Resonance results with the ALICE experiment in pp and Pb-Pb collisions at LHC energies

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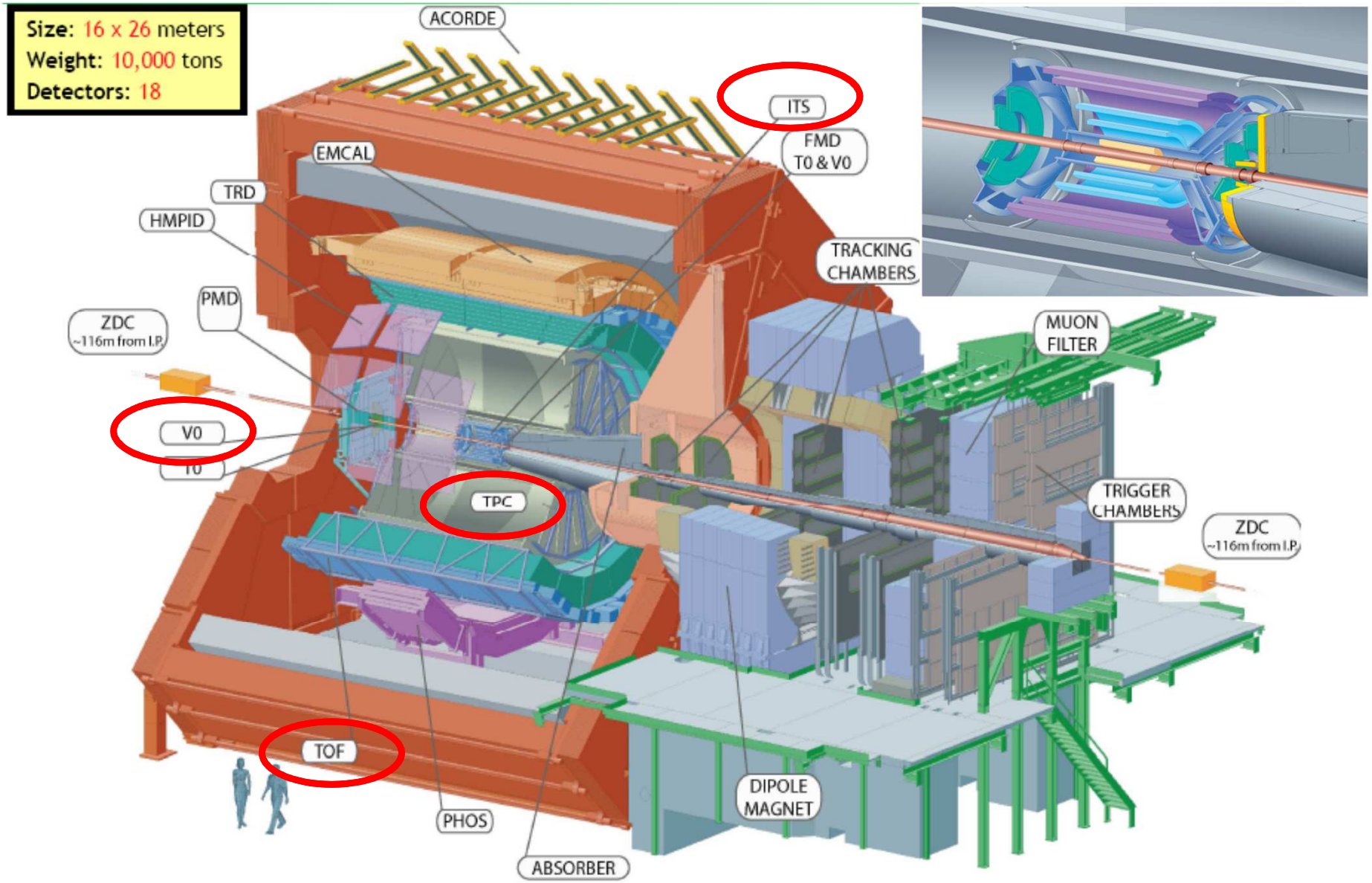
- Motivation
- Analysis details
- **pp@7 TeV**: $K^*(892)^0$, $\phi(1020)$, $\Sigma(1385)$, $\Lambda(1520)$, $\Xi(1530)$
- **Pb-Pb@2.76 ATeV**: $K^*(892)^0$, $\phi(1020)$
- Summary

Motivation

- pp collisions:
  - ✓reference for tuning QCD-inspired event generators
  - ✓the baseline for heavy-ion collisions
- AA collisions:
  - ✓restoration of chiral symmetry
    → modification of width, mass and branching ratio
  - ✓regeneration and rescattering effects
    → timescale between chemical and kinetic freeze-out

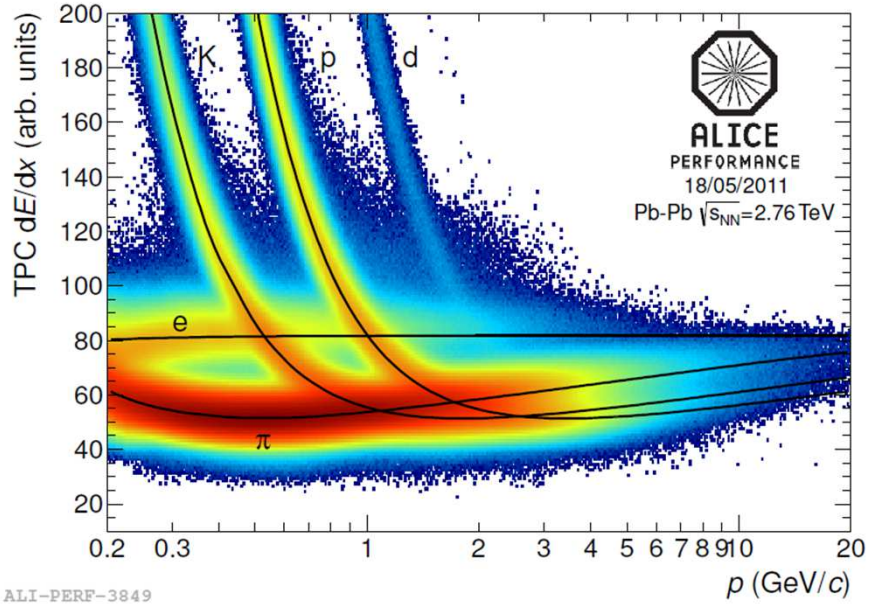
Resonance	Γ (MeV)	cτ (fm)	Decay
$K^*(892)^0$	50	4	**$\pi + K$**
$\phi(1020)$	4.3	46	**$K^+ + K^-$**
$\Sigma(1385)^\pm$	36	6	**$\Lambda + \pi^\pm$**
$\Lambda(1520)$	15.6	13	**$p + K^-$**
$\Xi(1530)^0$	9	22	**$\Xi^- + \pi^+$**

