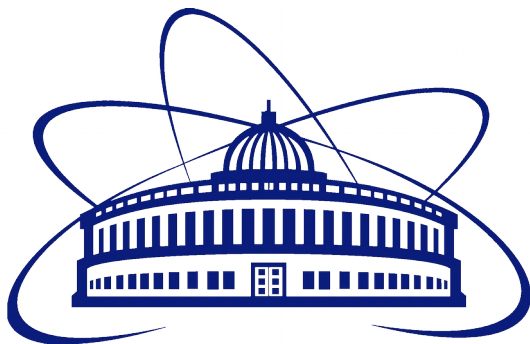


# Progress on the study of global polarization

Elizaveta Nazarova<sup>1</sup>

## **MPD Polarization Meeting «Vorticity and Polarization in Heavy-Ion Collisions»**

13.04.2021



<sup>1</sup> Joint Institute of Nuclear Research, Dubna, Russia





- Data: MC simulation using PHSD generator<sup>1</sup>
  - Au-Au,  $\sqrt{s_{NN}} = 7.7$  GeV,  $\sim 1.5$ M MB events
  - Global  $\Lambda(\bar{\Lambda})$  polarization
    - Thermodynamical (Becattini) approach<sup>2</sup>
- Track selection criteria for reconstruction:
  - Number of TPC hits:  $N_{\text{hits}} > 10$
  - $|\eta| < 1.3$

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<sup>1</sup>W. Cassing, E. Bratkovskaya, PRC 78 (2008) 034919; NPA831 (2009) 215; W. Cassing, EPJ ST 168 (2009) 3

<sup>2</sup>F. Becattini, V. Chandra, L. Del Zanna, E. Grossi, Ann. Phys. 338 (2013) 32



- MC-Glauber based centrality framework from MEPHI group
  - Code and documentation: <https://github.com/FlowNICA/CentralityFramework>
- Direct impact parameter reconstruction ( $\Gamma$ -fit)
  - Code and documentation: <https://github.com/Dim23/GammaFit>
  
- MC-Glauber (MC-Gl) framework
  - Obtain charged particle multiplicity
  - Comparison with MC Glauber simulation

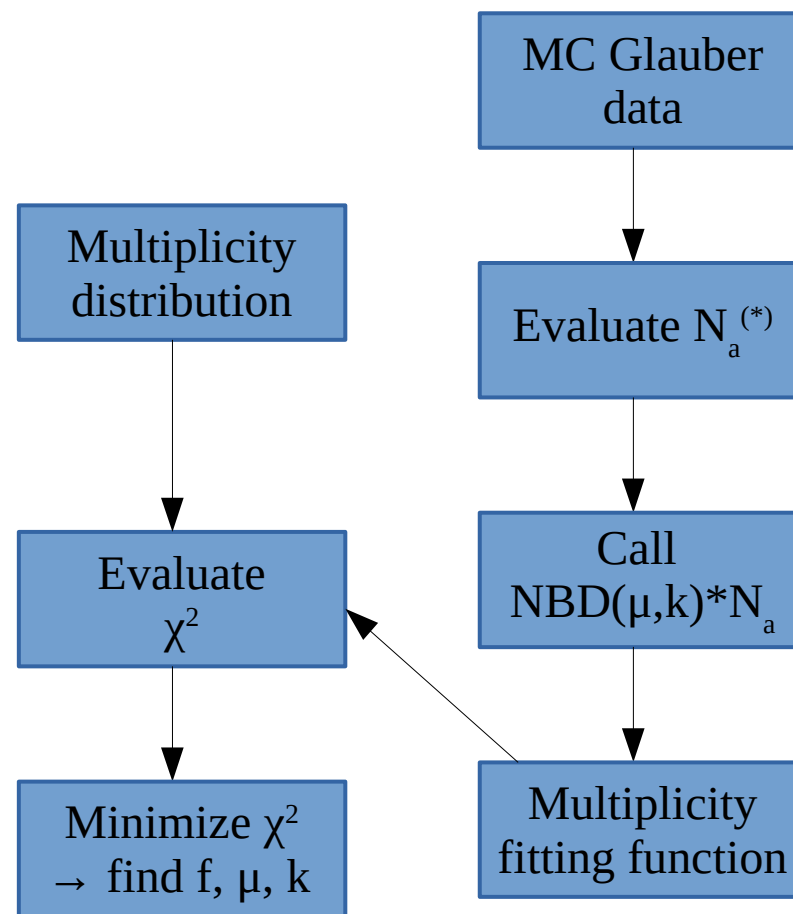
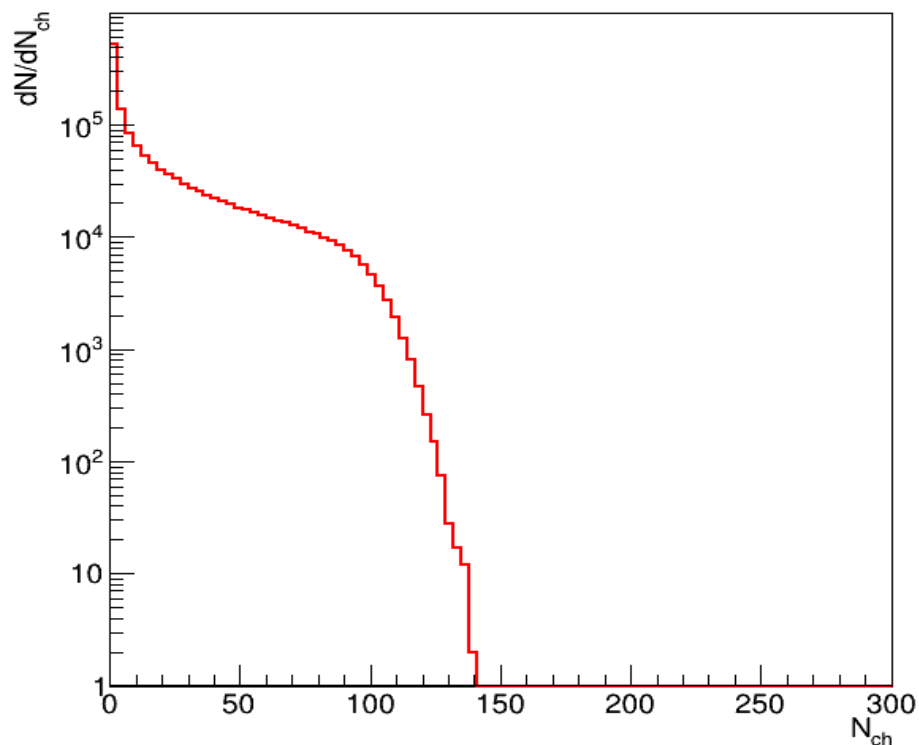
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MPD Physics Forum: 15.04. 10:00 (Moscow time)

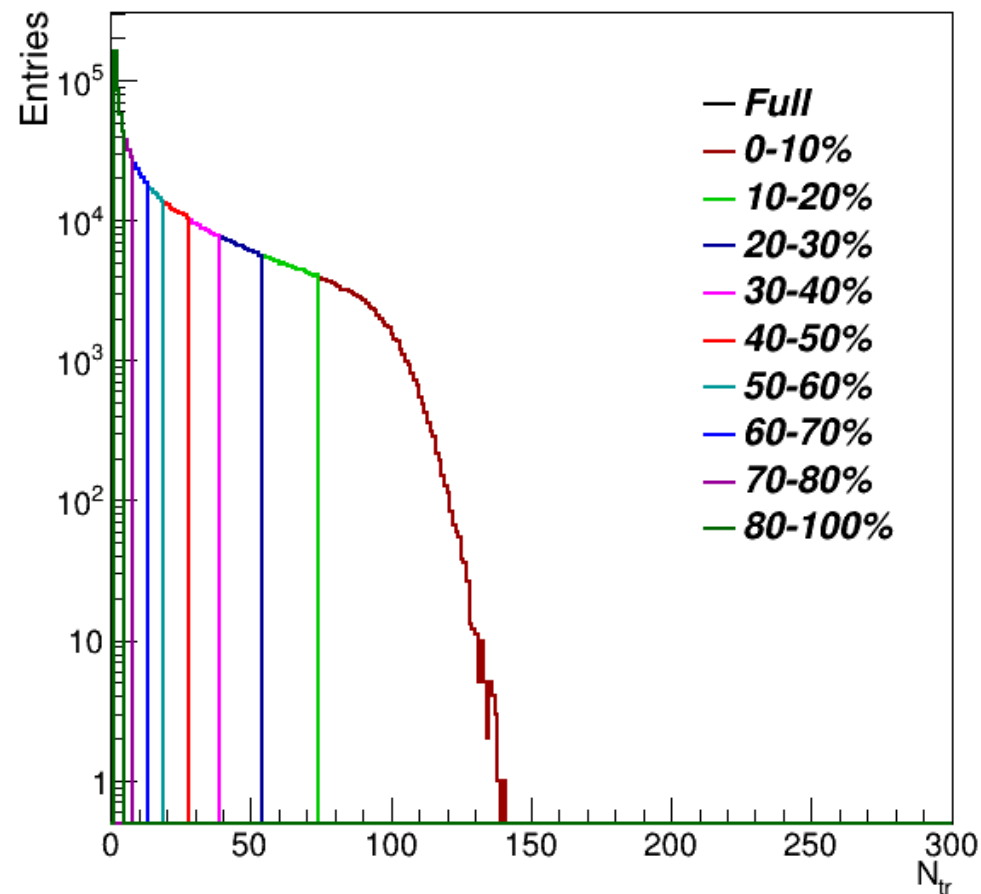
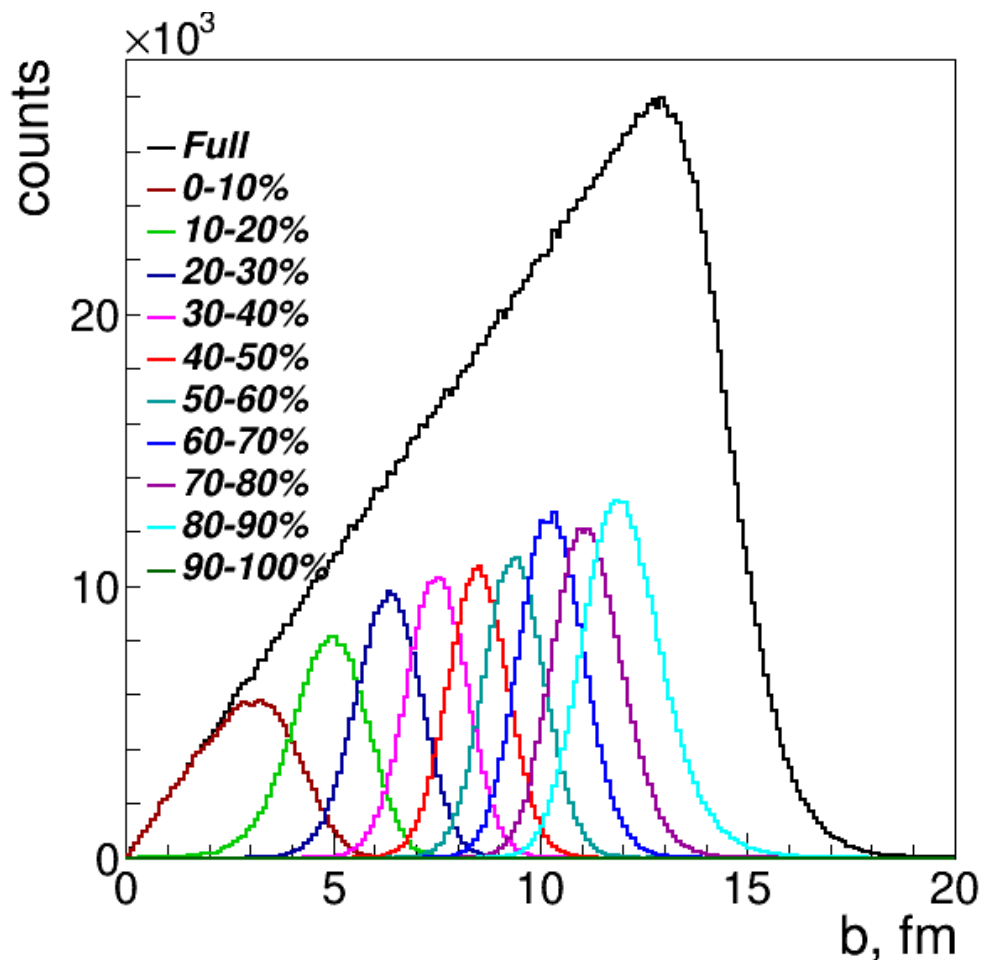
- MC-Glauber based centrality framework from MEPHI group
  - Comparison of multiplicity distribution with MC Glauber simulation

