Group meeting
May 24th, 2024

Instruction responsibilities

- Classes for Fall 2024:
  - PHY 331:
    - Need to make syllabus
  - PHY 361:
    - Need to make syllabus

Service responsibilities

- Committee:
  - GlueX Compton Analysis Review Committee:
    - Waiting for author response

Group responsibilities

- Undergrad: Met with Dylan on Tuesday
- Need to start writing DOE report that is due early June

Analysis

TPOL:

- Waiting for new cooked files from 2022 data
- Need to run parallel TPOL analysis on 2022 data:
  - Standard
  - compressed

$KK\pi$:

- Agave is alive but the Agave cluster is now dead ☹
- Need include polarization information in low-mass PWA

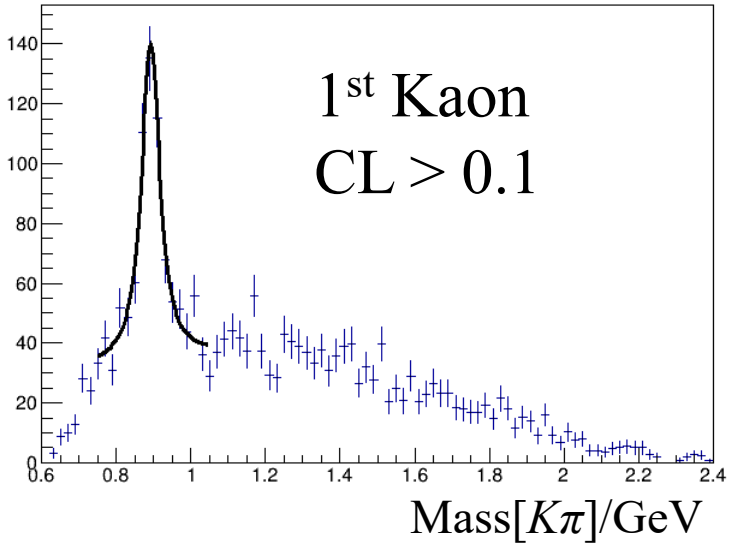
Ξ^*: Next slide

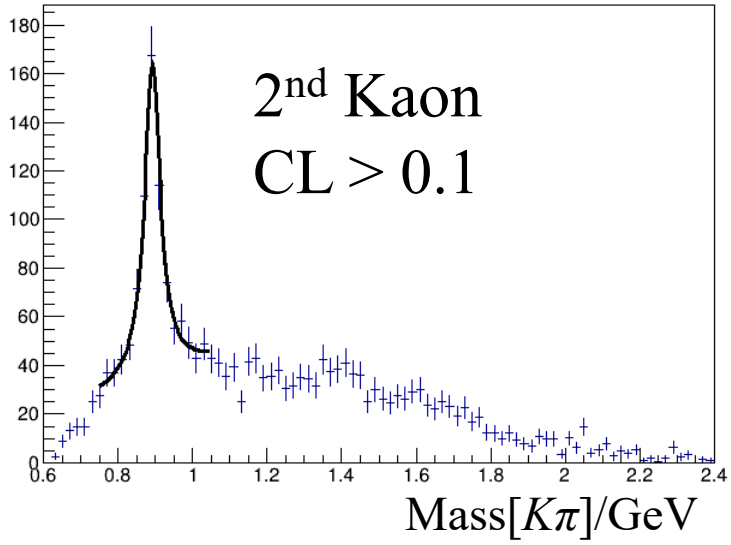
Ξ^* Analysis

Cuts:

- Best combo

Ξ^* Q-factors

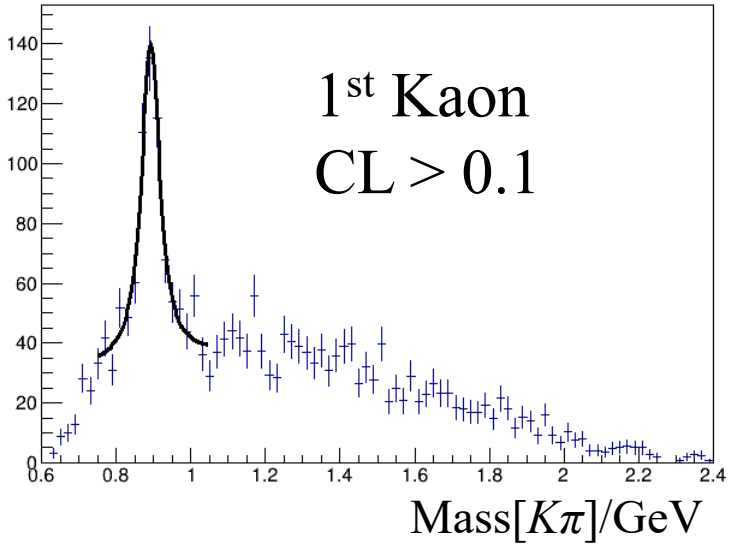


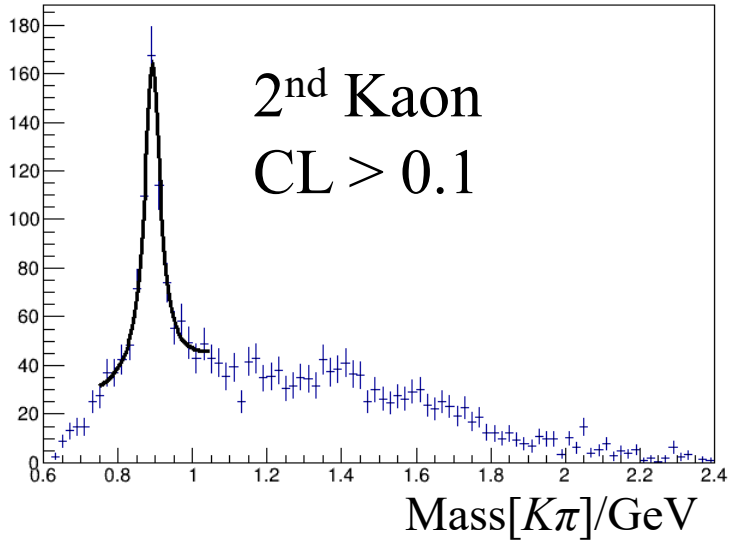


Fit with Voigtian:

- Center and width locked to PDG
- Resolution parameter σ allowed to vary

Ξ^* Q-factors



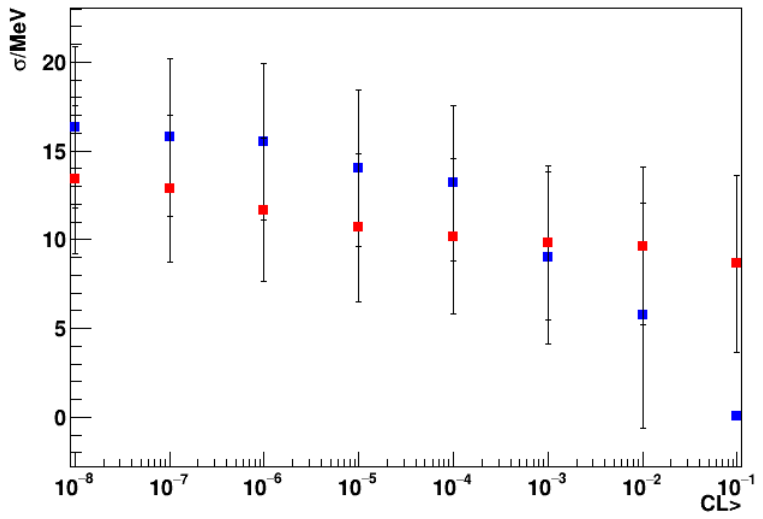


Fit with Voigtian:

- Center and width locked to PDG
- Resolution parameter σ allowed to vary

Found that the resolution was not consistent between 1st and 2nd Kaons

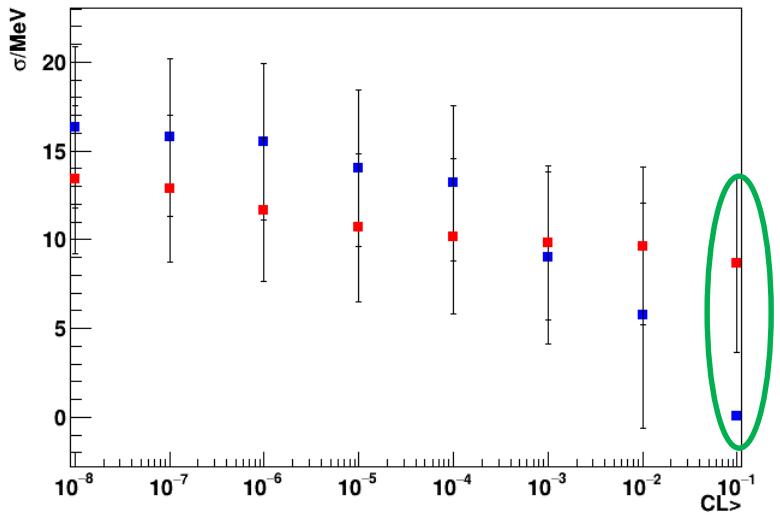
Ξ^* Q-factors



Red = first K^{+*}

Blue = second K^{+*}

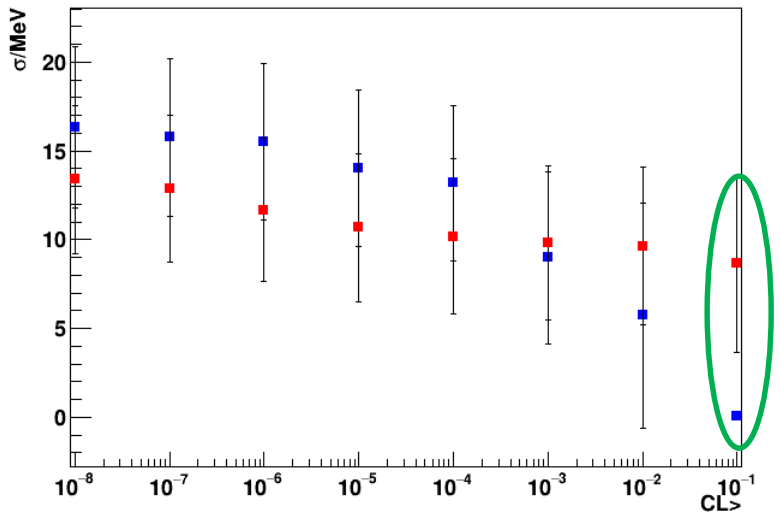
Ξ^* Q-factors



Red = first K^{+*}
Blue = second K^{+*}

- Red and blue consistent for fixed CL cut except at CL > 0.1

Ξ^* Q-factors



Red = first K^{+*}
Blue = second K^{+*}

- Red and blue consistent for fixed CL cut except at CL > 0.1
- Generated Q-factors using resolution of red to cut out K^*

Ξ^* Analysis

Cuts:

- Best combo
- CL>0.1

Table 1. Our estimate of the status of the Ξ resonances. Only those with an overall status of *** or **** are included in the Baryon Summary Table.

Particle	J^P	Overall status	Status as seen in — $\Xi\pi$	ΛK	ΣK	$\Xi(1530)\pi$	Other channels
Ξ(1318)	1/2+	****					Decays weakly
Ξ(1530)	3/2+	****	****				
Ξ(1620)		**	**				
Ξ(1690)		***	**	***	**		
Ξ(1820)	3/2−	***	**	***	**	**	
Ξ(1950)		***	**	**		*	
Ξ(2030)		***		**	***		
Ξ(2120)		*		*			
Ξ(2250)		**					3-body decays
Ξ(2370)		**					3-body decays
Ξ(2500)		*		*	*		3-body decays

****	Existence is certain, and properties are at least fairly well explored.
***	Existence ranges from very likely to certain, but further confirmation is desirable and/or quantum numbers, branching fractions, *etc.* are not well determined.
**	Evidence of existence is only fair.
*	Evidence of existence is poor.

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Ξ(1620)		**	**				
Ξ(1690)		***	**	***	**		
Ξ(1820)	3/2−	***	**	***	**	**	
Ξ(1950)		***	**	**		*	
Ξ(2030)		***		**	***		
Ξ(2120)		*		*			
Ξ(2250)		**					3-body decays
Ξ(2370)		**					3-body decays
Ξ(2500)		*		*	*		3-body decays

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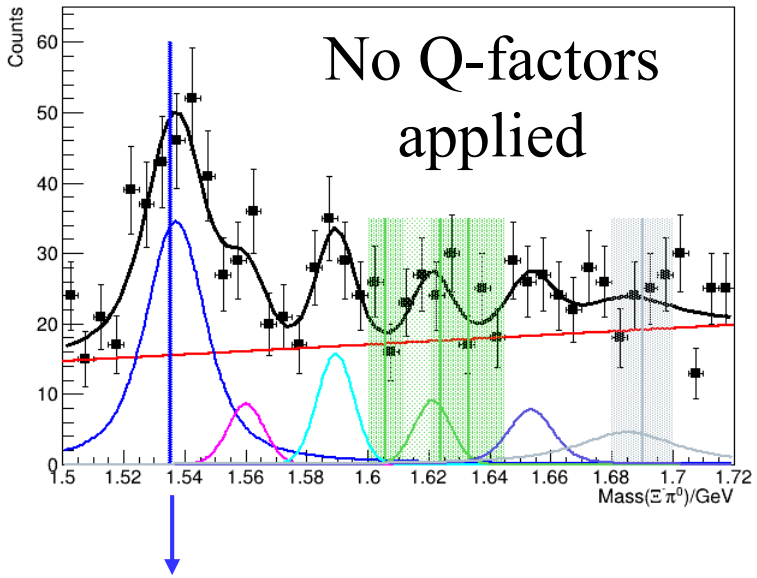
Looking in this range

Ξ^* Analysis



Ξ(1530) MASSES

Ξ(1530)^0 MASS

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
1531.80±0.32 OUR FIT	Error includes scale factor of 1.3.				
1531.78±0.34 OUR AVERAGE	Error includes scale factor of 1.4. See the ideogram below.				
1532.2 ±0.7		DEBELLEFON	75B	HBC	$K^- p \rightarrow \Xi^- \overline{K}\pi$
1533 ±1		ROSS	73B	HBC	$K^- p \rightarrow \Xi \overline{K}\pi(\pi)$
1531.4 ±0.8	59	BADIER	72	HBC	$K^- p$ 3.95 GeV/c
1532.0 ±0.4	1262	BALTAY	72	HBC	$K^- p$ 1.75 GeV/c
1531.3 ±0.6	324	BORENSTEIN	72	HBC	$K^- p$ 2.2 GeV/c
1532.3 ±0.7	286	KIRSCH	72	HBC	$K^- p$ 2.87 GeV/c
1528.7 ±1.1	76	LONDON	66	HBC	$K^- p$ 2.24 GeV/c
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1532.1 ±0.4	1244	ASTON	85B	LASS	$K^- p$ 11 GeV/c
1532.1 ±0.6	2700	[1] BAUBILLIER	81B	HBC	$K^- p$ 8.25 GeV/c
1530 ±1	450	BIAGI	81	SPEC	SPS hyperon beam

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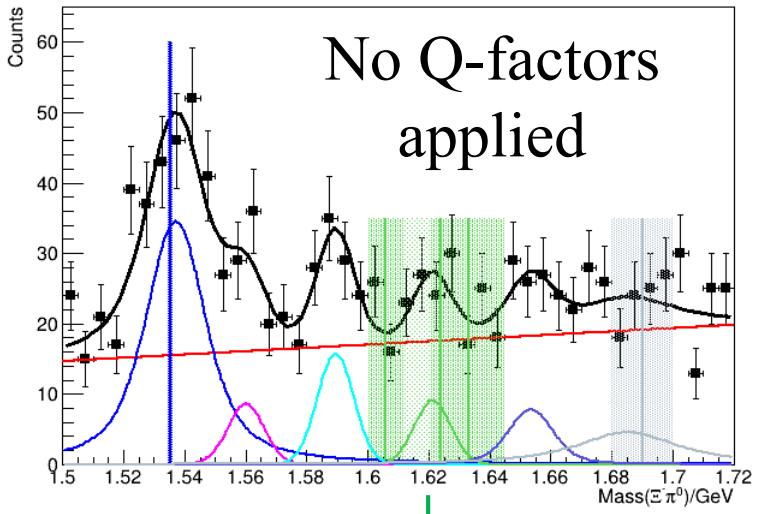
Ξ^* Analysis



Ξ(1620) $I(J^P) = \frac{1}{2}(?^?)$ Status: *

J, *P* need confirmation.

