JÜLICH FORSCHUNGSZENTRUM

p̄anda

Study of Excited Cascade Baryons (Update)

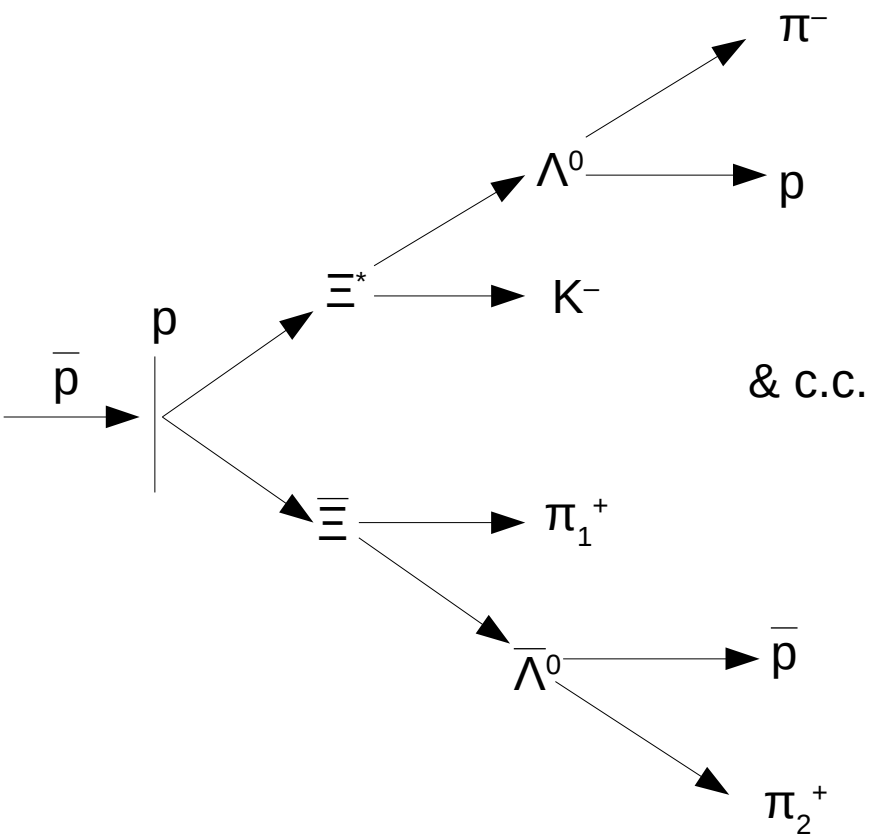
$\bar{P}$ANDA – Collaboration Meeting Mainz, September 13th 2016 | Jenny Pütz

Outline

- Simulation
- Reconstruction: Final State Particles
- Comparison ideal PR & realistic PR
- Reconstruction: Composite States
- Comparison different PID selections
- Summary and Outlook

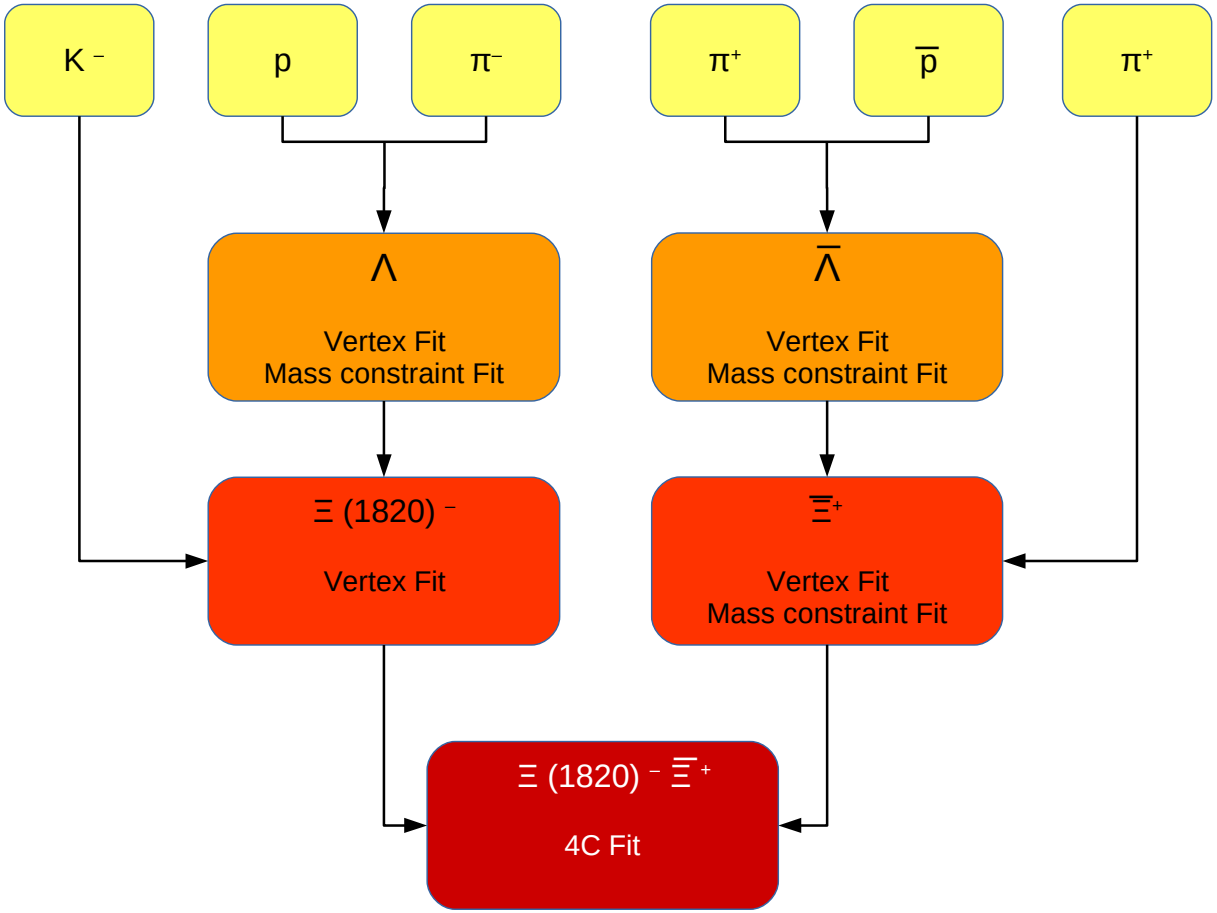
Simulation

- 1.5 million signal events
- $\bar{p}p \rightarrow \Xi(1820)\,\bar{\Xi}$ and c.c.
- Mass of Ξ(1820): $m_{\Xi(1820)} = 1.823\ \mathrm{GeV}/c^2$
- Width: $\Gamma = 24$ MeV
- Spin & Parity: $3/2^-$
- $p_{\bar{p}} = 4.6$ GeV/c (approx. 100 MeV above production threshold)
- PandaRoot: trunk rev. 29165 (former rev. 28958)

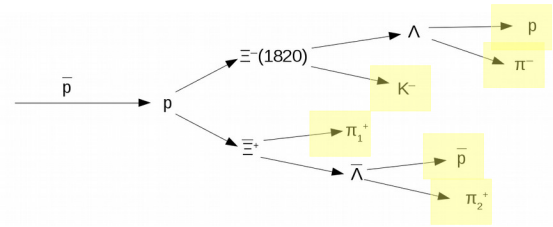


Ξ* denotes for Ξ(1820)

