Preliminary Cross Section for $\Xi(1530)$

Brandon Sumner

Preliminary $\Xi^{*-}(1530) \rightarrow \Xi^{-}\pi^{0}$ cross section

Decay chain

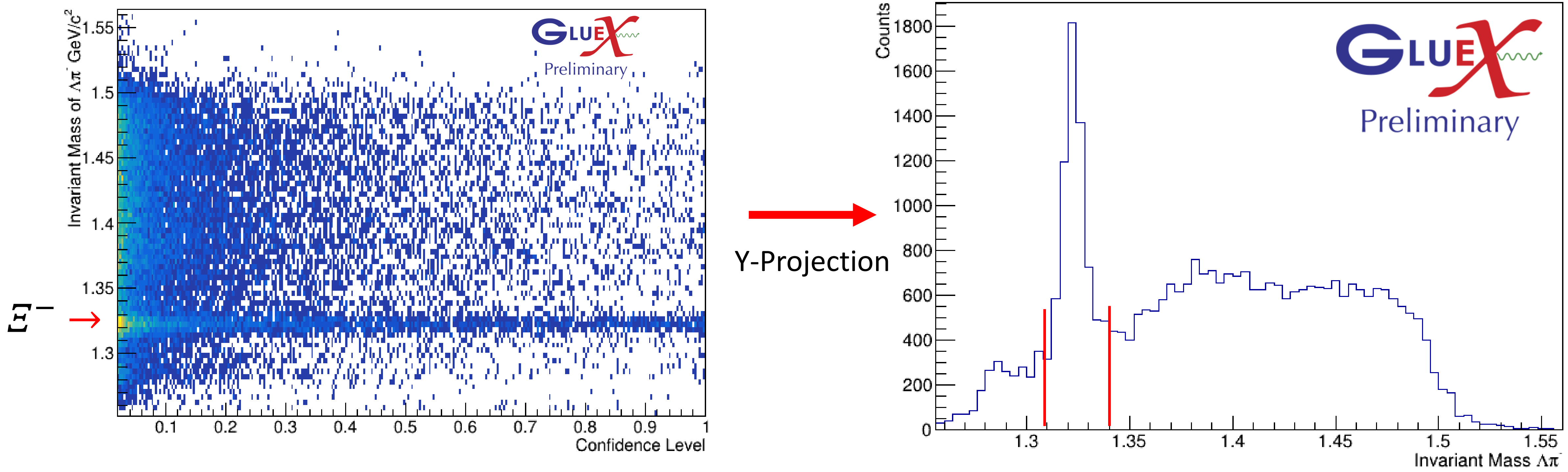
$$\gamma p \rightarrow K^+ K^+ \Xi^{-*}$$

$$\Xi^{-*} \rightarrow \Xi^- \pi^0$$

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

Note: $\pi^0 \rightarrow \gamma\gamma$ and $\Lambda \rightarrow p\pi^-$

Ξ^- Invariant mass selection



- Cut around the signal of the ground state cascade

Background contamination from K^*

- From the combinatorics of all final state particles, there can be an incorrectly linked K^* meson associated with the reaction

