

Nuclear modification of
transverse momentum spectra of
identified particles in Pb-Pb collisions at

$\sqrt{s_{NN}} = 2.76 \text{ TeV}$ with ALICE

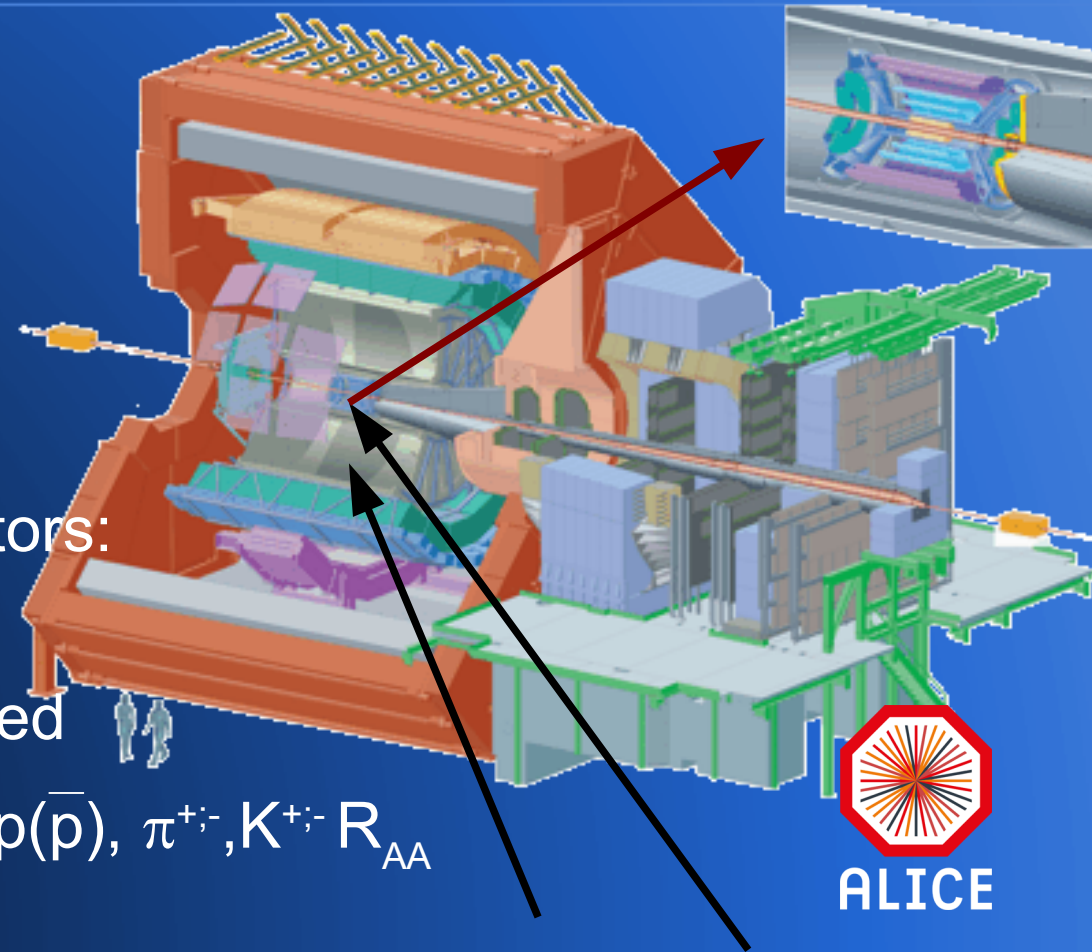
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Outline

- Motivation
- Λ and K_s^0
 - Reconstruction
 - Nuclear modification factors:
 R_{CP} and R_{AA}
 - Comparison to unidentified
charged particles and $p(\bar{p})$, $\pi^{+;-}$, $K^{+;-}$ R_{AA}
- Conclusions

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Sub-detectors of interest in this talk: ALICE TPC and ITS

Motivation I

- **Why looking at high p_T ?**

- Diagnostic potential to probe the created medium via :
 - the measurement of yields and particle ratios
 - comparison between AA and pp collisions

→ Parton energy loss and modified fragmentation pattern as a measure of the medium influence

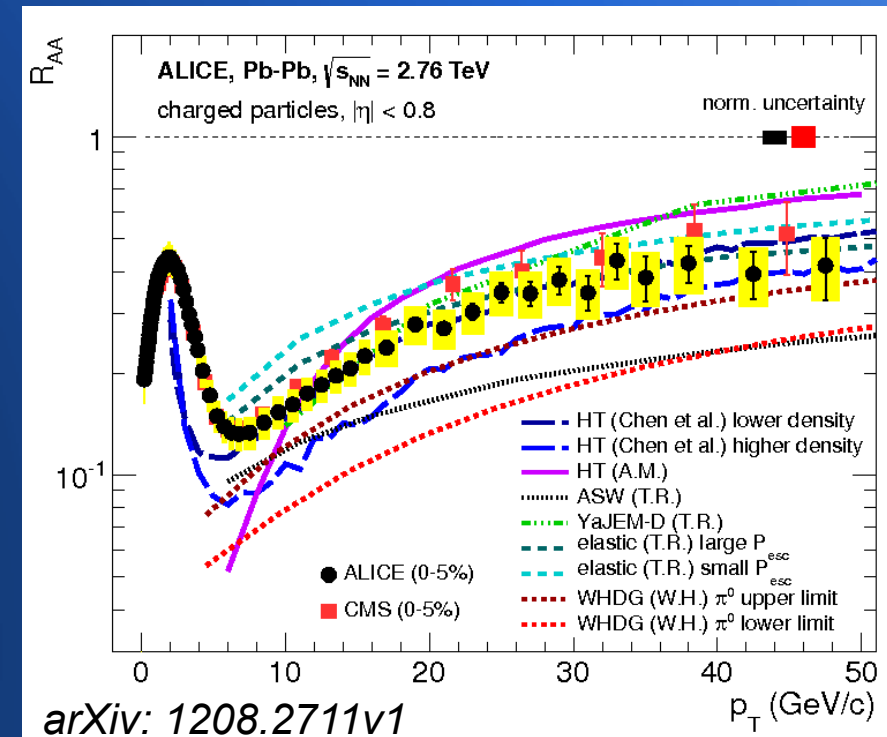
- **Charged particle R_{AA} :**

- Strong suppression in Pb-Pb collisions compared to pp around $p_T = 6-8$ GeV/c
- Rise towards high p_T

