Λ^{*} (1520) measurement in p+p collisions at 13 TeV with ALICE detector

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Outline

- Motivation
- Λ* Baryon
- Λ* Analysis
  - ♦ Data Set
  - ♦ Event Information
  - ♦ Track Information
  - ♦ PID plots
- Results
  - ♦ Invariant mass for integrated p_T bin.
  - ♦ Invariant mass for differential p_T bin. - for both like sign subtraction and mixed event subtraction method.
  - ♦ Fitted mass and width as a function of p_T.
- Summary & Future plans

Motivation

- Why pp system??
  - ♦ Study in pp system is important as it serves as a baseline measurement for p+A and A+A collisions.
  - ♦ pp results are used as a tool to test the QCD models/Monte Carlo.
- Why at 13 TeV??
  - ♦ Higher luminosity
  - ♦ Measurement in a new energy regime.
- Why resonance particle??
  - ♦ Short lifetime → Probe to study the in-medium properties.
  - ♦ Different lifetimes of different resonance particles

    → Helps to study the evolution of fire-ball.

Λ* Baryon

- Mass = 1519.5 ± 1.0 MeV.
- Full Width = 15.6 ± 1.0 MeV.
- Lifetime = ~ 13 fm/c.
- Decay Channels = $N\bar{K}$ ~ 45% (Other channels : Σ π (~ 42%), Λππ (~ 10%), Σππ(~0.9%), Λγ (~0.85%))
- Quark Content = uds

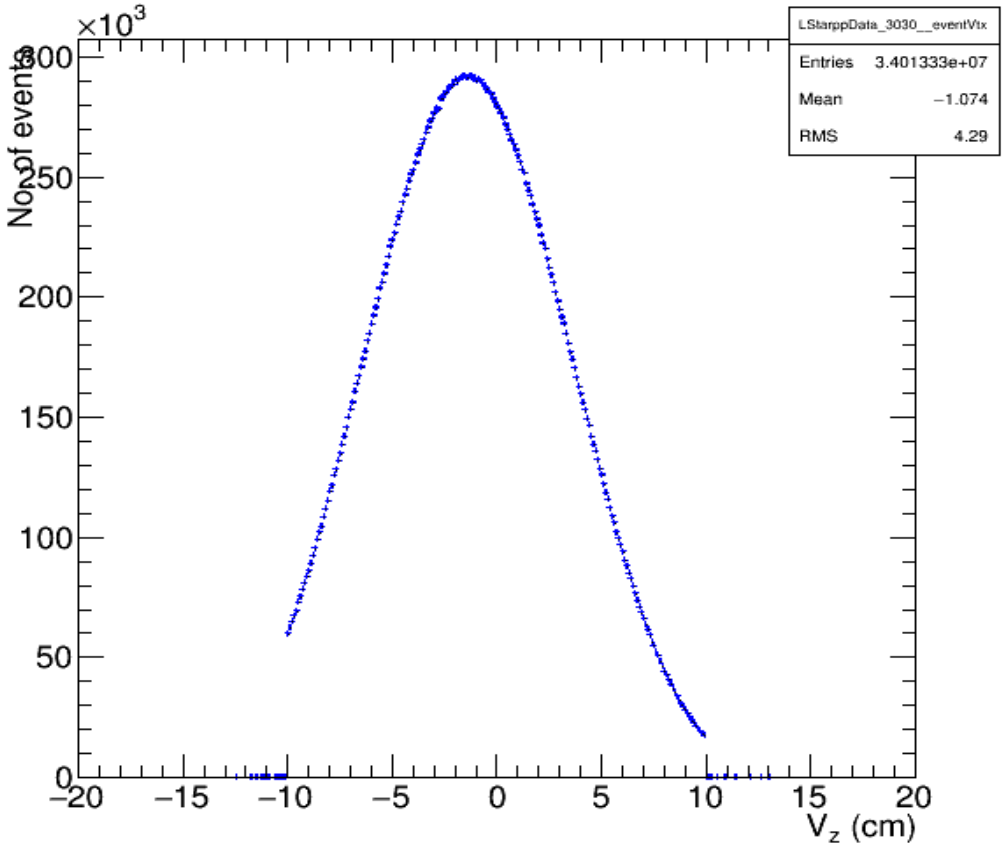
In this study the invariant mass is reconstructed through the decay channel PK (B.R ~ 22.5%)

Λ* Analysis

- Data Set :
  - ♦ pp data at center of mass energy 13 TeV.
  - ♦ Period : LHC15f (pass2, AOD data).
  - ♦ Total No of run : 56, Run no taken from web page https://twiki.cern.ch/twiki/pub/ALICE/PWG2Resonances/Runlist_LHC15f_Good_Runs_151127.txt
  - ♦ Trigger : kMB
  - ♦ No. Of events : 34.01 Million

Λ* Analysis

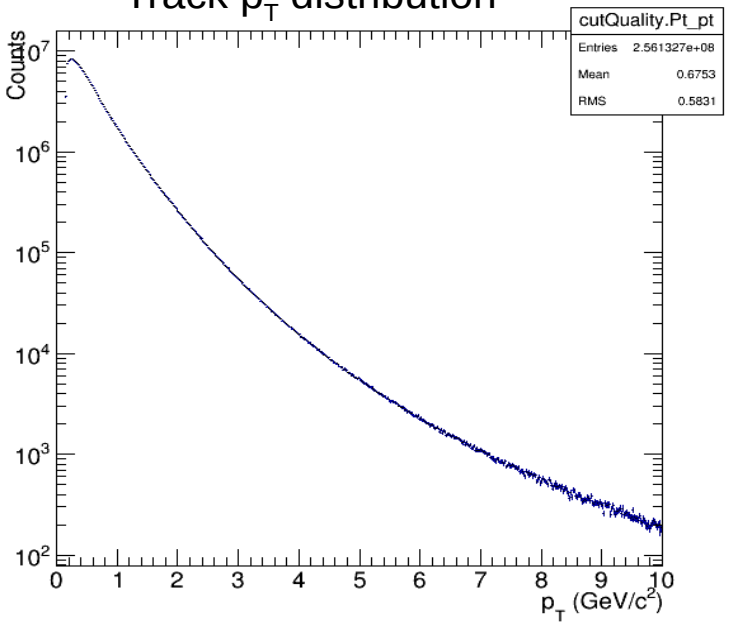
- Event Information :
  - ♦ $|V_z| < 10$ cm



