Analysis on Lambda(1520) in p-Pb at $\sqrt{s_{NN}}$ = 5.02 TeV

Sarita Sahoo
Institute Of Physics
Bhubaneswar
Supervisor: Prof. P.K. Sahu

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Plan Of Talk

- Motivation
- ALICE Detector System
- Data set and Cuts
- Signal Extraction Λ(1520)
- p_{T} spectrum
- Results
  - Minimum bias
  - Multiplicity bin
- Summary

Motivation

- ***What is Λ* ?***

Λ*(uds)[1] -> p^+ + K^- :: Branching Ratio: 22.5%

Decay Length ~12.6 fm

Λ^*_{Mass} = 1.51953±0.00019 GeV/c^2 :: Λ^*_{Width} = 15.64±0.29 MeV/c^2

- ***Why is Λ* important?***

Yields of resonances like L*, due to their short life time are being affected while passing through hadronic mediums in heavy ion collisions. The study estimates the time scale between chemical and kinetic freeze-out.

Increasing life time →

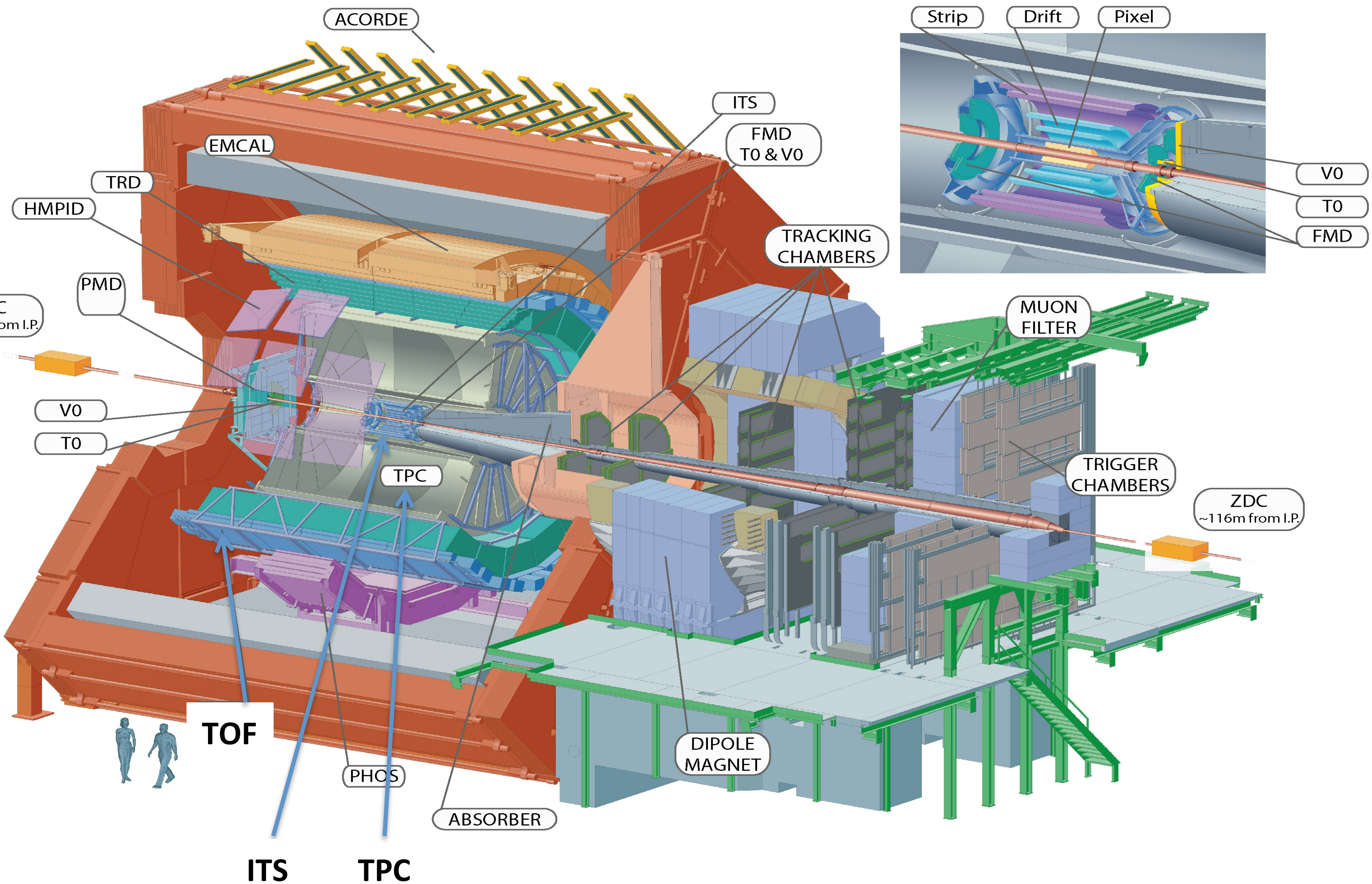
	ρ(770)	**K*(892)**	**Λ(1520)**	**Φ(1020)**
Γ (MeV)	151	47.4	15.6	4.27
	More suppressed ?	Suppressed	Still Suppressed ?	Not Suppressed

