MEX NICA

Analysis/Off-Line

MPD – PWG 1

Hyperons in BiBi collisions at $\sqrt{s_{NN}}$ = 11GeV

Production at generation, simulation and reconstruction level

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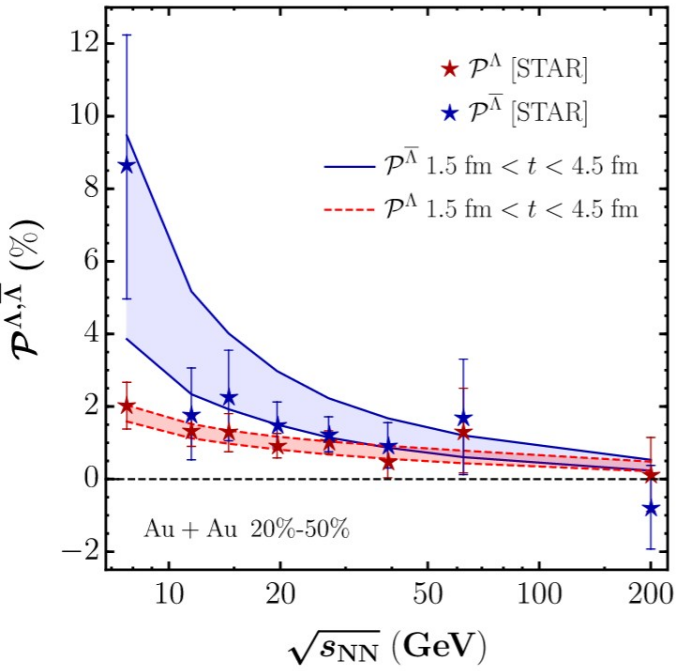
Content

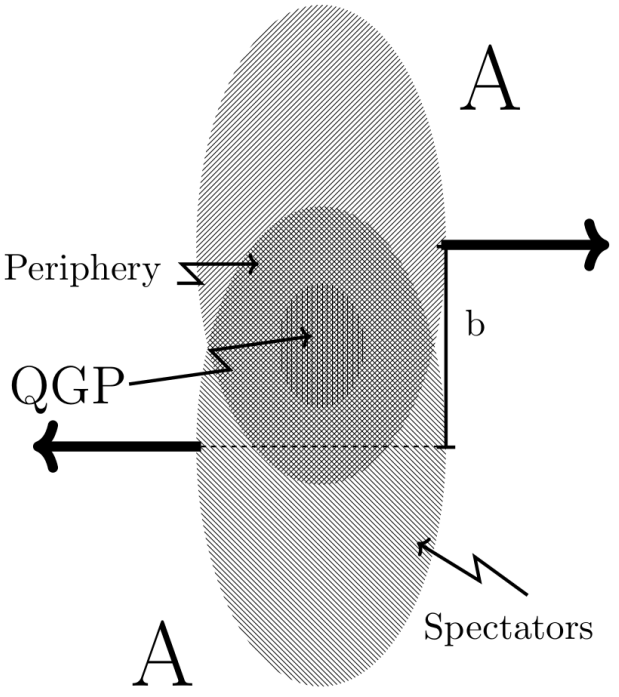
- Motivation
- Production in different sets of collisions and the maximum values that can be reconstructed.
- Pt ratio between the reconstructed and simulated Λ's primary (created by UrQMD) and secondary (interaction with the detector), at $|\eta|<1.3$ to estimate the maximum efficiency, we expect this value to decreases due to the cuts.
- Selection of kinematical cuts to reconstruct Λ and $\overline{\Lambda}$.

Motivation: Core meets Corona



Polarization of Λ and $\bar{\Lambda}$, compared with data from the BES [Nature 548,62-65(2017)]

A two component source to explain Λ and $\bar{\Lambda}$ global polarization in semi-central heavy-ion collisions. https://arxiv.org/abs/2003.13757 https://arxiv.org/pdf/2006.10015.pdf



$$\mathcal{P}^{\Lambda} = \frac{z\frac{N_{\Lambda\ \mathrm{QGP}}}{N_{\Lambda\ \mathrm{REC}}}}{\left(1+\frac{N_{\Lambda\ \mathrm{QGP}}}{N_{\Lambda\ \mathrm{REC}}}\right)}$$

$$\mathcal{P}^{\bar{\Lambda}} = \frac{\left(\frac{\bar{z}}{w}\right)\frac{N_{\Lambda\ \mathrm{QGP}}}{N_{\Lambda\ \mathrm{REC}}}}{\left(1+\left(\frac{1}{w}\right)\frac{N_{\Lambda\ \mathrm{QGP}}}{N_{\Lambda\ \mathrm{REC}}}\right)}.$$

z($\bar{z}$) – intrinsic polarization
w – $\bar{\Lambda}$/Λ ratio in periphery
QGP – central region
REC – periphery region

Data analyzed

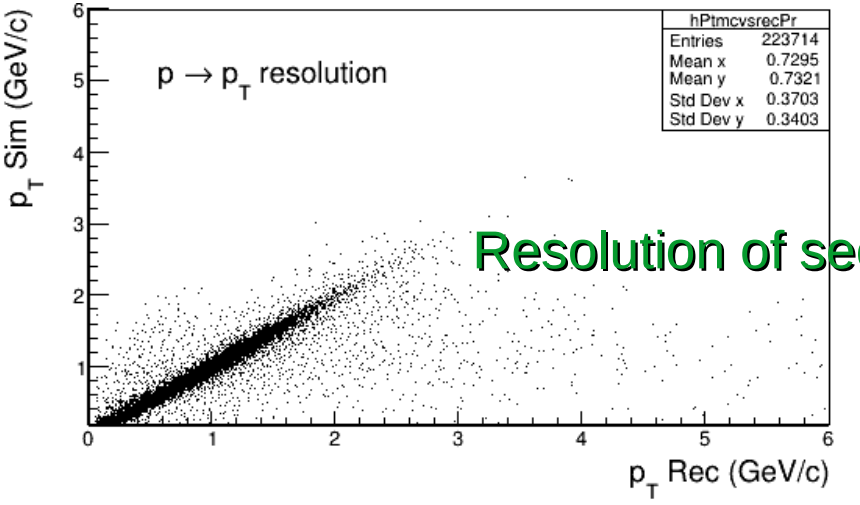
- ~ 100000 events for MB/ b<4fm / 6fm<b<8fm /b>10fm
- UrQMD for generation
- Simulation/Reconstruction → Geant3
  - TPC, TOF, EMC, ZDC
- Reconstruction analysis → only with TPCKalmanTracks

