Light flavoured hadron production in pp and p-Pb collisions

Gyula Bencedi

(Wigner Research Centre for Physics, Budapest)

Advisor/Collaborator

Antonio Ortiz (ICN/UNAM, Mexico City)

Red Mexicana Científica y Tecnológica para ALICE-LHC (Red ALICE)

Tlaxcala / 21-23 Oct 2016

Oct 22, 2016

Outline

- *Past and recent activities*
  - *Identification of pi/K/p using the TPC at the relativistic rise*
    - *Past: Analysis of pp coll. at 7 TeV and p-Pb coll. at 5.02 AteV*
      → *Paper published*
    - *Recent: Analysis of pp coll. at 13 TeV*
      → *Paper proposal (expected in couple of weeks)*

- *Status of analysis in pp coll. at 13 TeV*
  - *pi / k / p production*
  - K_0^S, Λ *and Multi-strange baryon production*
  - Φ, K^{*0} *production*

Analysis of pp coll. at 7TeV and p-Pb coll. at 5.02 ATeV

*Published paper, Phys. Lett. **B 760** (2016) 720 (10 Sep, 2016)*

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

CERN-EP-2016-003
05 January 2016

Multiplicity dependence of charged pion, kaon, and (anti)proton production at large transverse momentum in p–Pb collisions at $\sqrt{s_{NN}}$=5.02 TeV

ALICE Collaboration*

Abstract

The production of charged pions, kaons and (anti)protons has been measured at mid-rapidity ($-0.5 < y < 0$) in p–Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV using the ALICE detector at the LHC. Exploiting particle identification capabilities at high transverse momentum (p_T), the previously published p_T spectra have been extended to include measurements up to 20 GeV/c for seven event multiplicity classes. The p_T spectra for pp collisions at $\sqrt{s} = 7$ TeV, needed to interpolate a pp reference spectrum, have also been extended up to 20 GeV/c to measure the nuclear modification factor (R_{pPb}) in non-single diffractive p–Pb collisions.
At intermediate transverse momentum ($2 < p_T < 10$ GeV/c) the proton-to-pion ratio increases with multiplicity in p–Pb collisions, a similar effect is not present in the kaon-to-pion ratio. The p_T dependent structure of such increase is qualitatively similar to those observed in pp and heavy-ion collisions. At high p_T (> 10 GeV/c), the particle ratios are consistent with those reported for pp and Pb–Pb collisions at the LHC energies.
At intermediate p_T the (anti)proton R_{pPb} shows a Cronin-like enhancement, while pions and kaons show little or no nuclear modification. At high p_T the charged pion, kaon and (anti)proton R_{pPb} are consistent with unity within statistical and systematic uncertainties.

*See Appendix A for the list of collaboration members

- *Multiplicity dependence of charged pion, kaon, and (anti)proton production at large transverse momentum in p-Pb collisions at sNN = 5.02 TeV*
  - *Paper Committee members:*
    Antonio Ortiz (chair),
    Peter Christiansen,
    Gyula Bencedi,
    Giacomo Volpe
  - *Measured quantities:*
    Yields, K/pi, p/pi, Nuclear modification factor (R_{pPb})
  - *Main conclusions:*
    - *Cronin-enhancement for protons (attributed to change of proton spectra shape going from pp to p-Pb)*
    - *No modification of R_{pPb} for pi/K/p at high p_T*
    - *High-p_T integrated ratios system size independent*
- *Analysis note: https://aliceinfo.cern.ch/Notes/node/428*

Analysis of pp coll. at 7TeV and p-Pb coll. at 5.02 AteV

Published paper, Phys. Lett. ***B 760*** *(2016) 720 (10 Sep, 2016)*

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Multiplicity dependence of charged pion
production at large transvers
in p–Pb collisions at $\sqrt{s_{NN}}$

ALICE Collaboration*

Abstract

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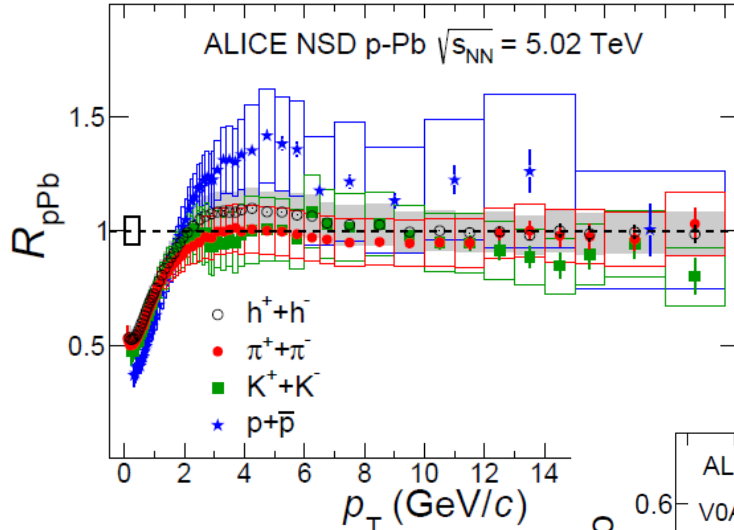
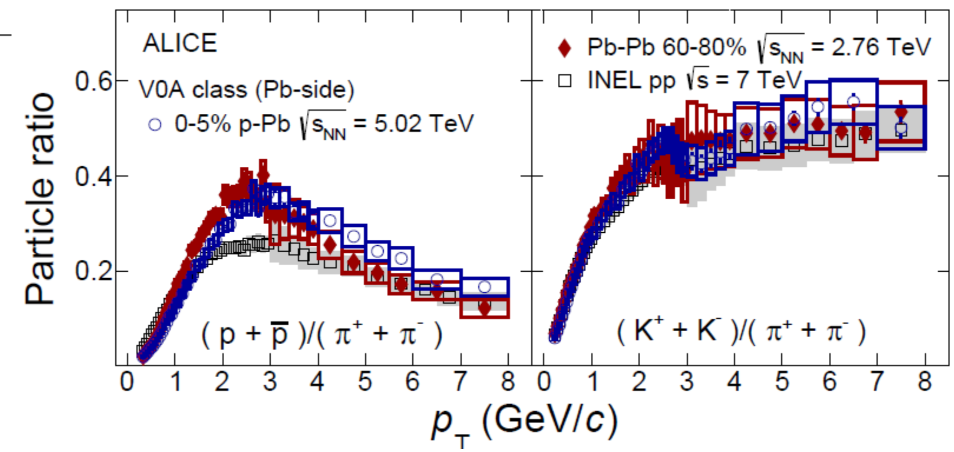
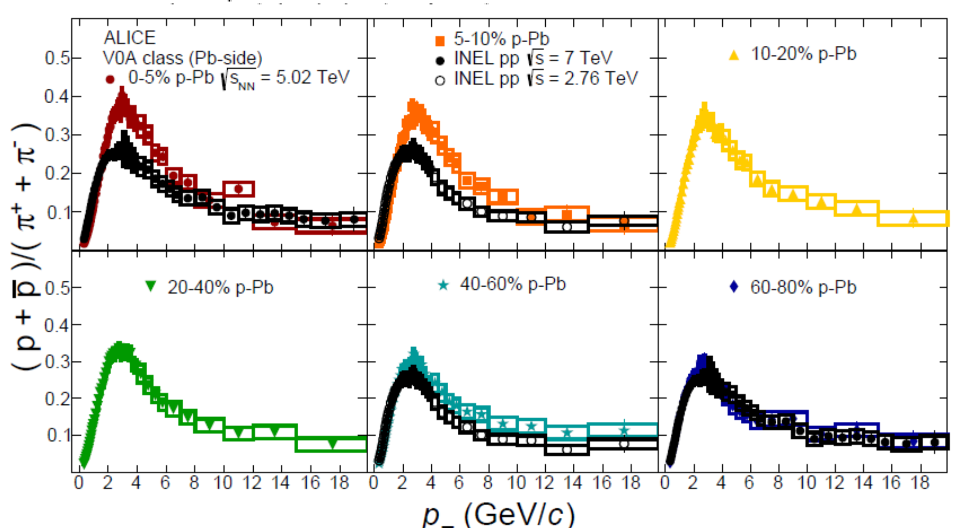
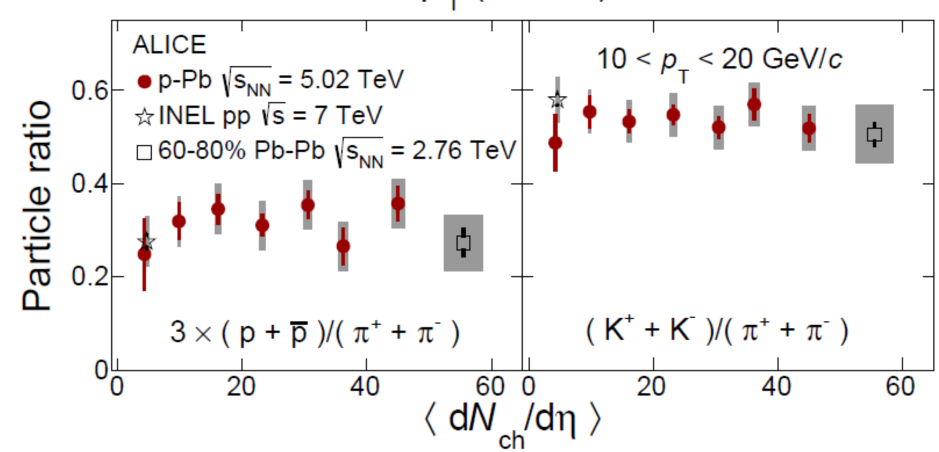
*See A



- **Nulcear modification factors**
- **Particle ratios vs. multiplicity**
- **Particle ratios vs. system size**







Analysis of pp coll. at 13TeV (minimum bias)

π K p K^0_S Λ Ξ Ω K^*_0 Φ

ALICE

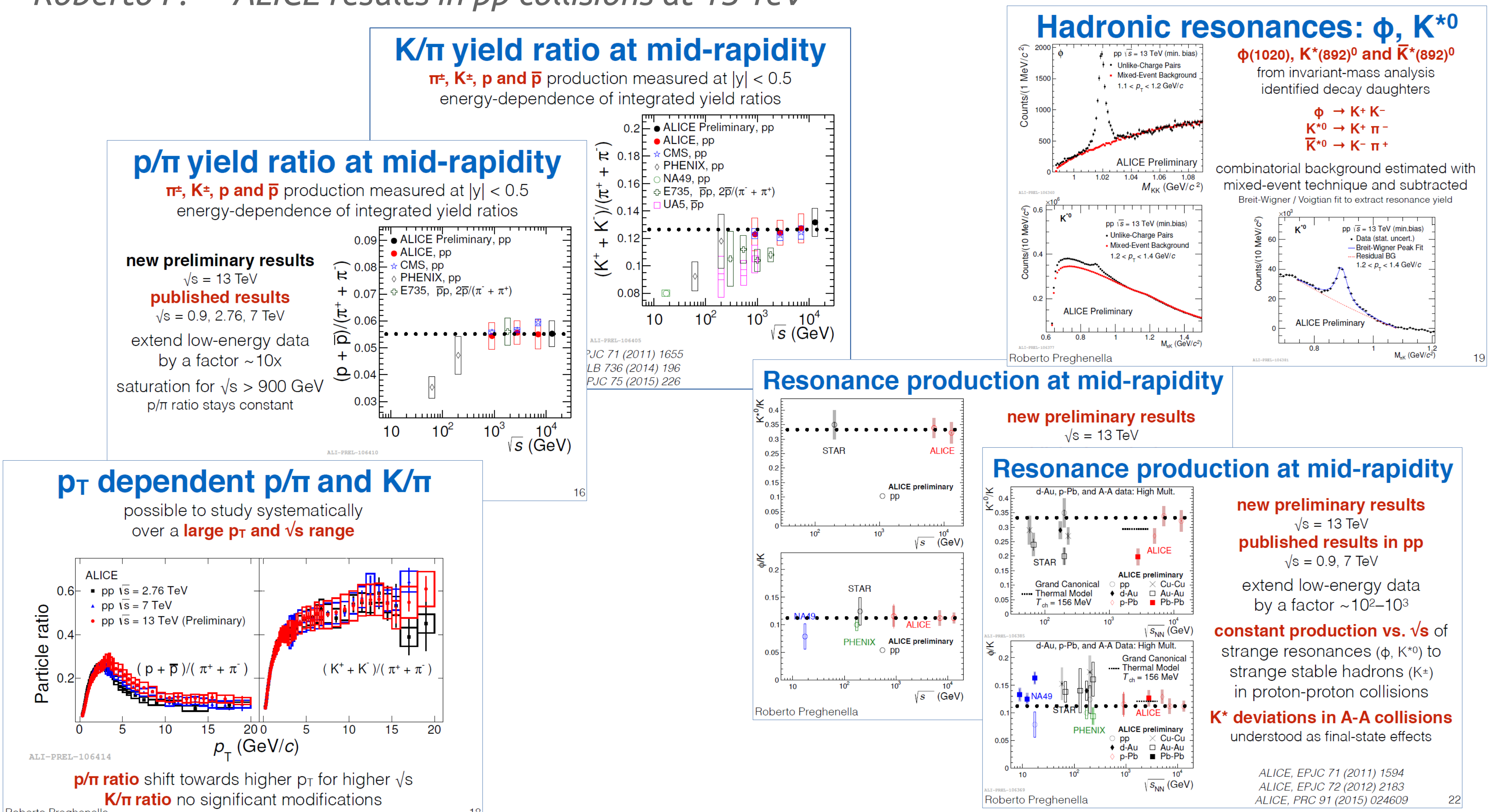
- Analysis of Run 2 data – LHC15f pass2 (ESDs): collected in 2015, 3–13 June
  - *pi / k / p production*
  - *K_0^S, Λ and Multi-strange baryon production*
  - *Φ, K^{*0} production*
- ***Preliminary results***
  - PWG-LF meeting - SQM approval session (6 June 2016)

    https://indico.cern.ch/event/539129/
- ***Goal: Paper –*** *Final results and have a long paper collecting light falvoured results → paper on arXiv for QM'17 (Feb 6, 2017)*
  - *Paper committee members: Gyula B.(chair), Anders K., Yasser C., Peter K., Sourav K.*
- ***Potential issues (we know of and strongly affect all analyses and paper as well)***
  - *[Missing]* INEL normalization of the spectra **(In progress…)**
    - Started in collaboration with Ernesto Calvo Villar (PWG-UD)
  - *[Wrong]* low p_T PID hypothesis for protons and kaons → Effect on Lambdas **(Resolved!)**
    - *https://alice.its.cern.ch/jira/browse/PWGPP-218*

Preliminary Results – presented on conferences

[June, 2016] Meson 2016 – http://meson.if.uj.edu.pl

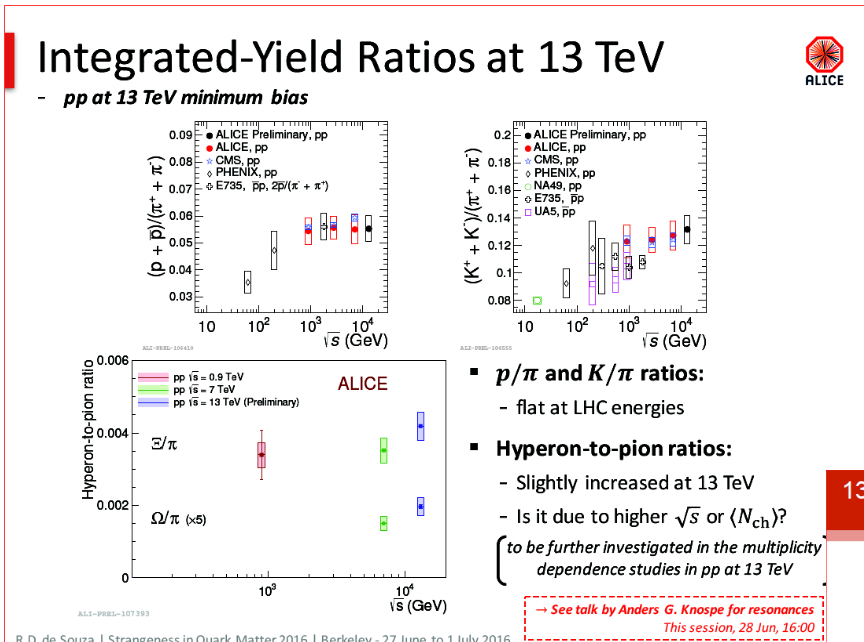
Roberto P. – "ALICE results in pp collisions at 13 TeV"

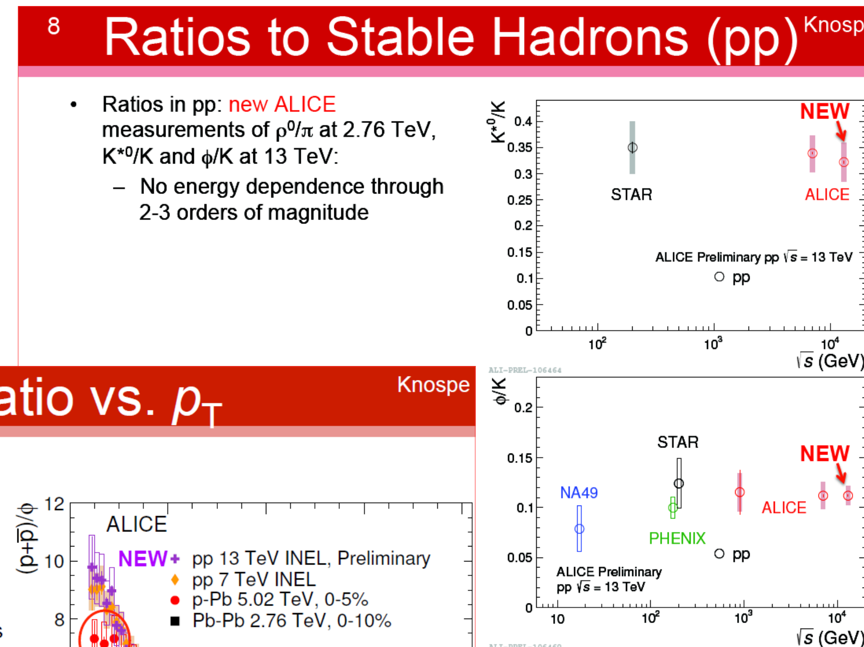


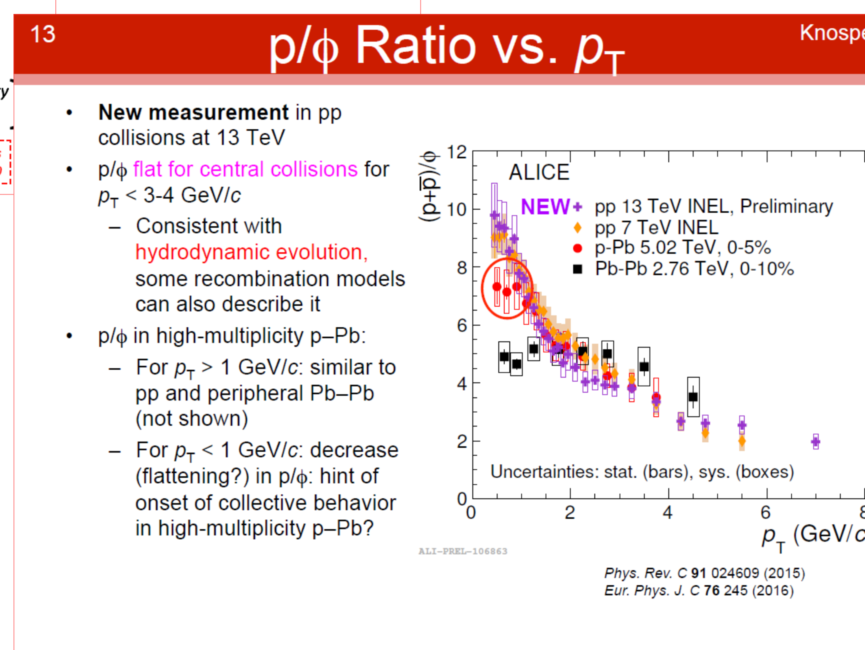
Preliminary Results – presented on conferences