- → **Identified particles?**

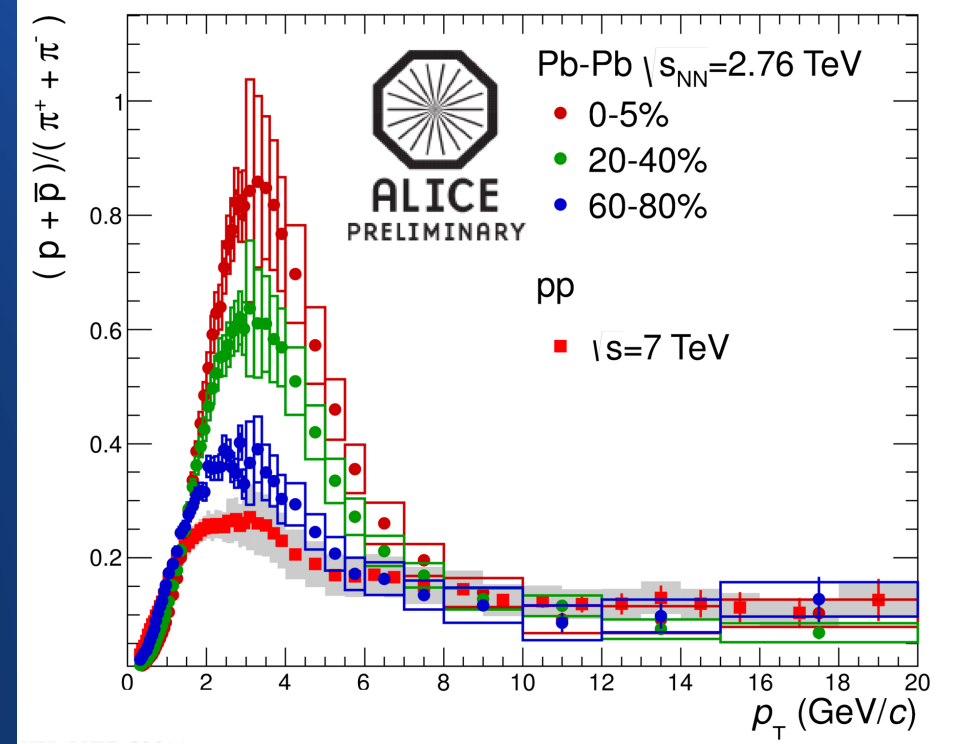
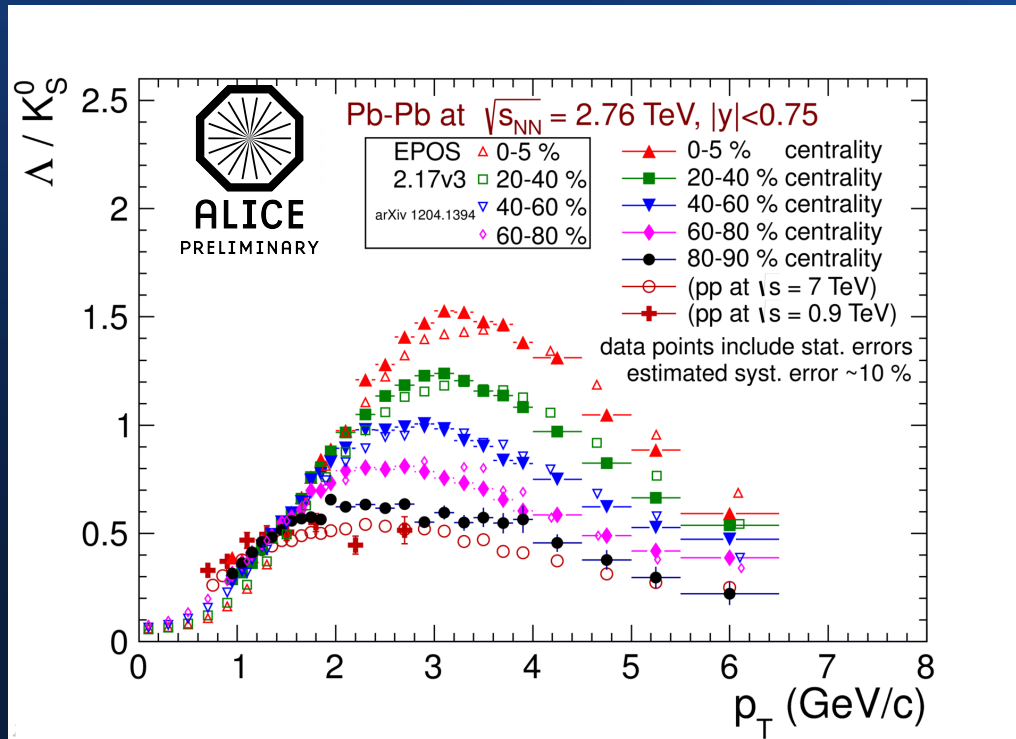
- → **Baryons versus mesons?**

$$\Rightarrow \Delta E_g > \Delta E_q > \Delta E_Q ?$$



Motivation II

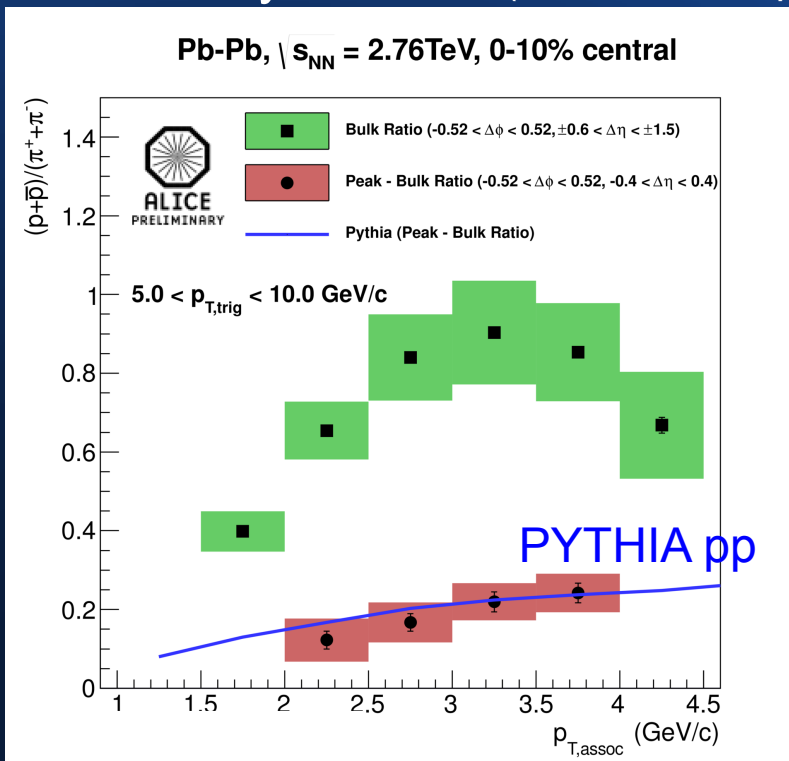
- Baryon to meson enhancement for light flavoured particles at low to intermediate p_T
- No centrality dependence at high p_T



- What is the effect on R_{CP} and R_{AA} ?

Motivation III

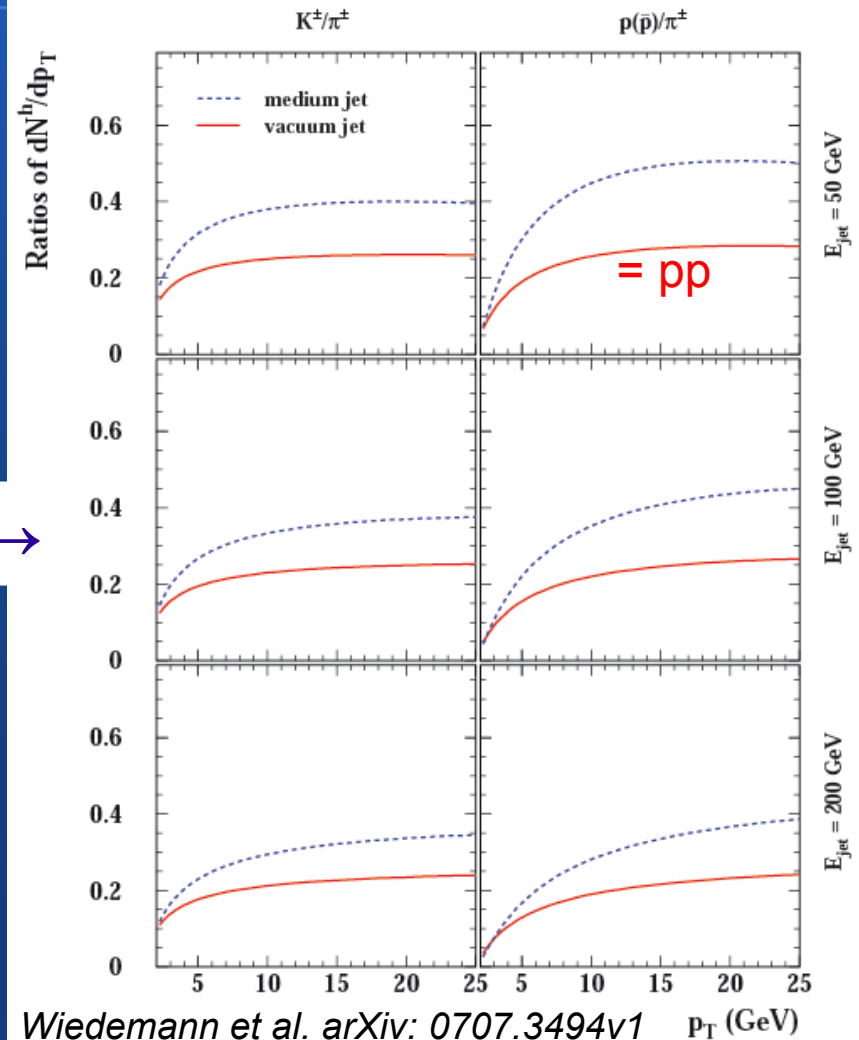
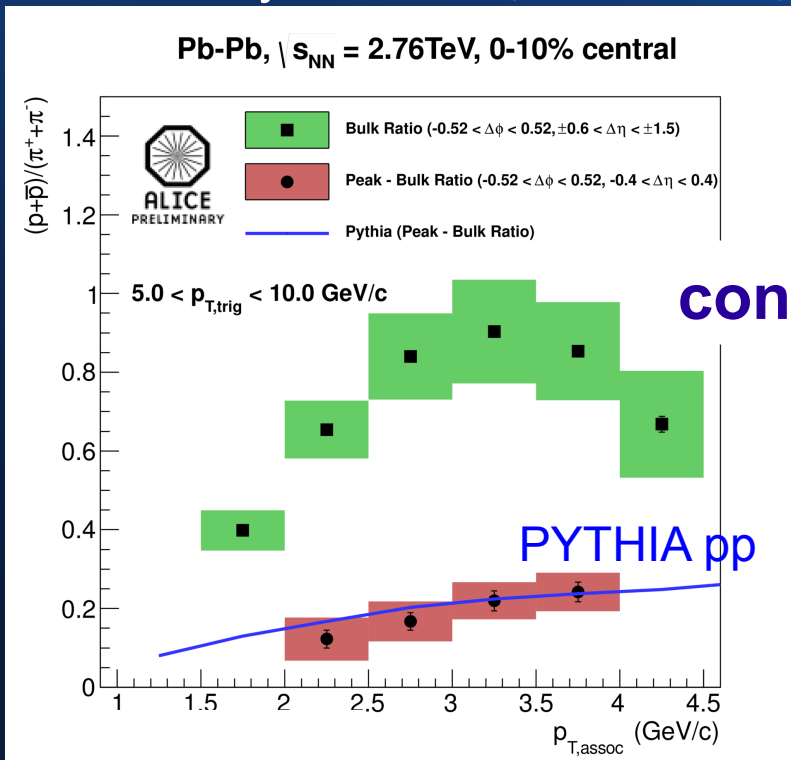
- Baryon to meson enhancement likely to be a bulk effect (M.Veldhoen, arXiv:1207.7195)
- Particle production in jets seems not to be affected by medium (A. Ortiz Velasquez, QM12)