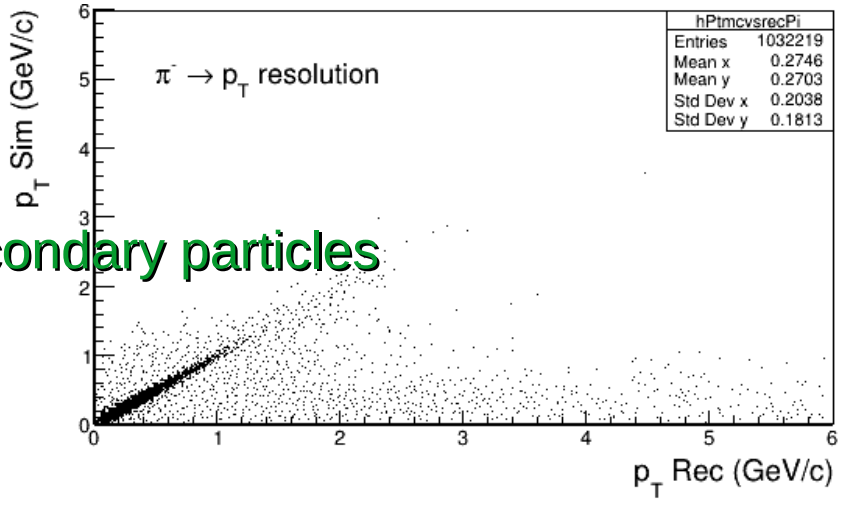
Data type: MC/Sim/Rec

MC data → Λ and $\bar{\Lambda}$ generated by UrQMD + particle decays, secondary interactions by GEANT3 transport package

Sim data → Findable Λ and $\bar{\Lambda}$, identification of products of its charged decay and p_T>0.001 GeV/c and |η|<1.3

Rec data → Reconstructed Λ and $\bar{\Lambda}$, by combination of identified secondary $p^+(p^-)$ and $\pi^-(\pi^+)$





Resolution of secondary particles

Production MC/Sim/Rec

Data	Generated		Simulated		Candidates for rec.	
	Λ	$\bar{\Lambda}$	Λ	$\bar{\Lambda}$	p	$\bar{p}$
MB	11.8	0.22	6.36	0.14	2.27	0.10
b > 10 fm	2.12	0.07	1.10	0.04	0.28	0.03
6 <b< 8 fm	24.0	0.45	13.1	0.28	4.56	0.20
b < 4 fm	50.6	0.74	28.2	0.47	11.4	0.32

But from candidates after Λ and $\bar{\Lambda}$ reconstruction we keep only tracks that have a mass according to pdg value.

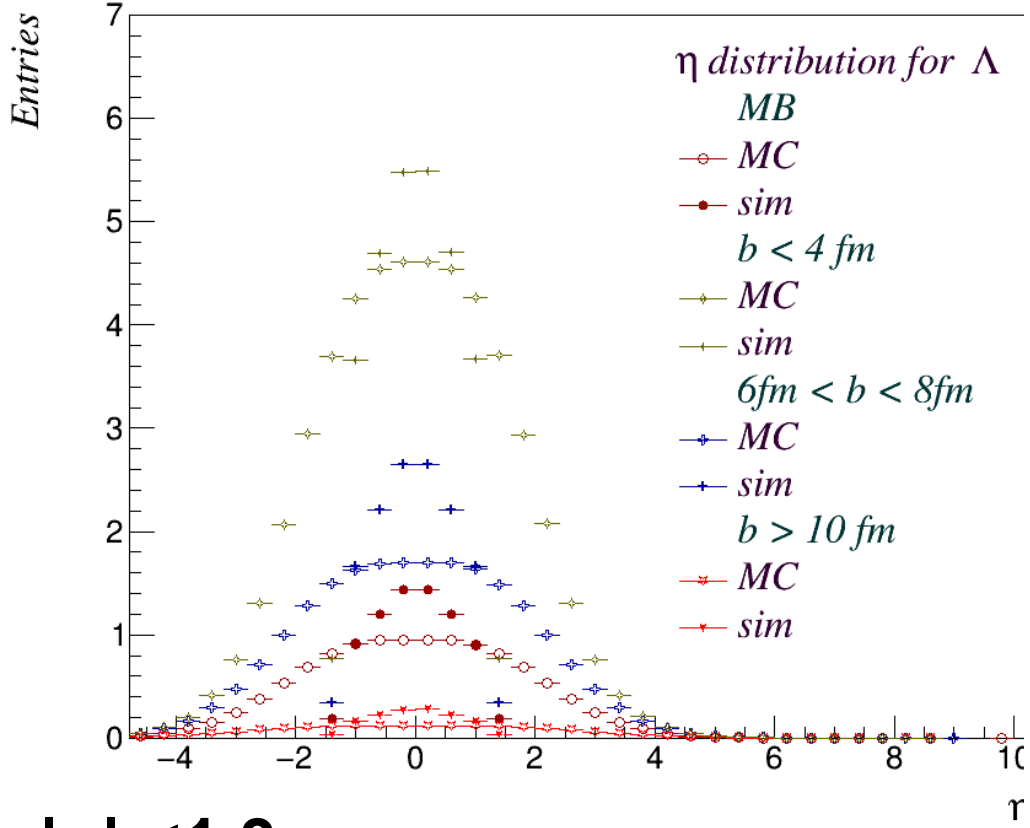
With perfect ID – MC we have
The ratio $\Lambda/\bar{\Lambda}$ increases as b increases

