Hyperon Global Polarization analysis at MPD
I. Maldonado
Analyzed data
Only generated data
Generated data with detector effects (Branch: MCTrack)
To Reconstruct the polarization (Branch: TPCKalman-Track)
Analysis Off-Line

Hyperon Global Polarization analysis at MPD:

STATUS AND PLANS

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PHSD data - Hyperons

Analyzed data

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- Generated PHSD datasets $\rightarrow$ AuAu at $\sqrt{s_{NN}} = 7.7$ GeV by V. Voronyuk
- Files phsd-0 %n.gz with $n \in (400, 561)$
- Files DST_corrected %n.root with $n \in (400, 561)$ by E. Nazarova
- Events analyzed $\rightarrow$ 402500

Projections of polarization as a function of b

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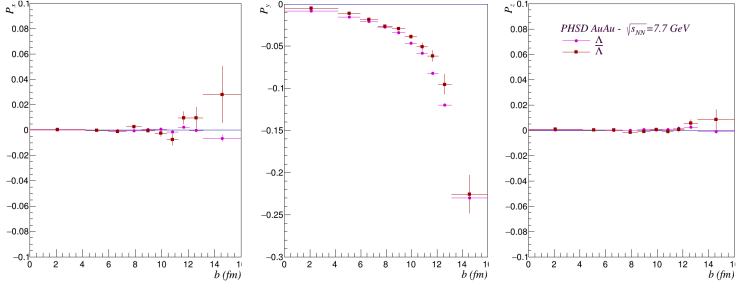
Analysis of generated data without transport and reconstruction through mpd detector

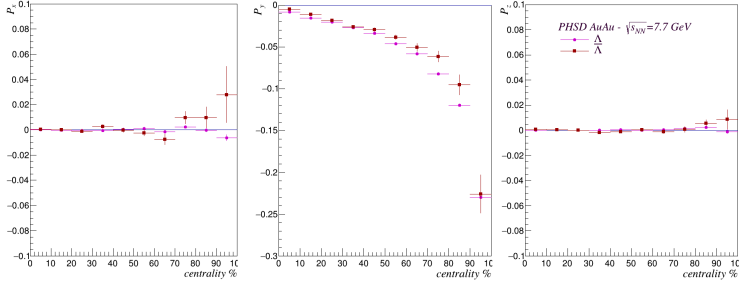


Arbitrary Bins of impact parameter x={0, 4.22, 5.96, 7.33, 8.475, 9.485, 10.405, 11.255, 12.095, 13.14, 16} to compare approximately with centrality bins

Only the proyection relative to angular momentum is different from zero

Projections of polarization as a function of "centrality"

Analysis of generated data without transport and reconstruction through mpd detector



Arbitrary Bins of impact parameter x={0, 4.22, 5.96, 7.33, 8.475, 9.485, 10.405, 11.255, 12.095, 13.14, 16} to compare approximately with centrality bins

The maximum value is $|P| \sim 0.23$ for peripheral collisions

MCTrack distributions

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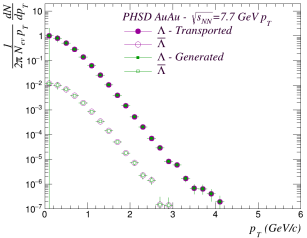
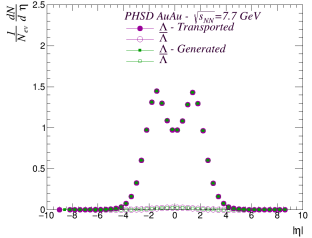
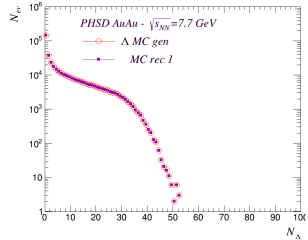
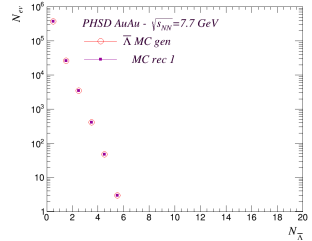
Generated data corresponds to primary particles in transported data $\rightarrow p_T$, η and $N_{\Lambda(\bar{\Lambda})}$

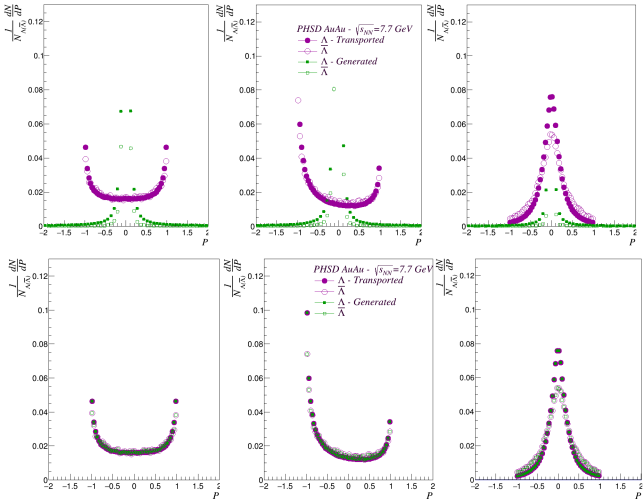








Polarization from generated and transported data differs



Normalization and Rotation of vector $\vec{P}$ to $\vec{P}'$, $(|\vec{P}|, \phi, \theta) \rightarrow (1, \phi + \pi, \theta)$