- Multiplicity in TPC:

- $|\eta| < 1.5$
- $0 < p_T < 3$
- $N_{\text{hits}} > 16$

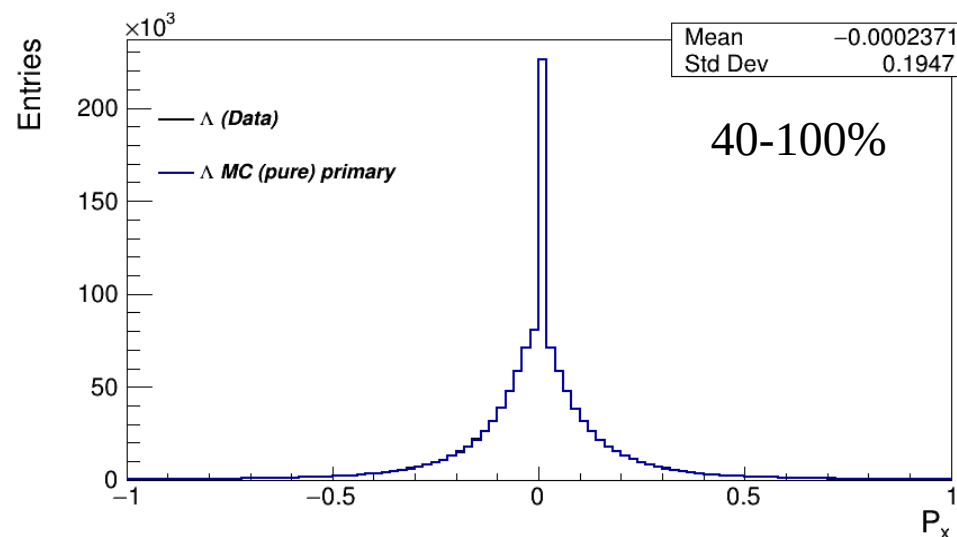
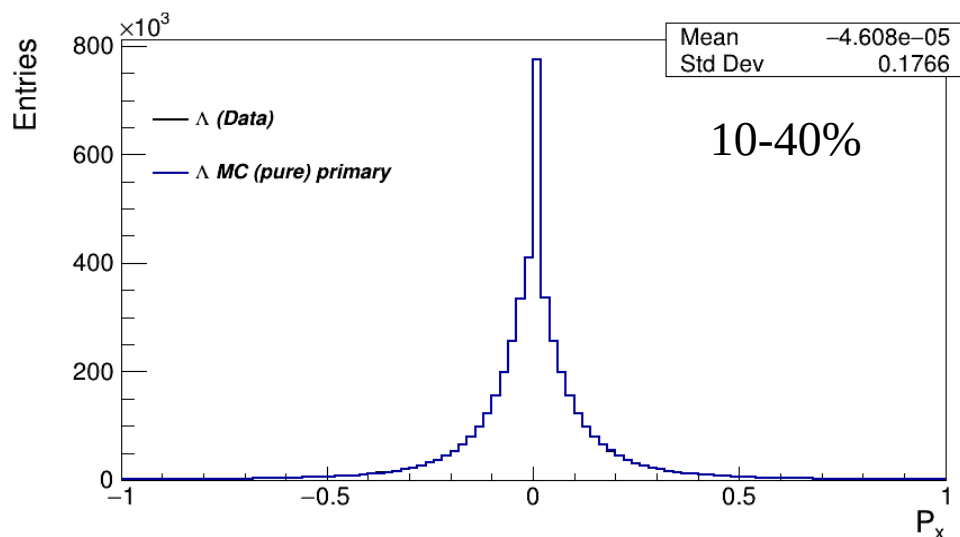
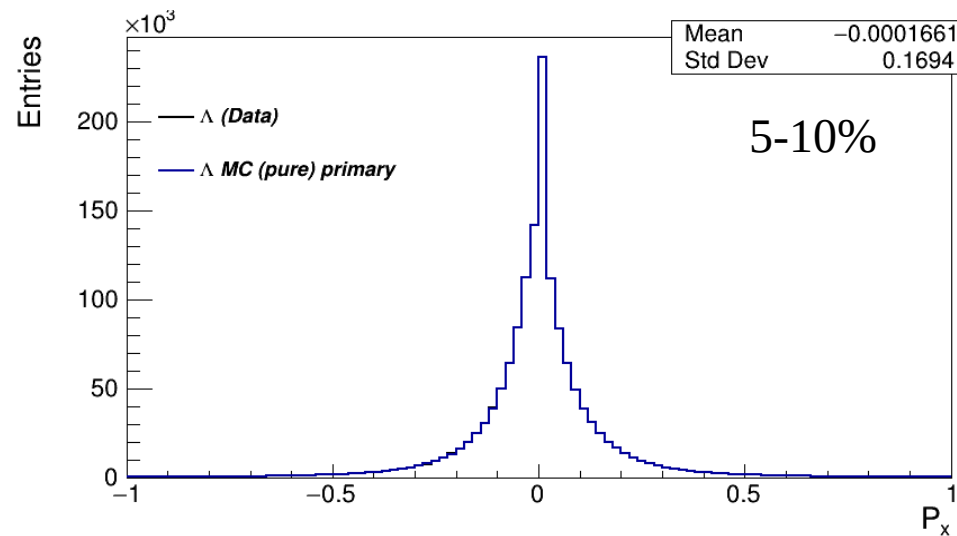
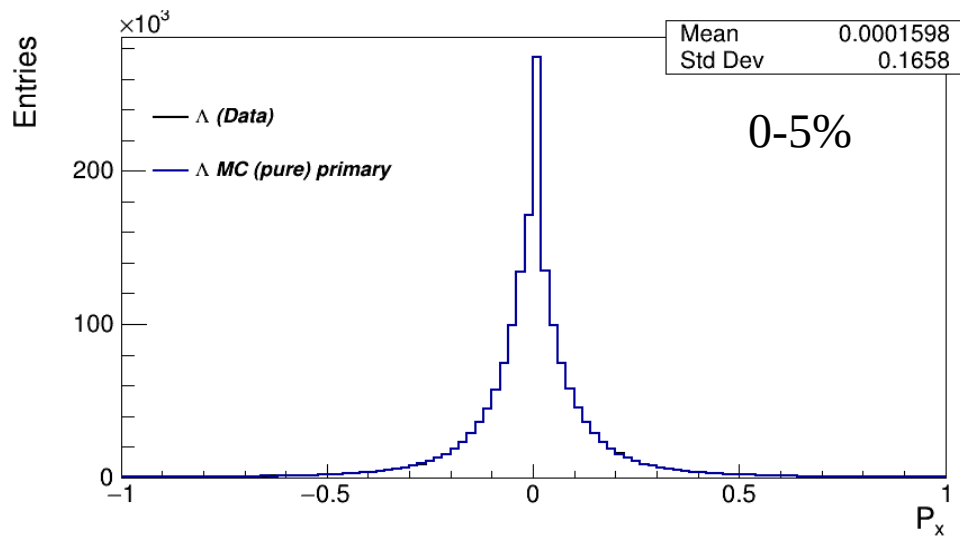