Reconstruction Strategy



Reconstruction
Final State Particles



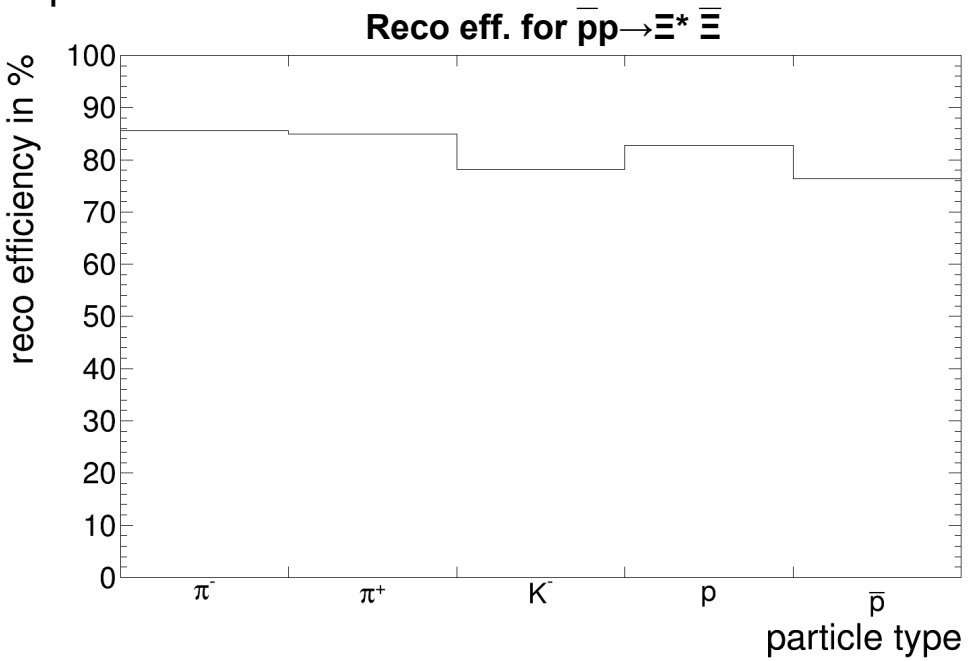
- Used ideal PR and ideal particle identification (PID)
- Selected only final state particles with $N_{Hits} \geq 4$ in any inner tracking detector (MVD, STT, GEM)
- Reconstruction efficiency for final state particles:

Reco eff. $\bar{p}p \rightarrow \Xi^* \bar{\Xi}$

particle	Reco. eff. in %
π^-	85.5
π_2^+ ($\bar{\Lambda}^0$)	86.5
π_1^+ ($\bar{\Xi}$)	83.3
K^-	78.2
p	82.7
$\bar{p}$	76.3

Reco eff. $\bar{p}p \rightarrow \Xi \bar{\Xi}^*$

particle	Reco. eff. in %
π^+	84.7
π_2^- (Λ^0)	86.1
π_1^- (Ξ)	82.9
K^+	82.9
p	78.7
$\bar{p}$	79.6



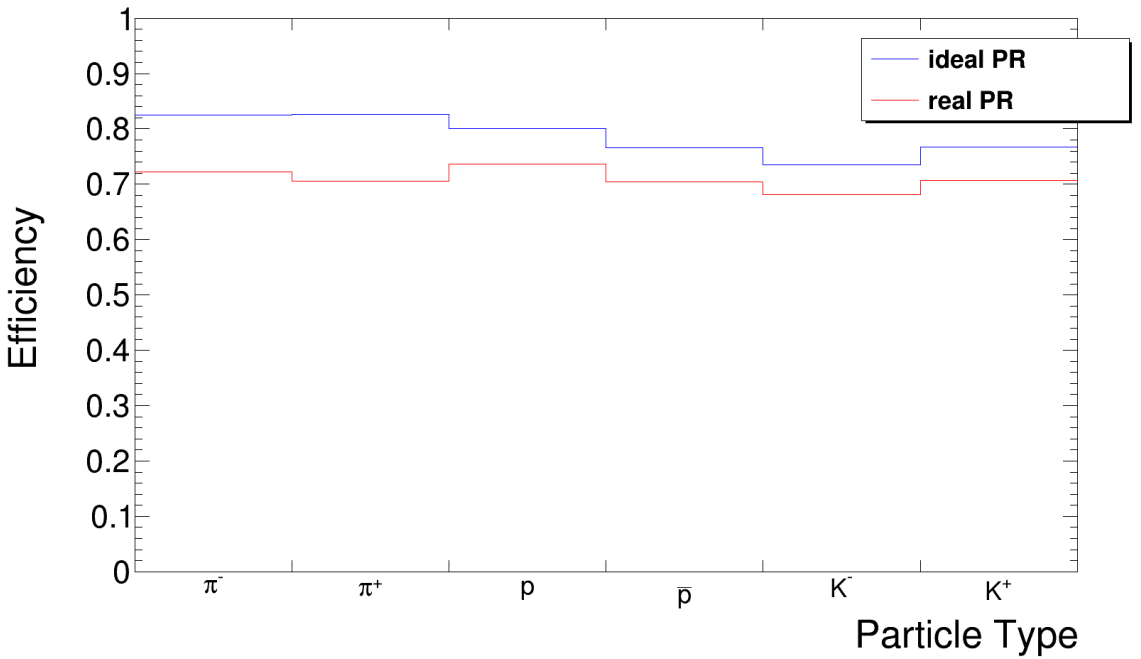
Comparison ideal PR & realistic PR

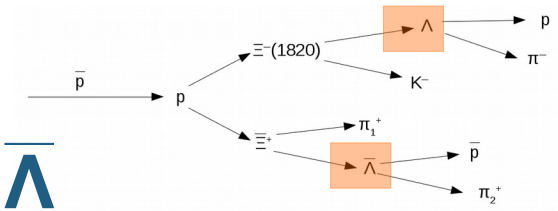
10,000 events
$p\bar{p} \rightarrow p\,\bar{p}\,\pi^+\,\pi^-\,K^+\,K^-$

Angle & momentum

π^+ & π^-: θ=[0..60]° p=[0.1..0.7] GeV/c
$\bar{p}$ & p : θ=[0..50]° p=[0.2..2.0] GeV/c
K^- & K^+: θ=[0..30]° p=[0.3..2.7] GeV/c

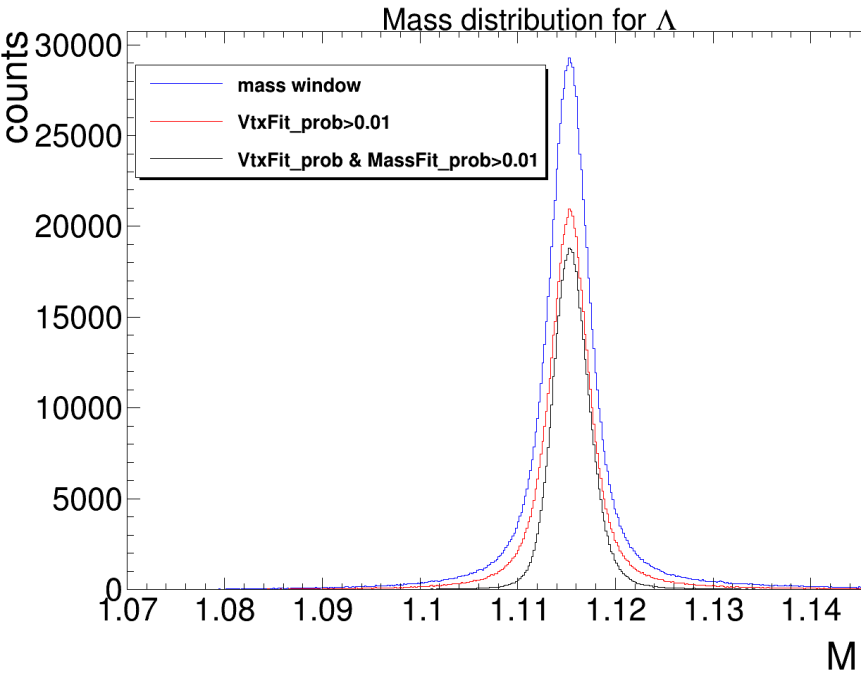
Particle	Efficiency loss [%]
π^+	14.6
π^-	12.4
K^-	7.3
K^+	7.9
p	8.0
$\bar{p}$	8.0