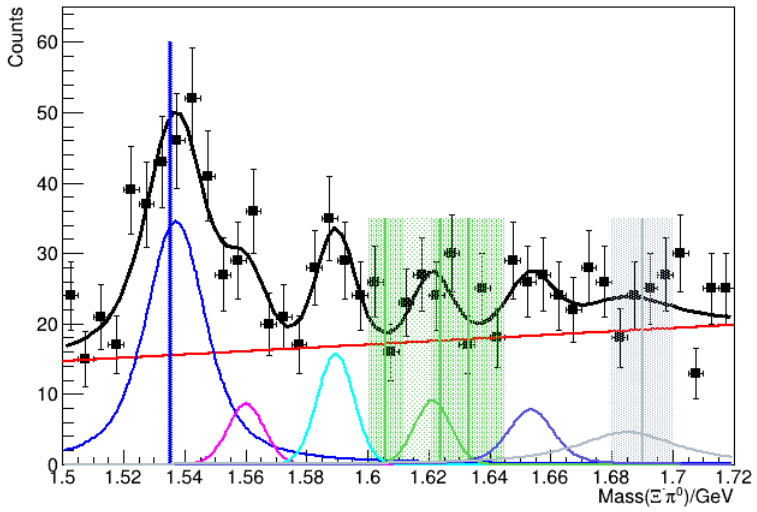
OMITTED FROM SUMMARY TABLE

What little evidence there is consists of weak signals in the $\Xi\pi$ channel. A number of other experiments (e.g., BORENSTEIN 72 and HASSALL 81) have looked for but not seen any effect.

Ξ(1620) MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
~ 1620 OUR ESTIMATE					
1624± 3	31	BRIEFEL	77	HBC	K^-p 2.87 GeV/c
1633±12	34	DEBELLEFON	75B	HBC	$K^-p \to \Xi^-\overline{K}\pi$
1606± 6	29	ROSS	72	HBC	K^-p 3.1–3.7 GeV/c

Ξ^* Analysis



Ξ(1690) MASSES

MIXED CHARGES

VALUE (MeV)	*DOCUMENT ID*
1690±10 OUR ESTIMATE	This is only an educated guess; the error given is larger than the error on the average of the published values.

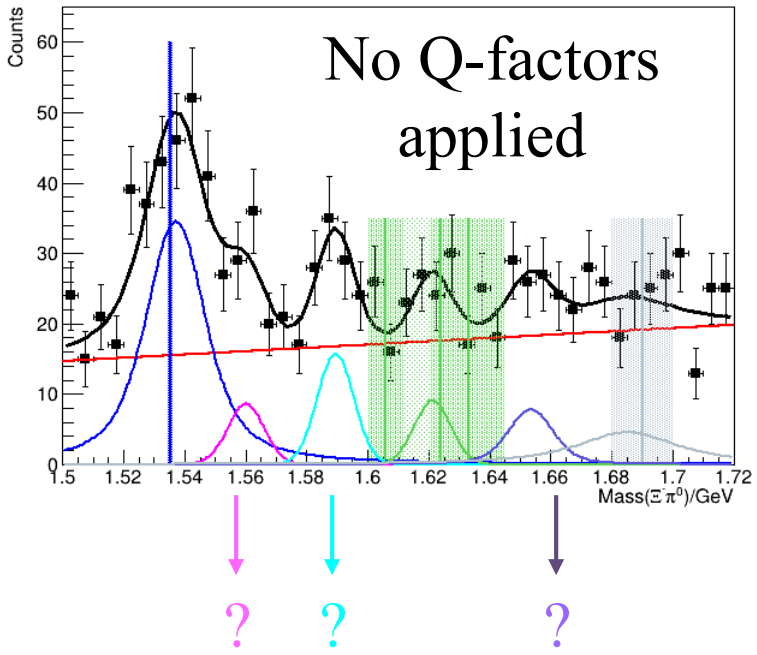
$\Xi(1690)^0$ MASS

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
1686±4	1400	ADAMOVICH	98	WA89	Σ^- nucleus, 345 GeV/c
1699±5	175	[1] DIONISI	78	HBC	$K^- p$ 4.2 GeV/c
1684±5	183	[2] DIONISI	78	HBC	$K^- p$ 4.2 GeV/c

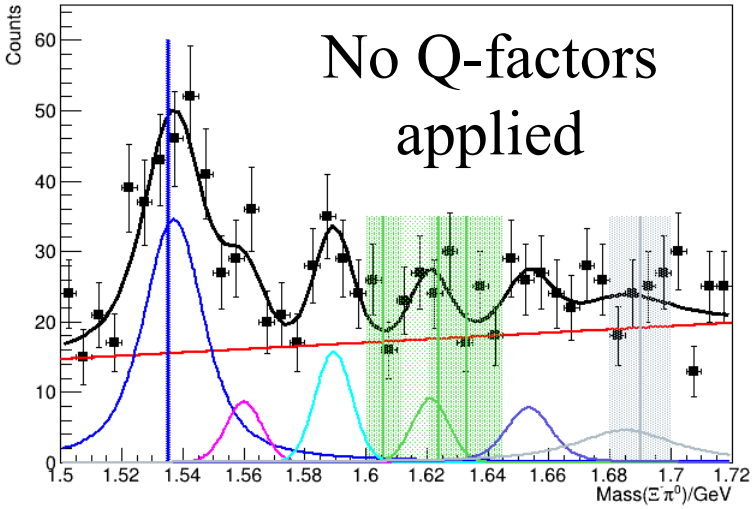
$\Xi(1690)^-$ MASS

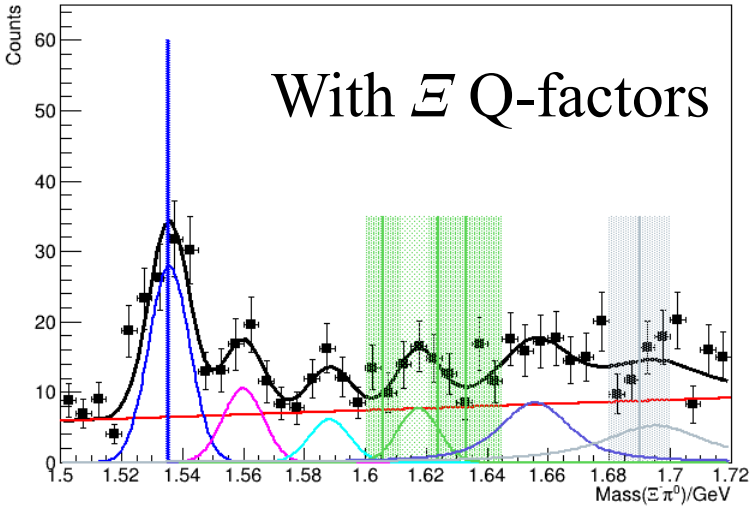
VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
1691.1± 1.9±2.0	104	BIAGI	87	SPEC	Ξ^- Be 116 GeV
1700 ±10	150	[3] BIAGI	81	SPEC	Ξ^- H 100, 135 GeV
1694 ± 6	45	[4] DIONISI	78	HBC	$K^- p$ 4.2 GeV/c

Ξ^* Analysis

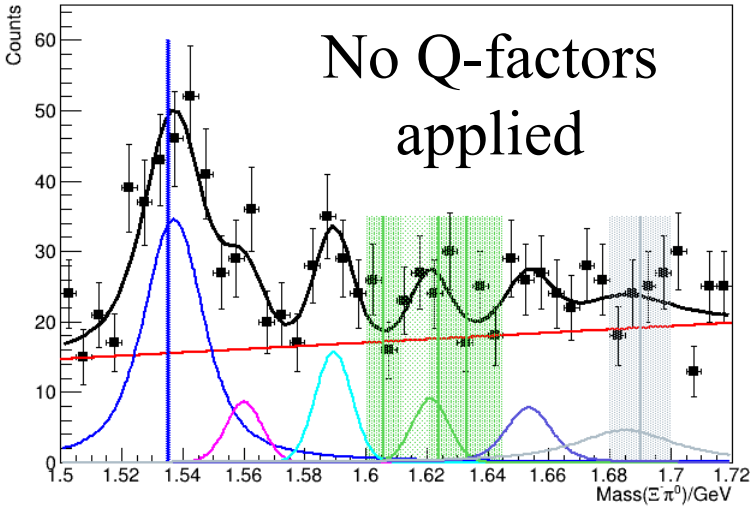

No Q-factors applied
Counts
60
50
40
30
20
10
0
1.5
1.52
1.54
1.56
1.58
1.6
1.62
1.64
1.66
1.68
1.7
1.72
Mass($\Xi^-\pi^0$)/GeV
?
?
?

