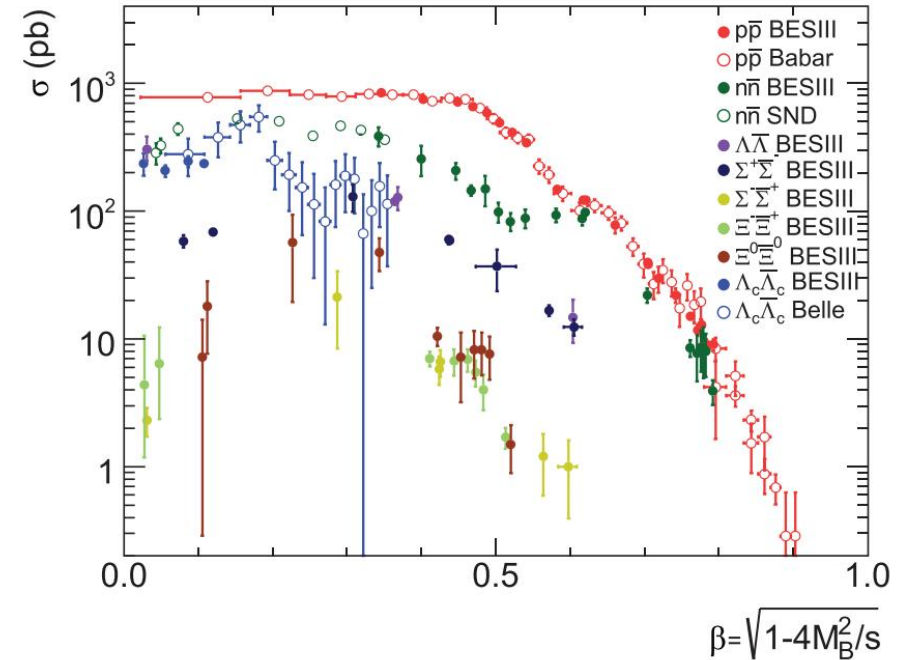


Measurement of the cross sections for

$$e^+e^- \rightarrow \Lambda\pi^+\bar{\Sigma}^- + c.c. \text{ and } e^+e^- \rightarrow \Lambda\pi^-\bar{\Sigma}^+ + c.c.$$

Motivation

1. Experimentally, the anomalous behavior of $e^+e^- \rightarrow p\bar{p}$, $n\bar{n}$, $\Lambda\bar{\Lambda}$ differing from the pQCD prediction around threshold is observed. The precision measurement of the e^+e^- cross section will be **very helpful for confirming the speculation** that whether or not there is an unexpectedly large cross section near threshold and **better understanding the decay dynamics**.



2. Until now, there is **the first** measurement of the decay $e^+e^- \rightarrow \Lambda\pi^+\bar{\Sigma}^- (\bar{\Lambda}\pi^-\Sigma^+)$ and $e^+e^- \rightarrow \Lambda\pi^-\bar{\Sigma}^+ (\bar{\Lambda}\pi^+\Sigma^-)$.
3. Searching for baryon decuplet $\Sigma^*(1385)$ and its related decays, such as $\Sigma\Sigma^*(1385)$ and $\Lambda\Sigma^*(1385)$.

Data and MC

➤ BOSS version : 665.p01

➤ Data samples :

The total luminosity is about 370 pb⁻¹;

ten data samples : the center energy

between 2.6444 to 3.080 GeV ;

2.800 GeV: data of 2012 and 2015

years, respectively.

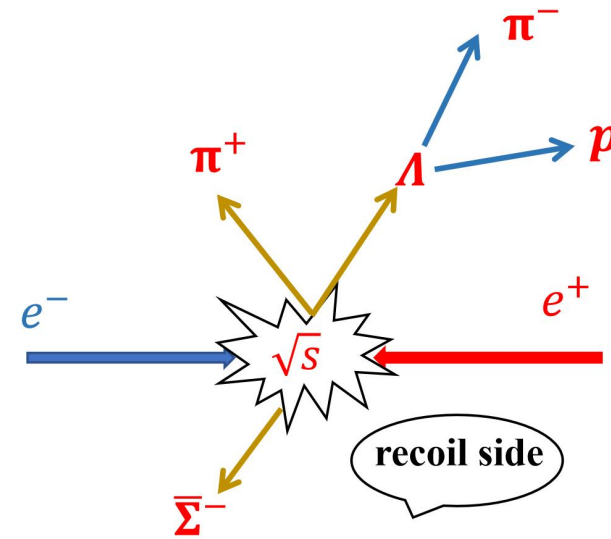
\sqrt{s} (GeV)	$\mathcal{L}(pb^{-1})$	Run No.	Boss version
2.6444	34.003	40128 ~ 40298	Boss665.p01
2.6464	33.722	40300 ~ 40435	Boss665.p01
2.7000	1.03	40436 ~ 40439	Boss665.p01
2.8000(2012)	3.753	28553 ~ 28575	Boss665.p01
2.8000(2015)	1.008	40440 ~ 40443	Boss665.p01
2.9000	105.253	39775 ~ 40069	Boss665.p01
2.9500	15.942	39619 ~ 39650	Boss665.p01
2.9810	16.071	39651 ~ 39679	Boss665.p01
3.0000	15.881	39680 ~ 39710	Boss665.p01
3.0200	17.290	39711 ~ 39738	Boss665.p01
3.0800	126.185	39355 ~ 39618	Boss665.p01

official Inclusive MC

Signal MC: $e^+e^- \rightarrow \Lambda\pi^+\bar{\Sigma}^-$ (PHSP), $\Lambda \rightarrow p\pi^-$ (PHSP), $\bar{\Sigma}^- \rightarrow anything$;

partial reconstruction method:

- (1) reconstruct **one** Λ with the clean process $\Lambda \rightarrow p\pi^-$;
- (2) combine **a** π^+/π^- produced by IP with Λ ;
- (3) check the **recoil mass of $\Lambda\pi$** system for $\bar{\Sigma}$ signal.



Event selection:

Good charged tracks :

➤ $|\cos\theta| < 0.93$

➤ tracks from Λ :

$$N_{track^+} > 1 \ \& \ N_{track^-} > 1$$

$$|V_z| < 20.0cm$$

➤ other tracks :

$$|V_{xy}| < 1.0cm \ \& \ |V_z| < 10.0cm$$

PID:

➤ $p: \text{prob}(p) > \text{prob}(\pi) \ \& \ \text{prob}(p) > \text{prob}(K)$

➤ $\pi: \text{prob}(\pi) > \text{prob}(p) \ \& \ \text{prob}(\pi) > \text{prob}(K)$

Reconstruct Λ :

➤ vertex fit and Secondary vertex fit successfully;

➤ $L/\sigma_L > 2$ and retain **one Λ with the maximum L/σ_L** ;

➤ $\chi^2 < 20$;

π^\pm from e^+e^- :

