K^{*0} & ϕ production as a function of charged particle muliplicity in p+p collisions @ 7 TeV

R. Singh, A. Ku. Dash, K. Nayak, B. Mohanty

School of Physical Sciences,
National Institute of Science Education and Research,
Bhubaneswar, INDIA

ALICE-India collaboration meeting, 6-7 February, 2016

Outline

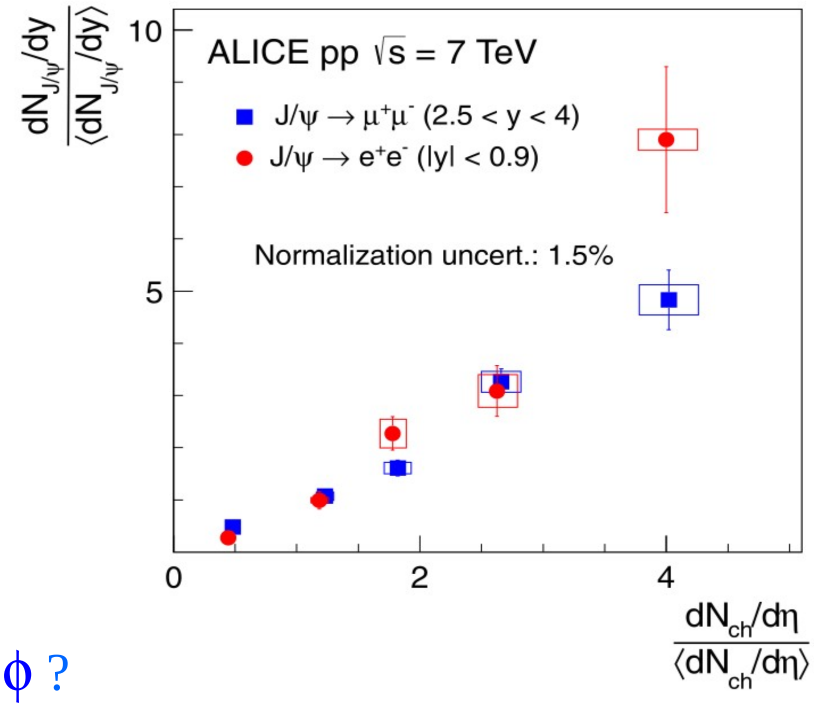
- ✔ Motivation
- ✔ Analysis Details
- ✔ Results
  - Spectra
  - dN/dy, $\langle p_T \rangle$
  - Particle ratios
- ✔ Summary

Motivation

- Charged particle multiplicities measured in high-multiplicity pp collisions at LHC energies are of the same order as those measured in heavy-ion collisions at lower energies.
  Whether pp collisions also exhibit any kind of collective behavior as seen in A-A collisions ?

- $\langle p_T \rangle$ Vs N_{ch} was measured in p-Pb collision at $\sqrt{s_{NN}}$ = 5.02 TeV and strong increase in $\langle p_T \rangle$ with N_{ch} is observed as compare to Pb-Pb collision at $\sqrt{s_{NN}}$ = 2.76 TeV.

- ALICE collaboration has measured J/psi yield as a function of charged particle density in pp collision at $\sqrt{s}$ = 7 TeV and is found to be increasing*.



- What is the behavior of resonances like K^{*0} and ϕ ?

*ALICE Collaboration, Phys. Lett. B. 712, 165 (2012); ALICE Collaboration, arXiv:1505.00664

Analysis Details : p+p data set and track cuts

Data Set used:

p+p : 7 TeV Period : LHC10d

Run no. : 122374–126437(44)

Data type: ESDs, pass2

Trigger : MinBias (kMB)

#Events : ~92 M

Tracks Selection:

StandardITSTPCTrackCuts2010()

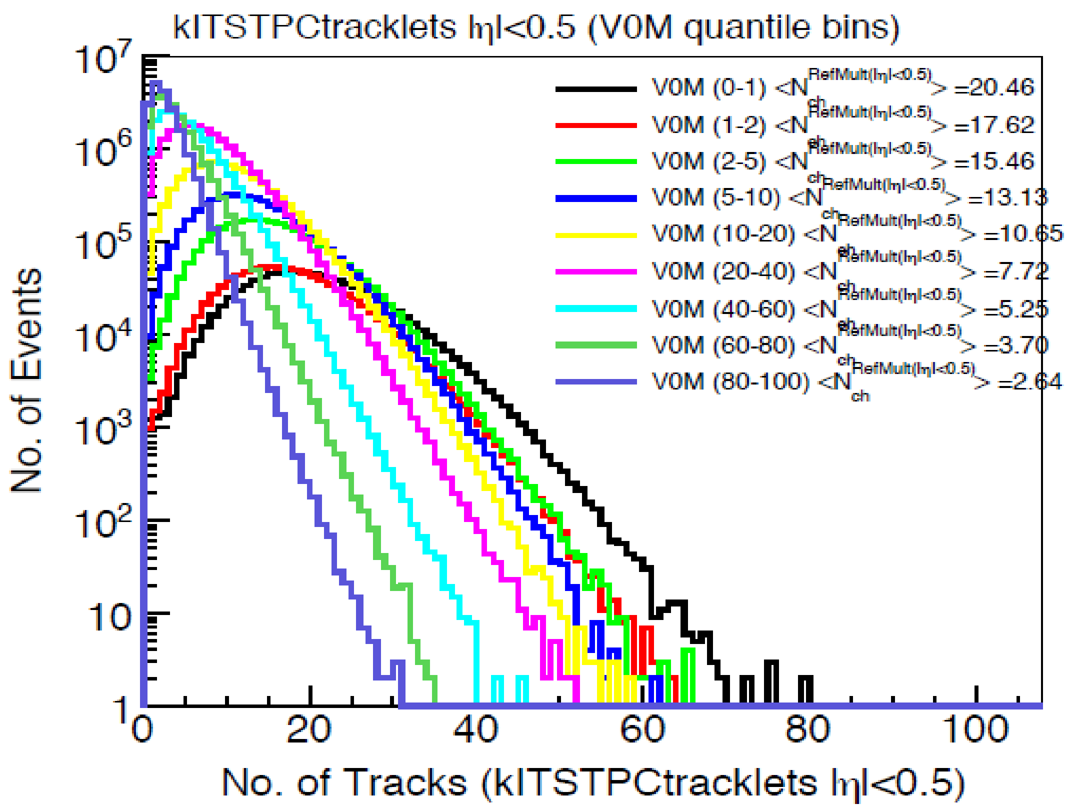
- Ncrossrows In TPC > 70
- $\chi^2/N_{TPC} > 4$
- Reject kink daughters
- $|\eta| < 0.8$
- Cluster requirements in ITS
- Reject kink daughters
- p_T-dependent cut on DCA_{XY} $(0.0182+0.0350/p^{1.01})$
- $DCA_Z < 2$ cm

Event Selection:

As strangeness ans π/K/p group:
Those events are selected which satisfy the following criteria:

-- Selected by Physics Selection (AliVEvent::kMB or AliVEvent::kHighMult)
-- Event must have at least an SPD-determined primary vertex
-- Event must have a primary vertex located within |z| < 10 cm
-- Event must not be tagged as pileup by AliESDEvent::IsPileupFromSPD()

