

# Sphericity dependent study of $\Lambda(1520)$ production in pp collisions at $\sqrt{s} = 13.6$ TeV in run-3 ALICE

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**ALICE**

# Table of Contents

- 1 Introduction
- 2 Motivation
- 3 Transverse Spherocity
- 4 Quality Assurance
- 5 Analysis Details
- 6 Results
- 7 Backup

# Introduction $\Lambda(1520)$ Resonance

- Invariant mass  $M_{\Lambda(1520)}$  is  $1519.42 \pm 0.19$  MeV
- Decay width  $\Gamma$  of  $\Lambda(1520)$  is  $15.73 \pm 0.26$  MeV
- Mean lifetime of  $\Lambda(1520)$  in its rest frame is 12.6 fm/c
- Some dominant decay modes of  $\Lambda(1520)$  resonance,
  - $\Lambda \rightarrow N\bar{K}$
  - $\Lambda \rightarrow \Sigma\pi$
  - $\Lambda \rightarrow \Lambda\pi\pi$
- Branching Ratio  $\Gamma(N\bar{K})/\Gamma_{Total}$  is 0.45 to 0.47

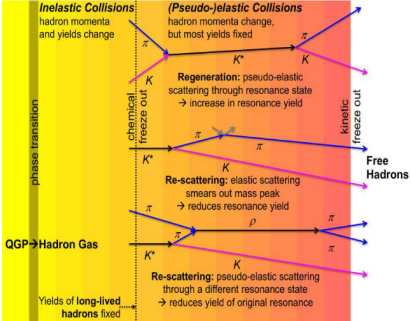
## Analysis Decay Channels

- $\Lambda \rightarrow pK^-$  with branching ratio 0.225.
- $\bar{\Lambda} \rightarrow \bar{p}K^+$  with branching ratio 0.225.

ref: [Particle Data Group](#)

# Motivation

- To study the rescattering and regeneration of hadrons in the hadronic phase.



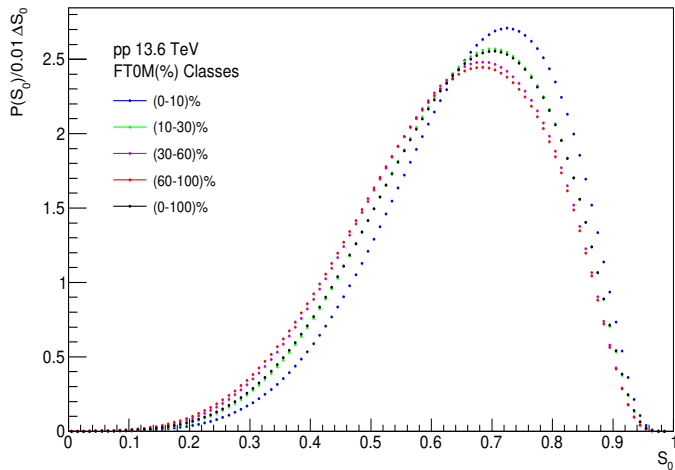
Study the production of  $\Lambda(1520)$  Resonance in Jetty and Isotropic Events.

## Transverse Sphericity Definition

$$S_0 = \frac{\pi^2}{4} \min_{\hat{n}} \left( \frac{\sum_{i=1}^{N_{trks}} |\hat{p}_{T,i} \times \hat{n}|}{N_{trks}} \right)^2$$

- Global tracks are used to compute transverse sphericity with  $N_{trks} \geq 10$
- This is an event shape variable which categorize an event into jetty ( $S_0 \rightarrow 0$ ) and isotropic ( $S_0 \rightarrow 1$ )
- Jetty events would be dominated by hard processes
- Isotropic events would be dominated by soft processes
- [Ref\\_I](#) [Ref\\_II](#)

# Sphericity Distribution



# Event and Track Selection Criterion

## p-p Collisions

$$\sqrt{s} = 13.6 \text{ TeV}$$

## Data Set

LHC22o\_pass4\_minBias\_medium

## Event Selections

- $|V_z| < 10 \text{ cm}$
- sel8() (T0A + T0C)

## Track Selections

- $p_T > 0.15 \text{ GeV}/c$
- $|\eta| < 0.8$
- $|DCA_z| < 1 \text{ cm}$
- $|DCA_{xy}| < 0.1 \text{ cm}$
- GlobalTracks()  
(TPC + ITS)  
ref: [O2Physics](#)
- PVContributor() Tracks

# Particle Identification

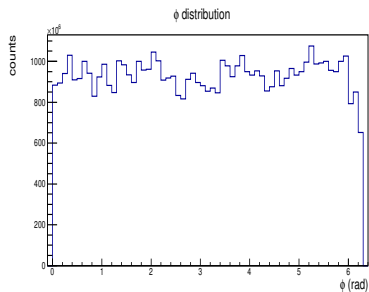
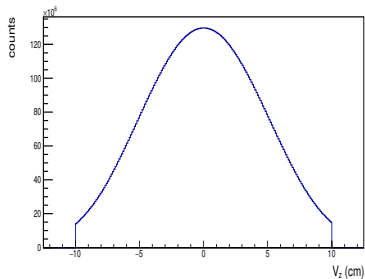
## PID Selection Criterion