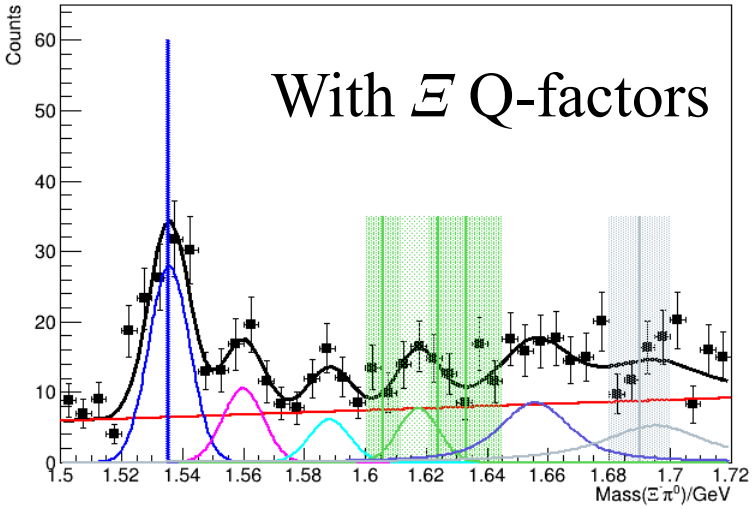
Ξ^* Analysis

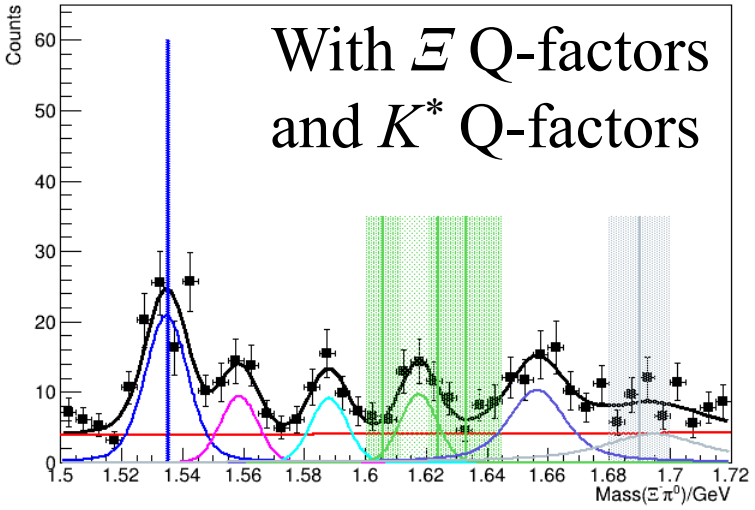

No Q-factors applied
Counts
Mass($\Xi^-\pi^0$)/GeV


With Ξ Q-factors
Counts
Mass($\Xi^-\pi^0$)/GeV

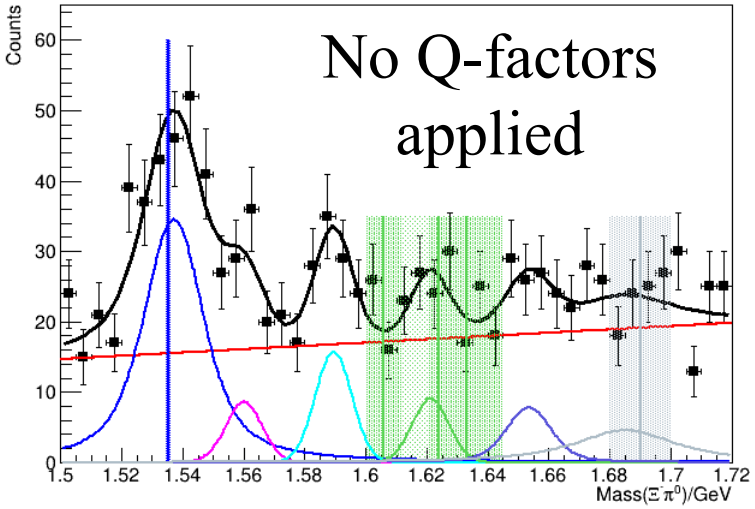
Ξ^* Analysis

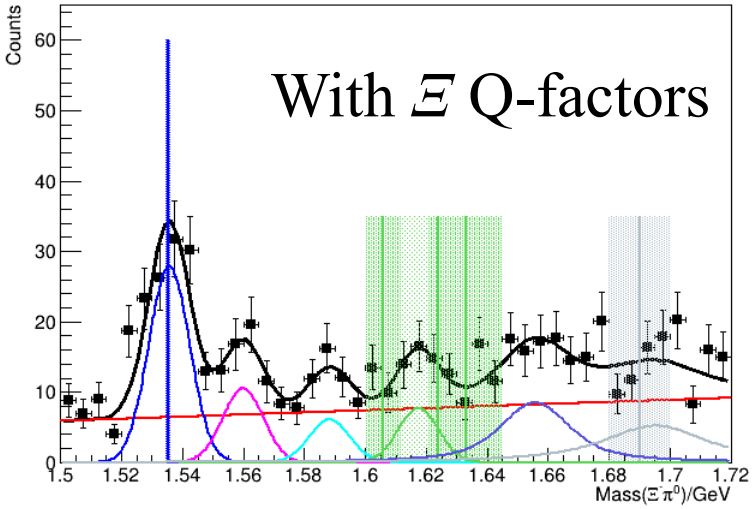

No Q-factors applied
Counts
Mass($\Xi^-\pi^0$)/GeV

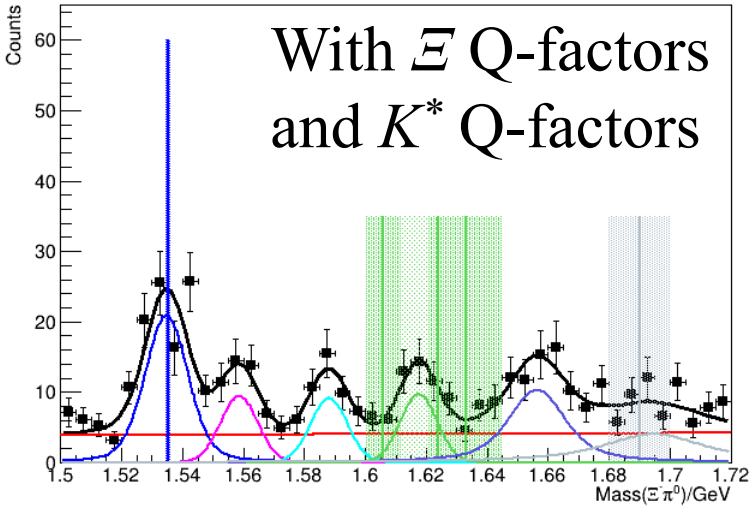

With Ξ Q-factors
Counts
Mass($\Xi^-\pi^0$)/GeV


With Ξ Q-factors and K^* Q-factors
Counts
Mass($\Xi^-\pi^0$)/GeV

Ξ^* Analysis

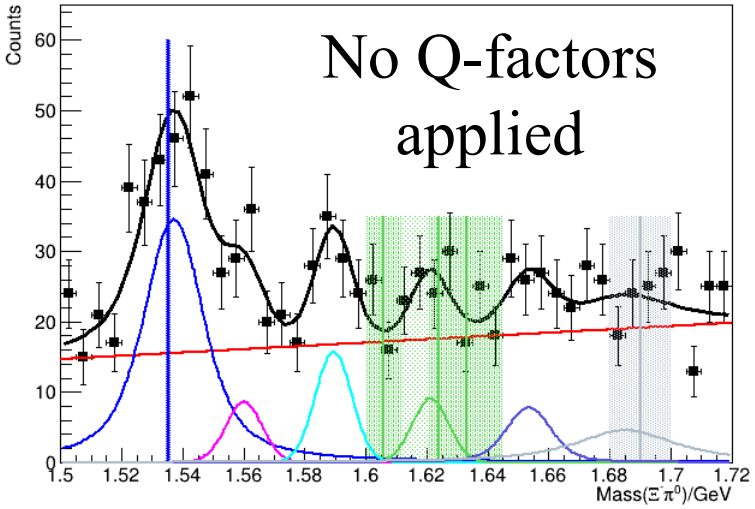


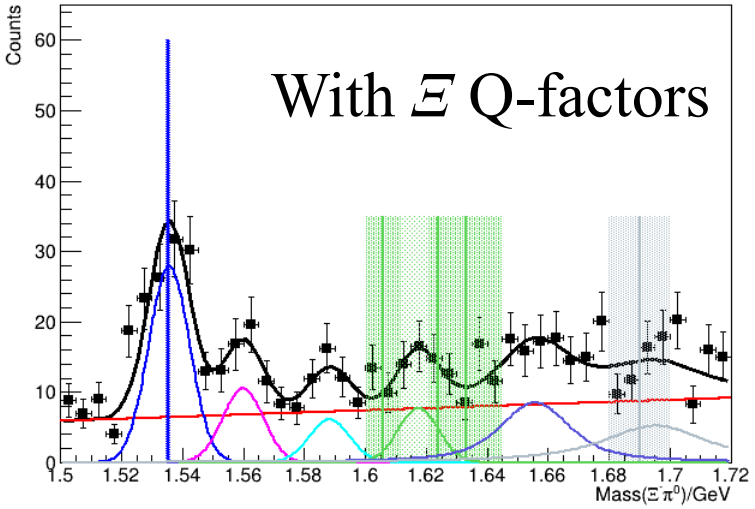


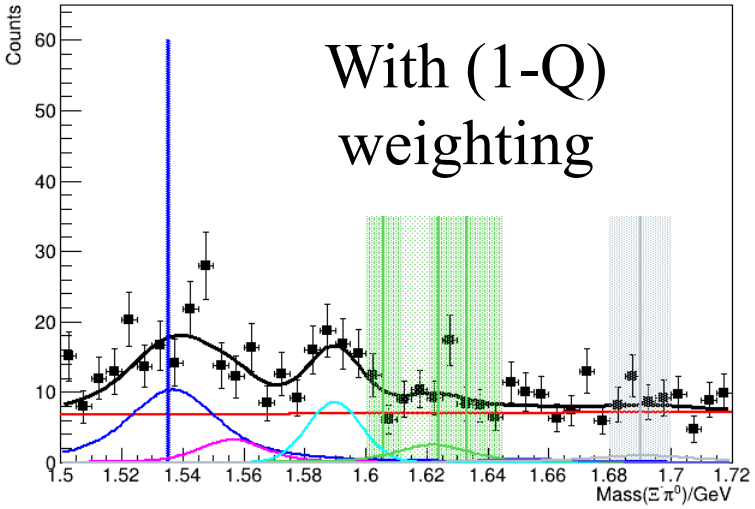


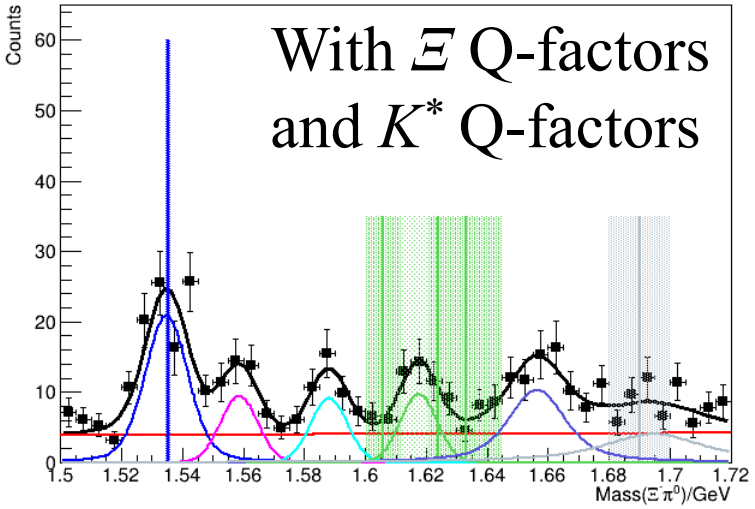
- Bump structure becomes more pronounced after background subtraction

Ξ^* Analysis


No Q-factors applied
Counts
Mass($\Xi^-\pi^0$)/GeV


With Ξ Q-factors
Counts
Mass($\Xi^-\pi^0$)/GeV

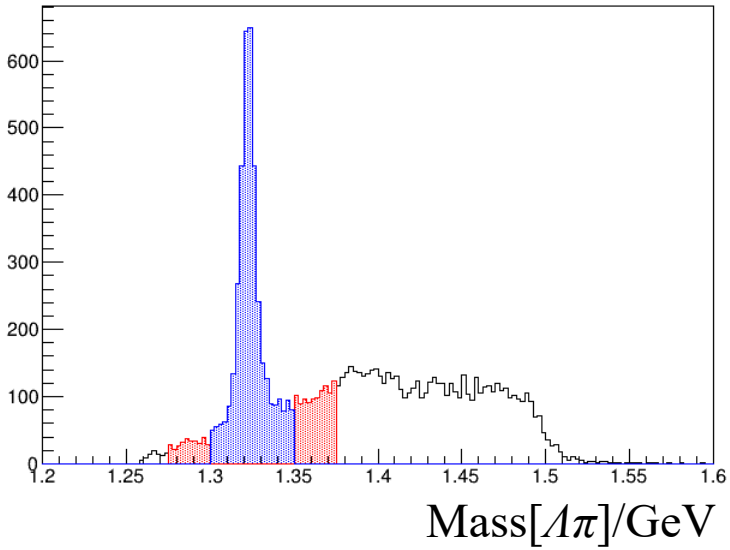

With (1-Q) weighting
Counts
Mass($\Xi^-\pi^0$)/GeV


With Ξ Q-factors and K^* Q-factors
Counts
Mass($\Xi^-\pi^0$)/GeV

Ξ^* Side Band check

- The side-band subtraction technique should yield similar results as the *Q*-factor method

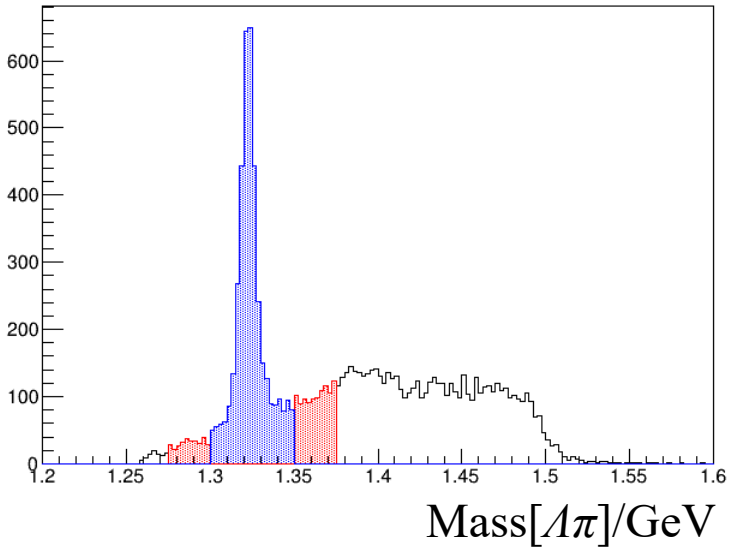
Ξ^* Side Bands

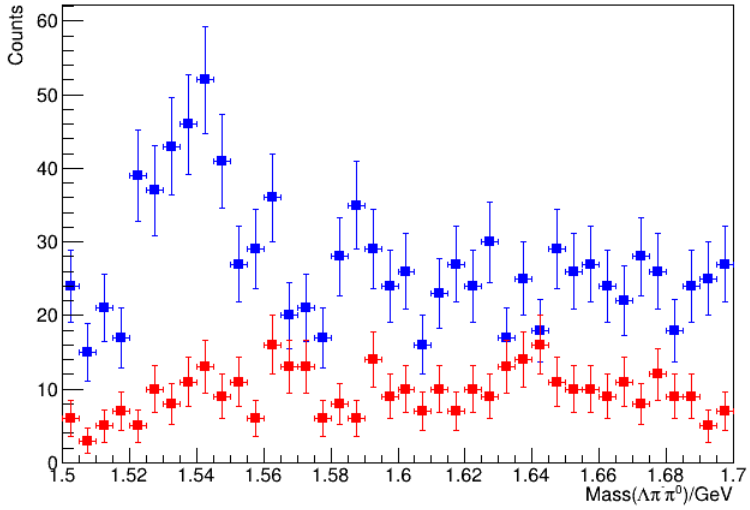


Blue = Center of Ξ peak

Red = Side bands

Ξ^* Side Bands





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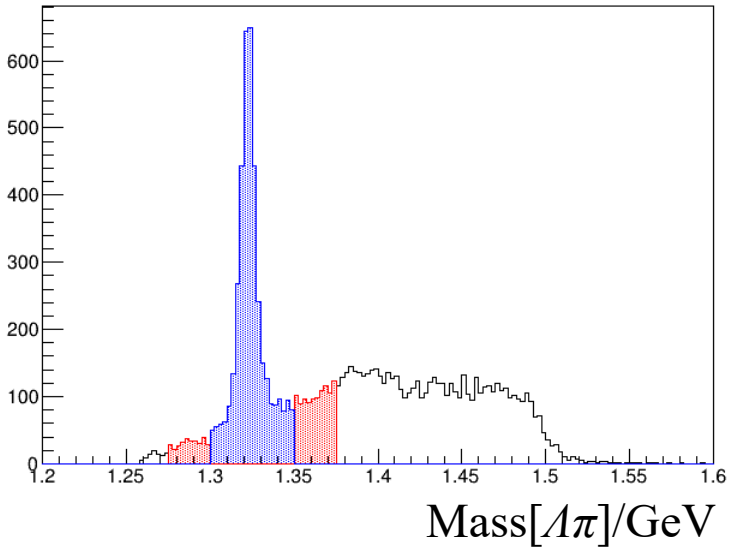
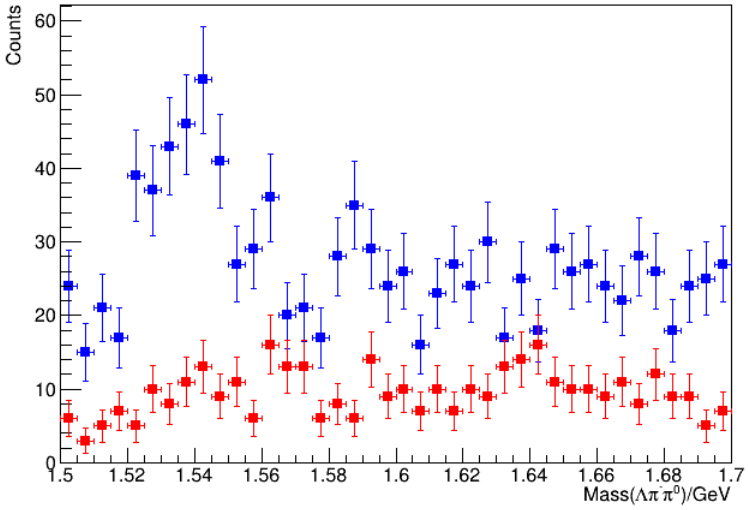
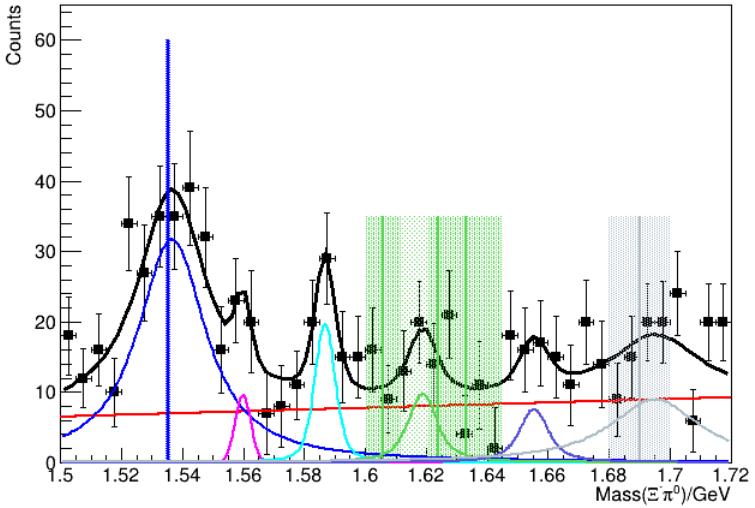
Ξ^* Side Bands