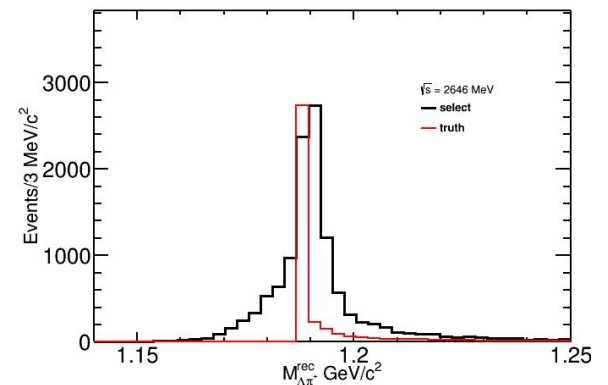
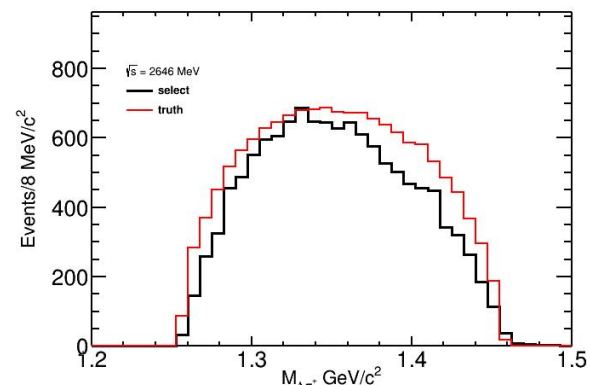
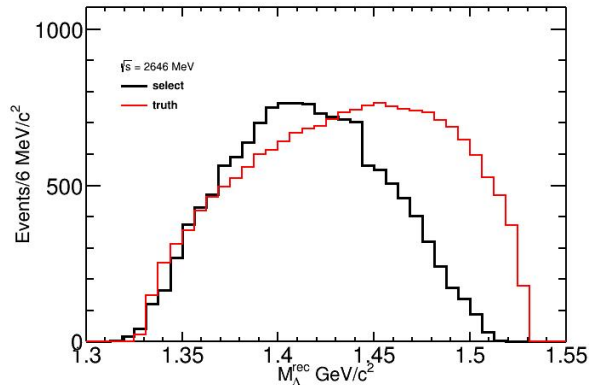
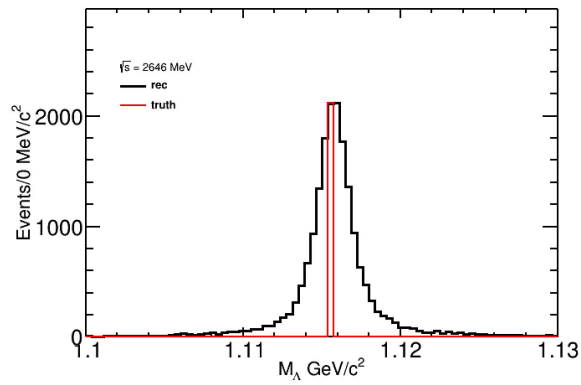
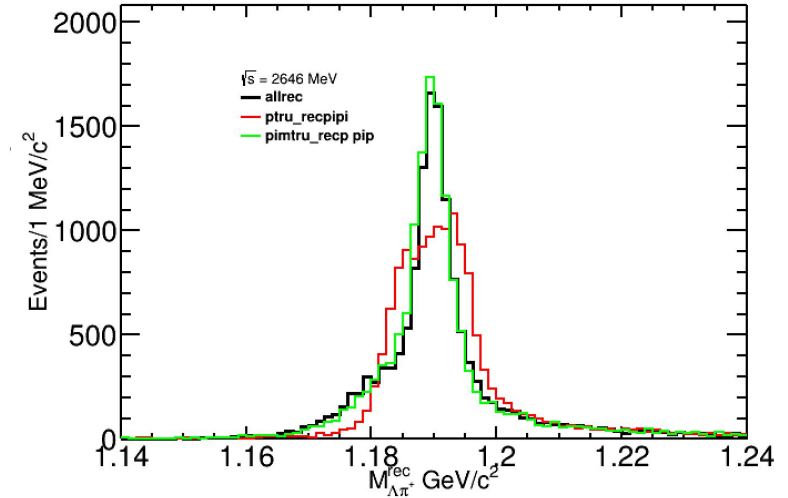
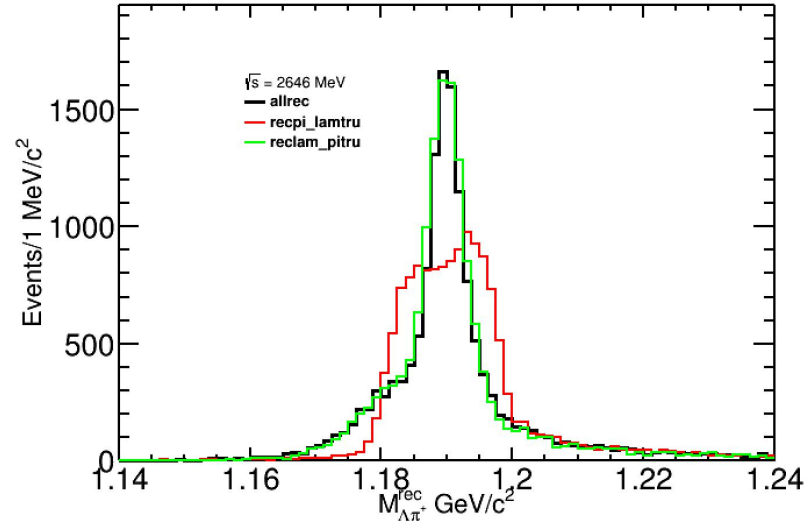
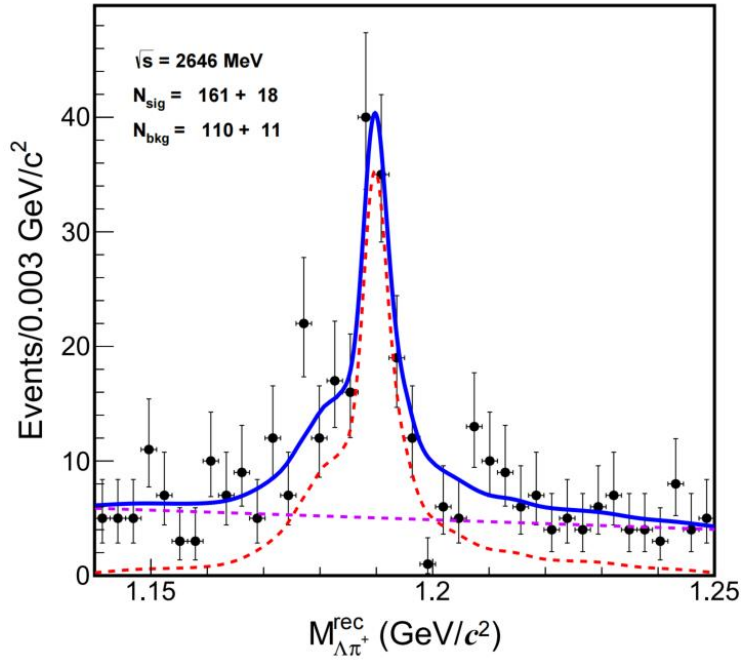
➤ **Skip** π^\pm that has been used to reconstruct Λ ;

➤ $|V_{xy}| < 1.0cm \ \& \ |V_z| < 10.0cm$

➤ $N_{\pi^+(\pi^-)} = 1$

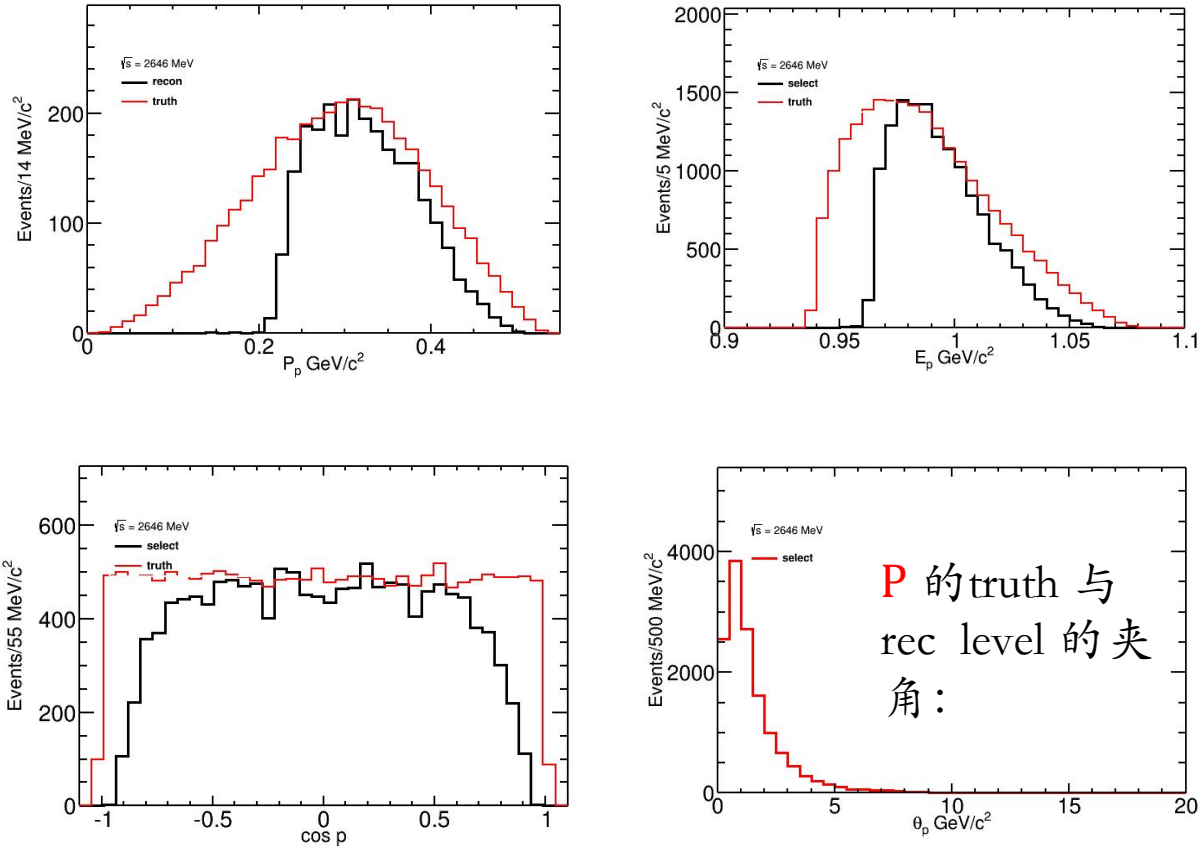
2.6464: $e^+e^- \rightarrow \Lambda\pi^+\bar{\Sigma}^-$

Mass:

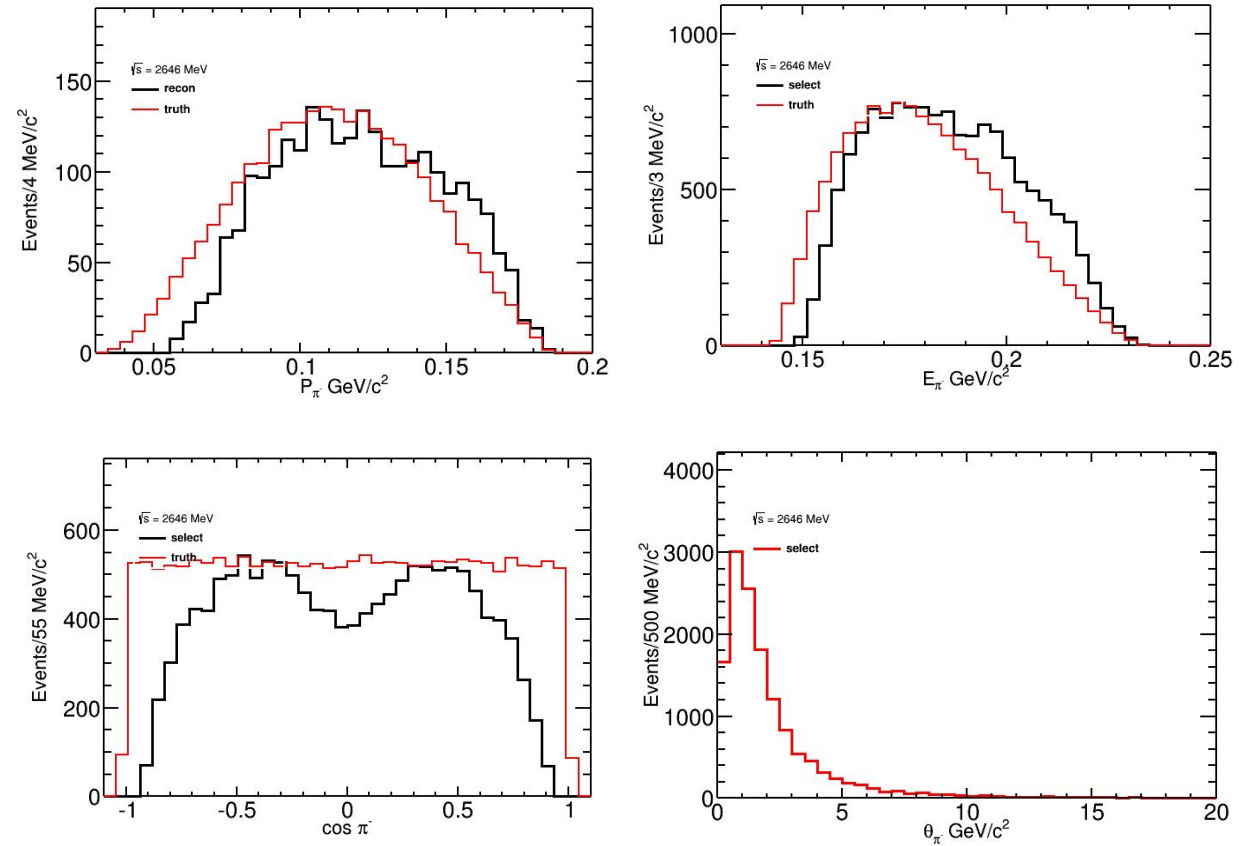


2.6464: $e^+e^- \rightarrow \Lambda\pi^+\bar{\Sigma}^-$

Λ 重建里的 p 的 truth 与 rec level :



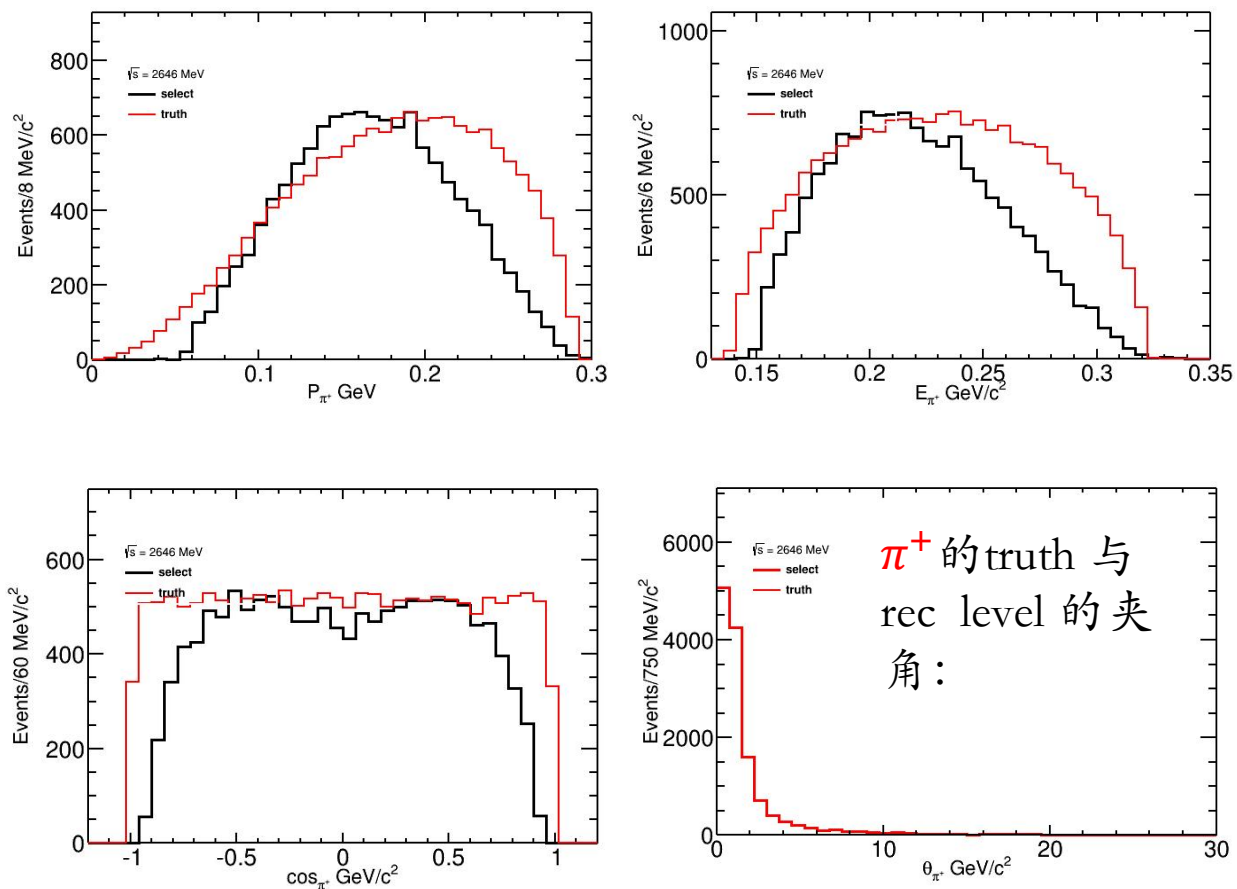
Λ 重建里的 π^- truth 与 rec level :



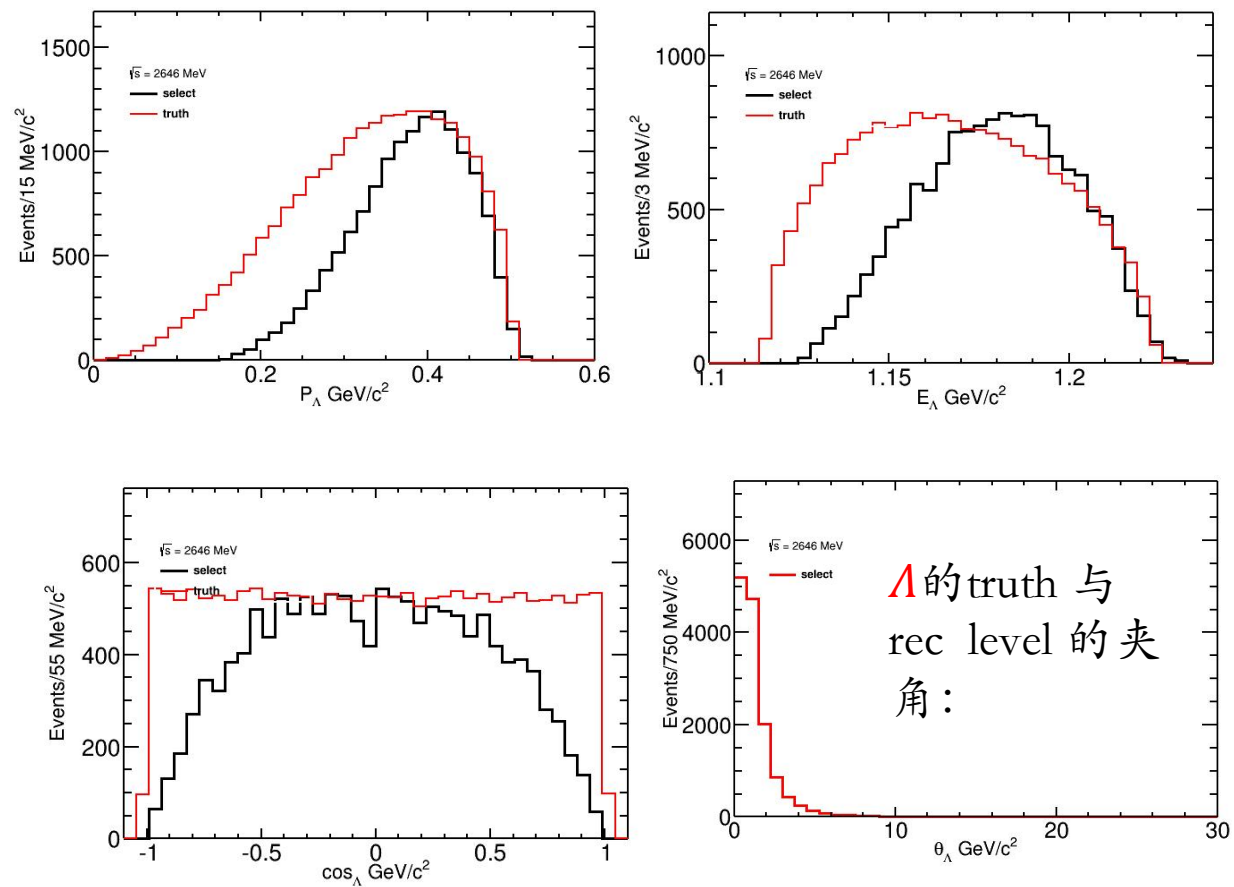
P 的 truth 与
rec level 的夹
角:

2.6464: $e^+e^- \rightarrow \Lambda\pi^+\bar{\Sigma}^-$

π^+ 的 truth 与 rec level 的四动量、角度对比:



Λ 的 truth 与 rec level 的四动量、角度对比:



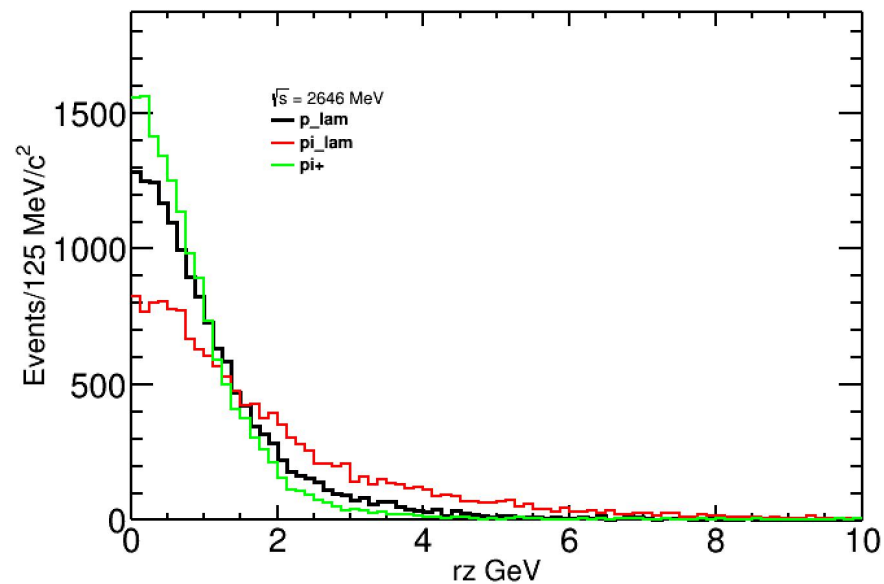
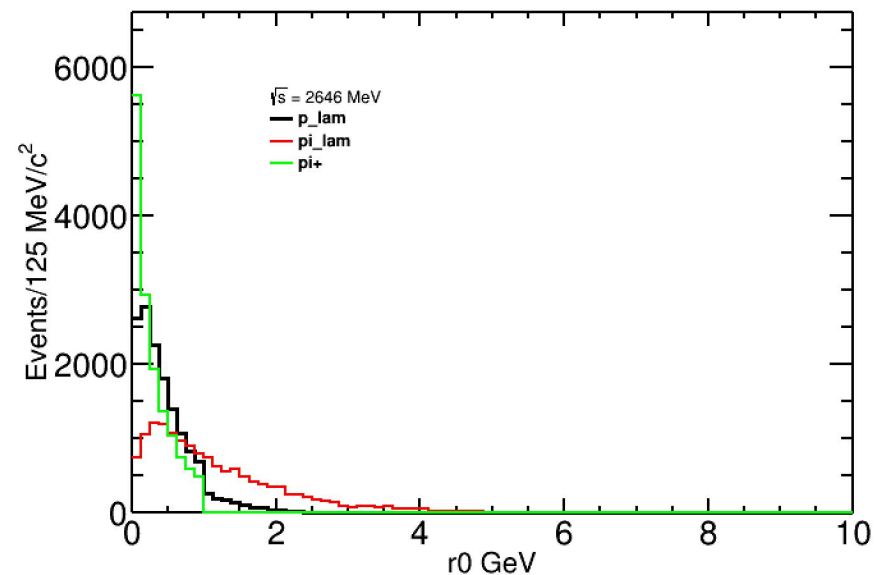
补充: DEC

```
noPhotos
Particle vpho 2.6464 0.0
Decay vpho
1.0000 gamma gamma* ConExc -2 3122 211 -3222;
Enddecay

Decay gamma*
1.0000 Lambda0 pi+ anti-Sigma- PHSP;
Enddecay

Decay Lambda0
1.0000 p+ pi- PHSP;
Enddecay