[July, 2016] SQM 2016 – https://indico.cern.ch/event/403913/overview

Anders K. – "Recent Hadronic Resonance Measurements at ALICE"







Rafael D. – "Identified particle production in pp collisions at 7 TeV and 13 TeV measured with ALICE"

Status of

π K p

pi / K / p production

Analysis Crew:

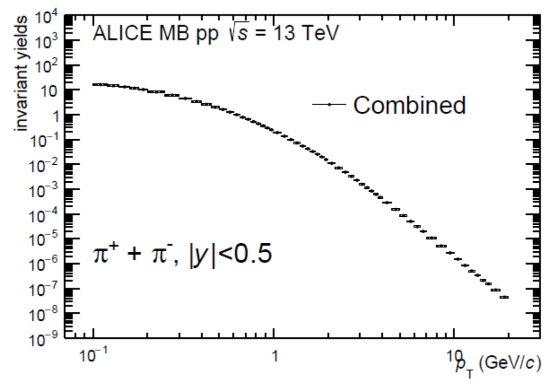
- **ITSsa:** Yasser, Ivan
- **low-p_T TPC:** Martin, Benjamin
- **HMPID:** Giacomo
- **TOF:** Tona
- ***r*TPC:** Gyula, Antonio, Peter C.
- **Kaons from kinks:** Martha

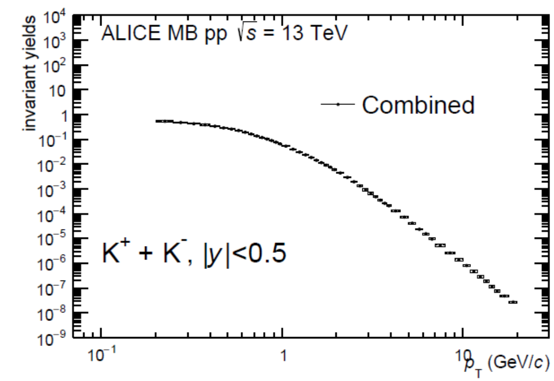
Analysis	Tracking	p_T range [GeV/c]			PID approach	Crew
		$\pi^+ + \pi^-$	$K^+ + K^-$	p + pbar		
ITS-sa	ITSsa	0.1-0.7	0.2-0.6	0.3-0.65	<dE/dx> cut	Ivan Ravasenga/ Yasser
TPC*	global tracks	0.15-20	0.3-20	0.4-20	multi-template fit	Martin Schmidt/ Benjamin Hess
TOF	global tracks	0.5-2.5	0.5-2.4	0.8-3.7	unfolding	Raul Tonatiuh Jimenez
HMPID	global tracks	1.5-4.0	1.5-4.0	1.5-6.0	unfolding	Giacomo Volpe
rTPC	global tracks	2.0-20.	3.0-20.	3.0-20.	unfolding	Gyula Bencedi/ Antonio Ortiz
Kink	global tracks	-	0.3-7.0	-	topological decay	Martha Spyropoulou

Combined results *– Standard procedure is used*

– Weighted mean with inverse square of "non-common" systematic uncertainties

– Adding common uncertainties to the combined results (e.g. global tracking eff., p_T dep. global tracking uncert.)





More details →

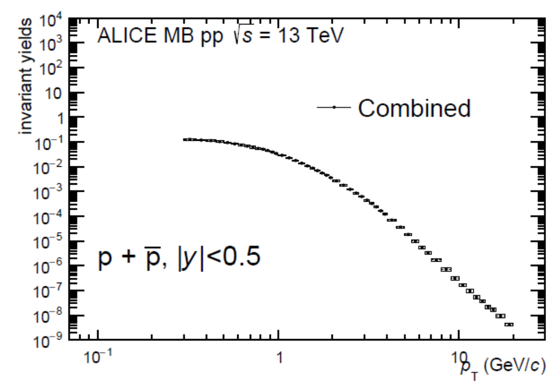
– AN note: https://aliceinfo.cern.ch/Notes/node/476

– ALICE Physics Week (7 March 2016)
https://indico.cern.ch/event/503876

– PWG-LF: Light Flavour Spectra (18 April 2016)
https://indico.cern.ch/event/520228

– Physics Forum - SQM previews (30 May 2016)
https://indico.cern.ch/event/534010

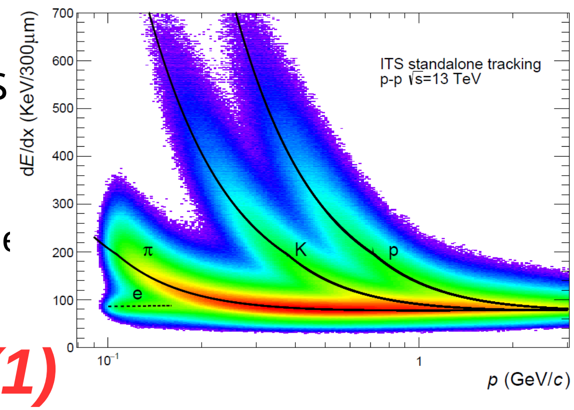
– PWG-LF meeting - SQM approval session (6 June 2016)
https://indico.cern.ch/event/539129



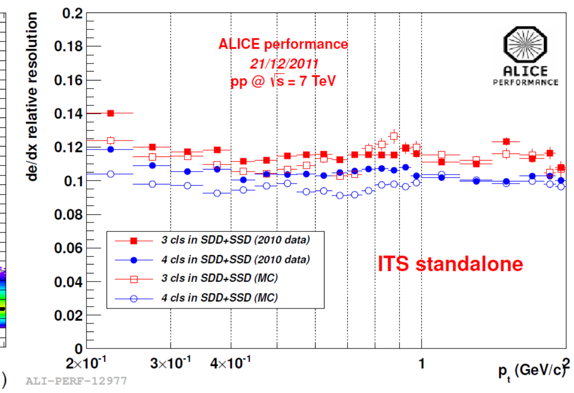
ITS stand-alone (ITSsa)

- ***(1)* Analysis based on the ITS information only**
  - ITSsa tracking, ITSPureSA set -all clusters in ITS
- PID via ITS dE/dx:
  - Species selected via the closest expected Bethe
  - PID via Nσ and Bayesian approaches
- Geant3/Geant4 correction
  - Negative K in all the measured p_T interval
  - Anti-protons for p_T < 400 MeV/c
- ***(2)* Main source of systematic uncert.**
  - ITS-sa tracking: track selection criteria varying cuts inside a reasonable range; Tracking efficiency
  - PID approach: nsigma/Bayesian PID
  - Material Budget; material budget was varied by +- 7.5%

(1)



(b) ITS PID performance



(a) ITS dE/dx resolution

(2)

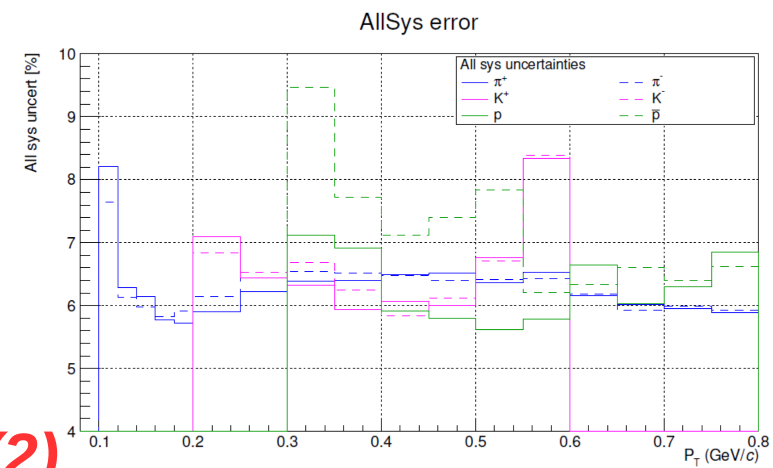


Fig. 12: Total Systematic uncertanties

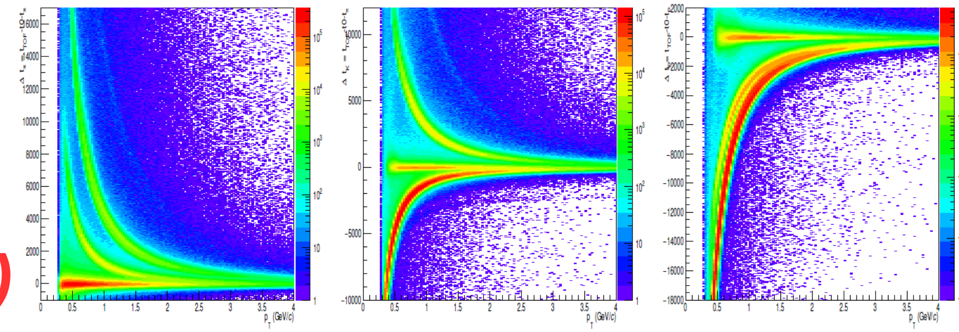
https://aliceinfo.cern.ch/Notes/node/476

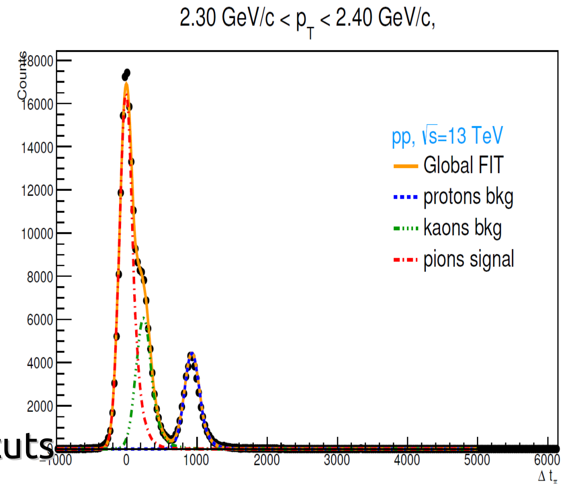
TOF

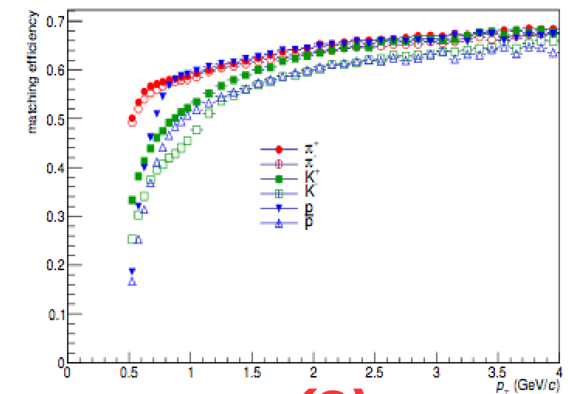
- *(1)* **TOF unfolding technique used to obtain the raw spectra**
  - Using Δt_i as a PID estimator $\Delta t_i = t_{TOF} - t_0 - t_{exp,i}$

    PID performance depends on time resolution, ~110*ps*
  - Raw yield extracted from the signal
- *(2)* Corrections
  - Tracking and matching efficiency
  - Feed down correction using DCA fits
  - Geant/Fluka correction only for K^-
- *(3)* Main sources of systematics uncertainties
  - Systematic due to raw yield extraction
  - Systematic due to track cuts → varying track cuts
  - Systematic due to tracking efficiency

(1)







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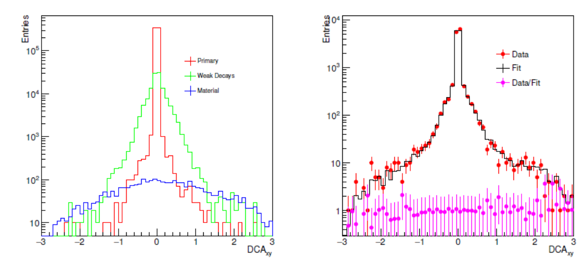
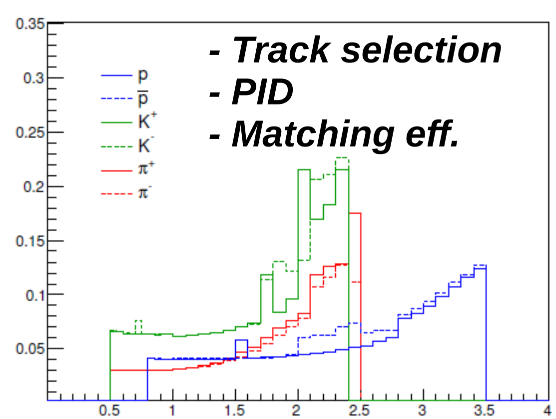


(3)



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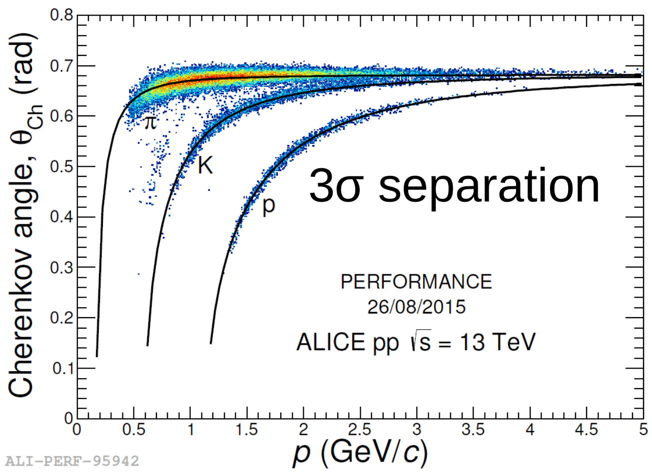


HMPID

$$\cos\theta_{Ch} = \frac{1}{n\beta} \Longrightarrow \theta_{Ch} = \arccos\left(\frac{\sqrt{p^2+m^2}}{np}\right)$$

(1)

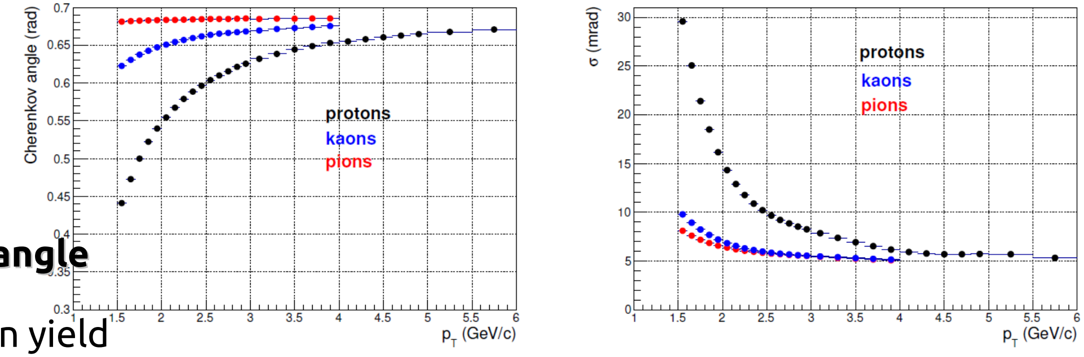
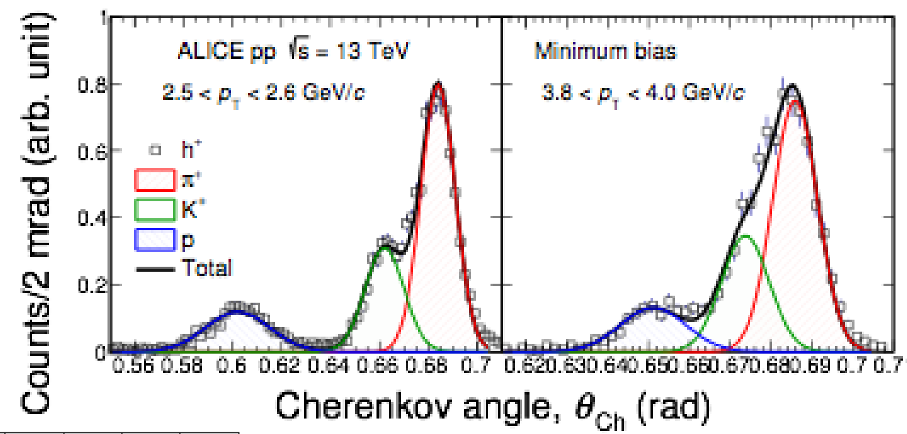
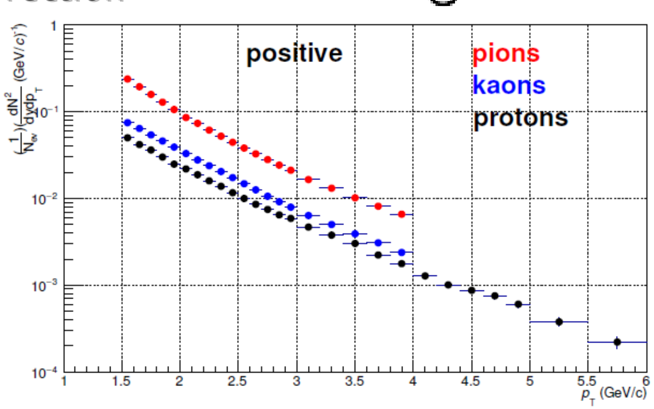


Fig. 32: Mean Cherenkov angle (left) and standard deviation (right) values for pions, kaons and protons obtained by the three-Gaussian fitting procedure as a function of p_T.