- ***Importance in pp and pPb collisions.***

Resonance production in pp and pPb collisions provides a reference for nuclear collisions and also data for tuning event generators inspired by Quantum Chromo-dynamics. Results from pPb analysis can be a connection between pp and heavy ion collision results.

[1] K.A. Olive *et al.* (Particle Data Group), Chin. Phys. C, **38**, 090001 (2014).

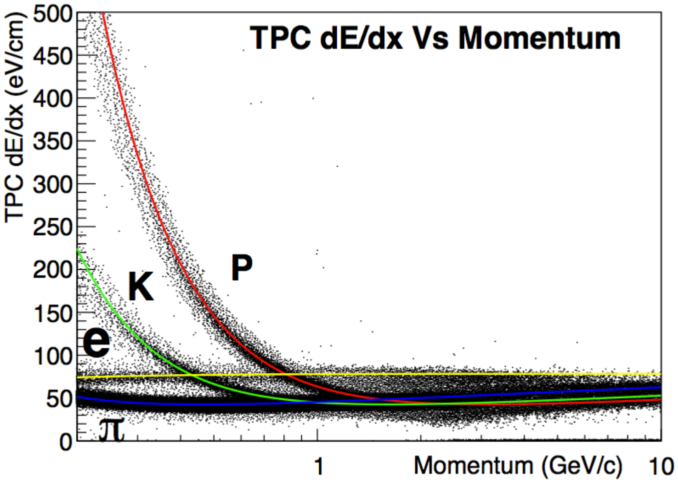
ALICE Detector System



Data set and Cuts

Particle	Lambda(1520)
System	p-Pb
Energy	5.02 TeV
Data Set	LHC13b (pass3) ,13c (pass2) (AOD139)
Track Cuts	Standard ITS-TPC cuts 2011 (Filter Bit 10) [2]
Trigger	kINT7 (99M Accepted events)
MC	LHC13b2_efix_pX, X=1,2,3,4
Pseudo-rapidity $\|\eta\|$ & pT	± 0.8 & > 0.15 GeV
Pair Rapidity (cm)	-0.5 to 0
Vertex Cut	±10 c.m.
PID Cut	TOF 2σ & TPC 5σ OR Not TOF Match & TPC 2σ p(p) < 1.1 GeV/c & p(K) < 0.6 GeV/c

Track cut :
η = (-0.8,0.8)
TPC cluster >= 50
TPC & ITS refit
DCA z = 2cm
DCA xy = 7σ (0.0105+0.035/pt^1.1)
Max chi2/cluster in TPC = 4
Max chi2/cluster in ITS = 36



[2] https://twiki.cern.ch/twiki/bin/viewauth/ALICE/PWGPPAODTrackCuts

Signal Extraction in p-Pb

Invariant Mass Reconstruction

$$m_0 = \sqrt{\left(\sum E\right)^2 - \left|\left(\sum \vec{p}c\right)\right|^2}$$