ALICE detector

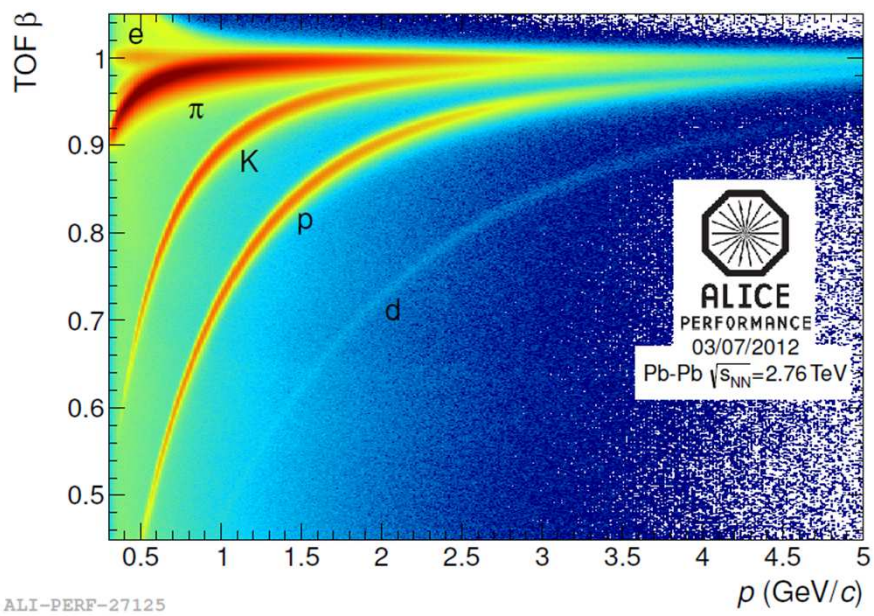


Particle identification, centrality in Pb-Pb

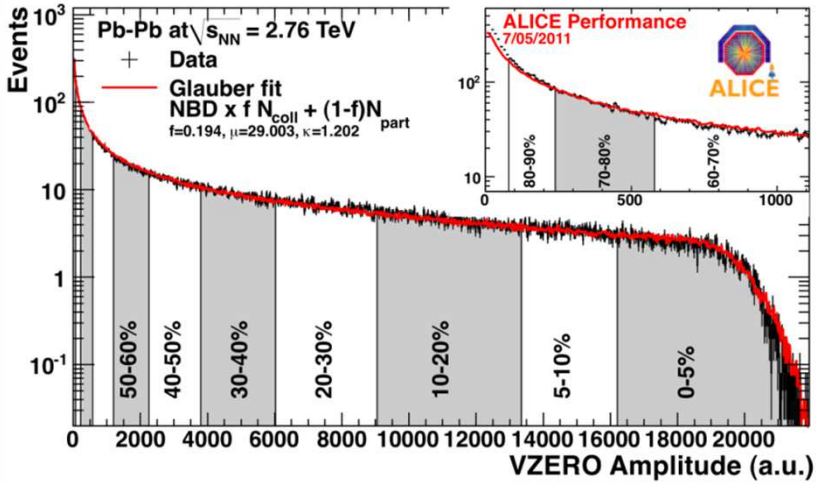
TPC resolution ~ 5 - 6%



TOF resolution ~ 90 ps



Pb-Pb: centrality selection using VZERO

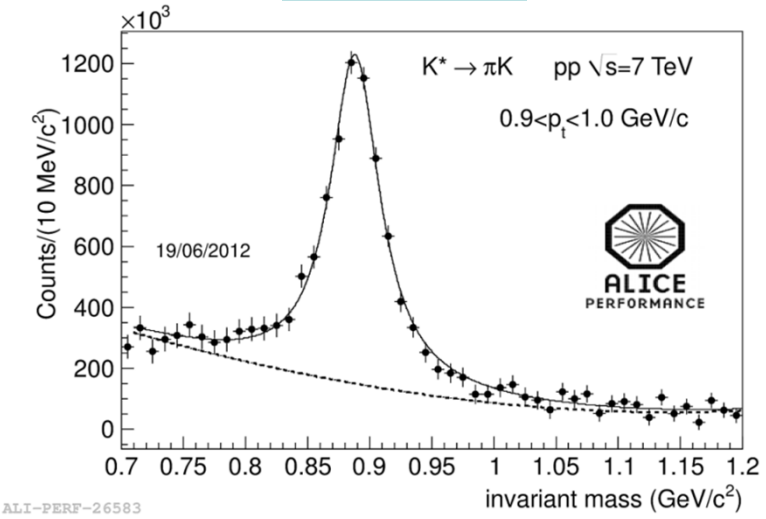


data collected by ALICE during 2010
and used for resonance analyses:
pp@7 GeV: ~ 60 – 200 Mevents
Pb-Pb@2.76 AGeV: ~ 10 Mevents

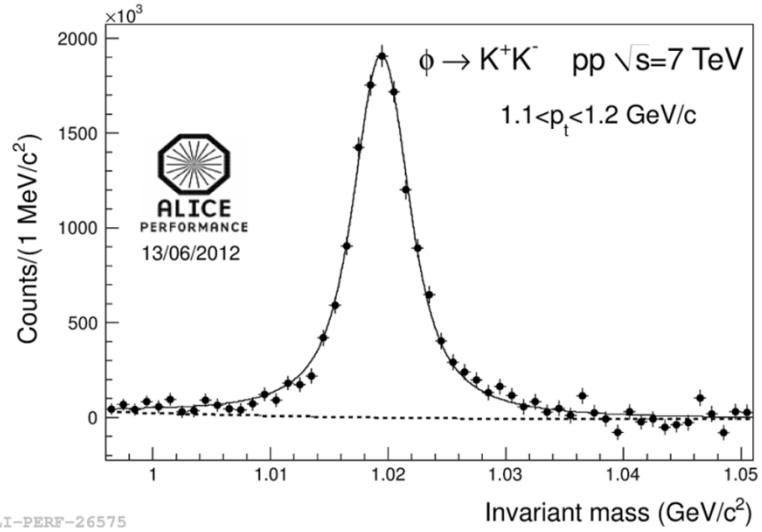
central rapidity region: $|y| < 0.5$

pp: signal extraction

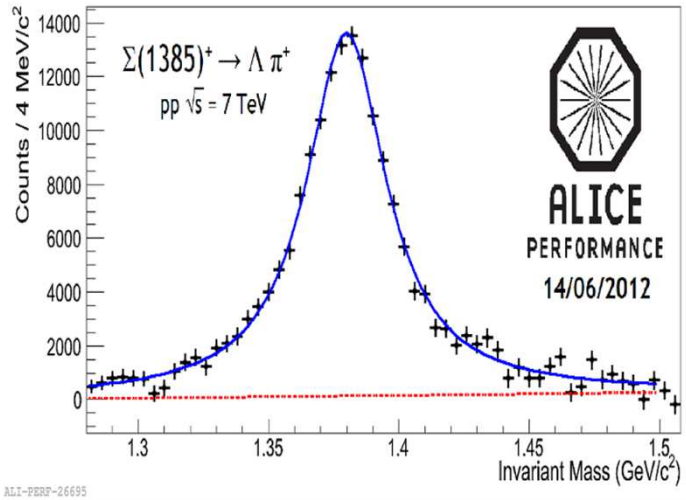
K*(892)^0



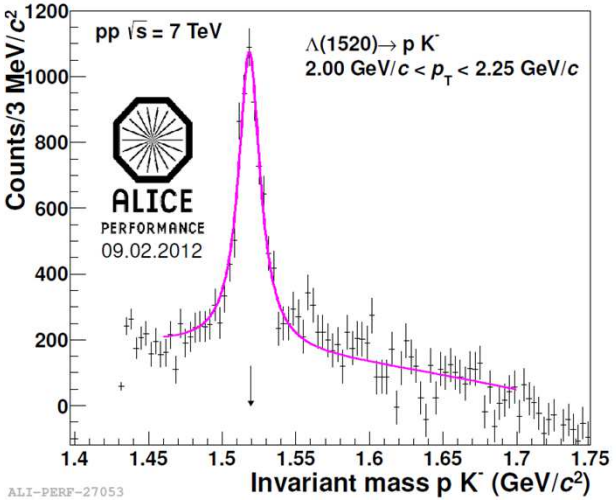
ϕ(1020)



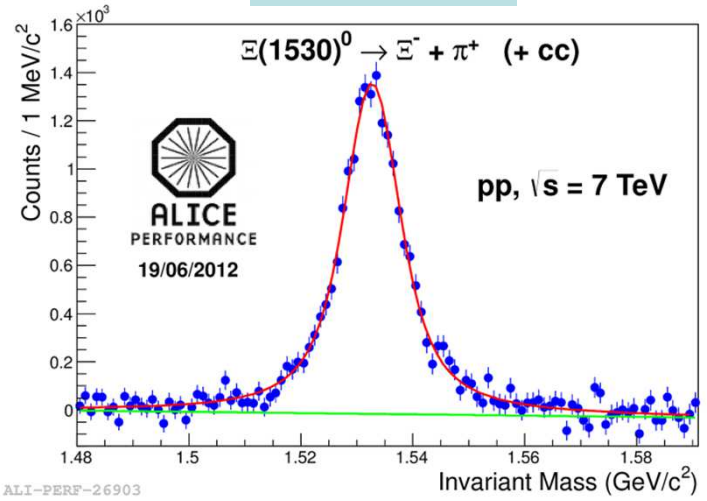
Σ(1385)



Λ(1520)