$$\gamma p \rightarrow K^+ K^+ \Xi^{-*}$$

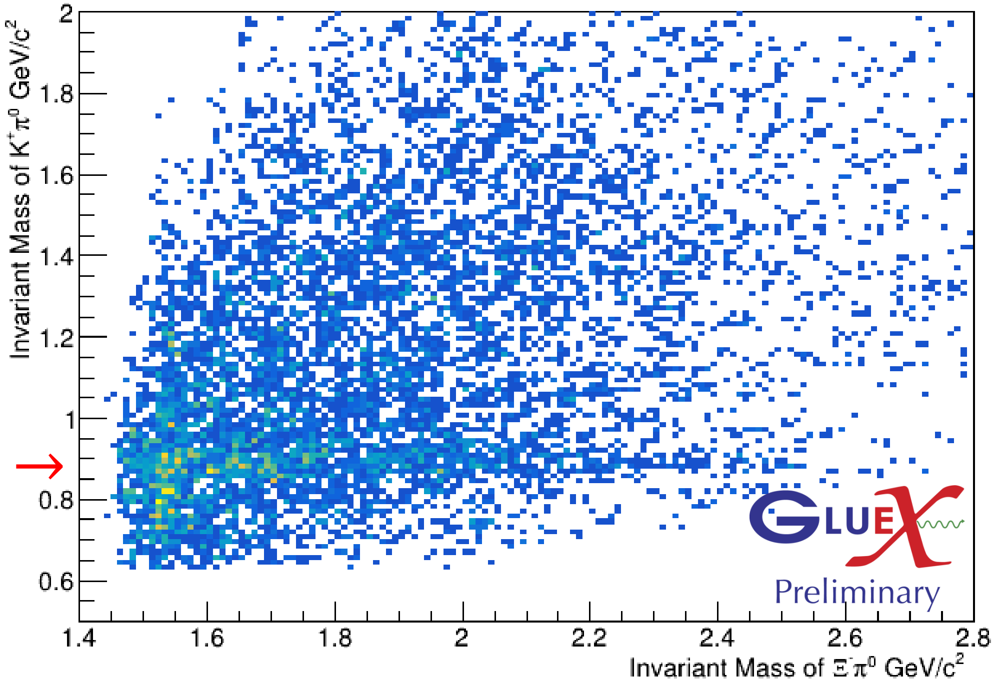
$$\Xi^{-*} \rightarrow \Xi^- \pi^0$$

$$\gamma p \rightarrow K^+ (K^+ \pi^0) \Xi^-$$

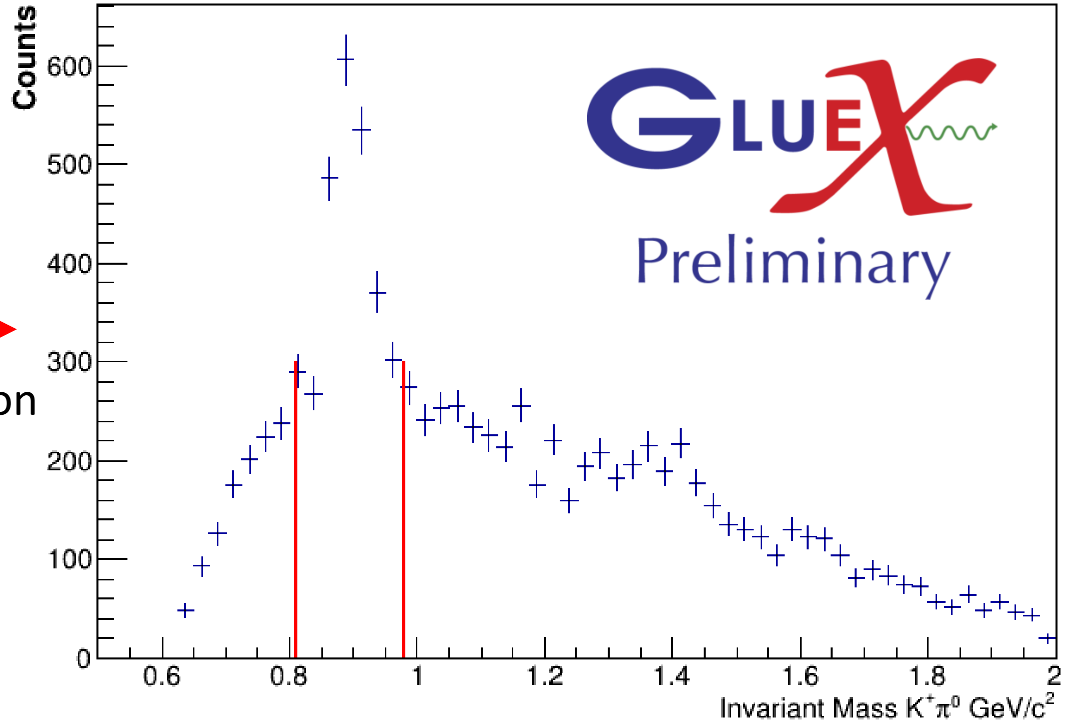
$$K^{*+} \rightarrow K^+ \pi^0$$

Background contamination from K^*

$K^* \rightarrow$

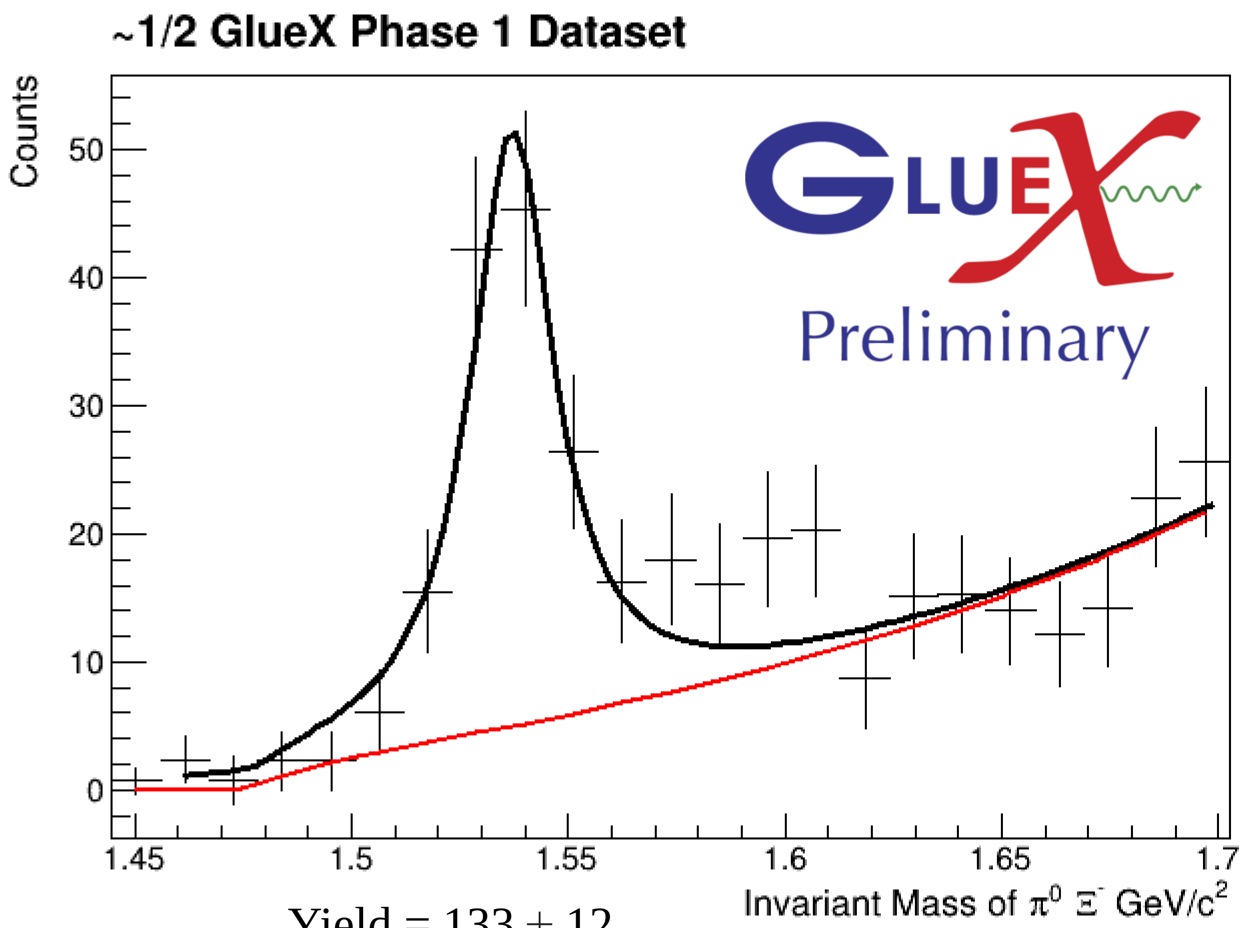


Y-Projection



- Reject events associated with $K^* \rightarrow K^+\pi^0$ contamination

Excited Cascade 1530 Reconstruction



Yield = 133 ± 12
Center = 1.537(2) GeV/c^2
Width = 12(3) MeV/c^2

$\Xi(1530)$ 3/2$^+$ $\quad I(J^P) = \frac{1}{2}(\frac{3}{2}^+)$

$\Xi(1530)^0$ mass $m = 1531.80 \pm 0.32$ MeV (S = 1.3)
$\Xi(1530)^-$ mass $m = 1535.0 \pm 0.6$ MeV
$\Xi(1530)^0$ full width $\Gamma = 9.1 \pm 0.5$ MeV
$\Xi(1530)^-$ full width $\Gamma = 9.9^{+1.7}_{-1.9}$ MeV