$$(*) N_a = f N_{\text{part}} + (1 - f) N_{\text{coll}}$$



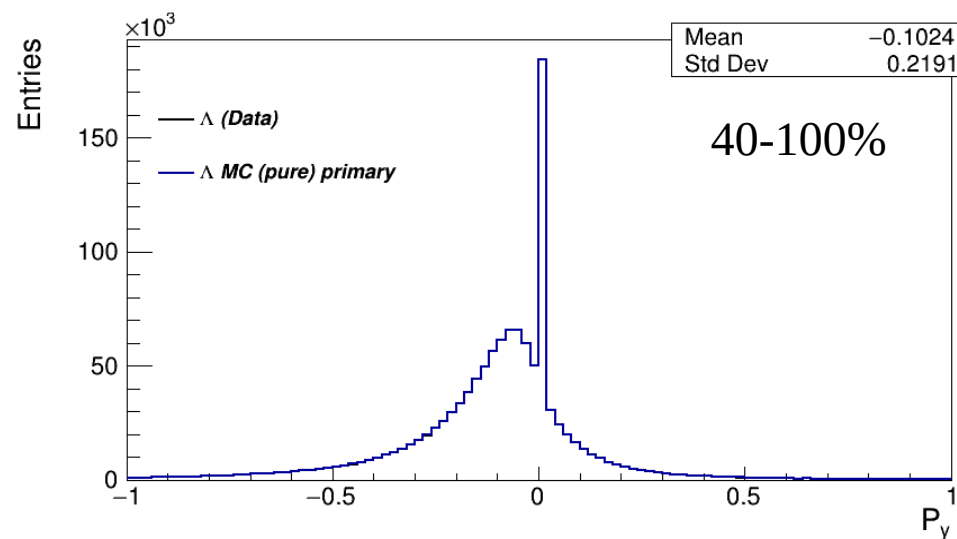
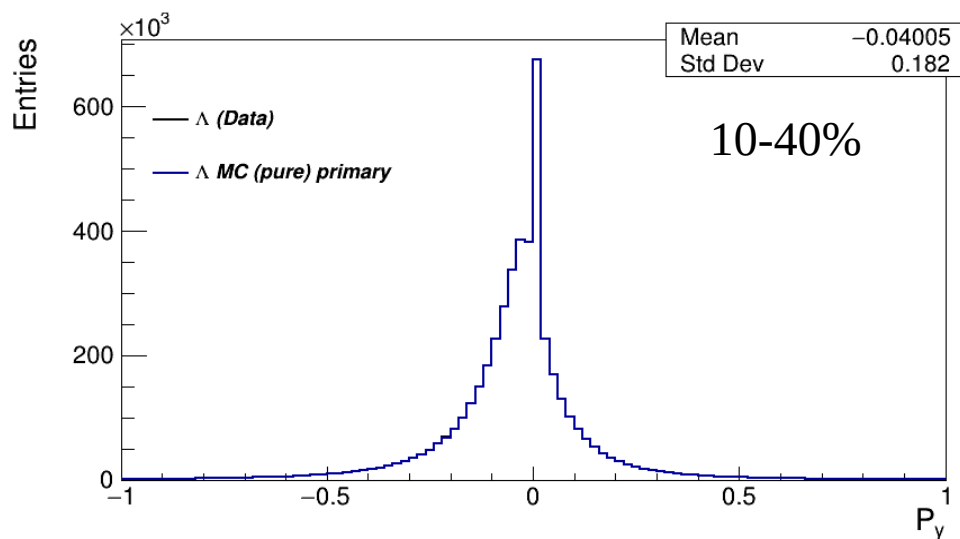
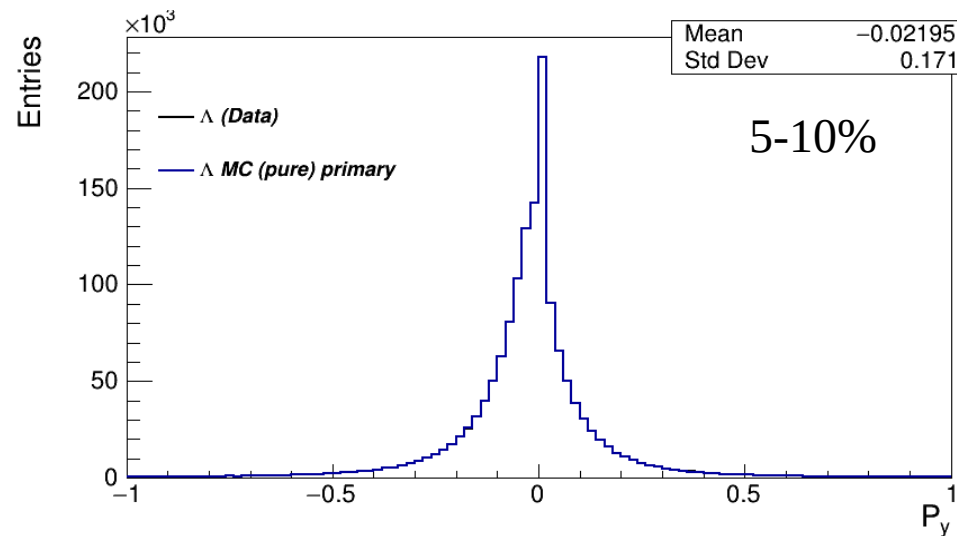
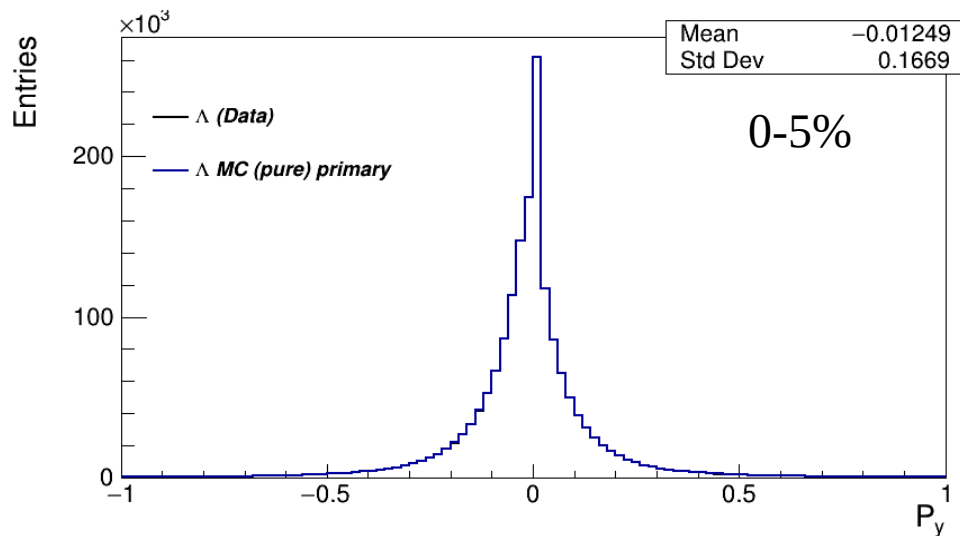
- › Centrality is calculated via TPC multiplicity
- › Last interval (90-100%) is not determined correctly
- ›  $\sim 300k$  events discarded due to zero multiplicity in TPC

# Checking Polarization transfer



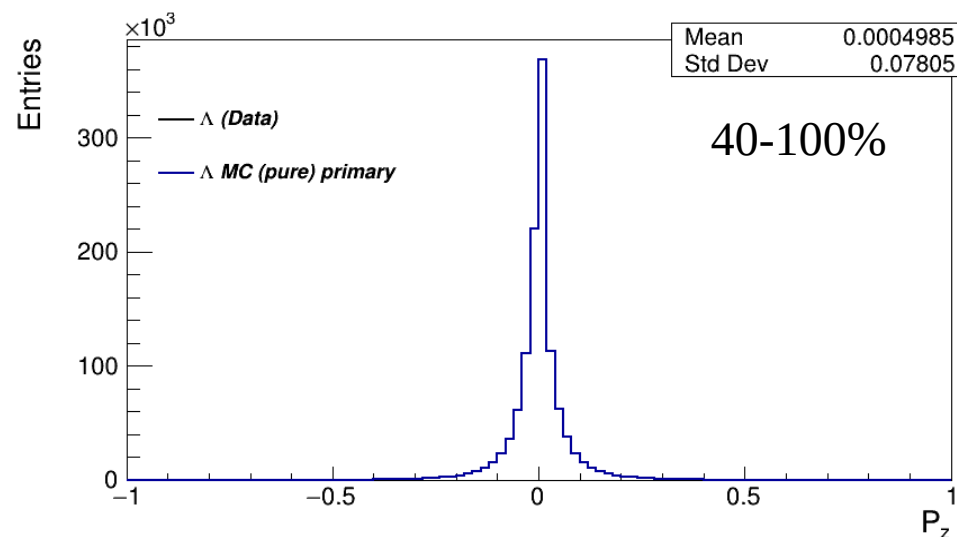
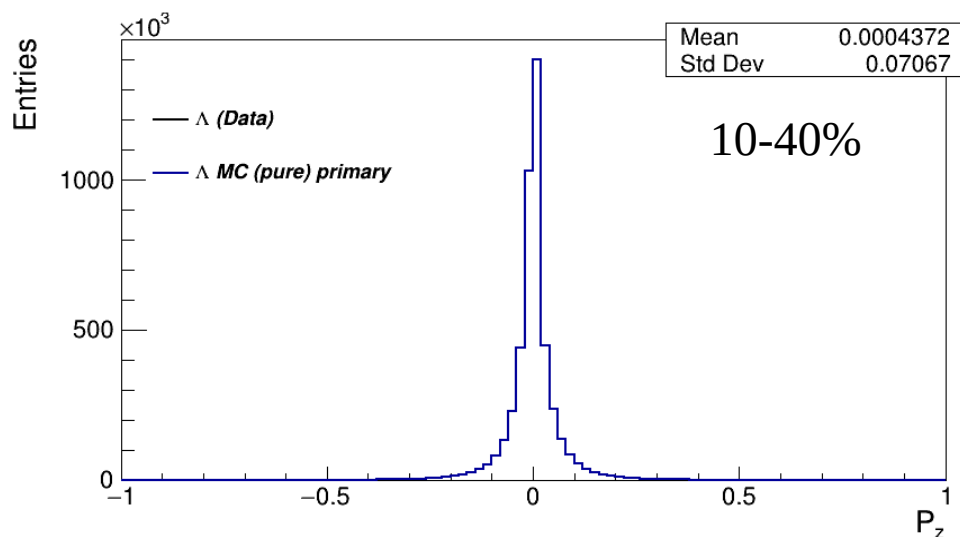
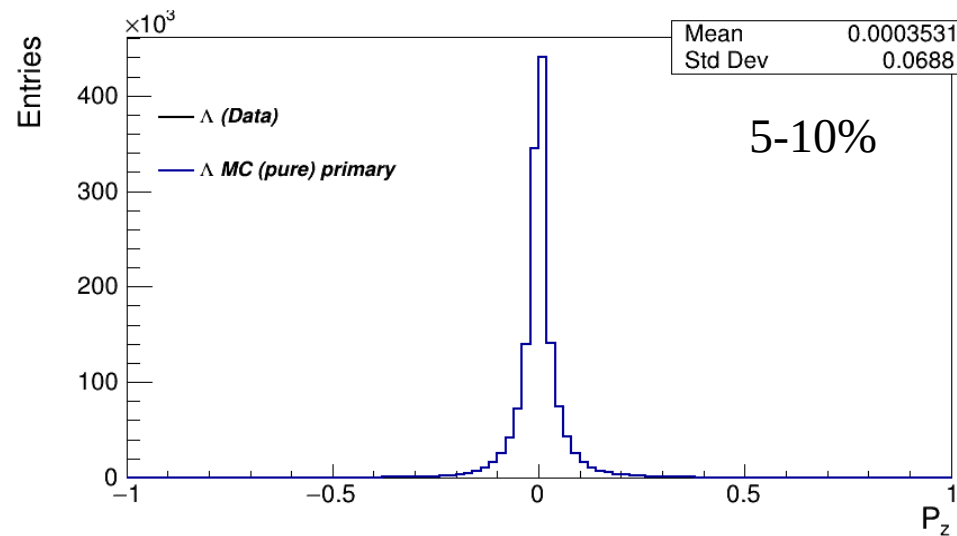
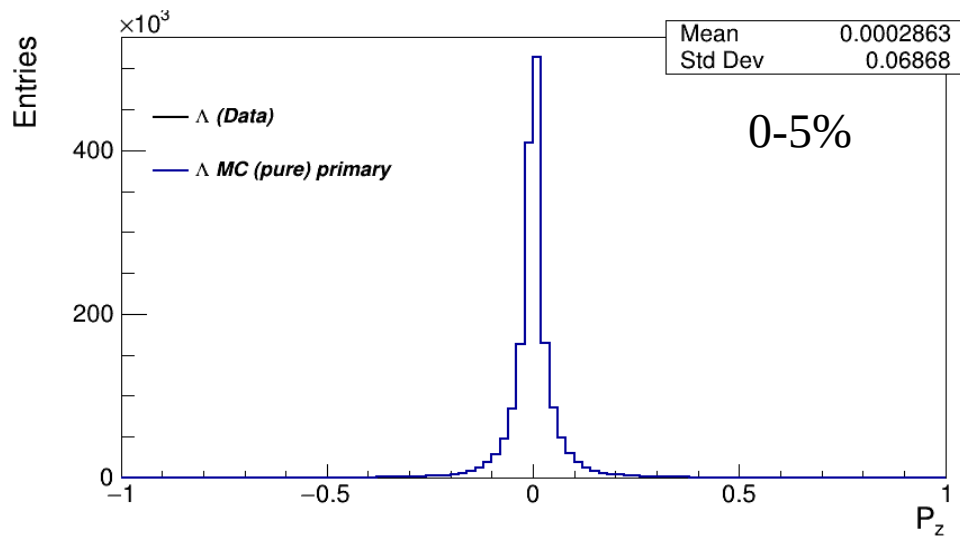
- › Distributions of  $P_x$  for Lambda
- › Distribution for MC Lambda exactly corresponds to the one from Data