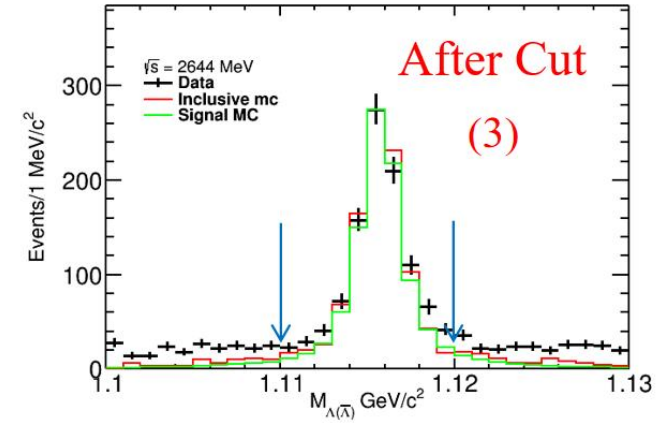
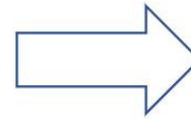
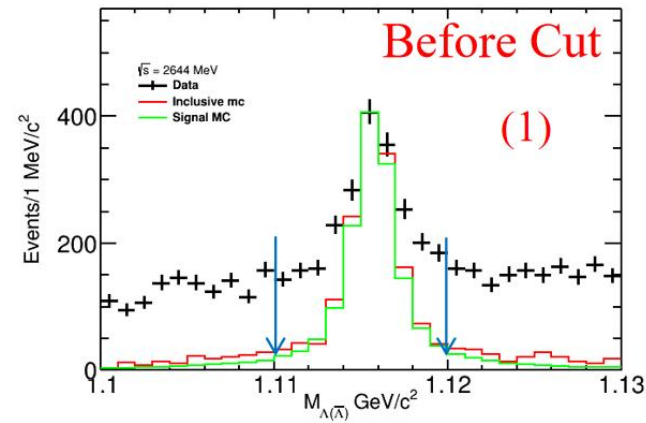
End
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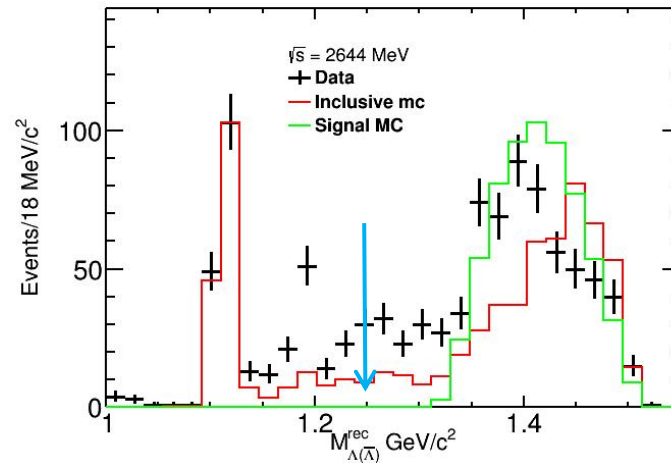
补充: BKG

- $1.11 < M_{\Lambda(\bar{\Lambda})} < 1.12 \text{ GeV}/c^2$

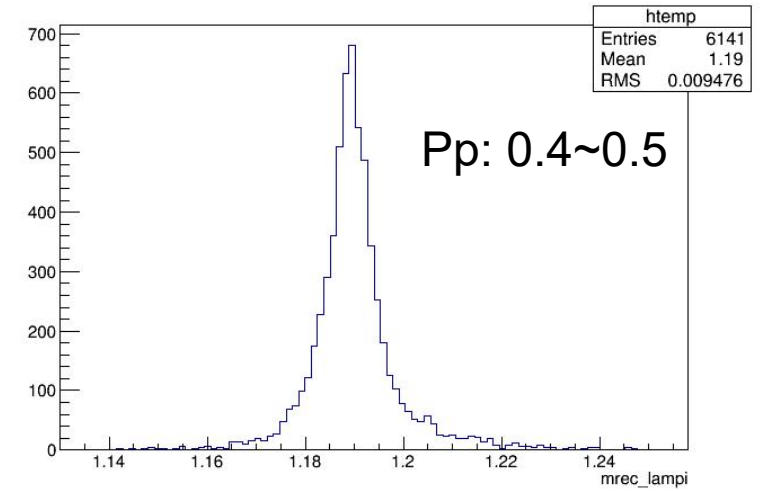
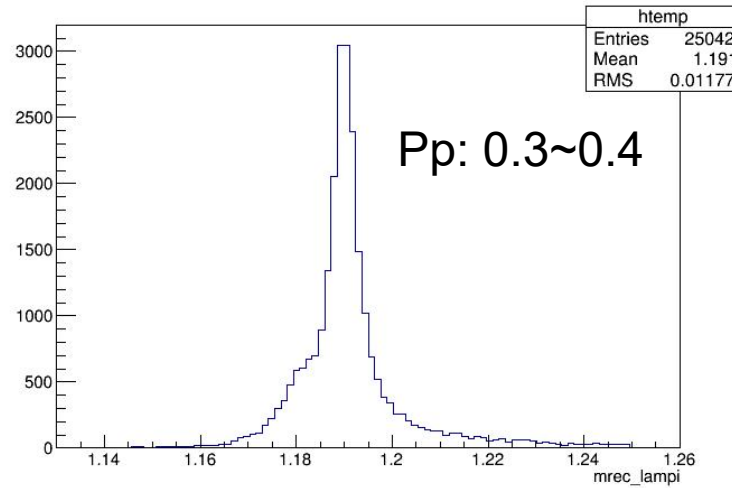
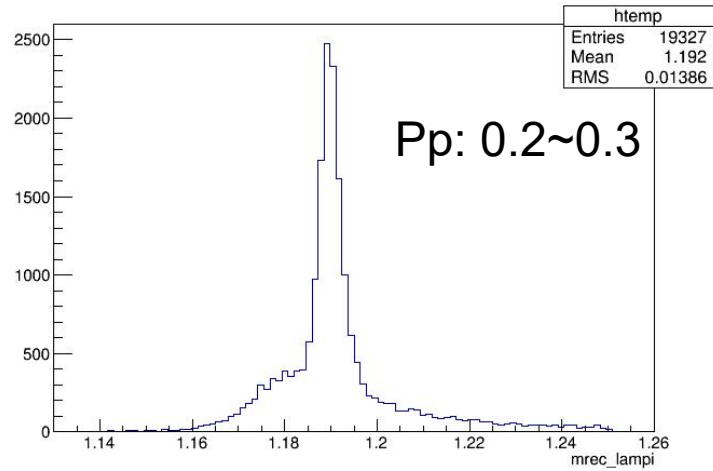
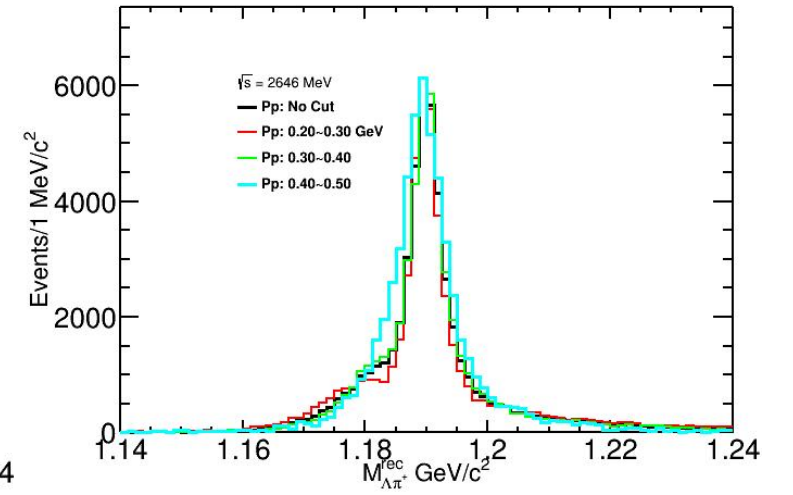