$\Xi(1530)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\Xi\pi$	100 %		158
$\Xi\gamma$	<4 %	90%	202

Modeling the cascade production in signal MC

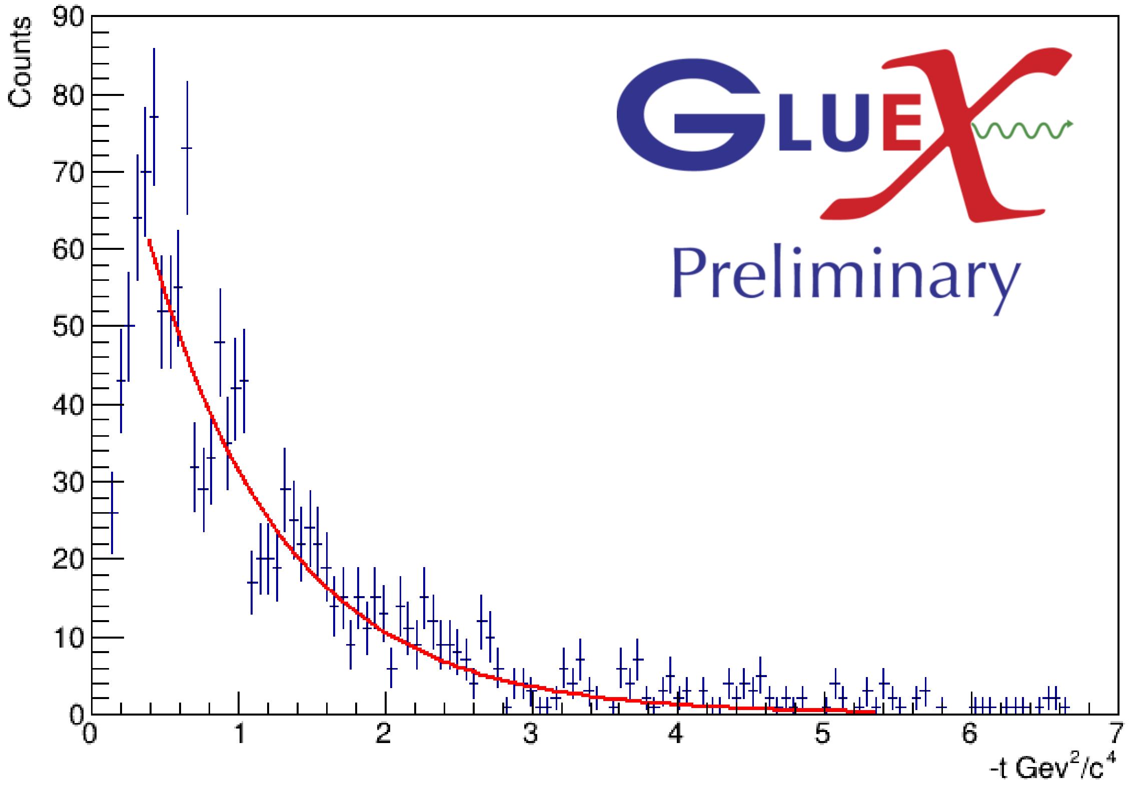
- Theoretical Calculations done by Nakayama, Oh and Haberzettl proposed the cascade/excited cascade are produced by a two-step process:

$$\gamma p \rightarrow K^+ Y^*$$

$$Y^* \rightarrow K^+ \, \Xi^{-*}$$

- Direct production of the Ξ^{-*} would be OZI suppressed with two strange- antistrange pairs at the production vertex. Therefore, I defined t as $t = (P_\gamma - P_{K^+})^2$