- TPC only cuts  $p_T \leq 0.8$  GeV/c for Protons
  - $|n\sigma_{TPC}| < 5 \forall 0.15 \leq p_T(\text{GeV}/c) < 0.5$
  - $|n\sigma_{TPC}| < 3.5 \forall 0.5 \leq p_T(\text{GeV}/c) < 0.7$
  - $|n\sigma_{TPC}| < 2.5 \forall 0.7 \leq p_T(\text{GeV}/c) < 0.8$
- TPC only cuts  $p_T \leq 0.45$  GeV/c for Kaons,
  - $|n\sigma_{TPC}| < 5 \forall 0.15 \leq p_T(\text{GeV}/c) \leq 0.25$
  - $|n\sigma_{TPC}| < 3 \forall 0.25 \leq p_T(\text{GeV}/c) \leq 0.3$
  - $|n\sigma_{TPC}| < 2.5 \forall 0.3 \leq p_T(\text{GeV}/c) \leq 0.45$
- TPC + TOF cuts for  $p_T > 0.8$  GeV/c for Protons and  $p_T > 0.45$  GeV/c for Kaons,
  - $|n\sigma_{TOF}| < 3$  and  $|n\sigma_{TPC}| < 3$
  - Only those TPC tracks are selected which are also present in TOF otherwise they are discarded



# Quality Assurance

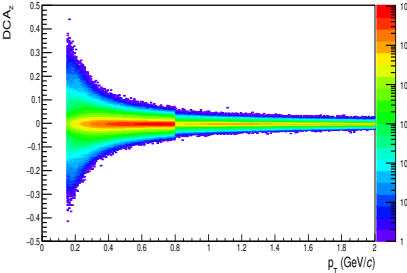
# $V_z$ and $\phi$ -Distribution



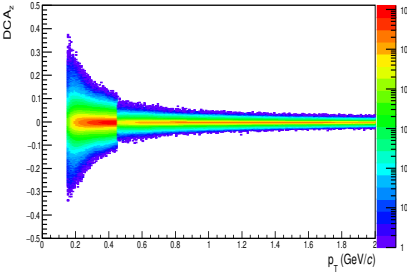
Total number of Events :  $1.522355 \times 10^{10}$

# DCA Selection

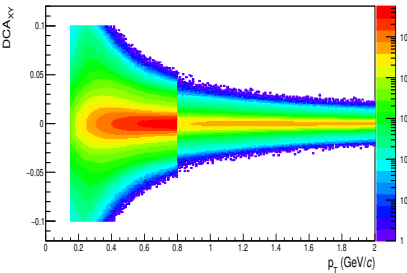
DCA<sub>z</sub> Protons



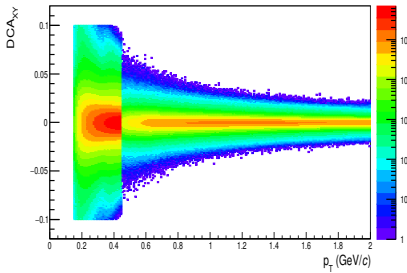
DCA<sub>z</sub> Kaons



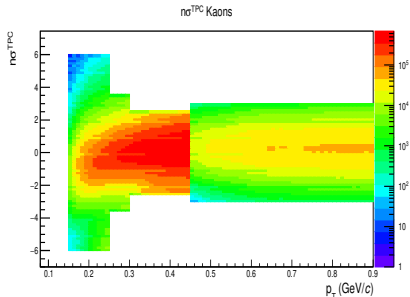
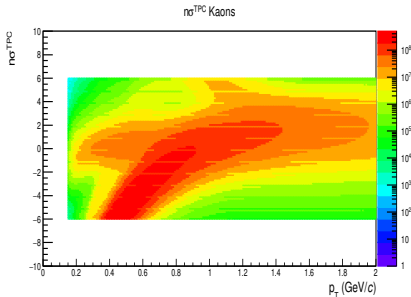
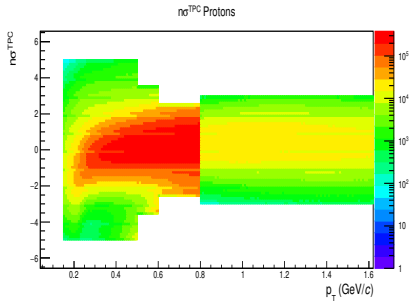
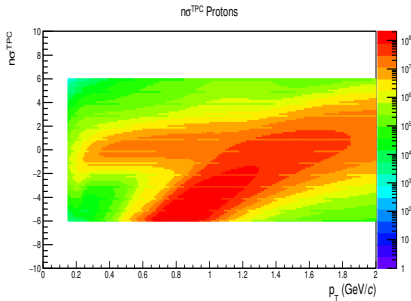
DCA<sub>xy</sub> Protons