Analysis Details : Multiplicity distribution

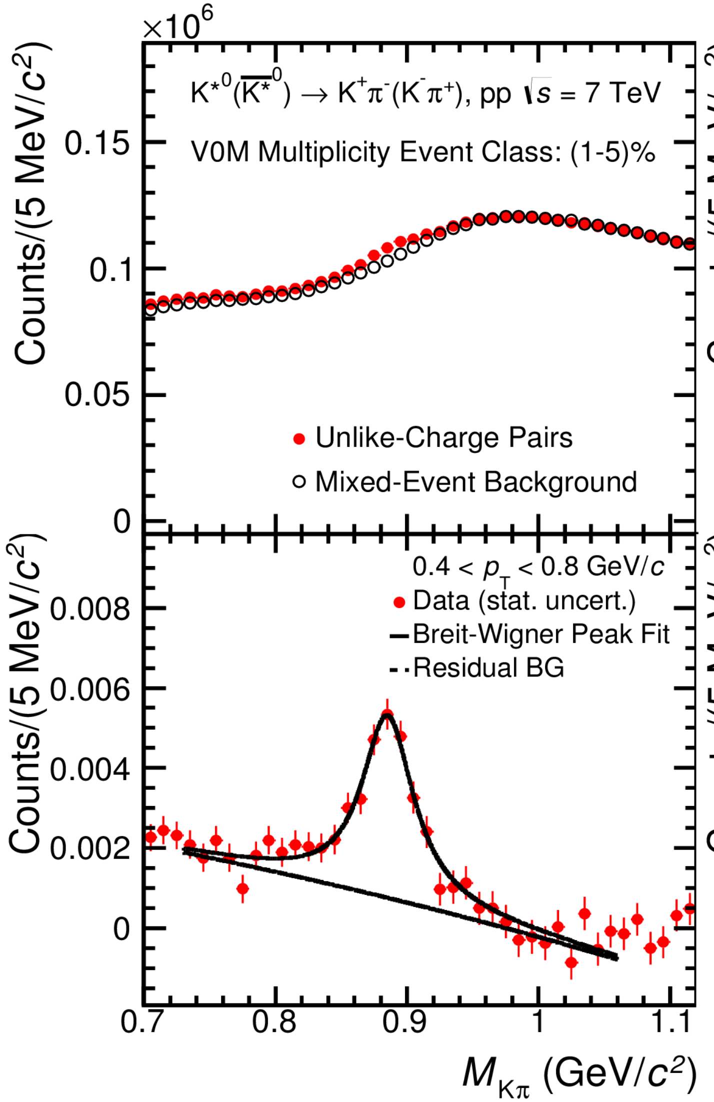


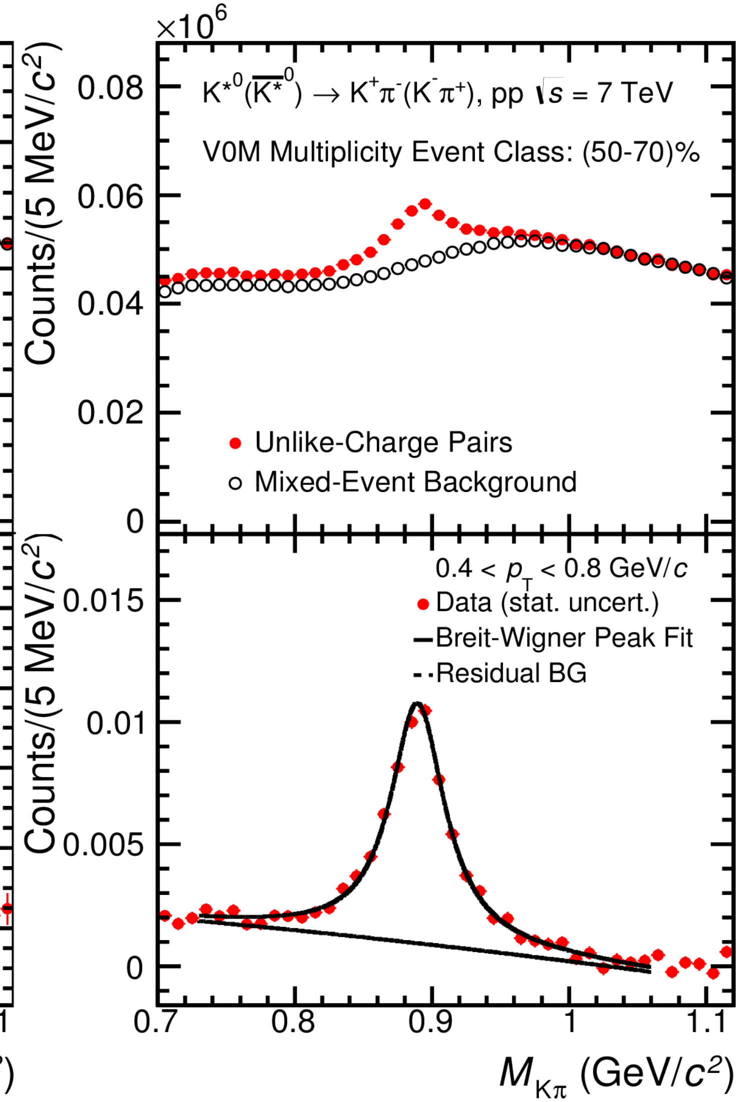
PID selection :

Only TPC is used : **For ϕ** ==> $n\sigma_{TPC}$ < 3 for all momnetum range	$\phi \rightarrow K^{+} K^{-}$
TPC + TOF is used : **For K^{*0}** ==> $n\sigma_{TPC}$ < 2 and $n\sigma_{TOF}$ < 3 (as veto)	$K^{*0} \rightarrow K^{+} \pi^{-}$

Invariant Mass : K^{*0}

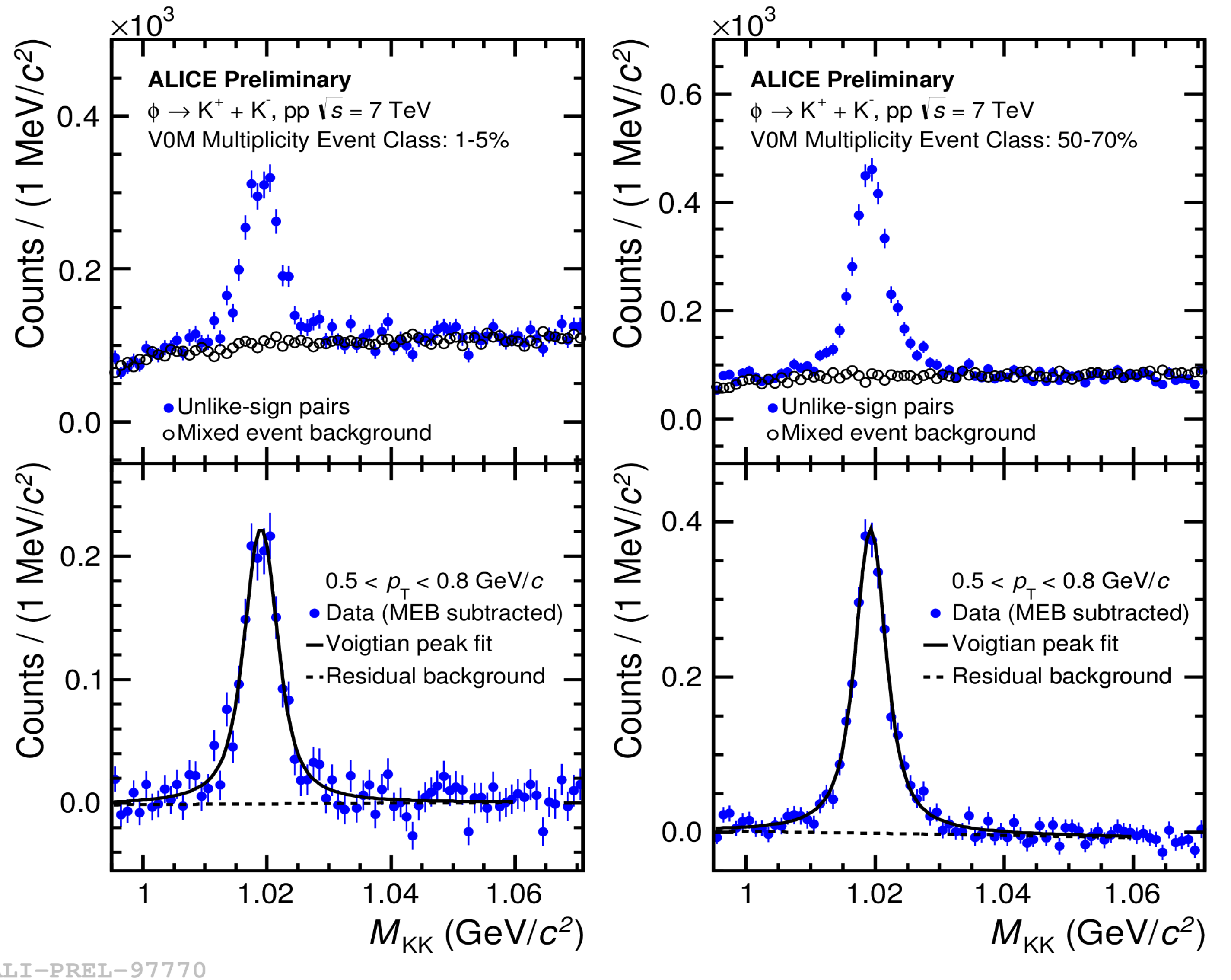
- ✔ Mix event:
  V_z difference 1 cm
  ($-10 < V_z < 10$ cm)
  Event mixed : 5
- ✔ V0M Multiplicity Event Class: 1-5%, 50-70%
- ✔ $0.4 < p_T < 0.8$ (GeV/c)