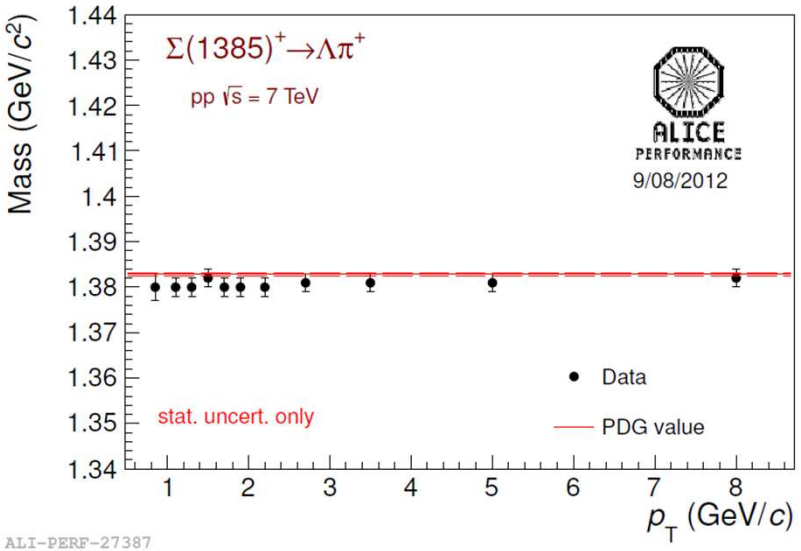


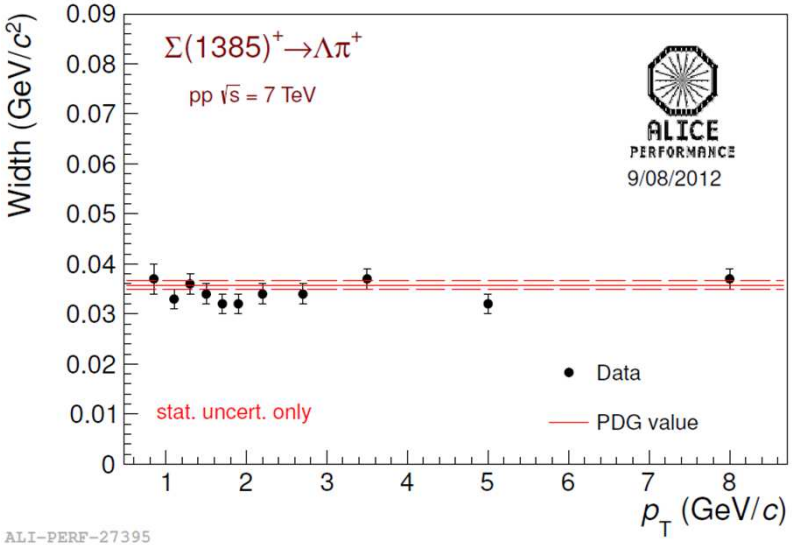
$\Xi(1530)^0$



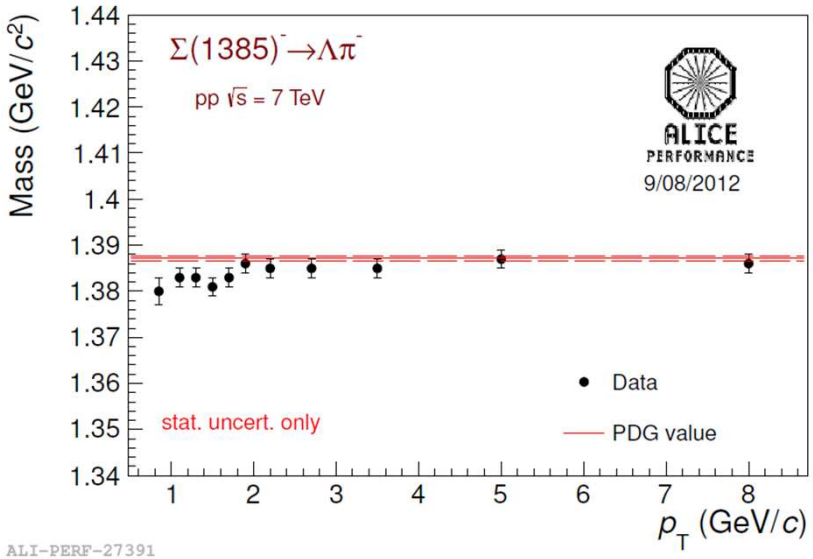
pp: mass and width

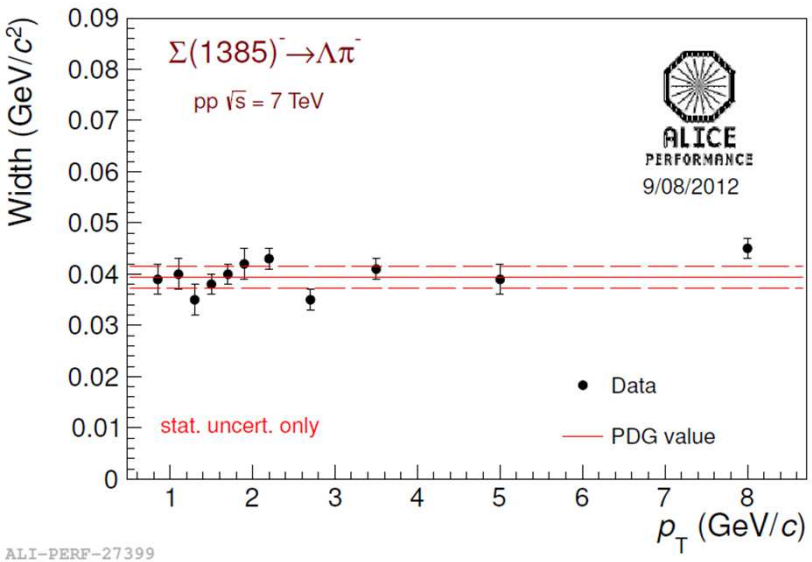
$\Sigma(1385)^+$





$\Sigma(1385)^-$



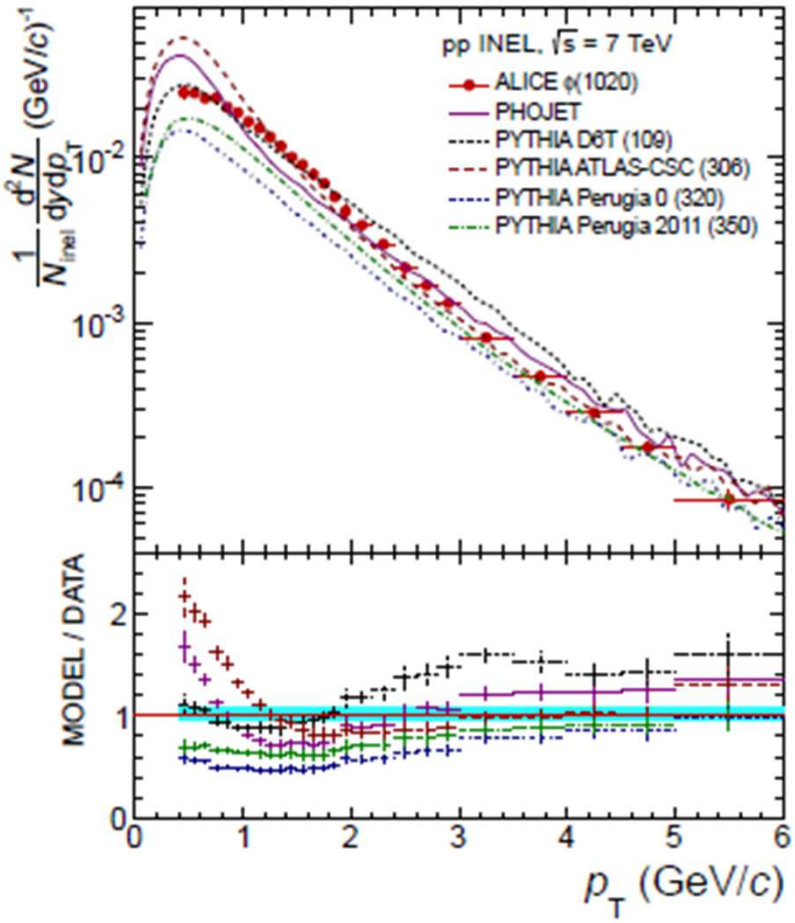


masses and widths agree with PDG values

pp: p_T spectrum

ϕ(1020)

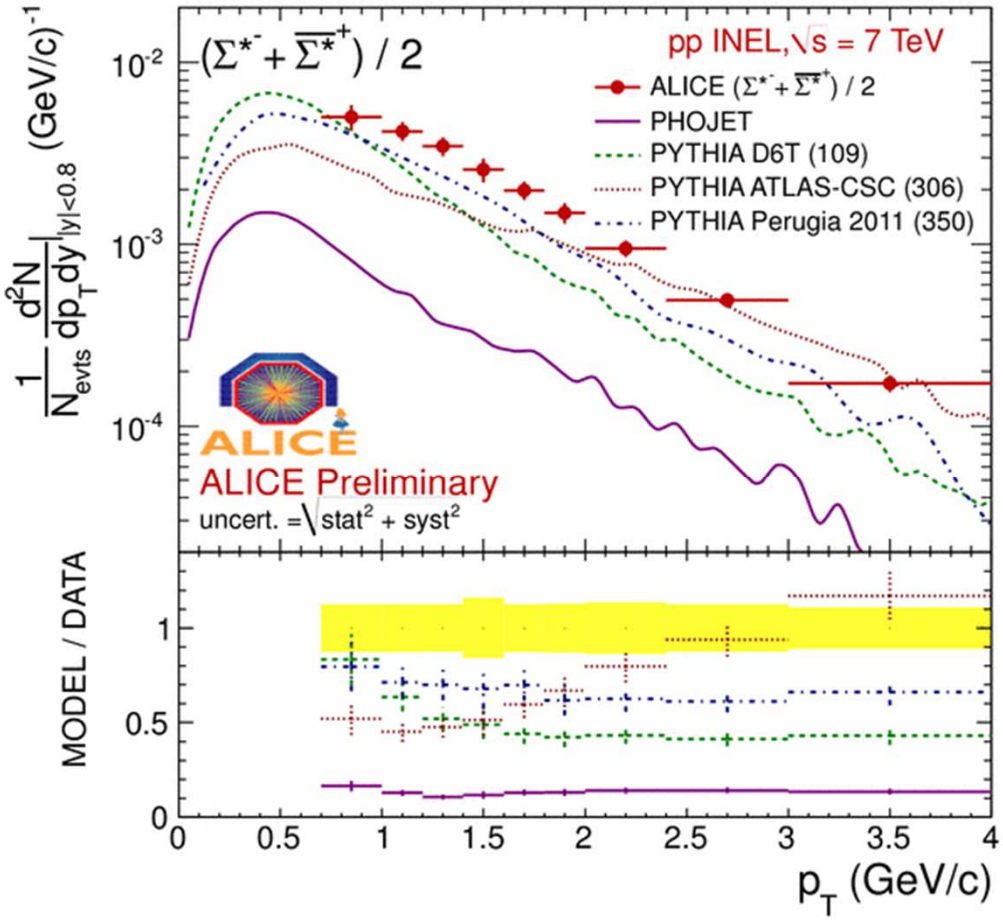
ALICE arXiv:1208.5717 [hep-ex]