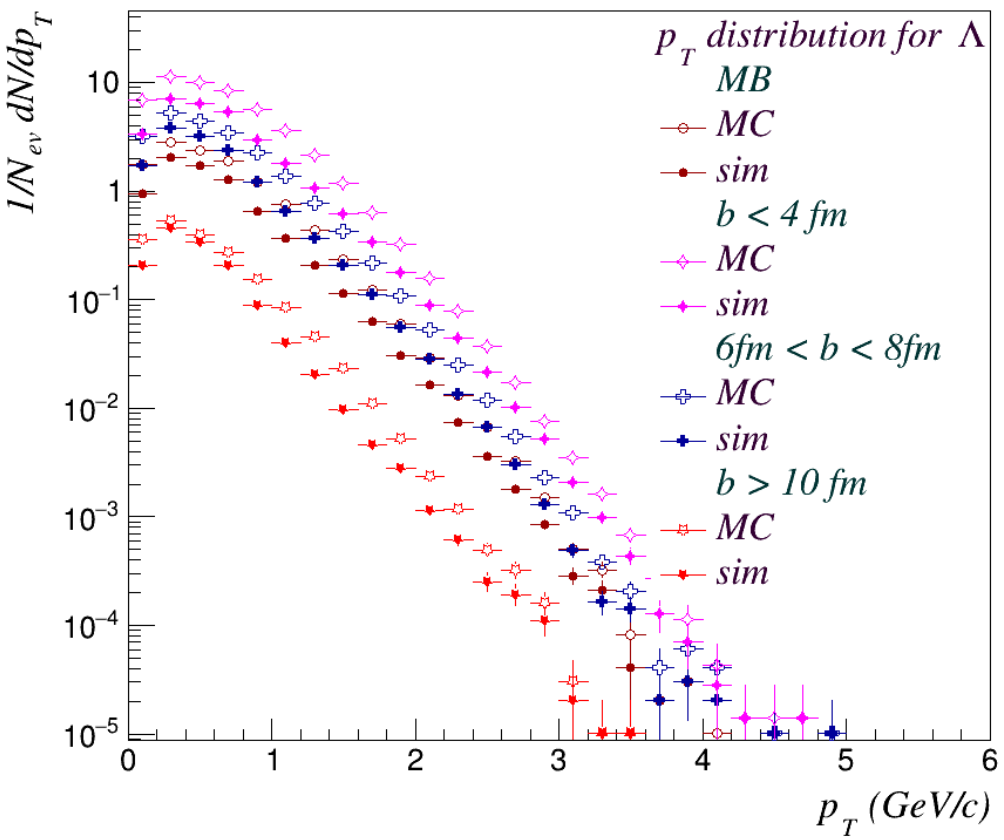
Data	Candidates for rec. MC	
	Λ	$\bar{\Lambda}$
MB	0.6	0.03
b > 10 fm	0.07	0.007
6 <b< 8 fm	1.09	0.05
b < 4 fm	2.95	0.09