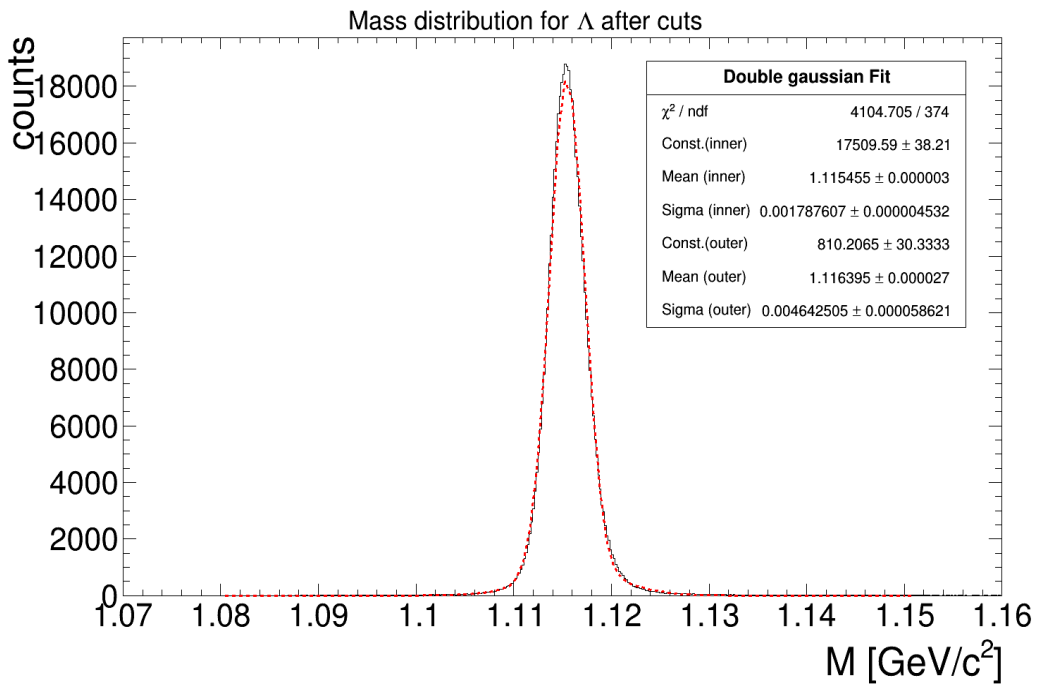


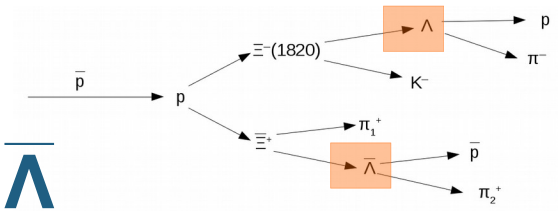


Reconstruction of Λ & $\bar{\Lambda}$

- Mass: $M_{\Lambda,PDG} = 1.116\ GeV/c^2$
- Selection: Mass window ($\pm 0.15\ GeV/c^2$), vertex fit, mass fit
- Fitted mass: $M_{\Lambda,fit} = 1.1155\ GeV/c^2$

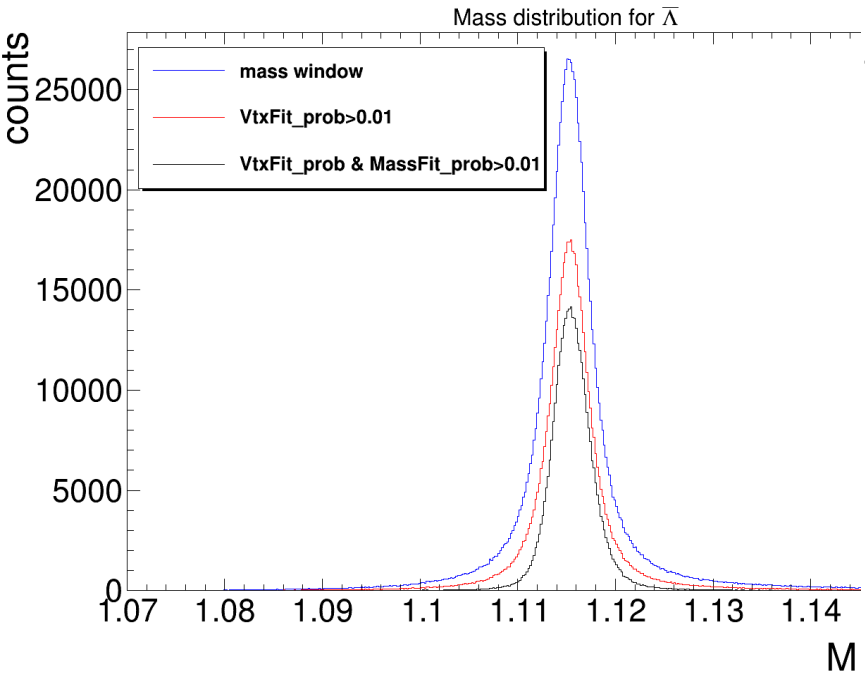


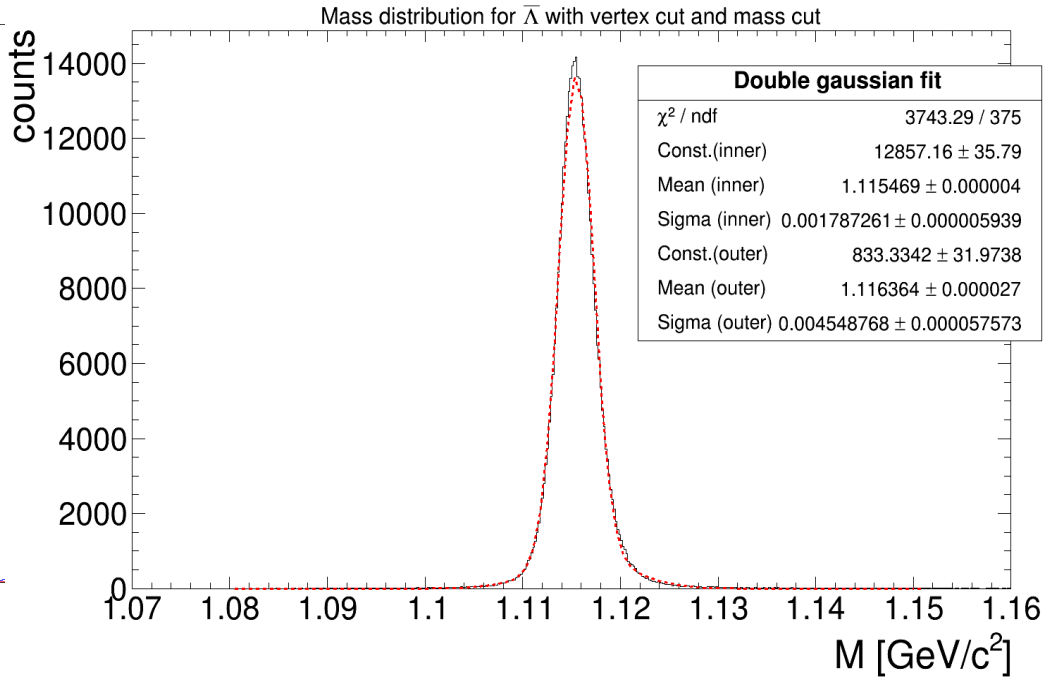




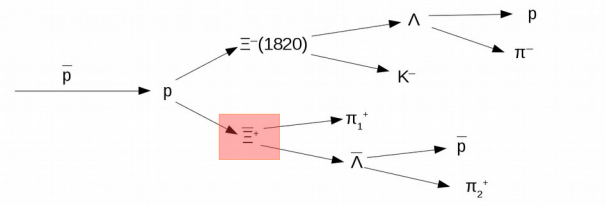
Reconstruction of Λ & $\bar{\Lambda}$

- Mass: $M_{\bar{\Lambda},PDG}$ = 1.116 GeV/c²
- Selection: Mass window (± 0.15 GeV/c²), vertex fit, mass fit
- Fitted mass: $M_{\bar{\Lambda},fit}$ = 1.1155 GeV/c²