$\sum E$ = Sum of energies of particles

$\sum \vec{p}$ = Vector Sum of momenta of particles

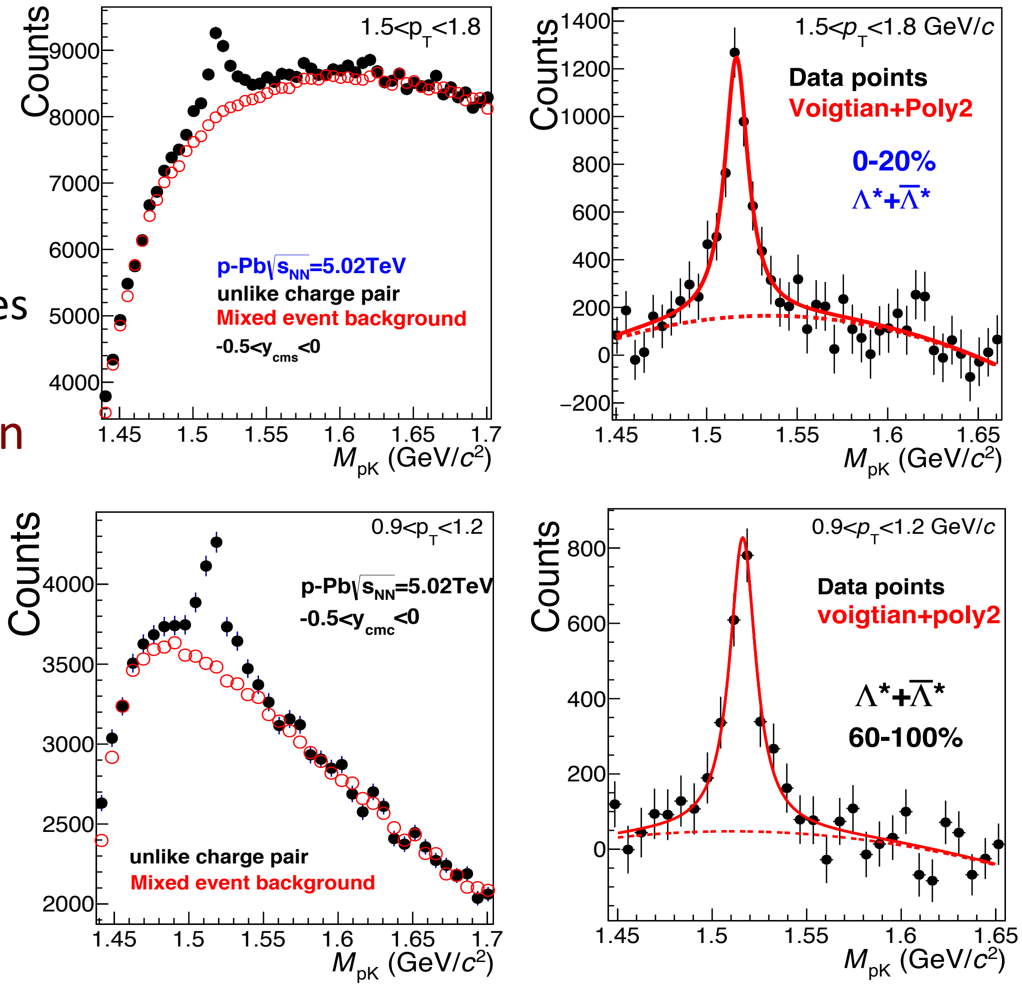
Combinatorial background subtraction

Mixed Event Background

# of Mix = 5, Mult Difference = 10

V_Z < 1 cm

$$\Lambda^* + \overline{\Lambda}^*$$

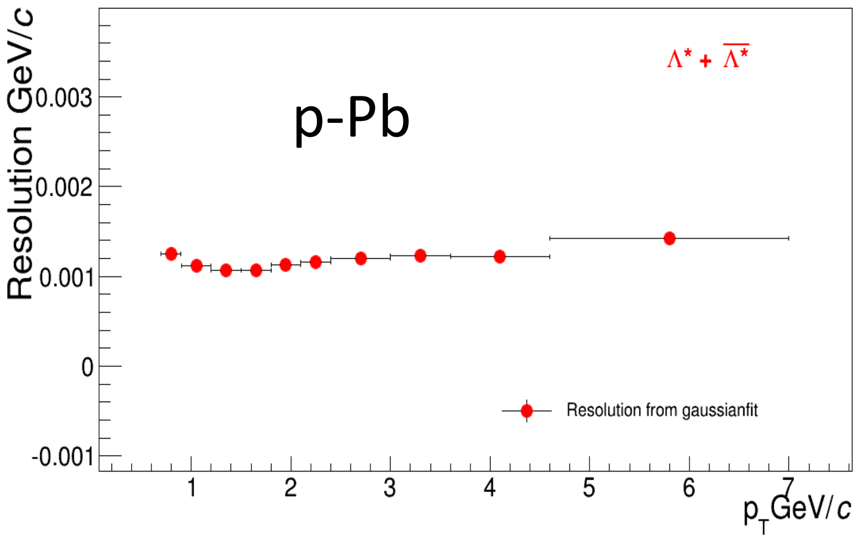


Voigtian function: $$\frac{dN}{dm} = A\int \frac{\Gamma/2\pi}{(m-m')^2+\Gamma^2/4}\,\frac{e^{-(m'-m_0)^2/2\sigma^2}}{\sigma\sqrt{2\pi}}dm' \qquad (1)$$