# Checking Polarization transfer



- › Distributions of  $P_y$  for Lambda, -  $\langle P_y \rangle$  corresponds to mean global polarization
- › Distribution for MC Lambda exactly corresponds to the one from Data

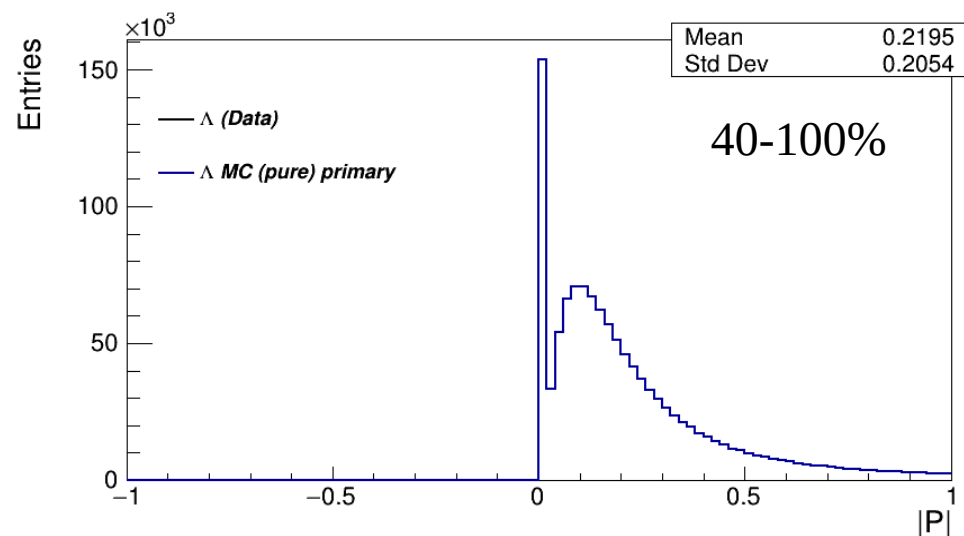
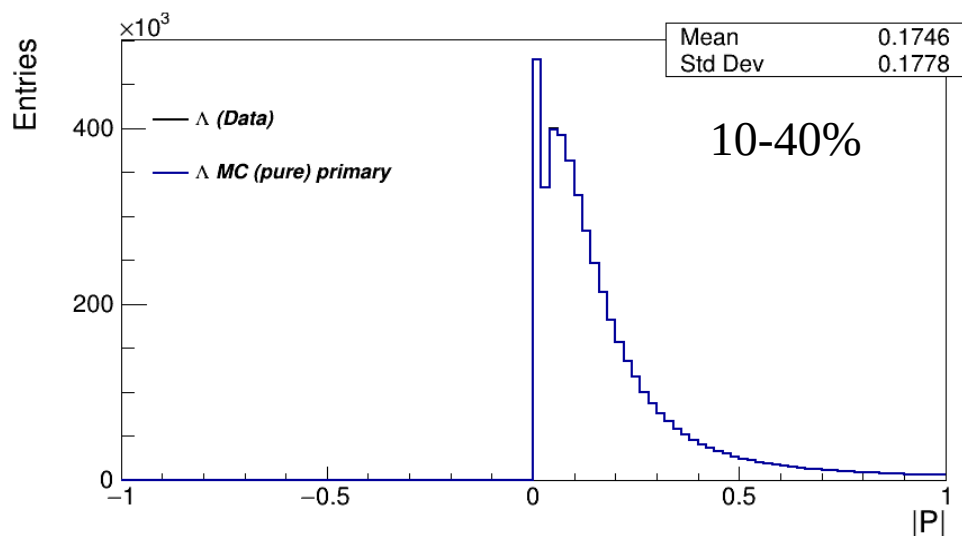
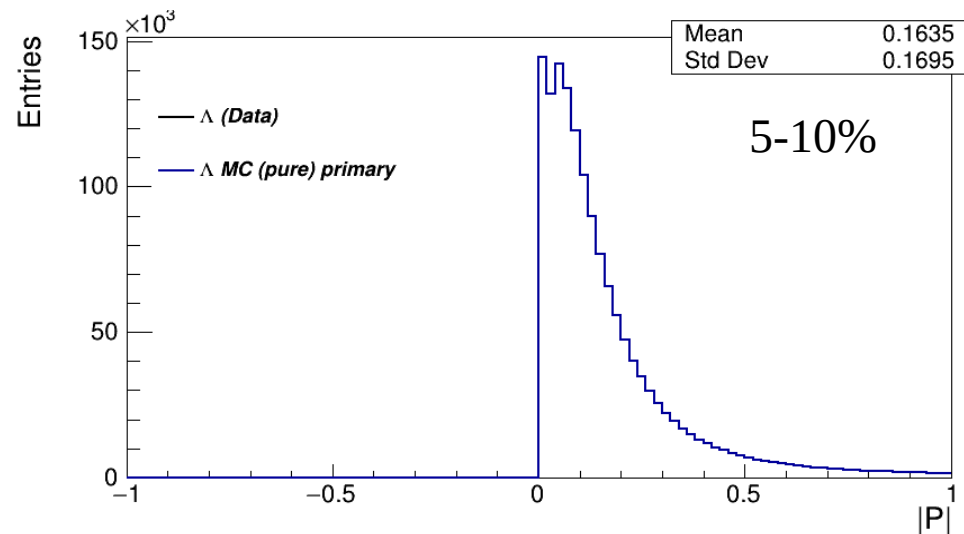
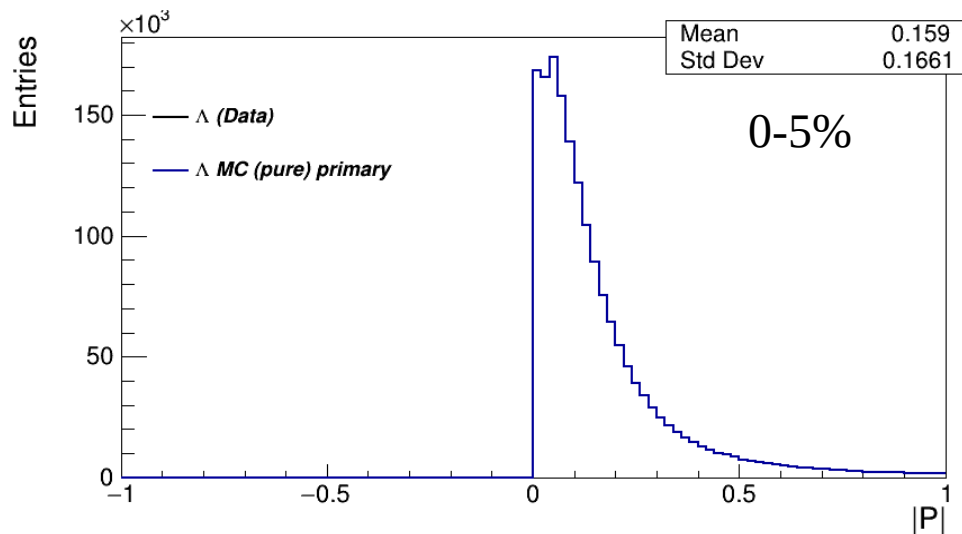
# Checking Polarization transfer



- › Distributions of  $P_z$  for Lambda
- › Distribution for MC Lambda exactly corresponds to the one from Data