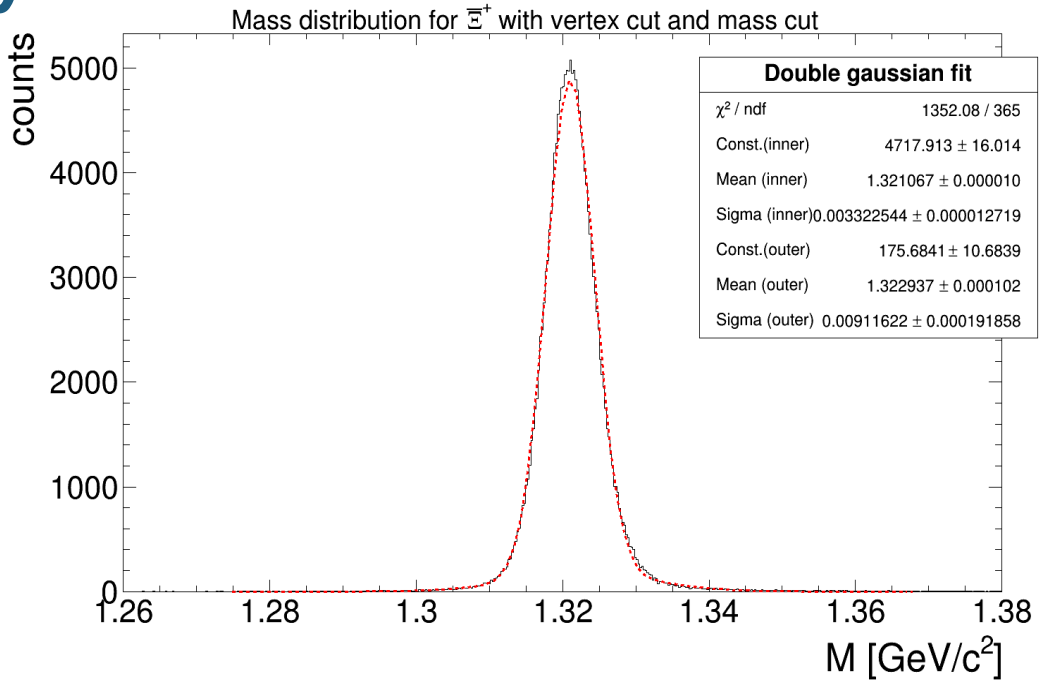


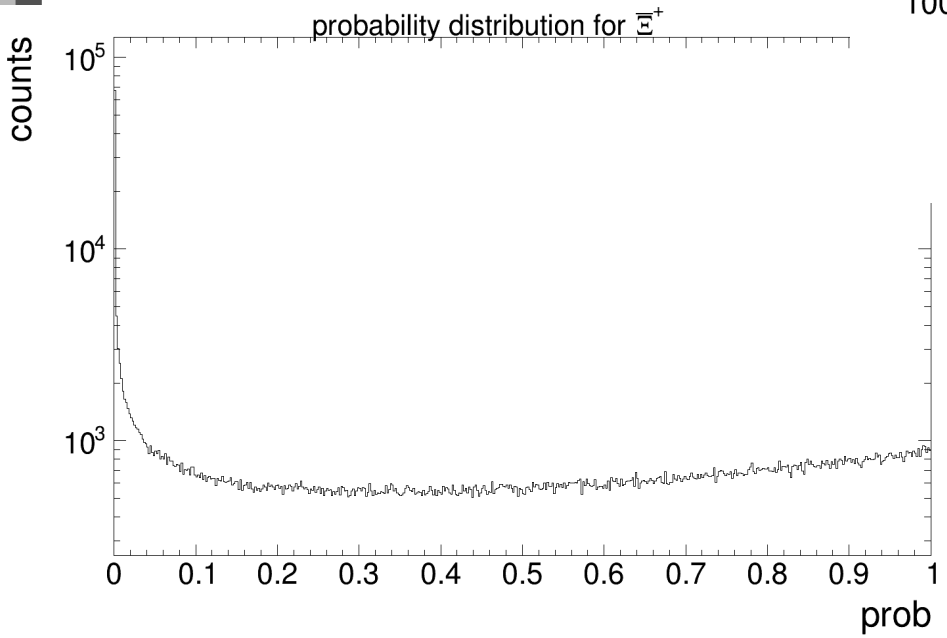


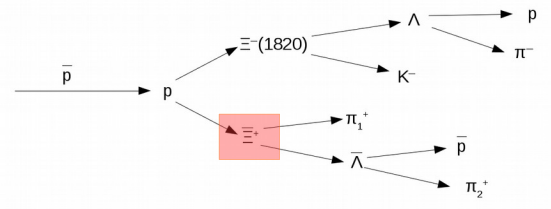
Reconstruction of $\bar{\Xi}$: Mass and probability



- Selection: similar to Λ
- Mass: $M_{\bar{\Xi},PDG} = 1.321$ GeV/c^2
- Fitted mass: $M_{\bar{\Xi},fit} = 1.3211$ GeV/c^2

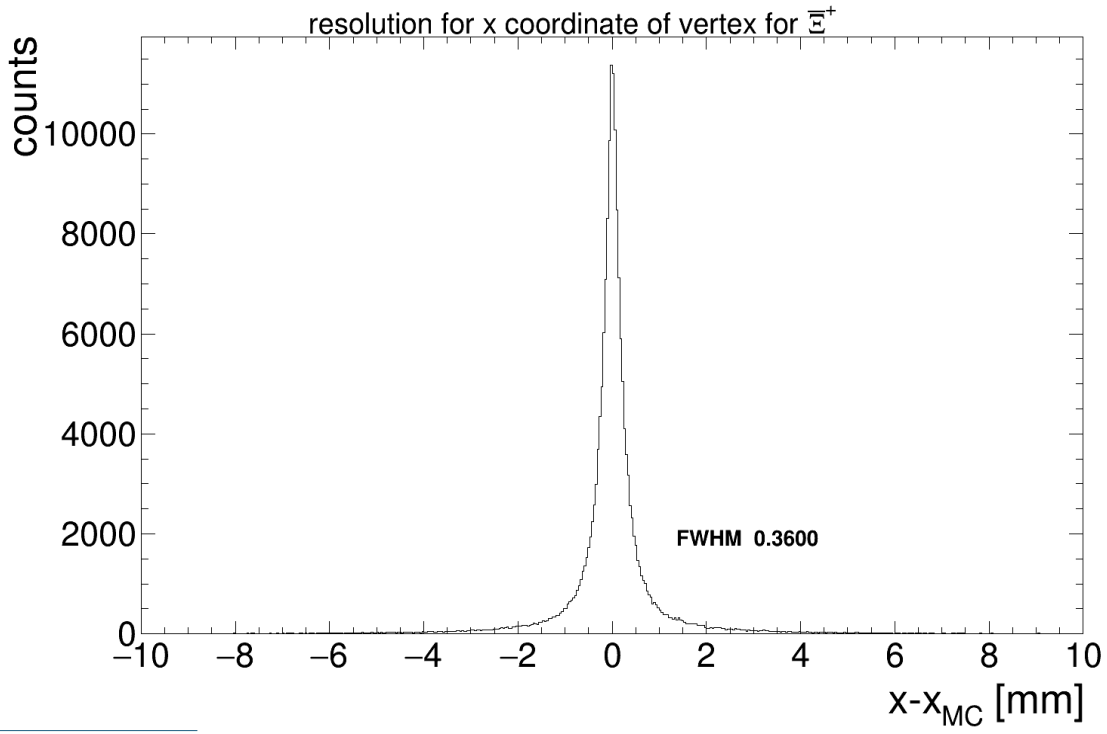






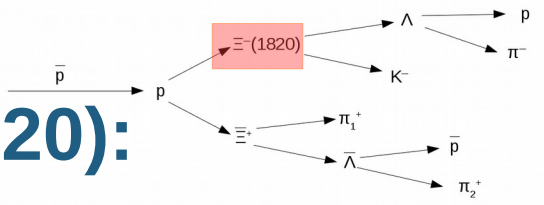
Reconstruction of $\bar{\Xi}$ Vertex resolution