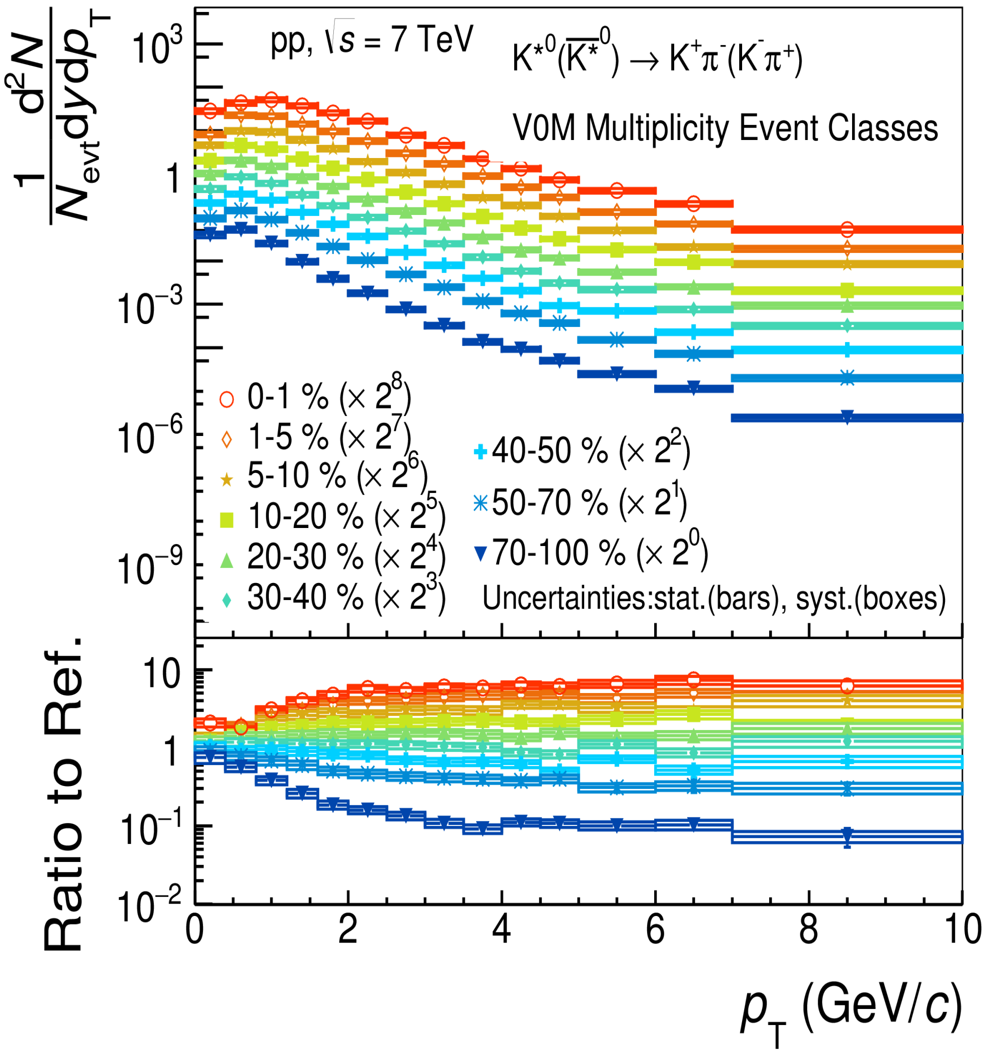
Invariant Mass : ϕ

- ✔ Mix event:
  V_z difference 1 cm
  ($-10 < V_z < 10$ cm)
  Event mixed : 5
- ✔ V0M Multiplicity Event Class: 1-5%, 50-70%
- ✔ $0.5 < p_T < 0.8$ (GeV/c)

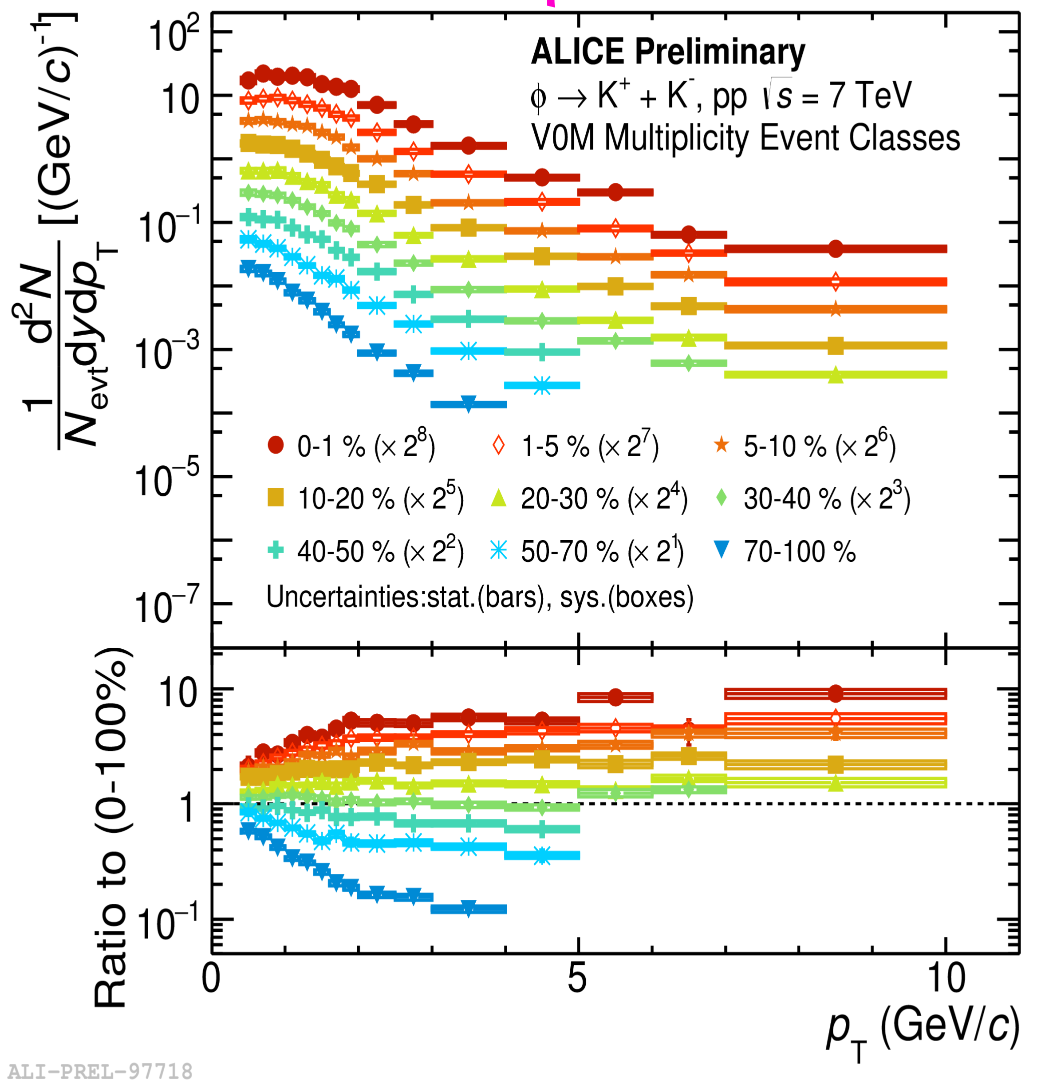


Corrected p_T spectra

K^{*0}



ϕ



Systematic uncertainties details : K^{*0}

List of systematics check:

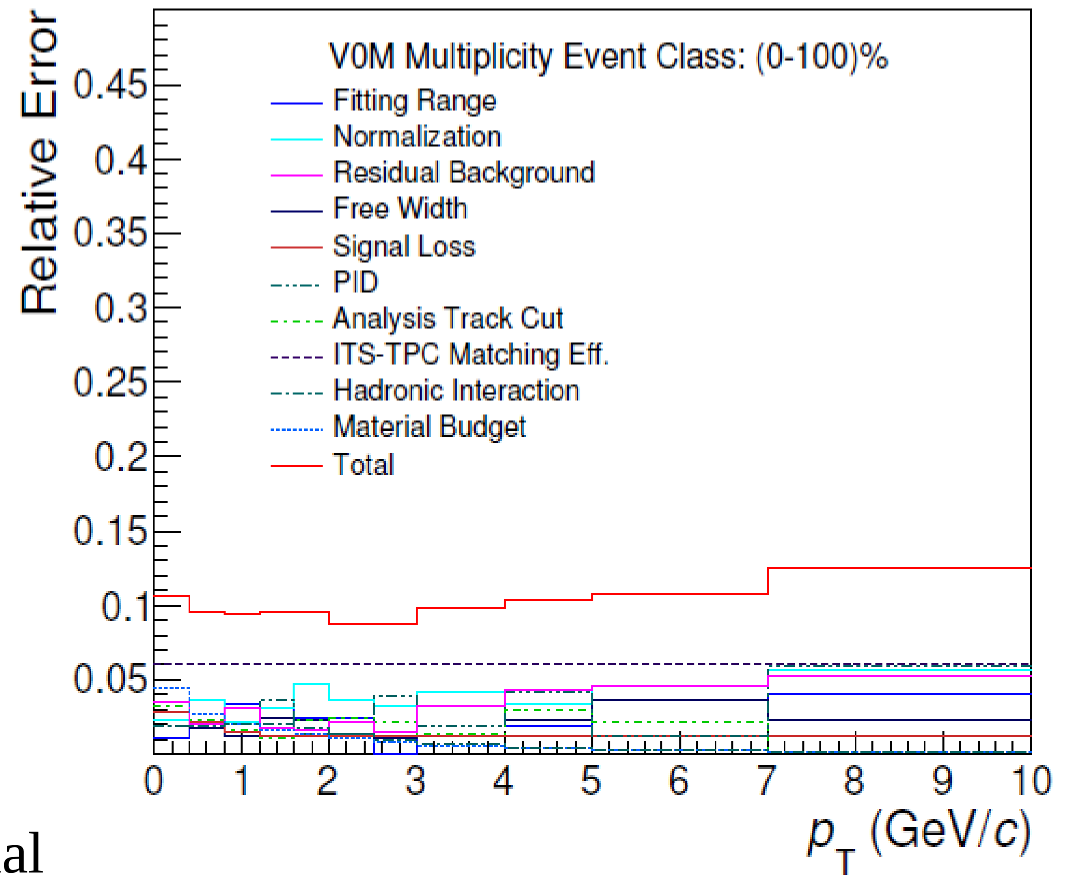
-- Fitrange variation: [0.75-1.07(Deft), 0.77-1.03,0.76-1.06, 0.79-1.04]

-- Normalization variation: [1.1-1.15 (Deft), 0.7-0.8, 1.03-1.05, 1.1-1.2, 1.0-1.1]

-- Residual Bkg: Poly2 (Deft), Poly3

-- Fixed width (Default) : Free width

-- Analysis track cuts, Signal Loss, Material budget, Hadonic interaction , PID



-- Total systematic variation is ~ 8-14%

Systematic uncertainties details : ϕ

List of systematics check:

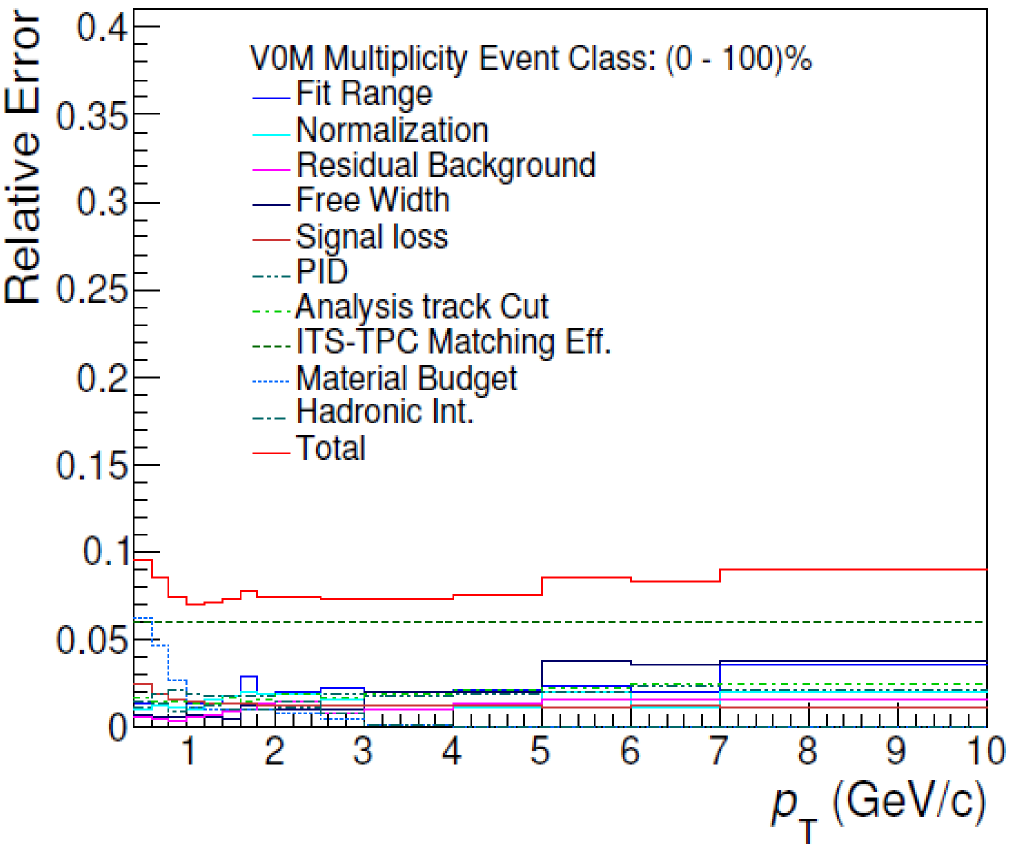
-- Fitrange variation
[.995-1.06(Deft), 0.99-1.65, 1.0-1.055]

-- Normalization variation
[1.1-1.15(Deft), 0.7-0.8, 1.03-1.05
1.1-1.2, 1.0-1.1]