t-Slope extraction

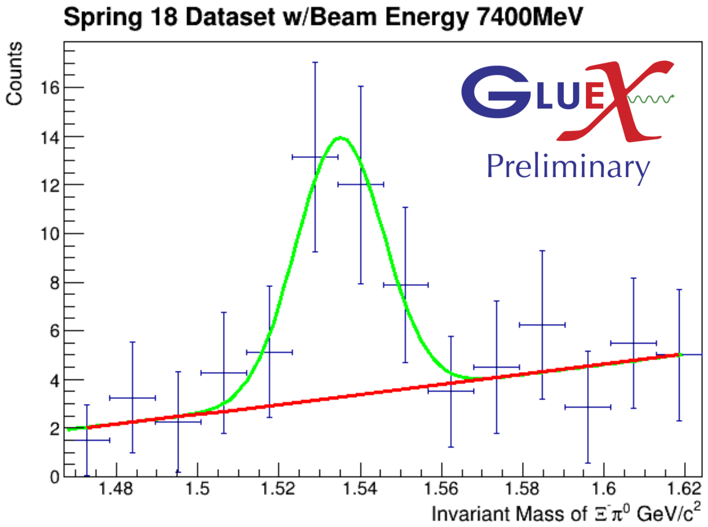


- Selecting events within the excited cascade 1530 peak

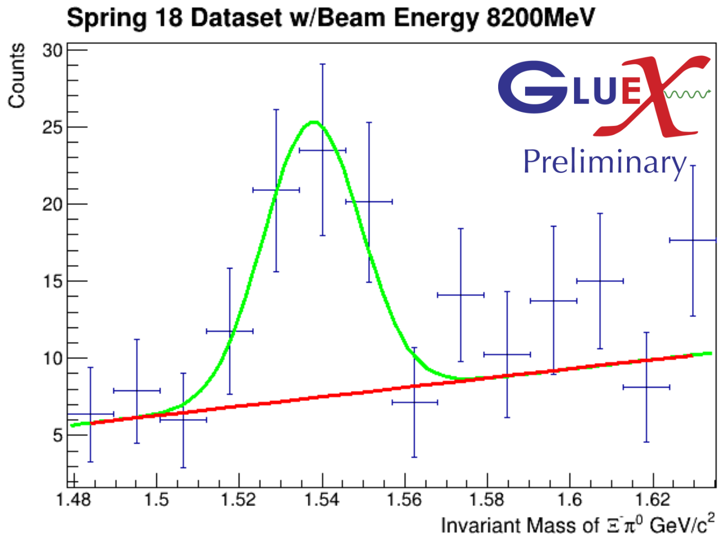
- Assuming : $\frac{d\sigma}{dt} \propto \; e^{-bt}$

$$b = 1.08(4)/\mathrm{GeV}^2$$

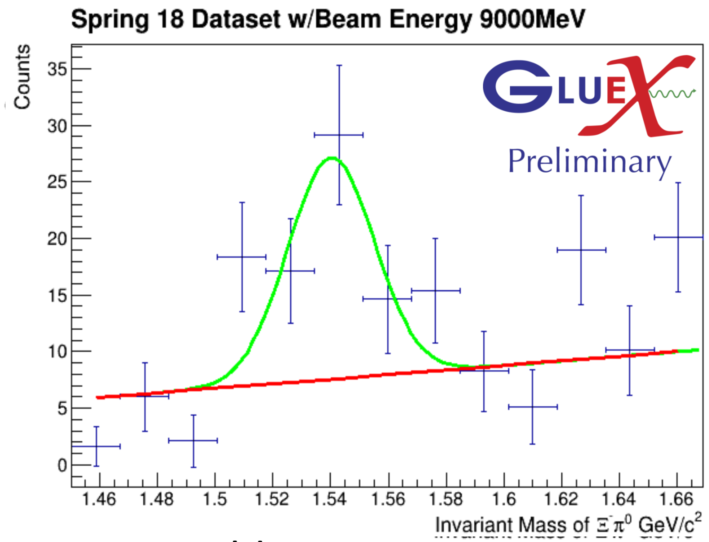
Energy-dependent $\Xi(1530)$ Yield Extraction