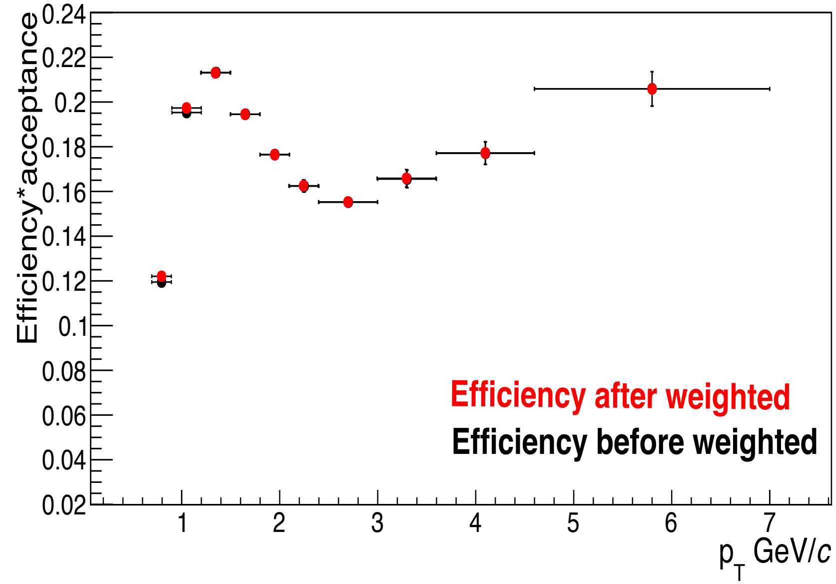
Where A, m_0, Γ and σ are the area under the peak, mass of Λ^*, width of the peak and the resolution parameter, respectively.

Λ^* Mass Resolution & Reconstruction Efficiency

Gaussian Fit to the distribution ($Mass_{Gen}$-$Mass_{Reco}$)



Efficiency, $\varepsilon_{rec} = N^{\Lambda^*}_{rec} / N^{\Lambda^*}_{gen}$;



Resolution varies between 1 to 1.5 MeV if calculated from (M_{Reco}-M_{gen}) distribution

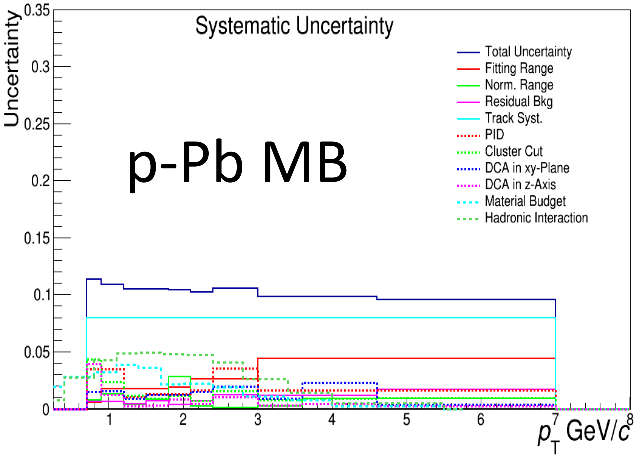
The drop in efficiency is seen because of the rejection of proton above $p > 1.1$ GeV/c And Kaon above $p > 0.6$ GeV/c when chosen from TPC track.

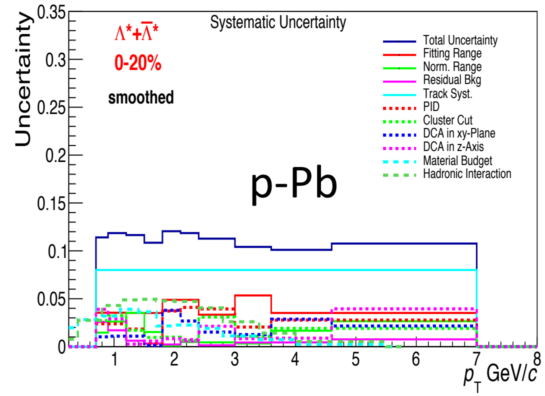
Systematic Uncertainty

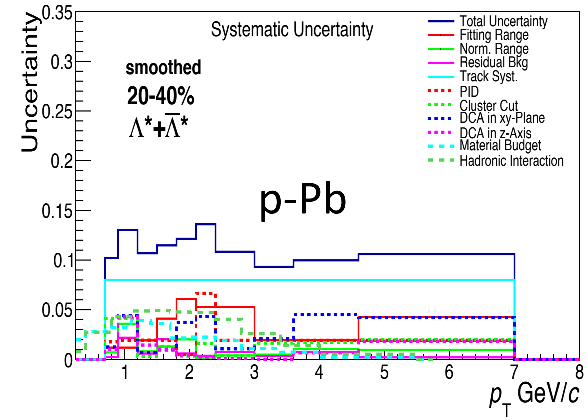
"Bin Counting" method is default for raw yield extraction
PID 2 σ (TPC and TOF with condition in slide 2) : Voigtian + Poly2