-- Fixed width (Default) : Free width

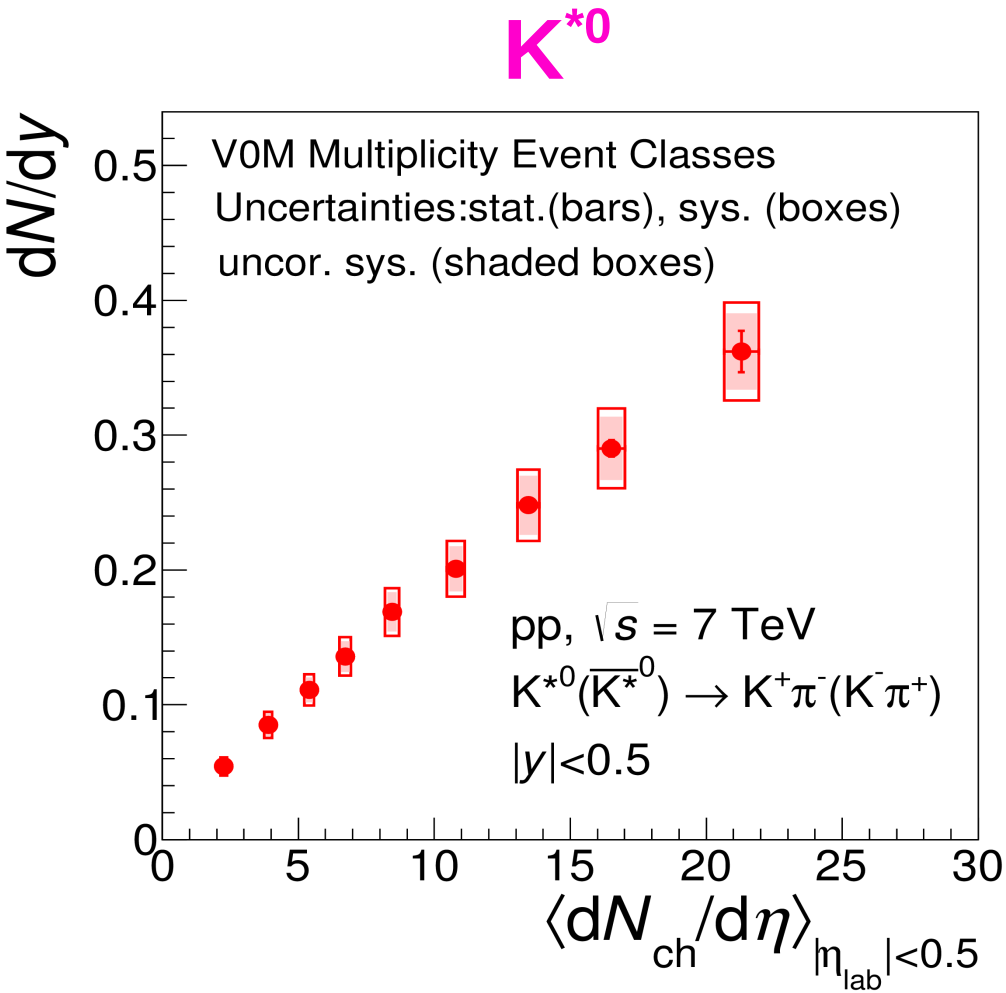
-- Residual Bkg: Poly2 (Deft), Poly3

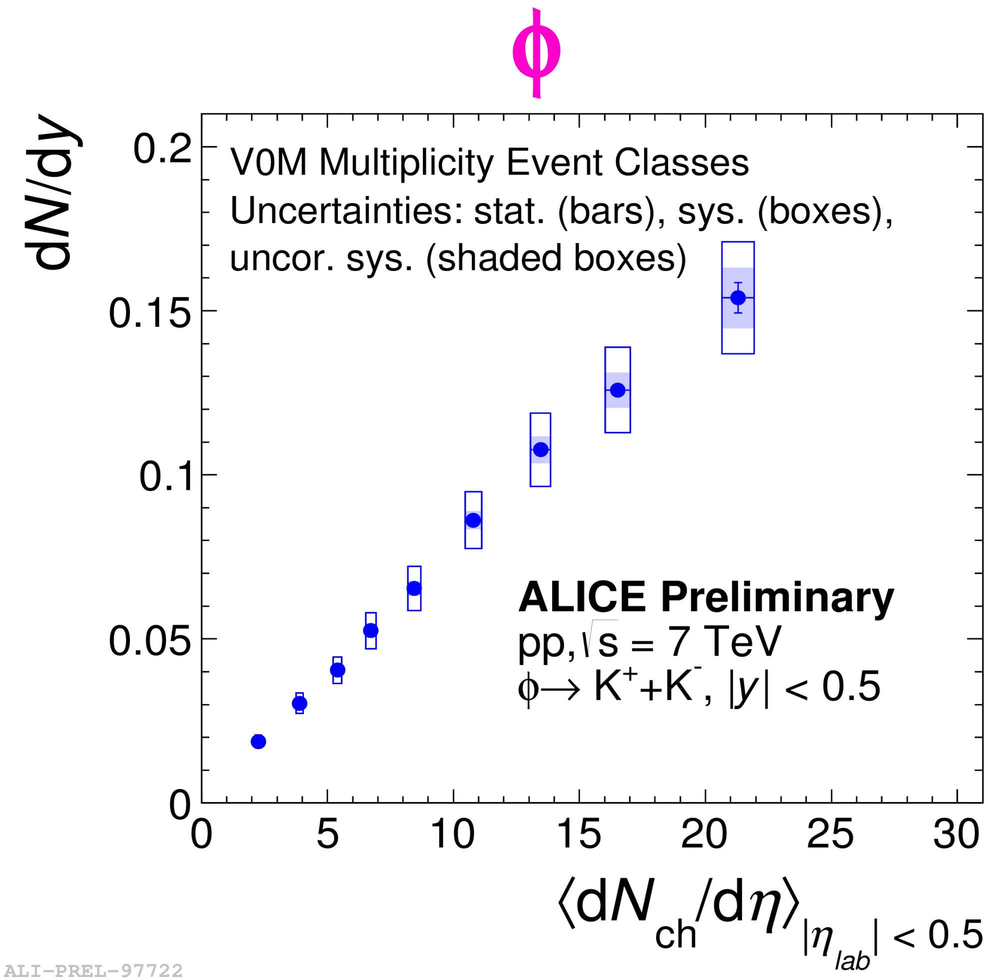
-- Analysis track cuts, Signal loss, Material budget, hadonic interaction , PID