- Vertex resolution evaluated with FWHM

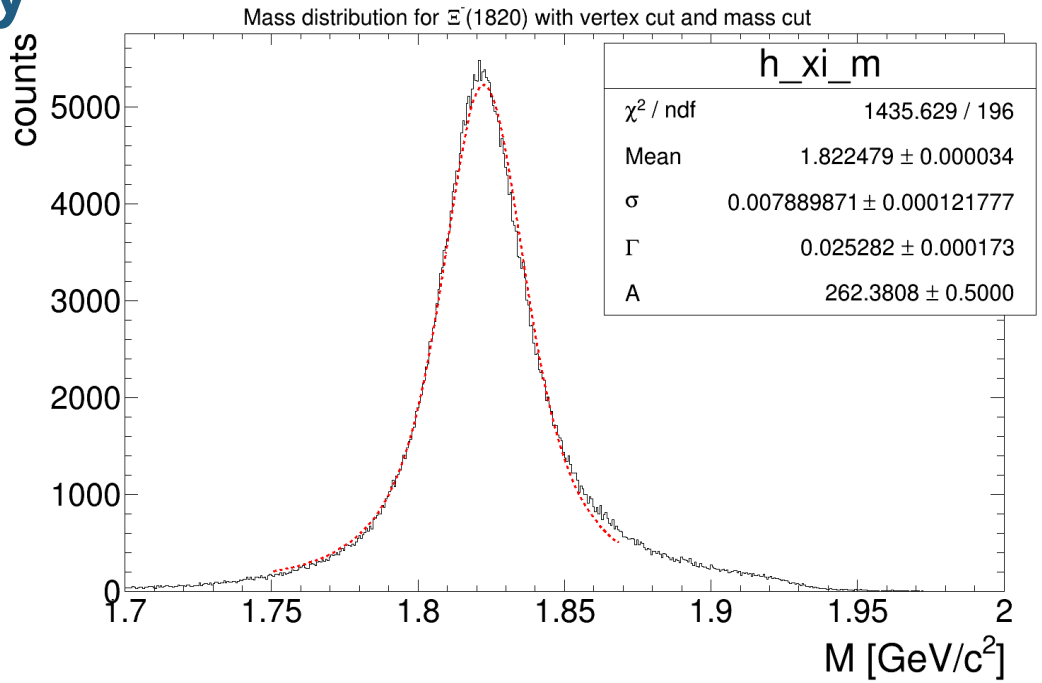


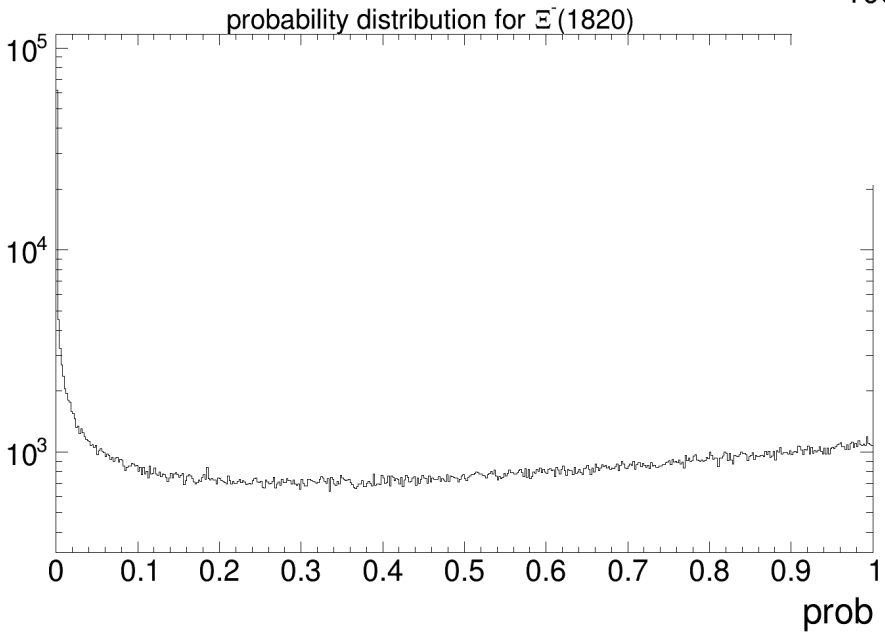
position	Vertex resolution	
	$\bar{\Xi}$	Ξ (c.c. channel)
x/mm	0.36	0.36
y/mm	0.36	0.36
z/mm	1.28	1.24

Reconstruction of Ξ(1820): Mass and probability

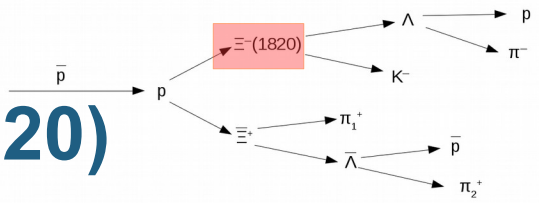


- Selection: similar to $\bar{\Xi}$ (w/o mass fit)
- Mass: $M_{\bar{\Xi},PDG} = 1.823$ GeV/c^2
- Width: $\Gamma_{\bar{\Xi},PDG} = 24$ MeV
- Fitted mass: $M_{\bar{\Xi},fit} = 1.822$ GeV/c^2
- Fitted width: $\Gamma_{\bar{\Xi},fit} = 25$ MeV