DCA<sub>xy</sub> Kaons



# TPC PID Before and After Selection Cuts

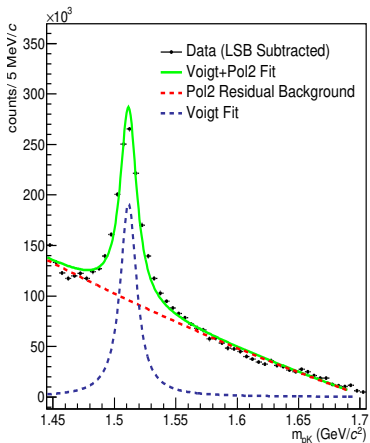
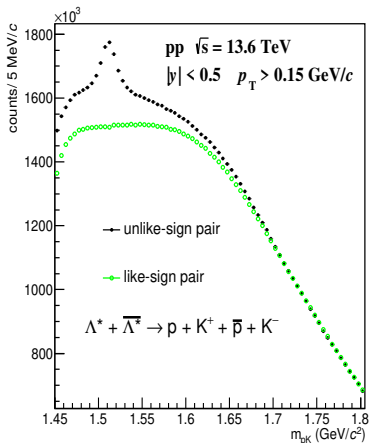


## Analysis Details

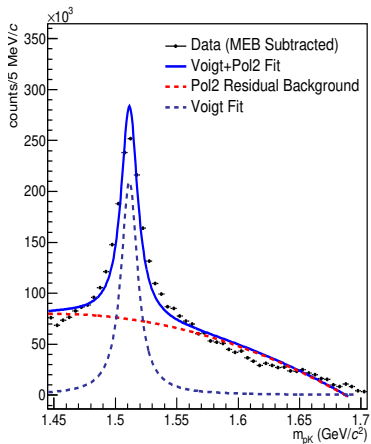
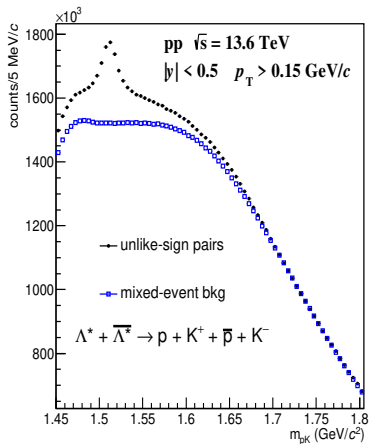
- $p_T$  (GeV/c) bins :  
(0.8 – 1.0), (1.0 – 1.3), (1.3 – 1.6), (1.6 – 2.0), (2.0 – 2.4), (2.4 – 2.9), (2.9 – 3.4), (3.4 – 3.9), (3.9 – 4.7), (4.7 – 6.0)
- Like Sign Background :  $2\sqrt{h_{+,+} \times h_{-,-}}$
- Normalization range for Mixed Event Background :  
1.70 – 1.75 GeV
- Event Mixing:
  - $-10 \leq V_z$  (cm)  $\leq 10$  with  $\Delta V_z = 10$ cm
  - FTOM: (0 – 10), (10 – 20), (20 – 30), (30 – 40), (40 – 50), (50 – 60), (60 – 70), (70 – 80), (80 – 90), (90 – 100)
  - Sphericity bins:  
(0 – 0.25), (0.25 – 0.5), (0.5 – 0.75), (0.75 – 1.0)
  - Number of events mixed : 15

# Results

# Invariant Mass Distributions of $\Lambda(1520)$ Resonance

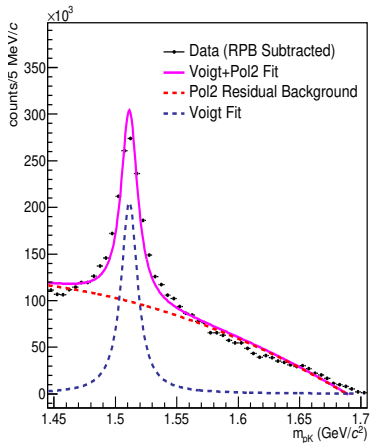
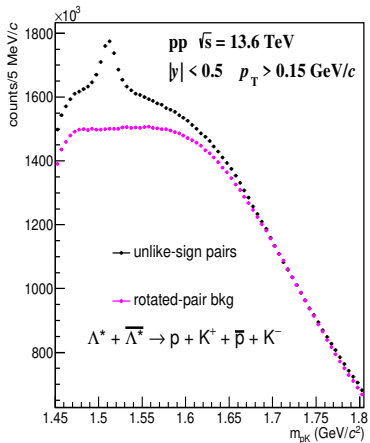