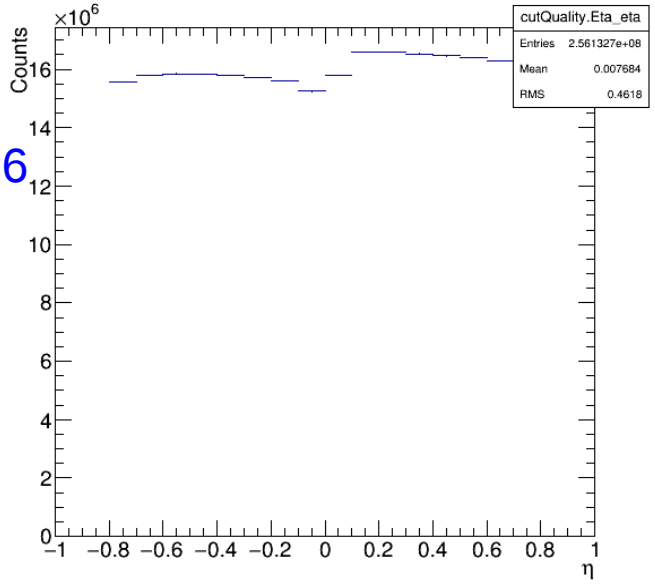
Λ* Analysis

- Track Information :
  - p_T > 0.15 GeV/c
  - |η| < 0.8
  - $|DCA_Z| < 2$ cm
  - $|DCA_{XY}| = 0.0182+0.035/p_T^{1.01}$
  - Min. No. Of crossed rows in TPC = 70
  - Min. No. Of crossed rows over findable Clusters = 0.8
  - Max. TPC χ^2 /cluster = 4,
  - Max. χ^2 Constrained global = 36
  - Max. ITS χ^2/cluster = 36
  - Rejection of kink daughters
  - ITS and TPC refits

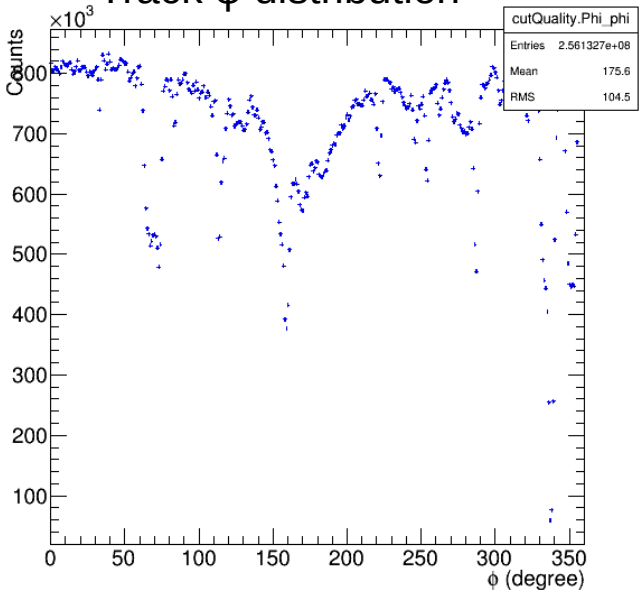
Track p_T distribution



Track η distribution



Track φ distribution



Λ* Analysis

- PID Information :

♦ Track is not in TOF

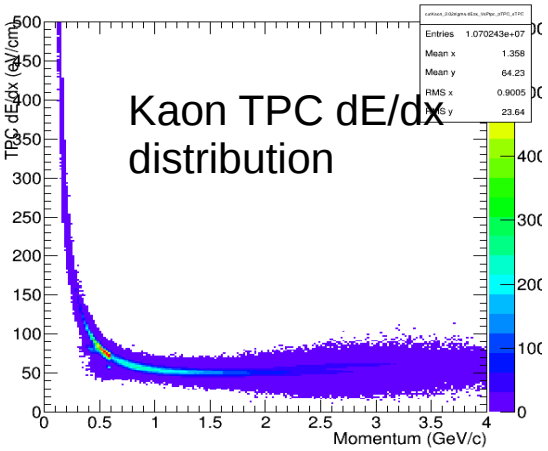
- Proton PID : $0 < p < 1.1$, $(N\sigma)_{TPC} = 2$

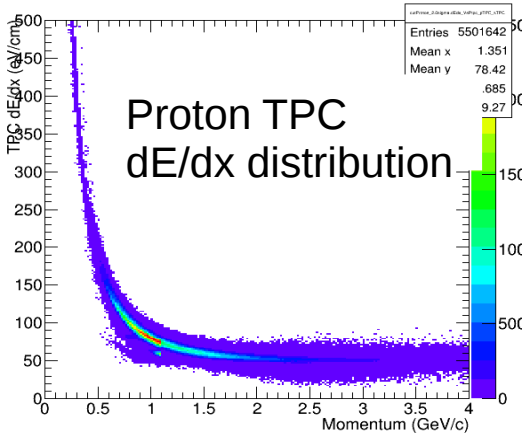
- Kaon PID : $0 < p < 0.6$, $(N\sigma)_{TPC} = 2$

♦ Track is in TOF

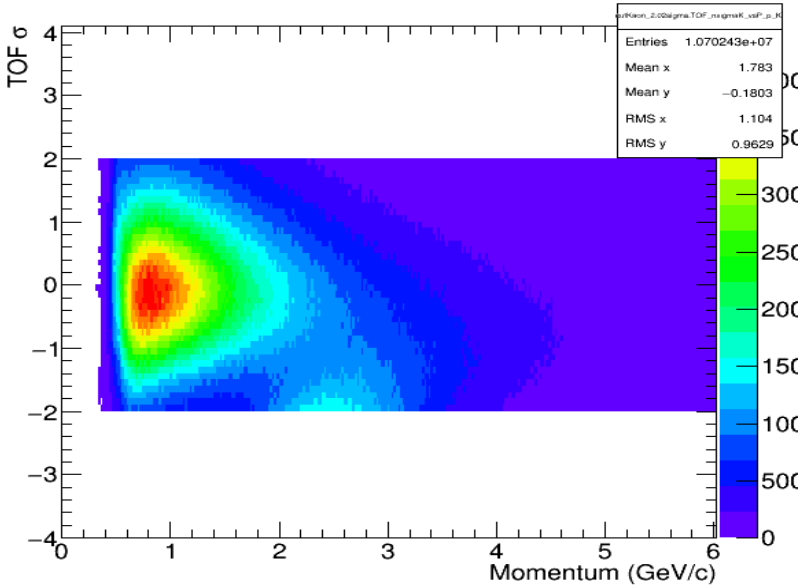
- $(N\sigma)_{TPC} = 5$ && $(N\sigma)_{TOF} = 2$ $(0 < p < 10.0)$