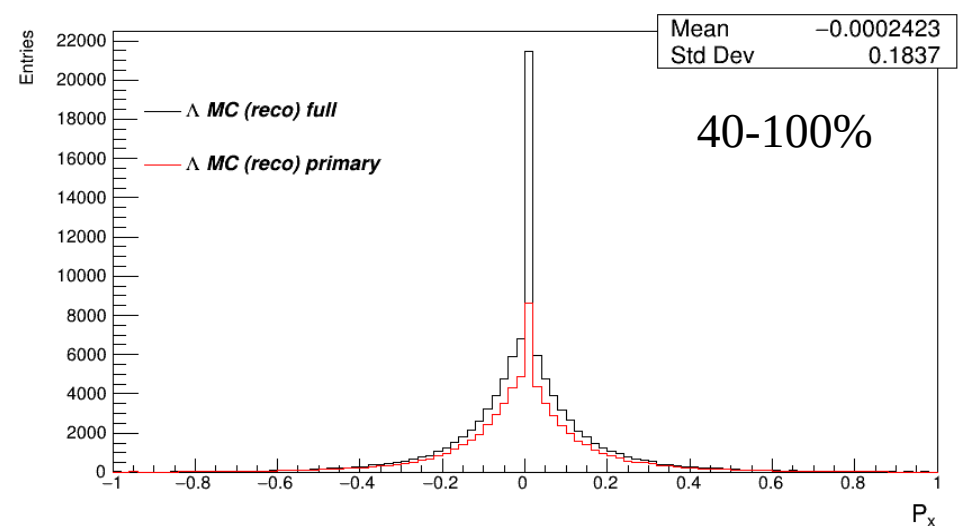
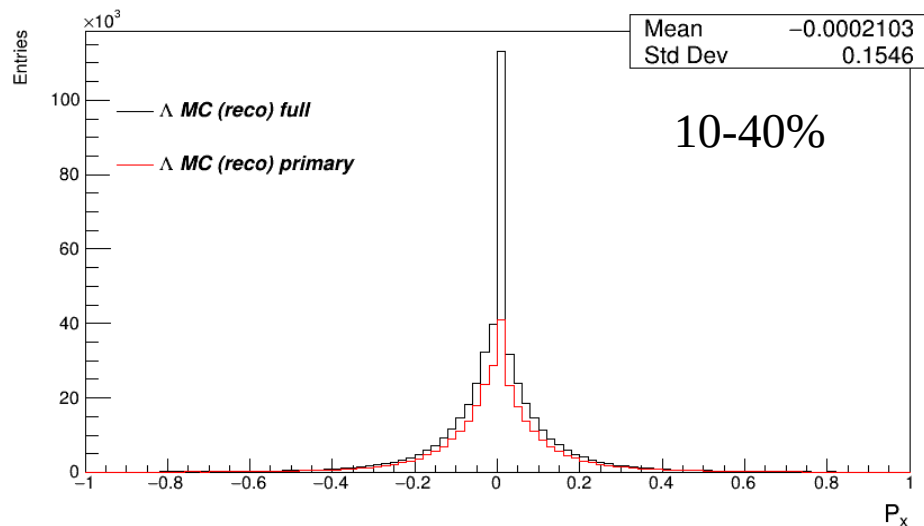
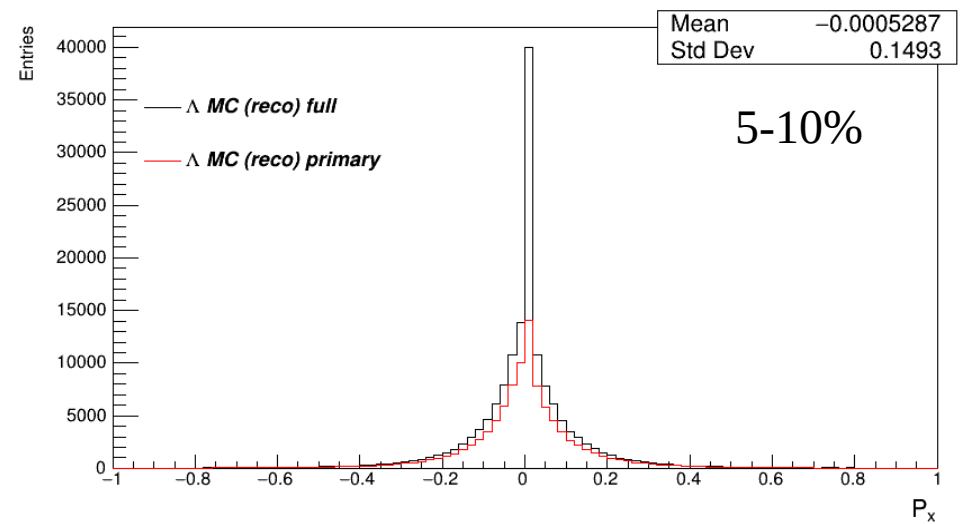
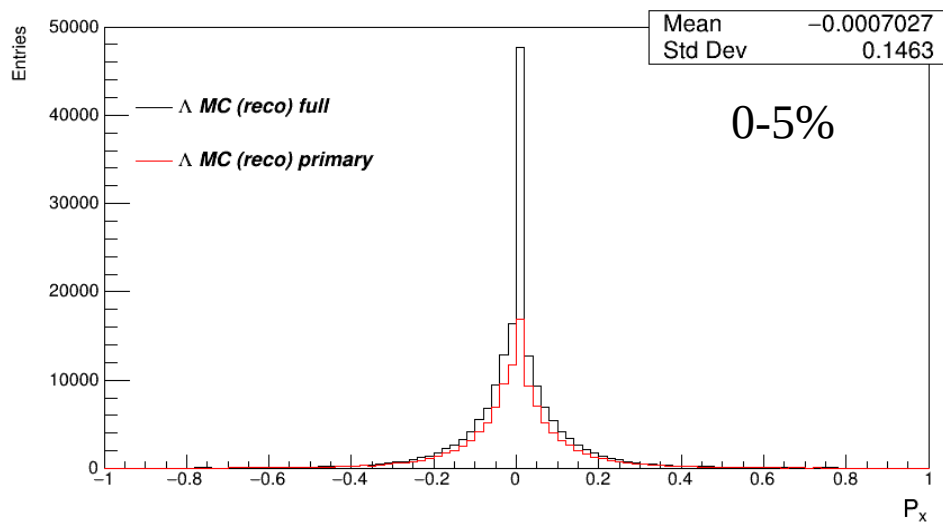


# Checking Polarization transfer



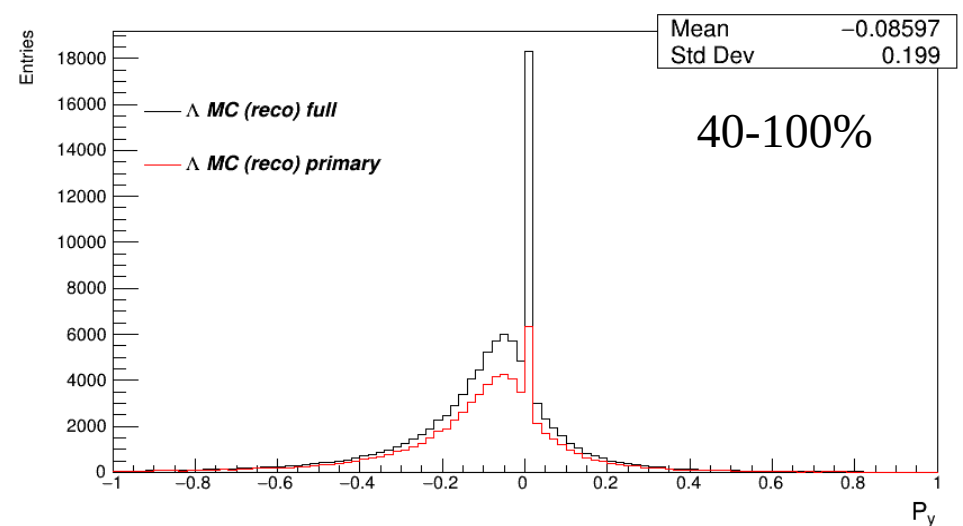
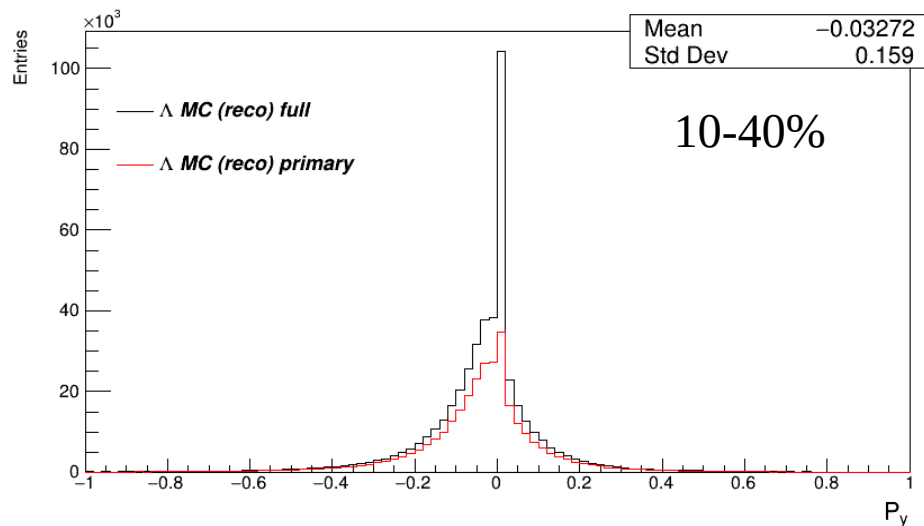
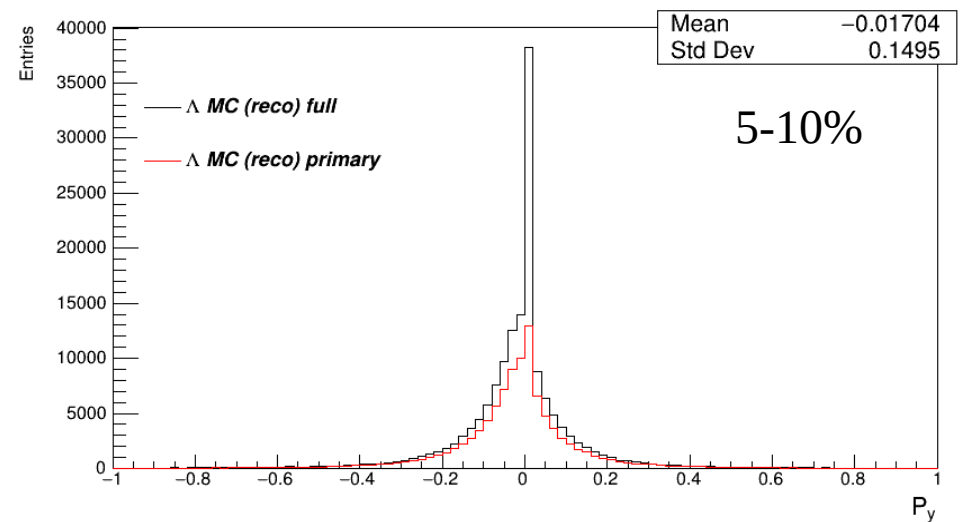
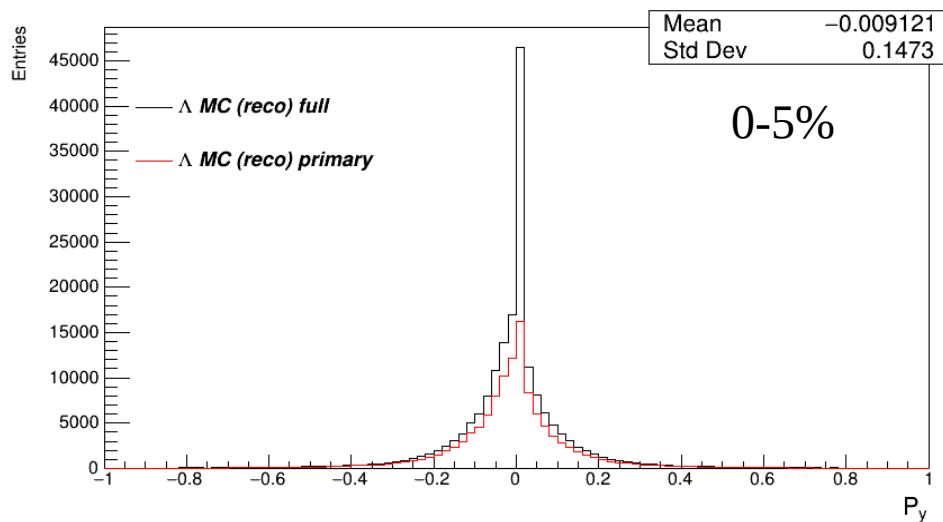
- › Norm of the polarization vector ( $|P|$ )
- › Distribution for MC Lambda exactly corresponds to the one from Data