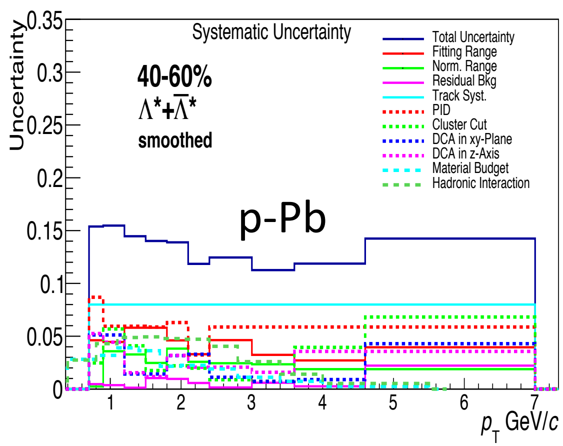
1. Fitting Range
2. Normalization Range
3. Fitting function
4. Residual bkg fit (Poly3)
5. Track Syst. (8%)
6. PID (1.5σ and 2.5σ)
7. Cluster Cut (p-Pb : 60,70)
8. DCA in xy-plane (p-Pb : 5σ and 4σ)
9. DCA in z-axis (p-Pb : 0.2 cm and 0.3 cm)
10. Material Budget
11. Hadronic Interaction

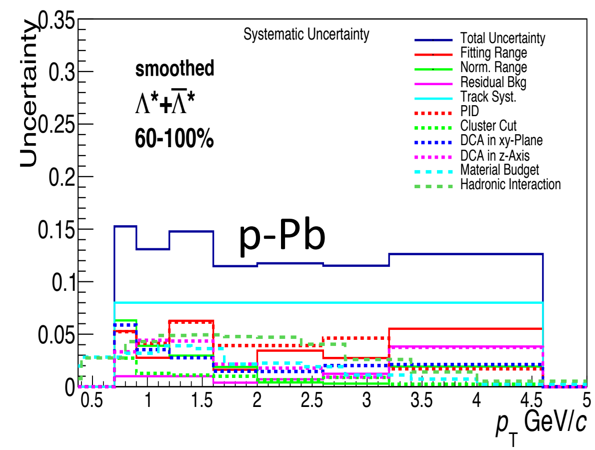
Systematic Uncertainty











Strategy for Systematic calculation:

- If bin fluctuates huge, is smoothed by its neighbor value.
- Standard deviation has been calculated if we have more than 2 values for one systematic source.
- Difference is chosen if there is only 2 values
- Systematics from all sources are added in quadrature.

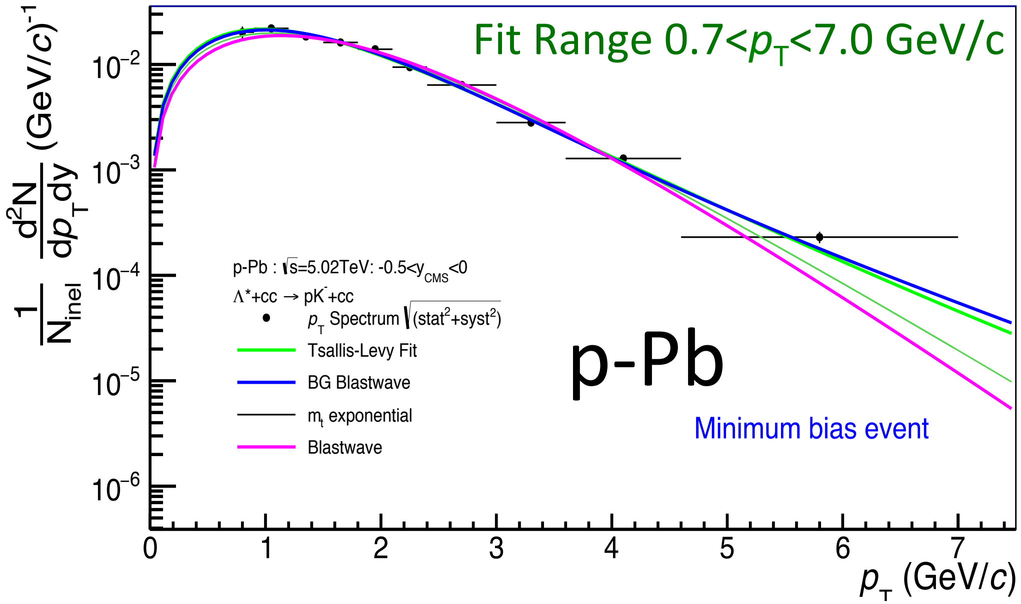
Transverse Momentum Spectrum Correction

The Corrected Yield:

$$\frac{1}{N_{inel}}\frac{d^2N}{dp_{\mathrm{T}}dy} = \frac{1}{N_{\mathrm{Accept}}}\frac{\varepsilon_{trig}}{\varepsilon_{rec}\,BR}\frac{N_{\Lambda^*}}{\Delta p_{\mathrm{T}}\Delta y}$$