-- Total systematic variation is ~ 8-11%

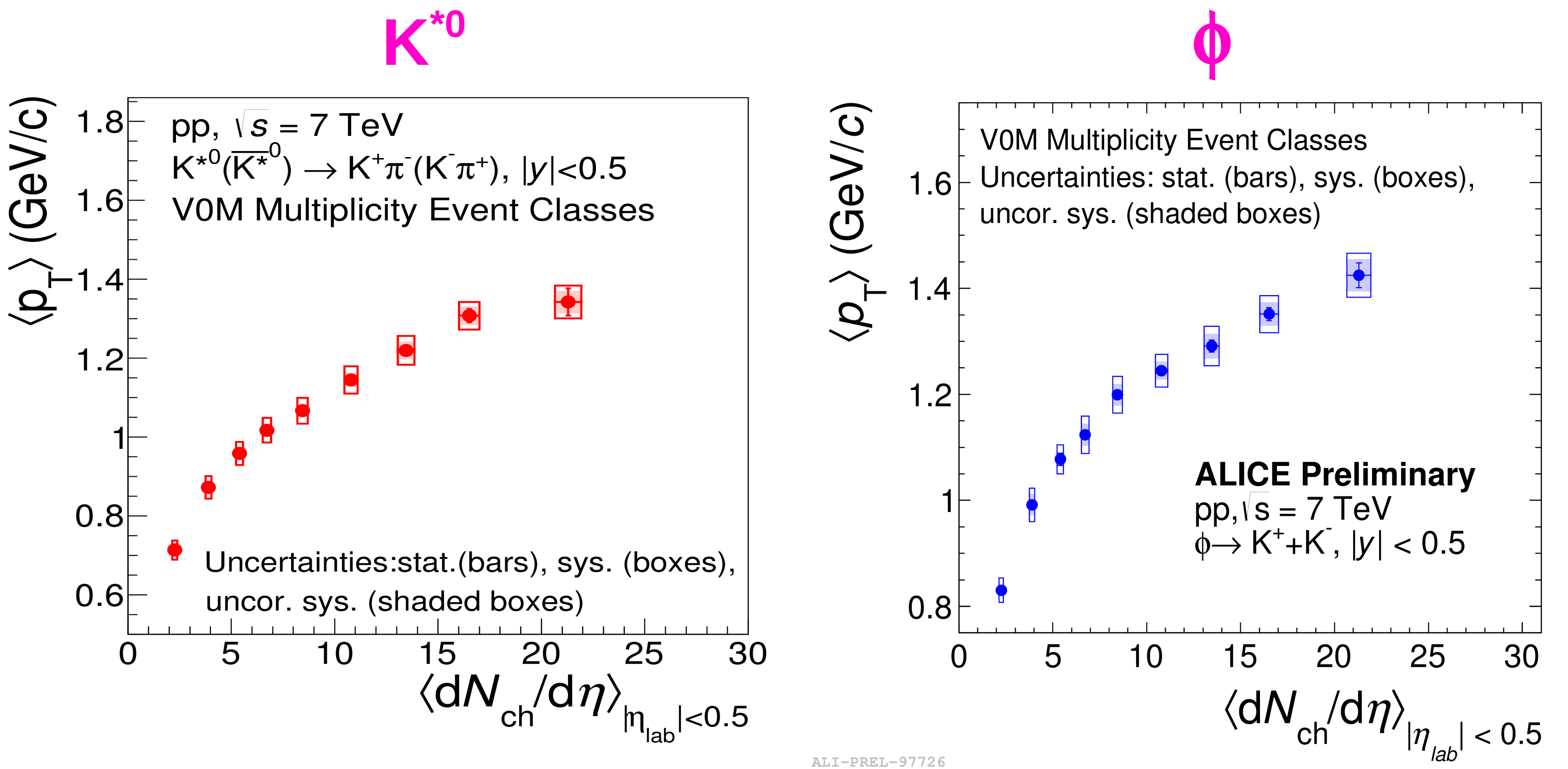
Yield as function of multiplicity





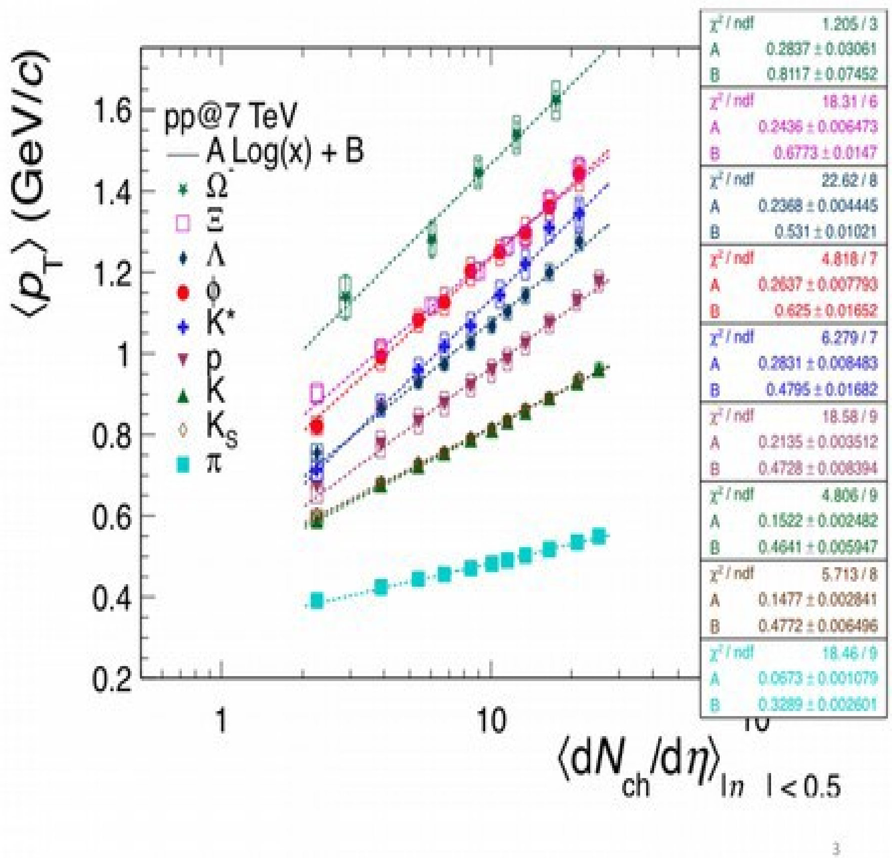
-- Yield increases with multiplicity

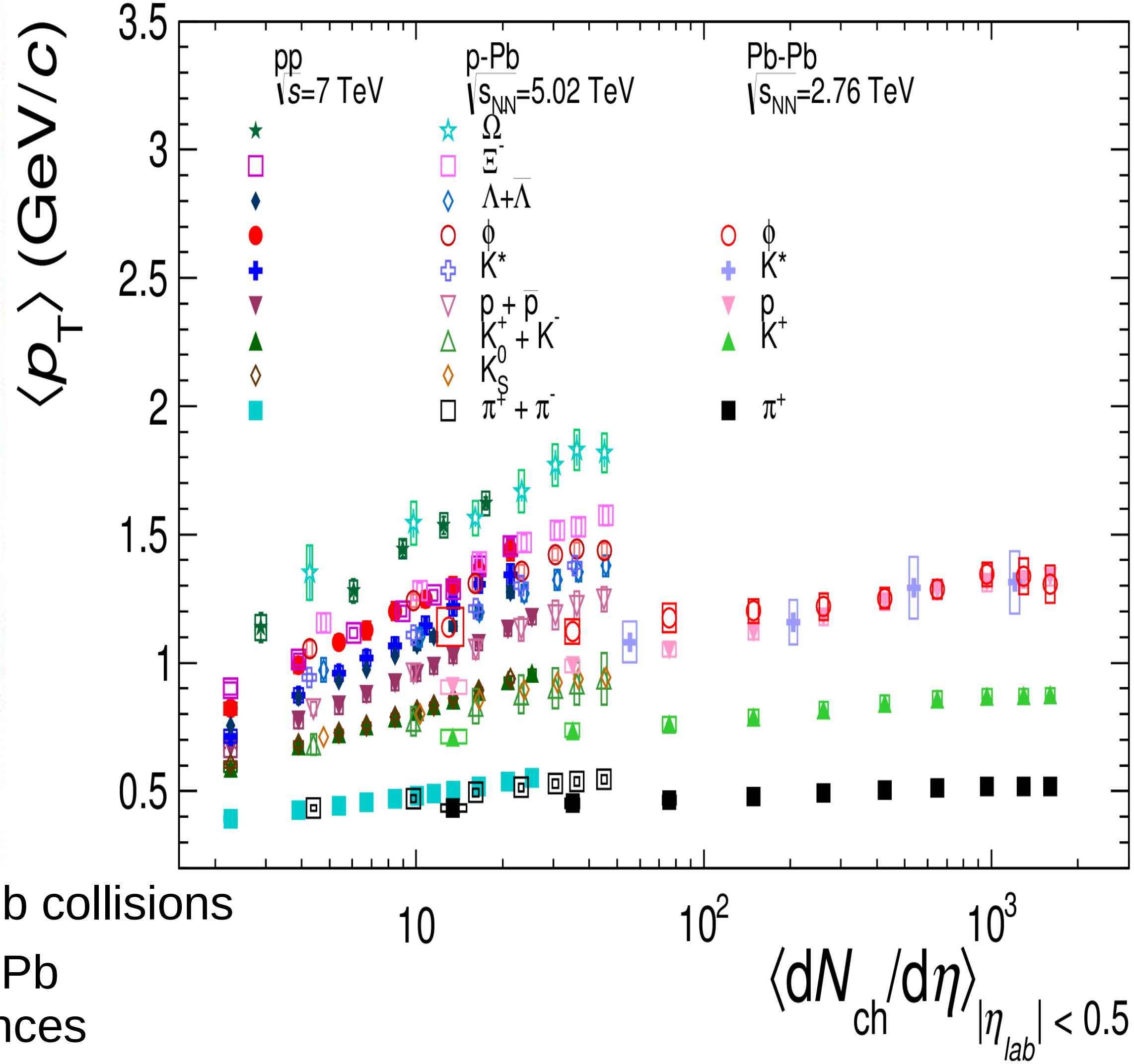
$\langle p_T \rangle$ as function of multiplicity