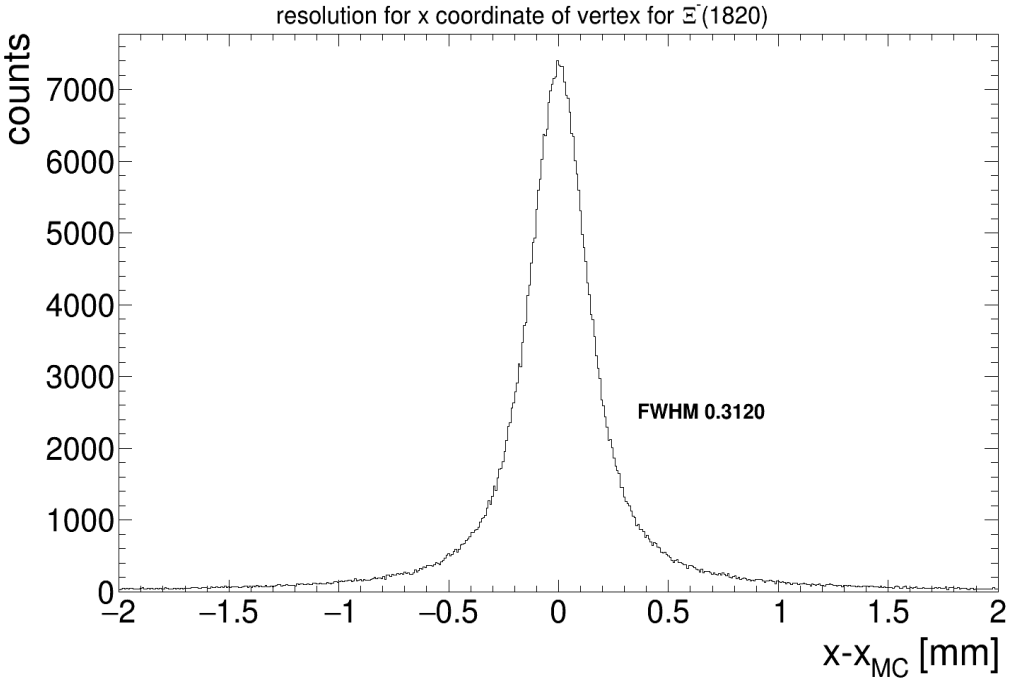




Reconstruction of Ξ(1820) Vertex resolution



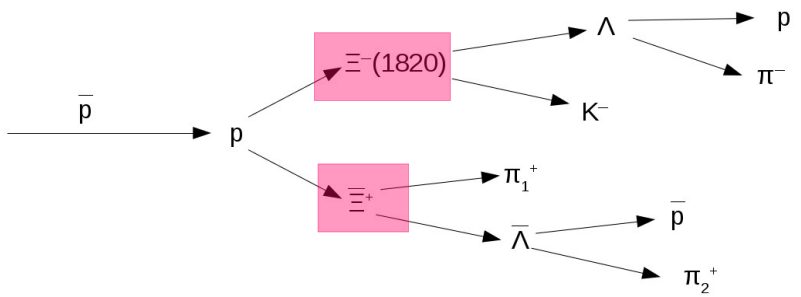
- Vertex resolution evaluated with FWHM

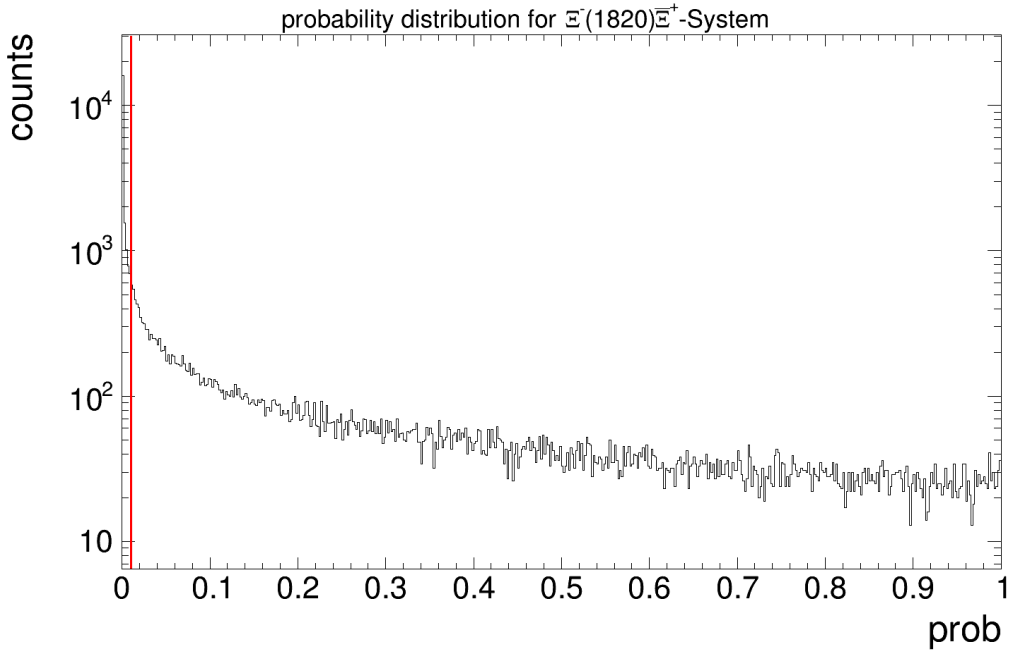


position	Vertex resolution	
	Ξ(1820)	$\bar{\Xi}$(1820) (c.c. channel)
x/mm	0.31	0.30
y/mm	0.30	0.29
z/mm	0.86	0.88

Reconstruction of Ξ(1820) $\bar{\Xi}$

- Combine Ξ(1820) and $\bar{\Xi}$
- Perform four momentum constraint fit
- Select candidates with p>0.01





Reconstruction Efficiencies

Reco efficiency $\bar{p}p \rightarrow \Xi^* \bar{\Xi}$	
Particle	Reco eff. in %
Λ^0	32.9
$\bar{\Lambda}^0$	25.2
$\bar{\Xi}$	13.0
$\Xi(1820)$	27.6
$\Xi(1820)\ \bar{\Xi}$ sys	2.1

Reco efficiency $\bar{p}p \rightarrow \Xi\ \bar{\Xi}^*$	
particle	Reco eff. in %
Λ^0	26.8
$\bar{\Lambda}^0$	31.2
Ξ	13.7
$\bar{\Xi}(1820)$	27.8
$\Xi\ \bar{\Xi}(1820)$ sys	2.2

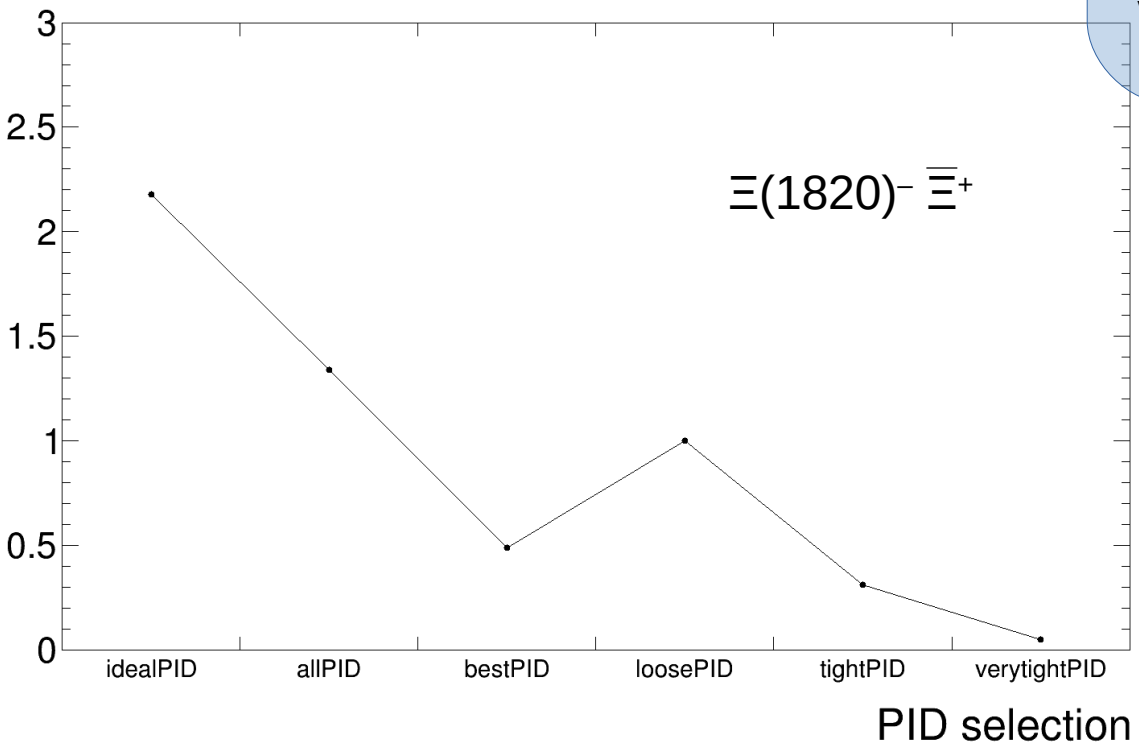
Comparison Ideal & Realistic PID

Simulation:

10,000 events for $\bar{p}p \rightarrow \bar{\Xi}^{+}\,\Xi(1820)^{-}$
@4.6 GeV/c PHSP
Used all PID arrays

PID selection tightness

Ideal:	P=	1, for correct species 0, for all others
all:	P≥	0
loose:	P>	0.25
tight:	P>	0.50
verytight:	P>	0.90
best:	P=	maximal for species



Summary & Outlook

- ✔ Simulated 1.5 million signal events for $\bar{p}p \rightarrow \Xi(1820)\,\bar{\Xi}$ + c.c
- ✔ Used selection criteria discussed
- ✔ Mass of Ξ(1820) (reco eff. approx 27%) can be well reconstructed
- ✔ Reconstruction efficiency for full reaction chain 2.1% (2.2% for c.c.)

- ▫ Switch to realistic PID → work in progress
- ▫ Background simulation → work in progress
- ▫ Cut optimization
- ▫ Partial wave analysis of $\Lambda^0\,K^-\,\bar{\Xi}$ (& c.c) final state will be explored

Thank you for your attention!