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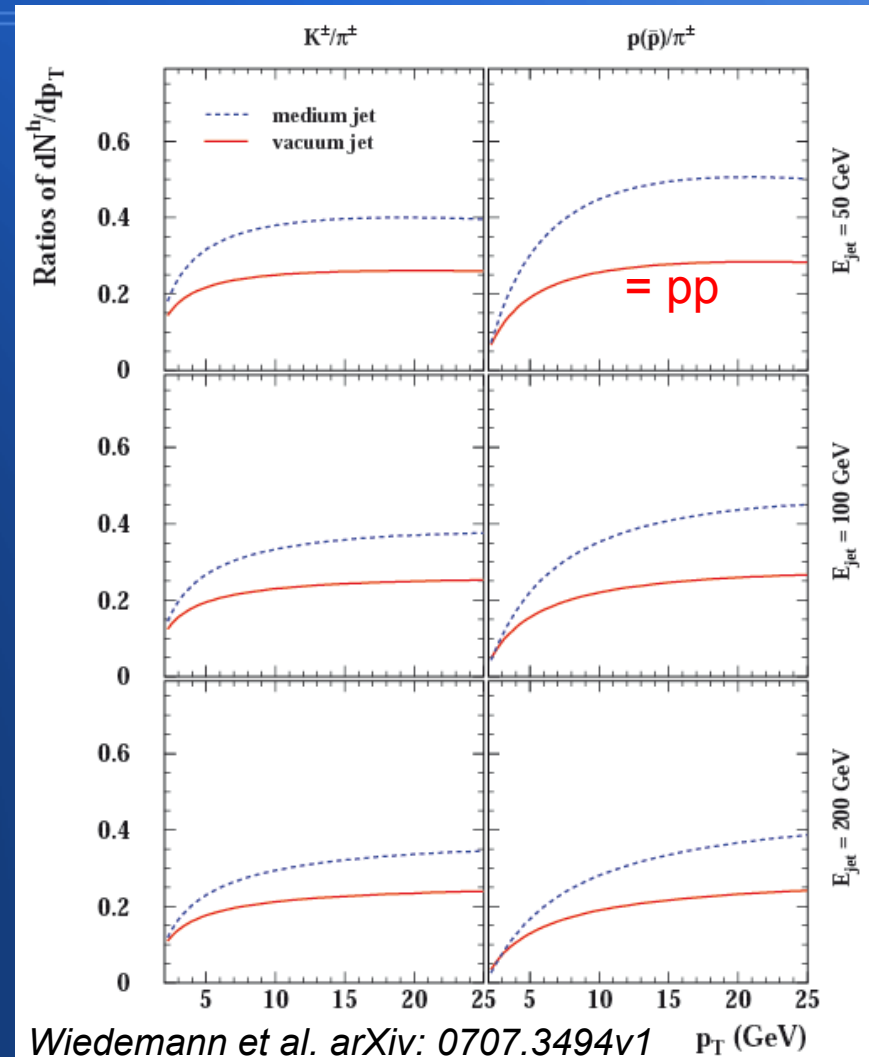
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Motivation IV

- Note that

$$\rho(AA) / \pi(AA) > \rho(pp) / \pi(pp)$$

$$\Rightarrow R_{AA}(\rho) > R_{AA}(\pi)$$
- Is this the case?



Measurement of identified particles

Measurement of identified particles at high p_T :

- Λ and K_s^0 : secondary vertex analysis of V0 decays

- Reconstruction via weak decay products:

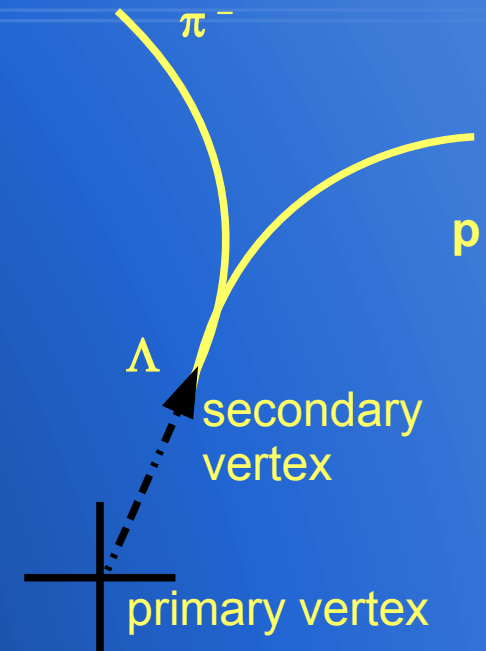


= Invariant mass analysis

→ Identification via topological track reconstruction

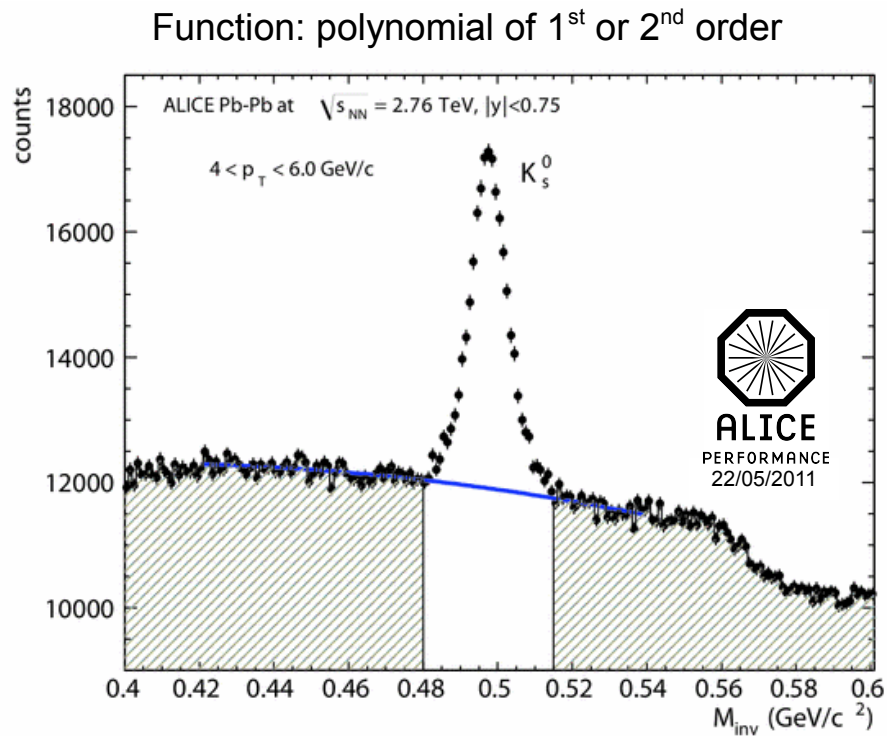
→ no PID necessary

- $p(\bar{p})$, $\pi^{+/-}$, $K^{+/-}$: identification via relative energy loss dE/dx in the TPC