# Polarization distribution (x-component)



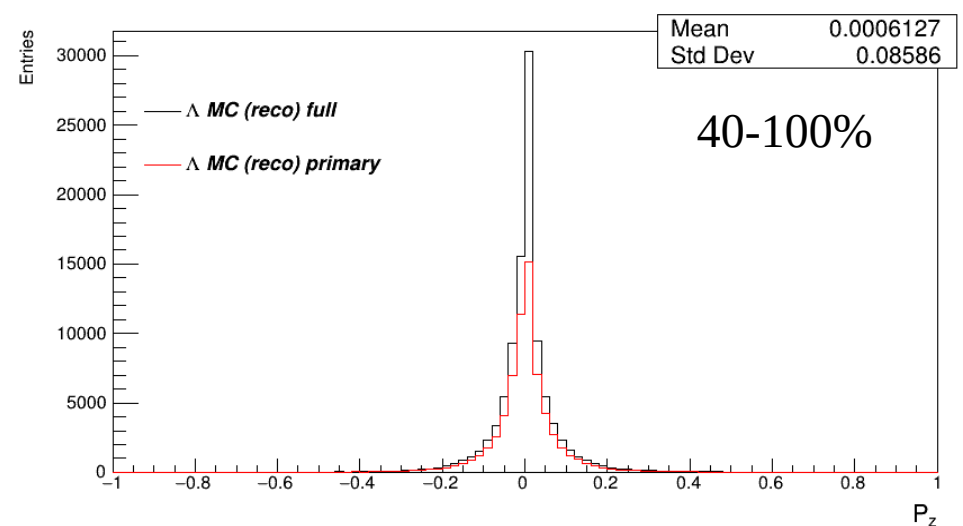
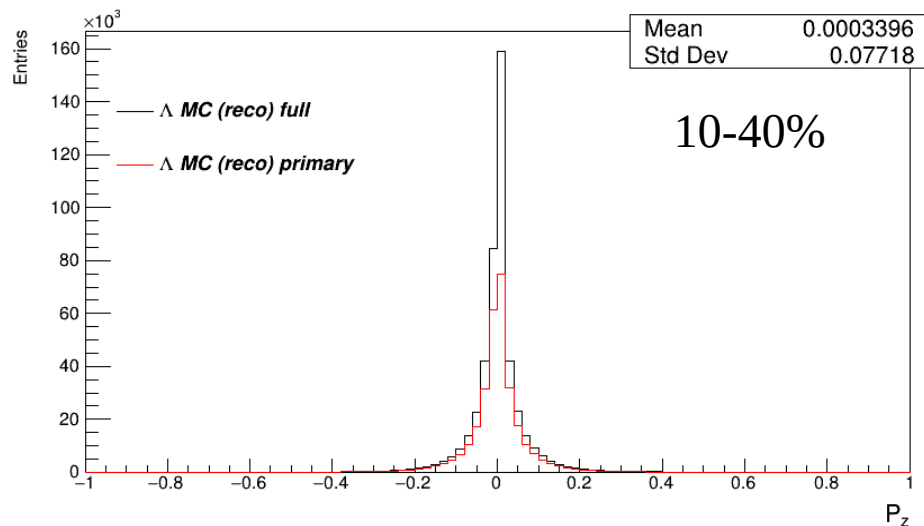
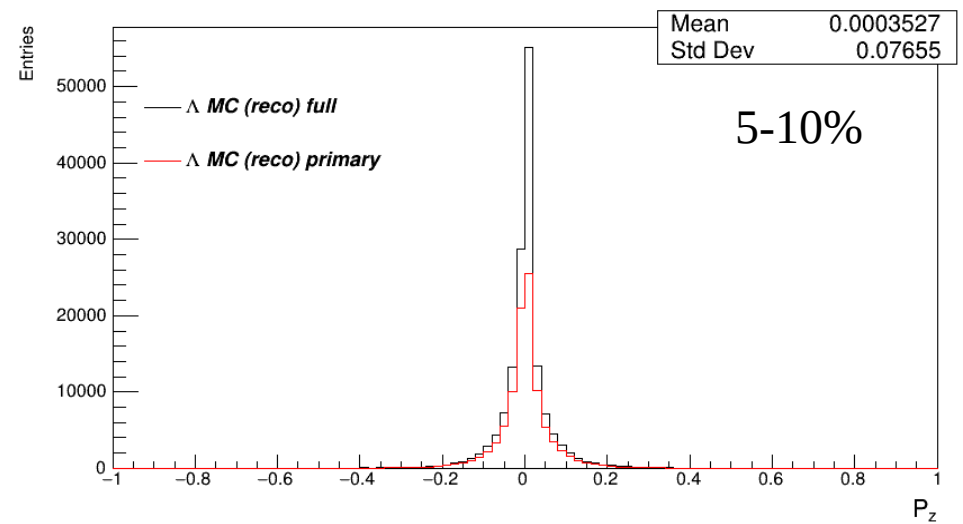
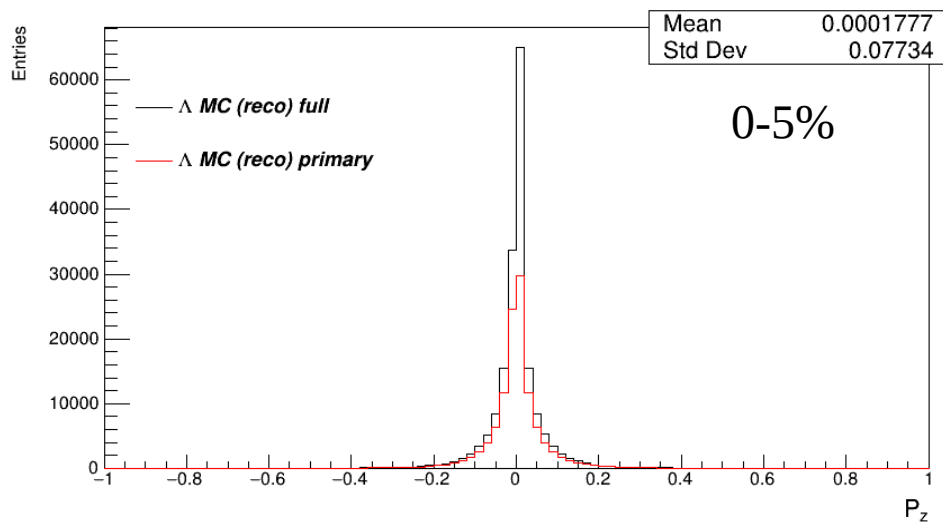
$P_x$  component of the polarization vector for full and primary MC Lambda, associated with the reconstructed Lambda