# Invariant Mass Distributions of $\Lambda(1520)$ Resonance

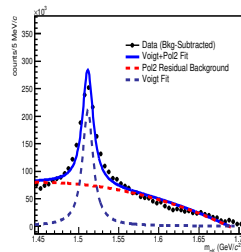
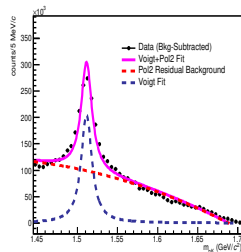
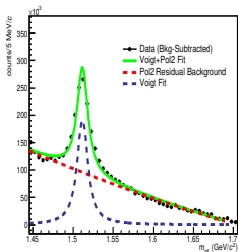
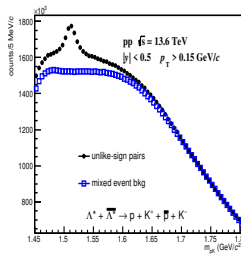
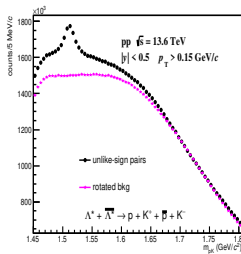
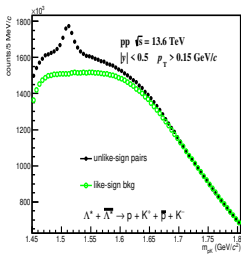




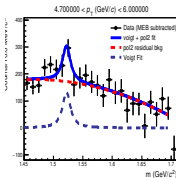
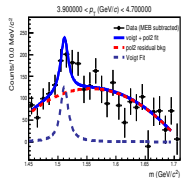
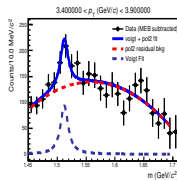
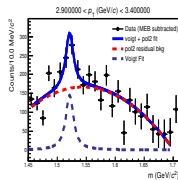
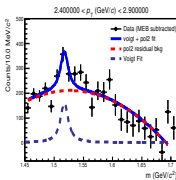
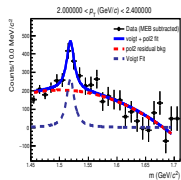
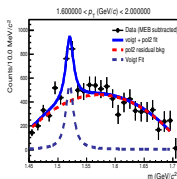
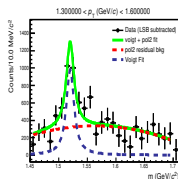
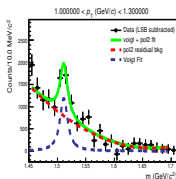
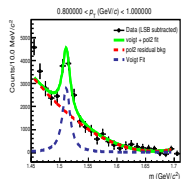
# Invariant Mass Distributions of $\Lambda(1520)$ Resonance



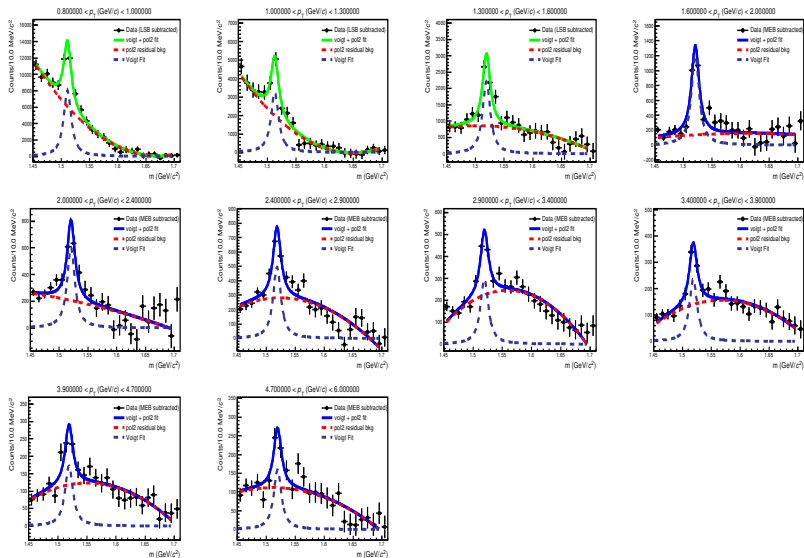
# Invariant Mass Distributions of $\Lambda(1520)$ Resonance



# 0 – 10% FTOM 20% Jetty



# 0 – 10% FTOM 20% Isotropic



## Future Work

- We will calculate raw yield and efficiency  $\times$  acceptance next.