η MC/Sim

We analyze pt as a reference for the other variables

p_T MC/Sim

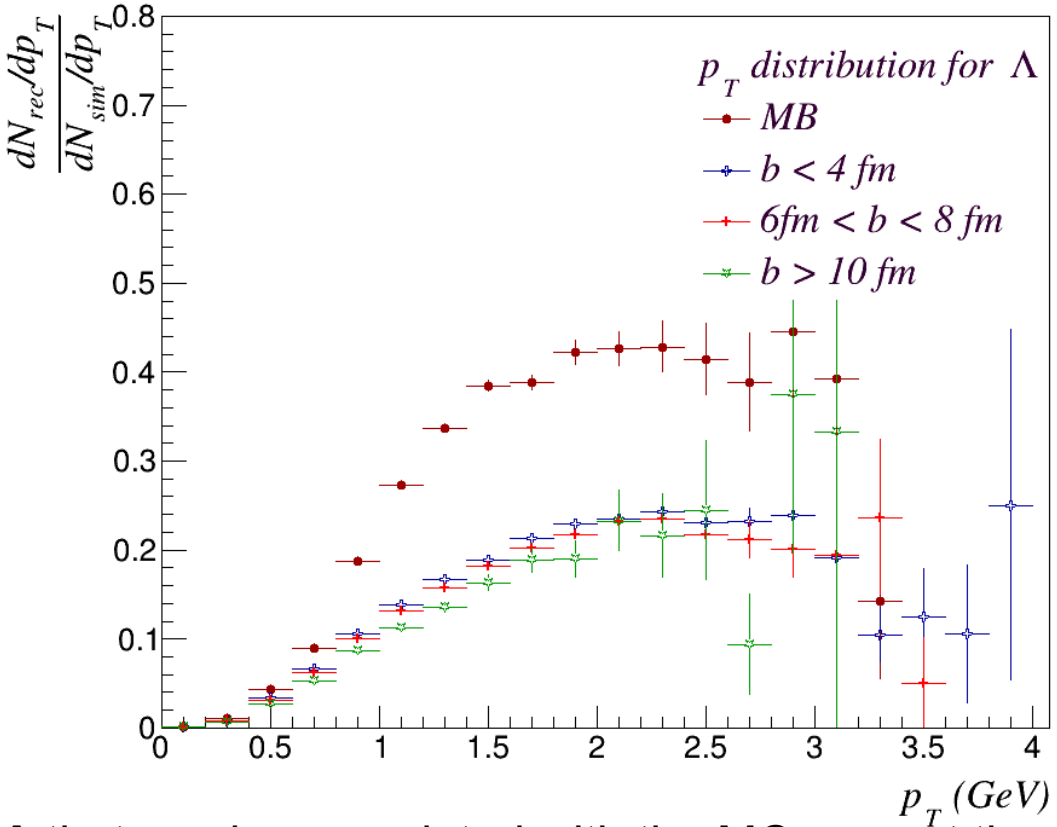




|η| <1.3

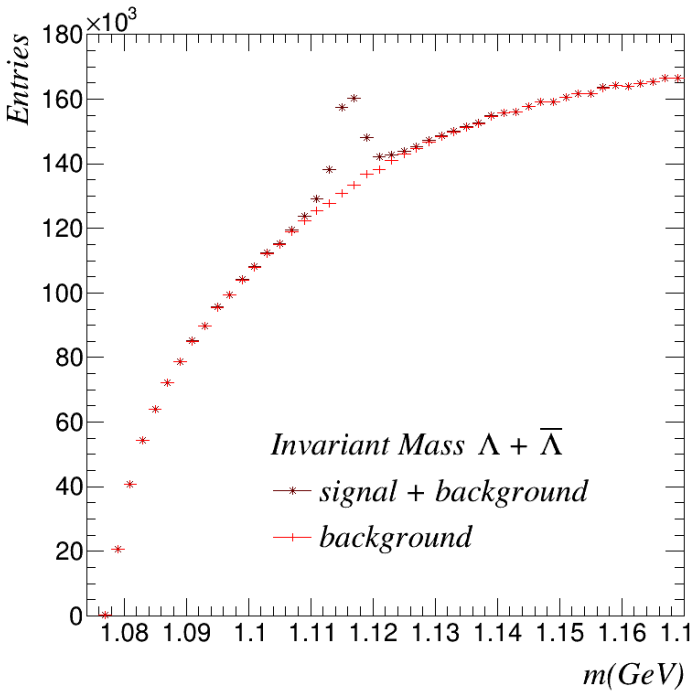
pt > 0.001

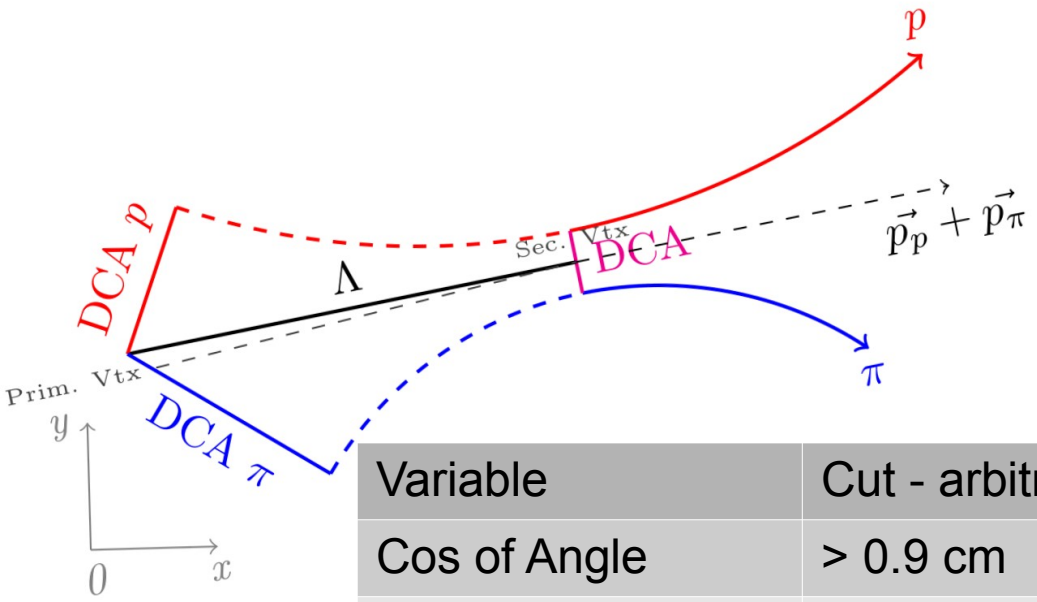
Max. eff for reconstruction in p_T



From candidates for **Λ** that can be associated with the MC, we get the ratio with simulated distributions as a function of pt. There is no difference for different impact parameters → get efficiency/acceptance max value?