- ***(1)* PID based on the measurement of Cherenkov angle**
  - Statistical unfolding used to extract raw hadron yield
  - *(2)* Raw yield extracted from the signal
- Main sources of systematic uncert.
  - Systematics due to raw signal extraction
    - Varying fit parameters (mean, sigma)
  - Systematics due to track cuts and event
    - Varying track cuts
  - Systematics due to Feed down correction
  - Systematics due to matching
    - MIP-track distance (Default 5cm); 6cm and 4cm

(2)





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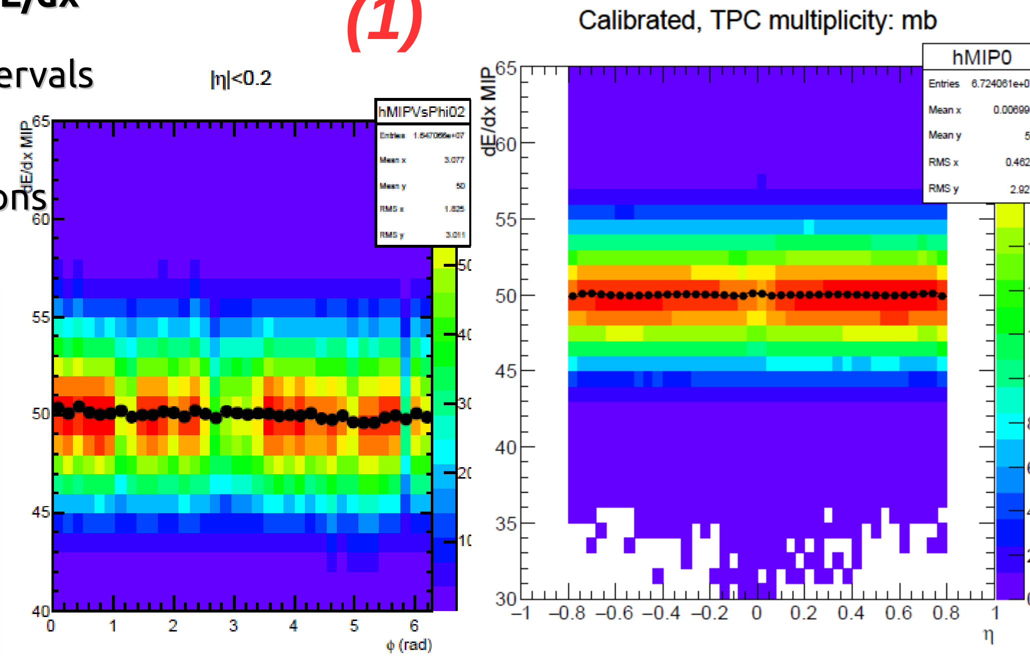
TPC rel. rise analysis

- **Signal extraction based on the precise knowledge of dE/dx**
  - (1) dE/dx recalibration in narrow pseudorapidity intervals
  - (2) New BB and $\sigma_{dE/dx}$ parametrization vs. η
  - (3) 4-Gaussian fits used to (4) extract particle fractions
  - (5) pi/k/p yields → particle frac. x charged spectrum

(1)



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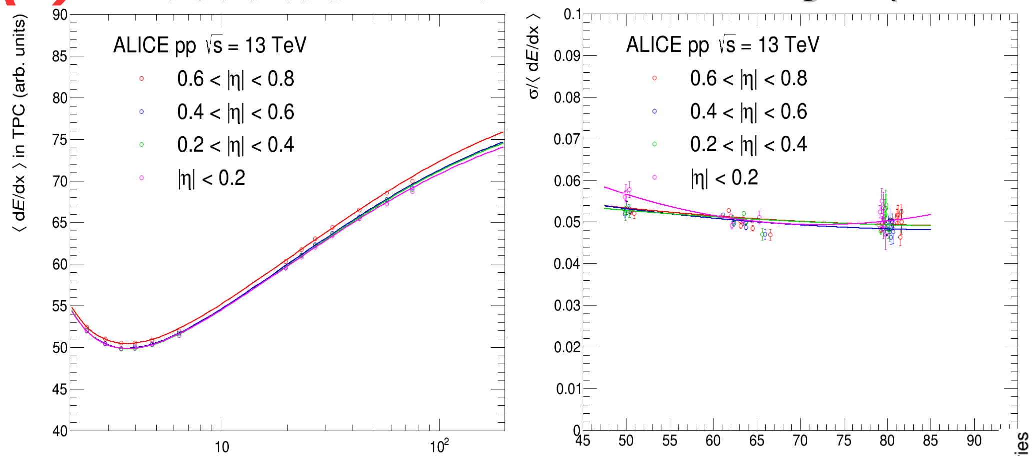

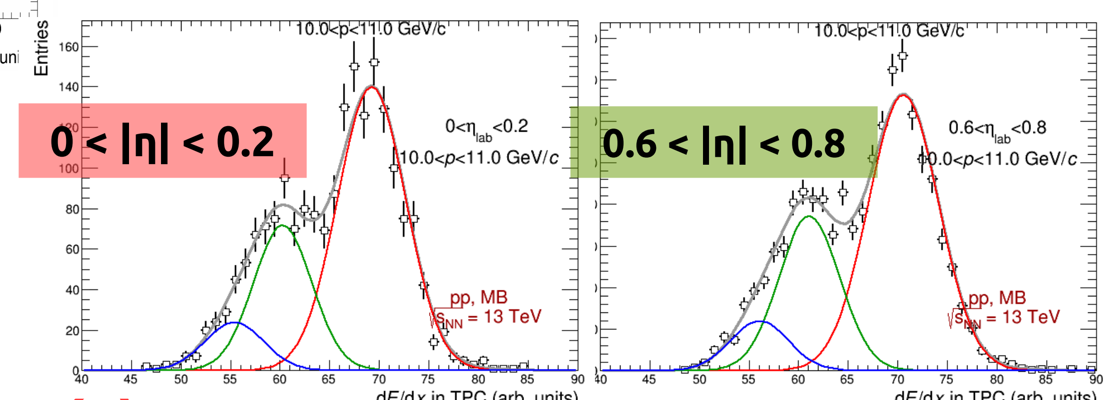

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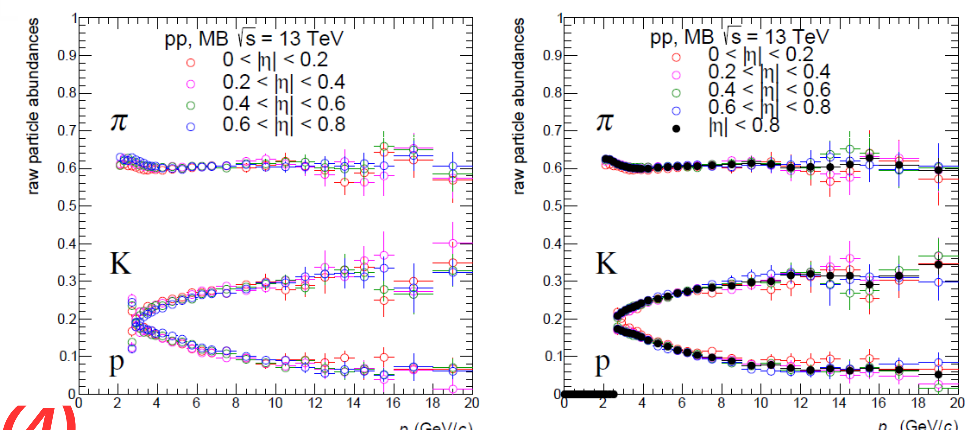

(4)

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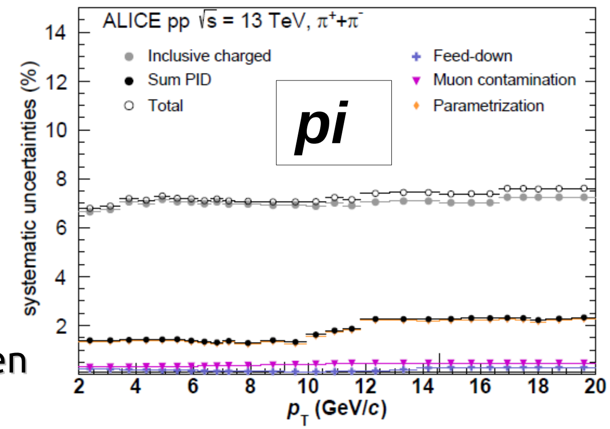
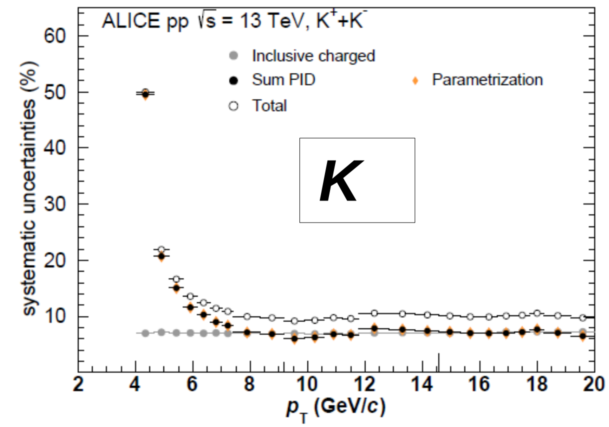
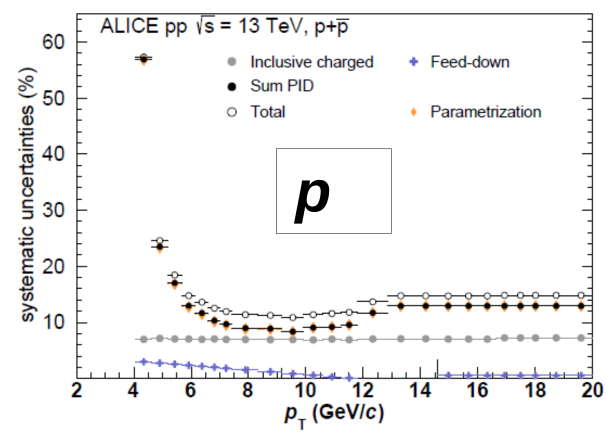
TPC rel. rise analysis

(6)



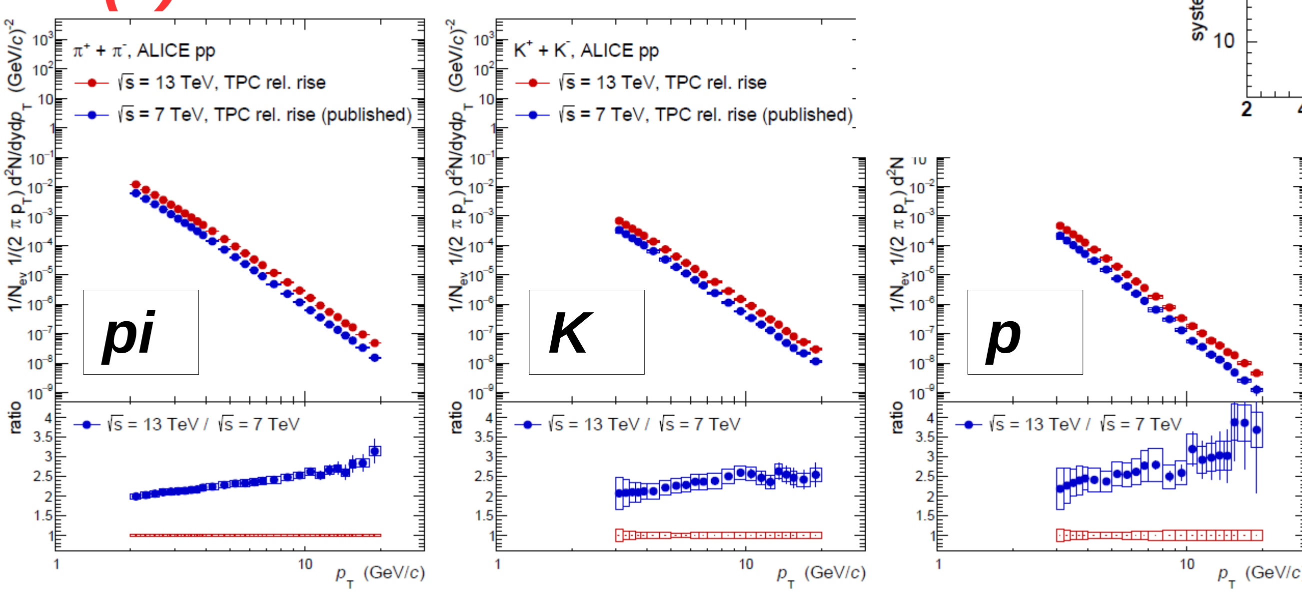




(6) **Main sources of systematic uncert.**

- Main contributions (due to tracking) are taken over from charged analysis
- Systematics due to feed down
- Systematics due to efficiencies and muon contamination

(5)



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TPC – Multi Template Fit

- Generate dE/dx Templates
- Fit to measured dE/dx distribution used to extract the particle fraction
- Main sources of systematic uncert.: secondaries, muon contamination, PID

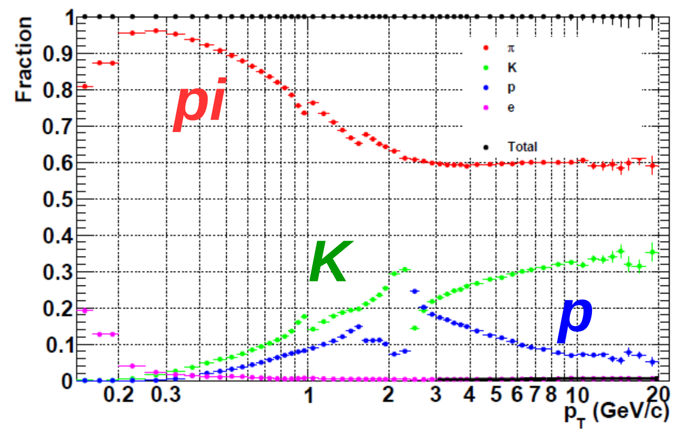


Fig. 78: Uncorrected and unregularized fractions obtained with the TPC MTF. The crossing regions are clearly visible due to the "jumping" behavior of the fit: π-K at 1 GeV, π-p at ≈1.6 GeV and the very problematic crossing K-p at ≈2.4 GeV

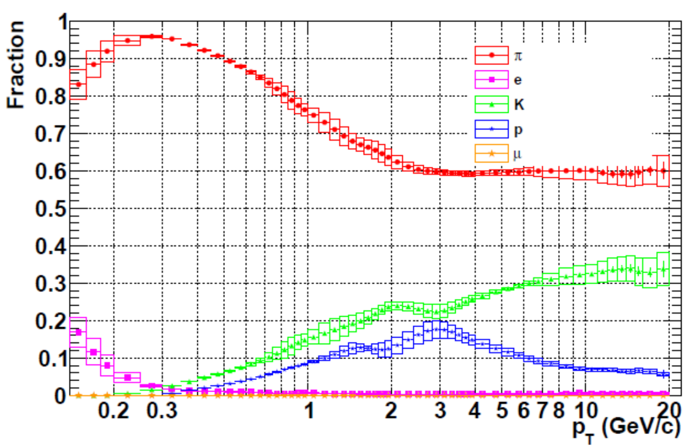


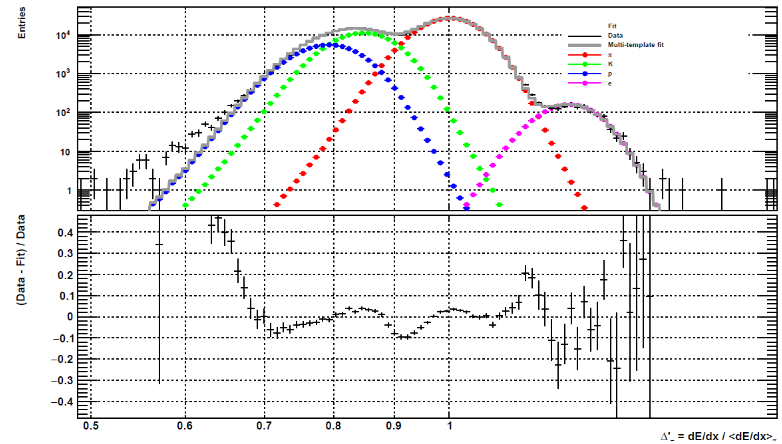
Fig. 79: The effect of the regularisation: In comparison to 78, the crossing regions are smoothed. The systematic uncertainties are added and are, as expected, large in the crossing regions

Restricted ranges in the combination with other analyses:

Pi: 0.25 – 3.0 GeV/c

K: 0.30 – 5.25 && 0.675 – 3.0 GeV/c

P: 0.45 – 1.05 && 2.10 – 3.0 GeV/c



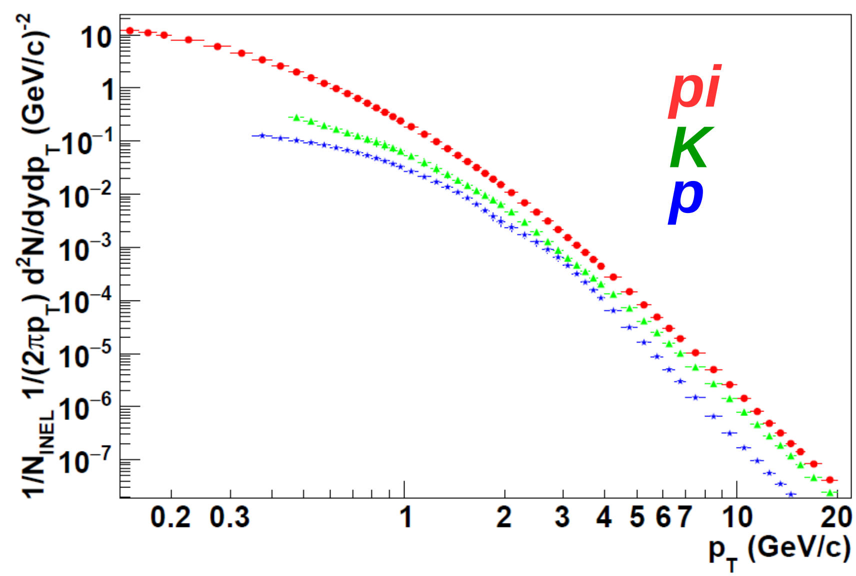


Fig. 77: Spectra obtained with the TPC MTF for π (red), kaons (green) and protons (blue). Note: The result is (despite the axis title) not normalized to the number of inelastic events (INEL)

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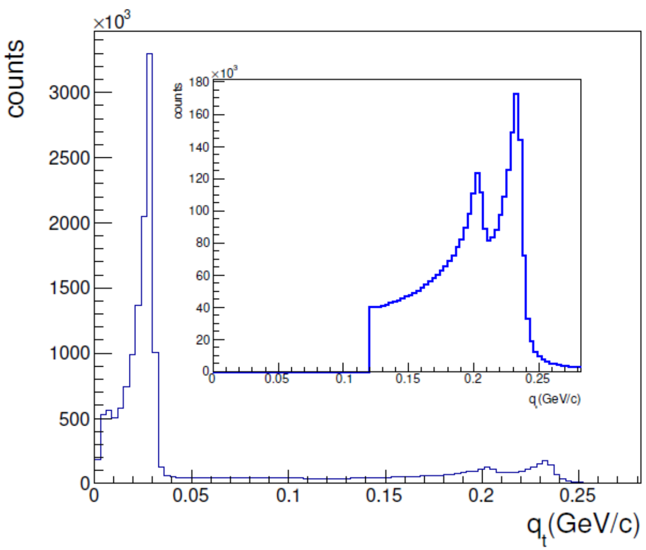
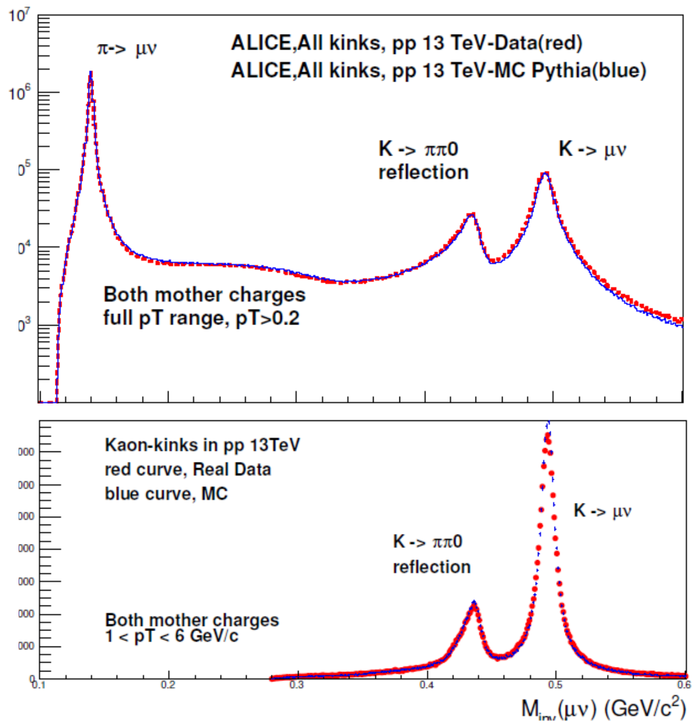
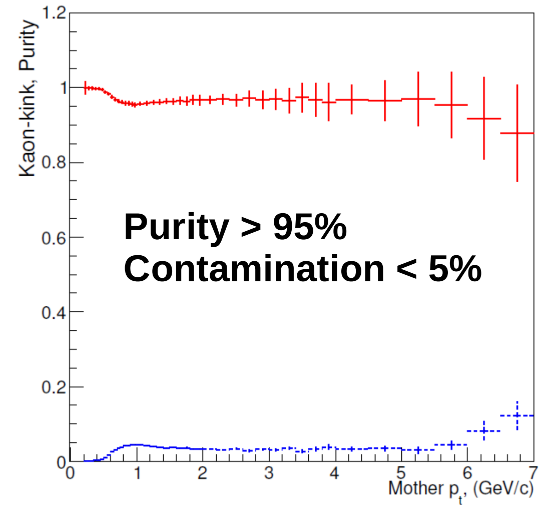
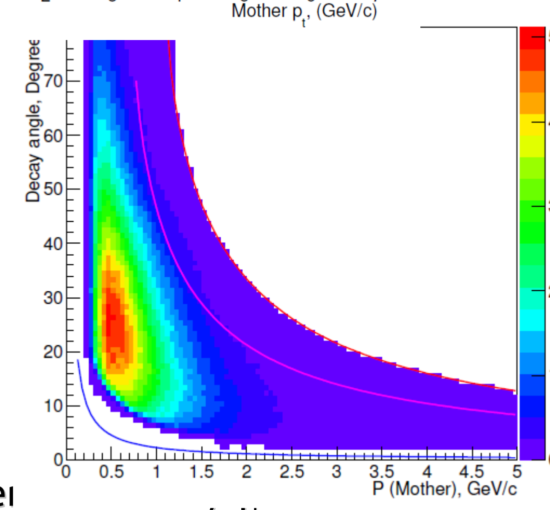
Kinks