-- $<p_T>$ increases with multiplicity

$\langle p_T \rangle$ Comparison in pp, p-Pb, Pb-Pb



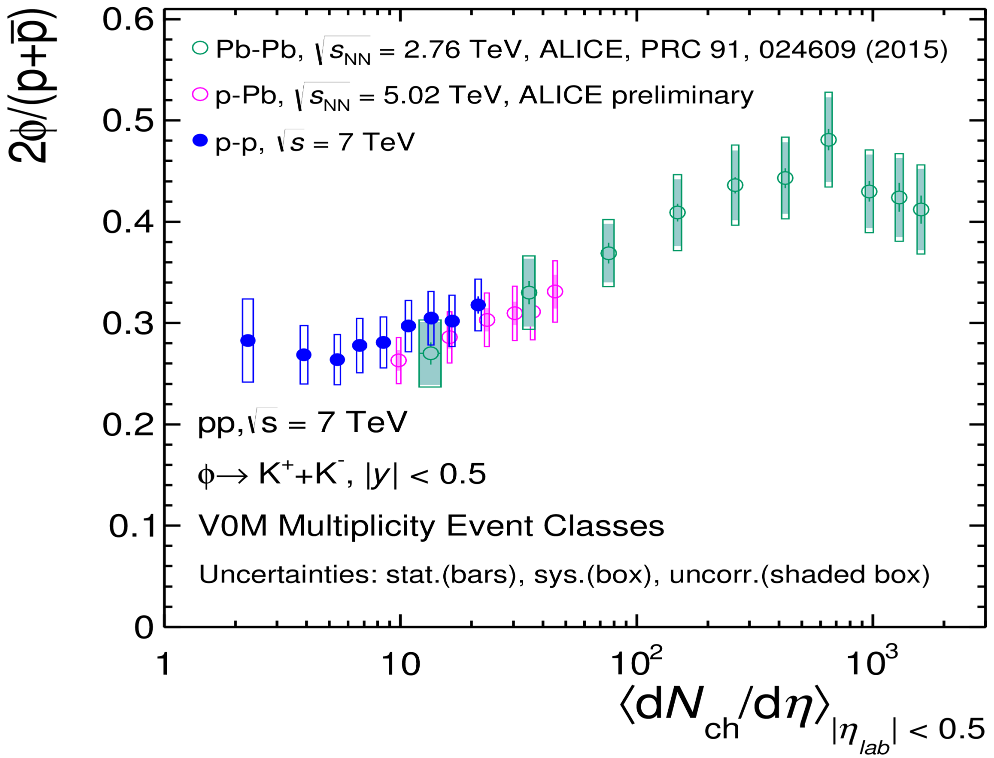


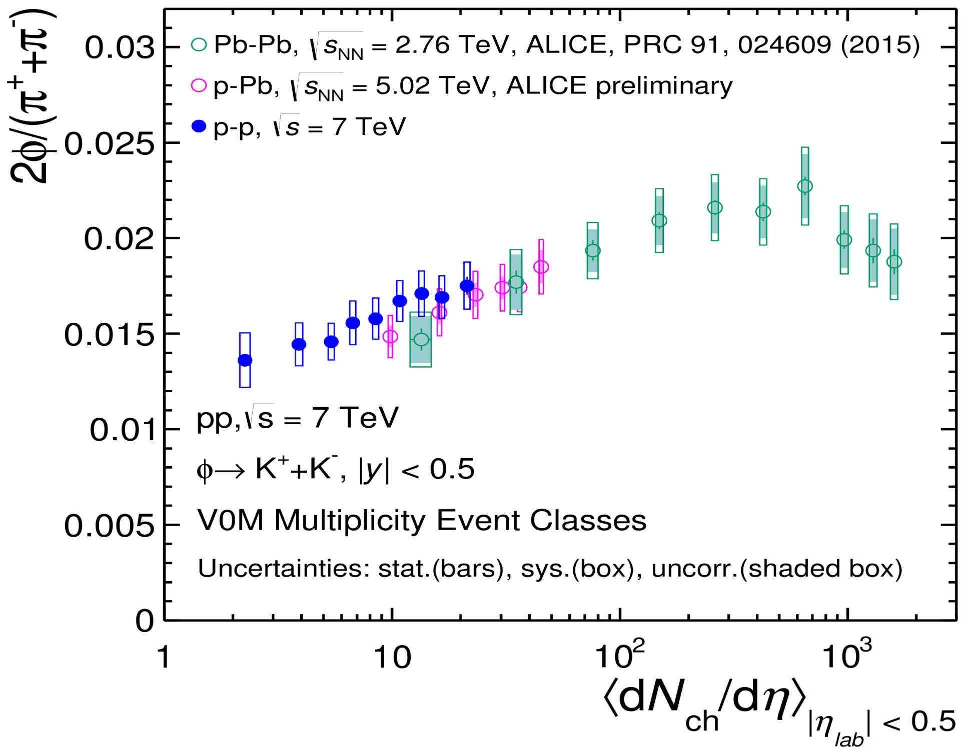
-- $<p_T>$ increases with multiplicity in pp, p-Pb collisions

-- <p> increases and then saturates for Pb-Pb

-- Mass ordering is not following by resonances

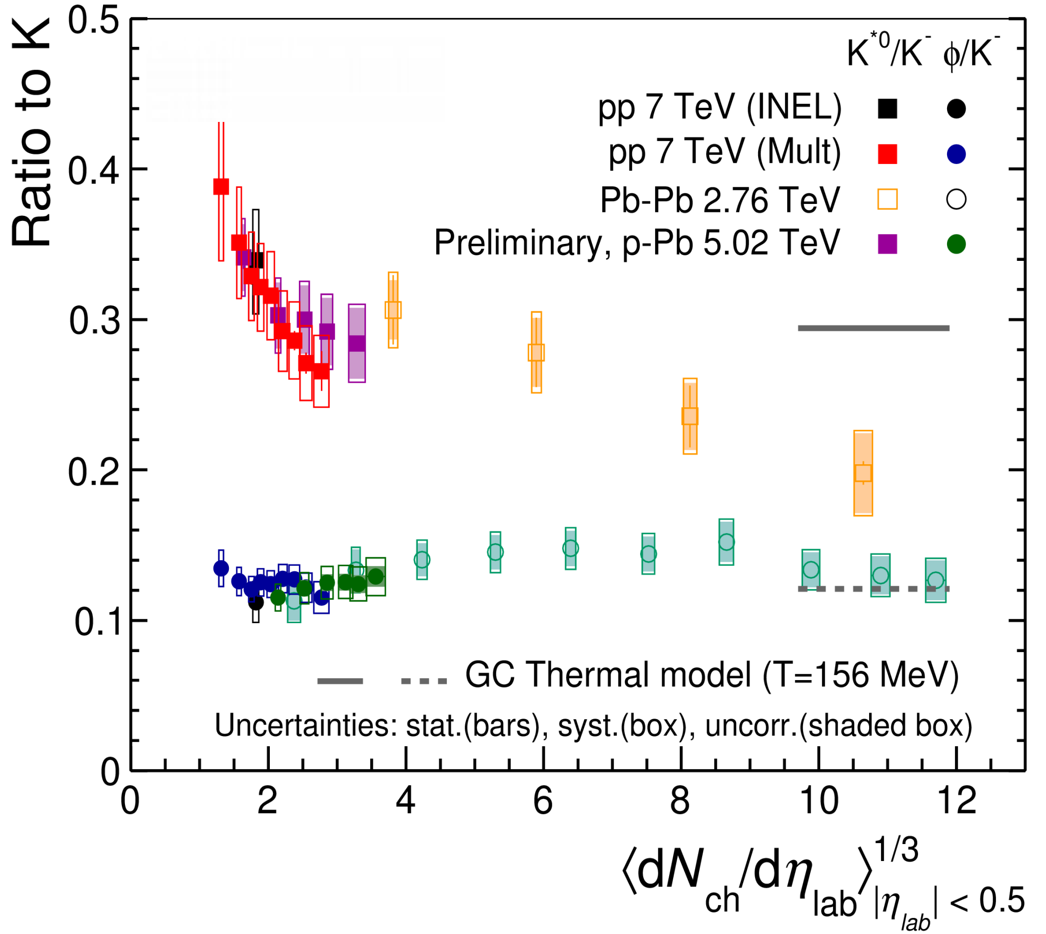
Particle ratios : ϕ/p, ϕ/π





- ϕ/π, ϕ/p ratios are flat with event multiplicity.
- Ratio smoothly follows the p-Pb trend