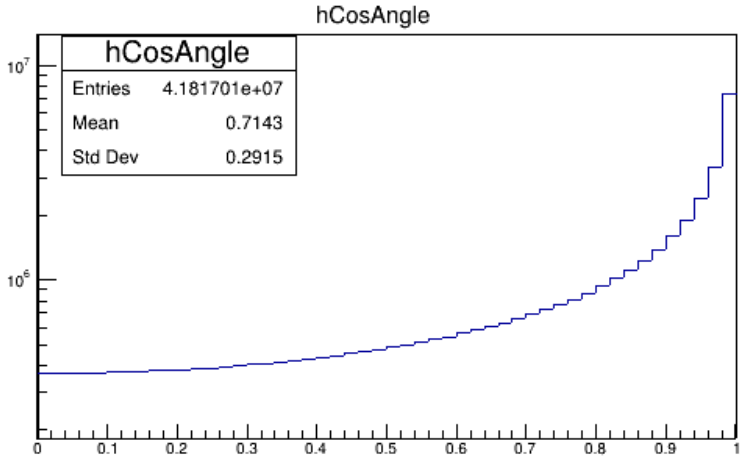
Reconstruction – cuts for selection



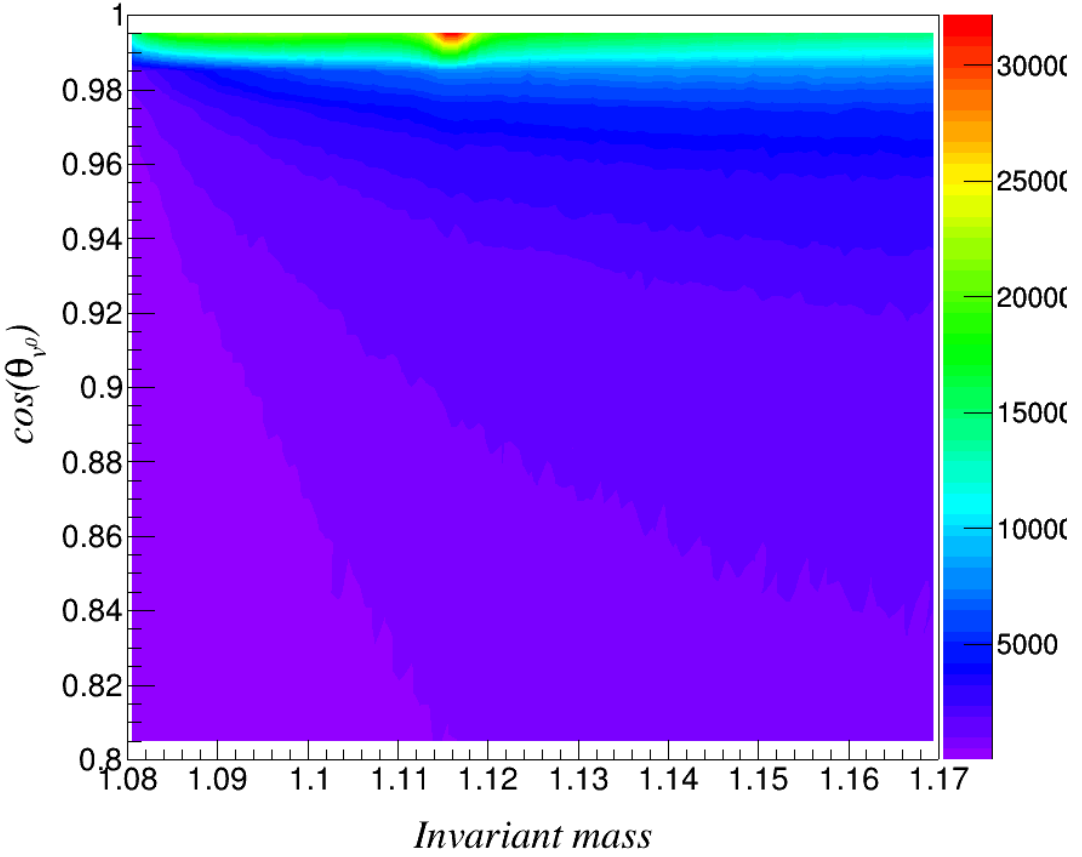


Variable	Cut - arbitrary
Cos of Angle	> 0.9 cm
DCA V0	< 1.0 cm
DCA p-track	> 1.0 cm?
DCA π-track	> 1.0 cm?