Kaons are identified using their weak decays (kink topology) inside the TPC









(1) *(2)* *(3)*

- **The method of identification of kaons from kink topology is based on the kinematical properties of their two-body decay modes**
  - *(1)* The transverse momentum of the daughter with respect to the mother
  - *(2)* The invariant mass of the $K \rightarrow \mu + \nu_\mu$ decay
  - *(3)* The decay angle of the kink v.s. mother's momentum

MORE DETAIL CLIK HERE

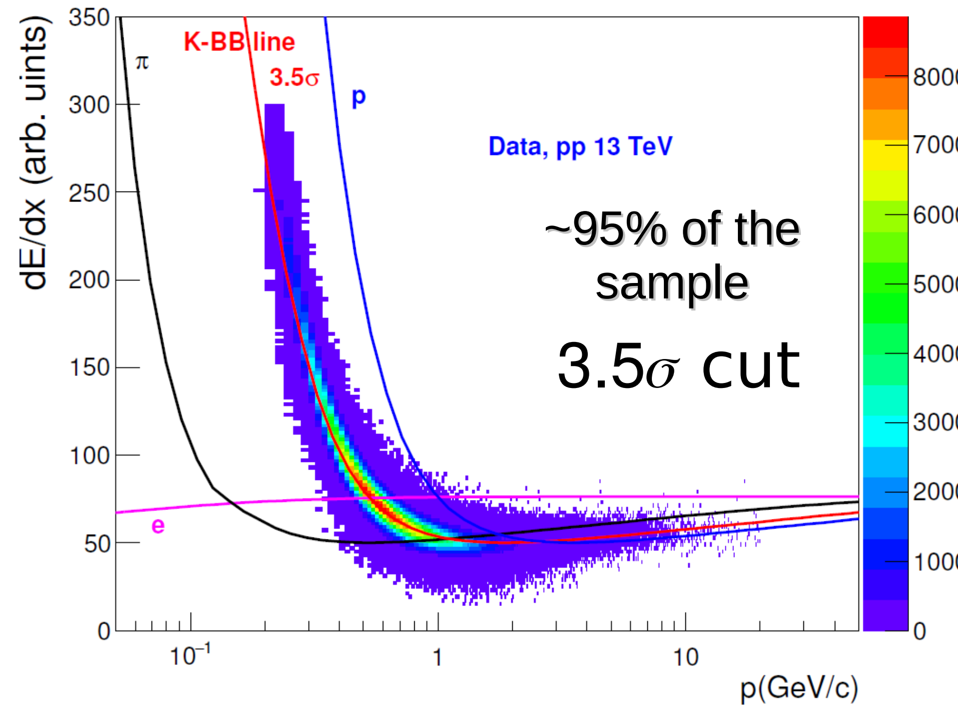
https://aliceinfo.cern.ch/Notes/node/476

Kinks

Kaons are identified using their weak decays (kink topology) inside the TPC

Table 4: Selection criteria for the kaons from kink topology

Primary tracks in each event
Main vertex from global(PrimaryVertexTracks) or SPD tracks with contributors >0
TPCrefit , ITSrefit
Ratio (Chi2/Numberof Clusters)$<$ 4.0
Kink tracks, mother tracks of "selected" kaons
Kink decay angle $>$ 2 degrees
kink vertex inside 120-210 cm radius (XY plane) (TPC volume)
$\|y(K)\| < 0.5$
$p_t > 200$ MeV/c
$q_t >$ 120 MeV/c
Invariant mass of $M(\mu\nu_\mu) < 0.8 MeV/c^2$
Maximum decay angle selection as a function of mother's momentum, Fig. 3)
Tails of the plot(e. g. kink-Radius, Number of Clusters, Fig. 5) are removed

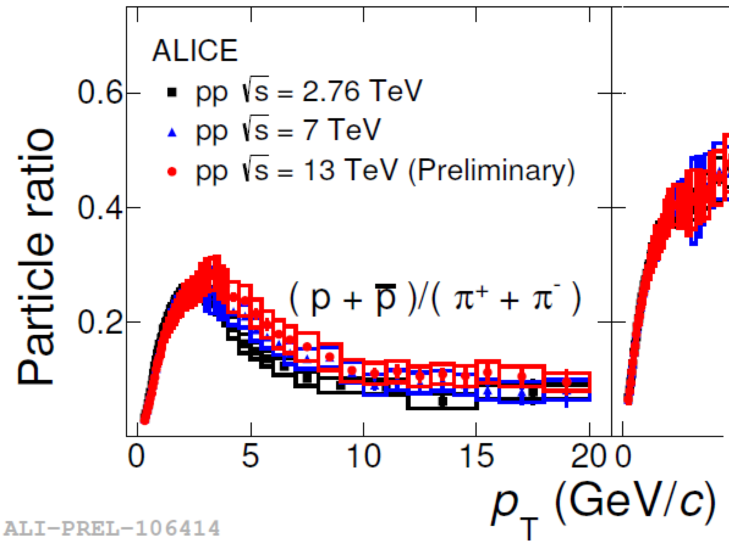


- **Main sources of systematic uncert.**
  - Event and track selection → varying kink and track selection cuts
  - Contamination of fake kinks
  - Kink reconstruction efficiency
  - Material budget

MORE DETAIL CLIK HERE

https://aliceinfo.cern.ch/Notes/node/476

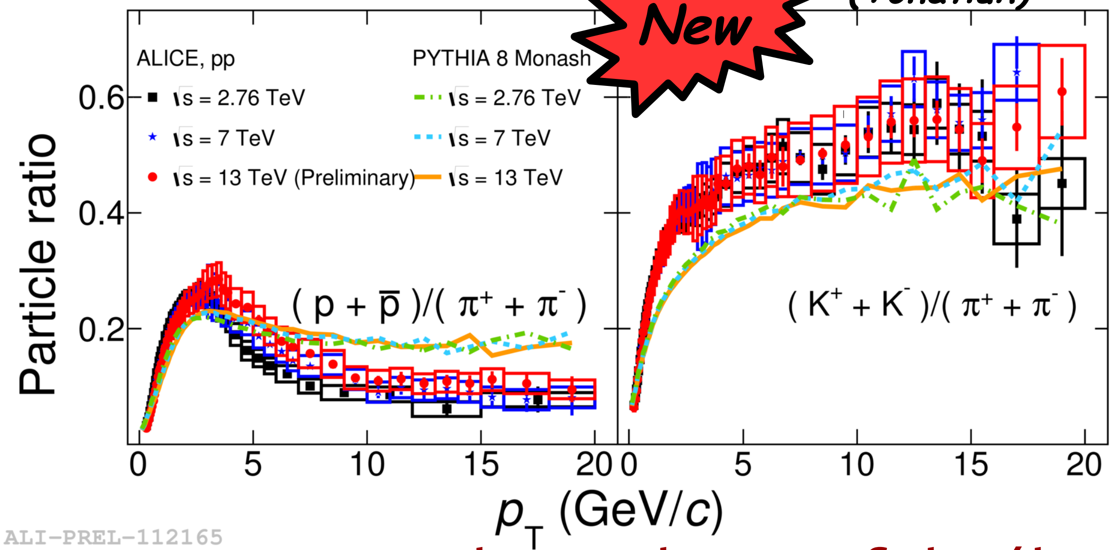
pi / K / p production – Preliminary Results



Energy dependence of particle ratios

for Hot Quarks '16 (Tonatiuh)

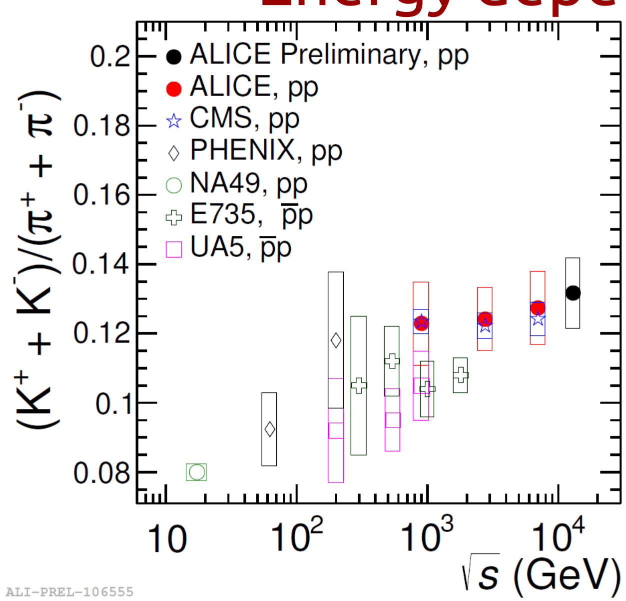
New

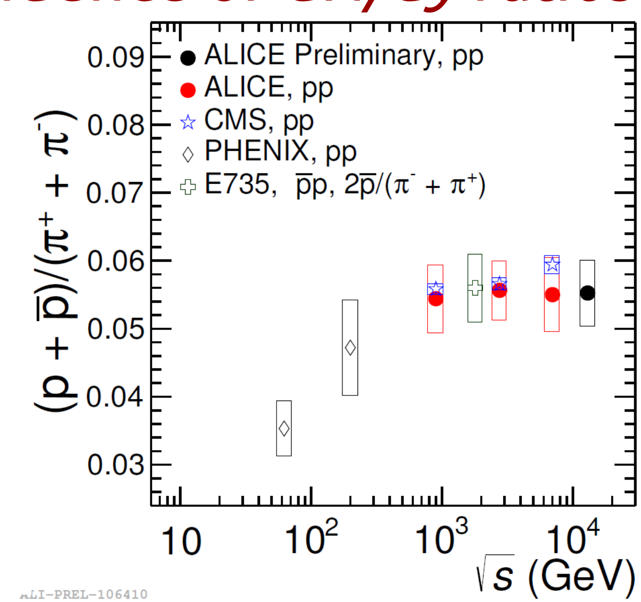


d*N*/dy and mean p_T

Particle	dN/dy	<pt> (Gev/c)
π⁺+π⁻	6.584 ± 0.401	0.487 ± 0.010
K⁺+K⁻	0.867 ± 0.042	0.807 ± 0.010
p + pbar	0.364 ± 0.023	0.967 ± 0.015

Energy dependence of d*N*/dy ratios





Status of

K^0_S Λ Ξ Ω

Strange and multi-strange baryon production

ALICE

Analysis Crew (V0):

Peter Kaliňák ,
Michal Šefčík ,
Marek Bombara ,
Ivan Králik

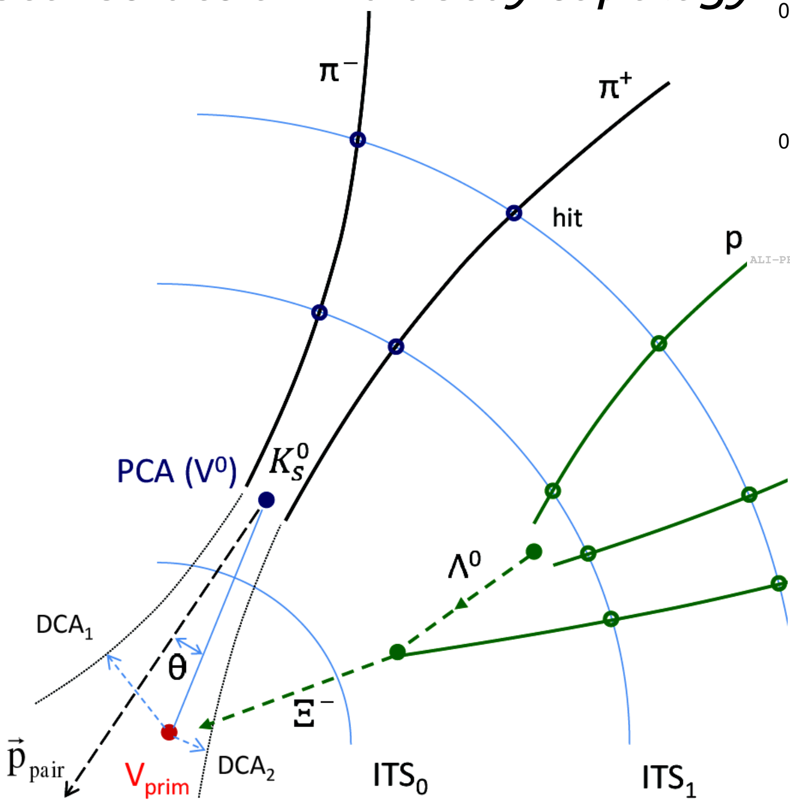
Analysis Crew (Cascade):

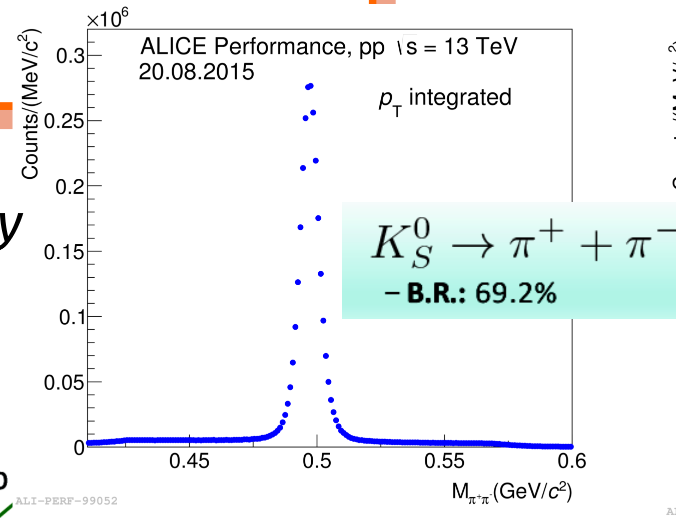
Domenico Colella ,
Domenico Elia

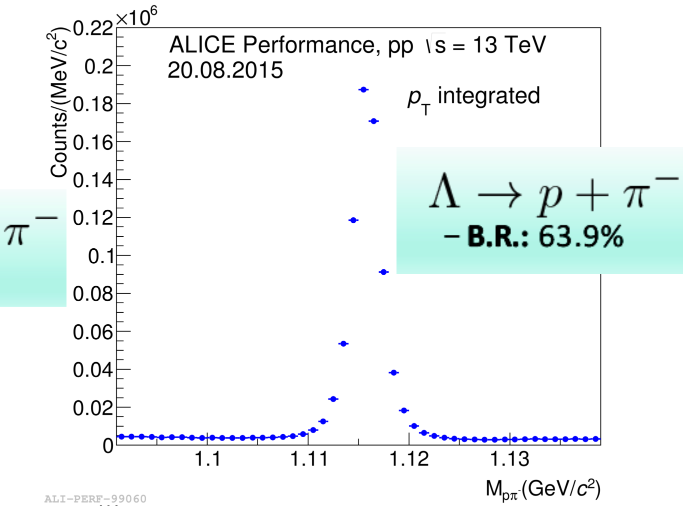
More details →

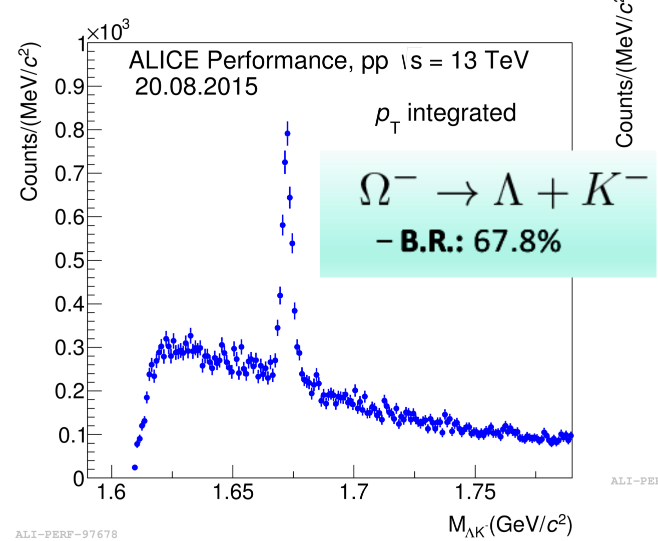
– *AN note: https://aliceinfo.cern.ch/Notes/node/425*
– *AN note:* https://aliceinfo.cern.ch/Notes/node/431
– *PWG-LF meeting - SQM approval session (6 June 2016)* *https://indico.cern.ch/event/539129*

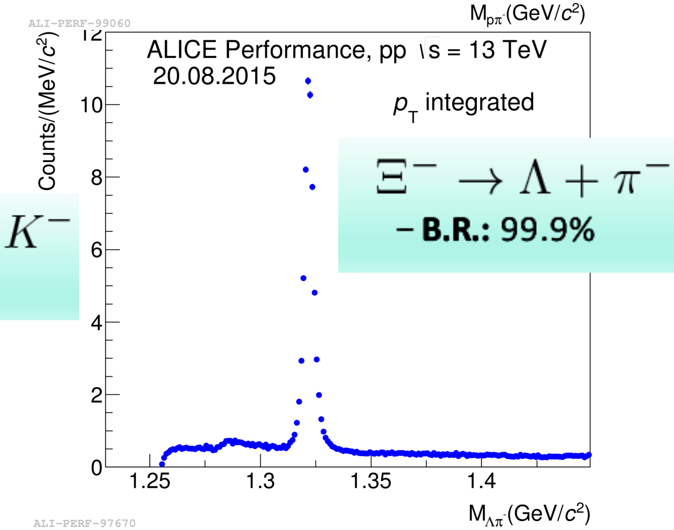
V_0's and Cascades reconstruction via decay topology



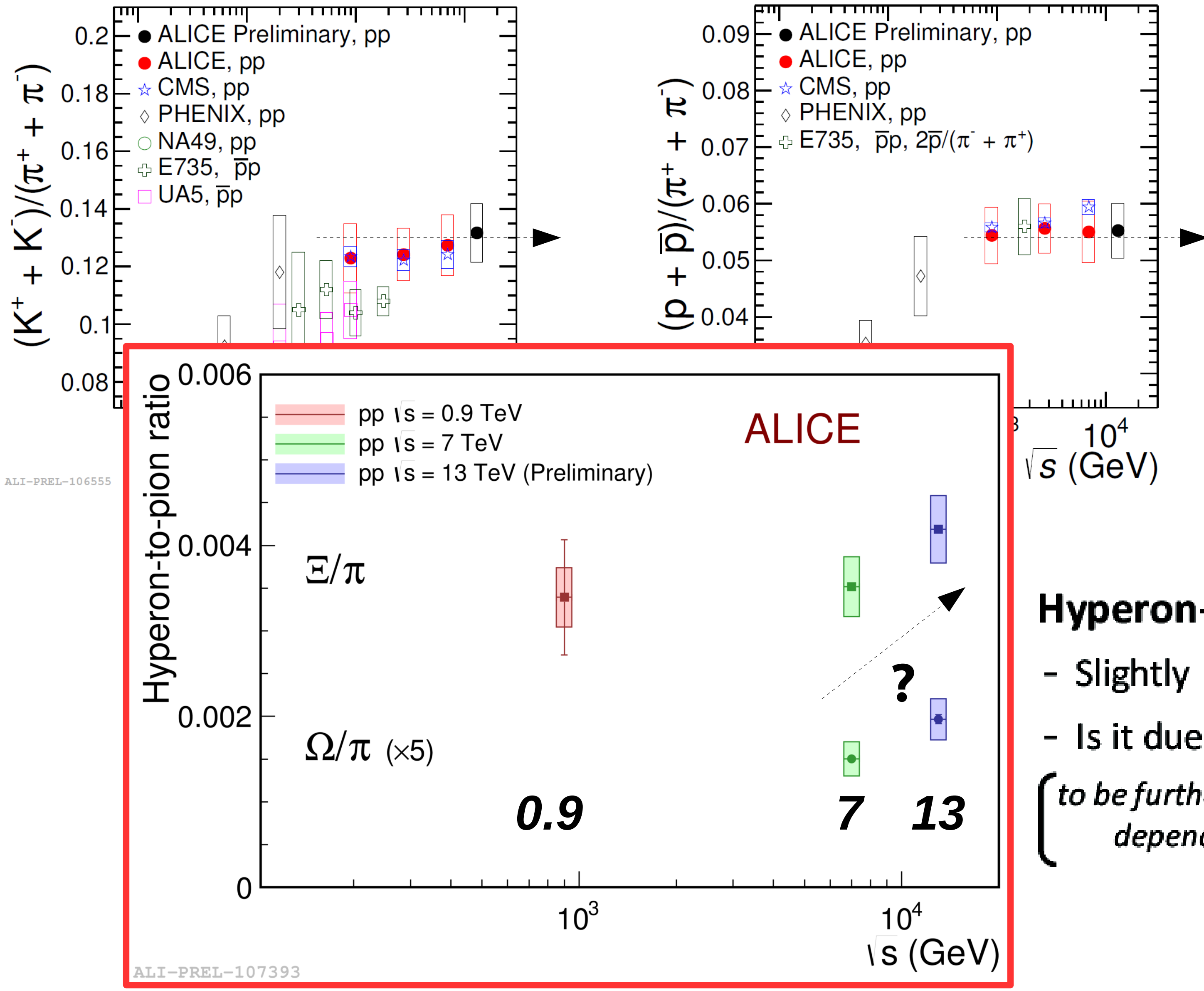








Strange and multi-strange baryon production – *Preliminary Results*



Hyperon-to-pion ratios:

- Slightly increased at 13 TeV
- Is it due to higher $\sqrt{s}$ or $\langle N_{ch} \rangle$?