p_T < 2 GeV/c: PYTHIA D6T

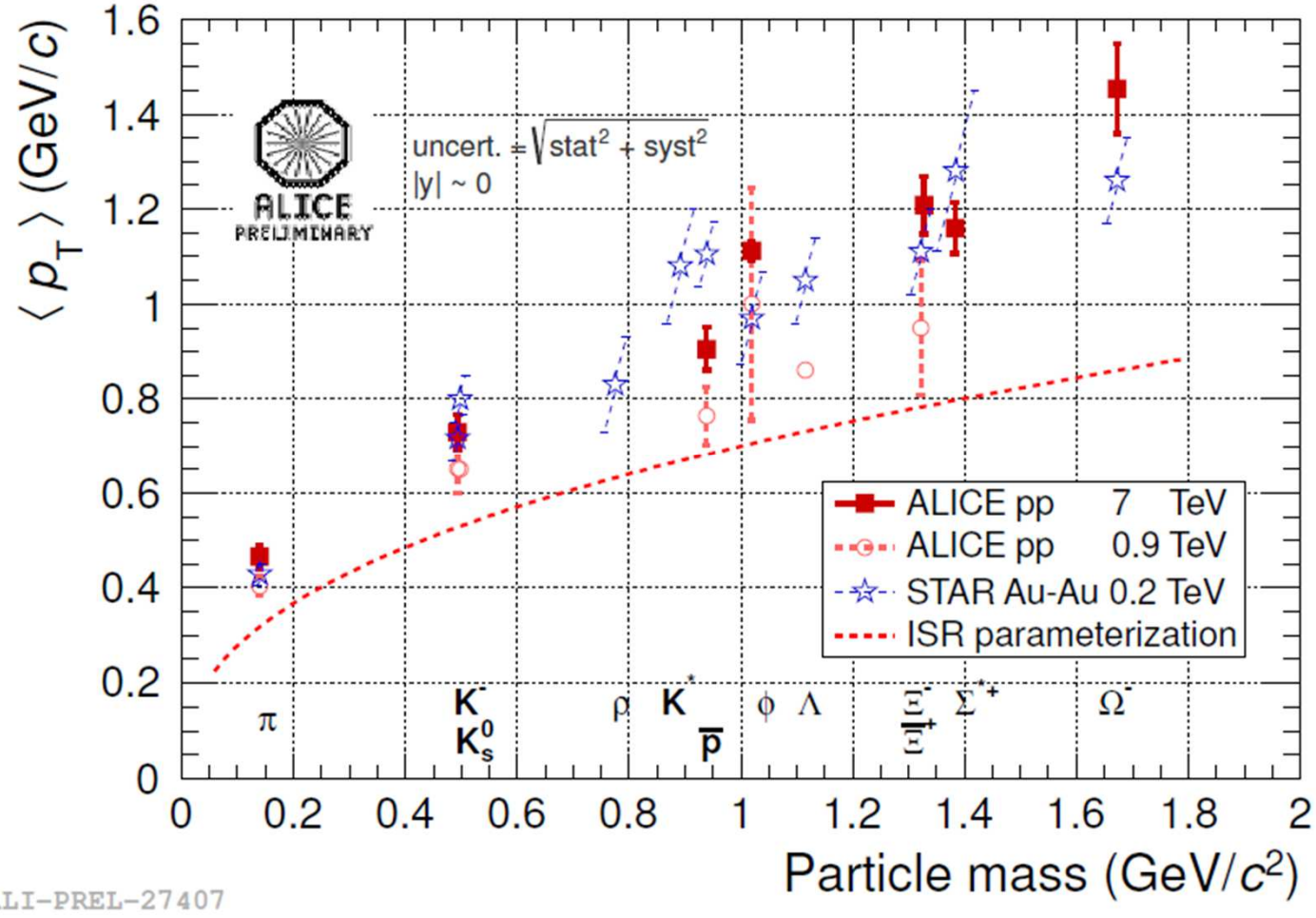
p_T > 2 GeV/c: PHOJET

Σ(1385)



The models underpredict the data

pp: ‹ p_T ›



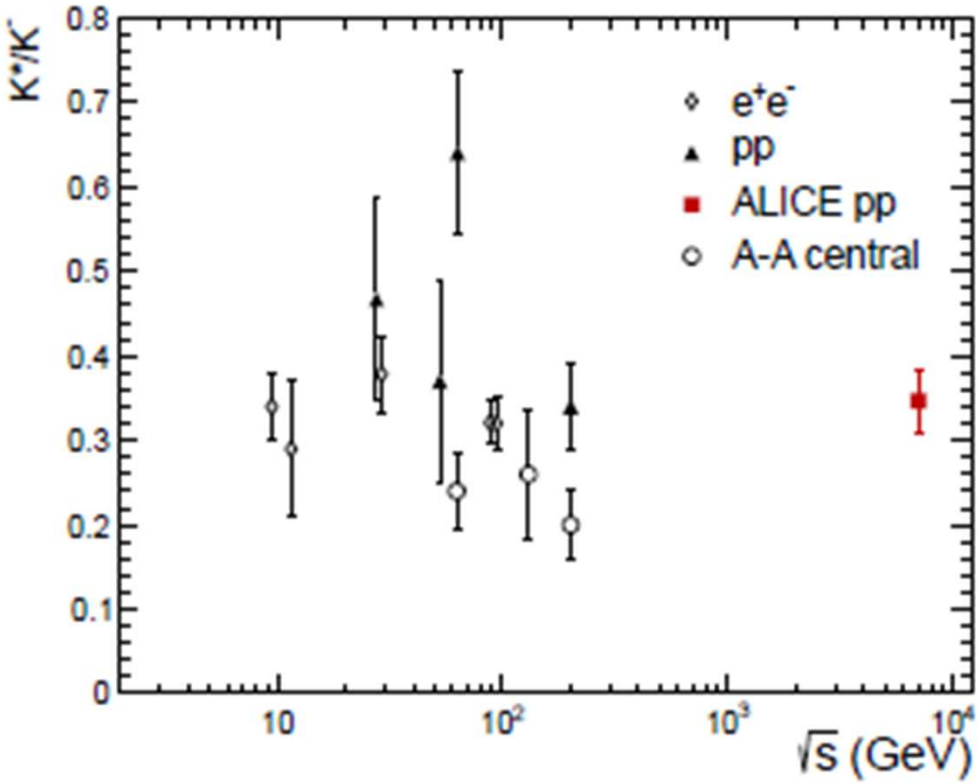
‹ p_T › increases with √s

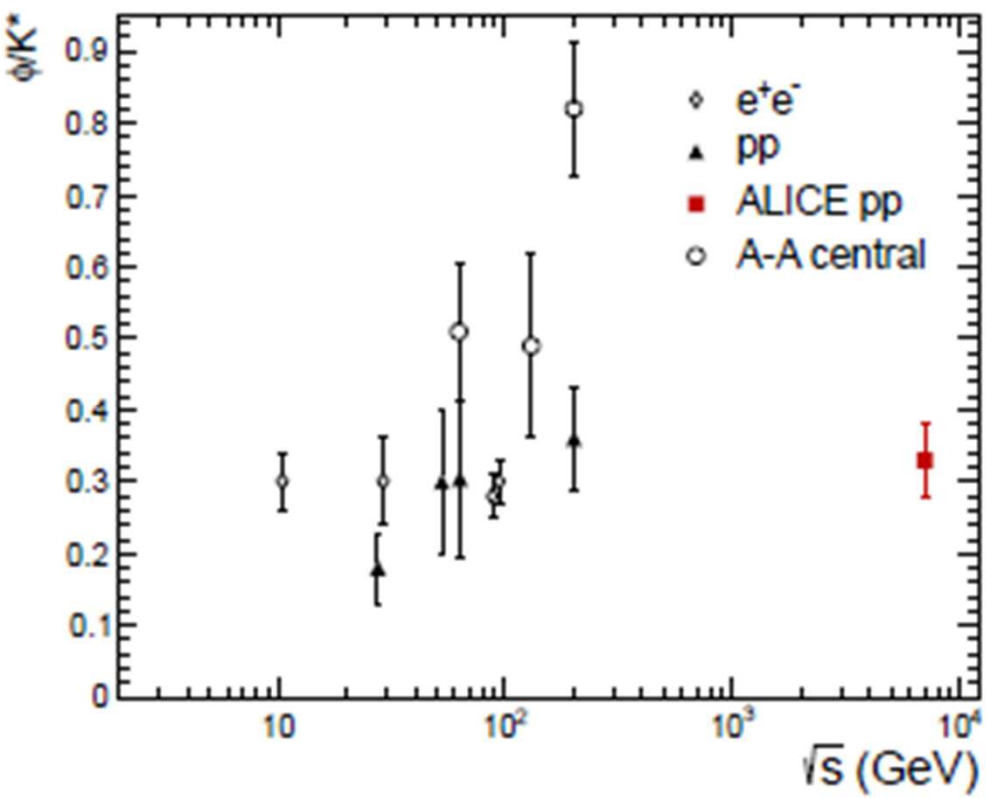
resonance ‹ p_T › in agreement with the trend drawn by other particles at 7 TeV , which in turn differs from the ISR parametrization of the old values from lower energy experiments

pp: particle ratios

K*(892)^0

ALICE arXiv:1208.5717 [hep-ex]