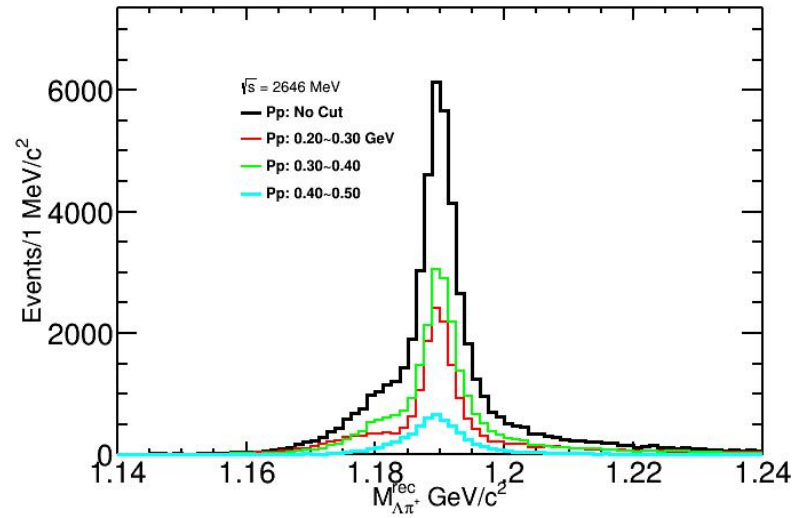
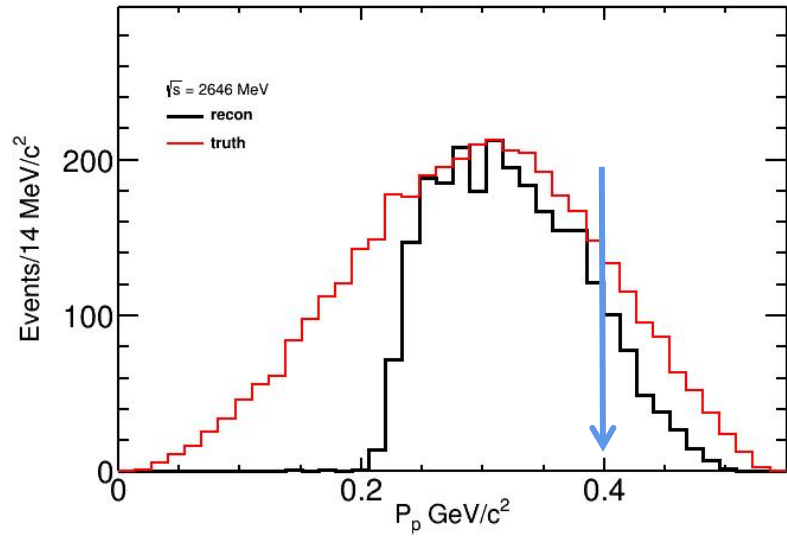
- $\chi^2 < 20$



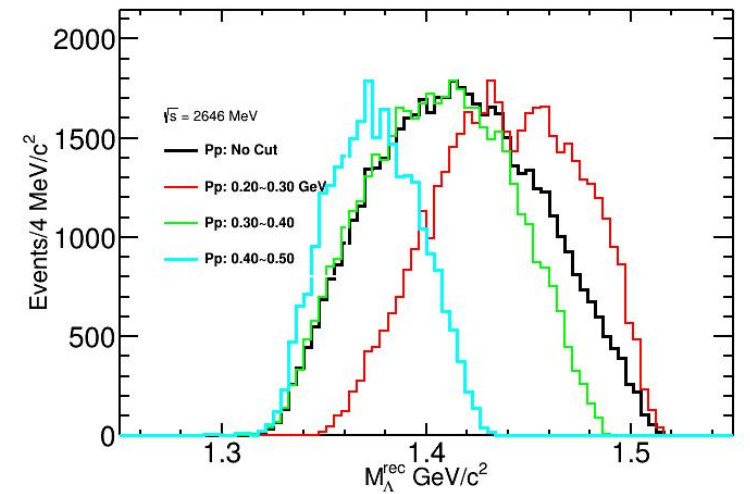
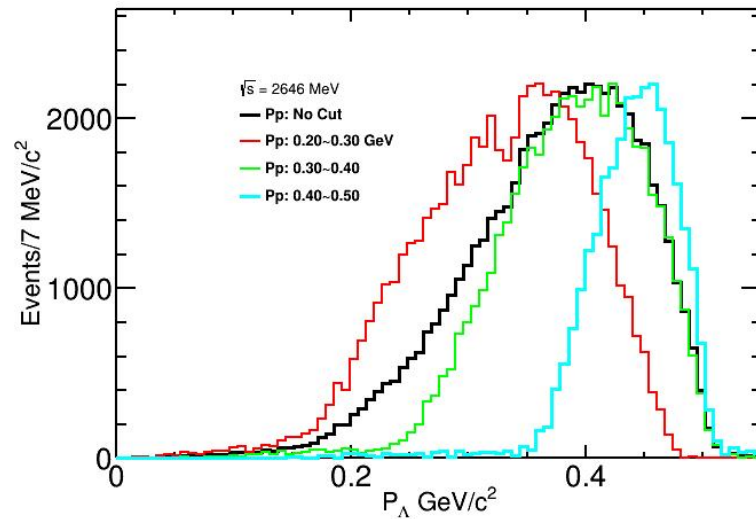
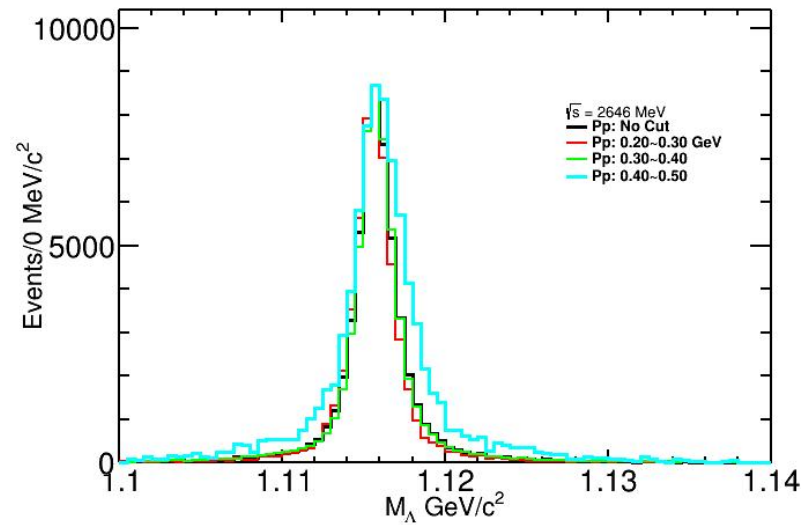
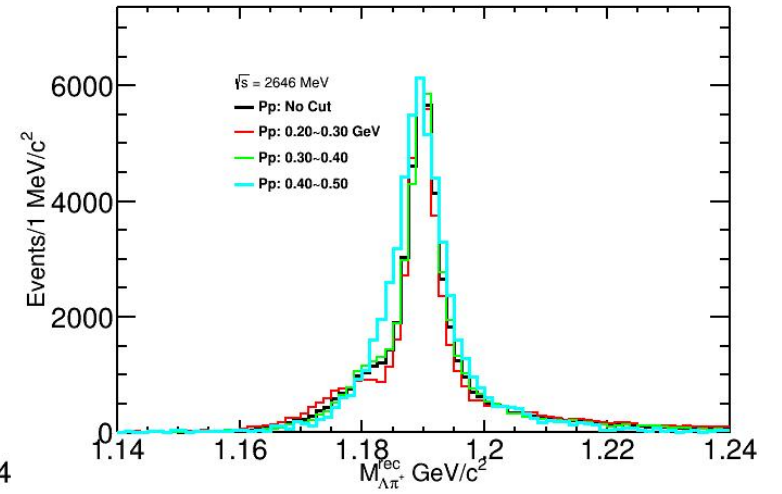
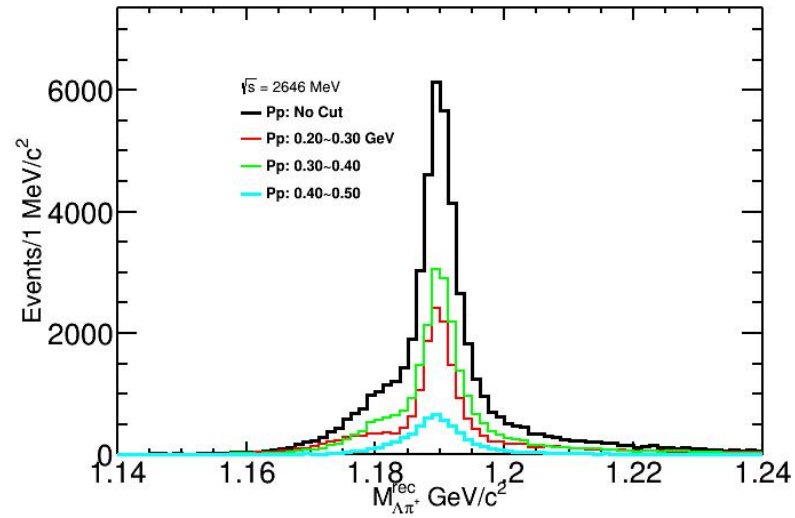
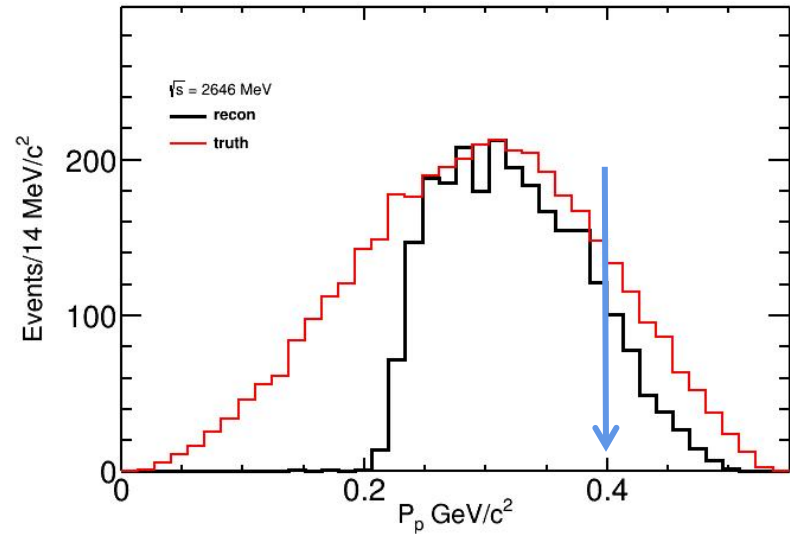
- $M_{\Lambda(\bar{\Lambda})}^{\text{recoil}} > 1.25 \text{ GeV}$



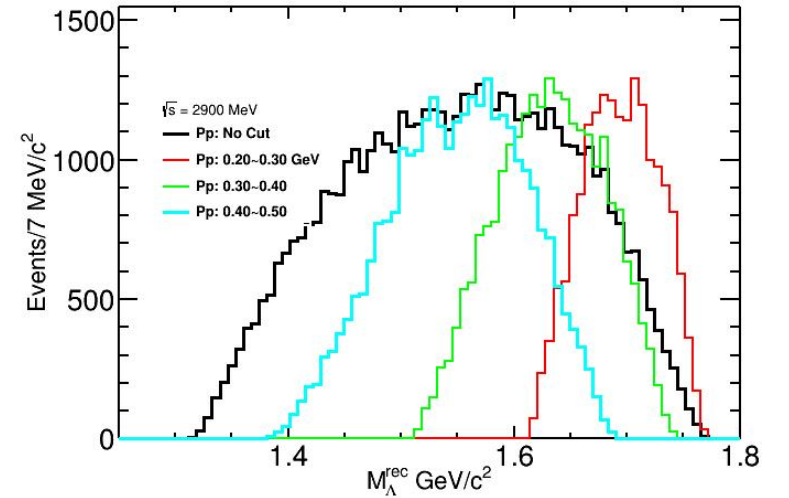