Resonance to stable particle ratios



-- K^{*0}/K in pp follows the same trend as in p-Pb

-- ϕ/K as function of system size is flat and follows the trend of p-Pb

Summary

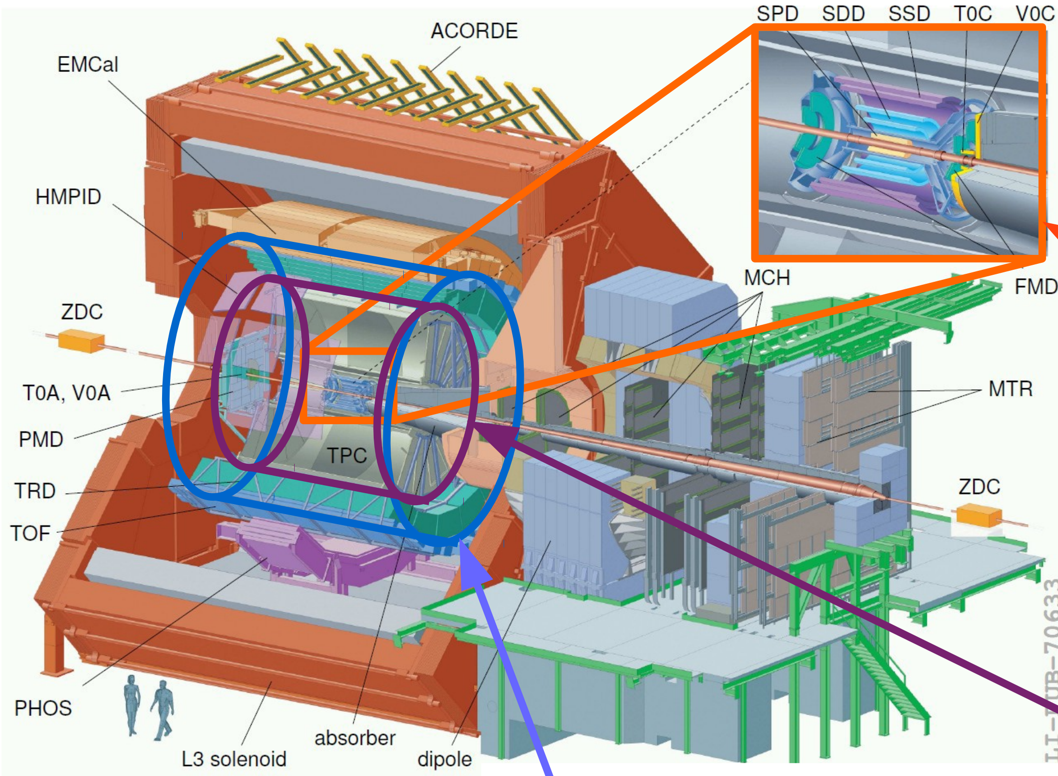
- K^{*0} and φ p_T spectra in different V0M multiplicity event classes in pp @ 7 TeV are reported.
- dNdy, <p_T> increases with event multiplicity.
- For <p_T>, mass ordering is not followed in by K^{*0} in p-Pb and Pb-Pb
- φ/p, φ/π are flat with respect to event multiplicity and follows the trend of p-Pb.
- K^{*0}/K follows the p-Pb trend and φ/K is flat as function of system size.

Paper draft is in preparation.
(This will be a long paper including all other identified particles)

Thank You!

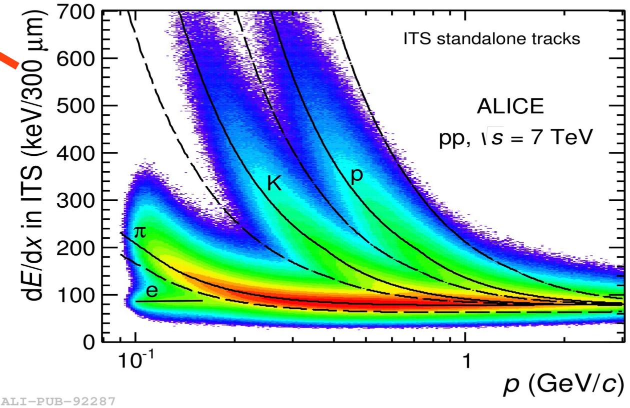
Backup

Particle identification with the ALICE

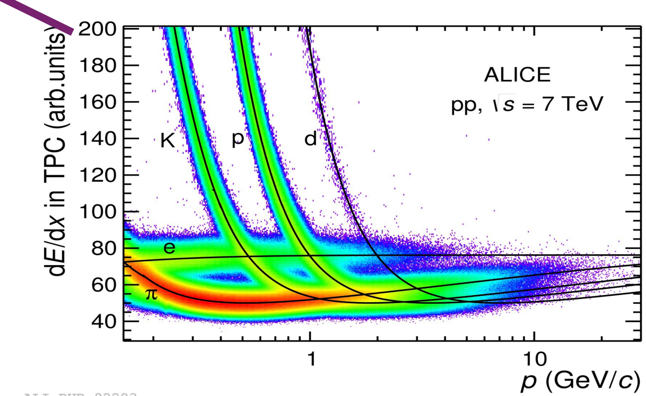


Detector used in this analysis:

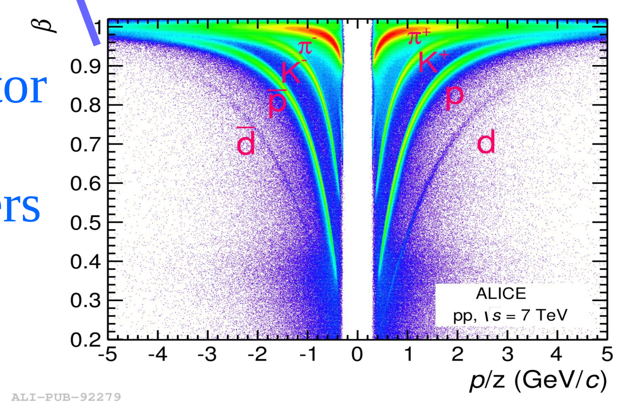
ITS($|\eta|<0.9$): 6 layers of silicon detectors:
→ trigger, tracking, vertex, PID (dE/dx)



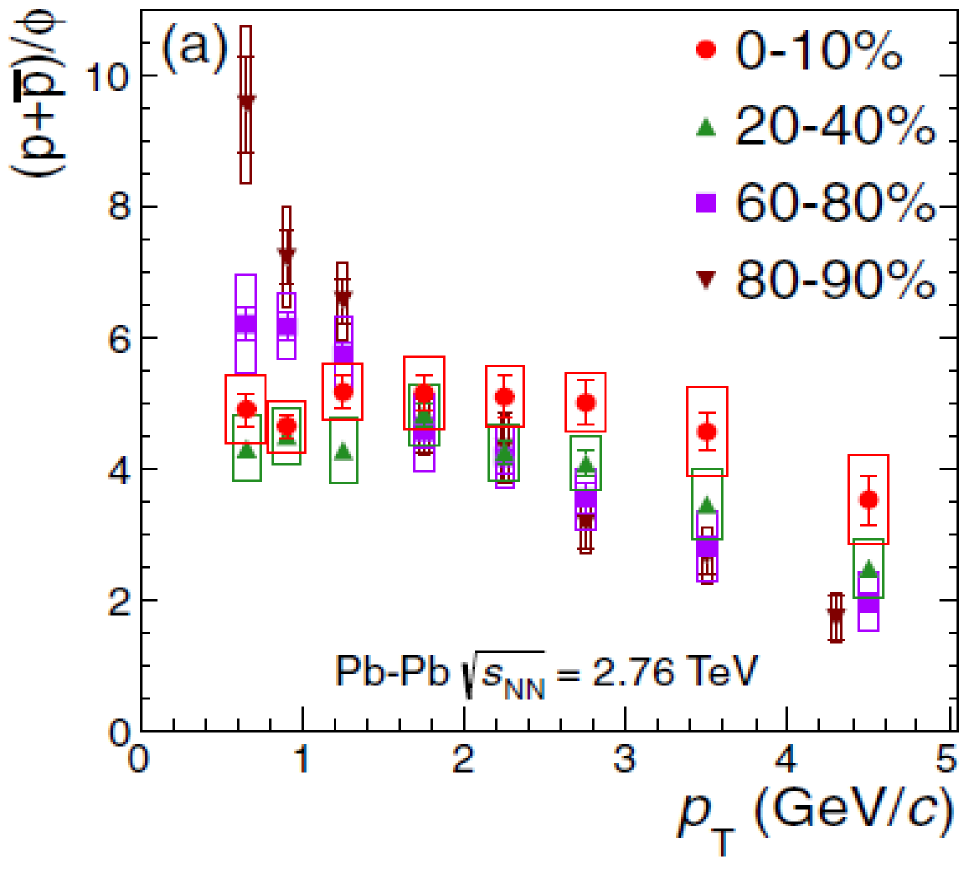
Time Projection Chamber ($|\eta| < 0.9$)
→ tracking, PID



Time Of Flight Detector ($|\eta| < 0.9$) multi-gap resistive plate chambers
→ PID



Particle Ratio: p/ϕ (Pb-Pb)



PHYSICAL REVIEW C **91**, 024609 (2015)