$N_{\Lambda*}$= Measure raw yield in a given $\Delta p_T \Delta y$ bin
N_{Accept} = No of triggered events in p-Pb collision
BR = Branching Ratio (22.5 % in pK channel)
ε_{rec} = Reconstruction Efficiency
ε_{trig} = Trigger Efficiency (For p-Pb 0.964)
For p-Pb multiplicity study no trigger efficiency correction was applied

p_T Spectrum with fit

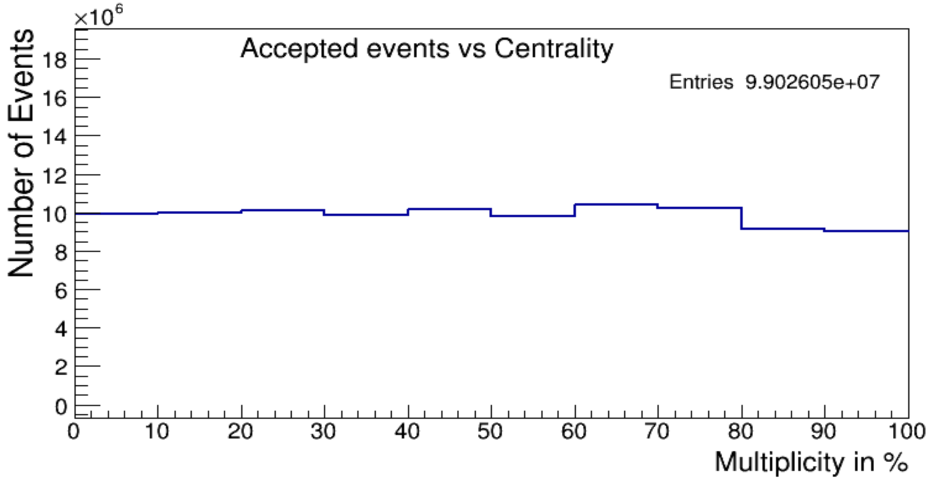


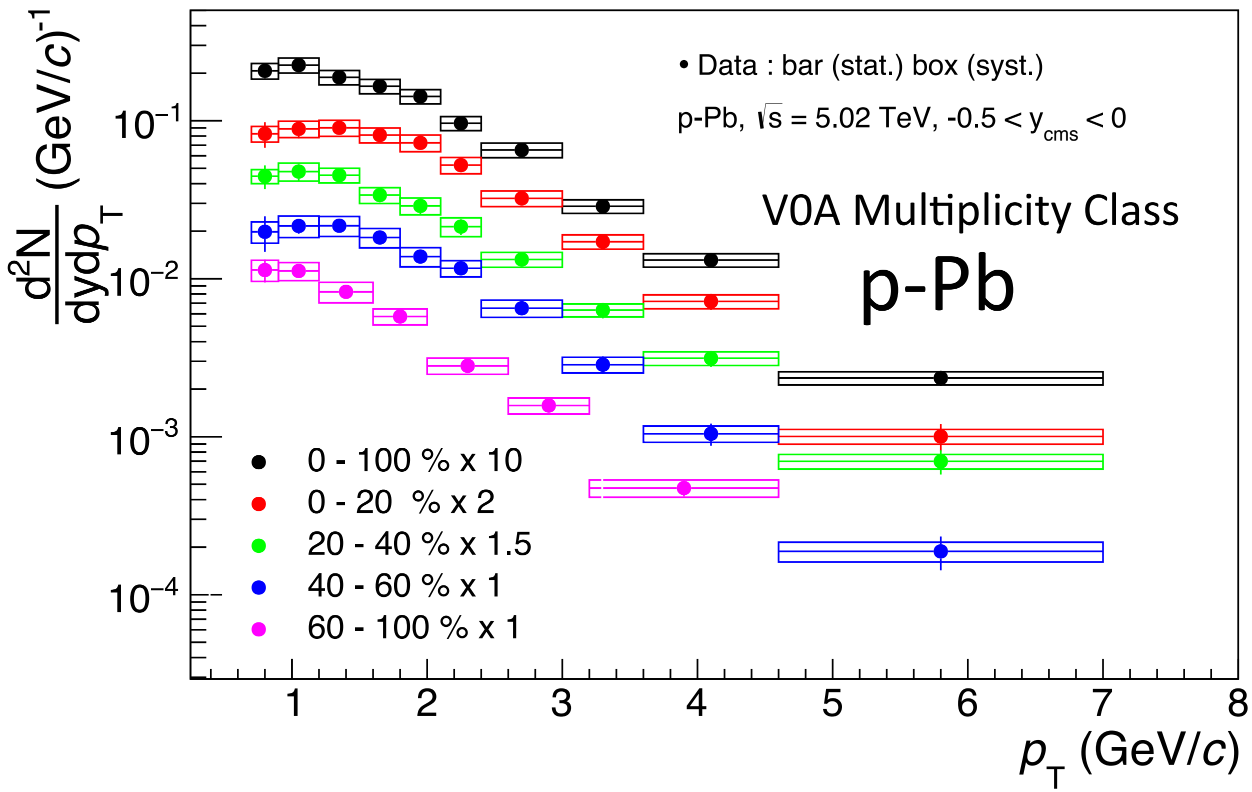
Multiplicity classes	dN/dy ± Stat. ± Syst.	Mean p_T ± Stat. ± Syst.
Minimum bias	0.0436 ± 0.00084 ± 0.003	1.57 ± 0.017 ± 0.03
0-20%	0.102 ± 0.0032 ± 0.0083	1.67 ± 0.026 ± 0.032
20-40%	0.0638 ± 0.0024 ± 0.0054	1.59 ± 0.034 ± 0.04
40-60%	0.045 ± 0.0017 ± 0.0064	1.5474 ± 0.032 ± 0.056
60-100%	0.0194 ± 0.0009 ± 0.0027	1.35 ± 0.04 ± 0.07