TPC dE/dx distribution

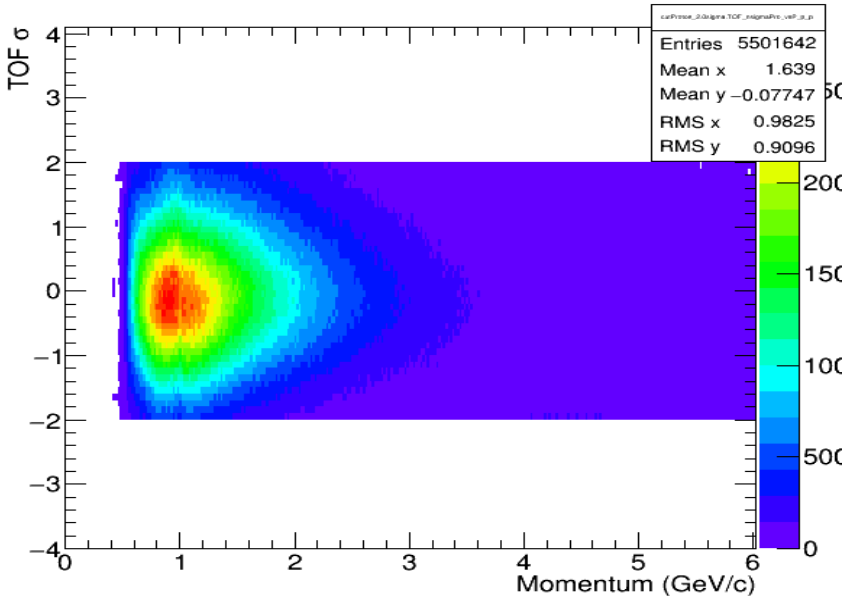




TOF σ distribution for kaon

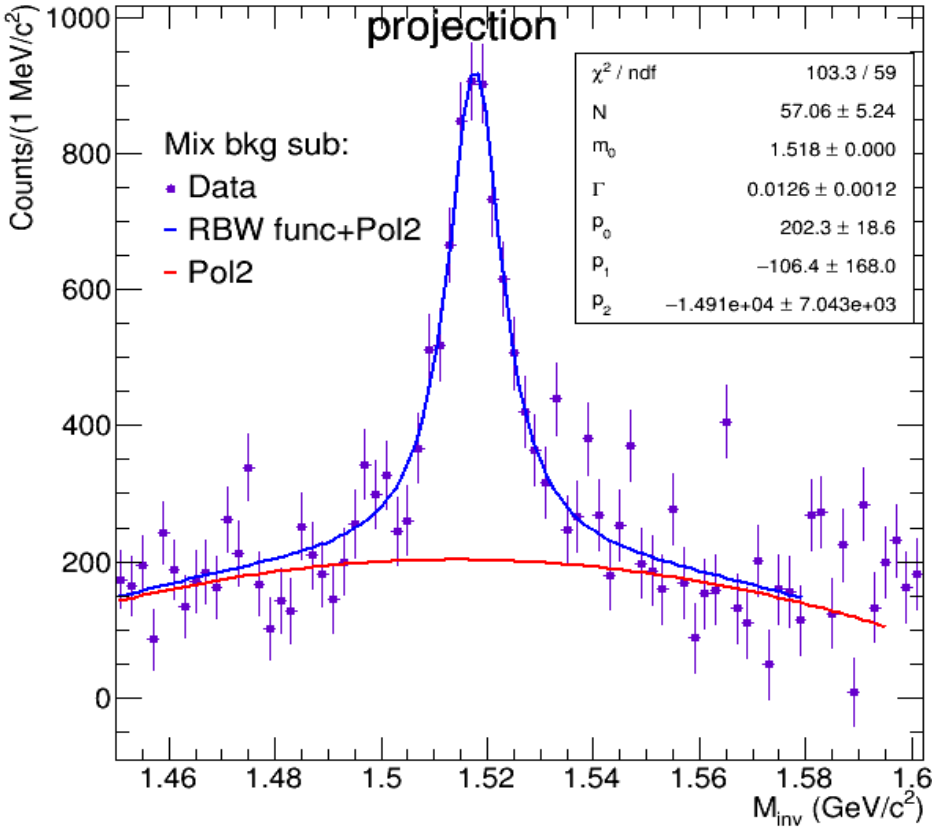


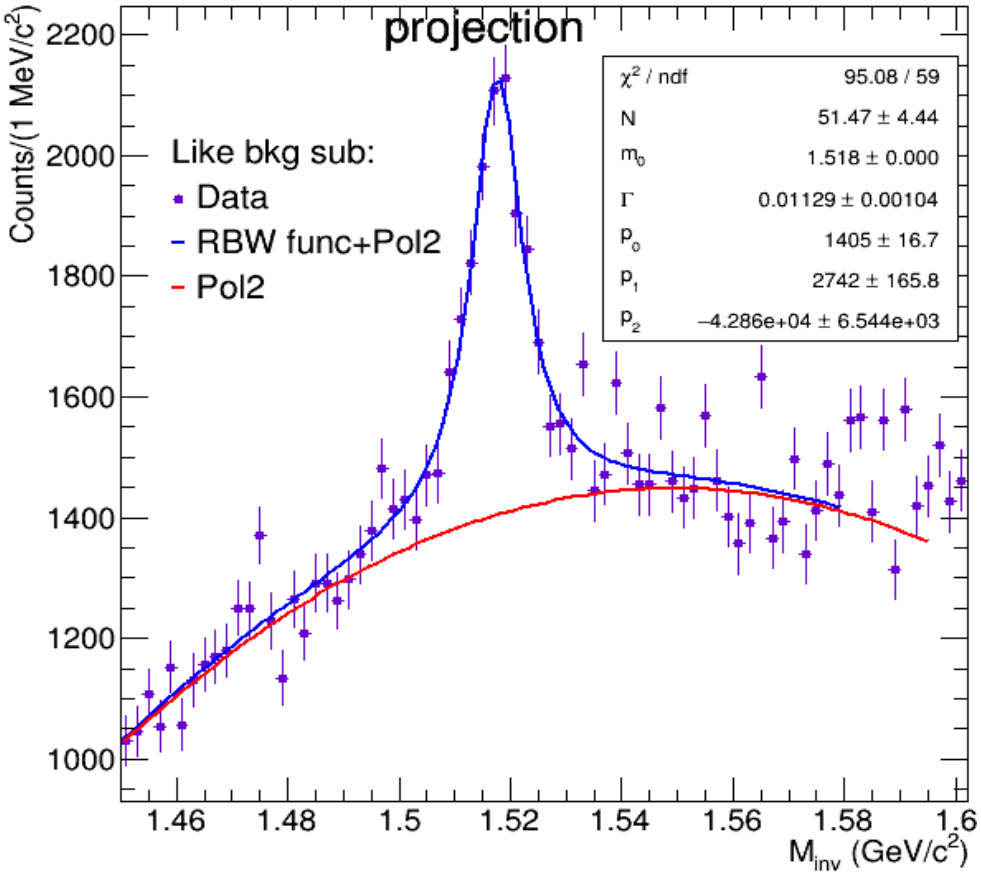
TOF σ distribution for proton



Results

- Invariant mass plots for integrated p_T bin :

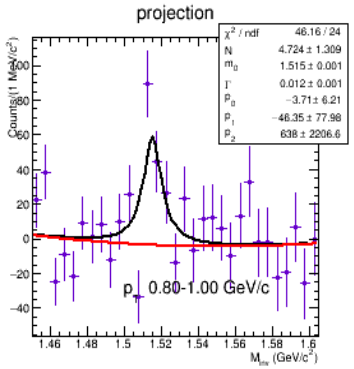


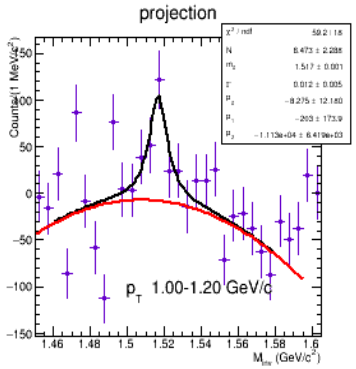