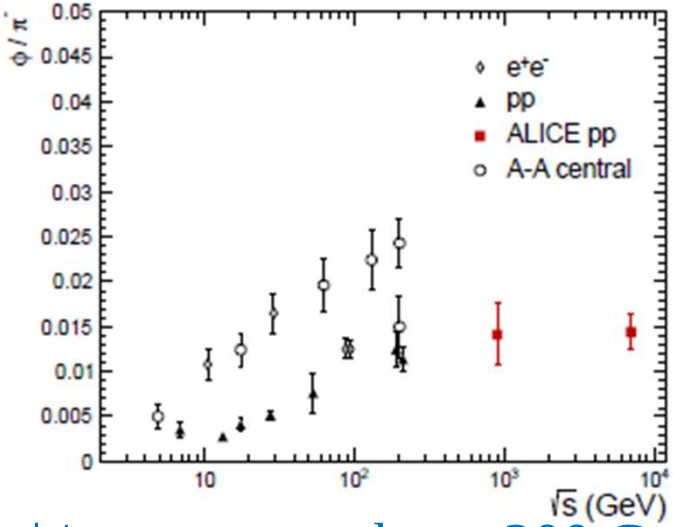


both K*/K$^-$ and ϕ/K* independent of $\sqrt{s}$

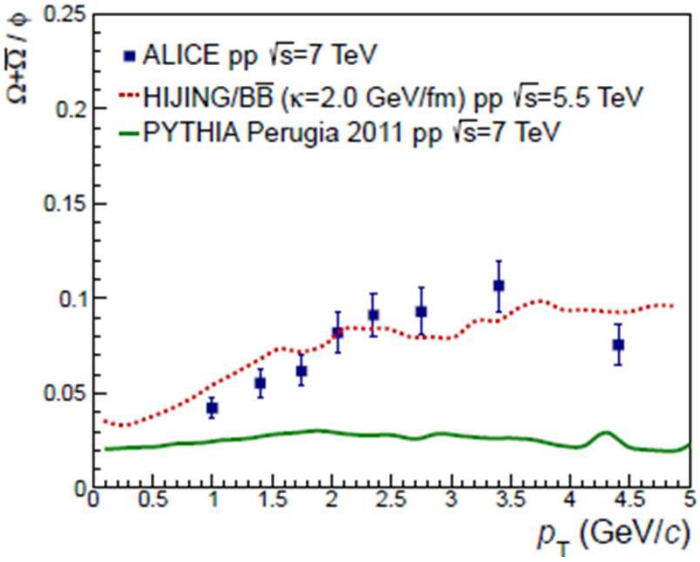
pp: particle ratios

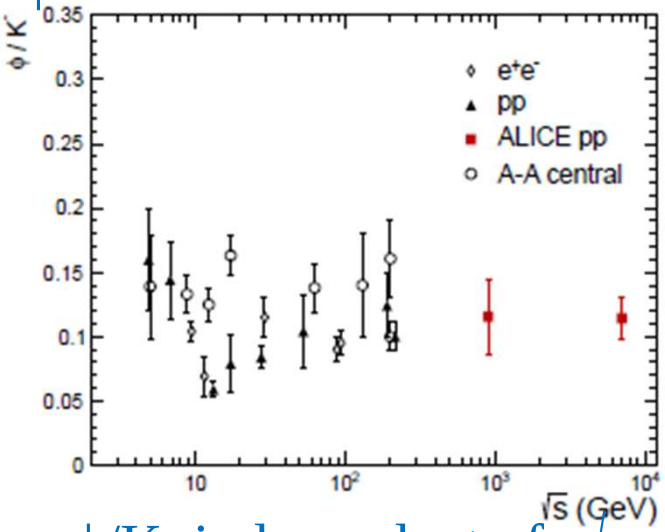
ϕ(1020)

ALICE arXiv:1208.5717 [hep-ex]



ϕ/π: saturates above 200 GeV





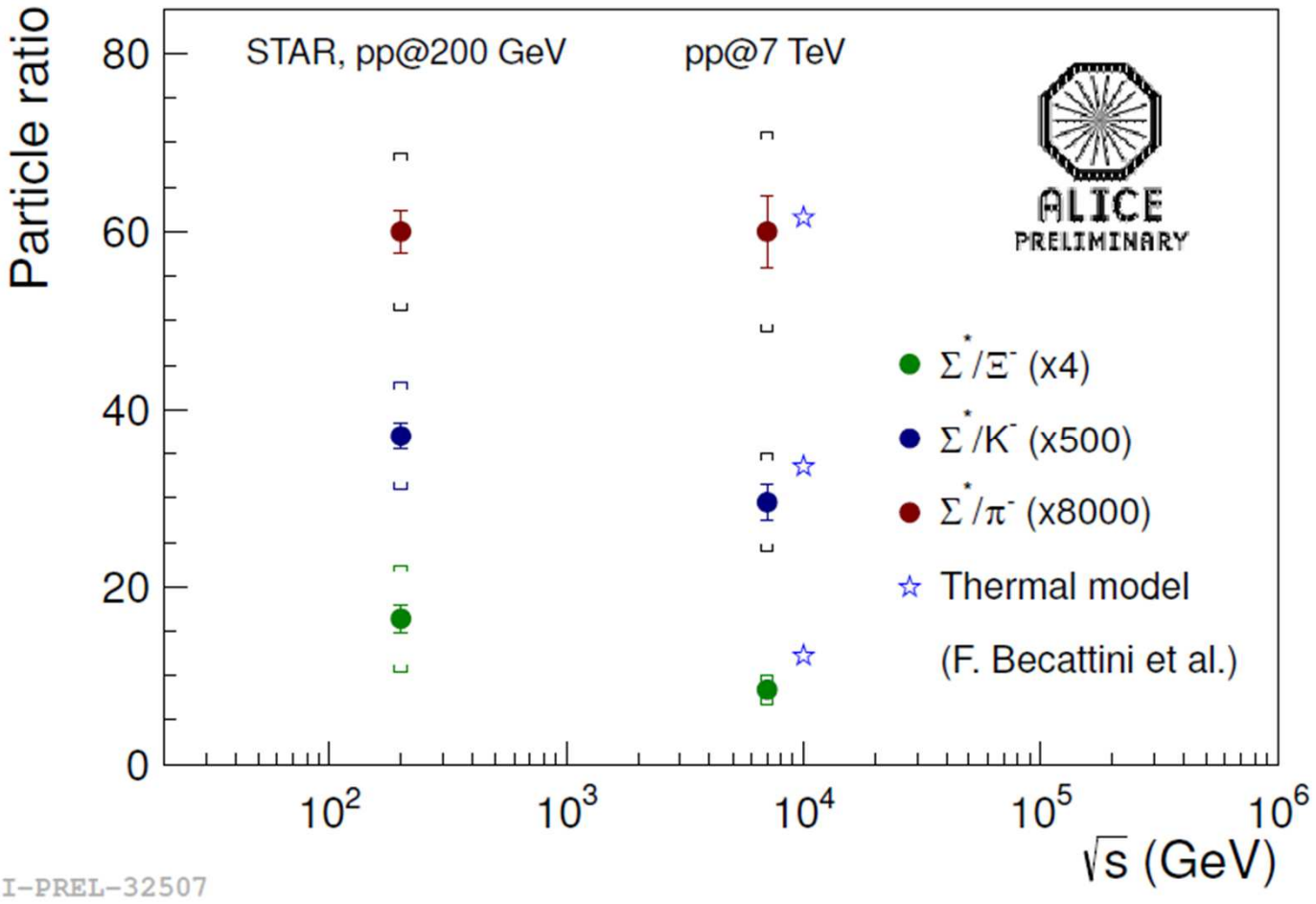
ϕ/K: independent of √s

Ω/ϕ: not reproduced by Pythia Perugia 2011

agreement with a prediction of HIJING/BB model with a Strong Color Field modeled with increased string tension

pp: particle ratios

Σ(1385)



Σ^*/π^- : independent of $\sqrt{s}$

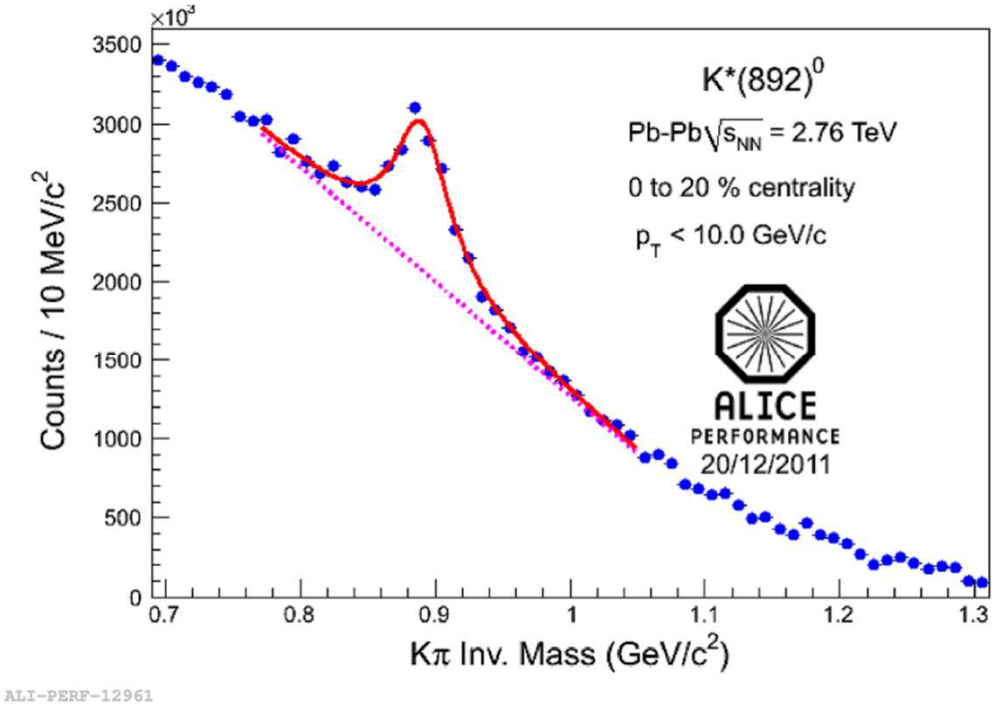
Σ^*/K^- : independent of $\sqrt{s}$ within errors