For uncertainty in lower extrapolation region, these 4 fit functions are used. And mt-exponential and Blastwave are fitted in region 0.7<p_T<3.4 GeV/c.

Extrapolation Uncert. For MB 1.5 % (Will be included in result plots)

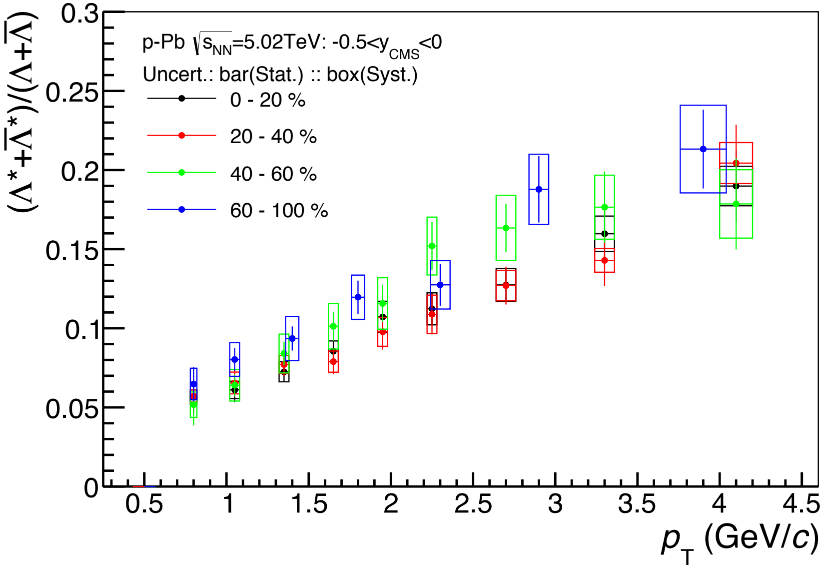
Spectrum

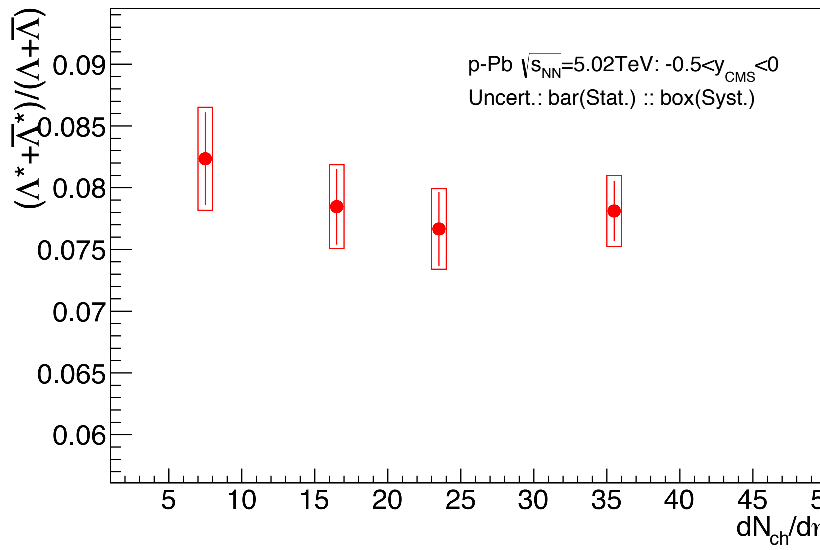


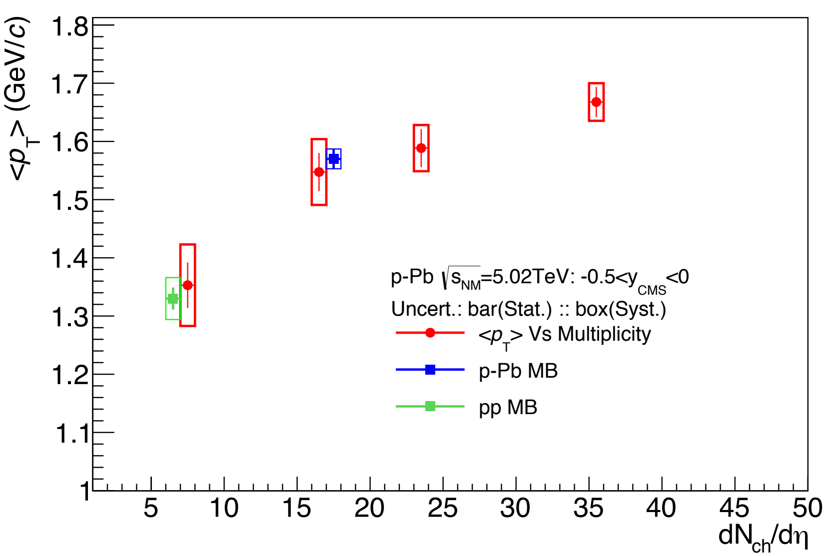


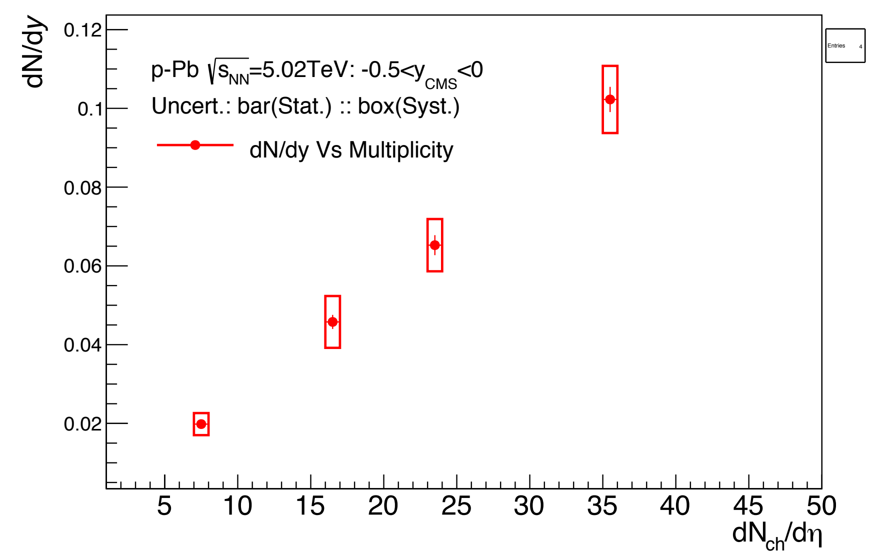
Multiplicity (%)	Events (e+07)
0-20	1.99355
20-40	1.99659
40-60	1.99629
60-100	3.87520
0-100	9.902605

Results









No correlated uncertainty is included in the results

Summary

- We have a good signal of the resonance from p_T 0.7 to 7 GeV/c
- Levy-Tsallis and Boltzmann-Gibbs Blast wave function are successful in describing the p_T spectra.
- Spectra for 4 multiplicity bins are shown.
- Yield (dN/dy) and $\langle p_T \rangle$ are calculated from minimum bias and 4 multiplicity bins, and are compared with the Lambda(1115).
- (dN/dy) and $\langle p_T \rangle$ both increase with charge multiplicity.

Future Plan:

- Doing more study in systematic uncertainties.
- Compare results with other resonances and stable particles

Thank You