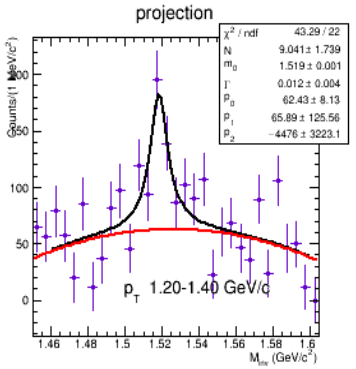
- Event mixing information:
  - No of events mixed = 5
  - Vertex binning = 1.0
  - Multiplicity binning = 10.0

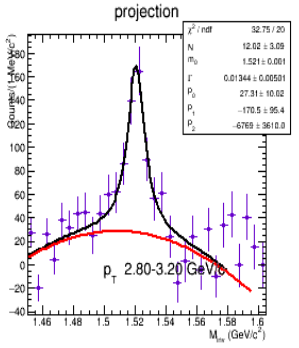
Results

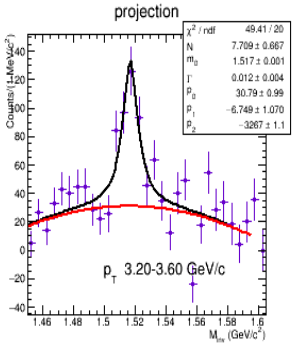
- Invariant mass plots for different p_T bin : (Mixed events background subtraction)