(*to be further investigated in the multiplicity dependence studies in pp at 13 TeV*)

Status of

K^{*}_{0} Φ

Φ(1020) and K*⁰(892) production

Analysis Crew:

Anders Knospe

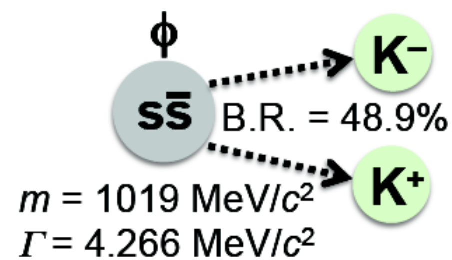
Analysis Crew:

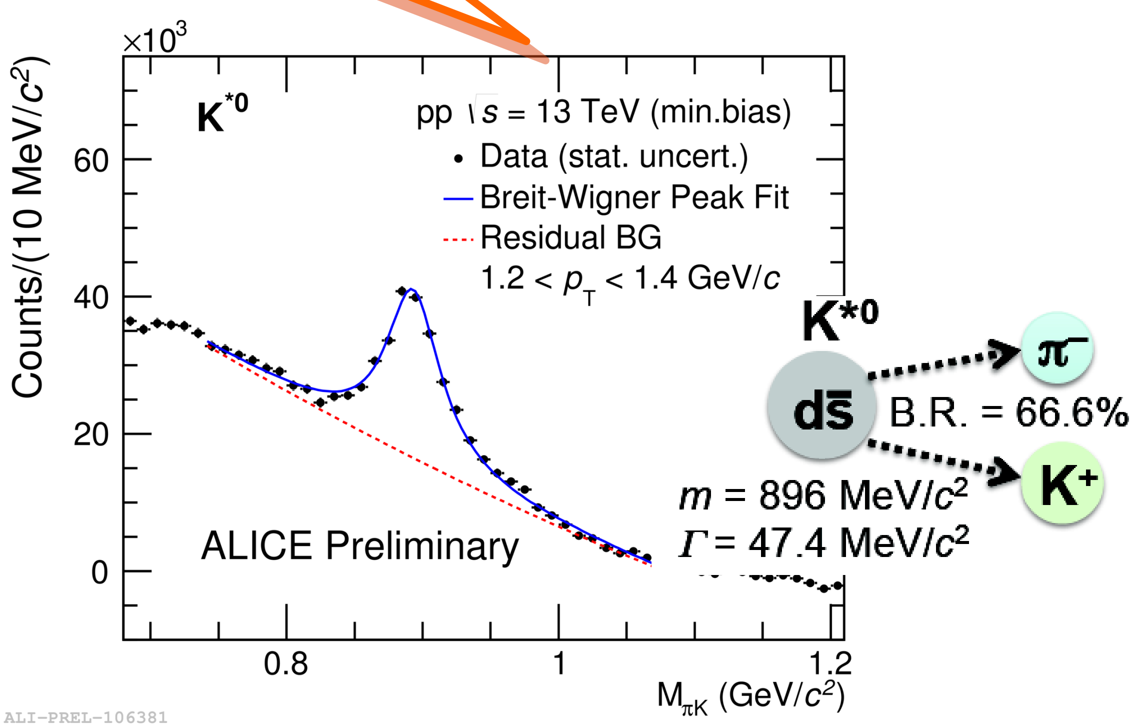
Sourav Kundu

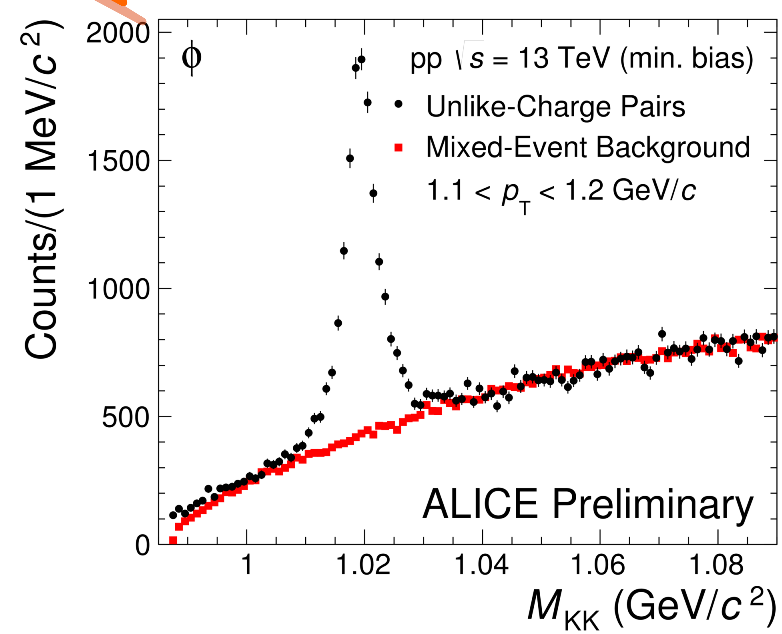
- *Invariant mass analysis reconstruction the decay daughters*
- *Combinatorial background estimated with mixed event technique and subtracted*
- *Breit-Wigner/Voigtian fit to extract resonance yield*

More details →

– AN note: https://aliceinfo.cern.ch/Notes/node/466
– *AN note:* https://aliceinfo.cern.ch/Notes/node/431
– PWG-LF meeting - SQM approval session (6 June)
https://indico.cern.ch/event/539129





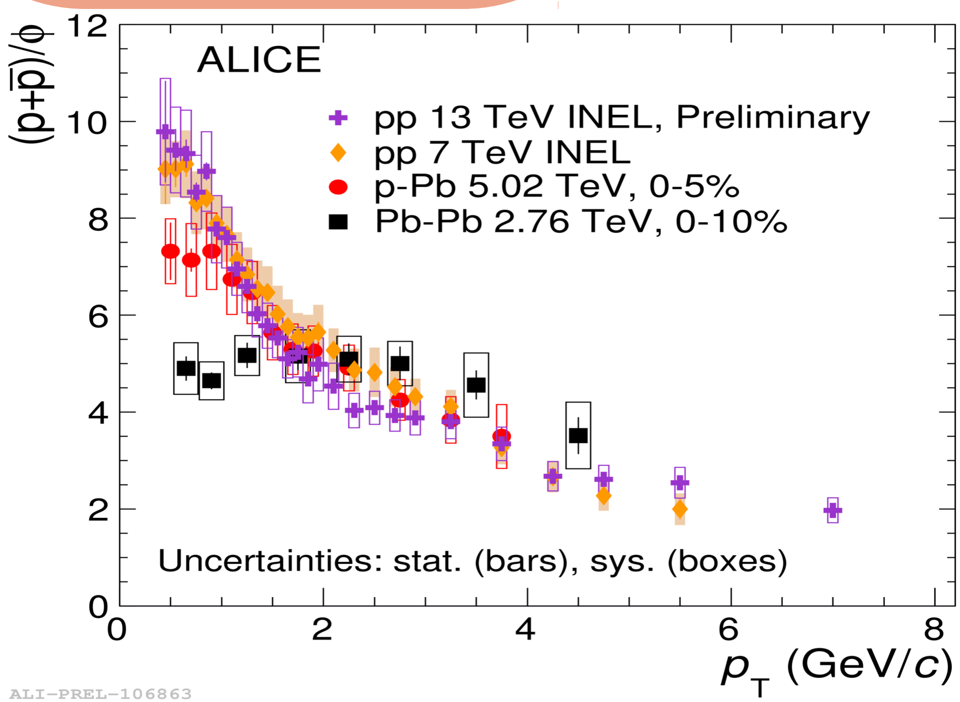


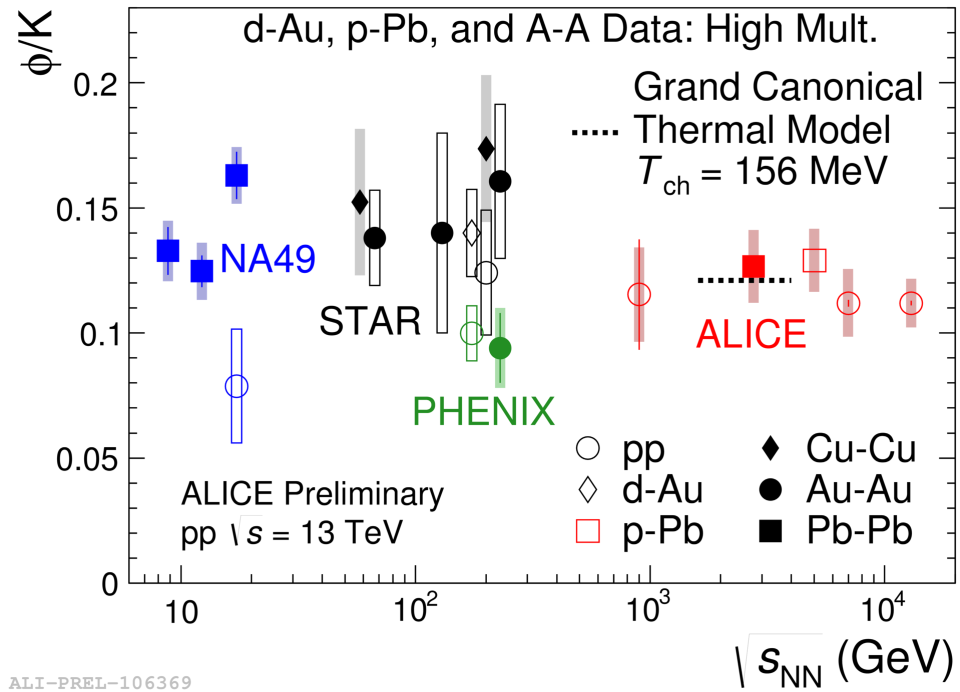
Φ production– *Preliminary Results*

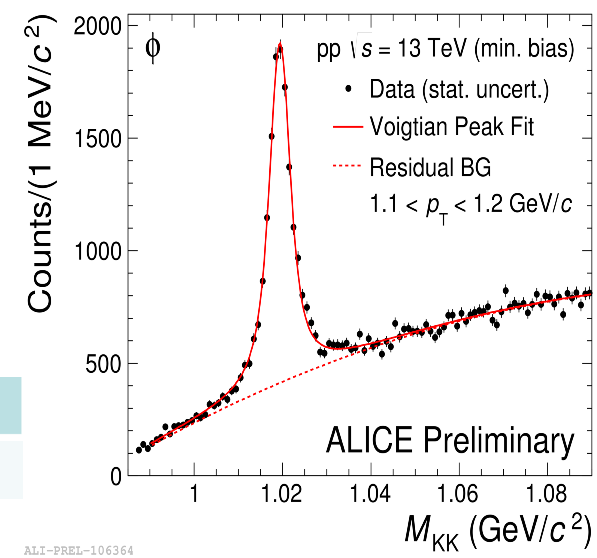
ALICE

Analysis Crew:

Anders Knospe







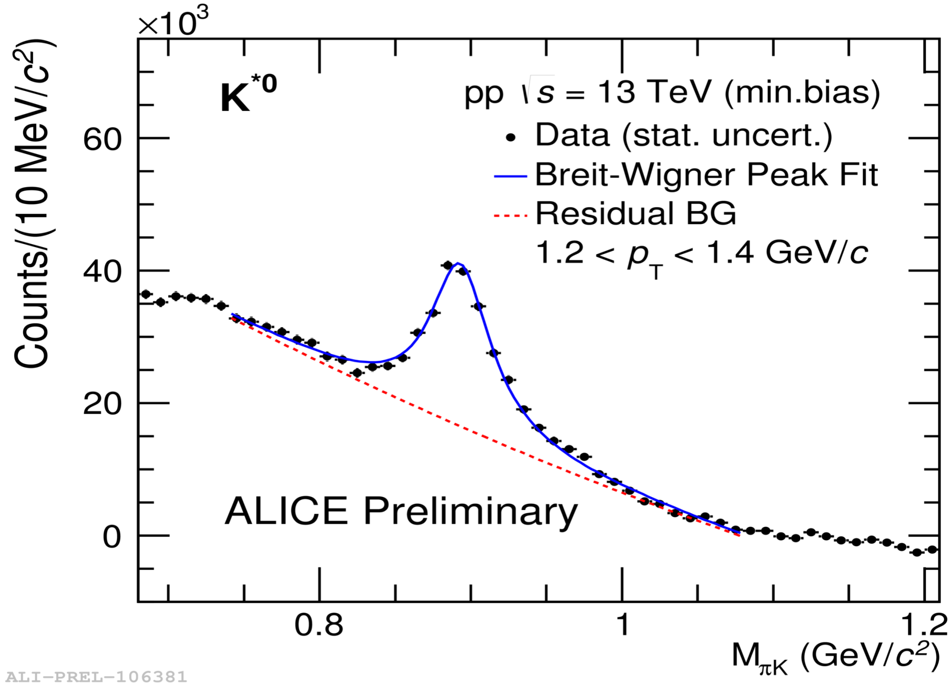
Particle	dN/dy	$\langle p_T \rangle$ (GeV/c)
ϕ	0.0485 ± 0.0004 ± 0.0035	1.241 ± 0.006 ± 0.031

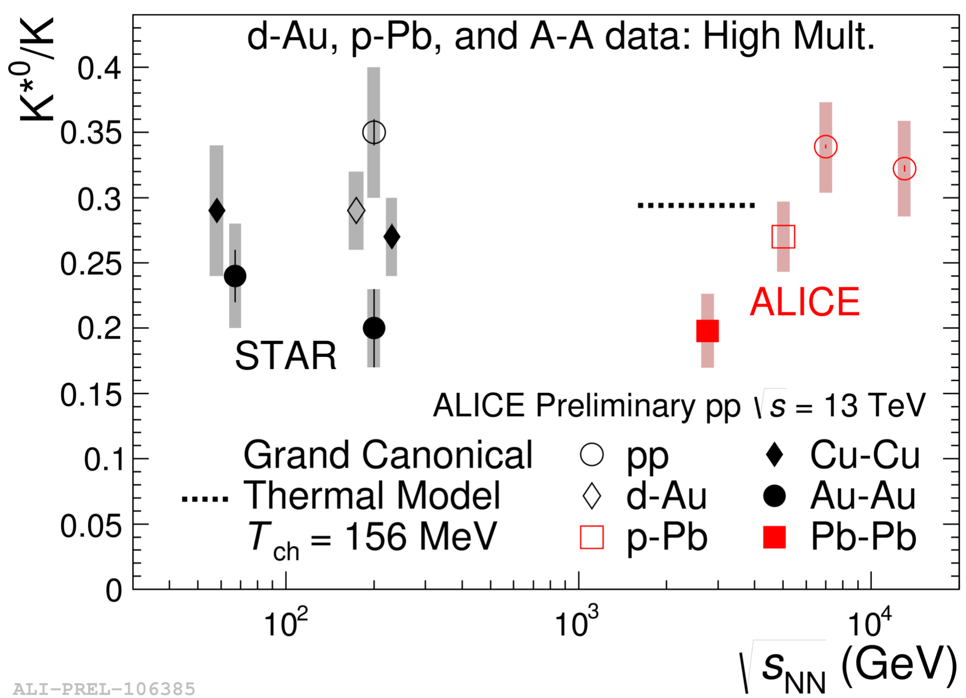
	X/π	X/K	X/p
ϕ	0.0147 ± 0.0001 ± 0.0014	0.1119 ± 0.0010 ± 0.0097	0.266 ± 0.002 ± 0.026

K*0 production – *Preliminary Results*

Analysis Crew:

Sourav Kundu





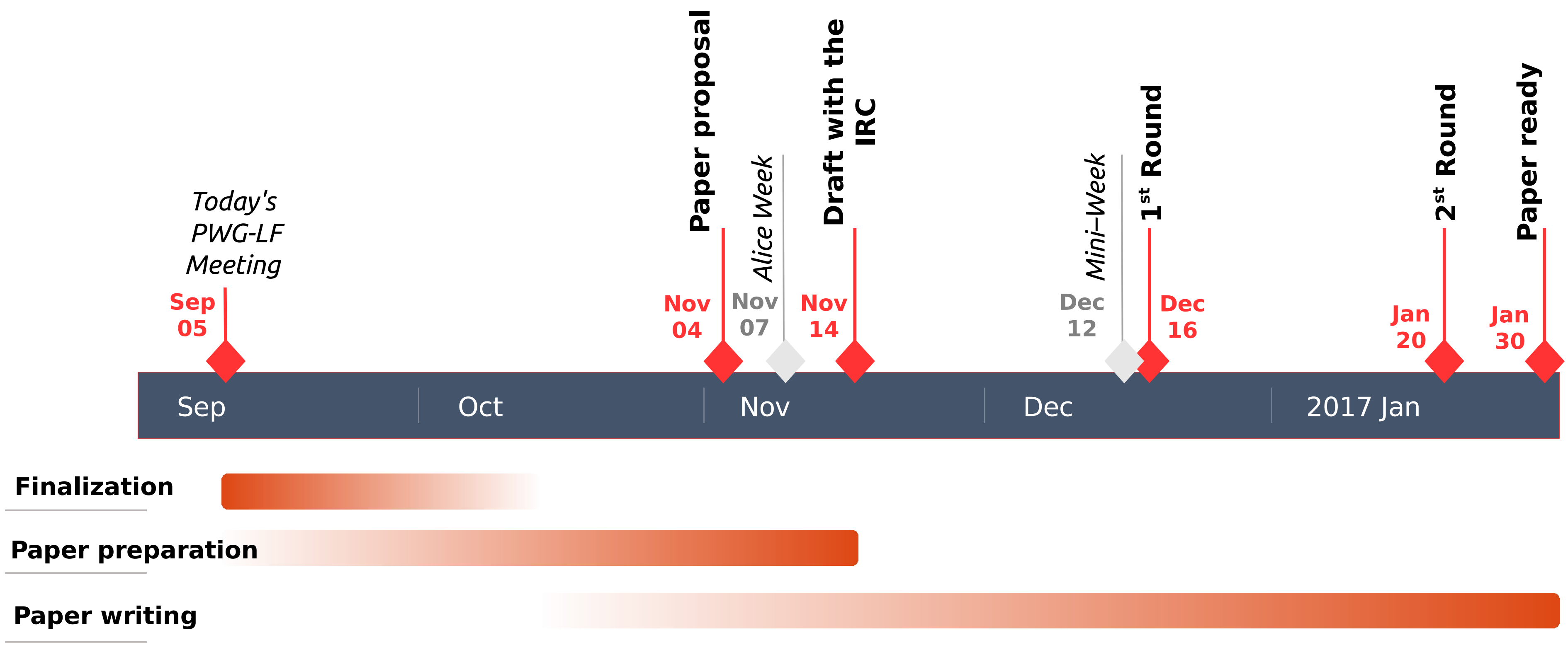
Particle	d*N*/dy	<p_T> (GeV/*c*)
K*0	0.1397 ± 0.0010 ± 0.0144	1.124 ± 0.005 ± 0.032