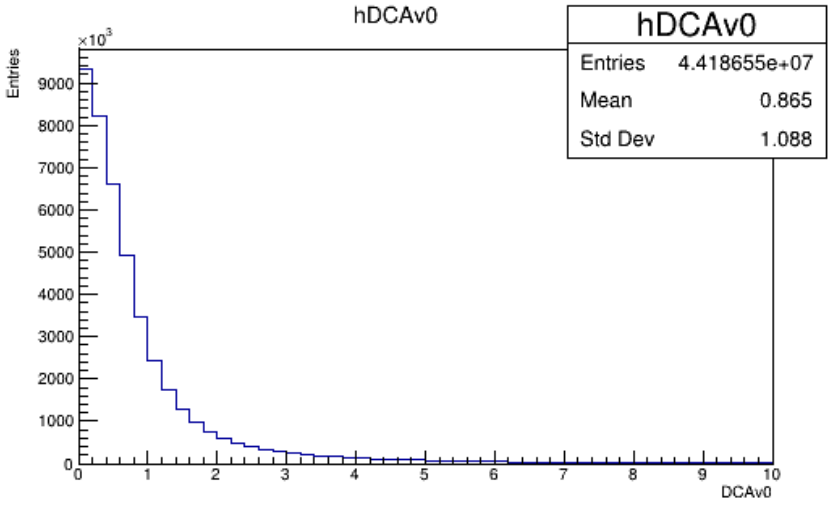
Cosine of Pointing Angle



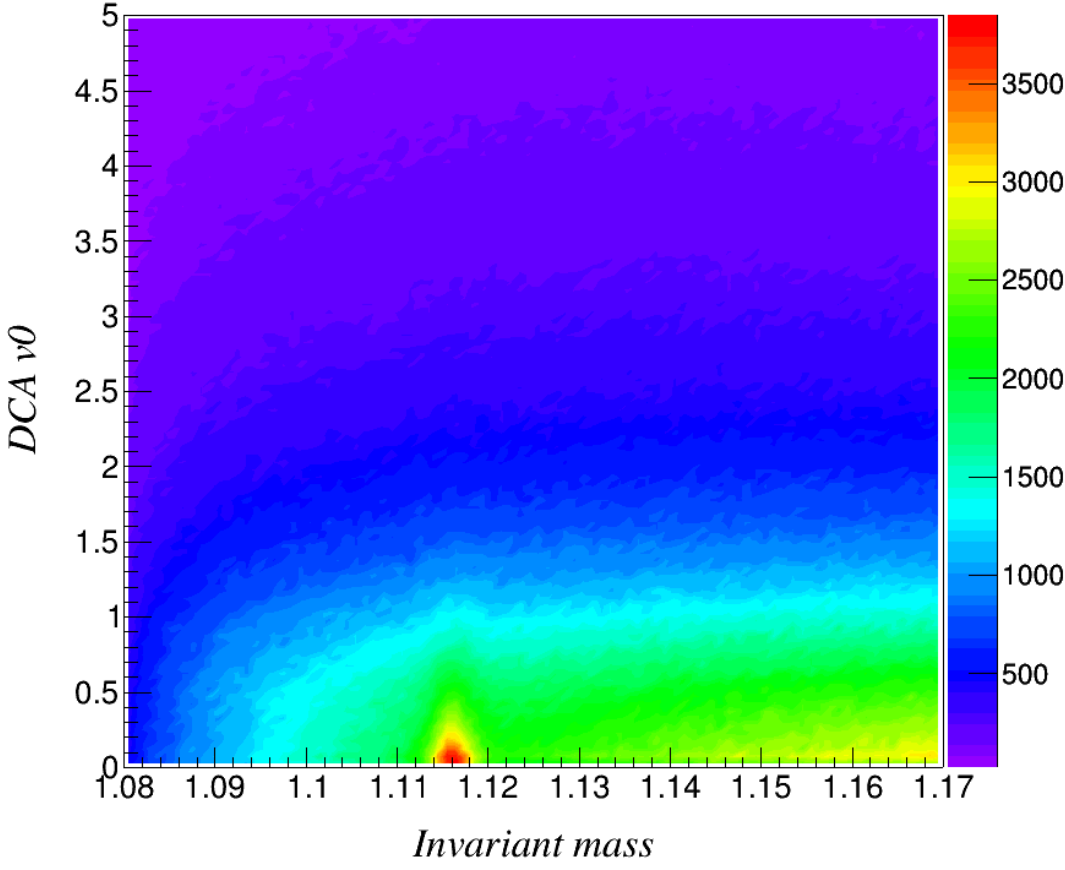
Cos(θ) > 0.98



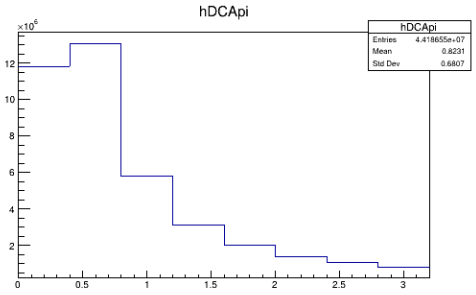
DCA V0



DCAv0 < 0.5 cm



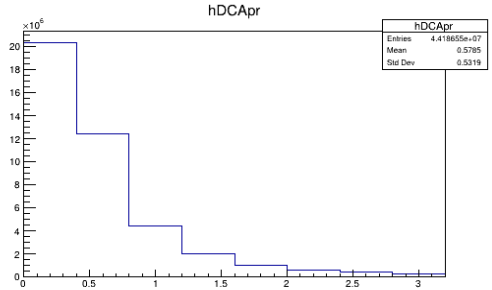
DCA of daughter tracks

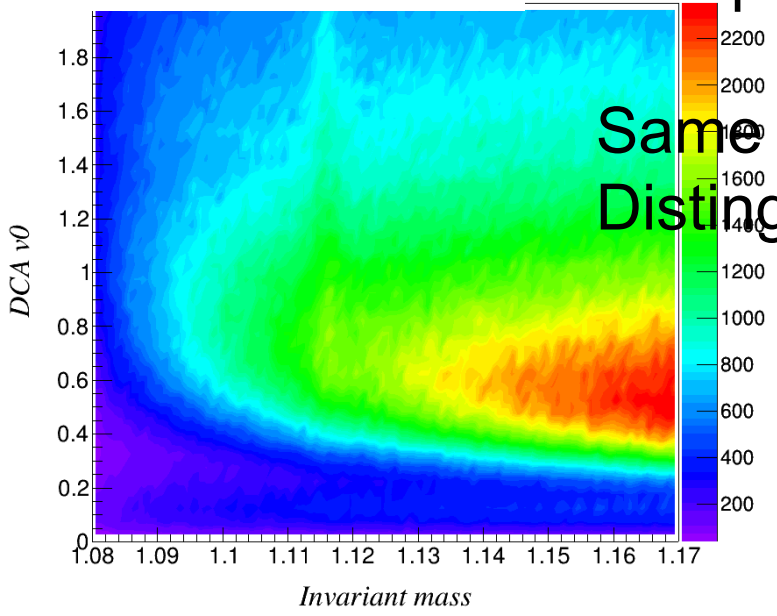


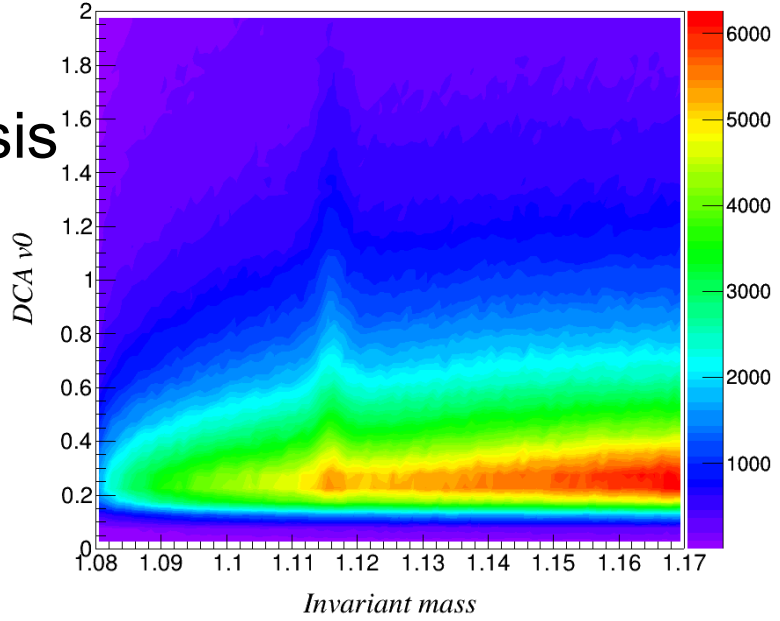
Different cuts for each track

DCApi > 0.3 cm
DCApr > 0.1 cm

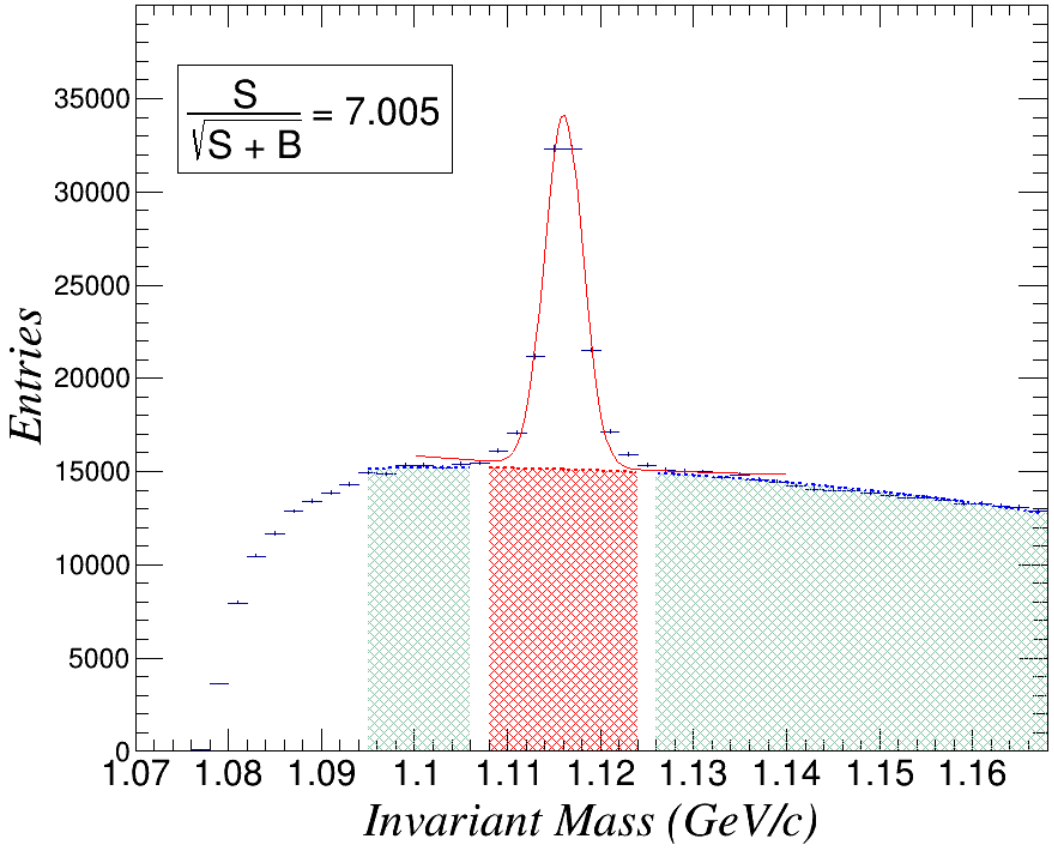
Same cut for some analysis
Distinguish Λ from $\overline{\Lambda}$