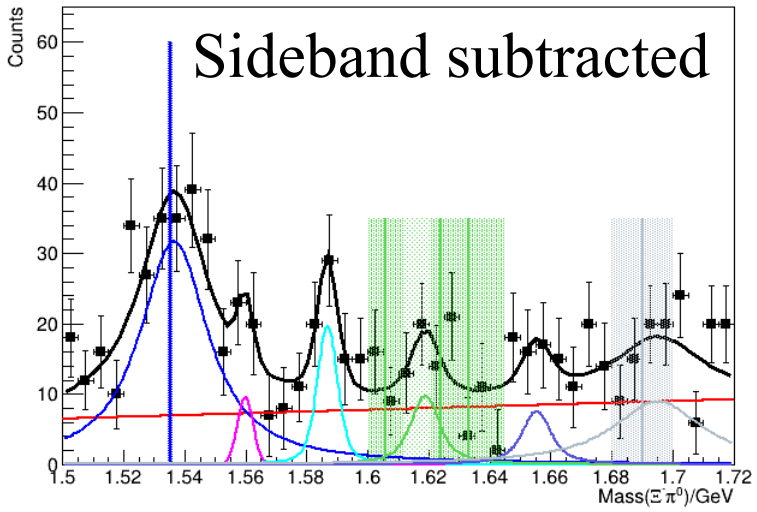


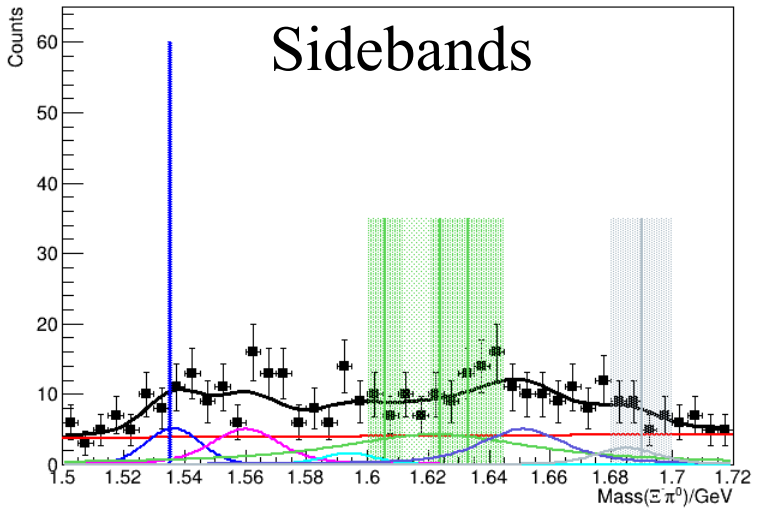


Blue = Center of Ξ peak
Red = Side bands
Black = Side band subtracted

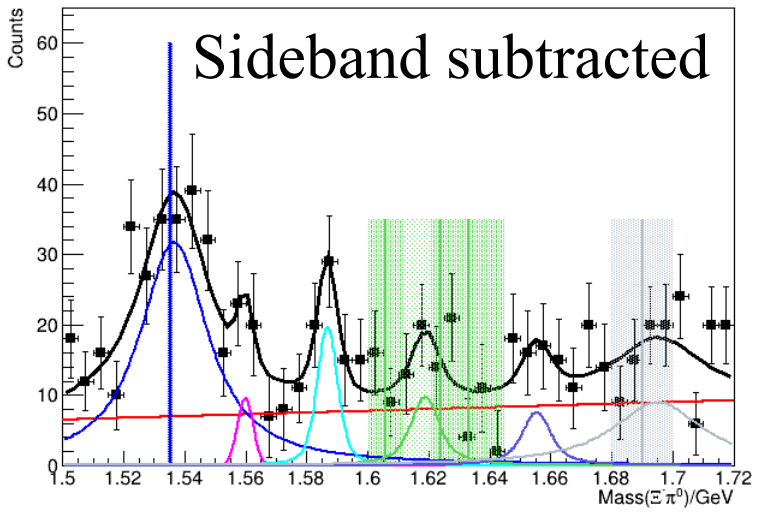
- Bump structure more pronounced after side-band subtraction