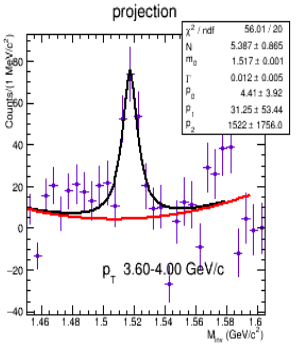


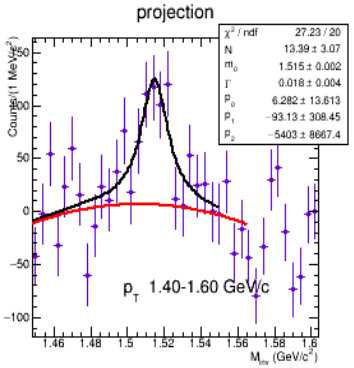


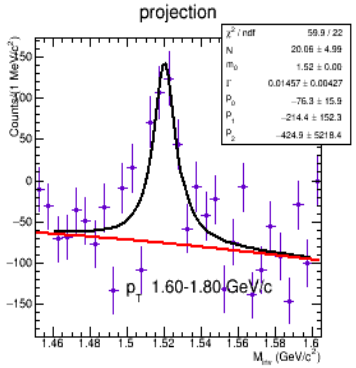


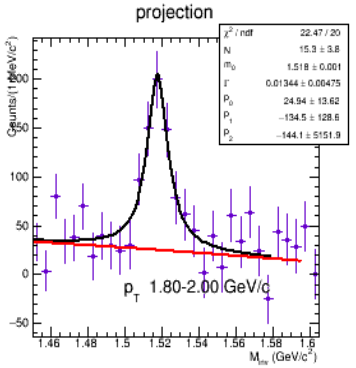


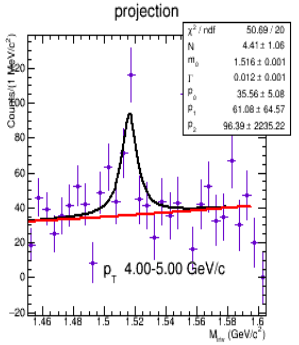


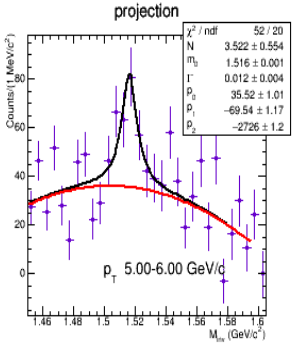


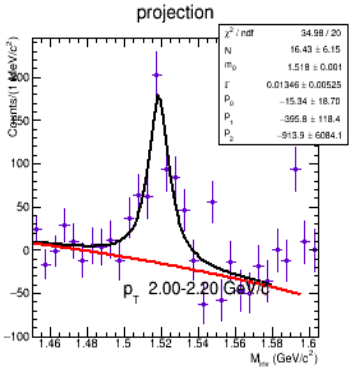


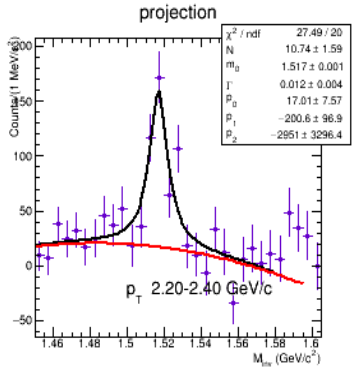


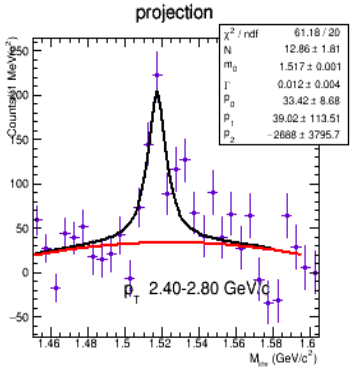






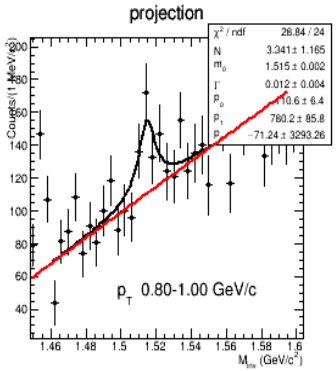


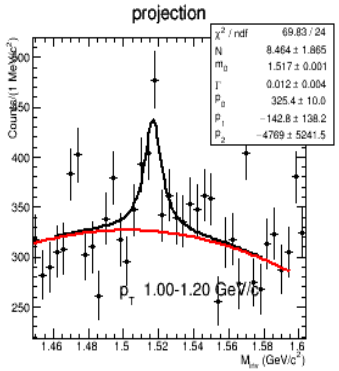


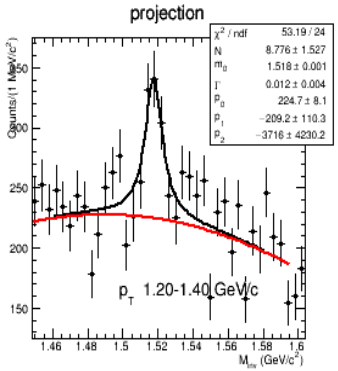


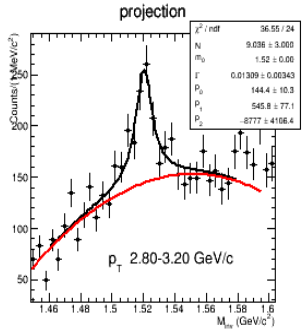
Results

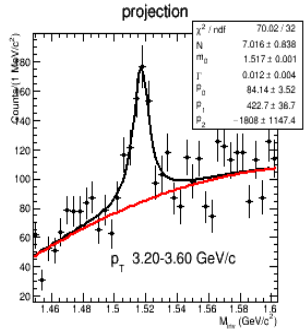
- Invariant mass plots for different p_T bin : (Like sign events background subtraction)