Polarization $\vec{P}$ to $\vec{P}'$

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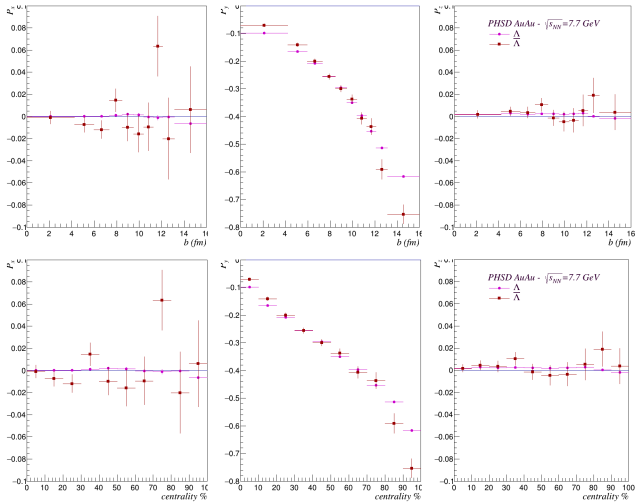
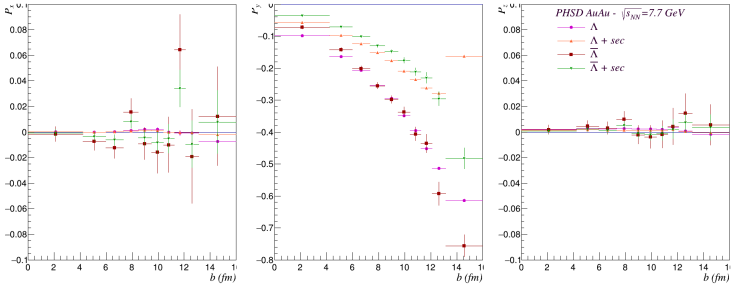
The magnitude of polarization increases from ~ 0.23 to ~ 0.6



Projections of polarization as a function of b

Transport of particles through detector produces several particles without polarization that decrease the mean value of polarization for each bin of impact parameter or centrality.



Projections of polarization as a function of "centrality"

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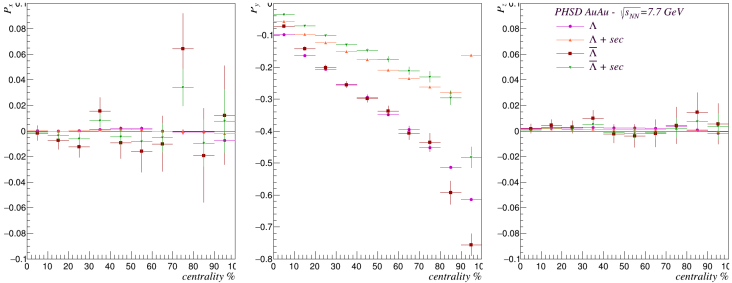
Analysis Off-Line

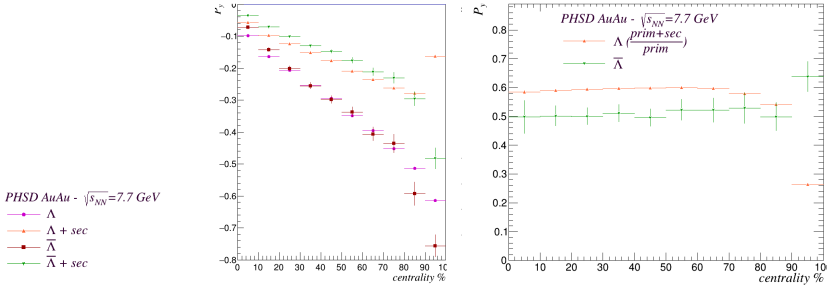
How this effect can change the value of polarization for reconstructed data?



Do we need to compare with generated data to correct by efficiency and acceptance or there is another method?

Projections of polarization as a function of "centrality"

How this effect can change the value of polarization for reconstructed data?