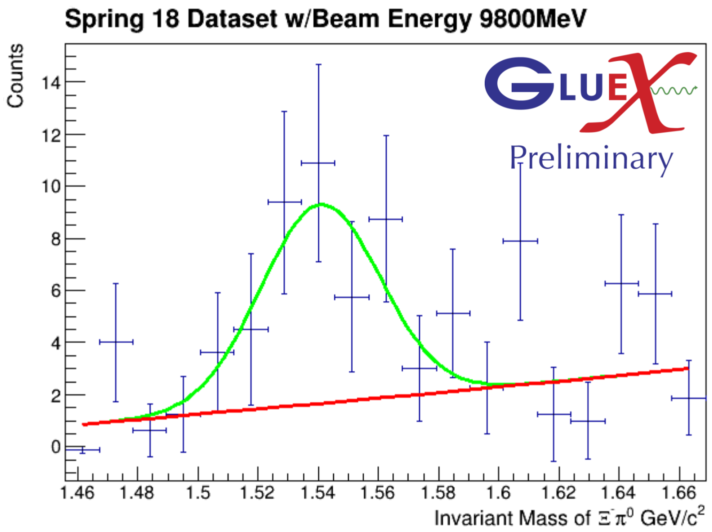
Yield = 25 ± 5



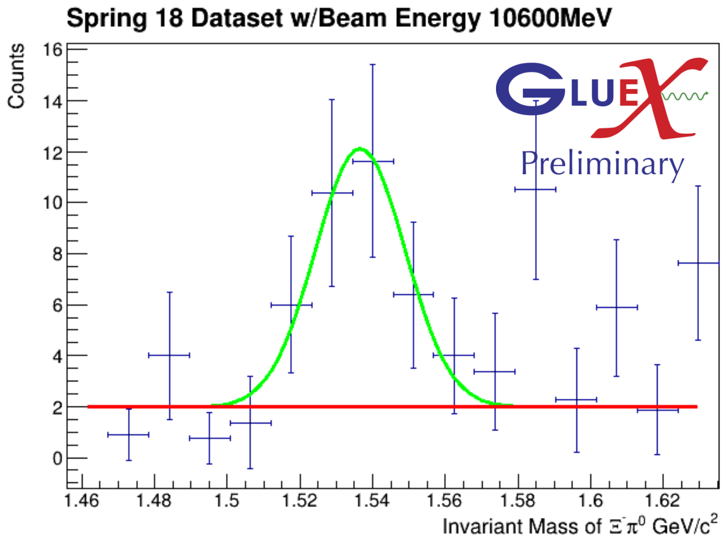
Yield = 51 ± 7



Yield = 52 ± 7

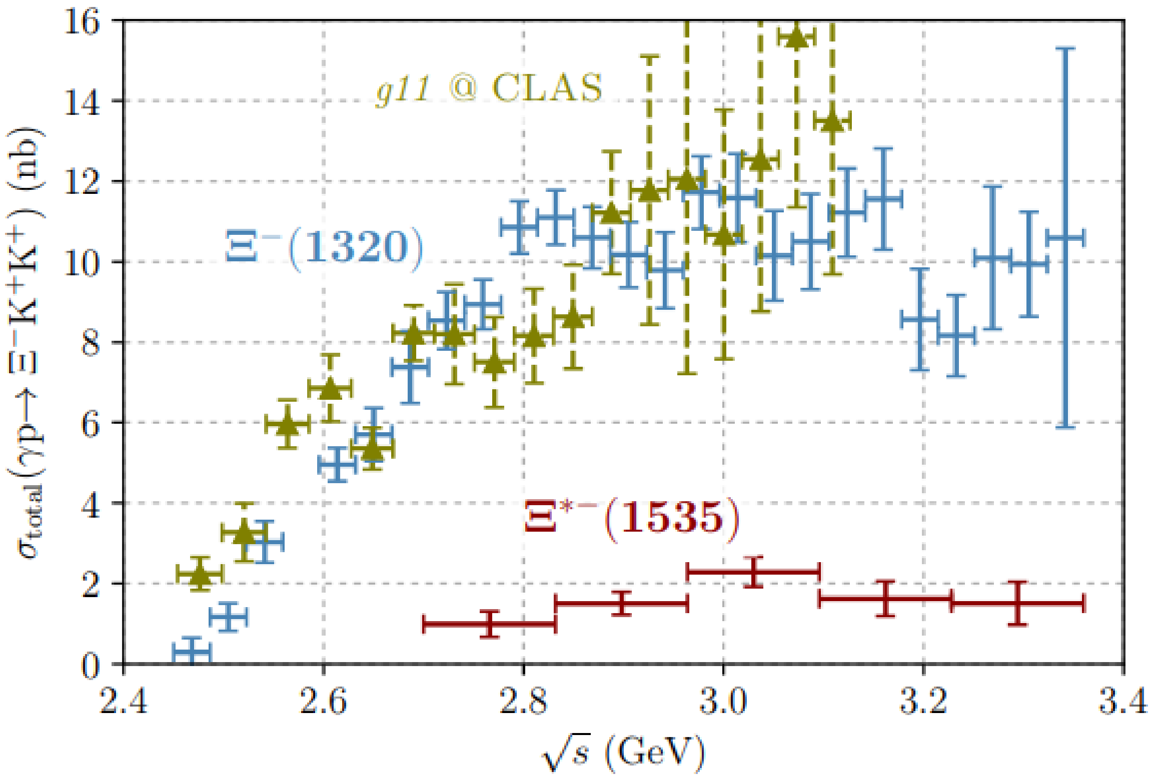


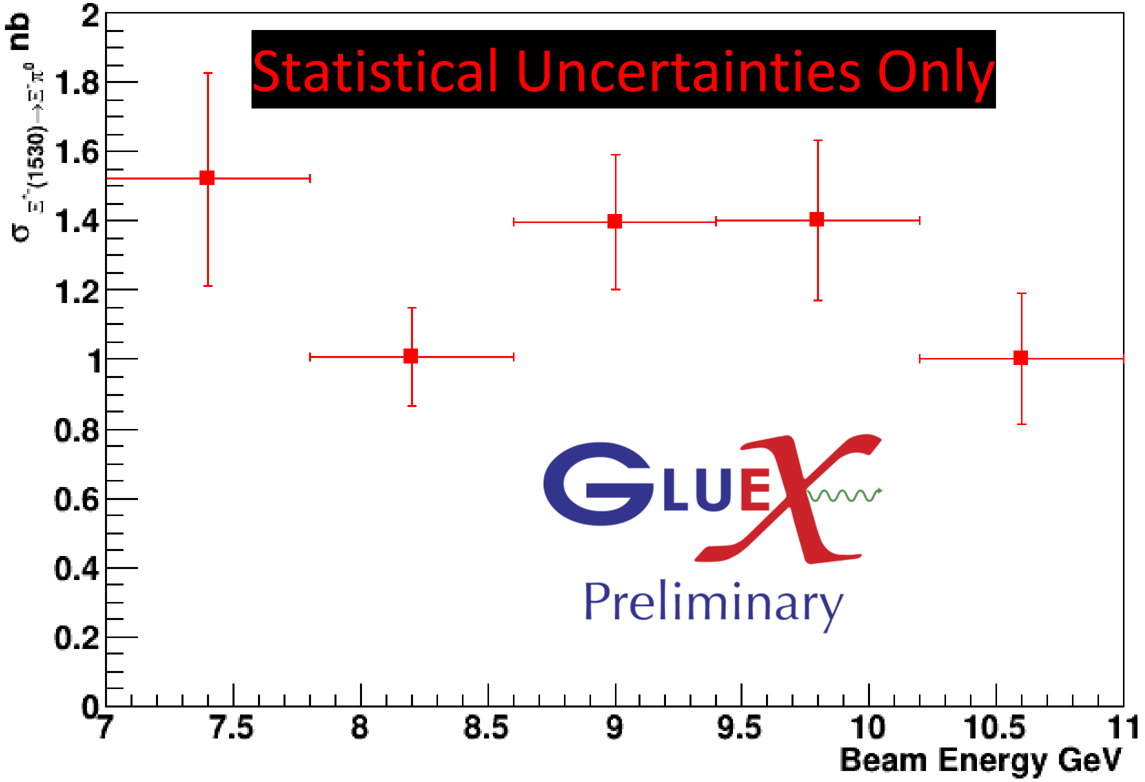
Yield = 37 ± 6



Yield = 28 ± 5

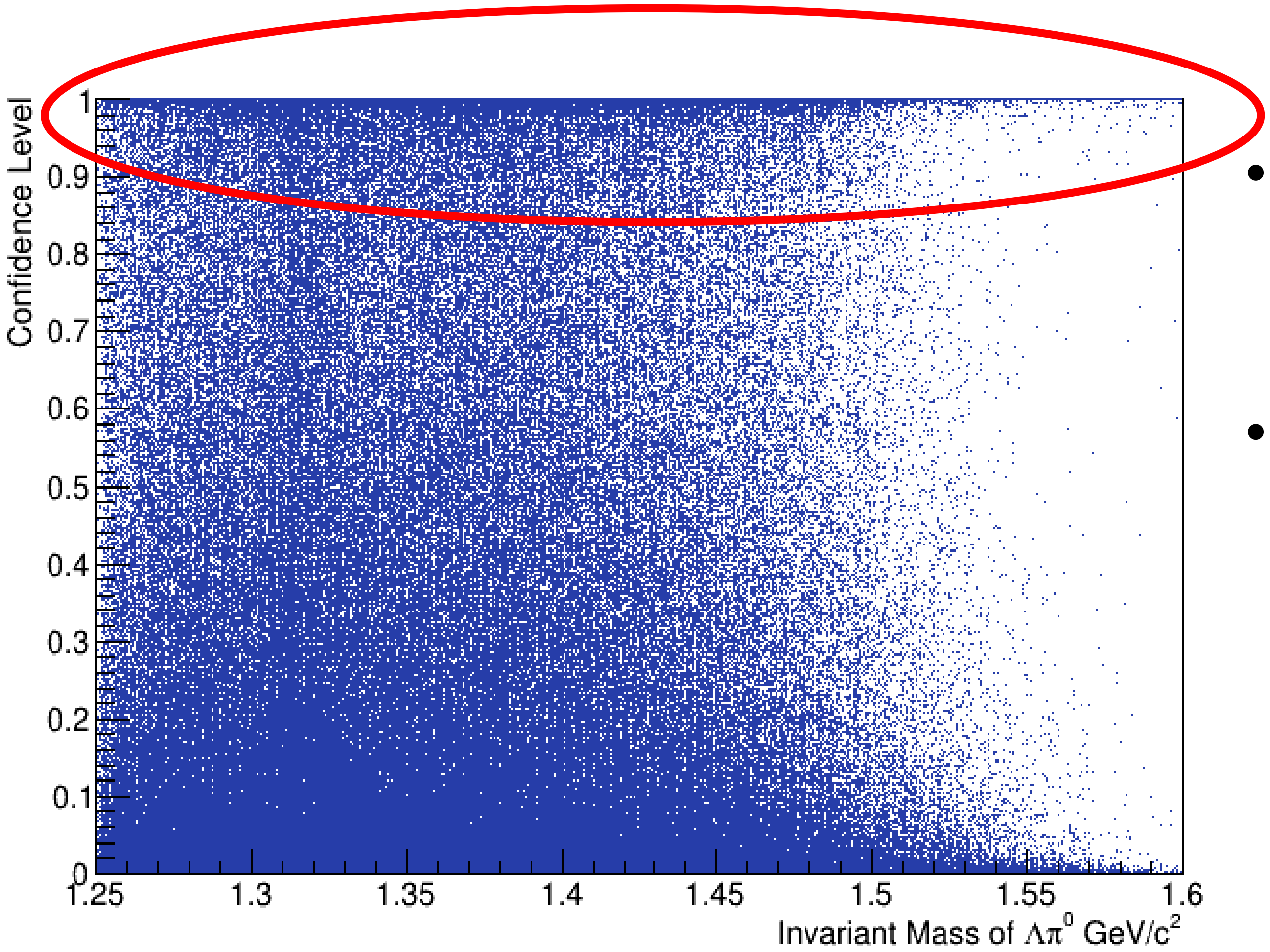
Cross sections for cascade baryons





"Upper limits were calculated on the production total cross sections of the three best-known