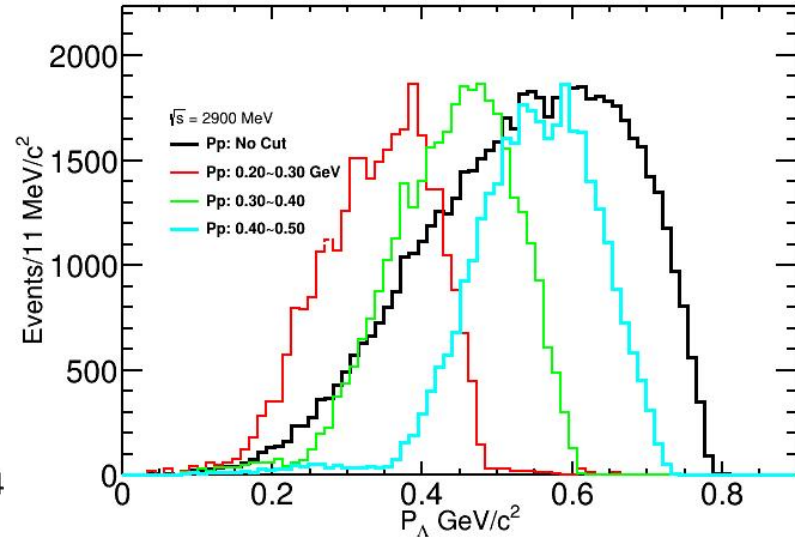
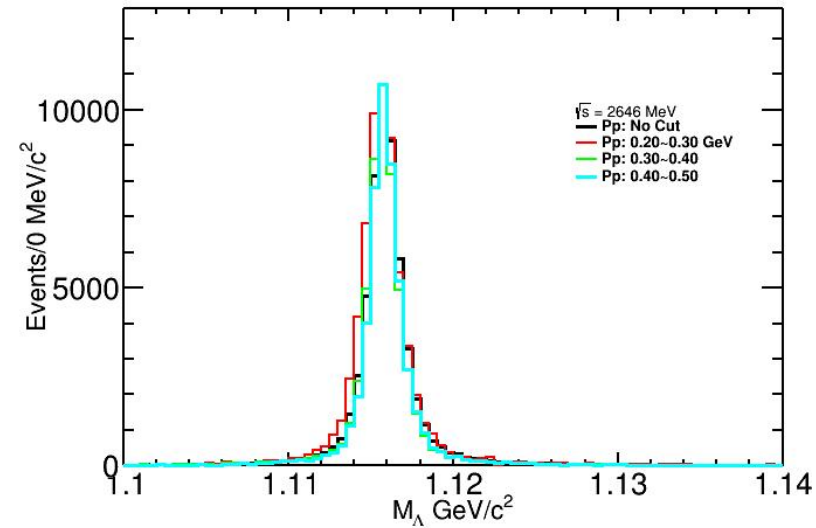
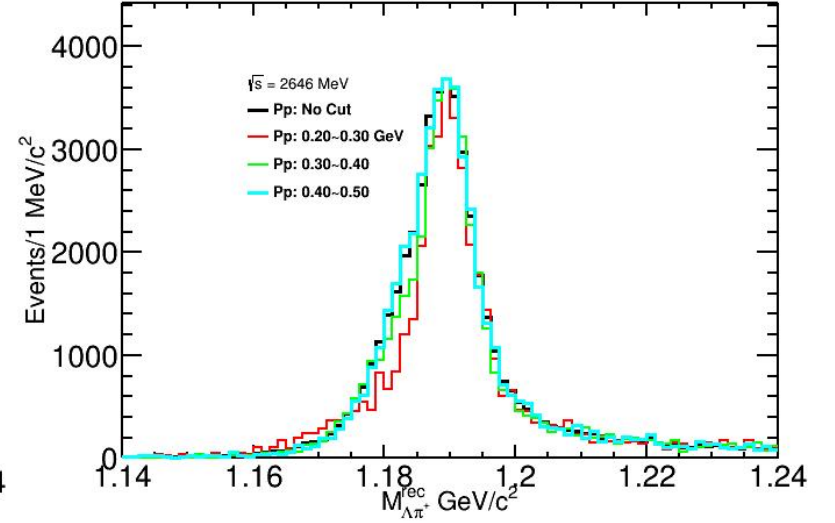
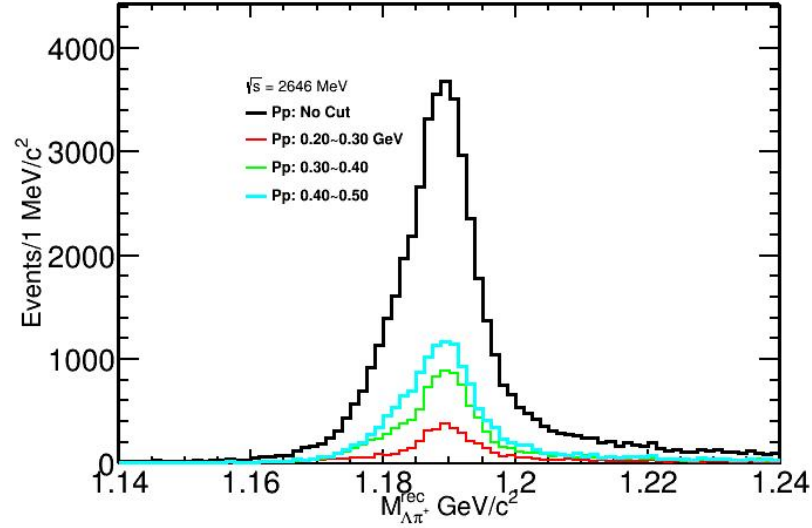
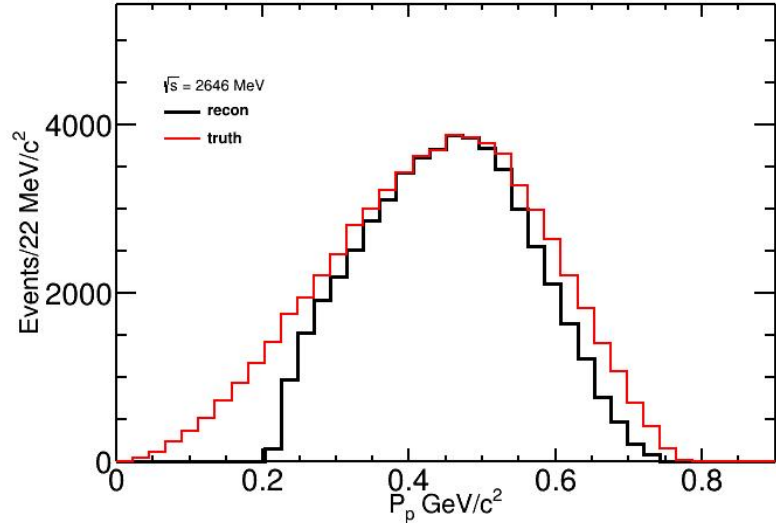
2.6464: $e^+e^- \rightarrow \Lambda\pi^+\bar{\Sigma}^-$

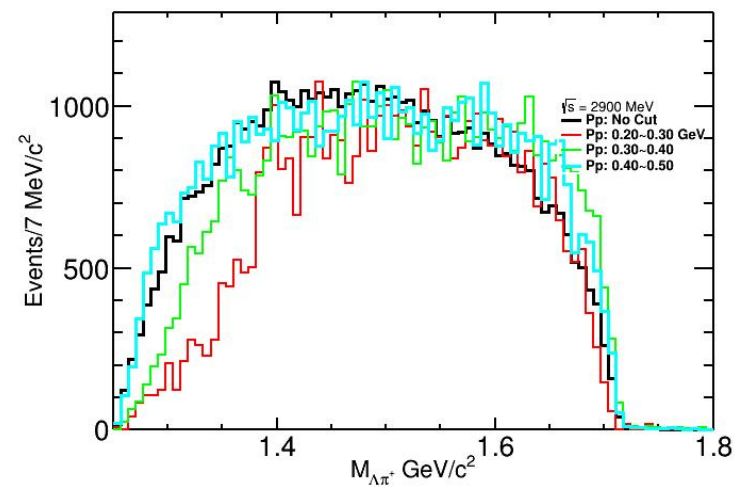
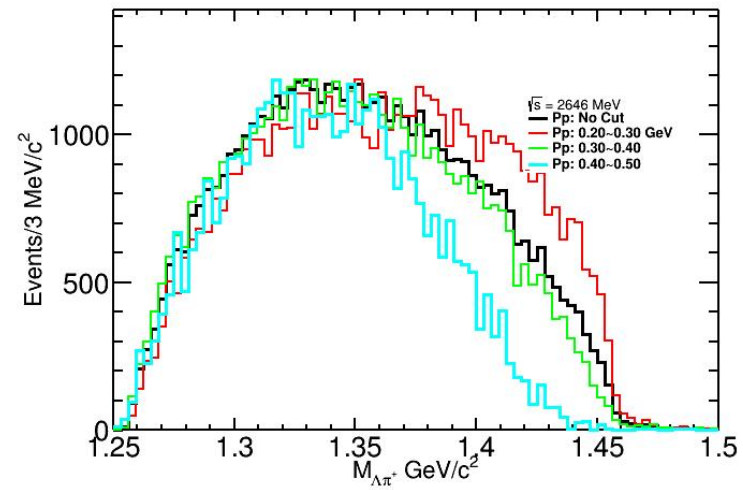
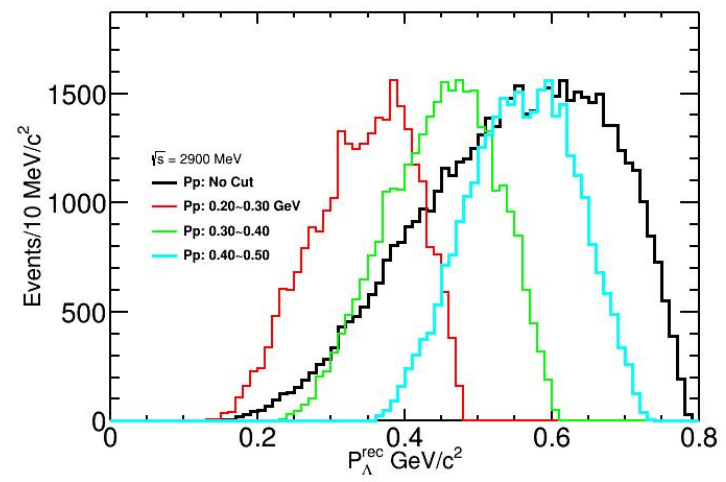
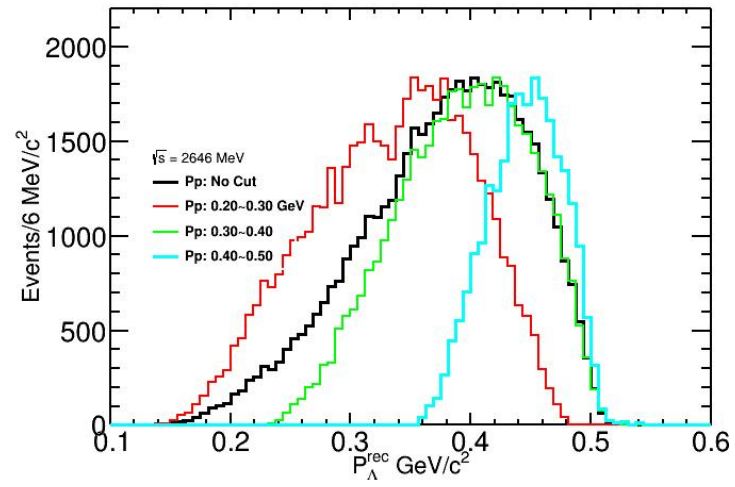