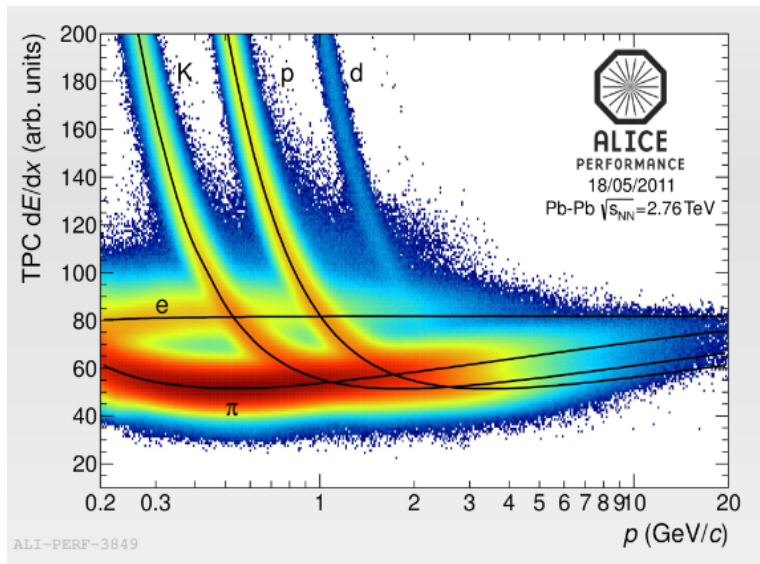
Thank you

# Backup

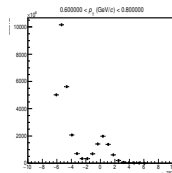
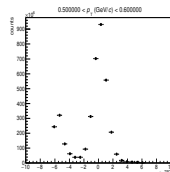
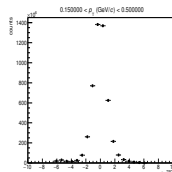
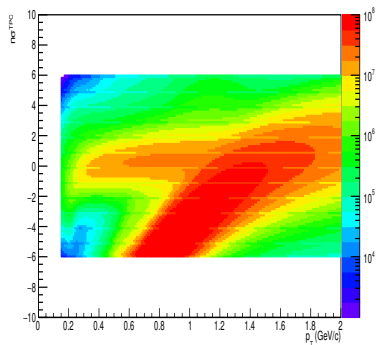
# Particle Identification



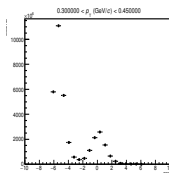
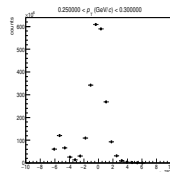
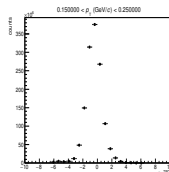
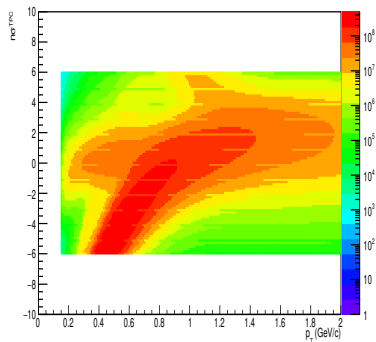
# TPC Signal



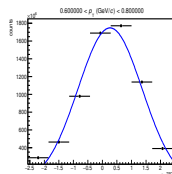
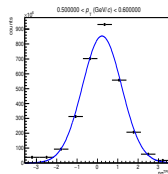
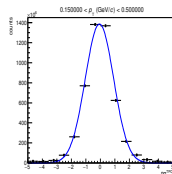
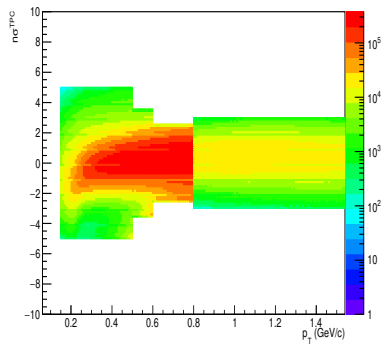
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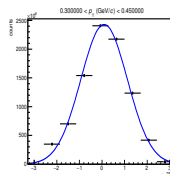
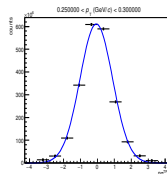
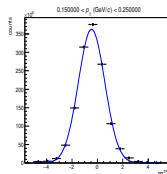
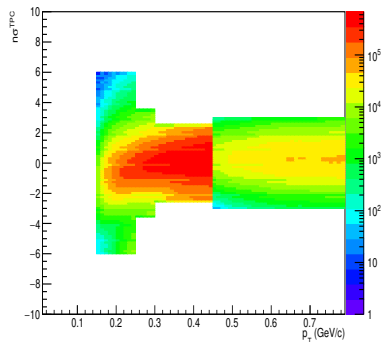
# PID TPC Kaons