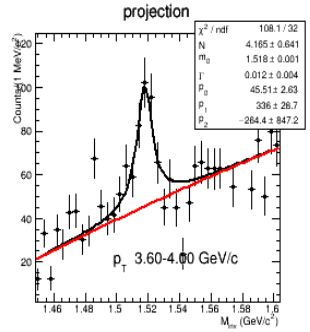


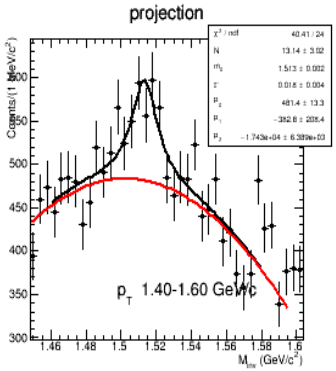


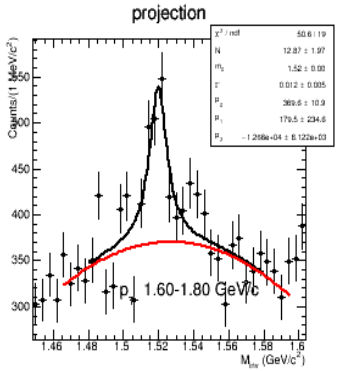


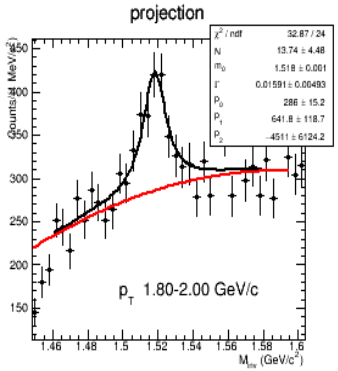


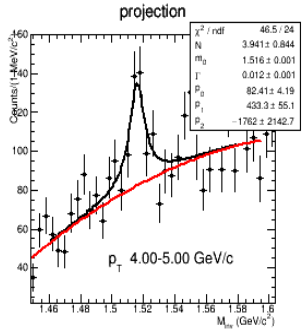


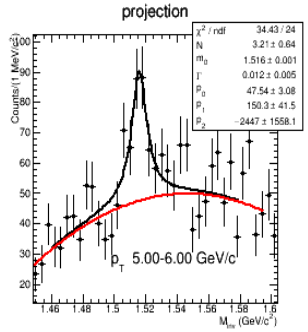


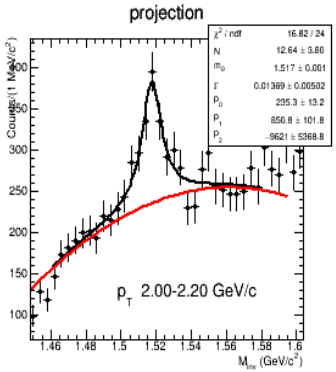


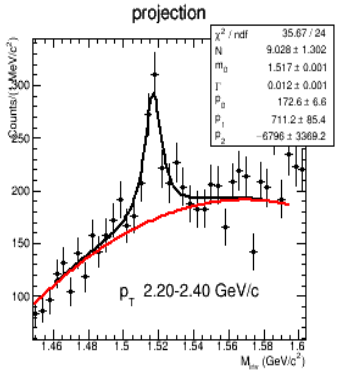


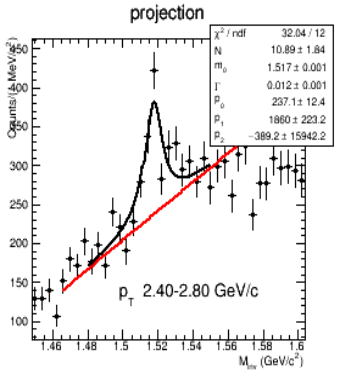






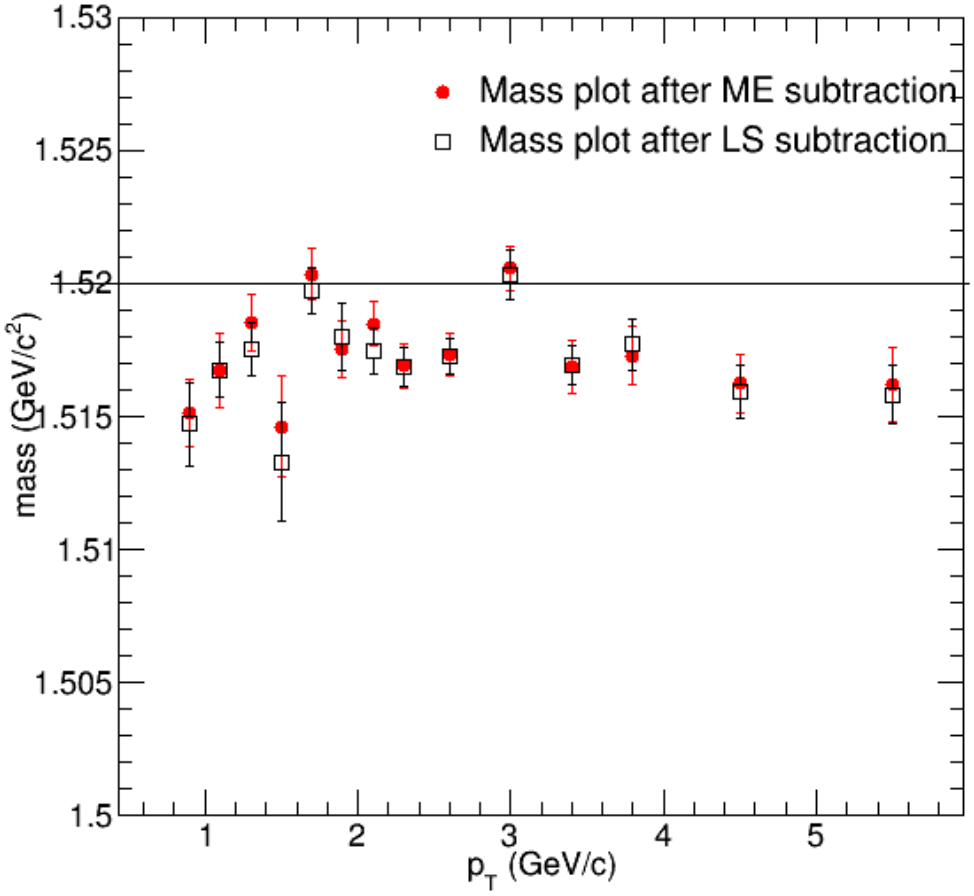


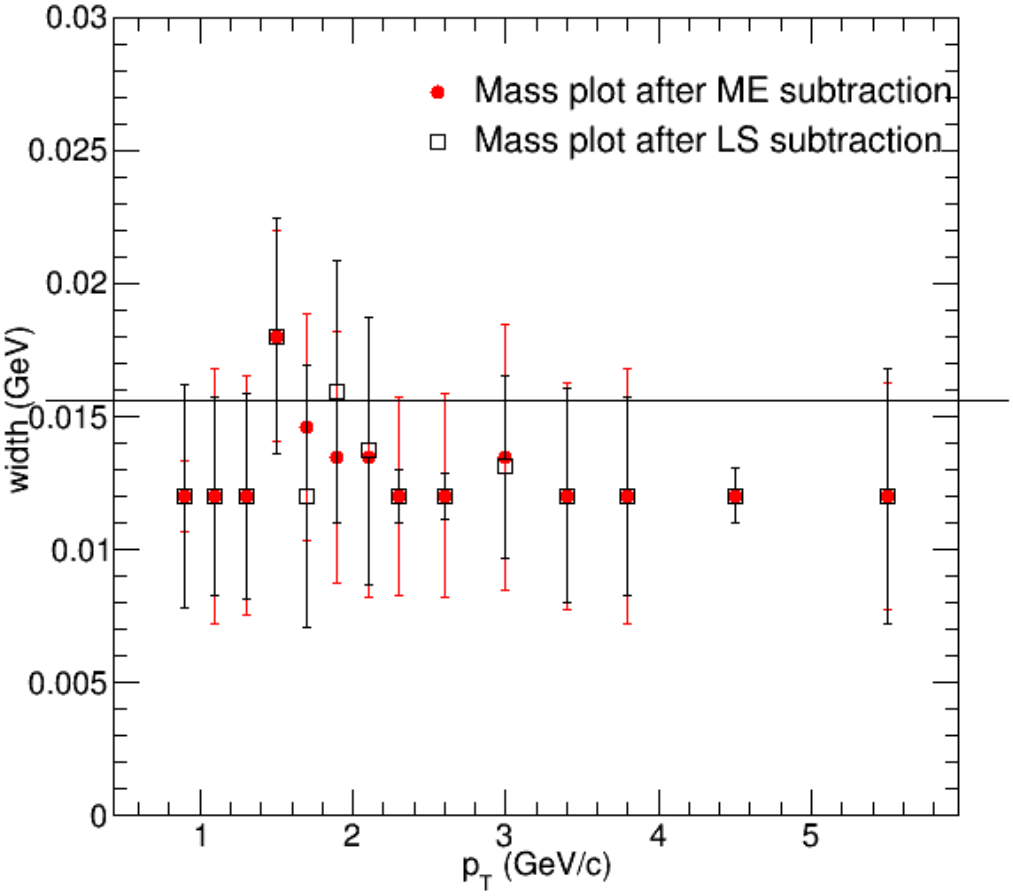




Results

- Fitted mass & width plots for different p_T bin : (M E and like sign events bkg subtraction)