	X/π	X/K	X/p
K*0	0.0424 ± 0.0003 ± 0.0051	0.322 ± 0.002 ± 0.037	0.768 ± 0.006 ± 0.093

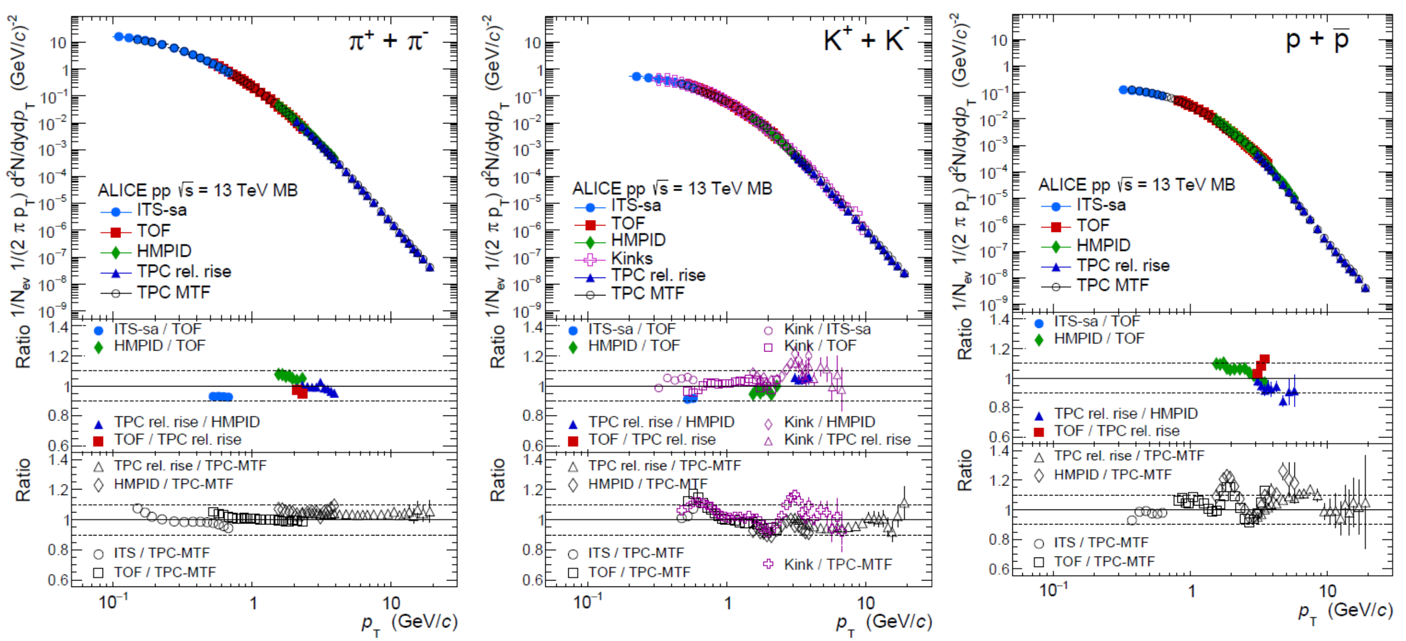
Thank you for your attention!

Backup slides

Estimated Timeline

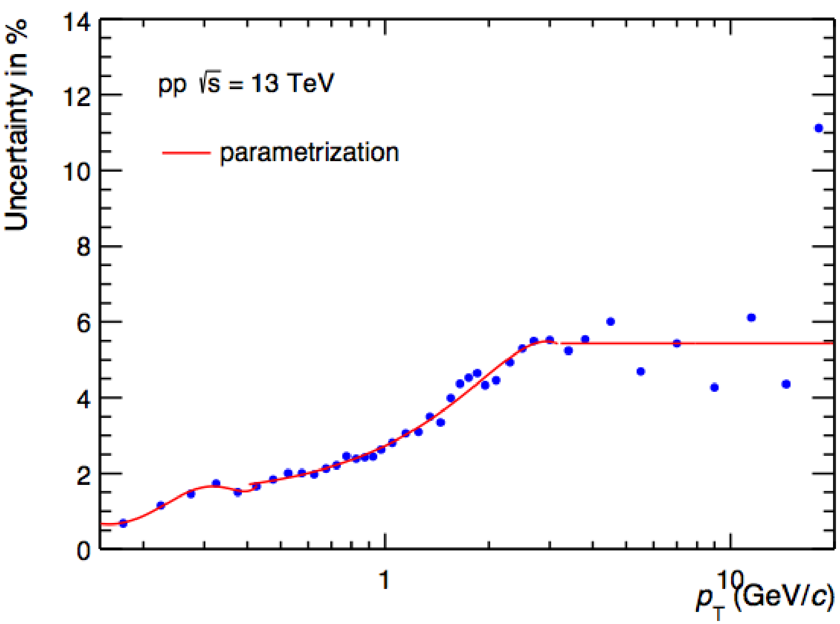


Comparison and combination of the results



Combined results

- Standard procedure is used as for precious analyses (e.g. for 7 TeV)
  - First step:
    - Weighted mean with inverse square of “non-common” systematic uncertainties
  - Second step:
    - Adding common uncertainties to the combined results (e.g. global tracking eff., p_T dependent global tracking uncert.)

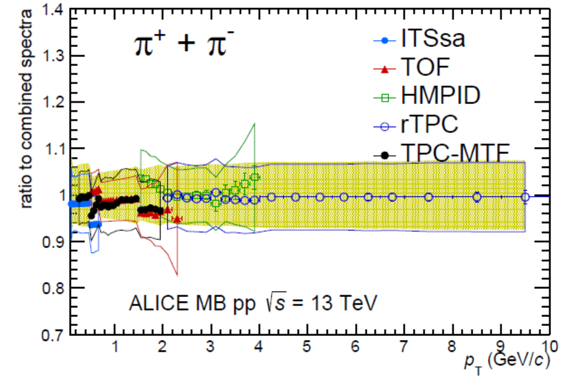


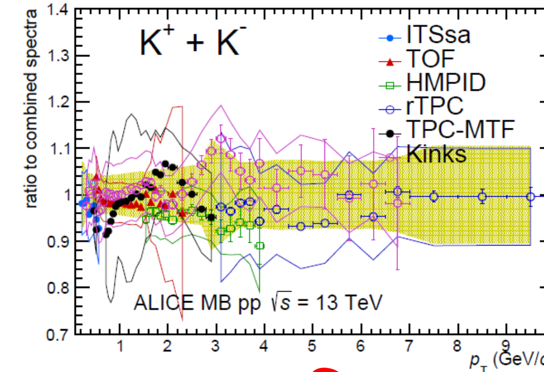
- p_T ranges considered in the individual analyses
  - TPC Multi Template Fit stops at 3 GeV/c and we excluded ranges of dE/dx crossing regions (visible as increased deviations to more reliable PID techniques)

	Analysis	$\pi^+ + \pi^-$	$K^+ + K^-$	$p + \bar{p}$
pp $\sqrt{s}$ = 13 TeV	ITS-sa	0.1 – 0.7	0.2 – 0.6	0.3 – 0.65
	TOF	0.5 – 2.4	0.5 – 2.4	0.8 – 3.6
	HMPID	1.5 – 4.0	1.5 – 4.0	1.5 – 6.0
	Kinks	–	0.2 – 7.0 (10.0)*	–
	TPC, Multi Template Fit	0.25 – 2.0	0.3 – 5.25; 6.75 – 3.0**	0.45 – 1.05; 2.10 – 3.0**
	TPC rel. rise	2 – 20	3 – 20	3 – 20

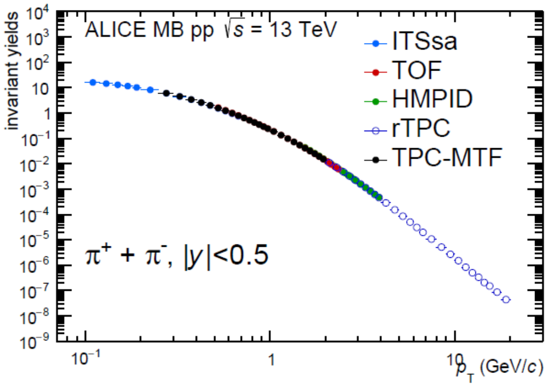
* Available with limited statistics (measurement for $p_T > 7$ GeV/c is not included in the combined spectrum).

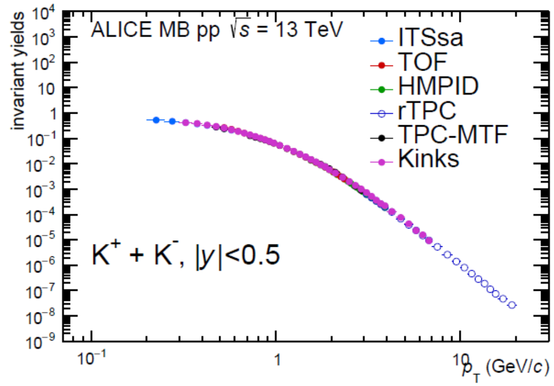
** Ranges in the dE/dx crossing regions were excluded.

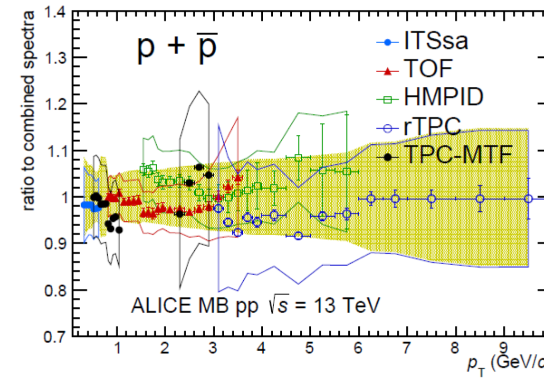




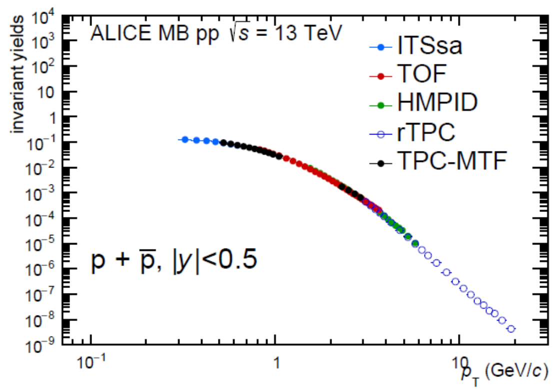
(1) spectra yields

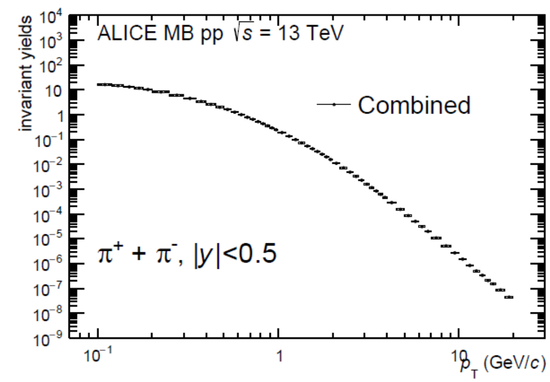


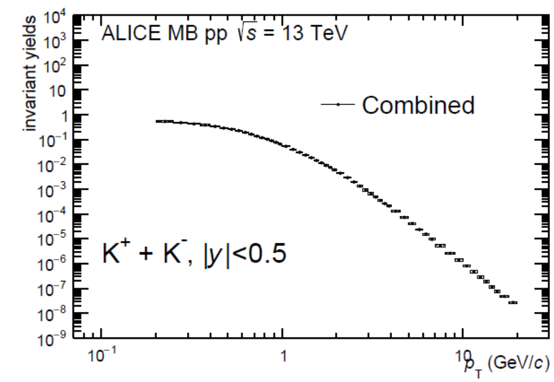




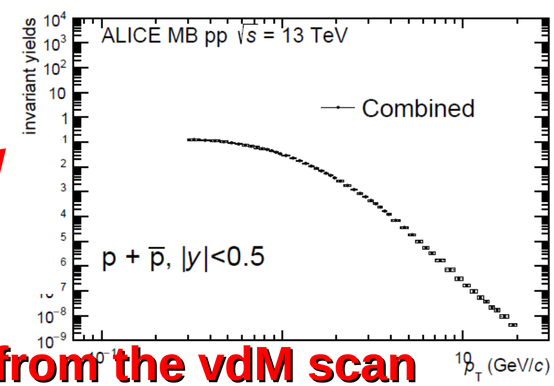
(2) ratio to combined







(3) final combined results



Normalization to INEL is still missing – not available from the vdM scan

Outlook – Some words about normalization

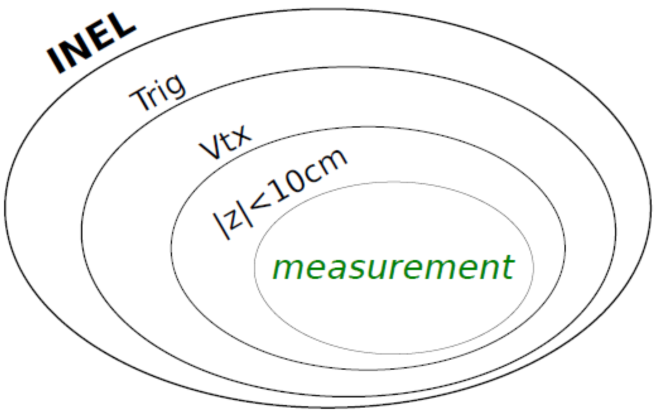


Figure 1: Event classes in ALICE.

Condideration on Normalization,
by David Chinellato, August 2013

(1) *Data driven method*

to relate the measured raw yield and the number of events after physics and vertex selection (Z_{vtx} < 10 cm) to the number of INEL events

Assumptions

- Signal loss due to the *Z* position of the reconstructed primary vertex are proportional to event loss.
- Trigger and vertex requirement only remove event which are empty in the measurement region at mid-rapidity.

$$N^{*}_{evt} = \frac{N_{PS} \times N_{vtx+|Z|<10}}{N_{vtx}}$$

N_{PS} # events after trigger+physics selection

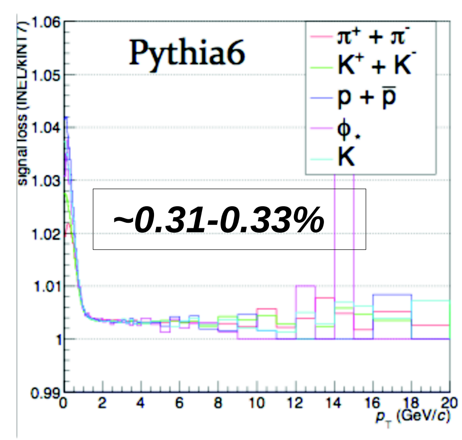
N_{vtx} # events with a reconstructed primary vertex

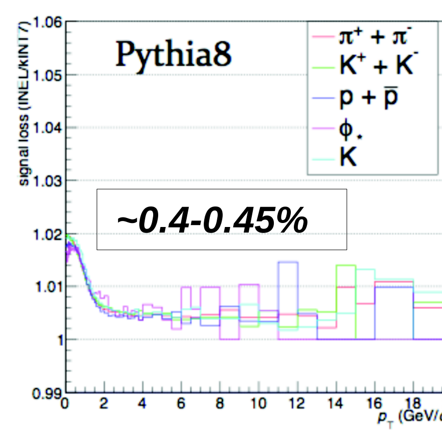
$N_{vtx+|Z|}$< 10 # events whose reconstructed primary vertex falls within $|Z|$ < 10 cm.

(2) *Correction* to account the signal losses due to kINT7 trigger selection

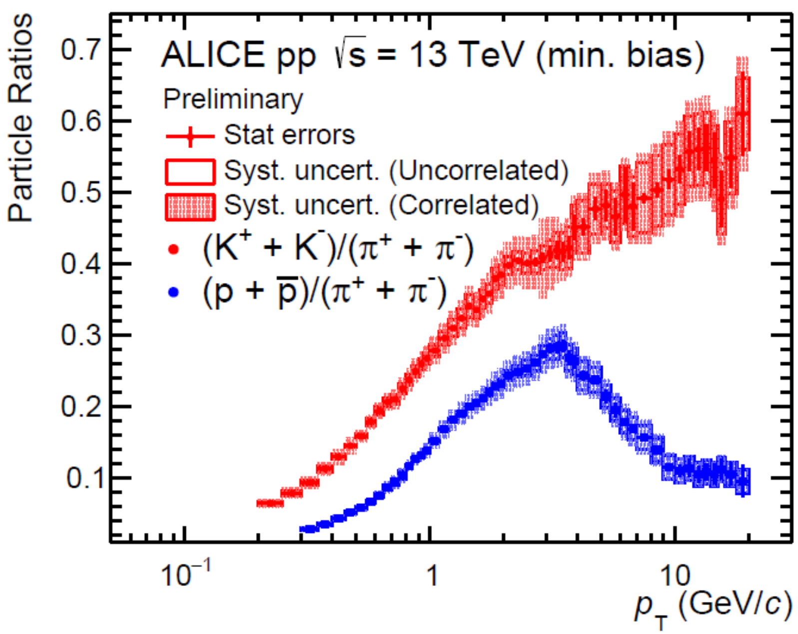
Signal losses due to kINT7 selection were extracted by the ratio of generated primary particles (if relevant) in INEL events and after kINT7 trigger (including all additional physics selection)

- We added extra systematic uncertainties in quadrature to the total systematic uncertainties:
  - up to 1 GeV/c by considering the computed values
  - p_T > 1 GeV/c we used a constant value taken from the last bin [0.95,1.0] GeV/c





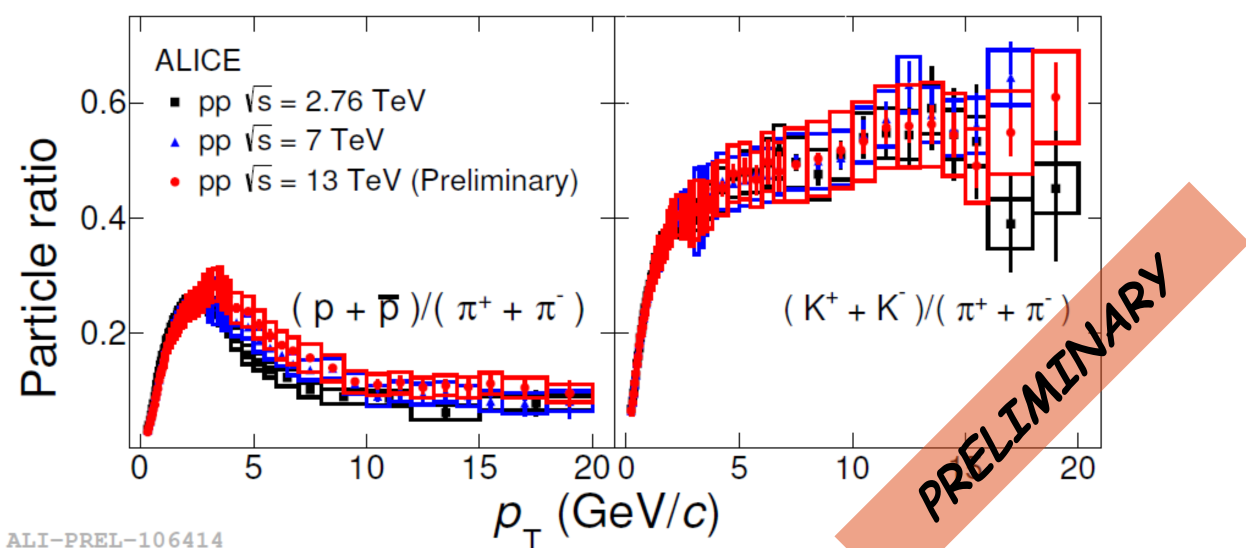
Particle ratios



- **Correlated (fully propagated from combined spectra)**
- **Uncorrelated (obtained from the combination of particle ratios)**