Define the preliminary cuts



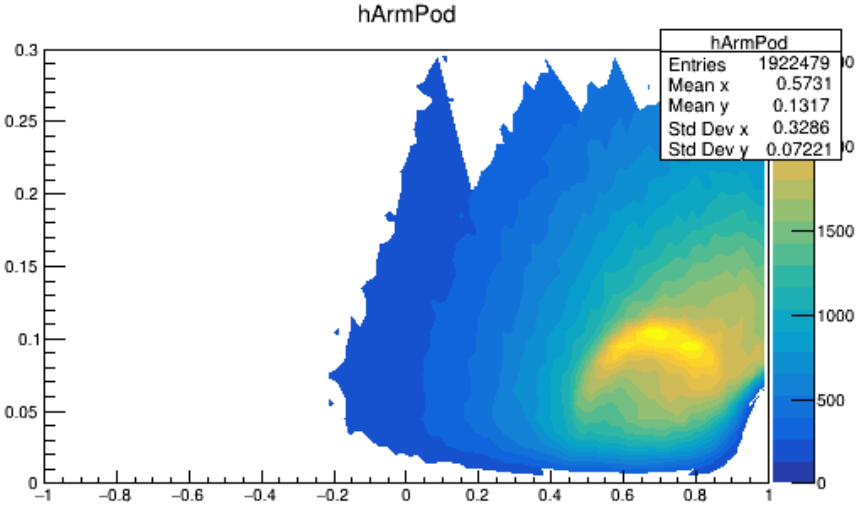
Variable	Cut
Cos of Angle	> 0.98
DCA V0	< 0.5 cm
DCA p-track	> 0.1 cm
DCA π-track	> 0.3 cm

Significance measured in 3.5σ from the peak

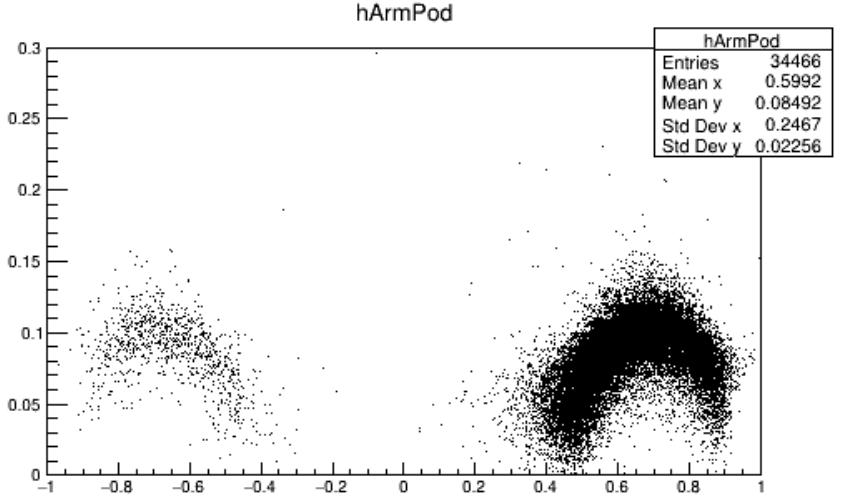
Distinguish between Λ and $\bar{\Lambda}$

$$\alpha = \frac{p_L^+ - p_L^-}{p_L^+ + p_L^-}$$

We use α > 0 to select Λ
α < 0 to select $\bar{\Lambda}$

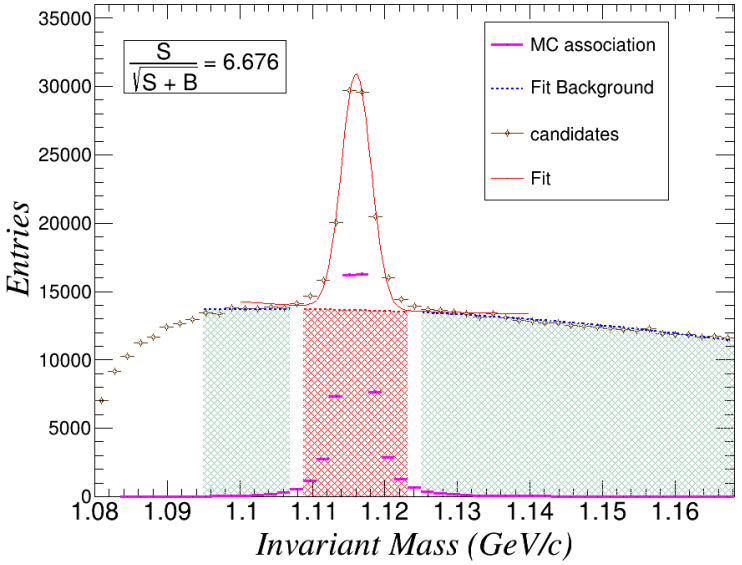


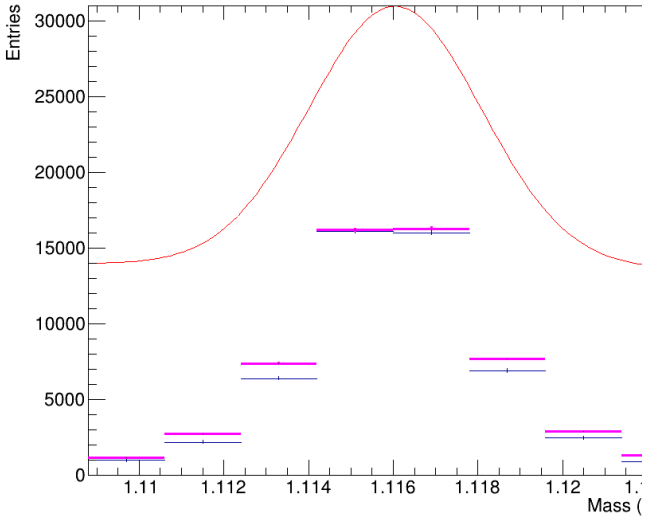
Strong cuts without MC identification, because of the background we can't see Λ