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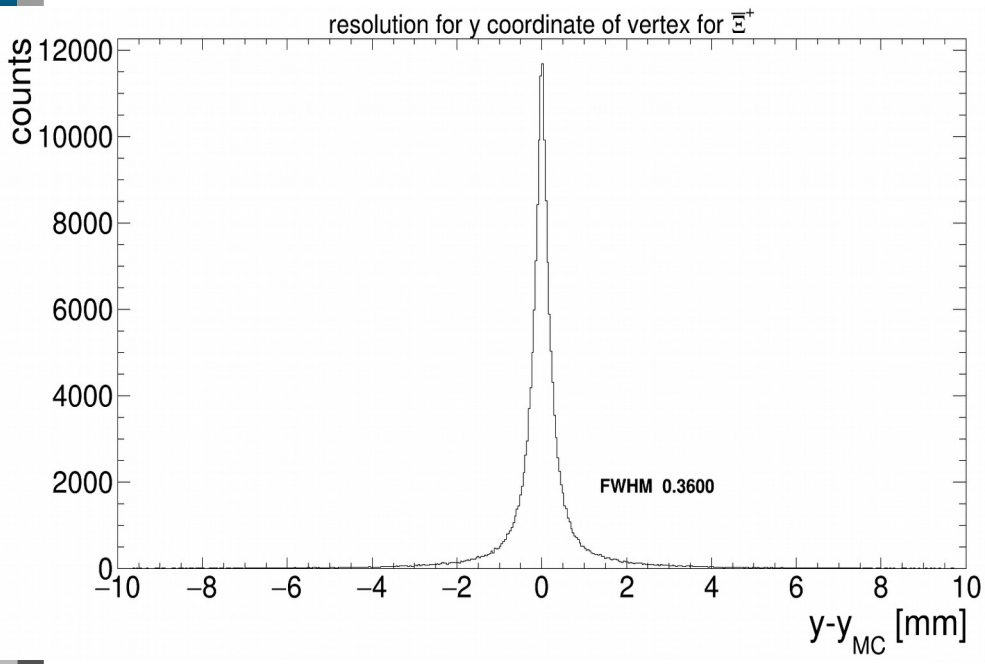
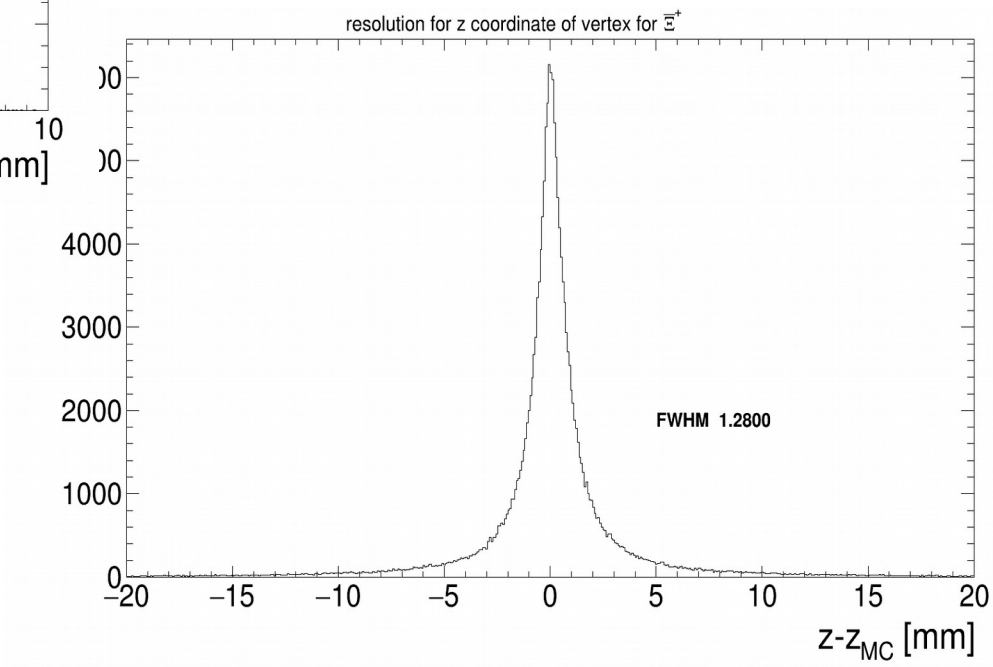
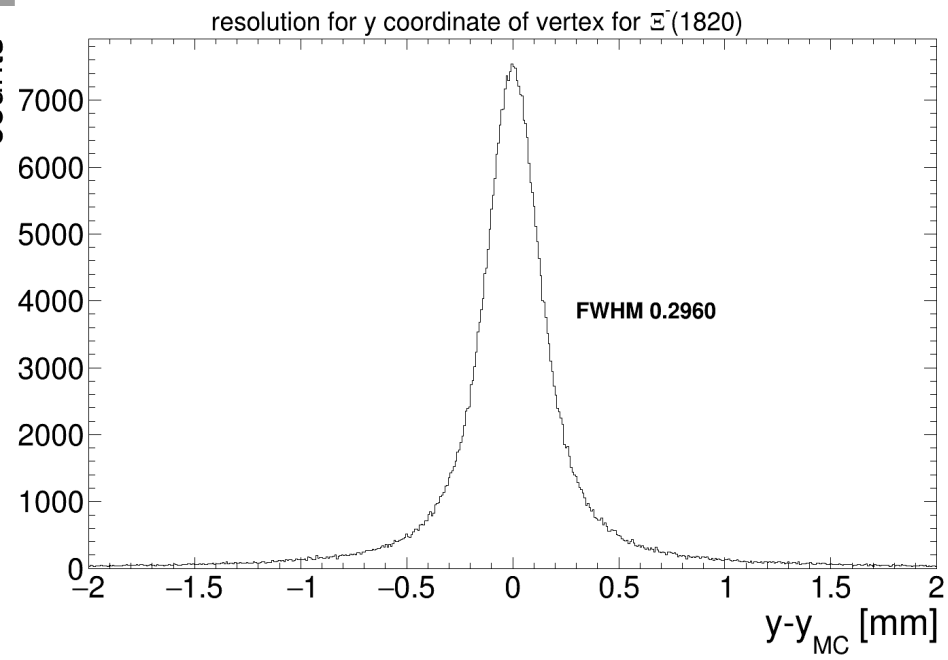
Backup