Summary & Future Plans

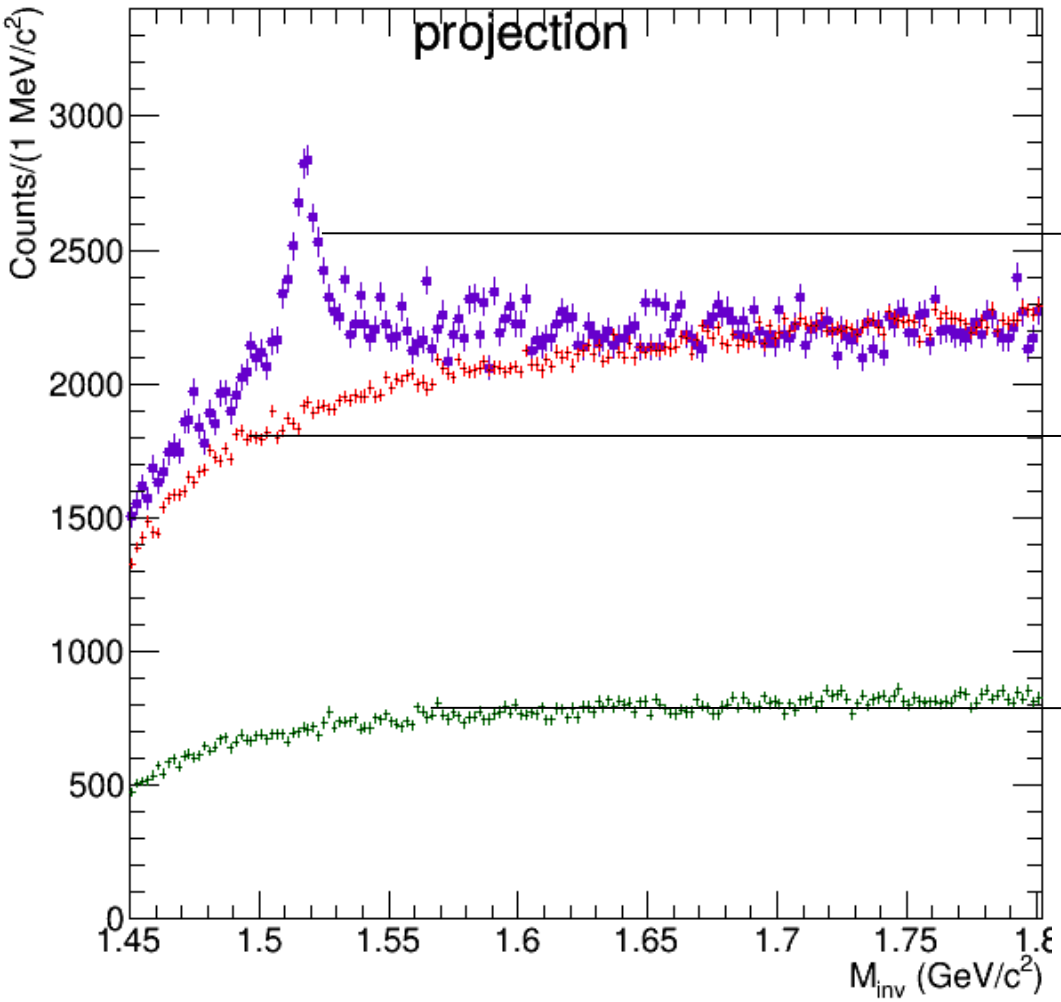
- Summary
  - ♦ This is the first look for Λ* in pp collisions at 13 TeV .
  - ♦ Standard 2010 cuts has been used for this analysis.
  - ♦ The initial results for the invariant mass peaks have been presented with RBW+Pol2 fits.
  - ♦ The fiited mass and width has also been presented.

- Future Plans
  - ♦ Using Voigtian function for mass peak fitting.
  - ♦ Monte Carlo results are yet to be seen.
  - ♦ Spectra will be obtained using MC results.
  - ♦ Systematic studies. (Long way to go)

Back up

$$\mathrm{RBW} = \frac{1}{2\pi} \frac{M_{KP}\, M_{\Lambda^*}\, \Gamma}{(M_{KP}^2 - M_{\Lambda^*}^2) + M_{\Lambda^*}\Gamma^2}$$