Correlated one is used for PRELIMINARY results

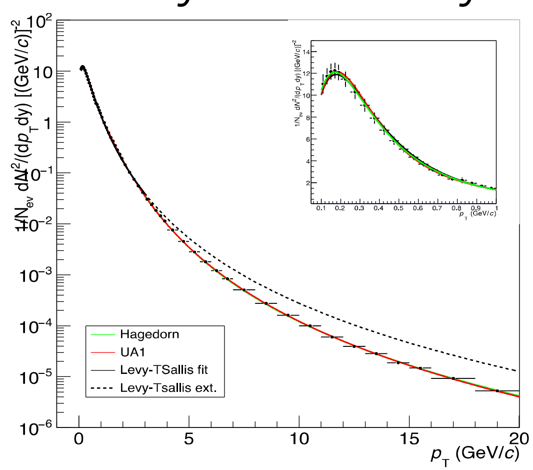
Energy dependence of the particle ratios

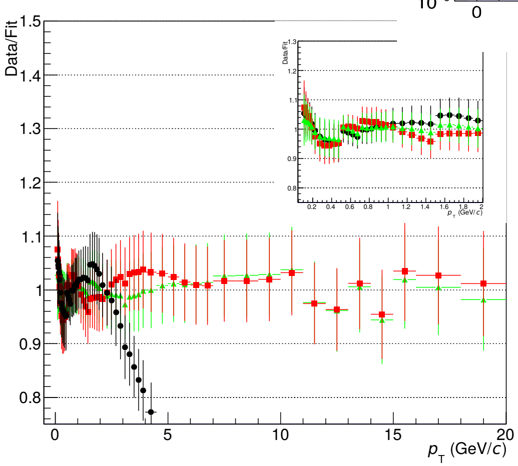


- **Maximum of p/pi ratio shifts to higher p_T values with increasing sqrt(s)**
- **Not observed for K/pi ratio**

Extraction of dN/dy and mean p_T

- dN/dy is calculated using PWGLF/SPECTRA/YieldMean.C
- Pions are fitted in p_T range 0-3 GeV/c
- Combined spectra are fitted (using total uncertainties) by Levy-Tsallis
- Fit results are used to extrapolate (p_T 0-20 GeV/c as proxy for 0-infinity)
- Statistical and systematic uncertainties of data points were taken into account
- Extrapolation uncertainty is estimated by comparing fits done by UA1 and modified Hagedorn functions

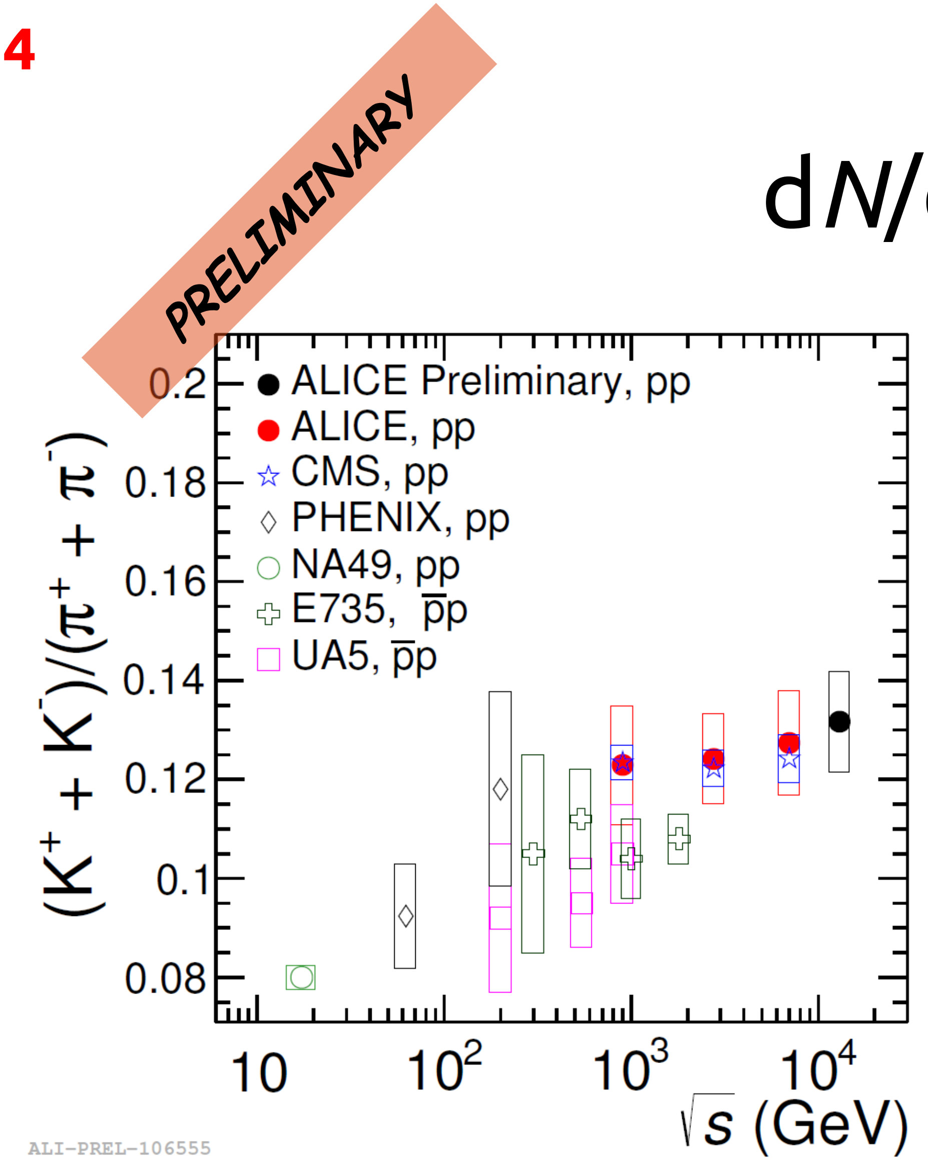


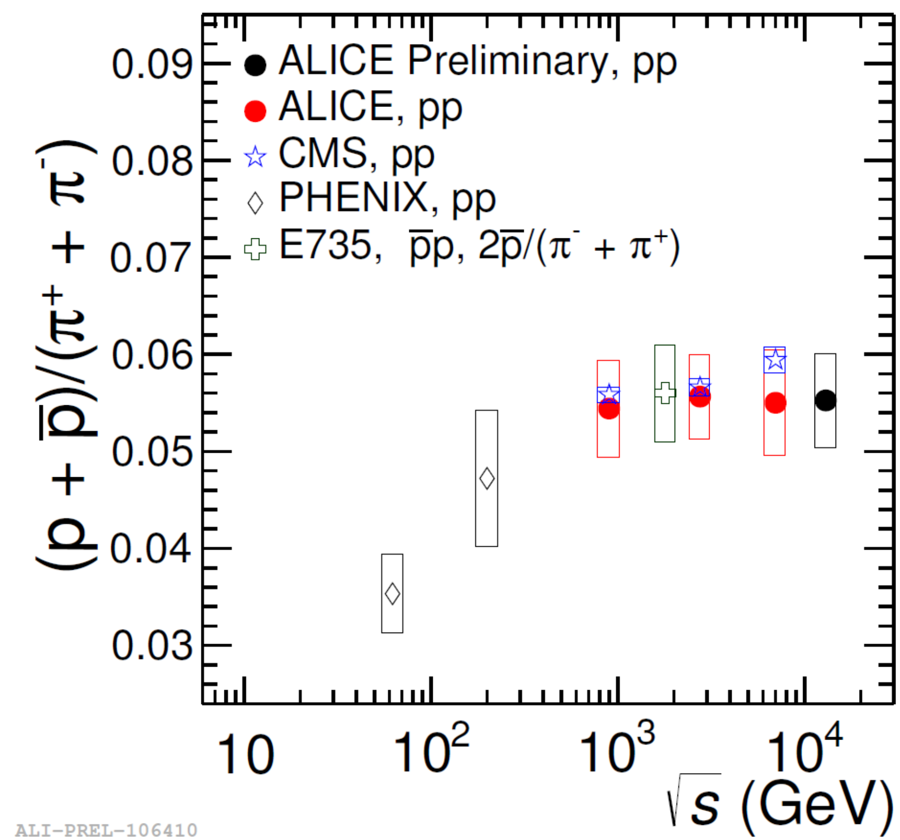


Particle	dN/dy	<pt> (Gev/c)	χ^2/ndf	L. pt (GeV/c)	Extr. (%)
$\pi^+ + \pi^-$	6.584 ± 0.401	0.487 ± 0.010	0.3	0.1	9.3
$K^+ + K^-$	0.867 ± 0.042	0.807 ± 0.010	0.3	0.2	9.4
p + pbar	0.364 ± 0.023	0.967 ± 0.015	0.8	0.3	11.3

Errors are the combination of statistical (negligible) and systematic uncertainties.

d*N*/d*y* ratios





saturation for √s > 900 GeV

p/π ratio remains constant

K/π ratio possible hint to increase at higher √s (no significant within syst.)

Kinks

Kaons are identified using their weak decays (kink topology) inside the TPC

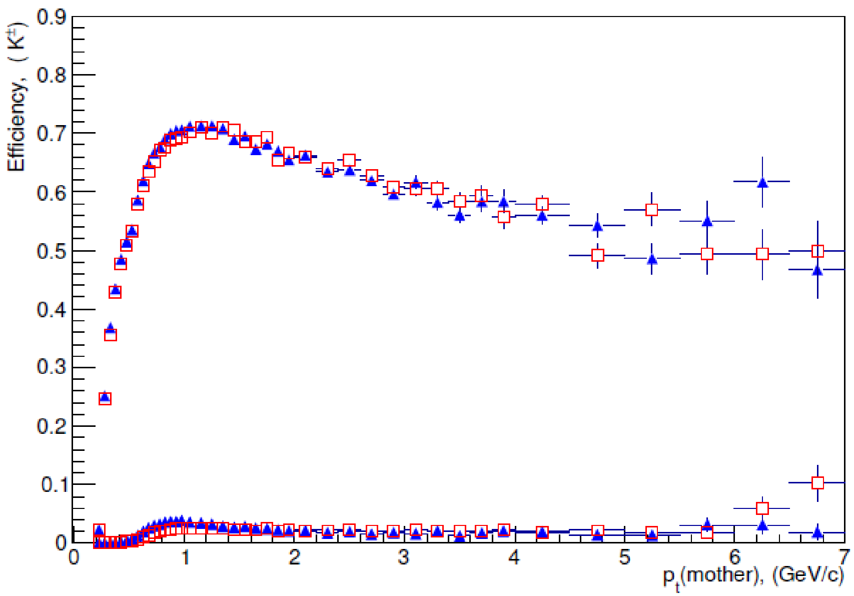


Fig. 62: MC simulation for 13 TeV pp collisions. The efficiency of 'reconstructed and identified' kaons from kinks as a function of the p_t (mother), separately for K^+ (blue full-triangles) and K^- (red open-squares), is shown. The lower curves correspond to the backgound efficiencies.

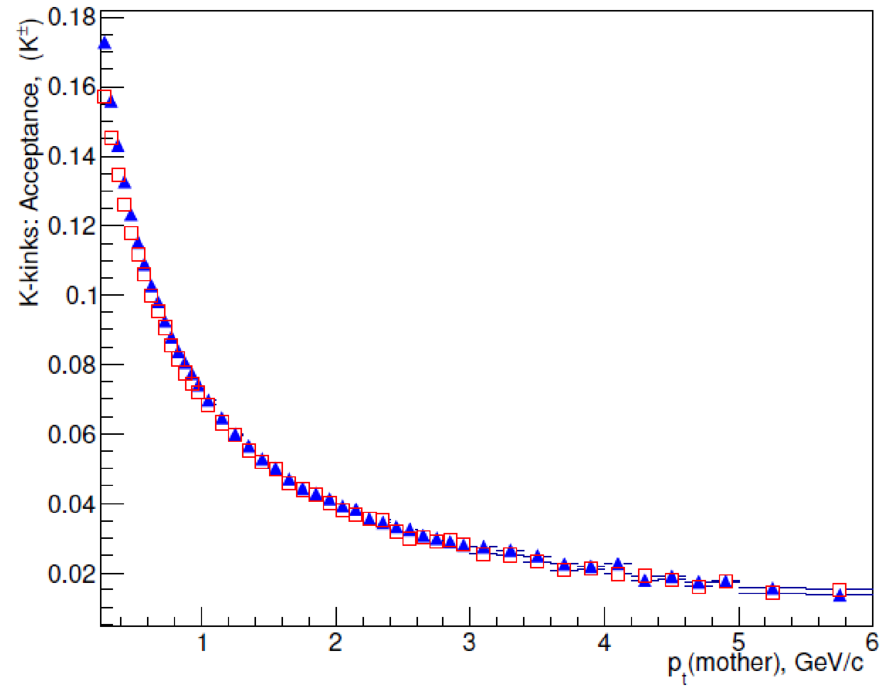


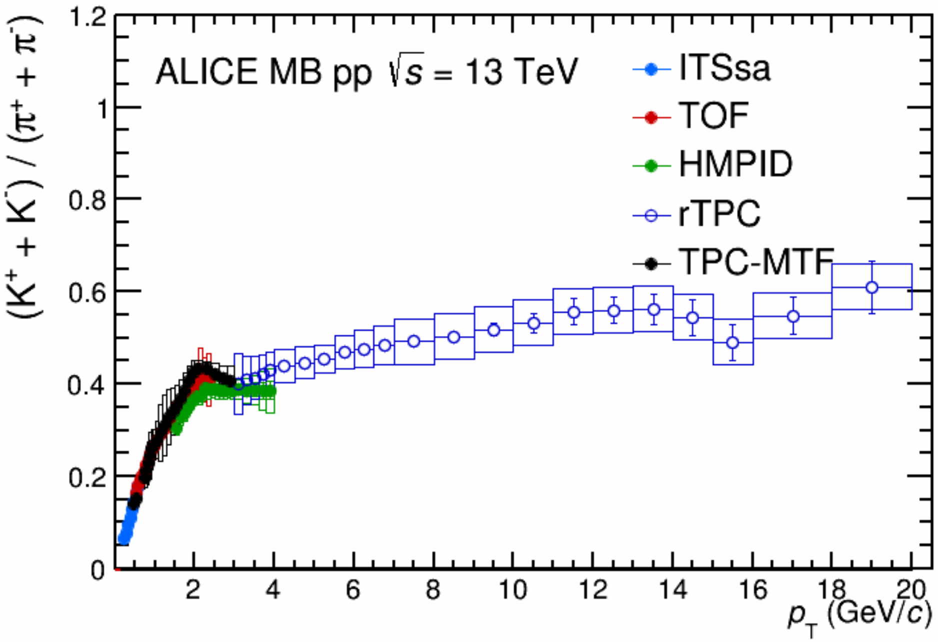
Fig. 63: MC simulation for 13 TeV pp collisions.The Acceptance and absorption correction factor of kaons decaying into $K \to \mu + \nu_\mu$ or $K \to \pi + \pi^0$.. or $K \to e +$., as a function of the p_t (mother) separately for K^+ (blue full-triangles) and K^- (red open-squares), is shown.