Σ^*/Ξ^- : decreases with $\sqrt{s}$

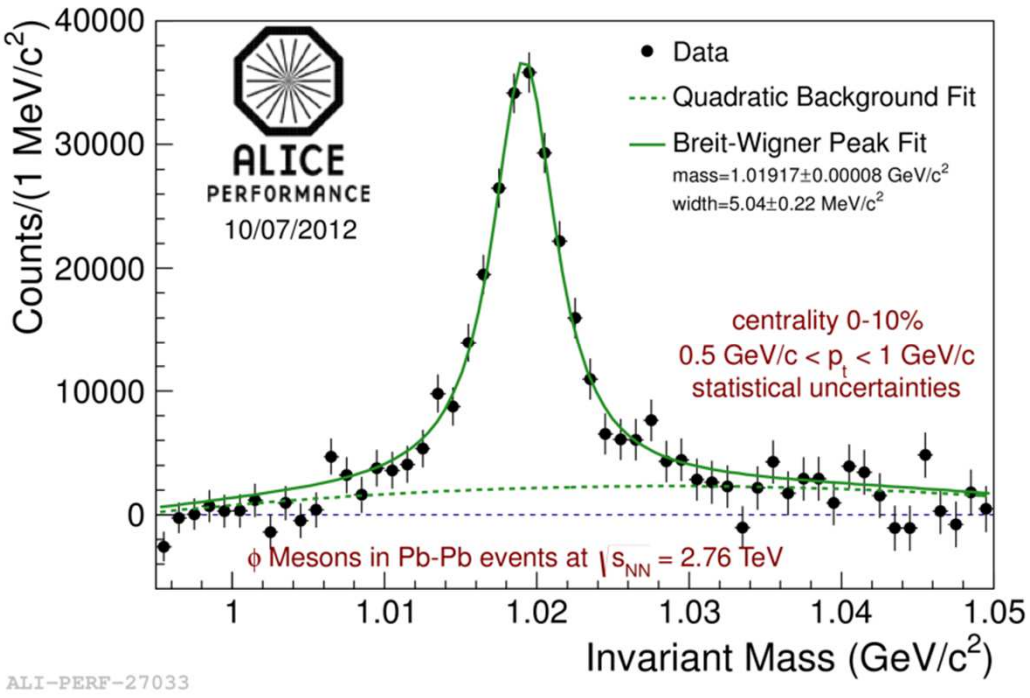
Σ^*/π^- and Σ^*/K^- :
agree with the thermal model

Pb-Pb: signal extraction

K*(892)^0



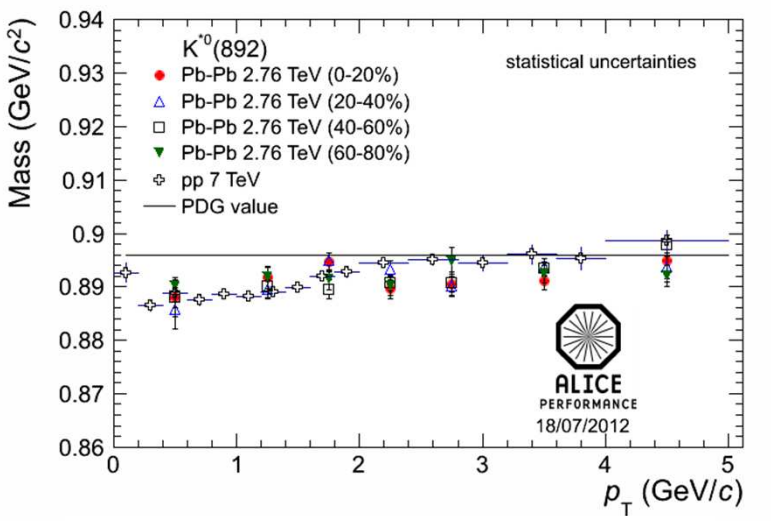
ϕ(1020)



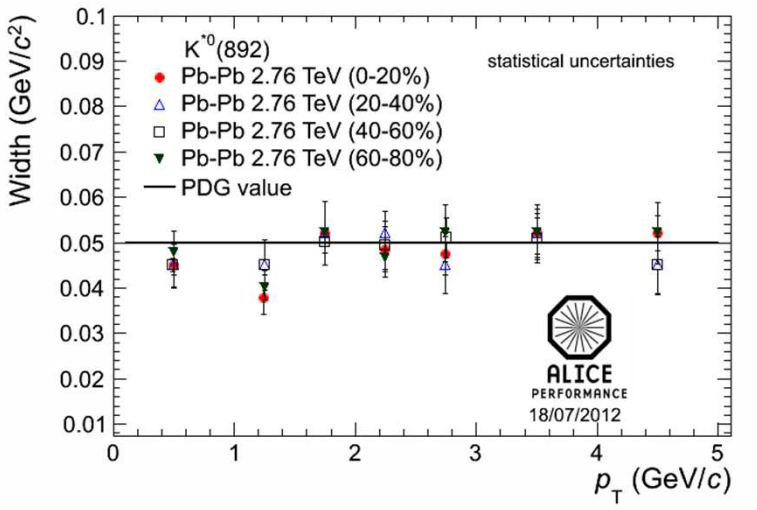
combinatorial background: mixed-event or like-sign techniques
fit: Breit-Wigner + polynomial

Pb-Pb: mass and width

K*(892)^0

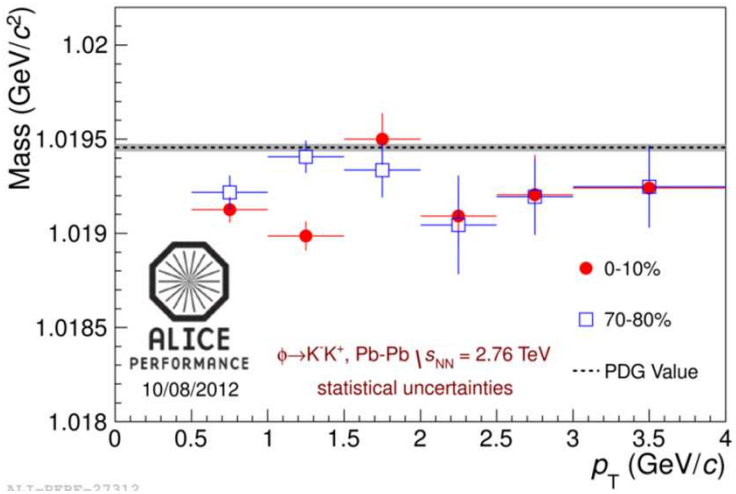


mass in Pb-Pb and pp are same

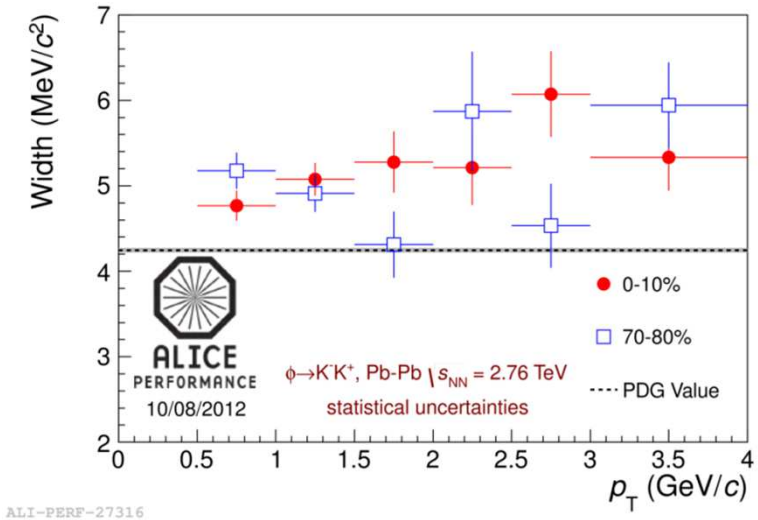


width close to PDG value

ϕ(1020)



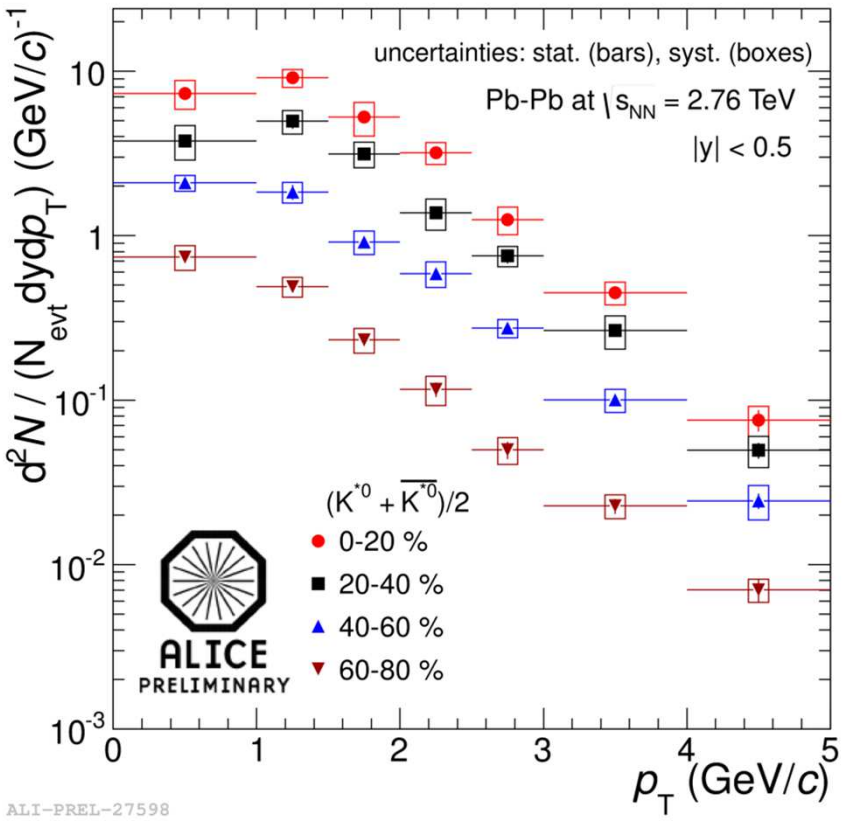
mass close to PDG value within a few MeV/c^2