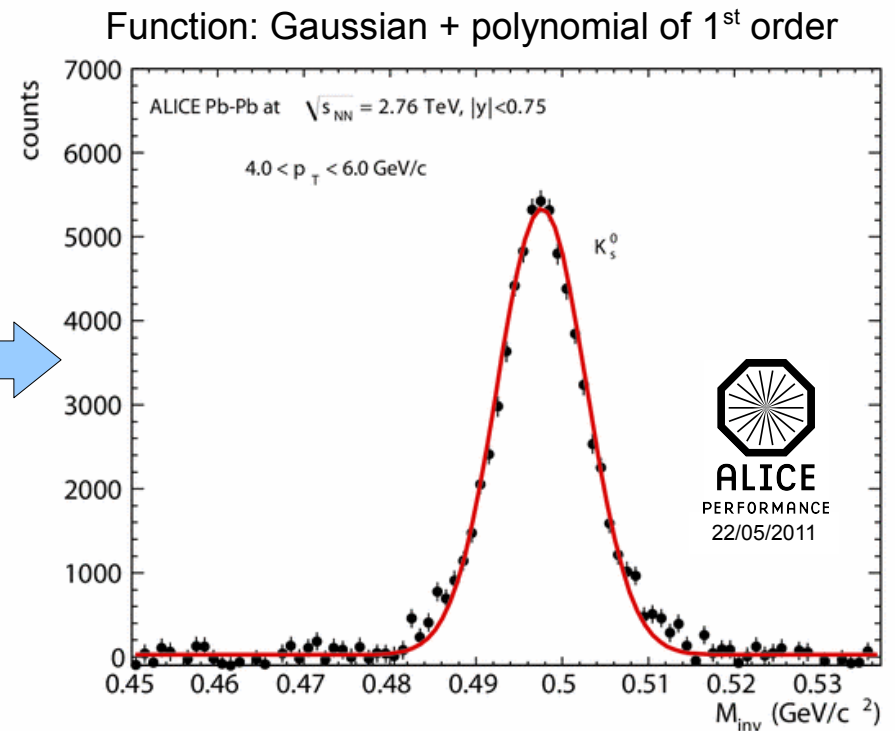


K_s^0 and Λ Analysis

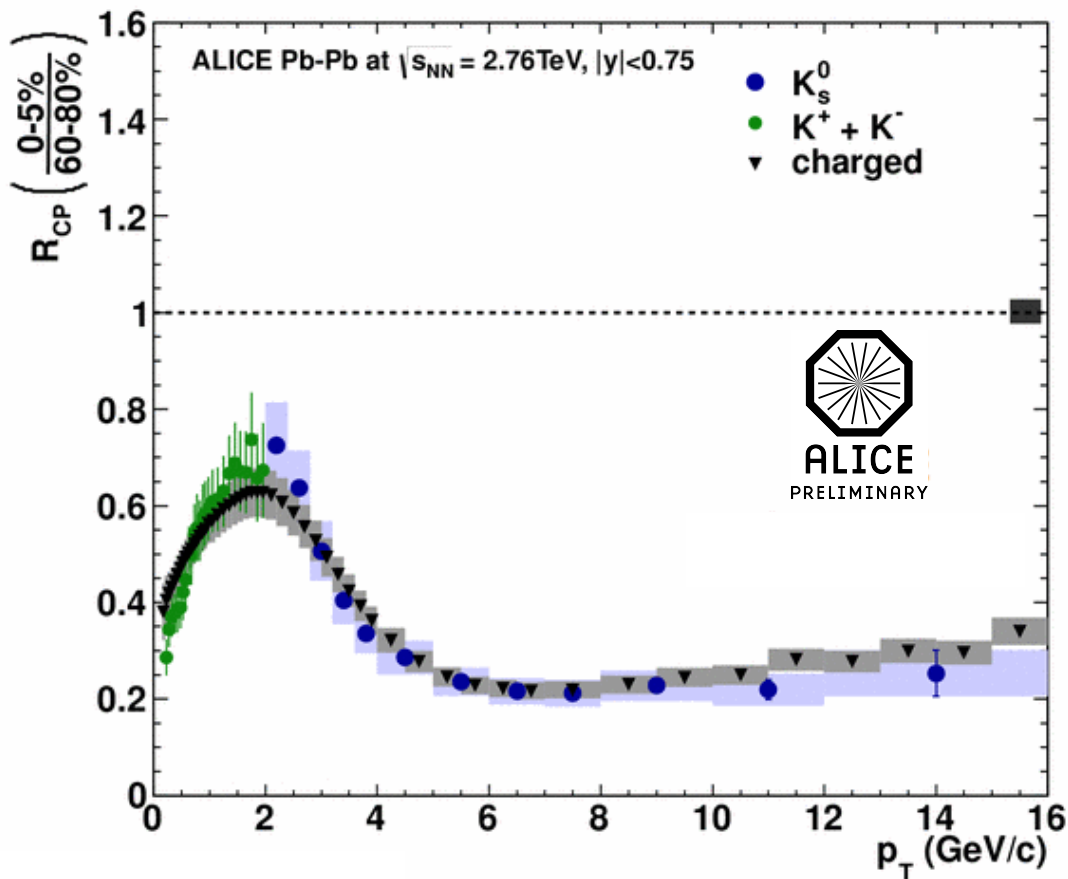
Fit of the background



Fit of the peak for mass and resolution extraction



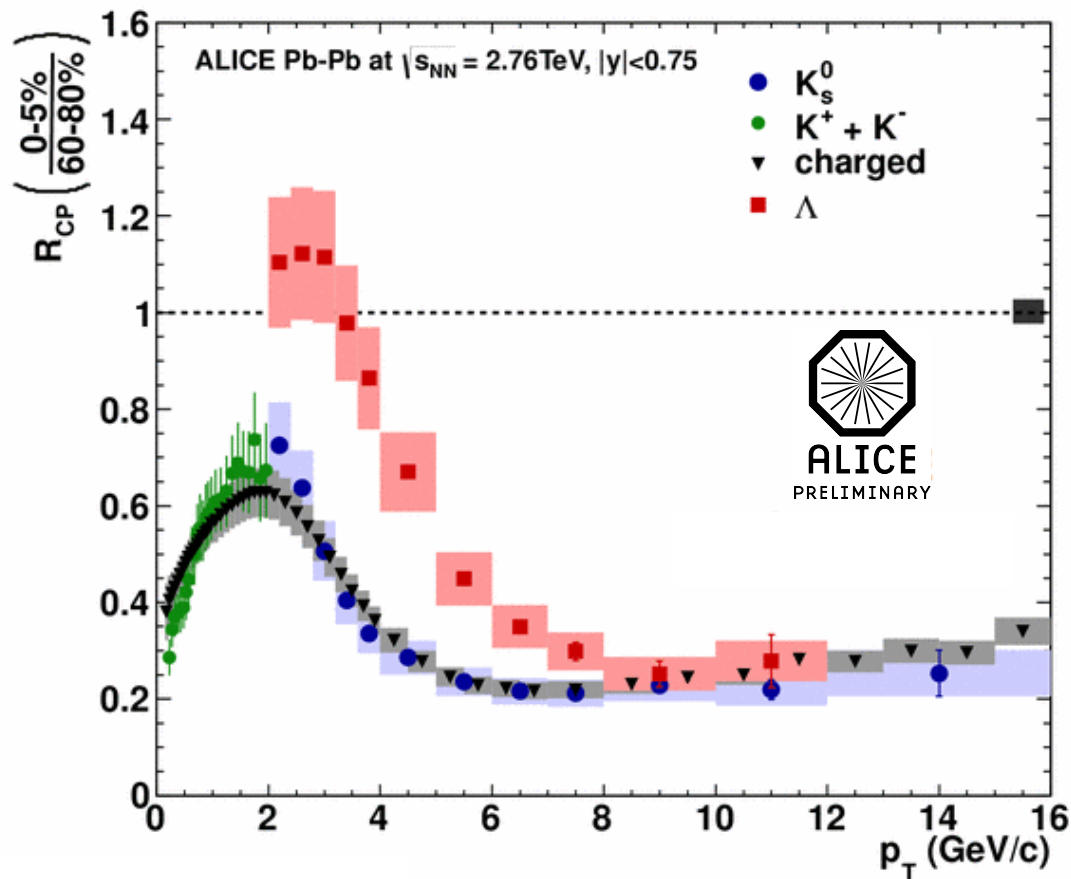
R_{CP} : comparison K_s^0 – charged



- R_{CP} of charged kaons match the K_s^0 R_{CP} at low p_T
- R_{CP} similar for charged particles and K_s^0
- Strong suppression of K_s^0 at high p_T

