data for d, dibaryon searches and p-Pb results