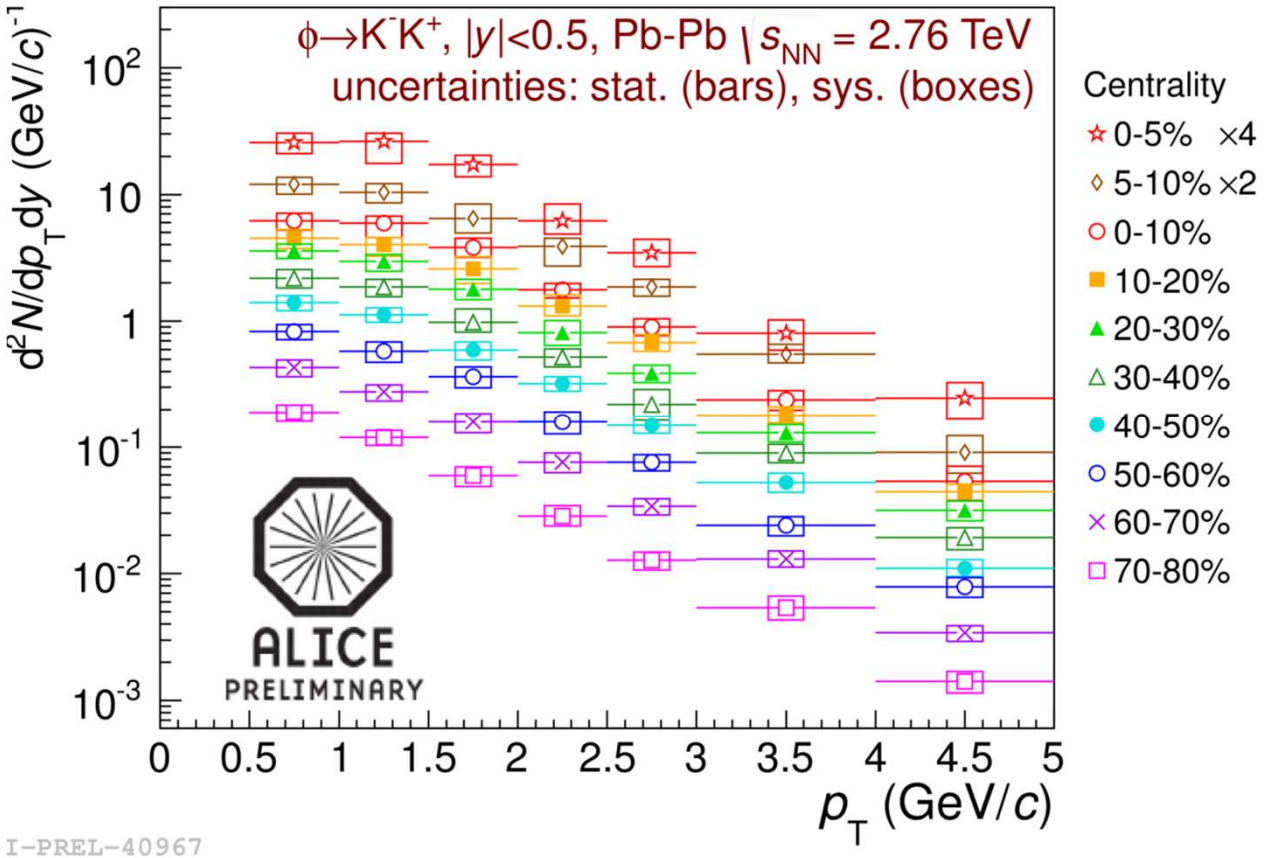
width close to PDG value within a few MeV/c^2

Pb-Pb: p_T spectrum

K*(892)^0

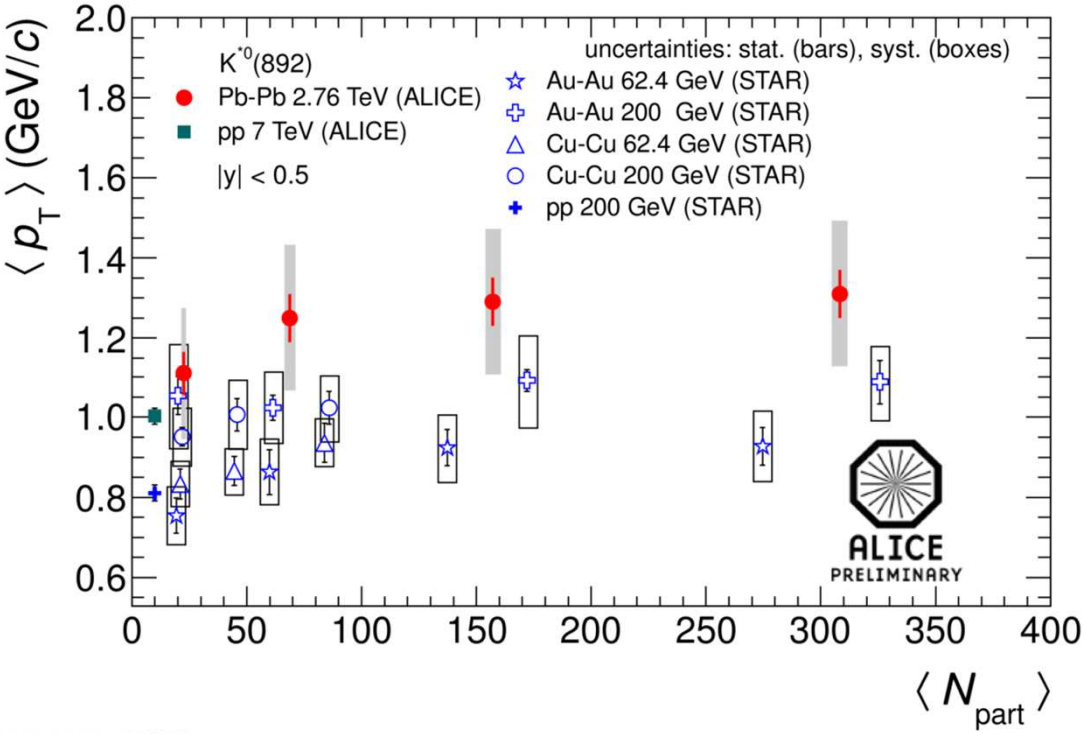


ϕ(1020)

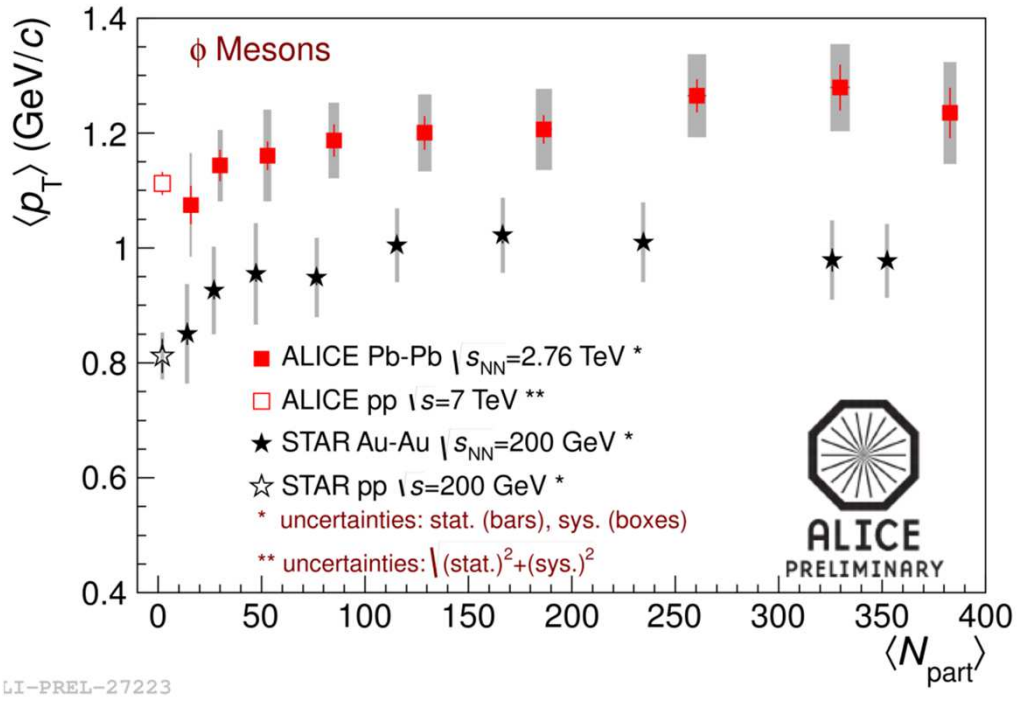


Pb-Pb: ‹ p_T ›

K*(892)^0



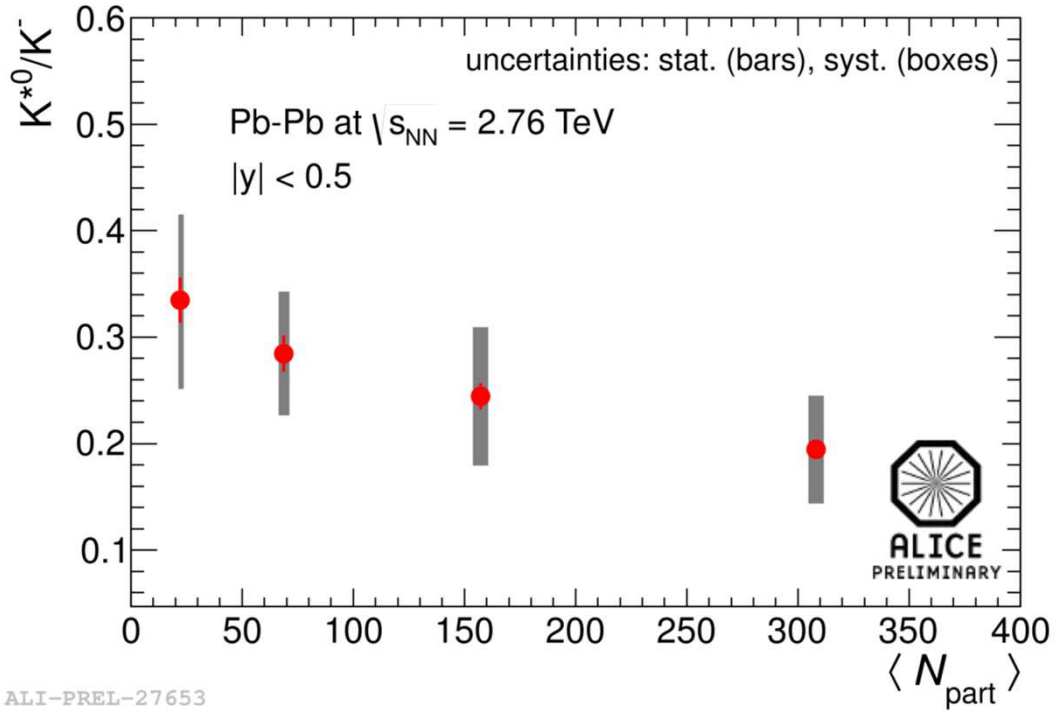
ϕ(1020)