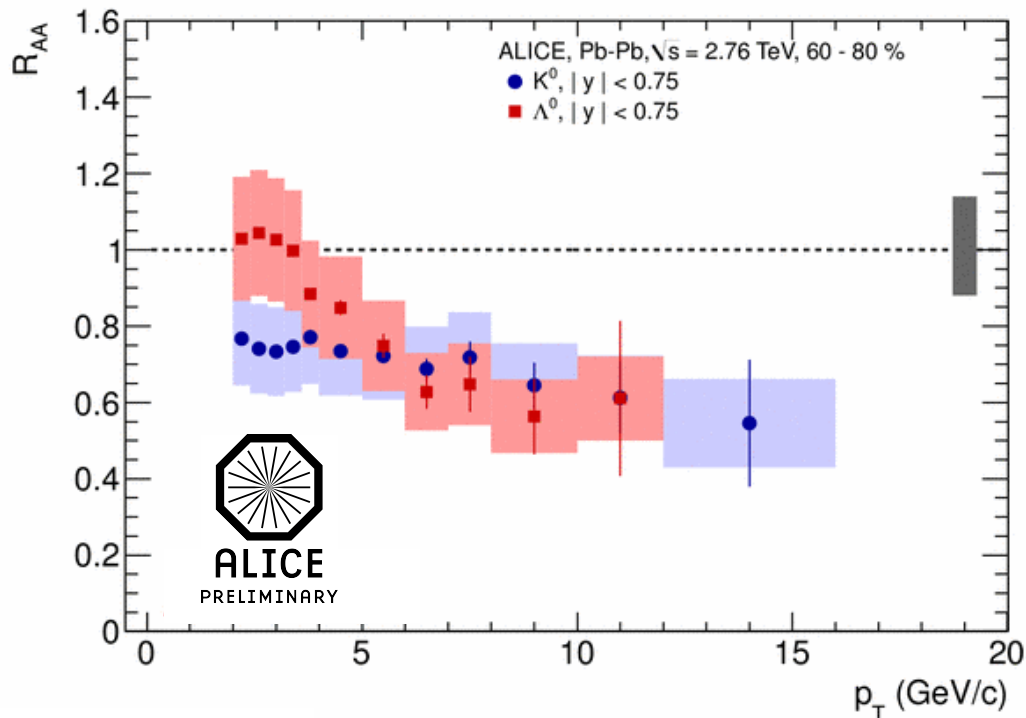
$$R_{CP} = \frac{dN_{central}/dp_T}{dN_{periph}/dp_T} \cdot \frac{\langle N_{coll} \rangle_{periph}}{\langle N_{coll} \rangle_{central}}$$

$R_{CP} : K_s^0$ and Λ



- Low p_T : Λ enhanced over K_s^0 (baryon to meson enhancement) up to $p_T = 8 \text{ GeV}/c$
- High p_T :
 - R_{CP} for Λ and K_s^0 compatible
 - Similar to R_{CP} of charged particles

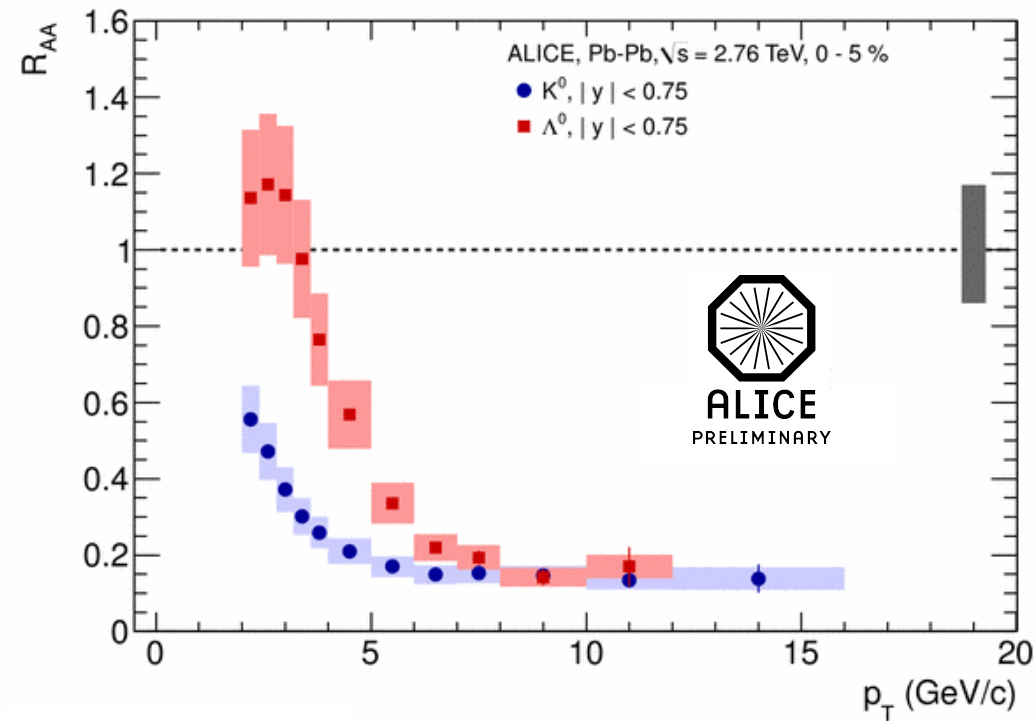
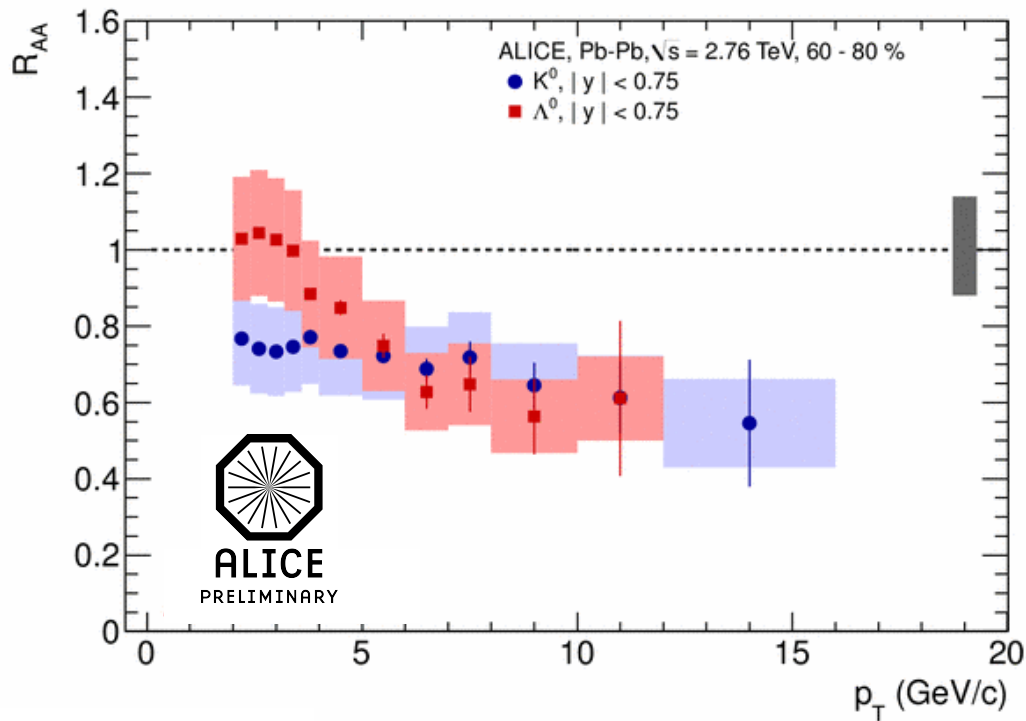
R_{AA} : peripheral Λ and K_s^0