excited states: the *Ξ*(1690), the *Ξ*(1820) and the *Ξ*(1950) [7] at 0.75 nb, 1.01 nb, and 1.58 nb, respectively"
-Study of *Ξ* Photoproduction from threshold to *W* = 3.3 GeV via CLAS collaboration

Issues w/Vertex fitting



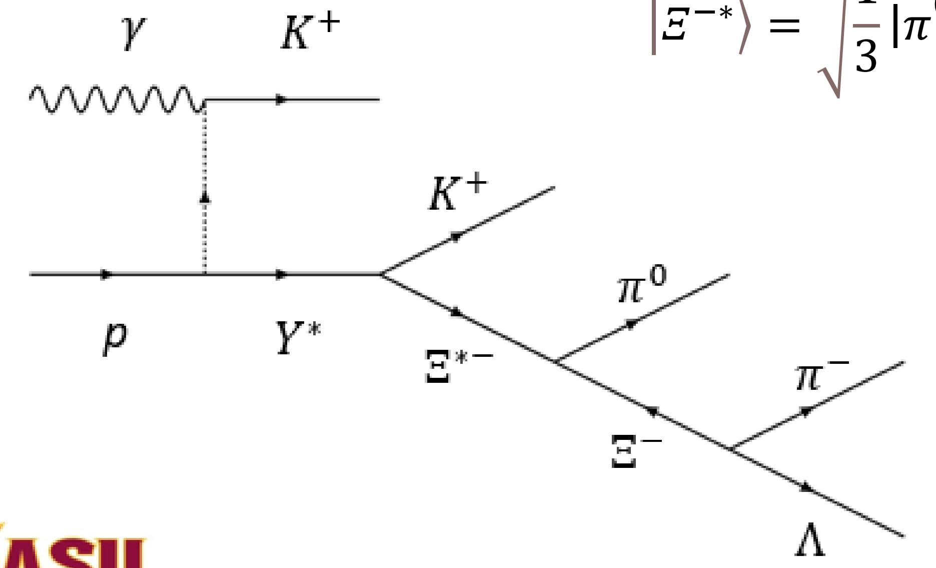
- Large contamination of misidentified particles at high confidence level
- The issues originates from the two neutrals come from the same vertex