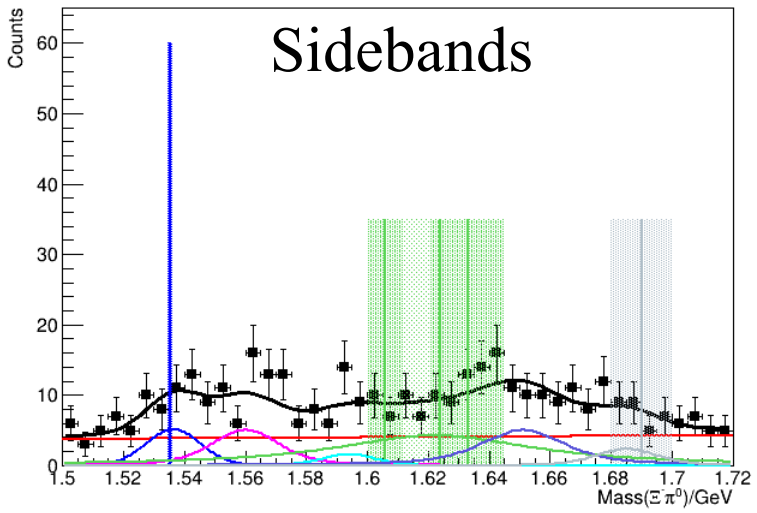
Ξ^* Analysis

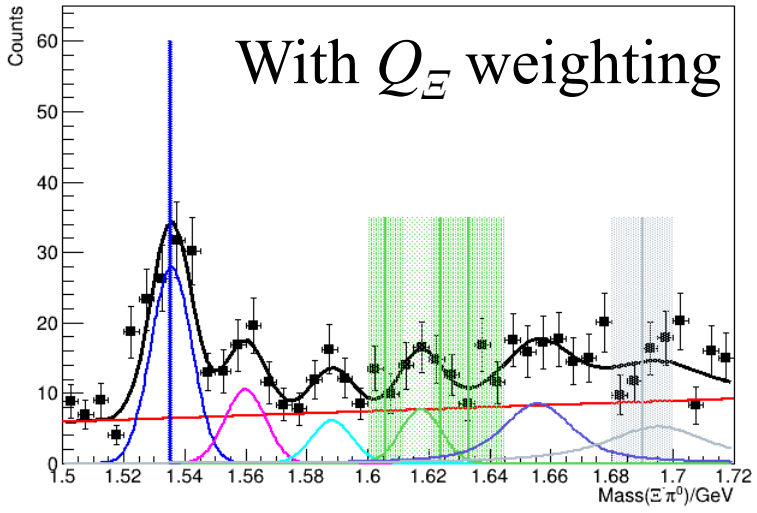

Sideband subtracted
Counts
Mass($\Xi^-\pi^0$)/GeV

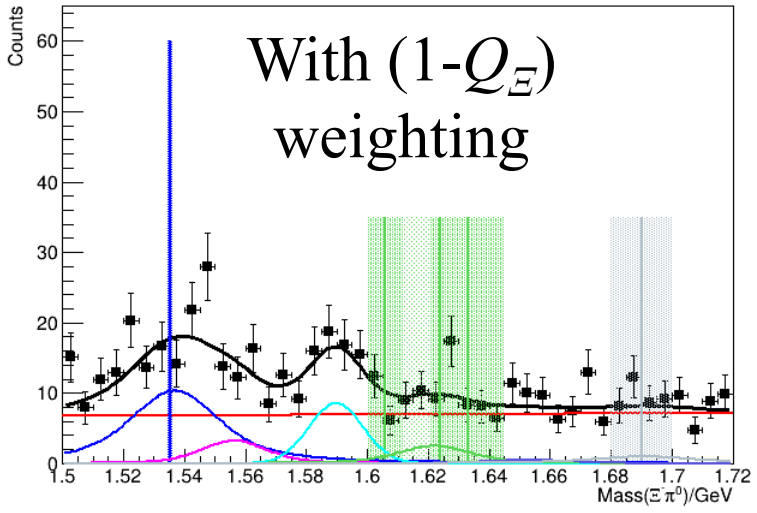

Sidebands
Counts
Mass($\Xi^-\pi^0$)/GeV

Ξ^* Analysis

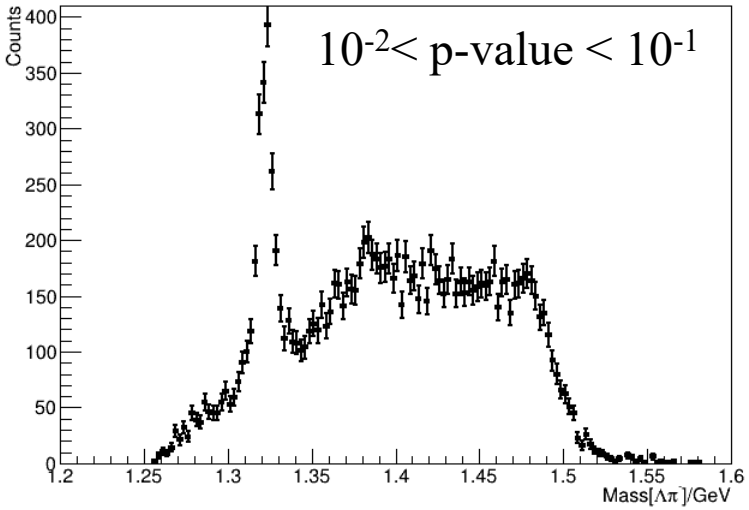

Sideband subtracted
Counts
Mass($\Xi^-\pi^0$)/GeV


Sidebands
Counts
Mass($\Xi^-\pi^0$)/GeV

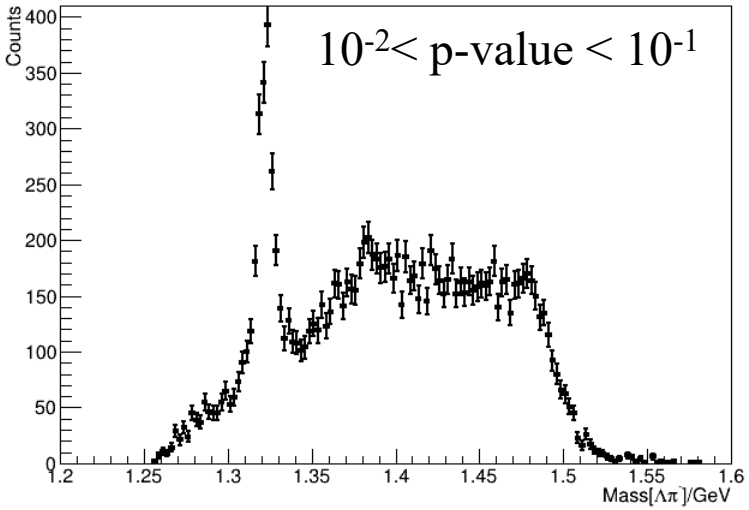

With Q_Ξ weighting
Counts
Mass($\Xi^-\pi^0$)/GeV

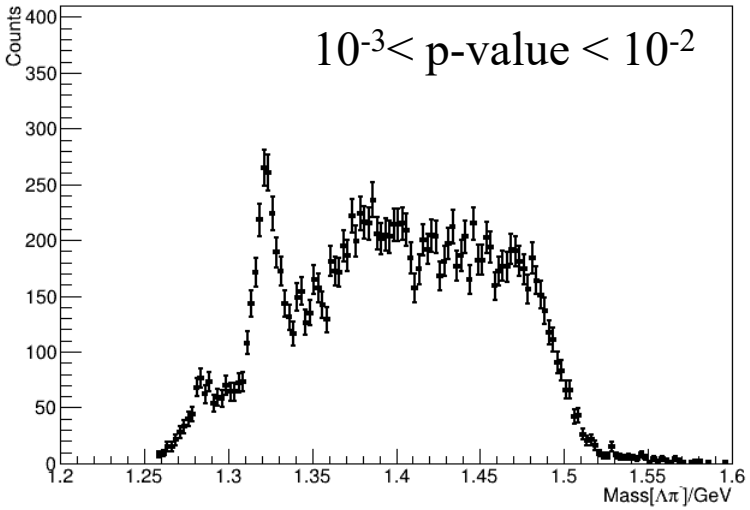

With (1-Q_Ξ) weighting
Counts
Mass($\Xi^-\pi^0$)/GeV

Ξ^* Analysis: *p*-value intervals

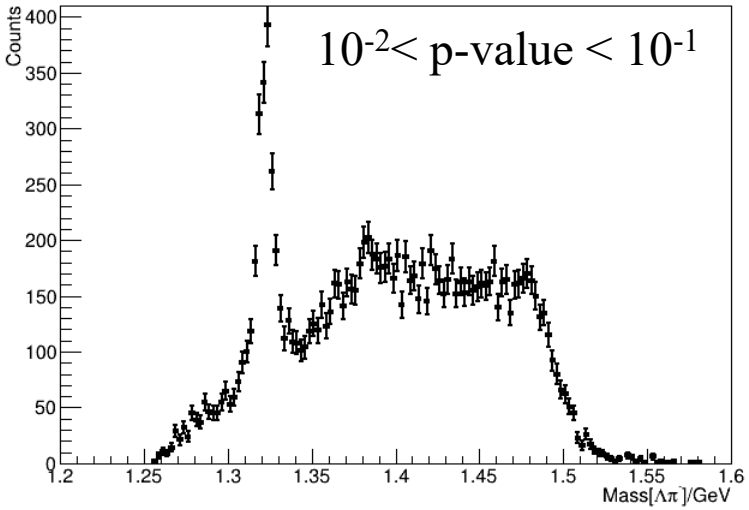


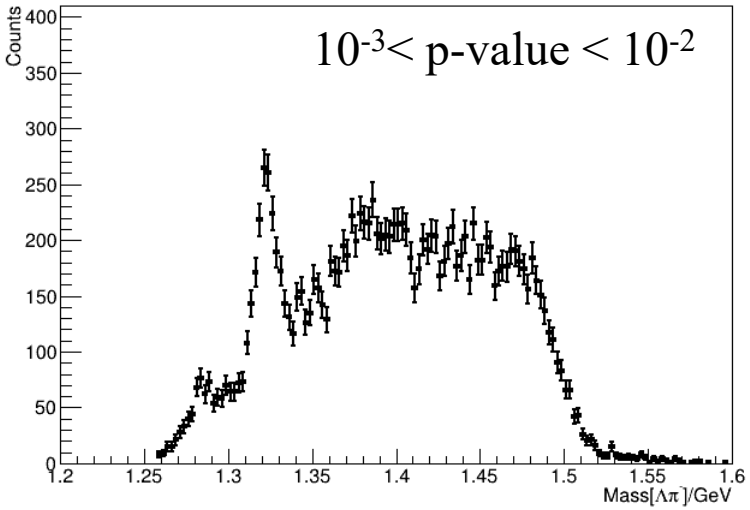
Ξ^* Analysis: *p*-value intervals

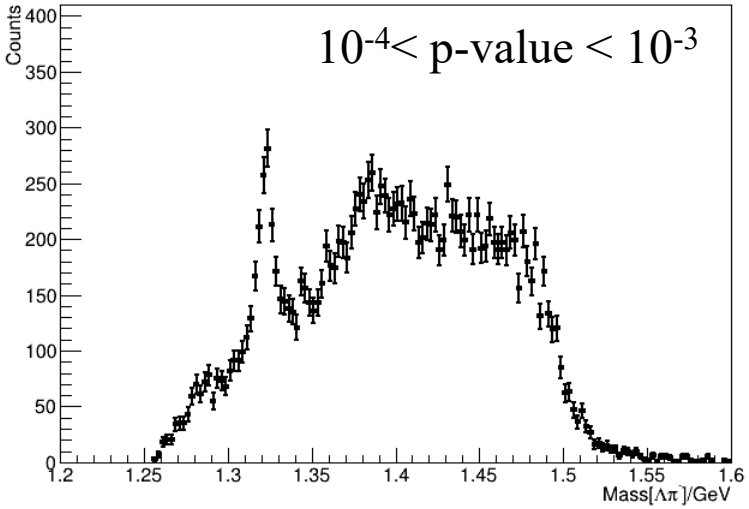




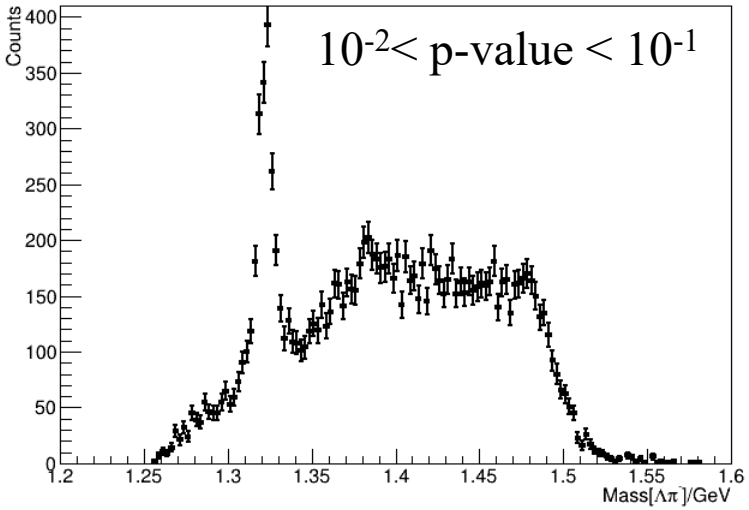
Ξ^* Analysis: *p*-value intervals

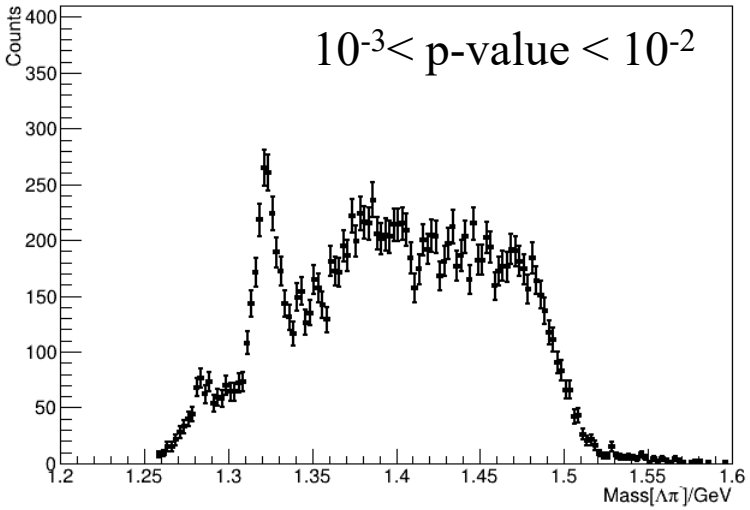


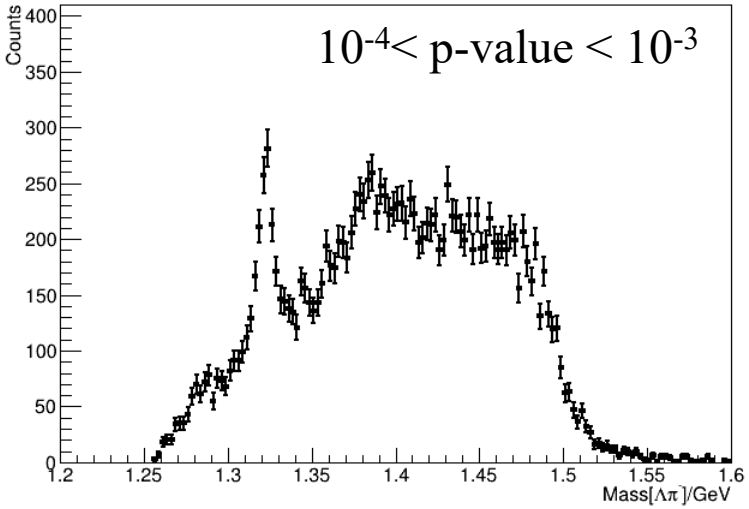


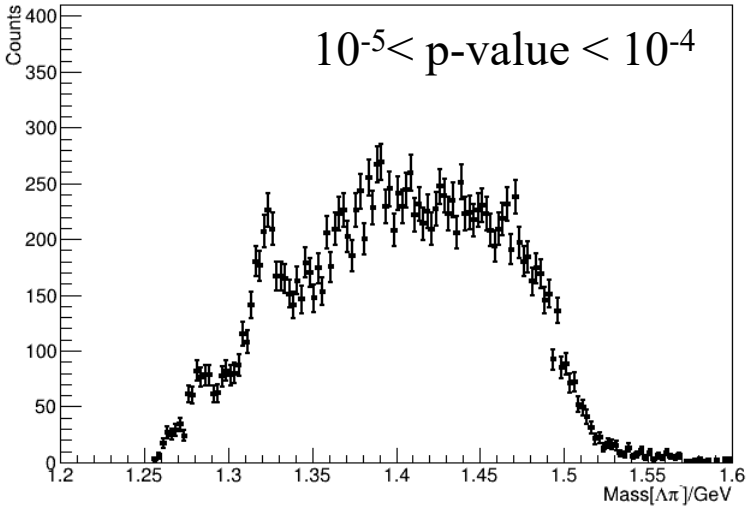


Ξ^* Analysis: *p*-value intervals

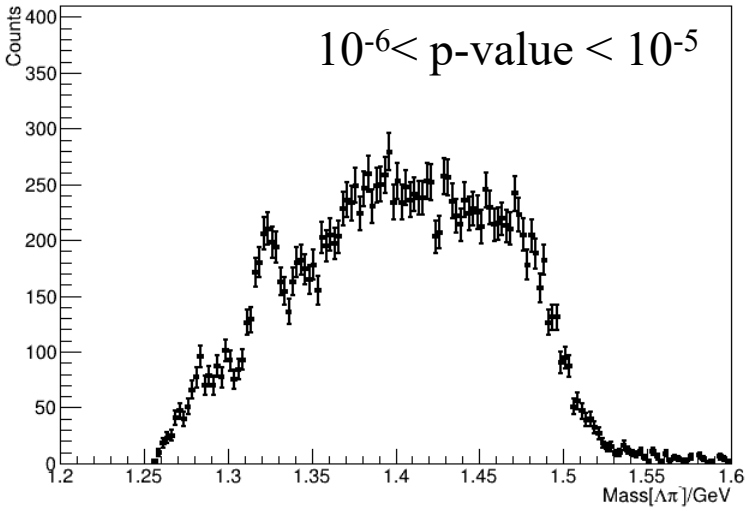




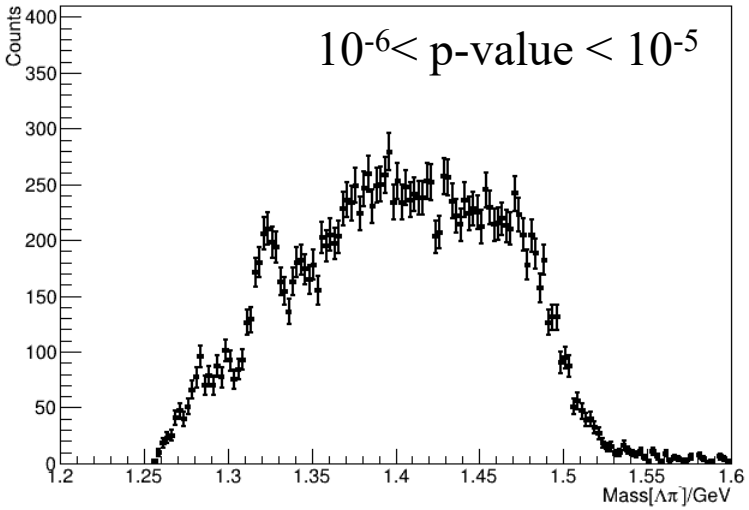


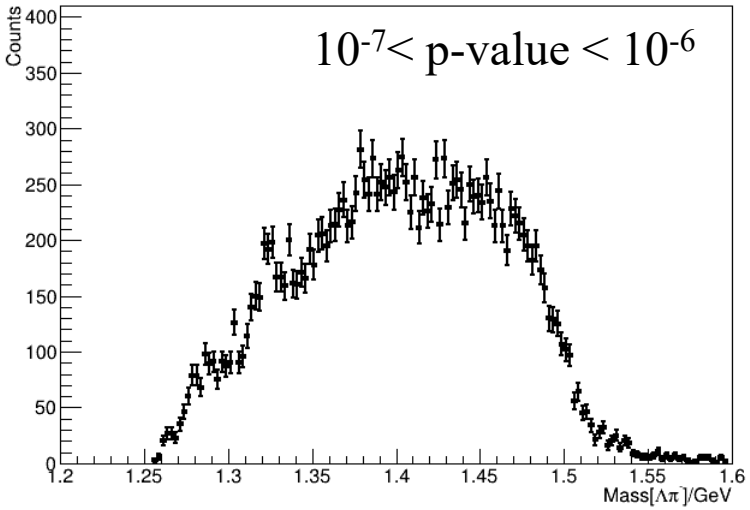


Ξ^* Analysis: *p*-value intervals

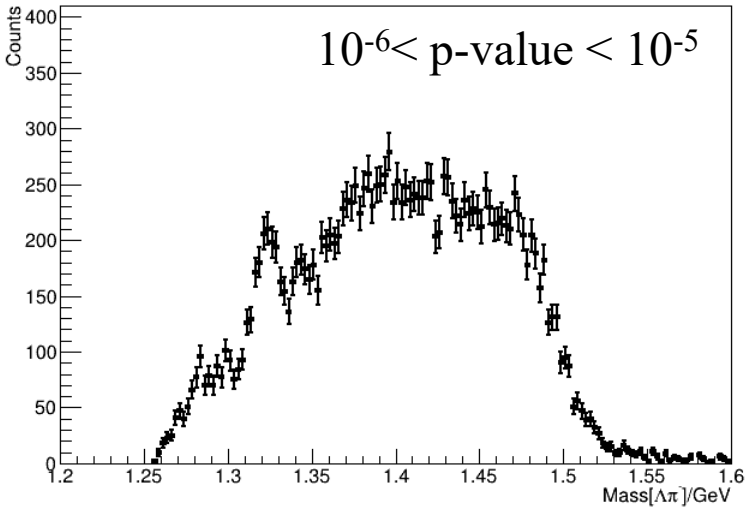


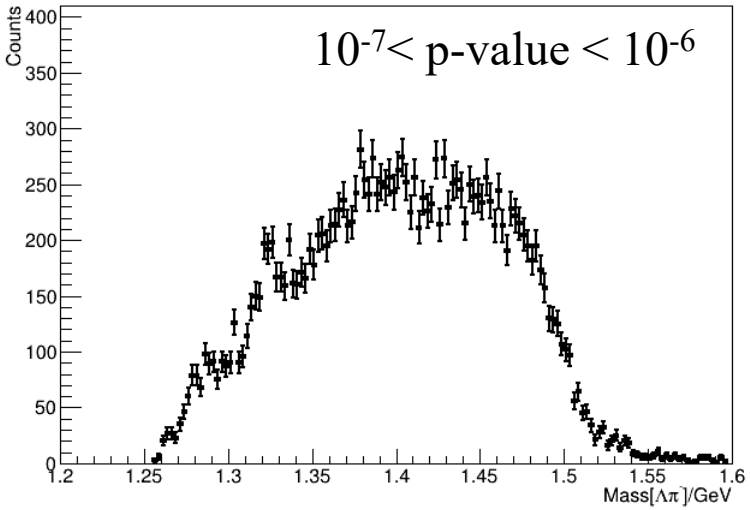
Ξ^* Analysis: *p*-value intervals

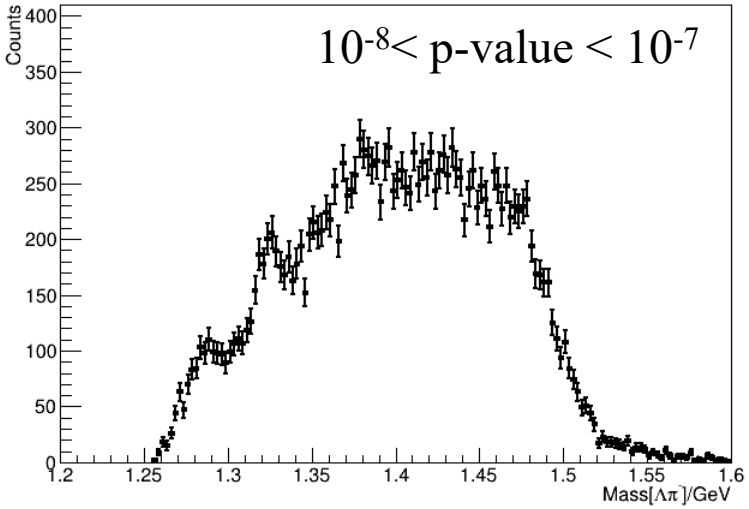




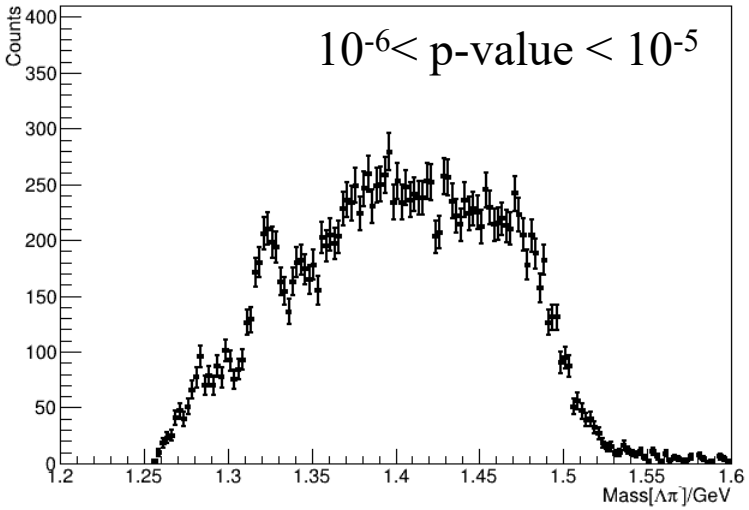
Ξ^* Analysis: *p*-value intervals