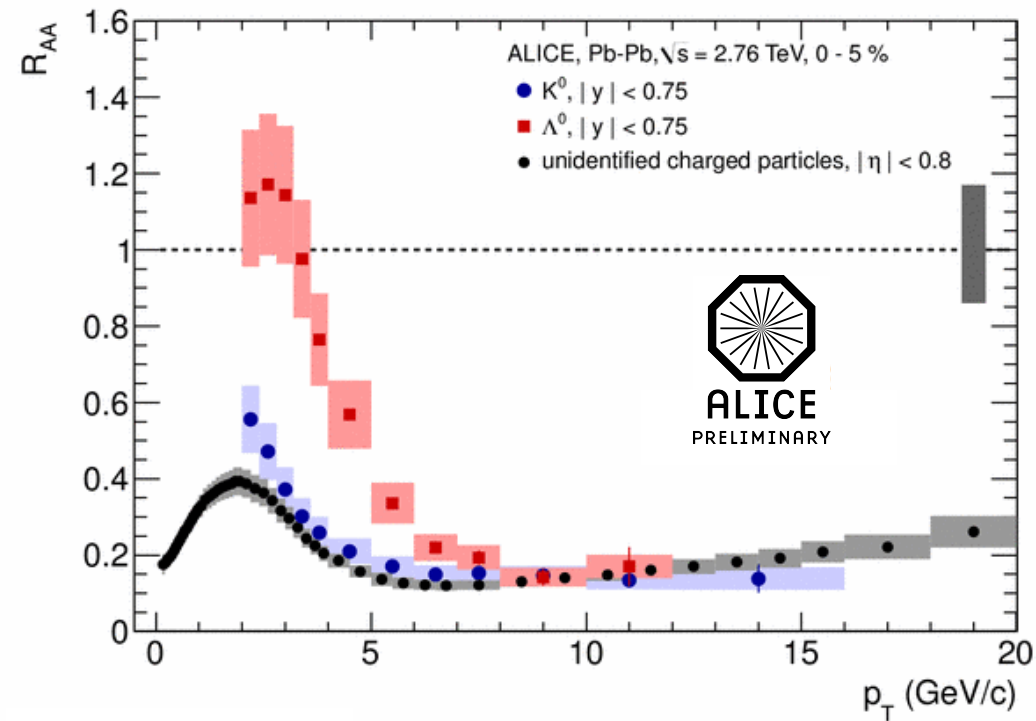
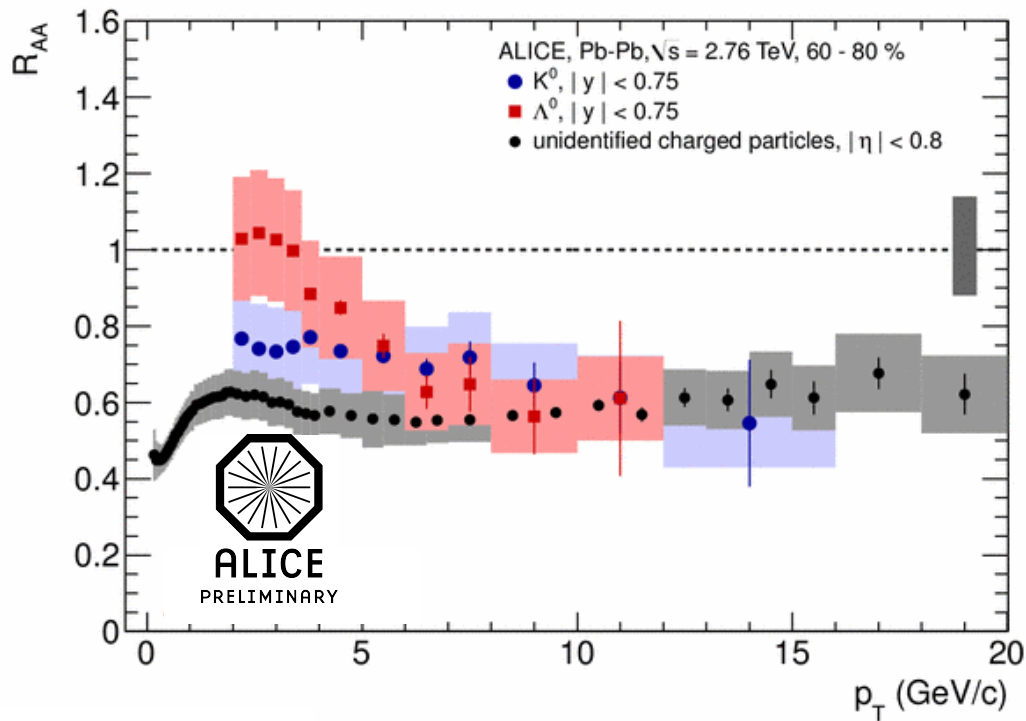
$$R_{AA} = \frac{dN_{AA}/dp_T}{dN_{pp}/dp_T} \cdot \frac{1}{\langle N_{coll} \rangle_{AA}}$$

- Low p_T :
 - Λ enhanced over suppressed K_s^0
- High p_T :
 - Λ and K_s^0 are suppressed similarly