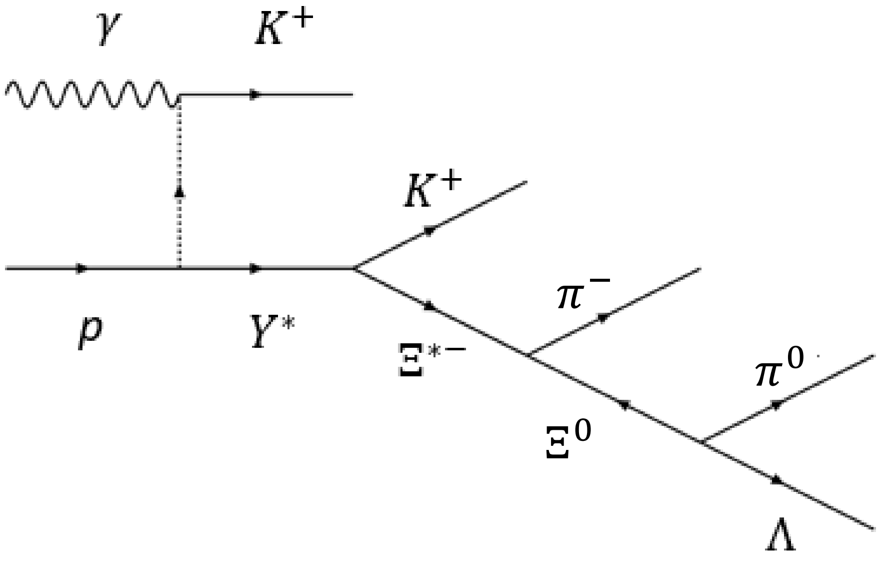
Clebsch Gordan study motivation

- This reaction $\Xi^* \rightarrow \Xi\pi$ should conserve isospin. Using Clebsch-Gordan coefficients we can that determine the neutral cascade channel should occur twice as often.

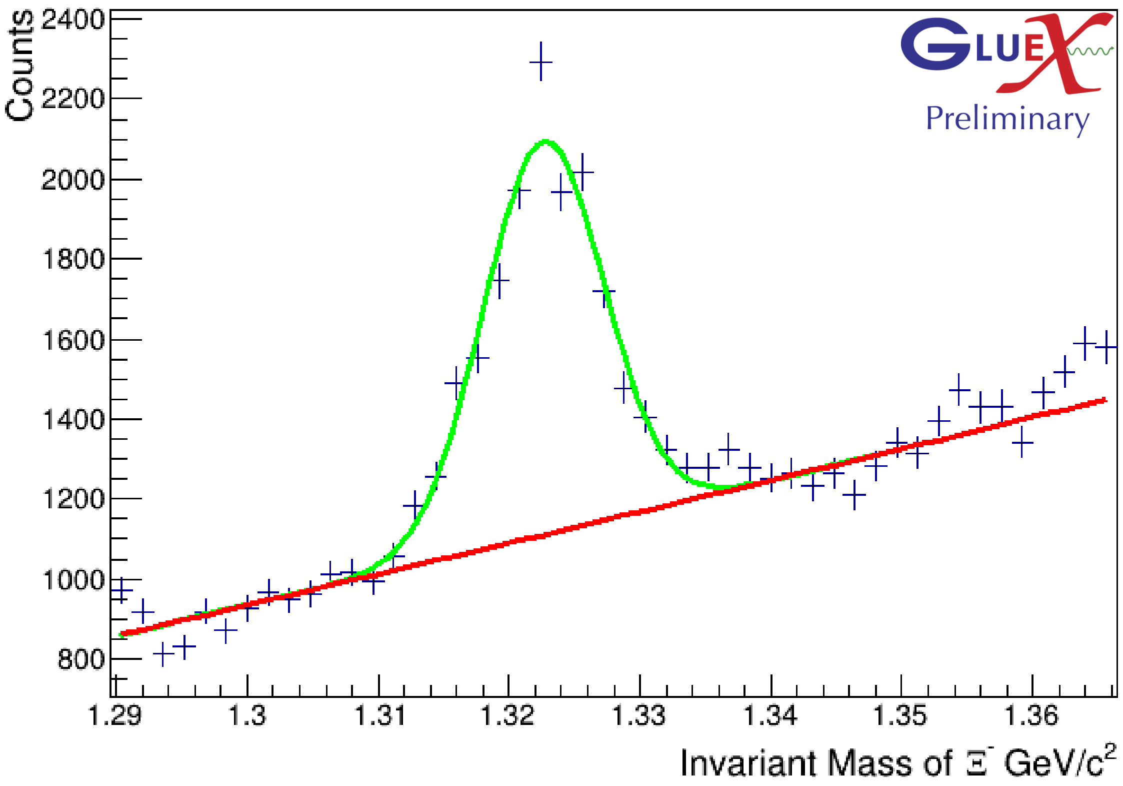
$$\left|\frac{1}{2}, -\frac{1}{2}\right\rangle = \sqrt{\frac{1}{3}}\left[|1,0\rangle\left|\frac{1}{2}, -\frac{1}{2}\right\rangle\right] - \sqrt{\frac{2}{3}}\left[|1,-1\rangle\left|\frac{1}{2}, \frac{1}{2}\right\rangle\right],$$

$$|\Xi^{-*}\rangle = \sqrt{\frac{1}{3}}|\pi^0\Xi^-\rangle - \sqrt{\frac{2}{3}}|\pi^-\Xi^0\rangle$$