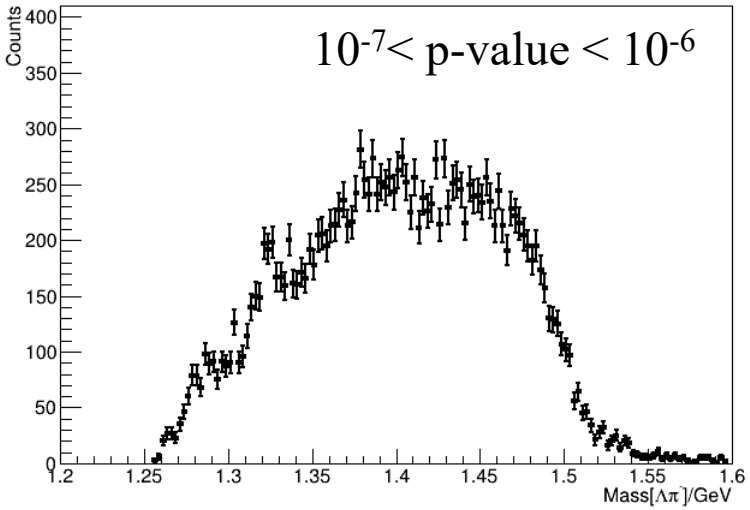


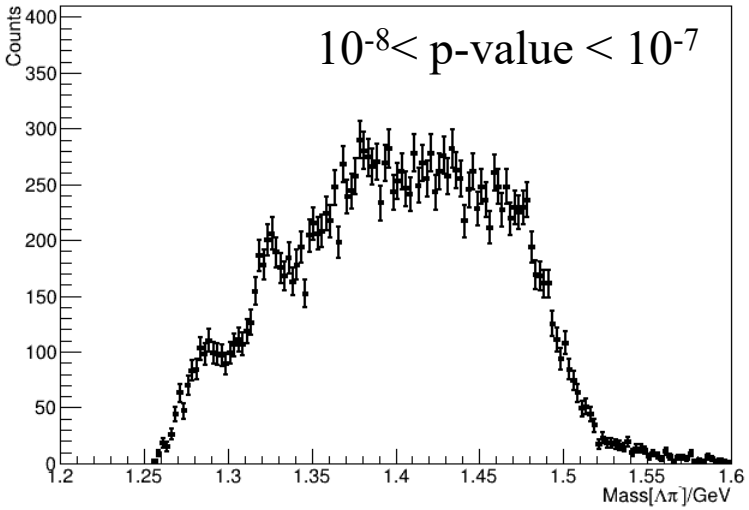


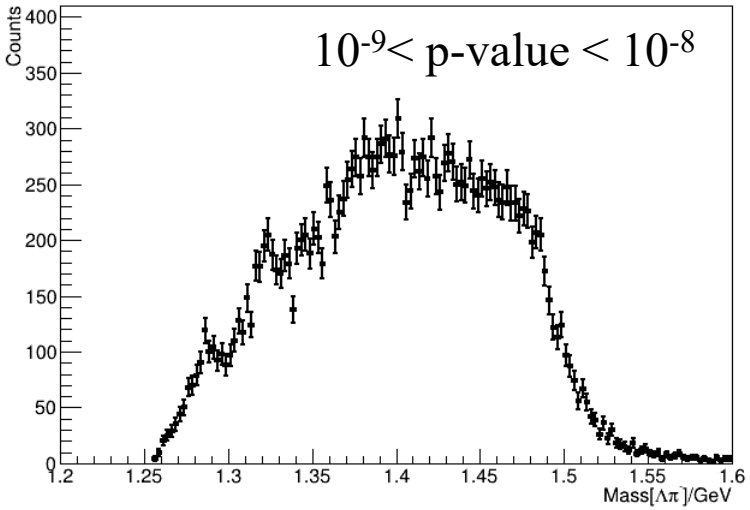


Ξ^* Analysis: *p*-value intervals









Reduced χ^2 vs. p-value for kinematic fit

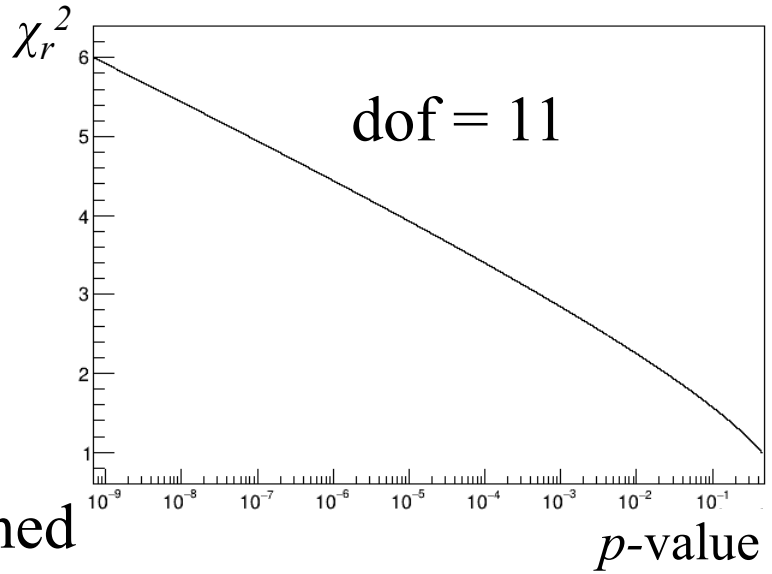
- The kinematic fit:

$\gamma\, p \rightarrow K^+K^+\Xi^-\pi^0$, where $\pi^0 \rightarrow \gamma\gamma$,

$\Xi^- \rightarrow \Lambda\pi^-$ and

$\Lambda \rightarrow p\pi^-$

- Mass of Ξ^- (or Ξ^*) not constrained



Note:

- p-value = 10^{-8} when $\chi_r^2 \sim 5.44$
- p-value = 10^{-1} when $\chi_r^2 \sim 1.57$
- p-value ~ 0.44 when $\chi_r^2 = 1.0$

ASU

Reduced χ^2 vs. p-value for kinematic fit

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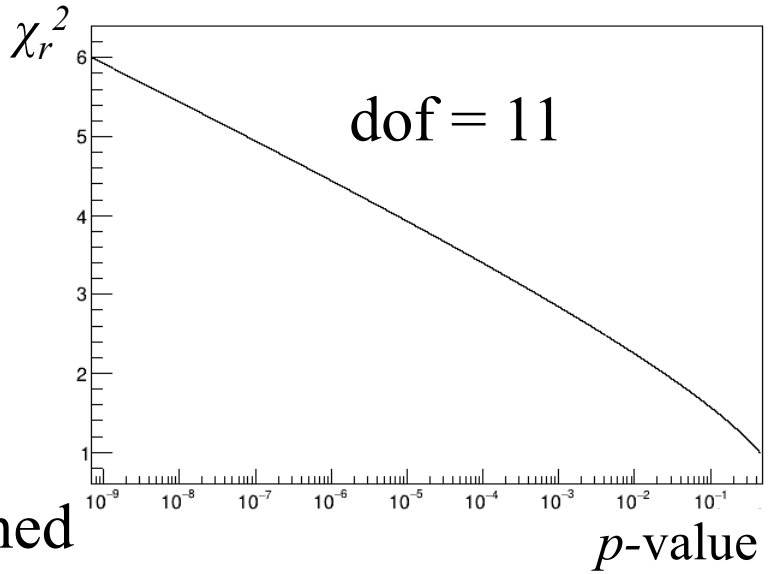

Note:

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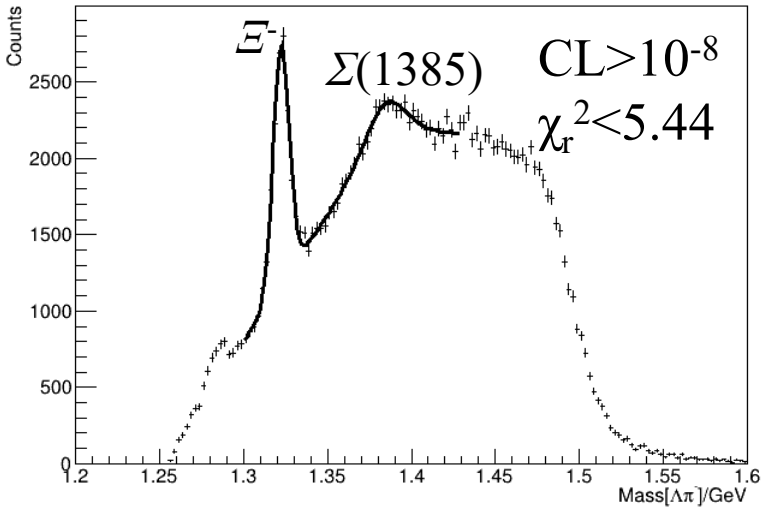
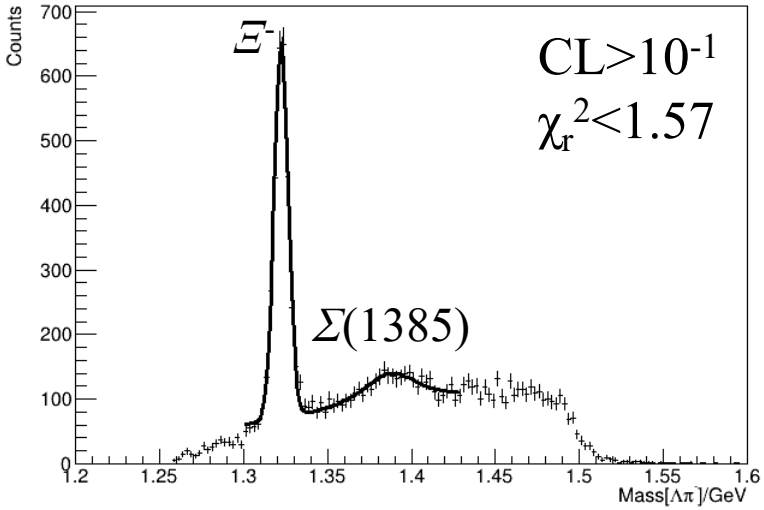
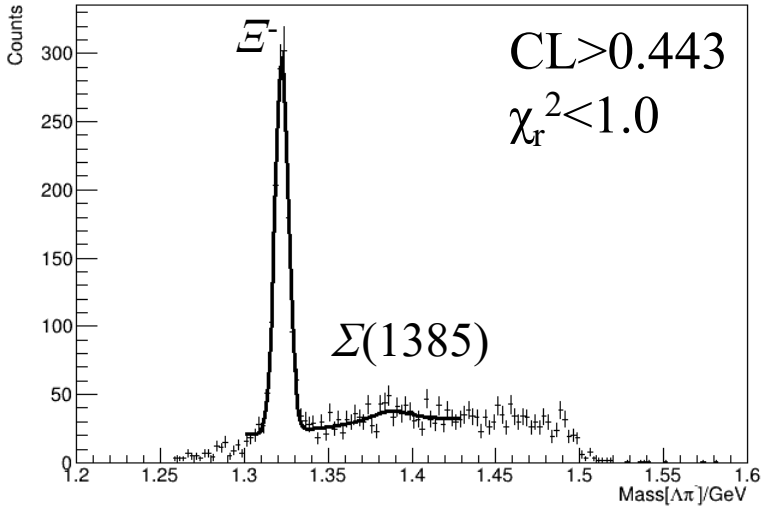
- p-value ~ 0.44 when $\chi_r^2 = 1.0$

Probably about as extreme as we would ever want to go

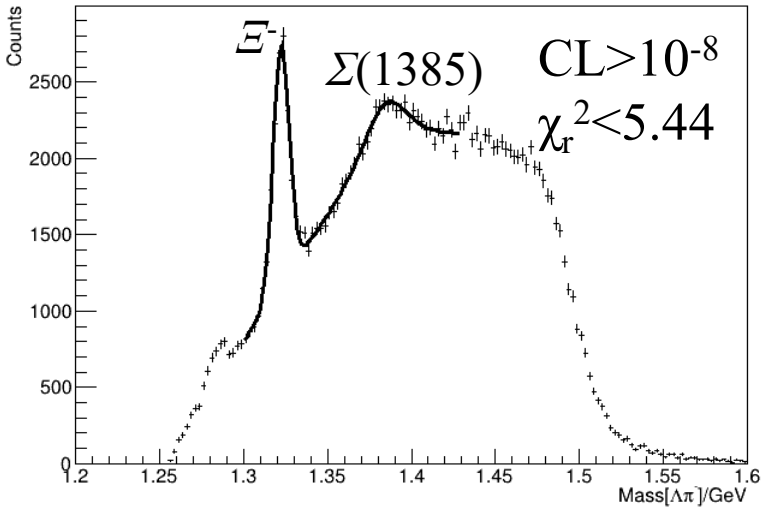
Ξ^* Analysis: mass[$\Lambda\pi^-$]

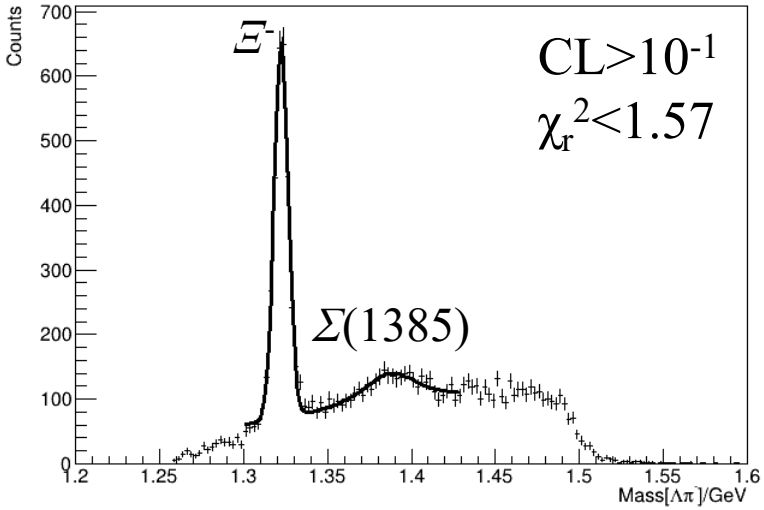


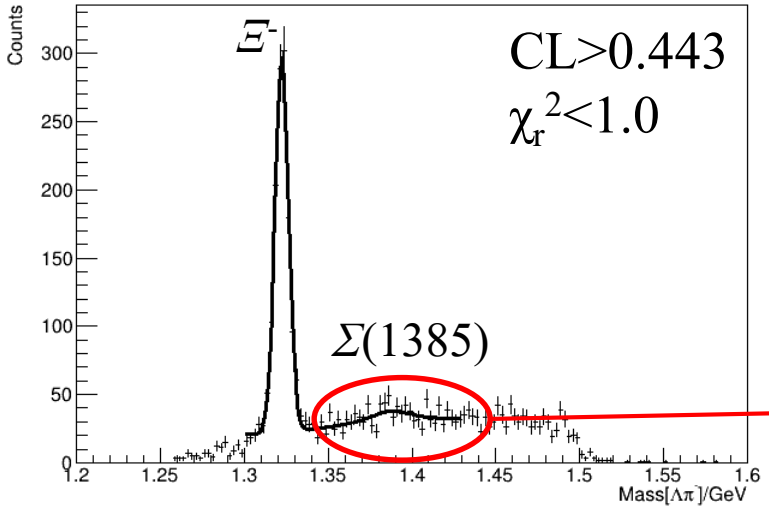




Ξ^* Analysis: mass[$\Lambda\pi^-$]

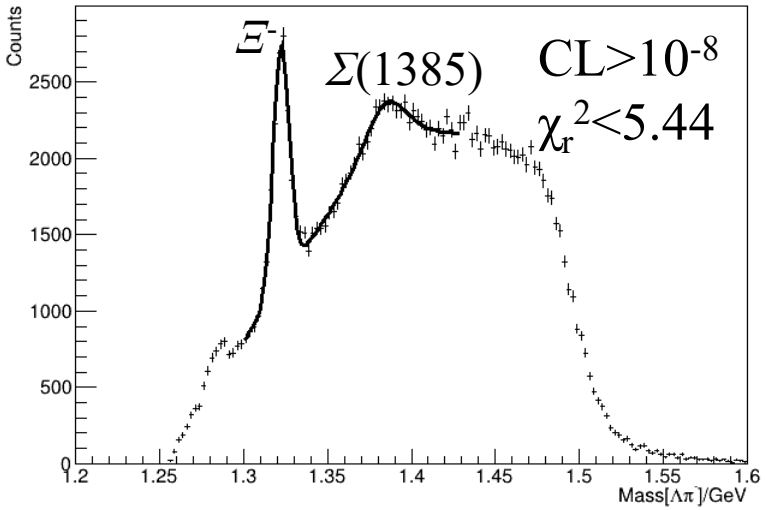


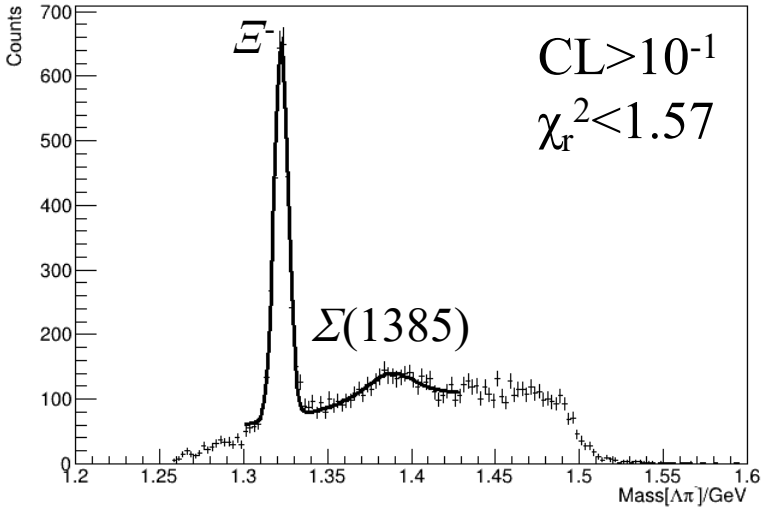


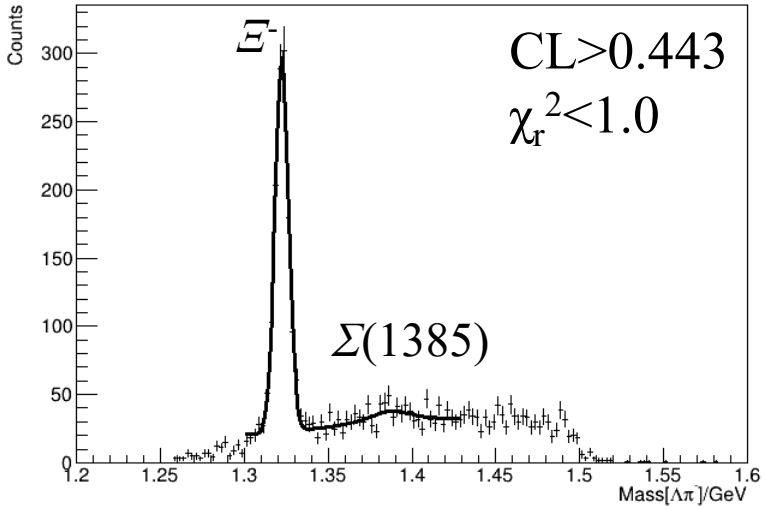


Almost completely removed but cut is too extreme

Ξ^* Analysis: mass[$\Lambda\pi^-$]