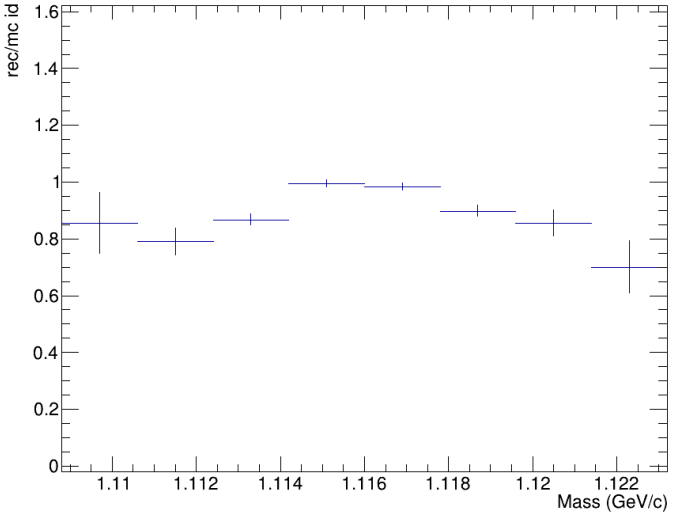


Only a few percent correspond to generated hyperons, as we can see after MC identification of the reconstructed tracks

Invariant Mass ratio for Λ

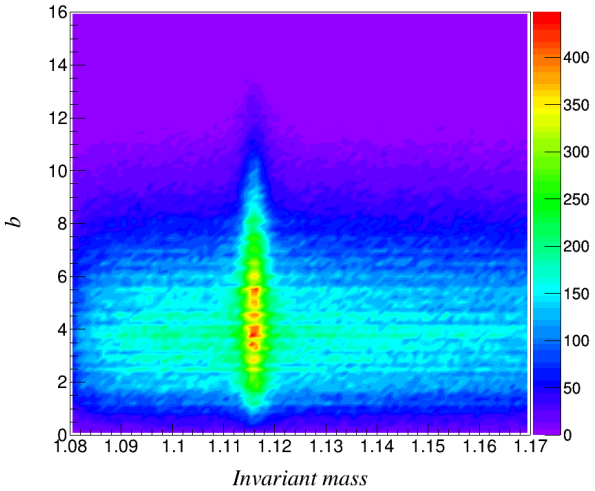


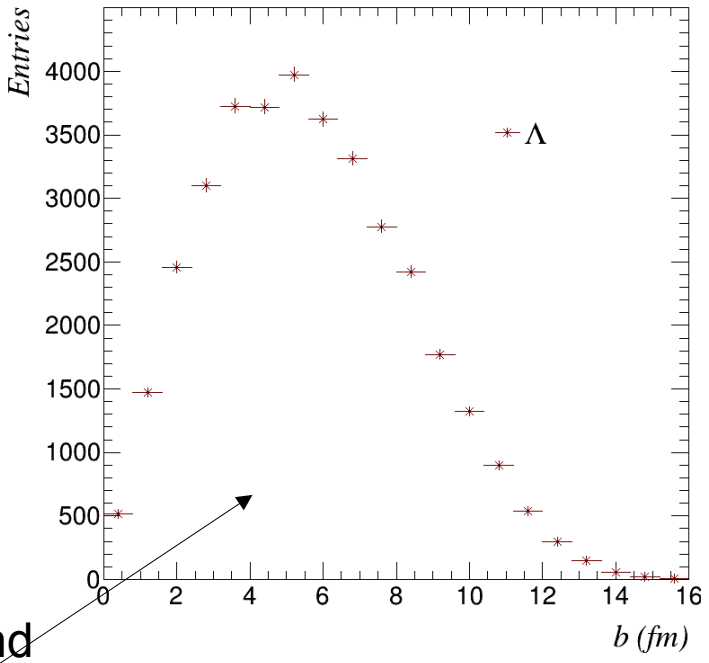




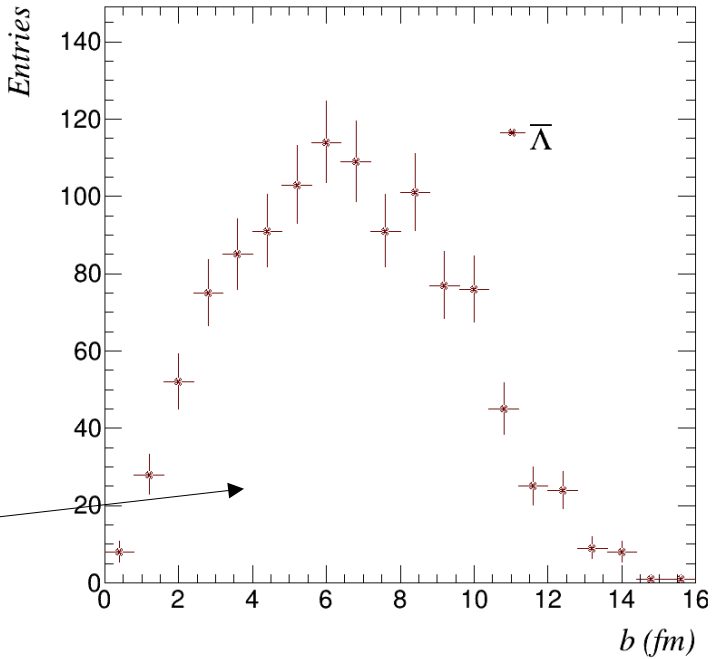
Signal cleaned and compared with MC association of V0 candidates

Λ and $\bar{\Lambda}$ vs Impact Parameter





For these two distributions we get the MC identification of the reconstructed tracks after kinematic cuts



To do:
With bin counting background subtraction method, we can clean the signal to get distributions like

Code:
b = (FairMCEventHeader*)→ GetB();

To do

- We get invariant mass distribution → we need to Improve track selection
- Implement analysis for different impact parameter - centrality
- Check PID for reconstructed tracks

Suggestions?