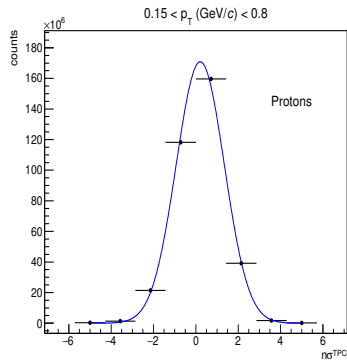
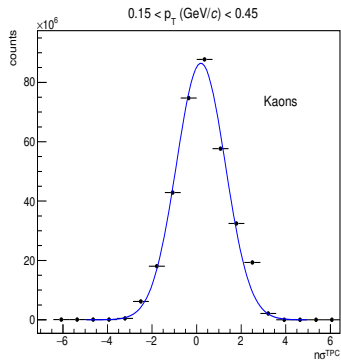
# PID TPC Protons



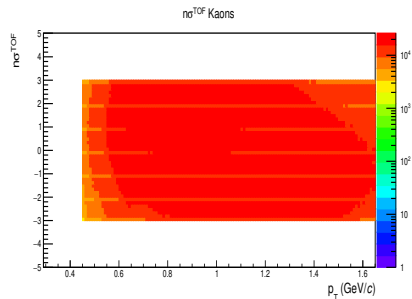
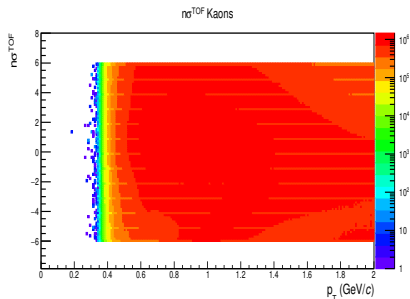
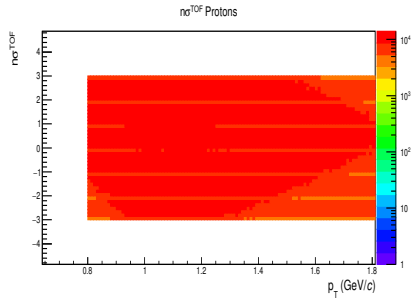
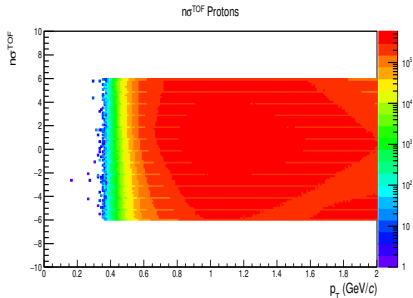
# PID TPC Kaons



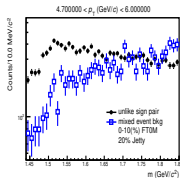
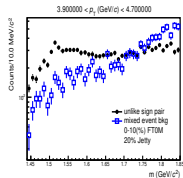
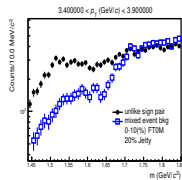
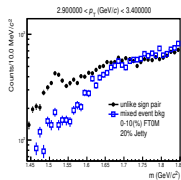
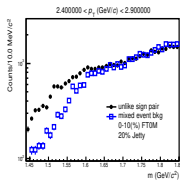
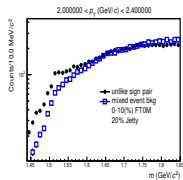
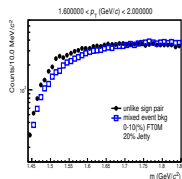
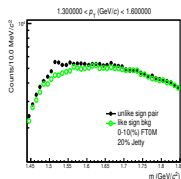
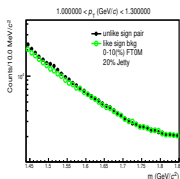
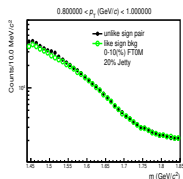
# PID TPC Protons and Kaons