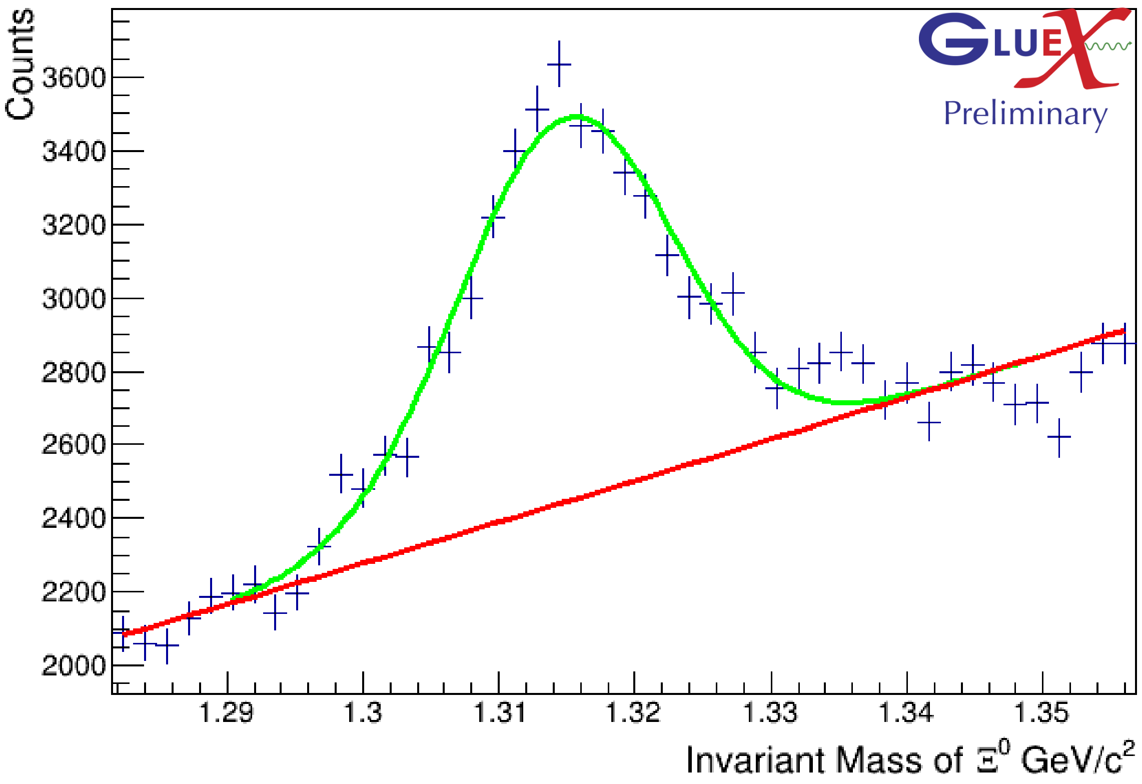




Yields from Ξ^0 and Ξ^- w/o vertex fitting w/CL above 10^{-3}



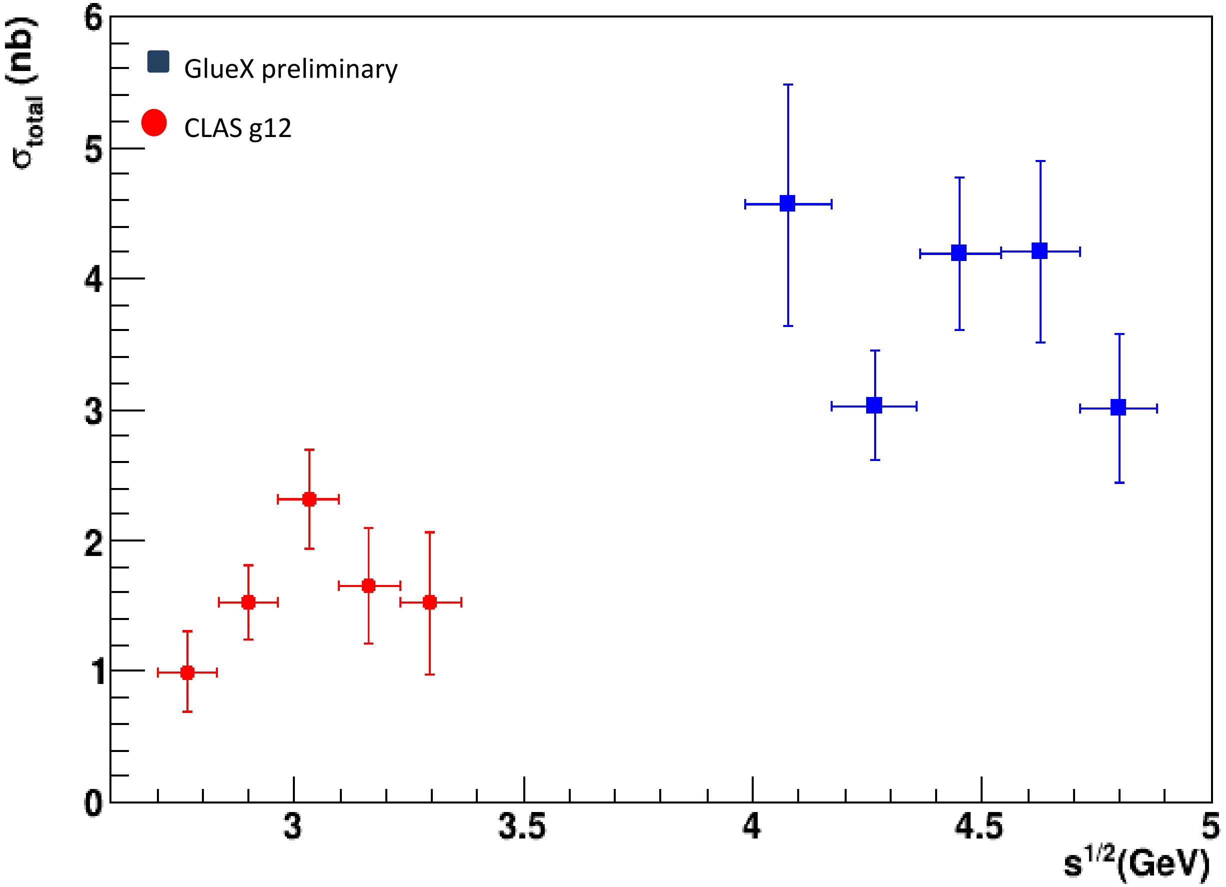
Yield(Ξ^-) = 7270 ± 85



Yield(Ξ^0) = 13351 ± 116

$$\frac{N[\Xi^-(1320)]}{N[\Xi^0(1320)]} = 0.54(2)$$

Preliminary total cross section for $\Xi^{*-}(1530) \rightarrow \Xi\pi$



$$\sigma_T = \sigma_{\Xi^-\pi^0} + \sigma_{\Xi^0\pi^-}$$

$$\sigma_{\Xi^0\pi^-} = 2.0\,\sigma_{\Xi^-\pi^0},$$

$$\sigma_T = 3.0\,\sigma_{\Xi^-\pi^0}.$$

End