# Polarization distribution (y-component)



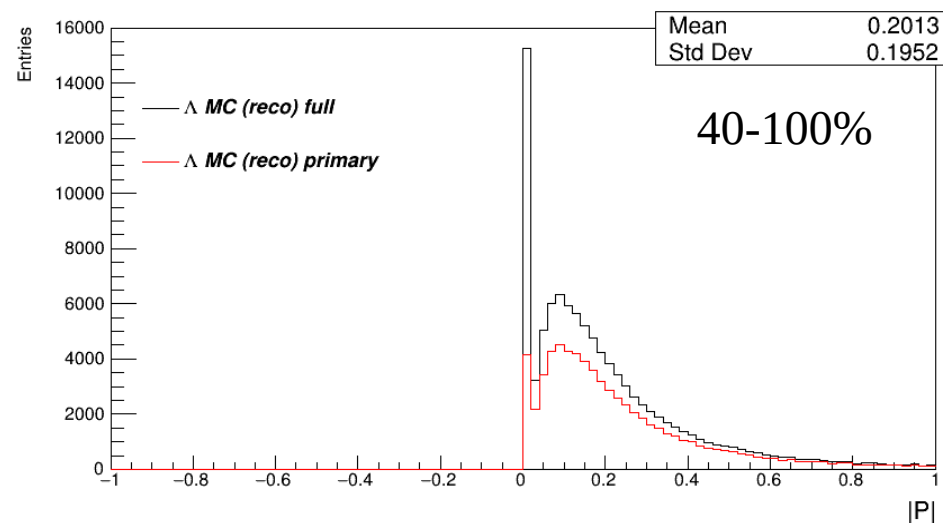
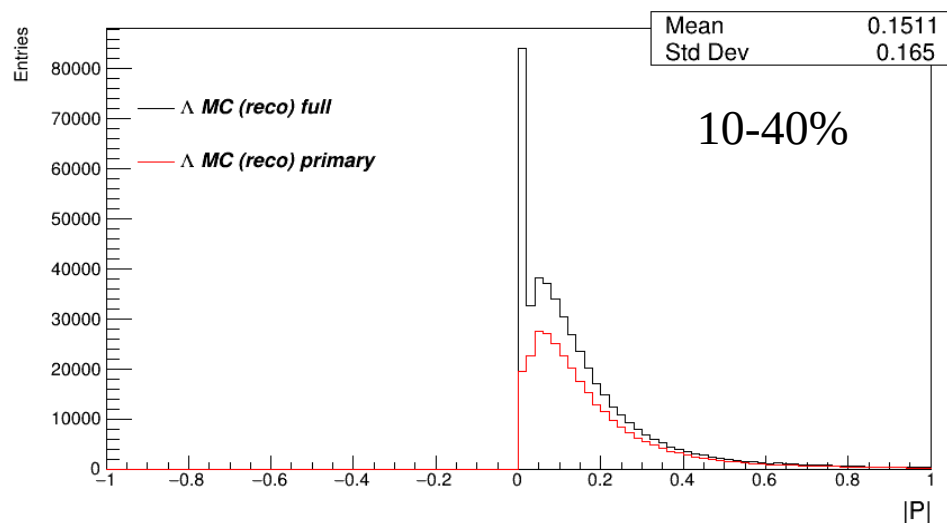
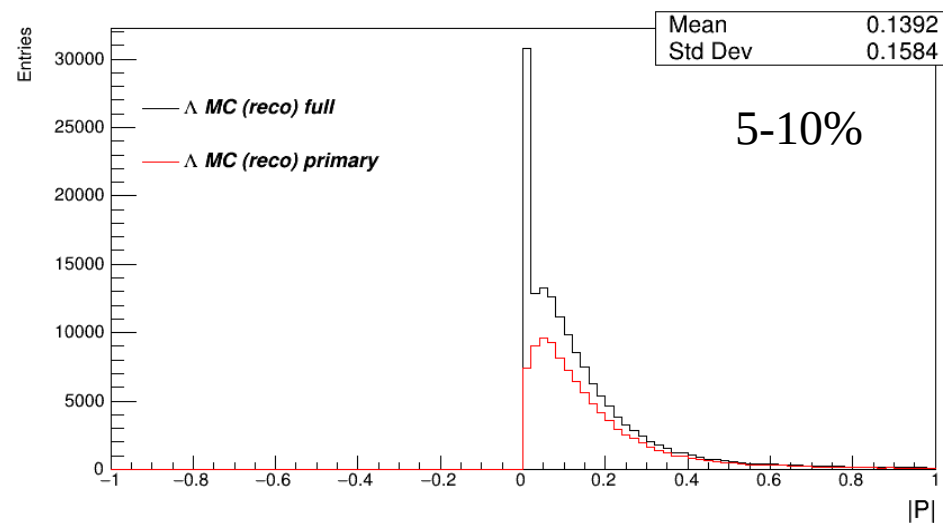
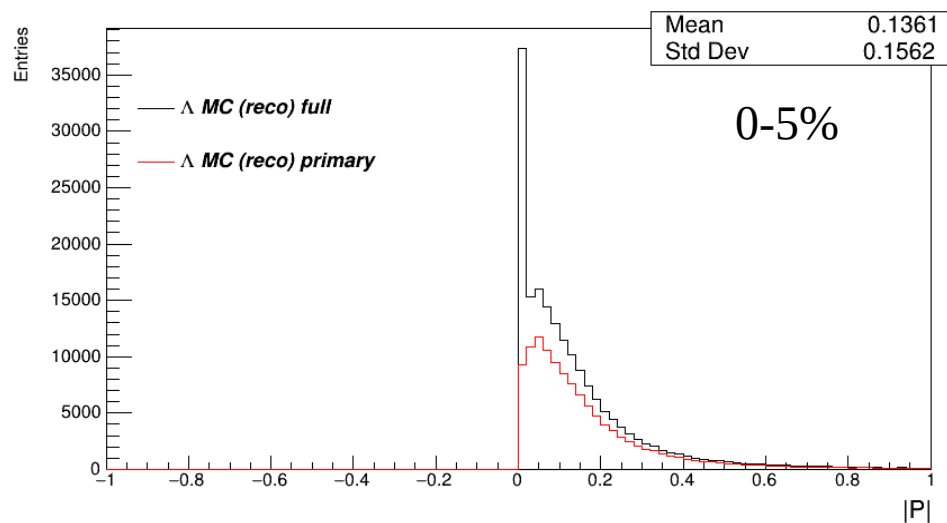
$P_y$  component of the polarization vector for full and primary MC Lambda, associated with the reconstructed Lambda

# Polarization distribution (z-component)

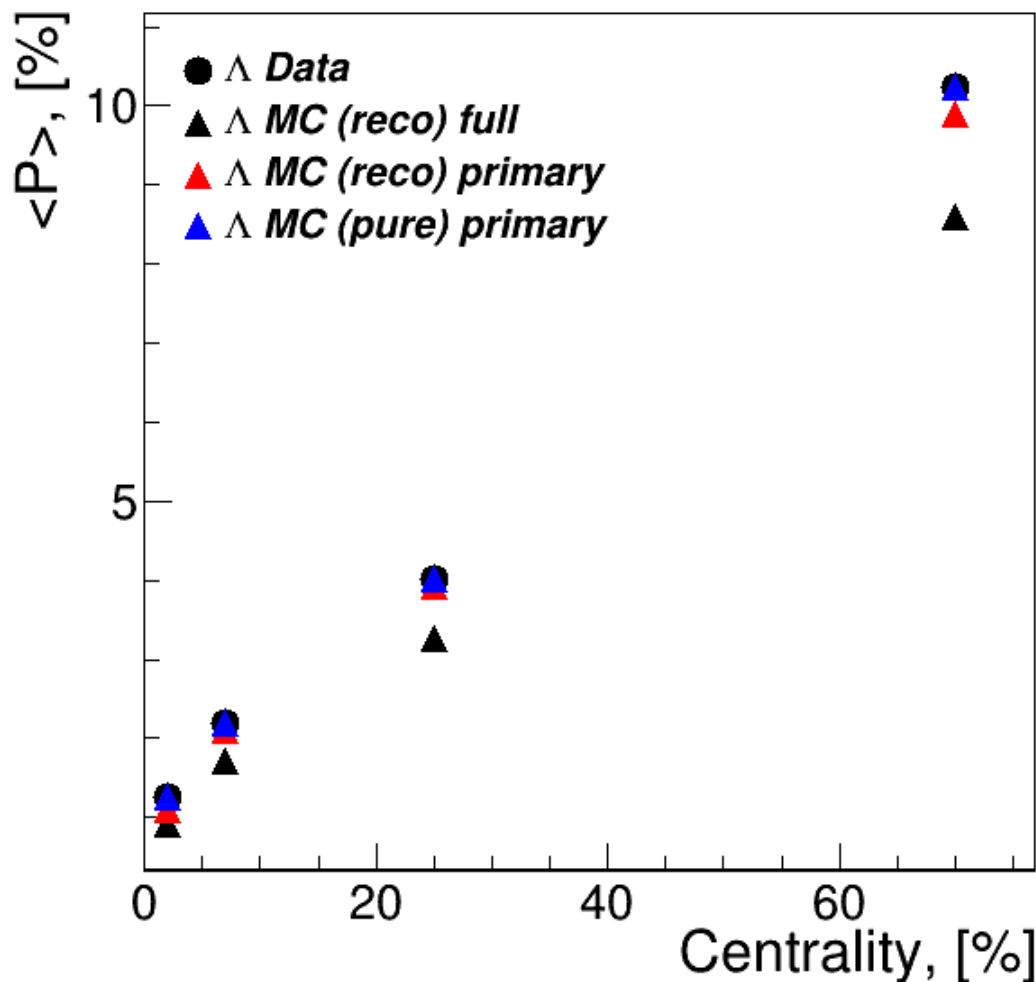


$P_z$  component of the polarization vector for full and primary MC Lambda, associated with the reconstructed Lambda