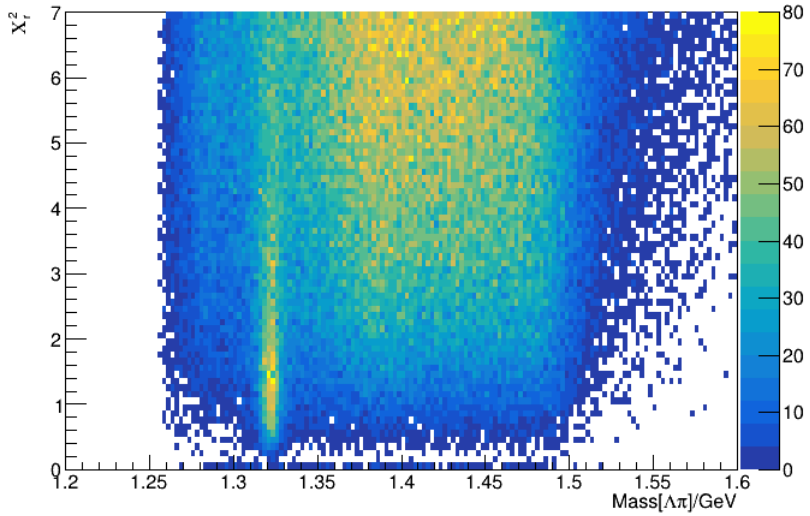




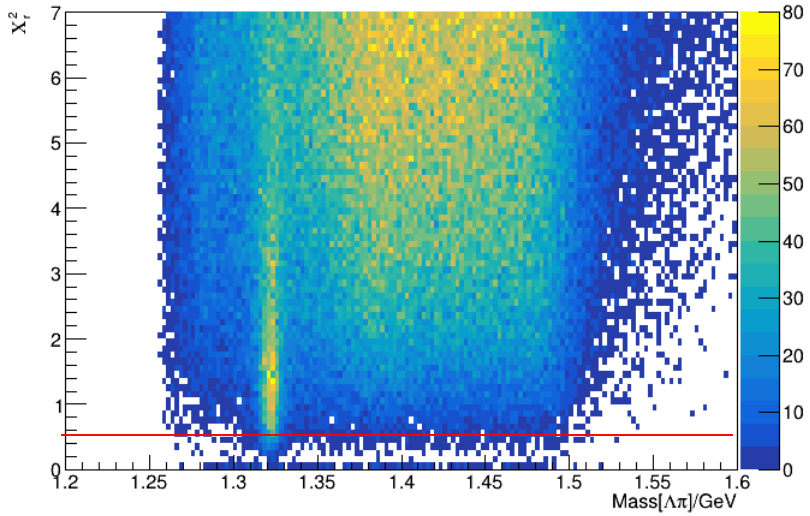


- What if we go to even lower χ_r^2 values (for the heck of it)?

χ_r^2 versus mass[$\Lambda\pi$]

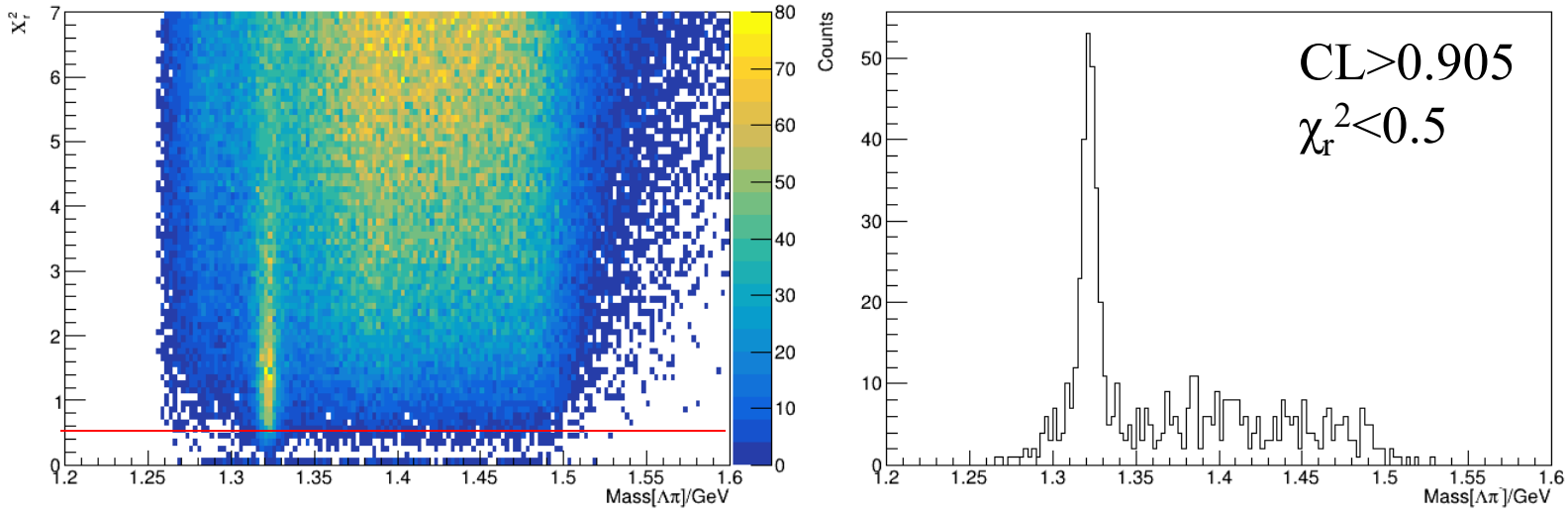


χ_r^2 versus mass[$\Lambda\pi$]



- Looks like we could make a cut at about $\chi_r^2 < 0.5$ (CL>0.905) to remove nearly all of the $\Sigma(1385)$ background

χ_r^2 versus mass[$\Lambda\pi$]



- Looks like we could make a cut at about $\chi_r^2 < 0.5$ (CL>0.905) to remove nearly all of the $\Sigma(1385)$ background

Track-χ_r^2 versus mass[$\Lambda\pi$]

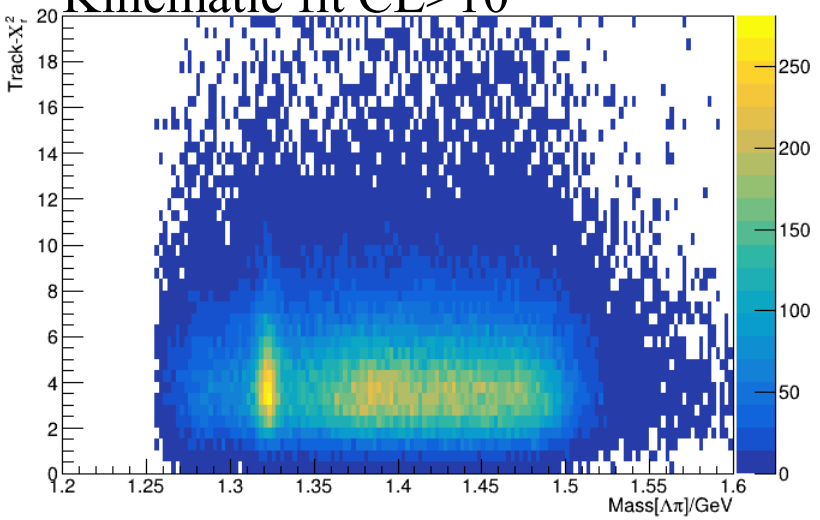
Define:

Track-χ_r^2 as [tracking χ_r^2 of 1st K^+] + [tracking χ_r^2 of 2nd K^+]

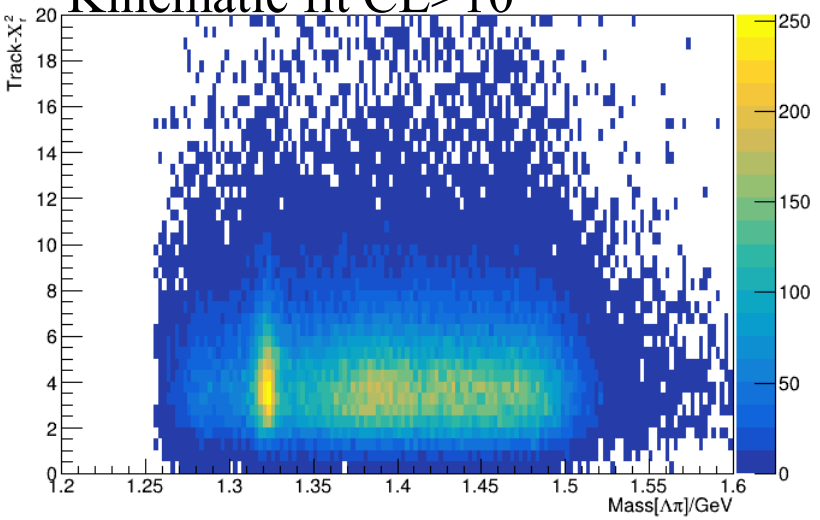
- Looking to see if there are any obvious cuts to make on Track- χ_r^2

Track-χ_r^2 versus mass[$\Lambda\pi$]

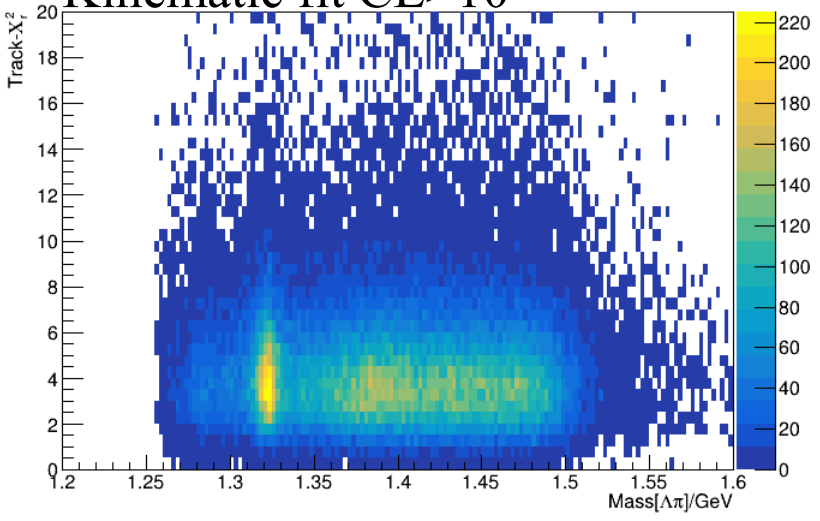
Kinematic fit CL>10^{-8}



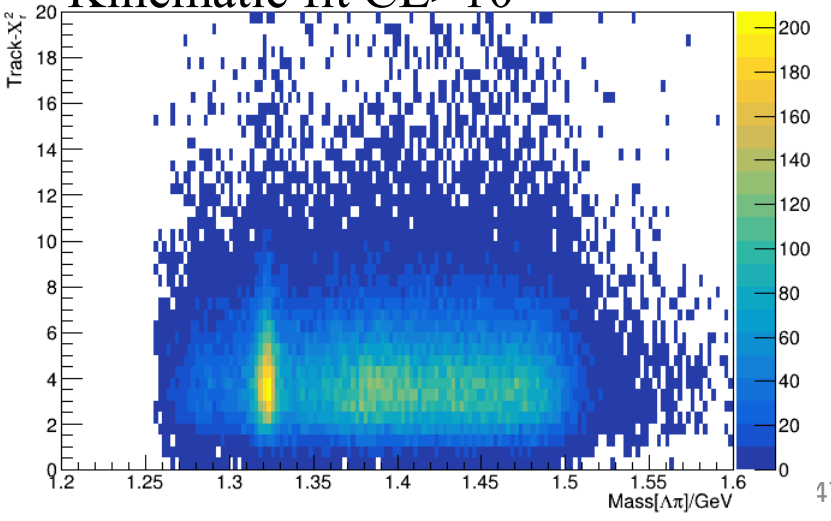
Kinematic fit CL>10^{-7}



Kinematic fit CL>10^{-6}



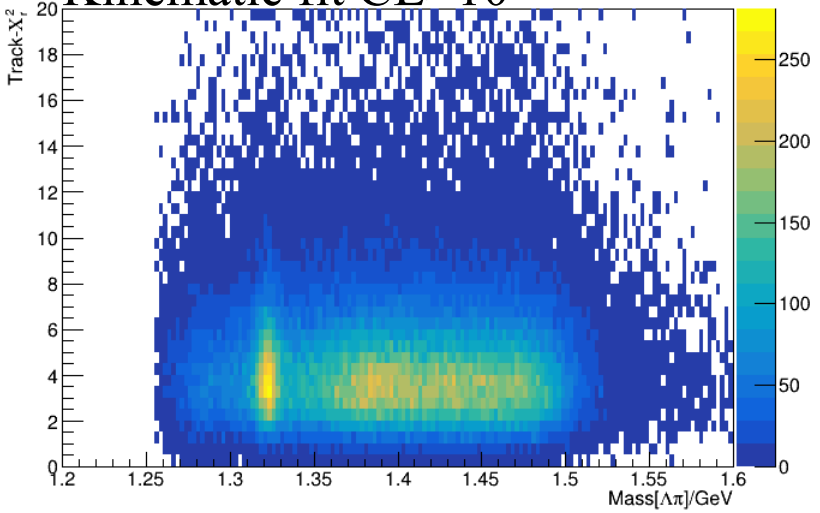
Kinematic fit CL>10^{-5}



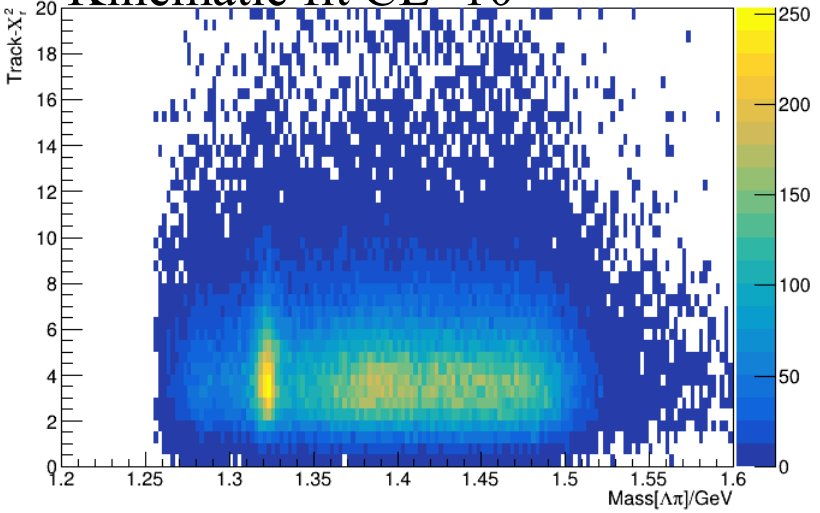
Track-χ_r^2 versus mass[$\Lambda\pi$]