Decreases the mean value $\sim 40\,\%$ for Λ and $\sim 50\,\%$ for $\bar{\Lambda}$

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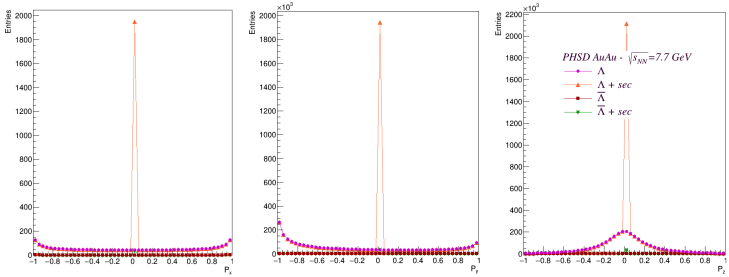
Analysis Off-Line

The difference between secondaries and primary particles is in $P_{x,y,z} = 0$



Do we need to compare with generated data to correct by efficiency and acceptance or there is another method?

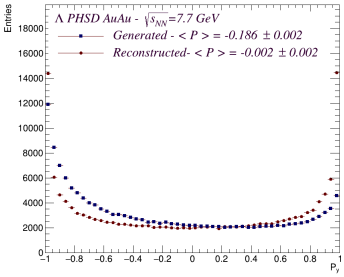
Reconstructed polarization

I want to compare the "y" projection of polarization P_y with $sin(\Psi_{EP} - \phi_p)$ keeping in mind that

$$P = \frac{8}{\pi \alpha_H} \langle sin(\Psi_{EP} - \phi_p) \rangle$$

where Ψ_{EP} is the true angle of the event plane given by the MCEventHeader, ϕ_p is the proton azimuthal angle and α the weak-decay asymmetry parameter.

The reconstructed polarization is symmetrical and on average zero:
$\rightarrow$ polarization is not considered for the decay.



For the proton identification I use MC association

Polarization with $sin(\Psi_{EP} - \phi_p)$

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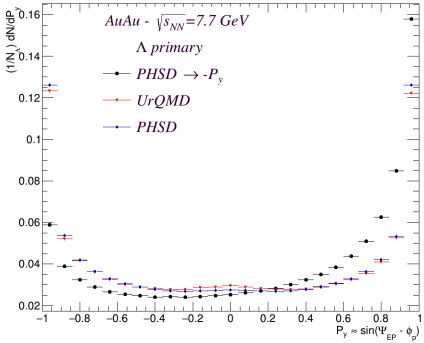
P_y distribution is similar for UrQMD data without polarization.



Polarization with $dN/d\Omega = N/4\pi(1 + \alpha P cos(\theta))$

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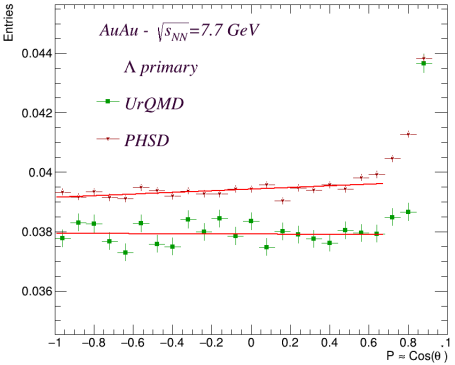
With this distribution we can infer a zero polarization for PHSD, the same as UrQMD, The procedure requires to check the behaviour at values close to 1.



Reconstructed Λs with MC association

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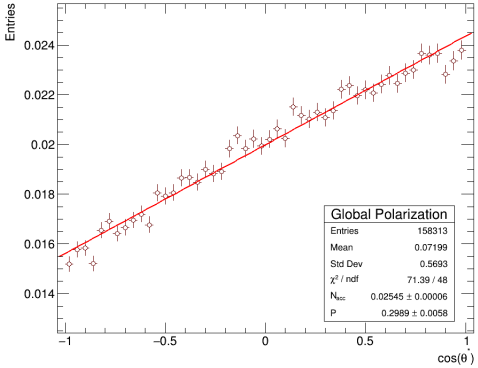
The goal is to get a distribution with reconstructed tracks and correct it by efficiency to recover the generated polarization.



Unpolarized?

Transport of Polarization?

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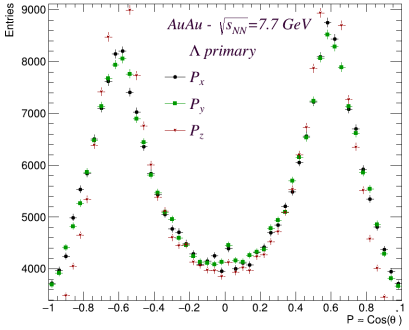
Setting the polarization as a function of the distribution of the protons, considering an isotropic decay.



can we reconstruct the polarization?

Summary

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- We have shown that decays of hyperons are isotropic, consistent with zero polarisation.
- Particles produced by interaction with detectors are not polarized and diminishes hyperon global polarization in $\sim 40\,\%$.
- We have a preliminary distribution with polarization related to the products of decay.
- We have to analyze the feasibility to reconstruct this generated polarization which needs to be studied carefully.