# Polarization distribution (norm)



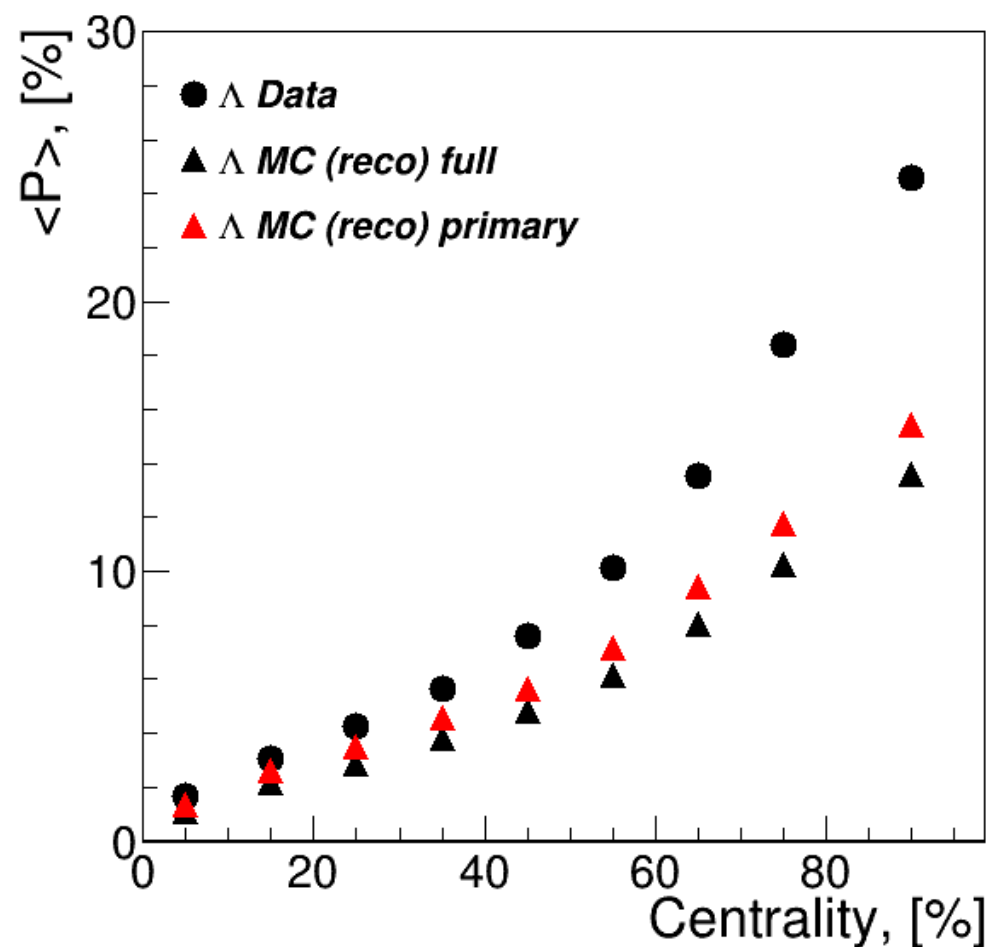
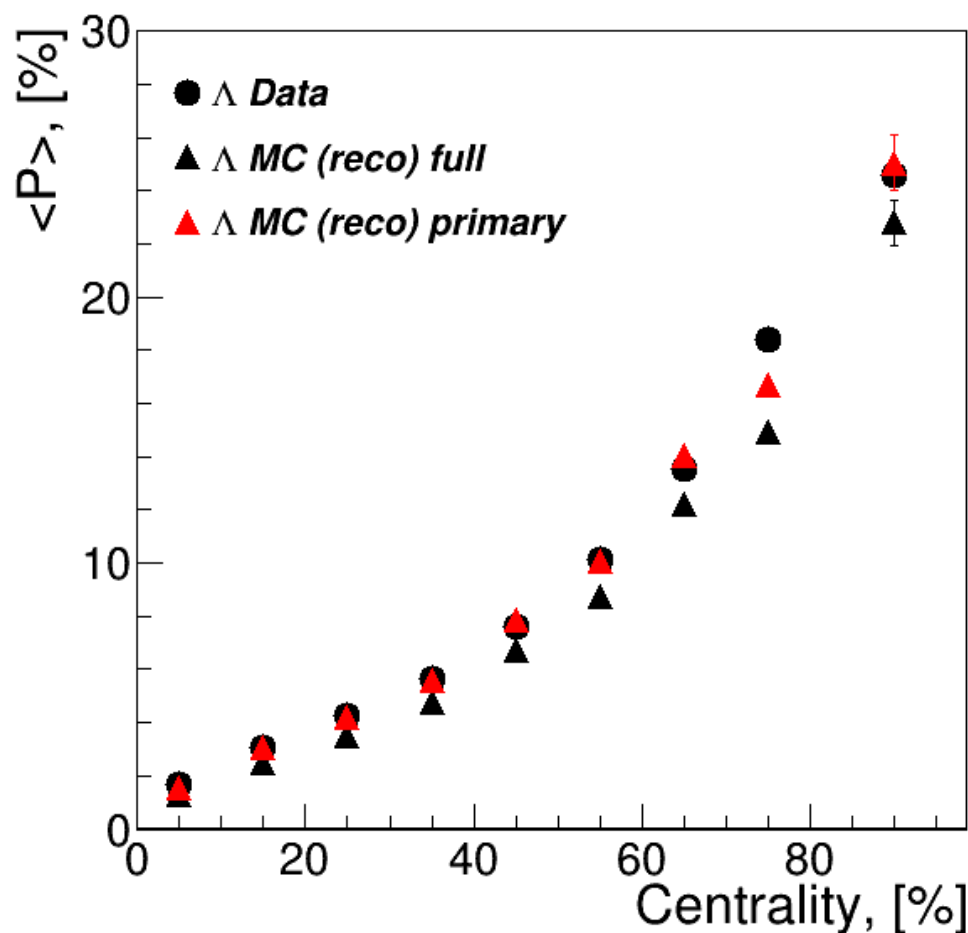
Norm of the polarization vector ( $|P|$ ) for full and primary MC Lambda, associated with the reconstructed Lambda



- Mean global Polarization for  $\Lambda$  ( $P_J = -P_y$ )
- Centrality calculated wrt impact parameter\*
- Comparison between Data, MC, MC tracks associated with reconstructed  $\Lambda$  (full and primary)

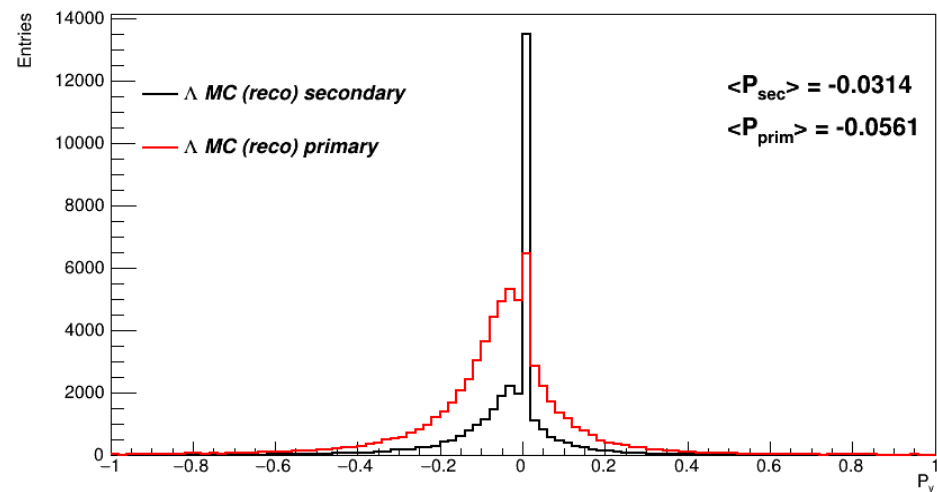
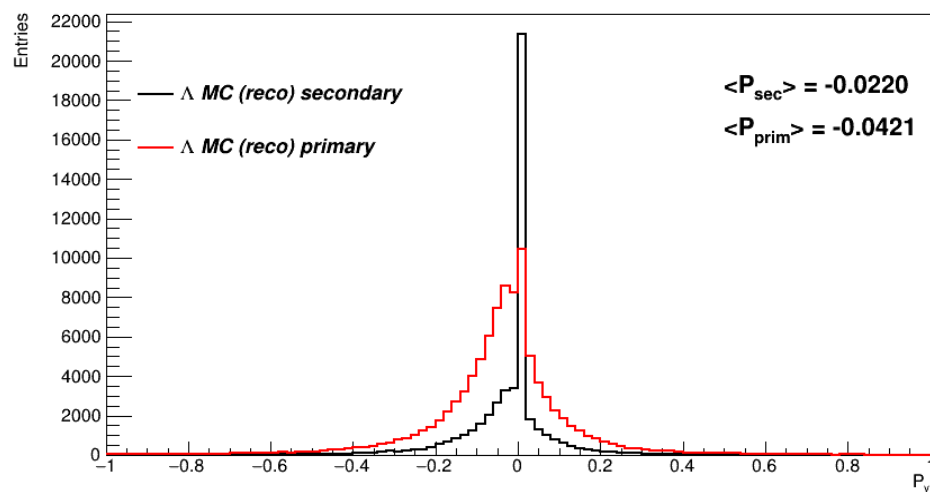
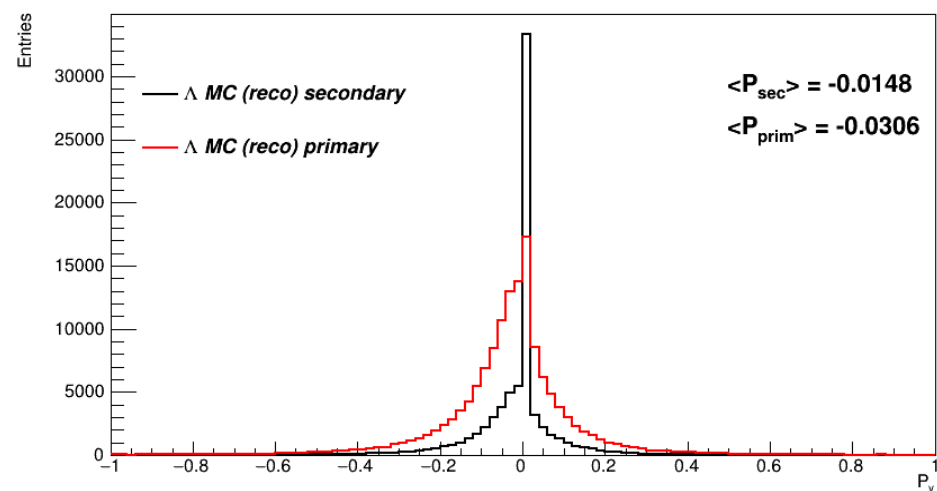
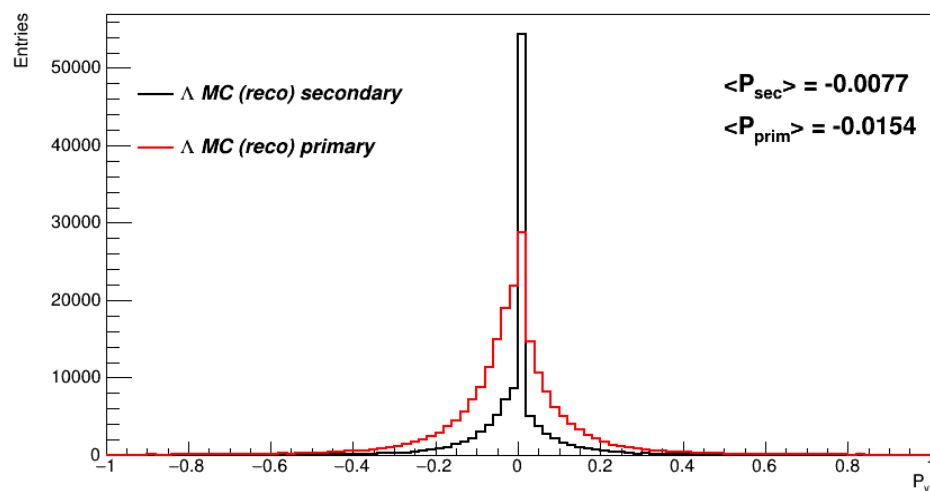
$$(*) Cent = 100 \left( \frac{b}{2 \cdot 7.5} \right)^2$$

- › Correct transfer of polarization values from Data to MC
- › Slight difference wrt MC tracks associated with RECO Lambda
- › Secondary  $\Lambda$  decrease the value



- MC tracks associated with reconstructed  $\Lambda$  (full and primary)
- Left: centrality estimated from impact parameter
- Right: centrality estimated through TPC multiplicity (MC-GI method)

# Polarization of secondary Lambda



Secondary Lambda are polarized  $\rightarrow$  less smear of full polarization towards zero  
Correct transfer of polarization to secondary Lambda is not finished



- Progress update
  - › Ready-to-use framework for centrality calibration (MEPhI group)
  - › Correct polarization transfer (Data → MCTracks)
  - › Less smear of polarization due to secondary Lambdas
- Outlook
  - › Global polarization reconstruction
  - › Polarization transfer to secondary lambda



Thank you for your attention!