# TOF PID Before and After Selection Cuts

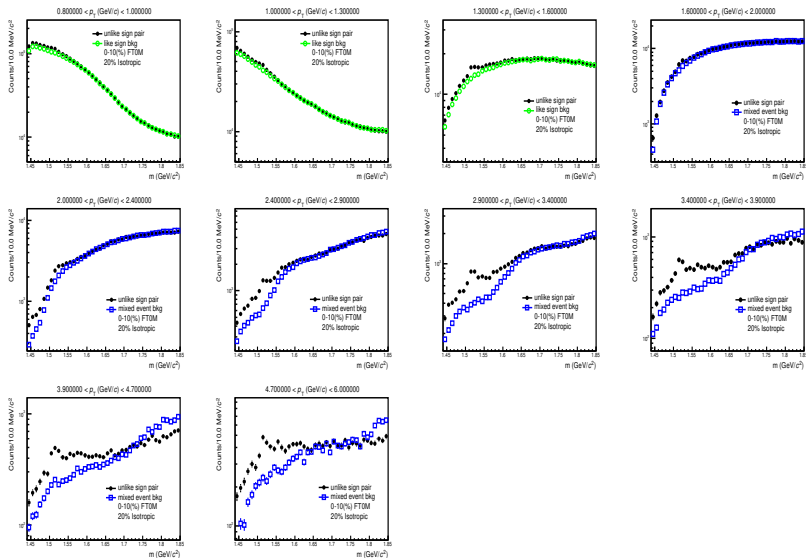


# 0 – 10% FTOM 20% Jetty



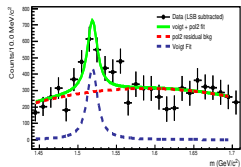
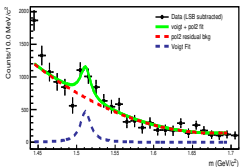
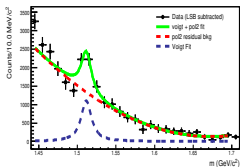
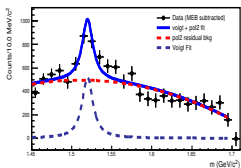
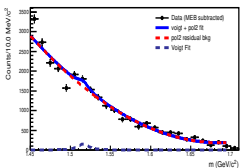
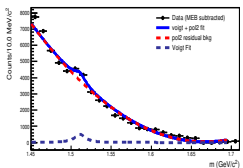
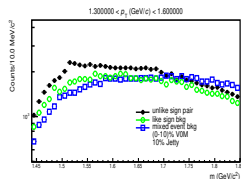
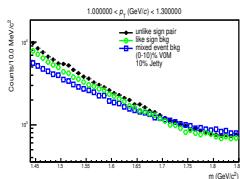
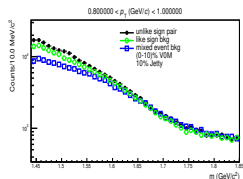


# 0 – 10% FTOM 20% Isotropic

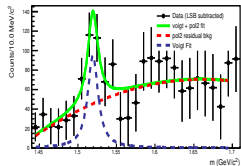
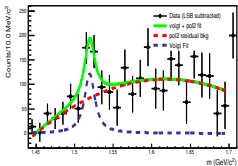
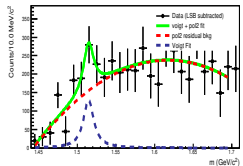
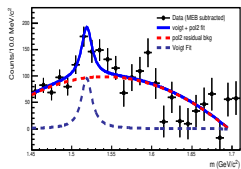
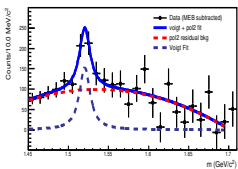
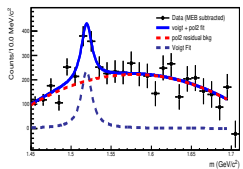
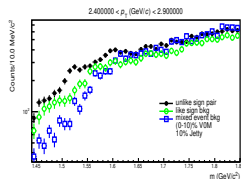
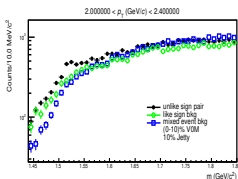
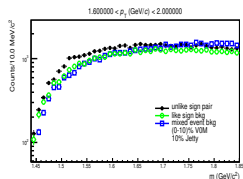


# Mixed Event and Like Sign Comparision

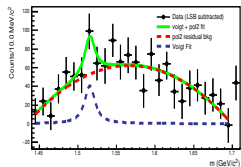
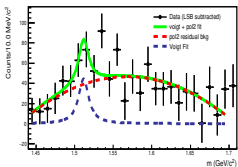
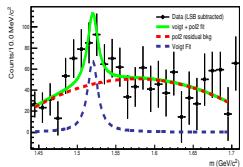
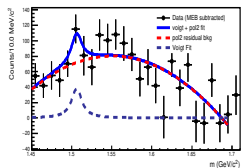
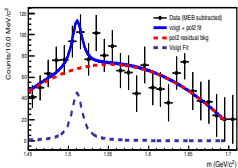
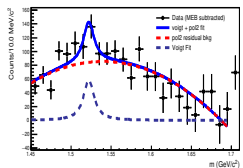
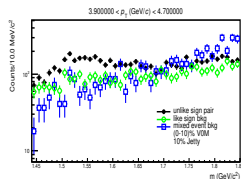
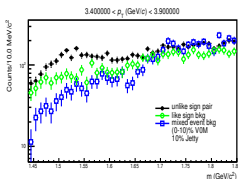
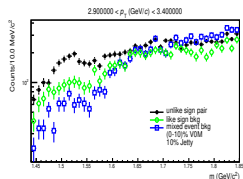
# 0 – 10% FTOM 20% Jetty