Back up

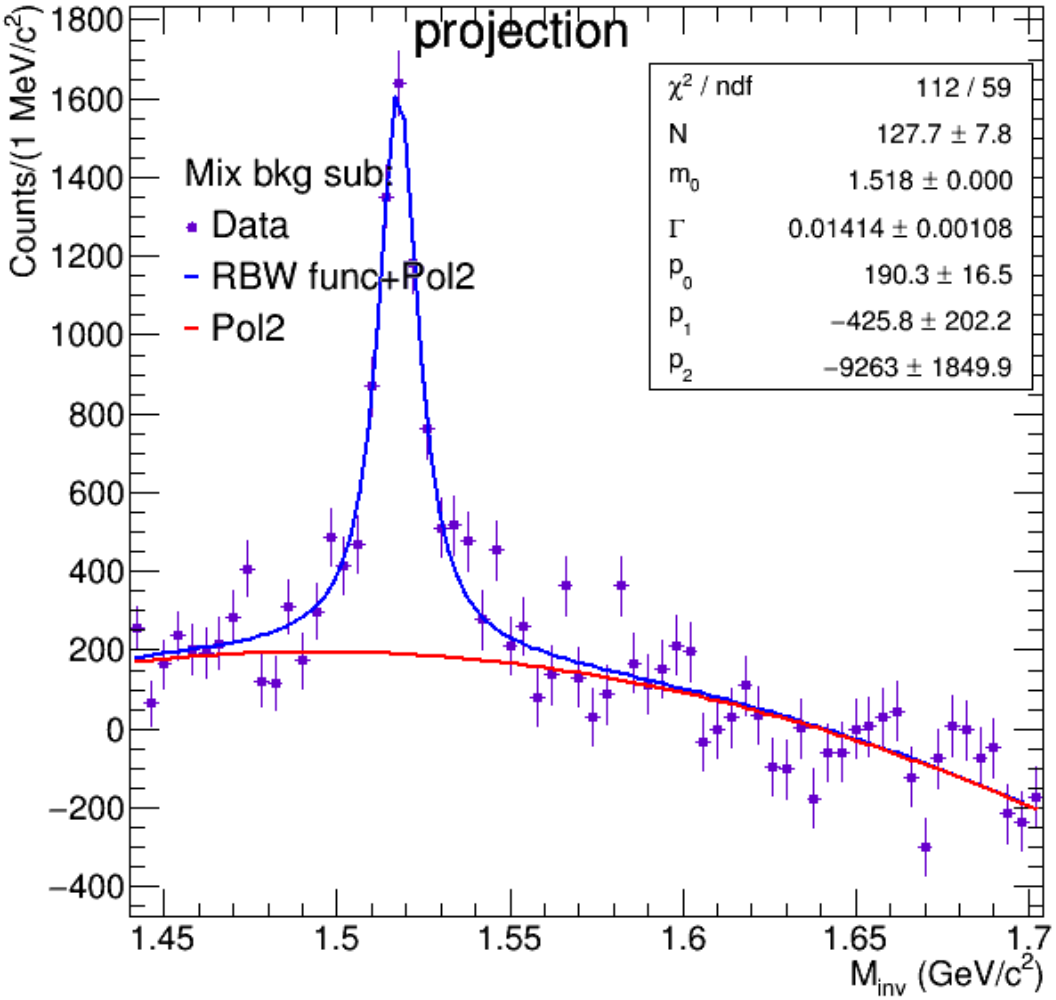


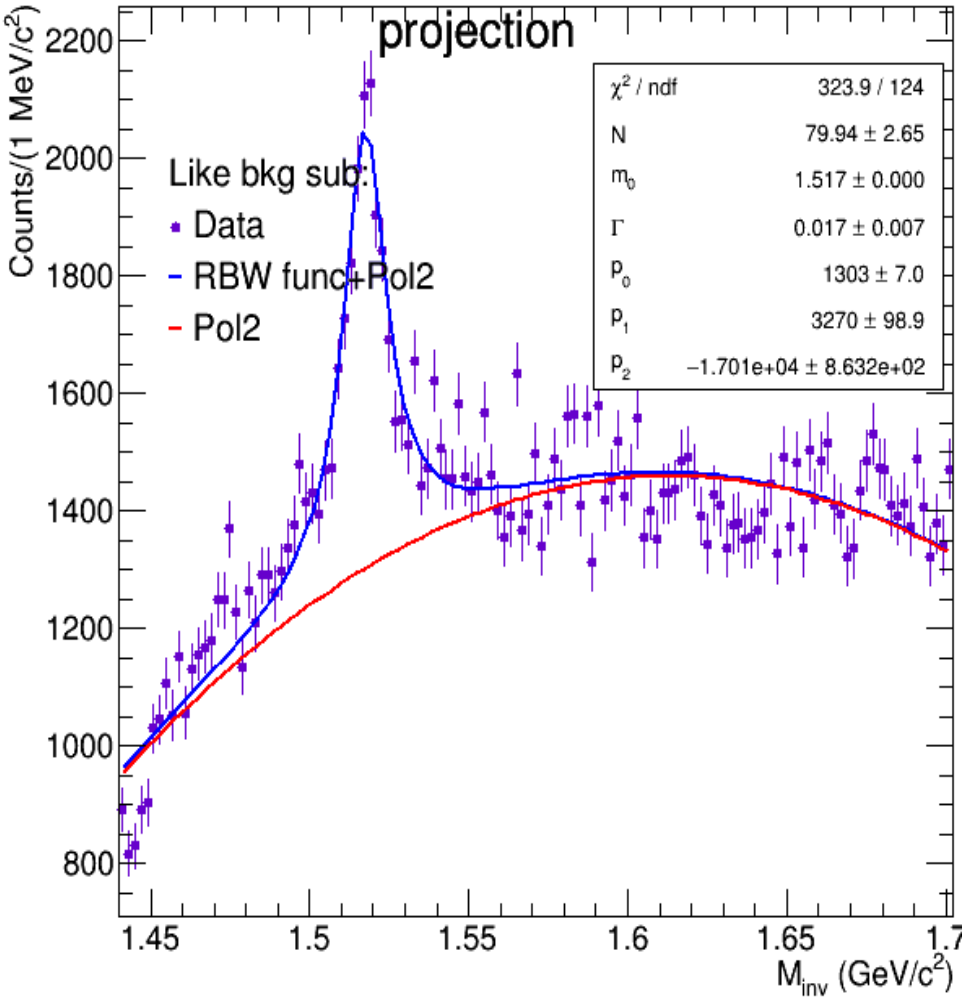
Invariant mass
Data

Background generated by
Mixed event technique

Background generated by
Like sign technique

Back up


projection
Mix bkg sub:
Data
RBW func+Pol2
Pol2
χ² / ndf 112 / 59
N 127.7 ± 7.8
m0 1.518 ± 0.000
Γ 0.01414 ± 0.00108
p0 190.3 ± 16.5
p1 −425.8 ± 202.2
p2 −9263 ± 1849.9
Counts/(1 MeV/c²)
M_inv (GeV/c²)


projection
Like bkg sub:
Data
RBW func+Pol2
Pol2
χ² / ndf 323.9 / 124
N 79.94 ± 2.65
m0 1.517 ± 0.000
Γ 0.017 ± 0.007
p0 1303 ± 7.0
p1 3270 ± 98.9
p2 −1.701e+04 ± 8.632e+02
Counts/(1 MeV/c²)
M_inv (GeV/c²)