No obvious cut to make for these

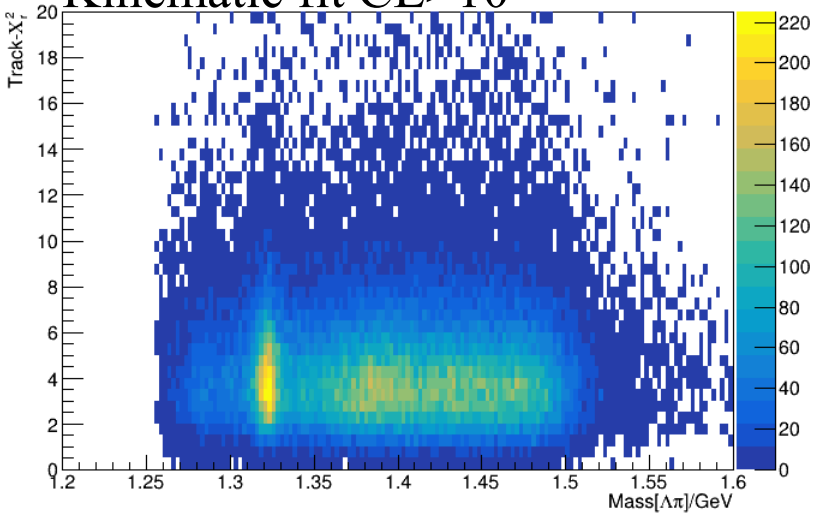
Kinematic fit CL>10^{-8}



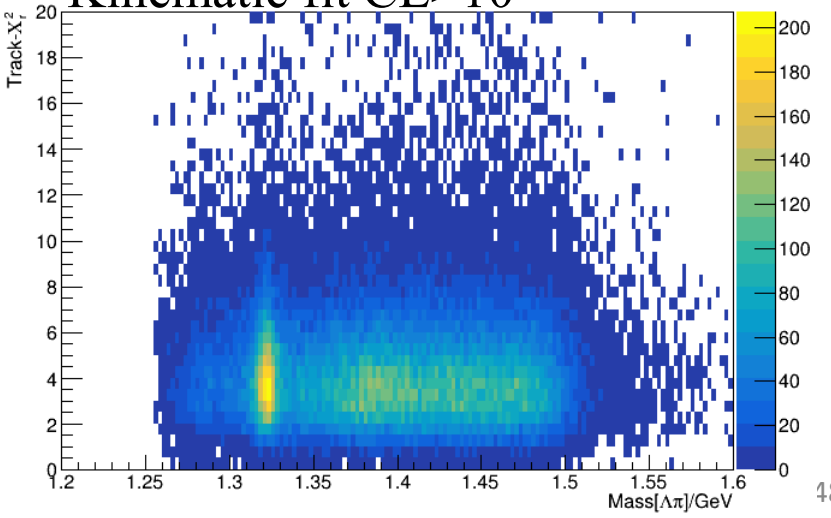
Kinematic fit CL>10^{-7}



Kinematic fit CL>10^{-6}

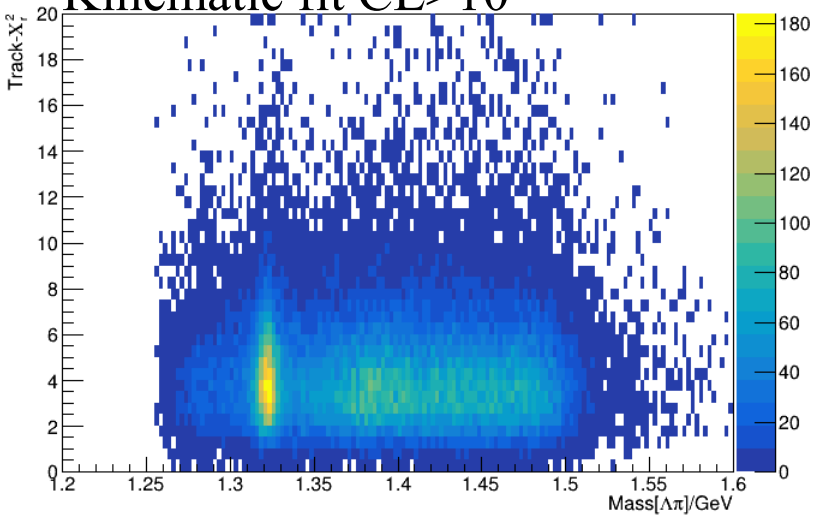


Kinematic fit CL>10^{-5}

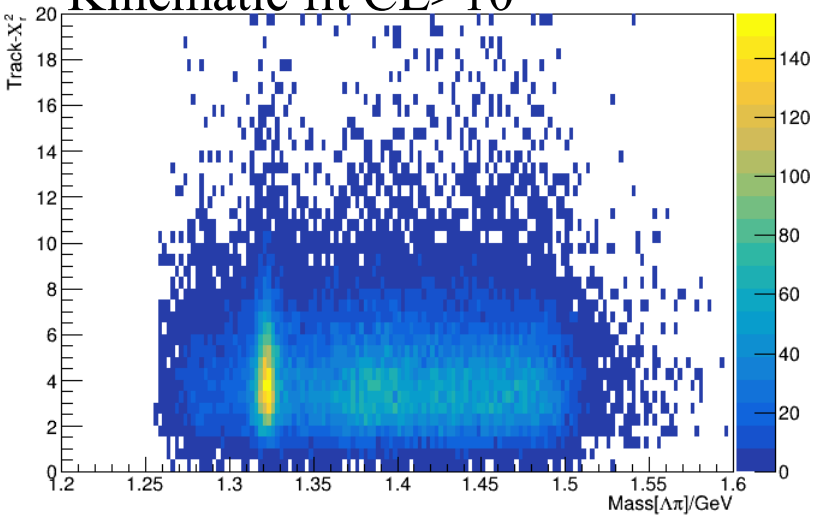


Track-χ_r^2 versus mass[$\Lambda\pi$]

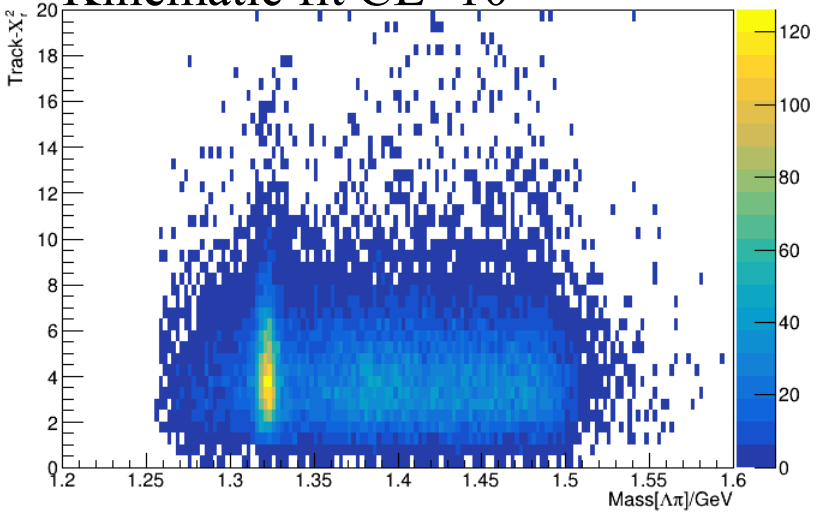
Kinematic fit CL>10^{-4}



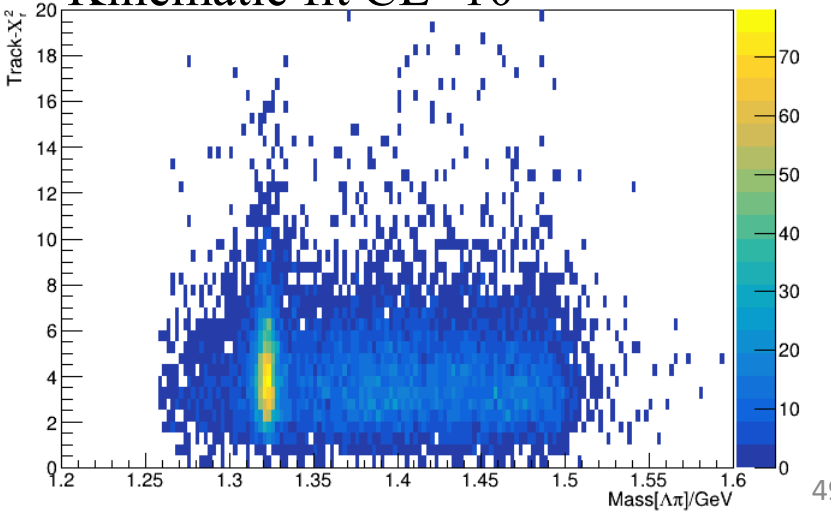
Kinematic fit CL>10^{-3}



Kinematic fit CL>10^{-2}



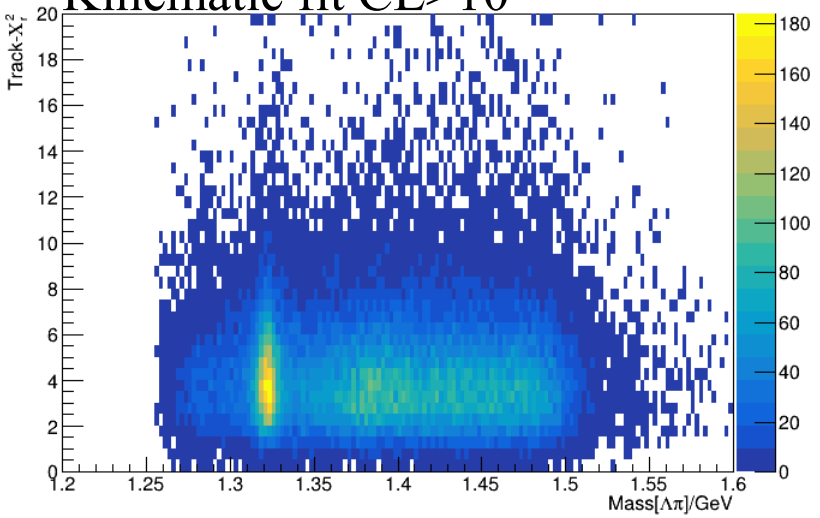
Kinematic fit CL>10^{-1}



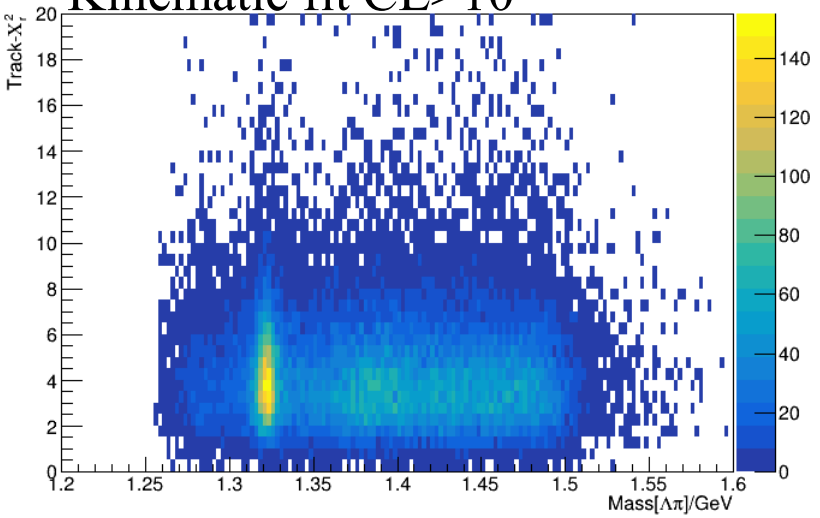
Track-χ_r^2 versus mass[$\Lambda\pi$]

No obvious cut to make for these

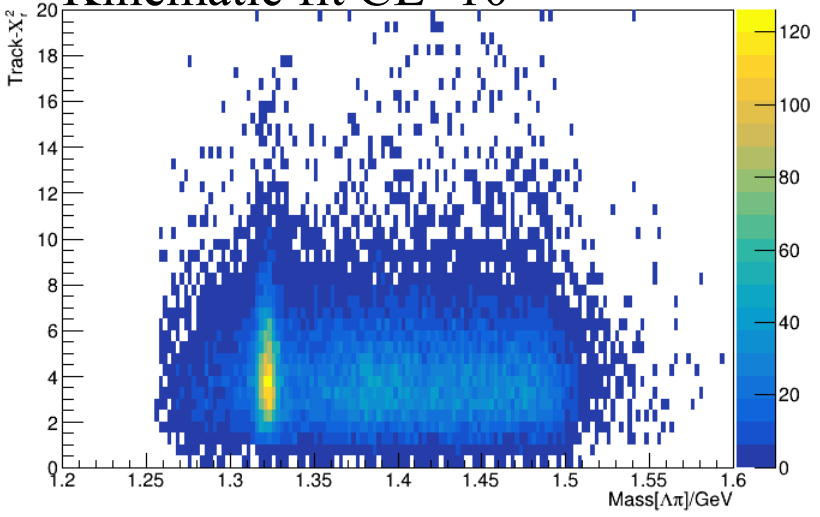
Kinematic fit CL>10^{-4}



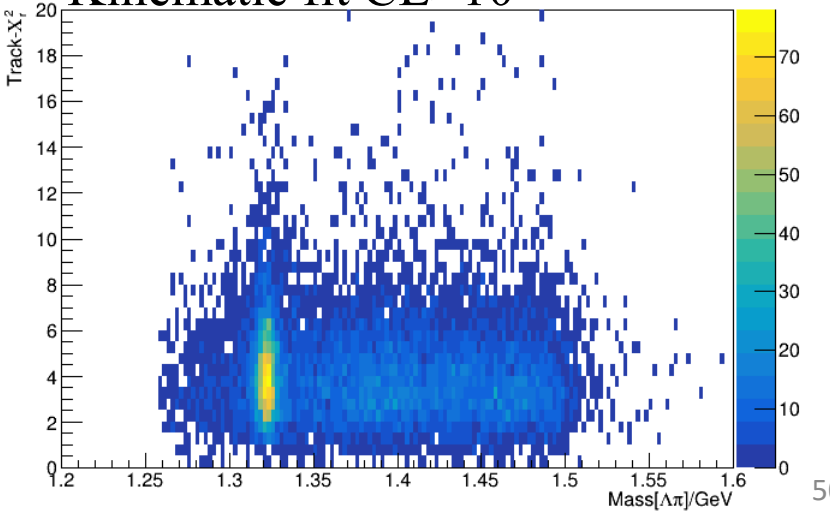
Kinematic fit CL>10^{-3}



Kinematic fit CL>10^{-2}



Kinematic fit CL>10^{-1}



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