R_{AA} : central vs peripheral

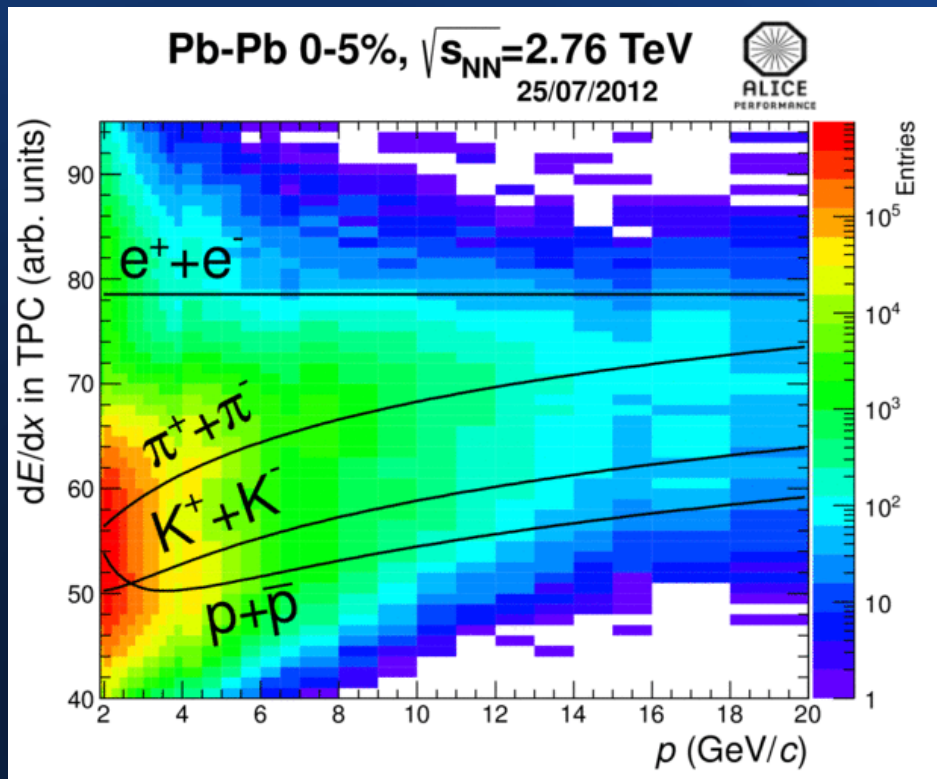


R_{AA} : comparison to charged

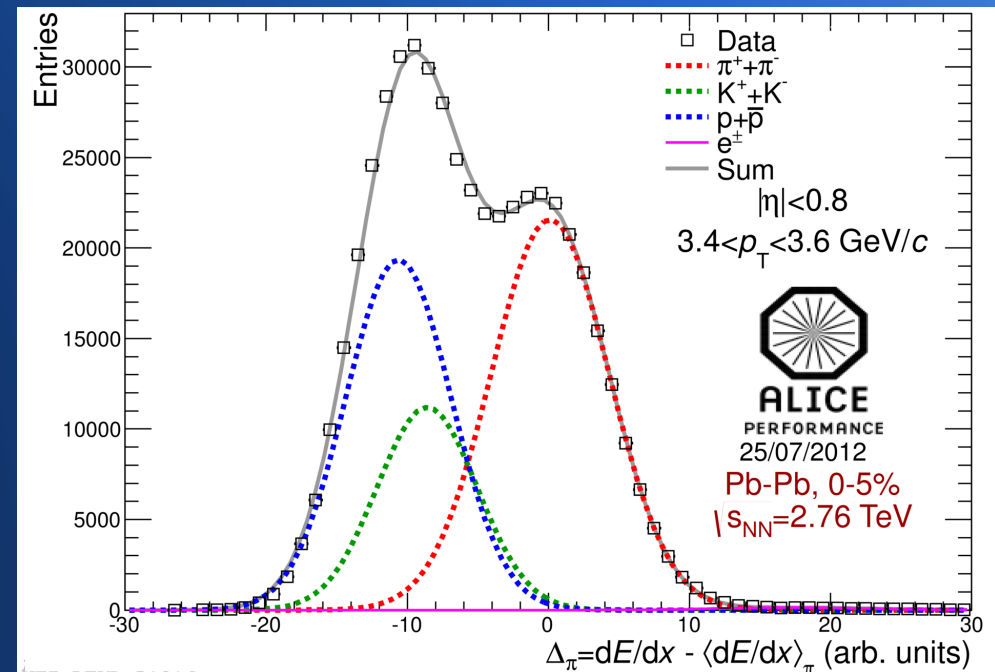


Identified charged particles: p, π, K

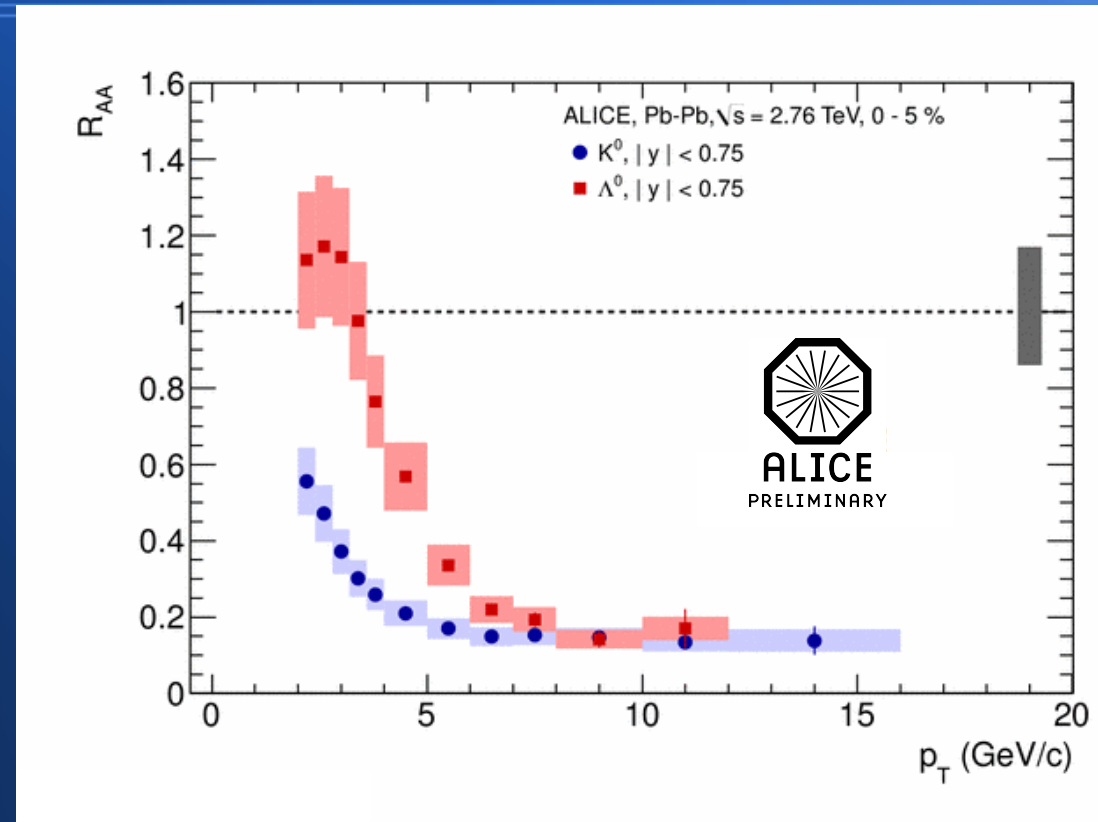
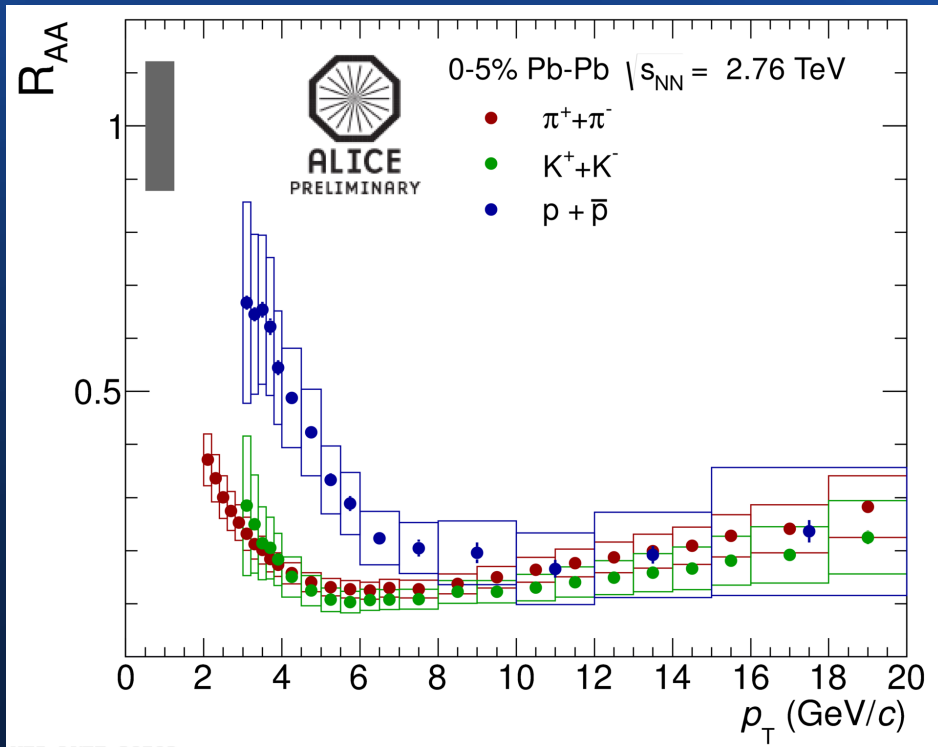
- Separation of particles at relativistic rise not perfect \rightarrow need for statistical PID
- \rightarrow Extract particle fractions via