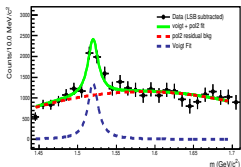
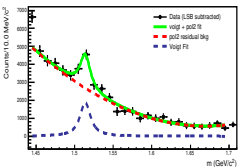
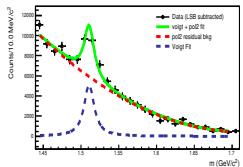
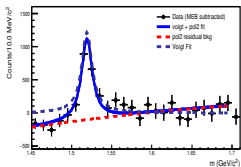
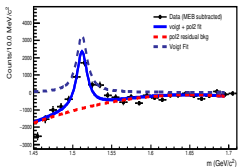
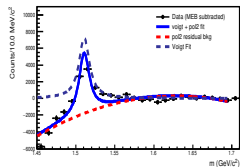
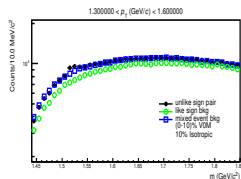
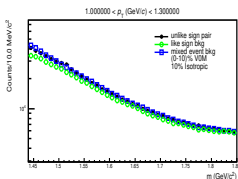
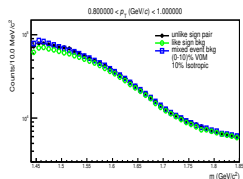
# 0 – 10% FTOM 20% Jetty



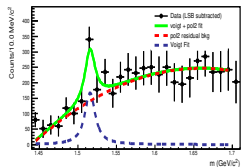
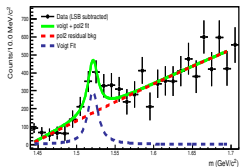
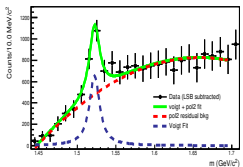
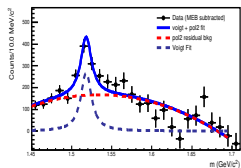
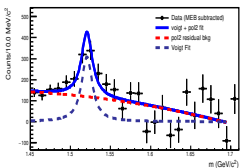
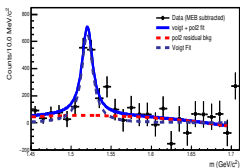
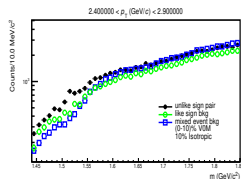
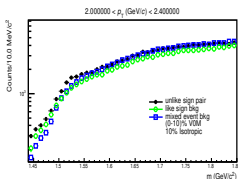
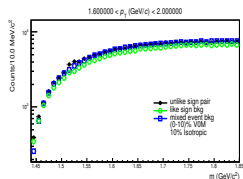
# 0 – 10% FTOM 20% Jetty



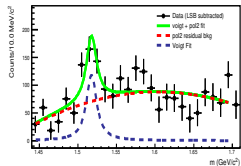
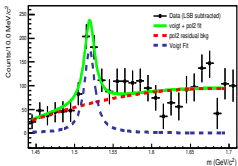
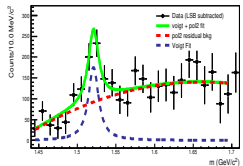
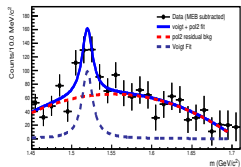
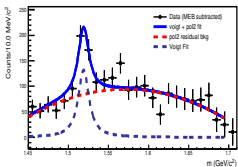
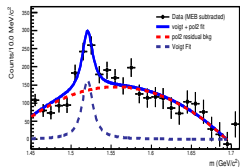
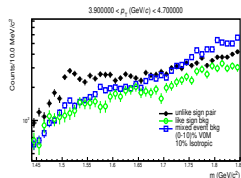
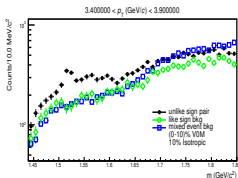
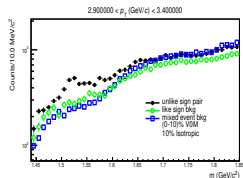
# 0 – 10% FTOM 20% Isotropic



# 0 – 10% FTOM 20% Isotropic



# 0 – 10% FTOM 20% Isotropic





## Sphericity ranges for Jetty and Isotropic in different FTOM(%) Classes

- Jetty:
  - 0 – 100(%) : 0 – 0.439508
  - 0 – 10(%) : 0 – 0.470458
  - 10 – 30(%) : 0 – 0.442540
  - 30 – 60(%) : 0 – 0.422611
  - 60 – 100(%) : 0 – 0.415308
- Isotropic:
  - 0 – 100(%) : 0.829869 – 0.9999
  - 0 – 10(%) : 0.842566 – 0.9999
  - 10 – 30(%) : 0.829640 – 0.9999
  - 30 – 60(%) : 0.820642 – 0.9999
  - 60 – 100(%) : 0.819370 – 0.9999