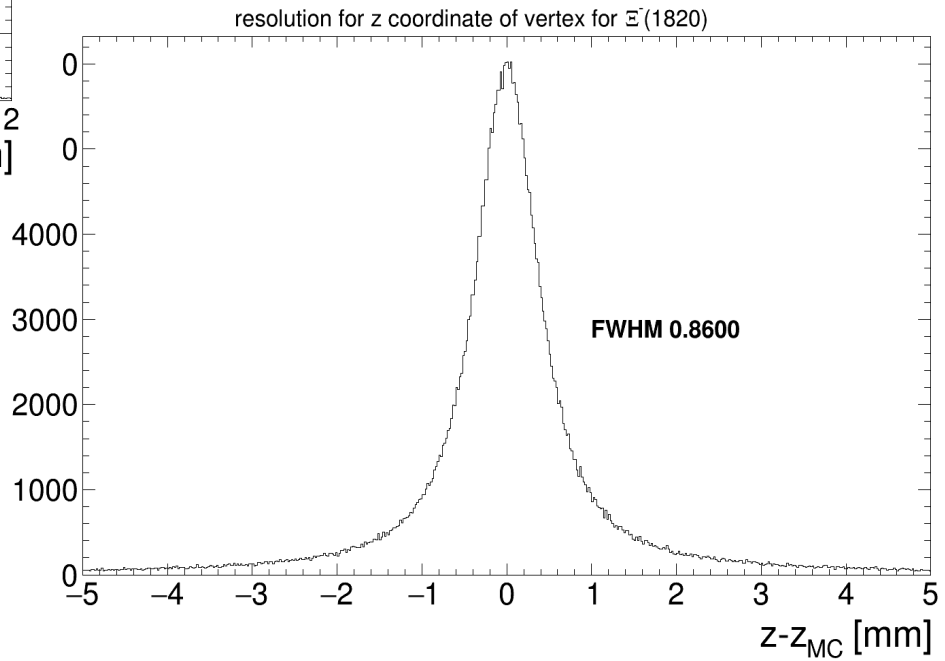
Vertex Resolution $\bar{\Xi}$



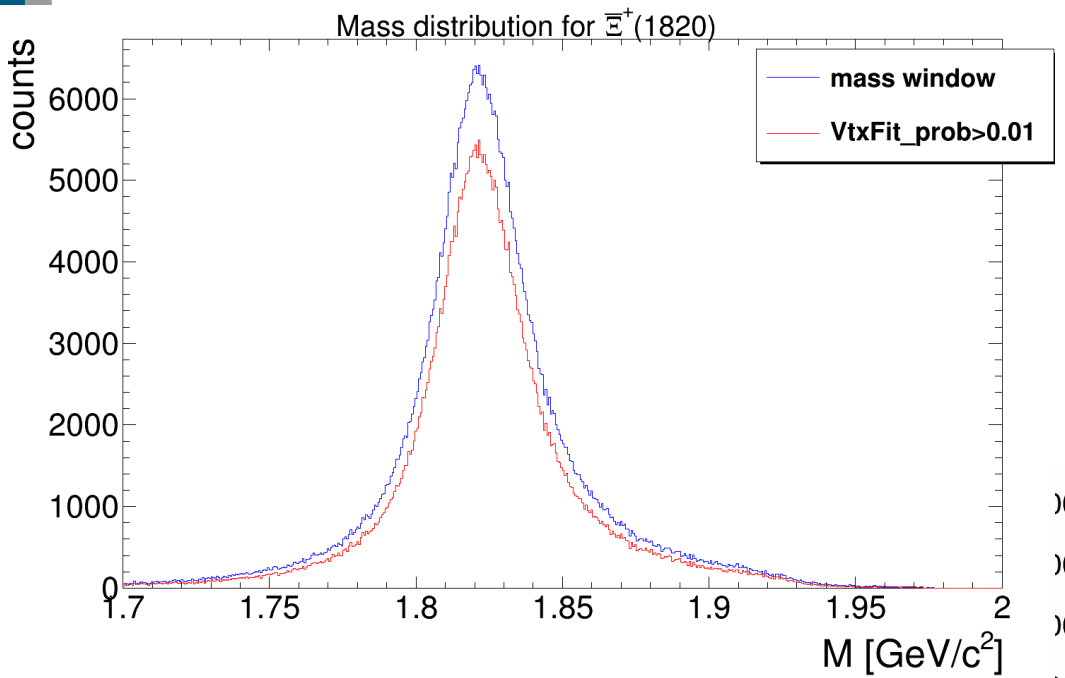


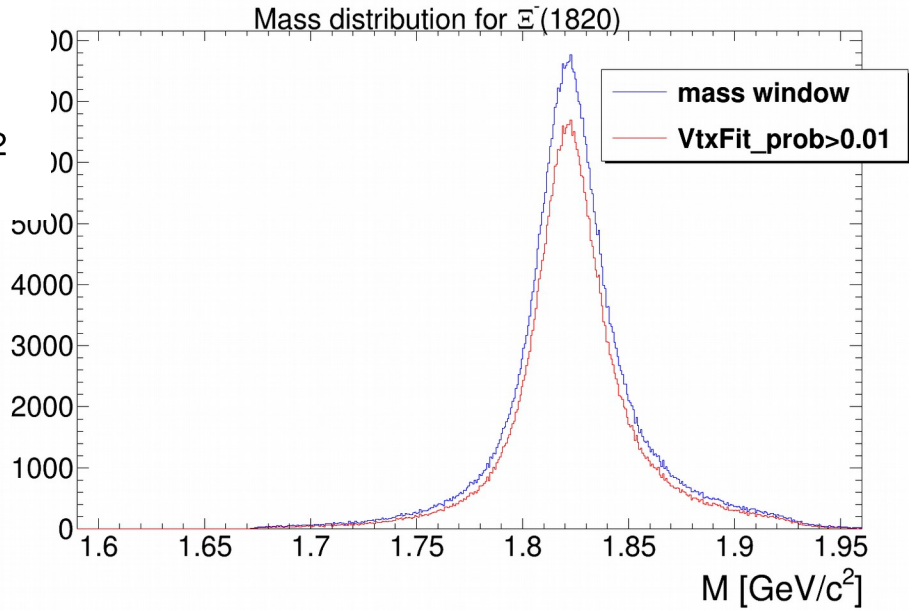
Vertex Resolution Ξ(1820)



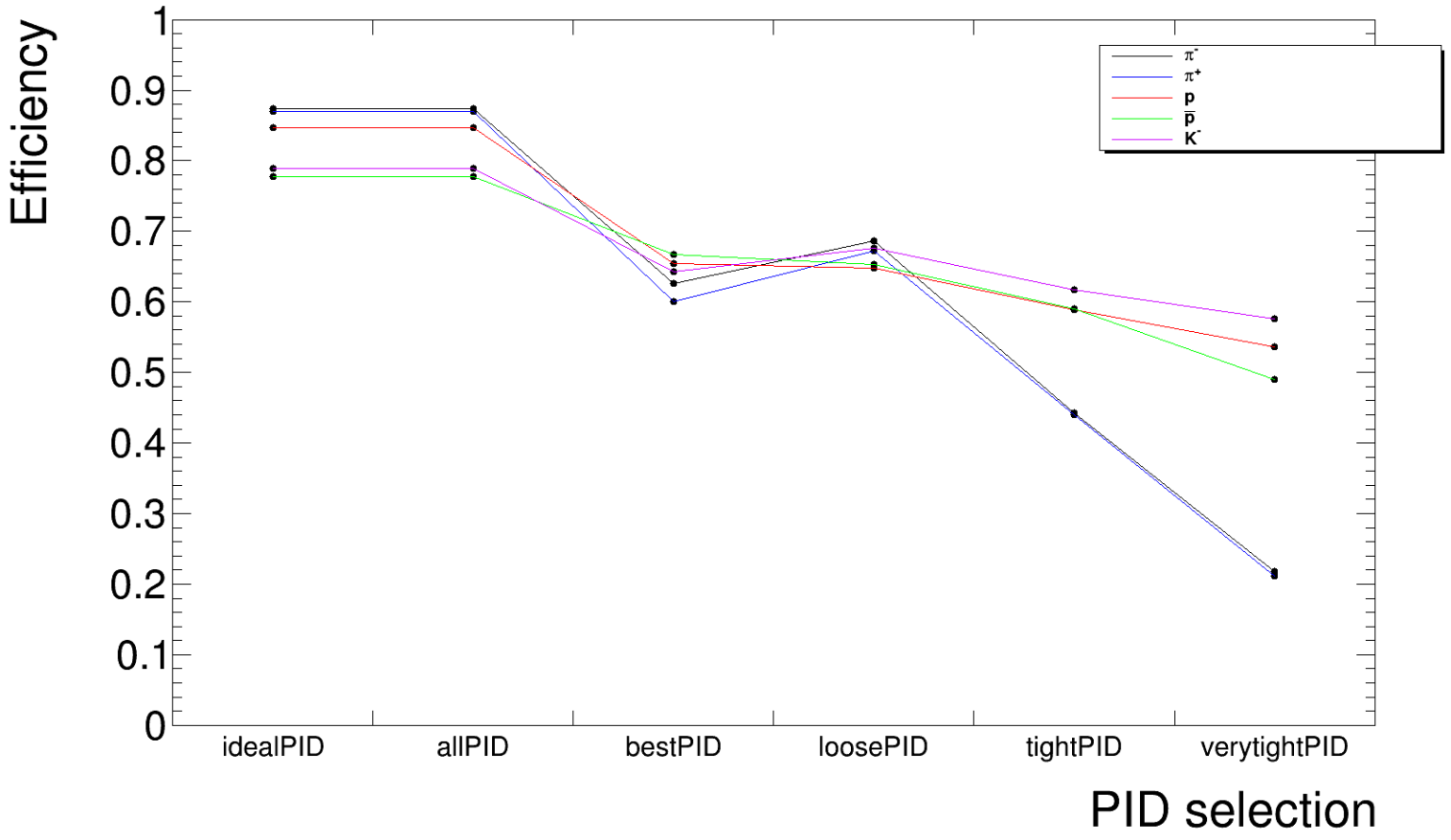


Mass after diff cuts: Ξ(1820) and $\bar{\Xi}$(1820)





Comparison Ideal & Realistic PID



Simulation and PID Selection

Simulation:

10,000 events for $\bar{p}p \rightarrow \bar{\Xi}^{+}\,\Xi(1820)^{-}$ @4.6 GeV/c PHSP

PID Array names:

PidAlgoMvd – Based on MVD info
PidAlgoStt - Based on STT info
PidAlgoDrc - Based on Barrel DIRC info
PidAlgoDisc - Based on Disc DIRC info
PidAlgoEmcBayes - Based on EMC info

PID selection tightness

Ideal:	P=	1, for correct species 0, for all others
all:	P≥	0
loose:	P>	0.25
tight:	P>	0.50
verytight:	P>	0.90
best:	P=	maximal for species