$$\Delta_\pi = \frac{dE}{dx} - \left\langle \frac{dE}{dx} \right\rangle_\pi$$

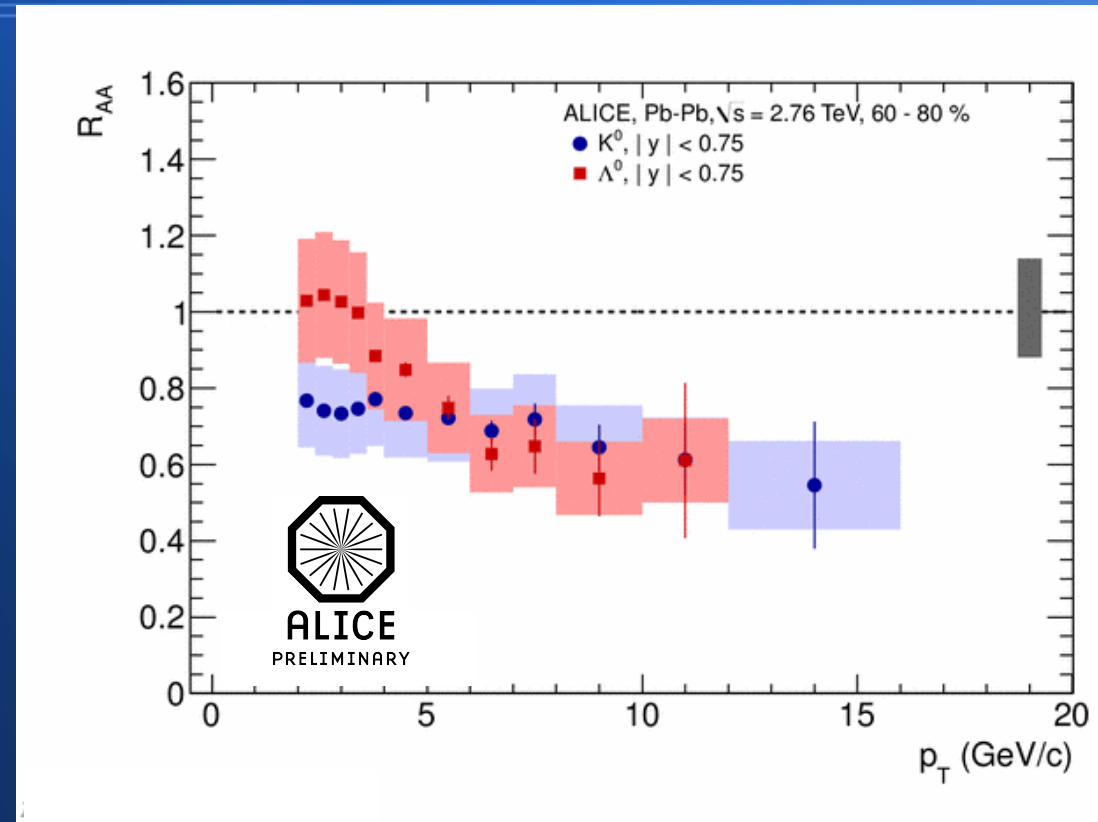
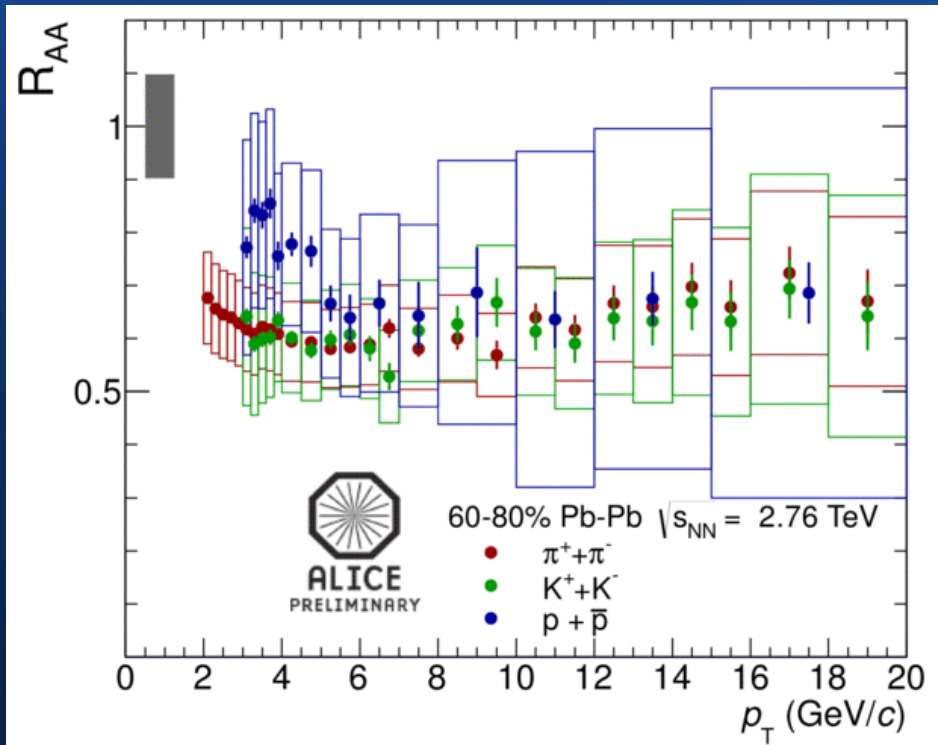


R_{AA} : p, π, K versus Λ and K_s^0



- Low p_T : R_{AA} of protons exceeds the pions, kaons \rightarrow qualitative similar to Λ, K_s^0
- High p_T : $R_{AA} \sim 0.12$ at $p_T = 6$ GeV/c. Universal behaviour at higher p_T within systematics

R_{AA} : p, π, K versus Λ and K^0_s



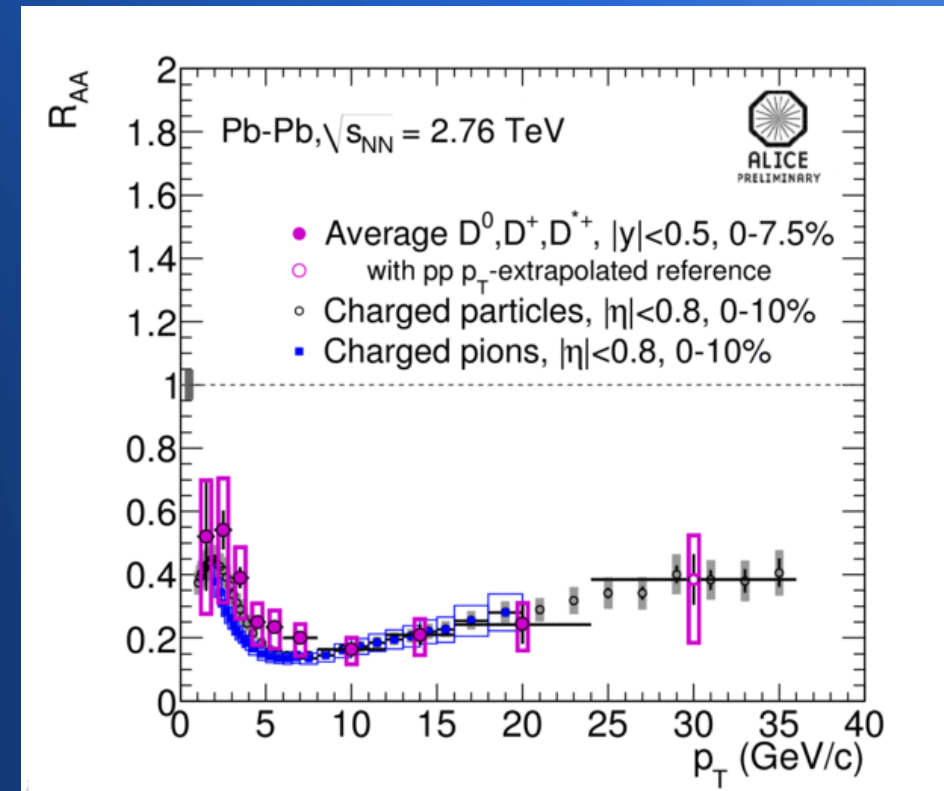
- ... same picture for peripheral collisions

R_{AA} : flavour independence at high- p_T (?)

- No significant difference between baryons and mesons at high p_T
- → no indication for different gluon and quark energy loss, or modified fragmentation in medium

R_{AA} : flavour independence at high- p_T (?)

- No significant difference between baryons and mesons at high p_T
- → no indication for different gluon and quark energy loss, or modified fragmentation in medium
- ... also no significant difference for charmed hadrons observed
- Is this understood: $\Delta E_g > \Delta E_q > \Delta E_Q$?



Summary

- Λ , K_s^0 , $p(\bar{p})$, $\pi^{+;-}$, $K^{+;-}$, R_{CP} , R_{AA} measured in Pb-Pb and pp at $\sqrt{s_{NN}} = 2.76$ TeV up to $p_T = 16 - 20$ GeV/c.
- Strong suppression observed at high p_T ($p_T > 8$ GeV/c):
 - $p(\bar{p}), \pi^{+;-}, K^{+;-}, \Lambda$ and K_s^0 compatible
- At lower p_T ($p_T < 5$ GeV/c):
 - p and π , Λ and K_s^0 different in R_{AA} (R_{CP}):
→ Baryon to meson enhancement
- No indication for parton type dependence of energy loss at high p_T observed in ALICE so far