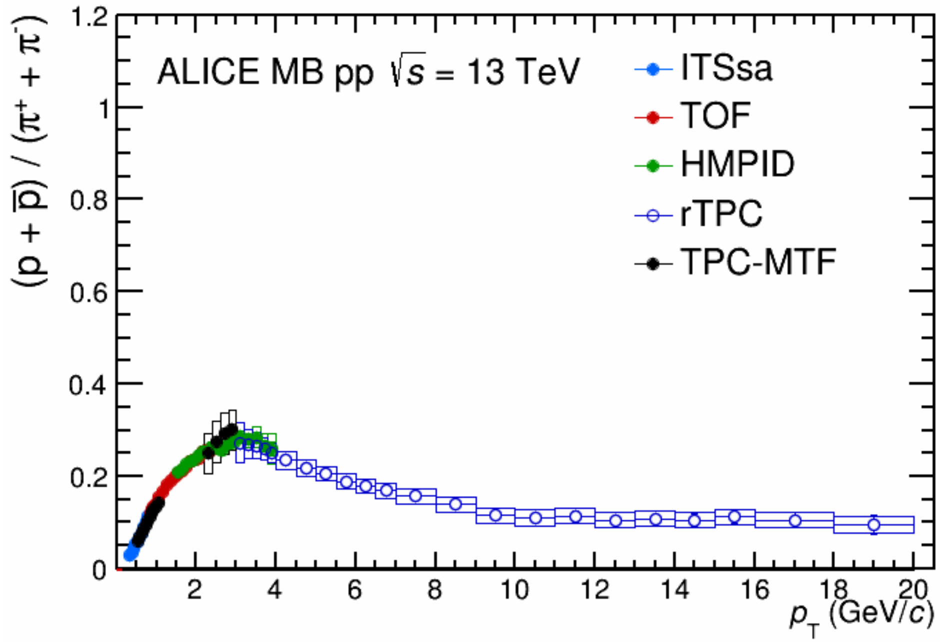
MORE DETAIL CLIK HERE

https://aliceinfo.cern.ch/Notes/node/476

Combined results

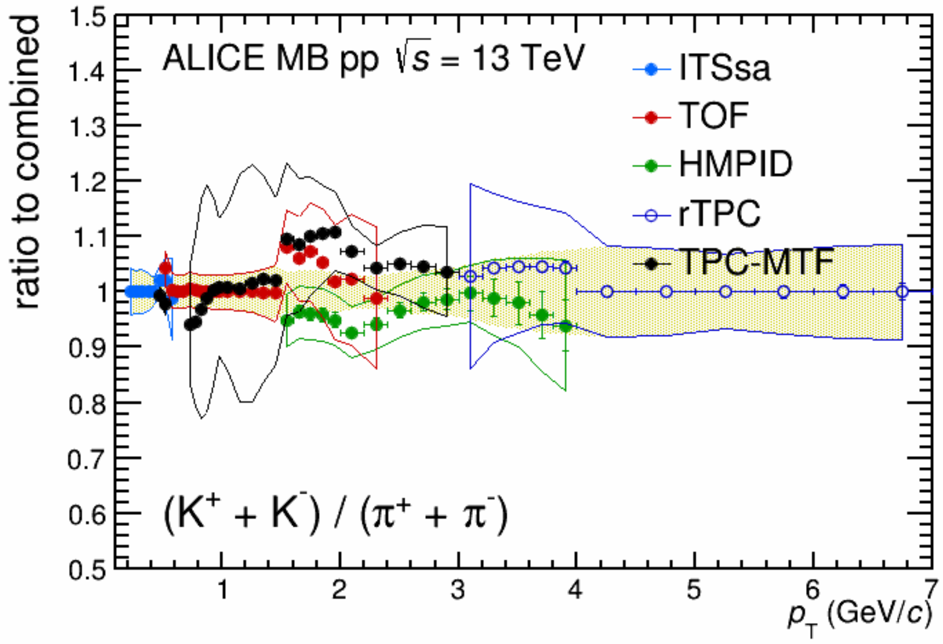
Particle ratios – Individual analyses

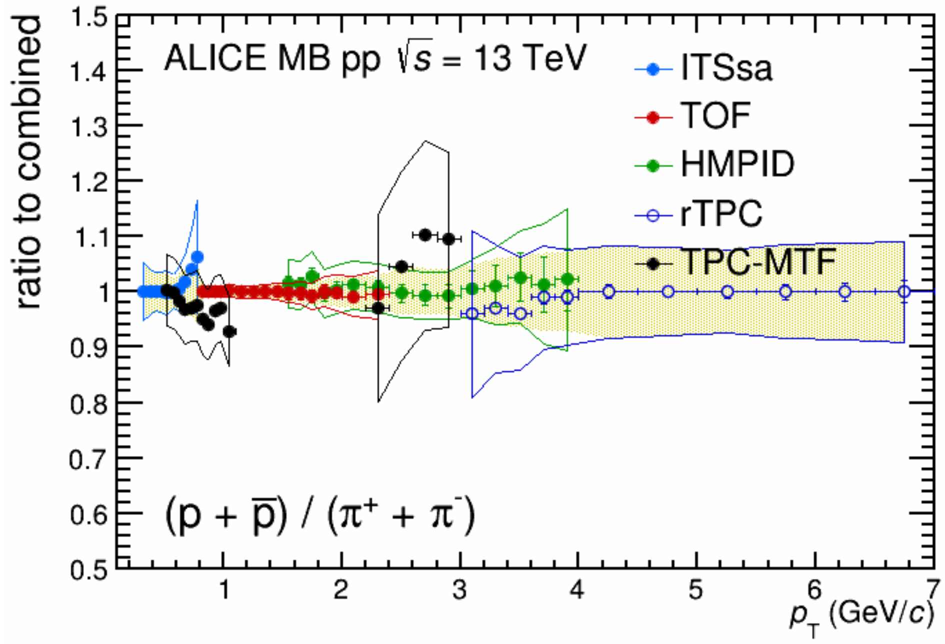




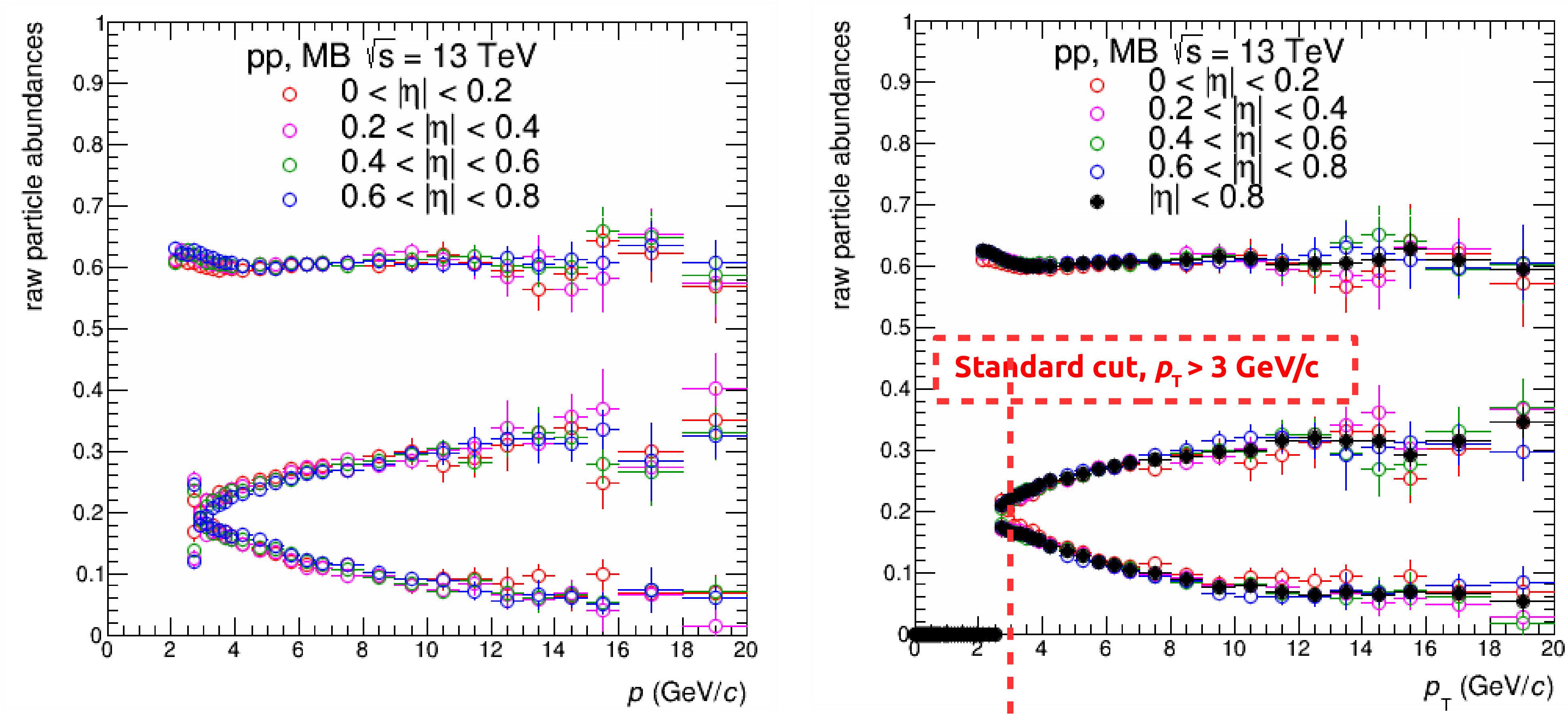
Combined results

Particle ratios – Individual analyses to combined



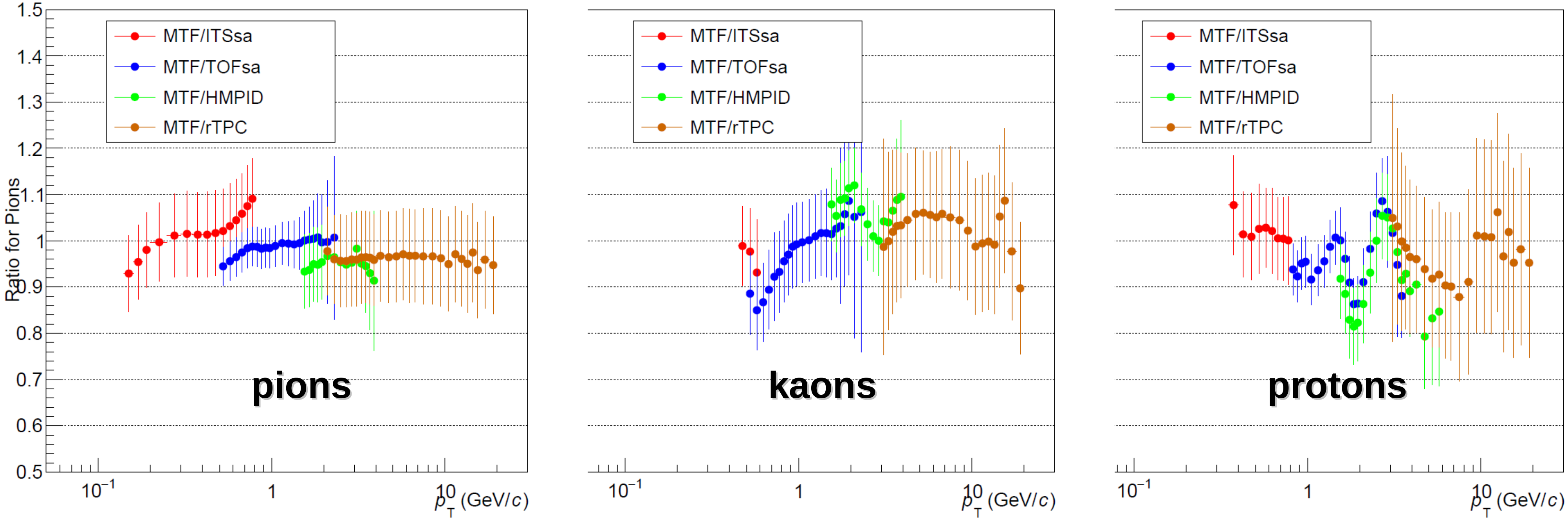


TPC rel. rise analysis
Particle fractions vs. *p* and p_T

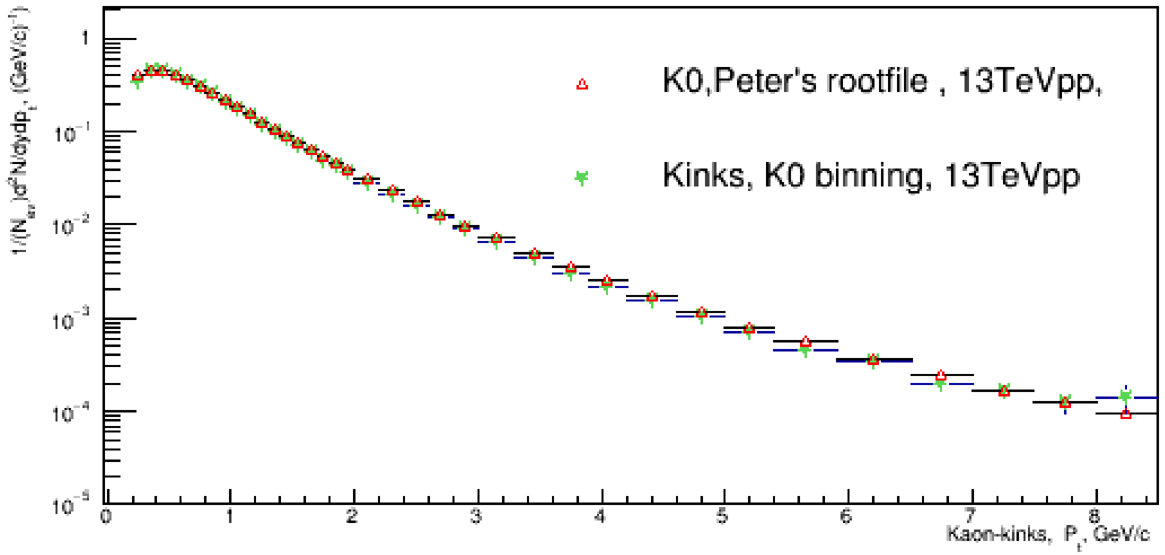


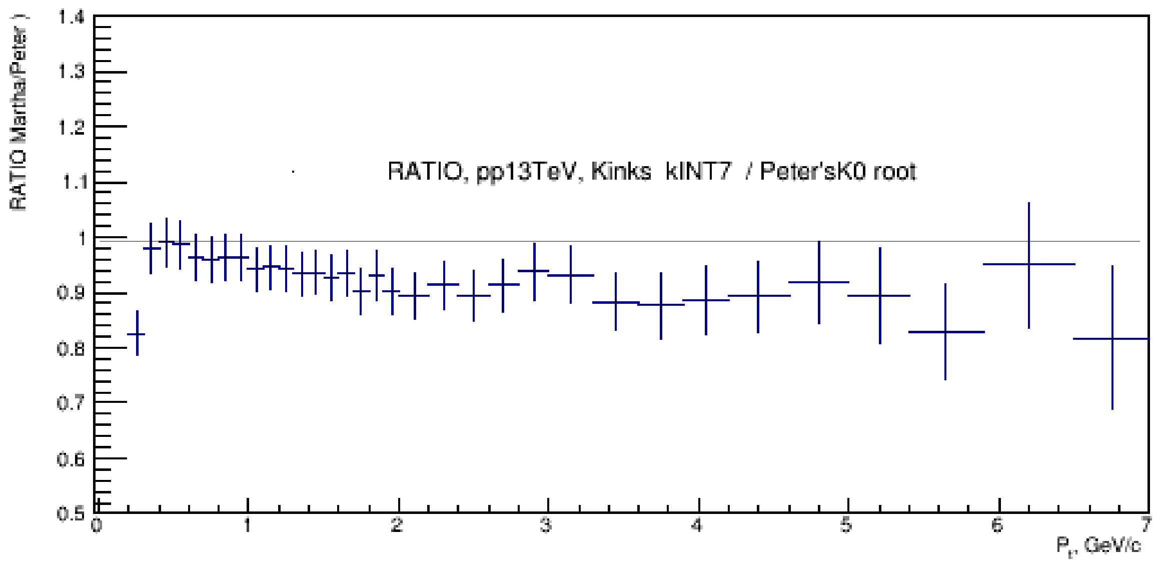
We have tried to go down to 2.6 GeV/c for kaons and protons, but the systematic uncertainties are quite large → keep p_T = 3 GeV/c cut (K,p)

Comparison of TPC Multi Template Fit to other analyses

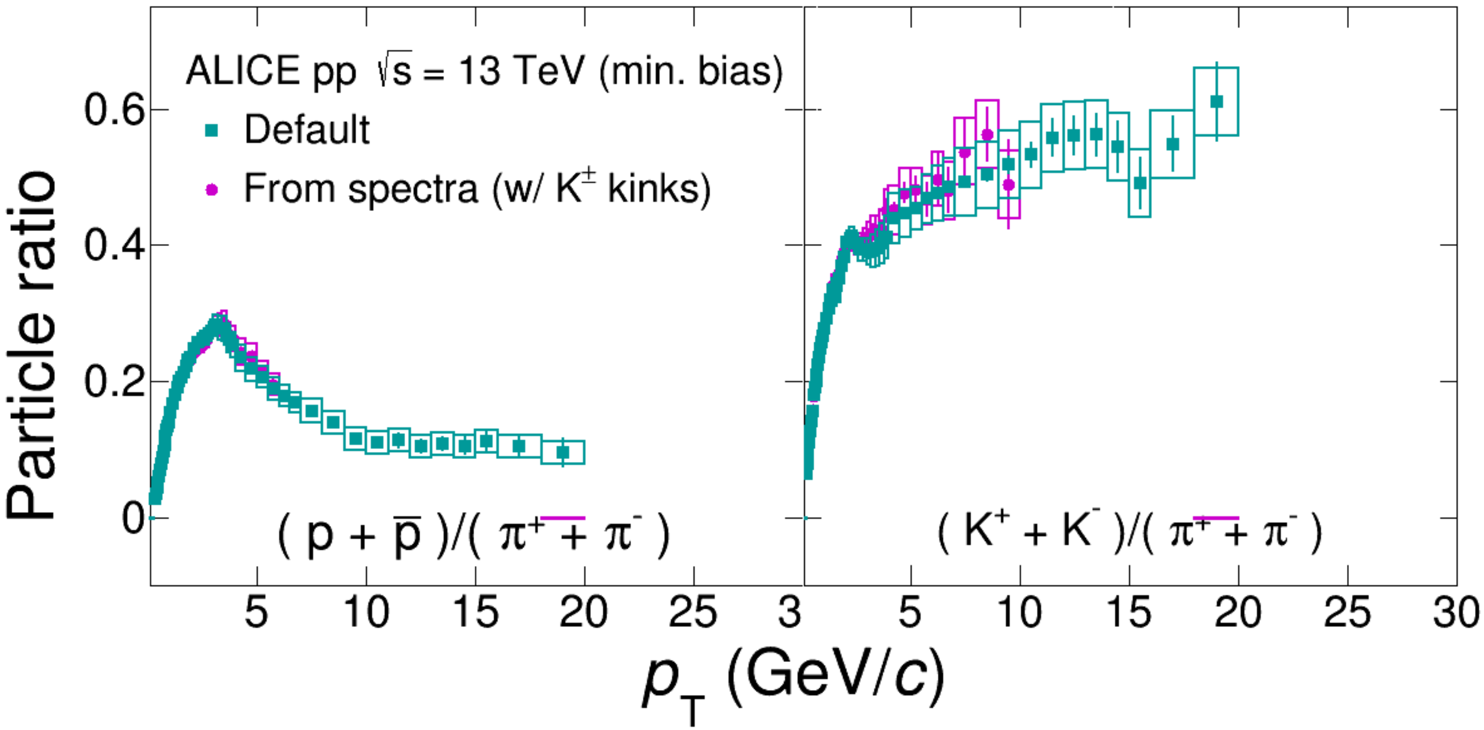


Comparison of Kaons from Kinks and K0 short analyses

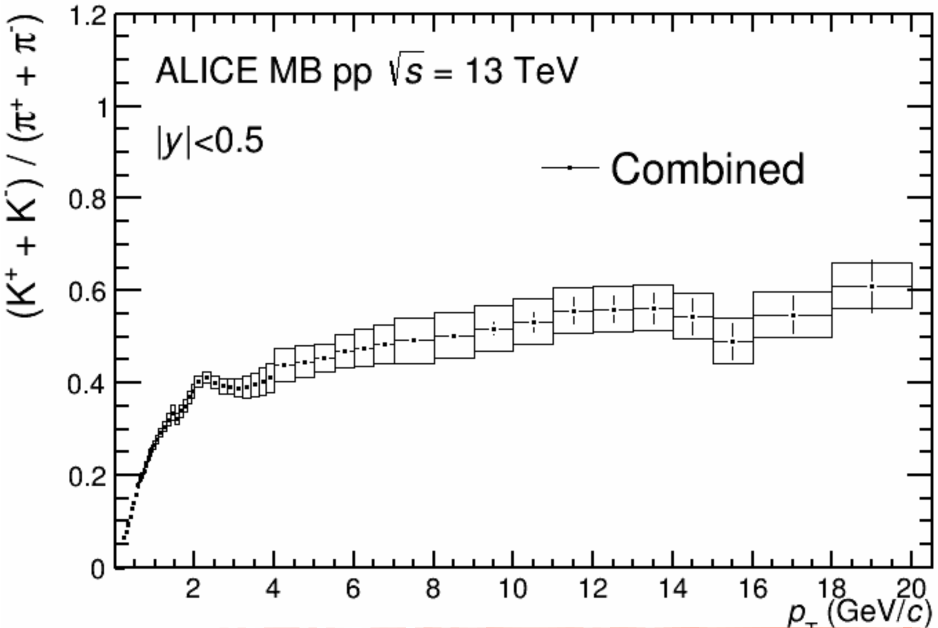


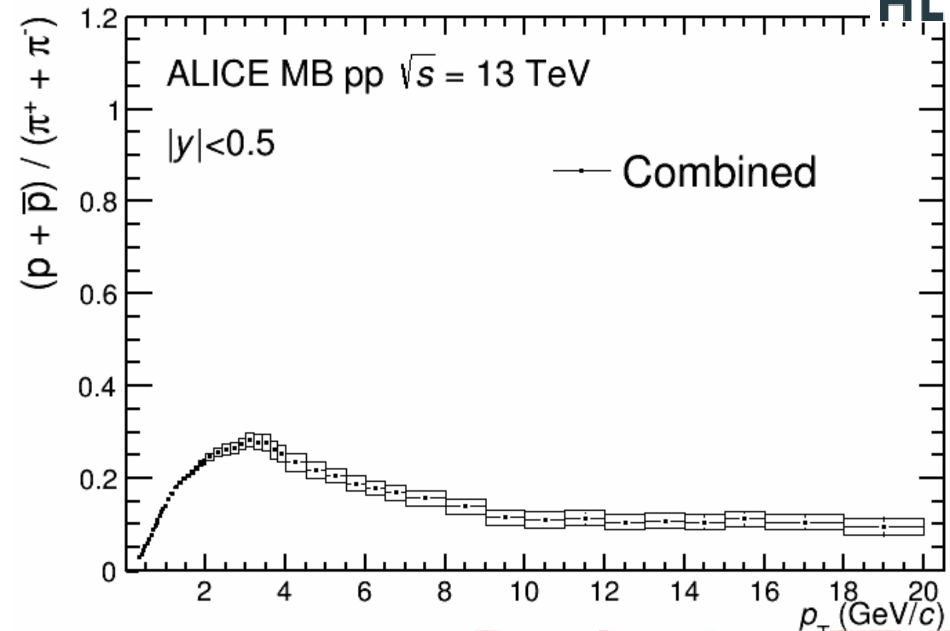


Comparison of particle ratios obtained with different methods



Particle ratios – Combined results





- ***[Method 1] – Default for preliminary results***
  - we obtained the particle ratio central values by dividing the combined spectra
  - The systematic uncertainties on the central, points obtained this way, are taken from the produced combined particle ratios (above)

  - In this way the Kink analysis is taken into account in the K/pi particle ratio
  - The systematics for the Kinks (in a given p_T region) is not considered

- [Method 2]
  - Alternatively one can build a combined ratio from the ratios of the individual analyses (excluding kinks) which yields similar results (see backup)

② Specific items

$\bar{\Lambda}$ issue in the first low p_T points

SLIDE FROM PREVIOUS PRESENTETAION

- Not understood behavior for the $\bar{\Lambda}$ spectrum at low p_T
- Checks done:
  - Signal extraction
  - Feed-down correction
  - GEANT3 vs GEANT4 correction