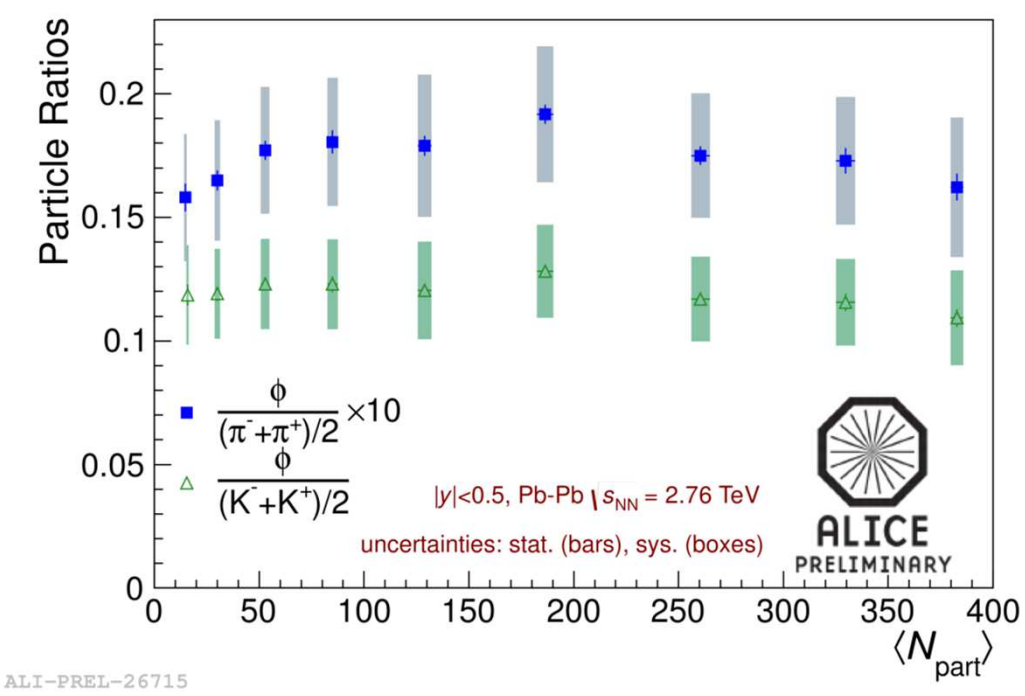
‹ p_T ›$_{LHC}$ > ‹ p_T ›$_{RHIC}$

Pb-Pb: particle ratios vs. ‹ N_{part} ›

K*(892)^0



ϕ(1020)

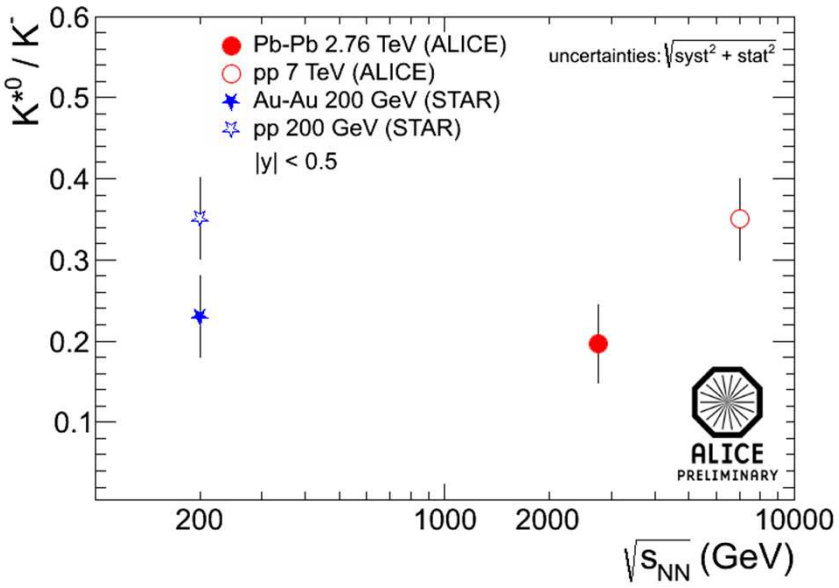


K^{*0}/K^- : decreasing trend
→ a possible increase in re-scattering effects for central collisions

ϕ/π, ϕ/K : independent of collision centrality
→ disfavors ϕ production through kaon coalescence

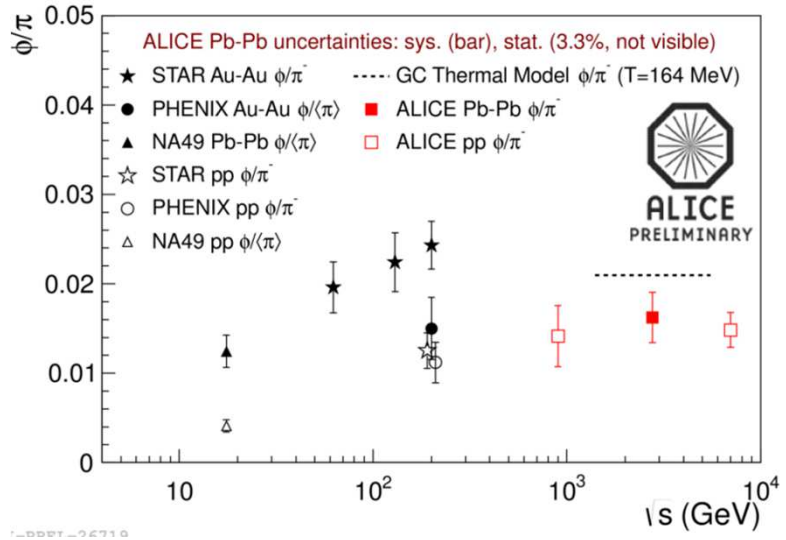
Pb-Pb: particle ratios vs. $\sqrt{s_{NN}}$

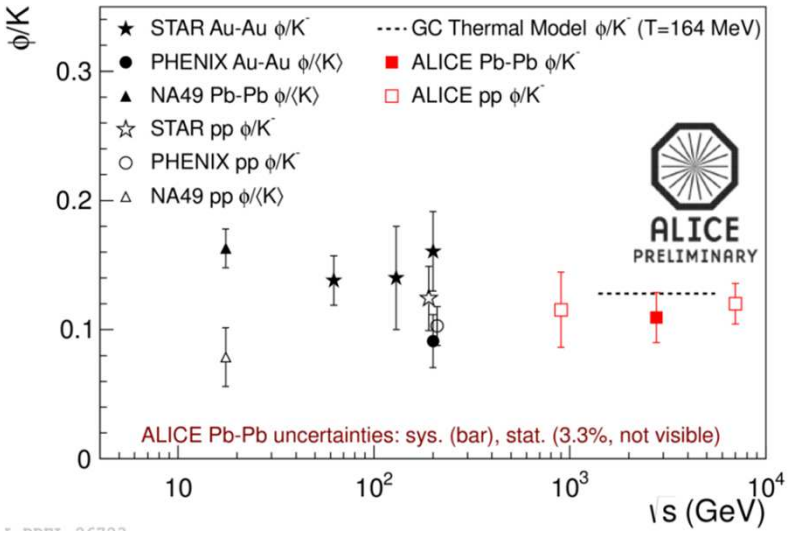
K*(892)^0



$(K^*/K)_{AA} < (K^*/K)_{pp}$
→ re-scattering effects

ϕ(1020)





ϕ/π, ϕ/K : independent of $\sqrt{s}$

Summary: pp

pp@7 TeV: $K^*(892)^0$, $\phi(1020)$, $\Sigma(1385)$, $\Lambda(1520)$, $\Xi(1530)$

✓mass and width agree with PDG values

✓none of PHOJET and PYTHIA tunes give a fully satisfactory description of p_T spectrum. In particular they underestimate strange baryon resonances yields

✓$\langle p_T \rangle$ increases with $\sqrt{s}$

✓particle ratios:

- K^*/K^-, K^*/ϕ and ϕ/K are independent of $\sqrt{s}$
- ϕ/π: saturates above $\sqrt{s}$ = 200 GeV
- Ω/ϕ: not reproduced by PYTHIA, agrees with HIJING/BB model with a Strong Color Field modeled with increased string tension
- Σ^*/π^- and Σ^*/K^- : independent of $\sqrt{s}$, agree with the thermal model
- Σ^*/Ξ^- : decreases with $\sqrt{s}$, overpredicted by the thermal model

Summary: Pb-Pb

Pb-Pb@2.76 ATeV: $K^*(892)^0$, $\phi(1020)$

✓ masses and widths close to PDG values

✓ $\langle p_T \rangle_{LHC} > \langle p_T \rangle_{RHIC}$

✓ particle ratios:

- ϕ/K , ϕ/π → independent of collision centrality and $\sqrt{s}$
- K^*/K^- → weak centrality dependence
- $(K^*/K^-)_{AA} < (K^*/K^-)_{pp}$ → re-scattering effects.