2.6464: $e^+e^- \rightarrow \Lambda\pi^+\bar{\Sigma}^-$

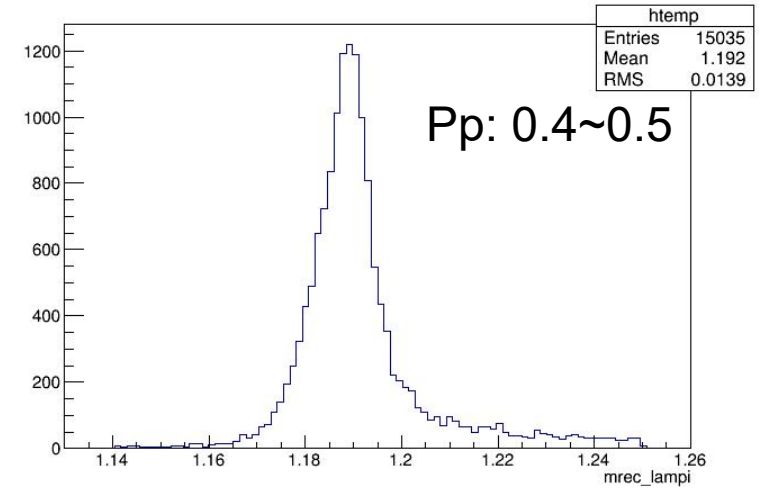
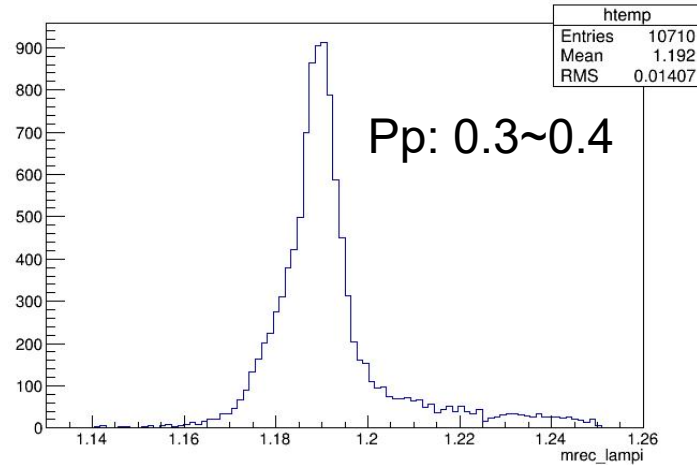
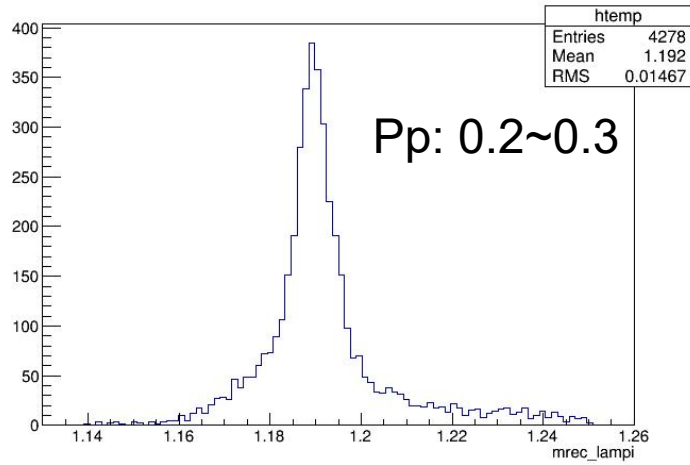
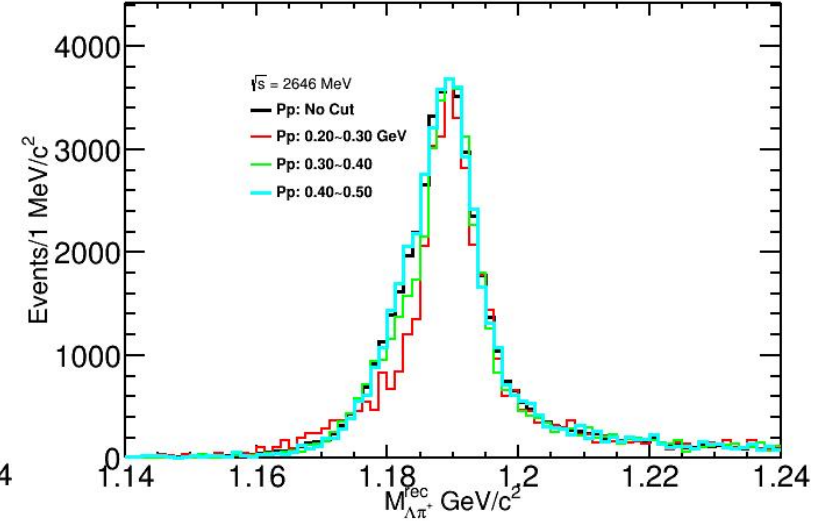
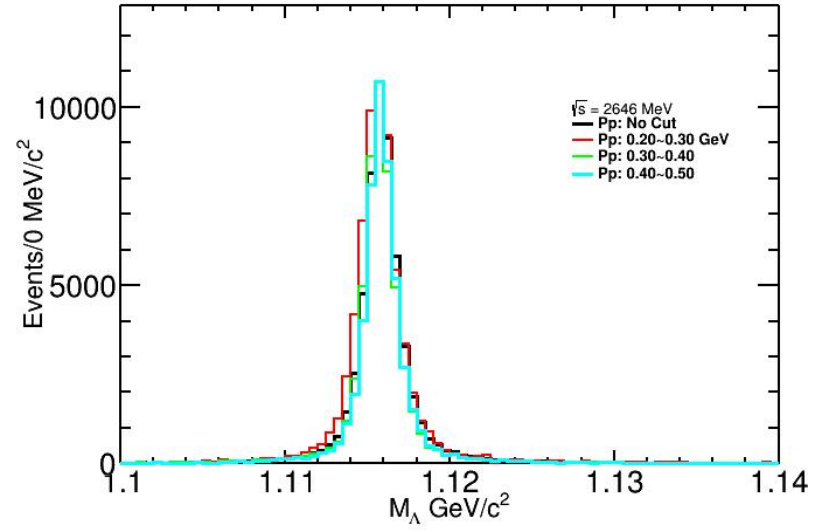
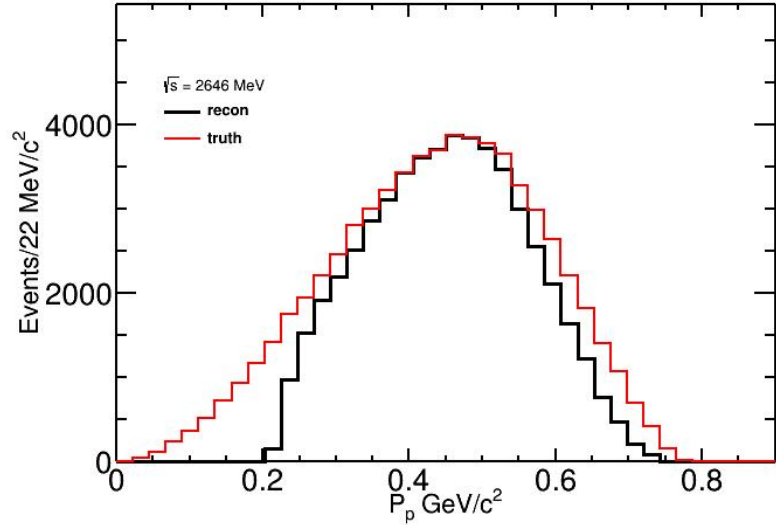


2.9000: $e^+e^- \rightarrow \Lambda\pi^+\bar{\Sigma}^-$

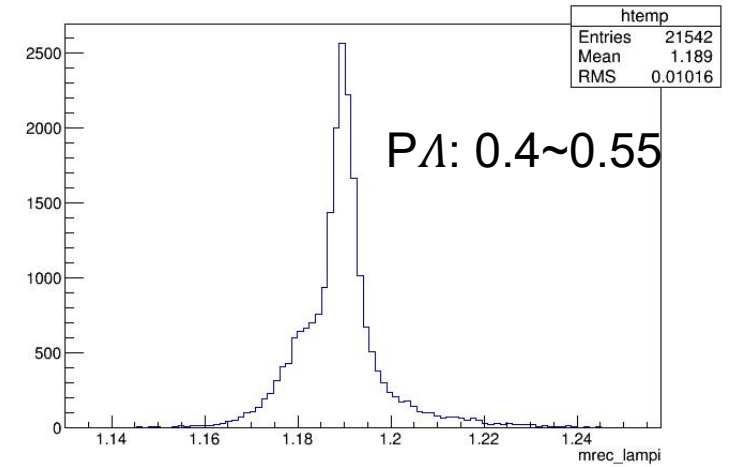
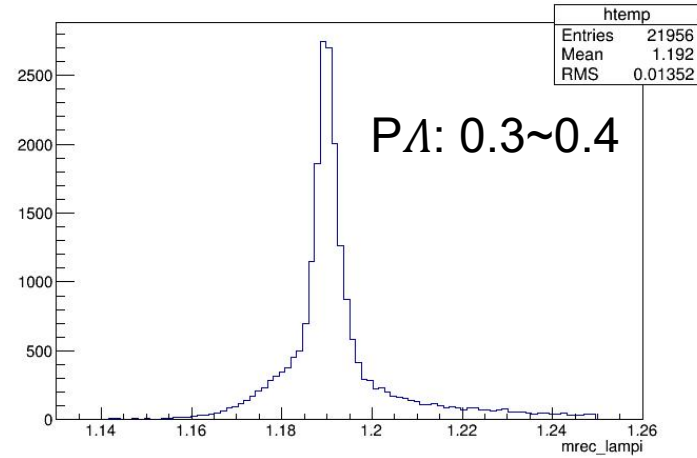
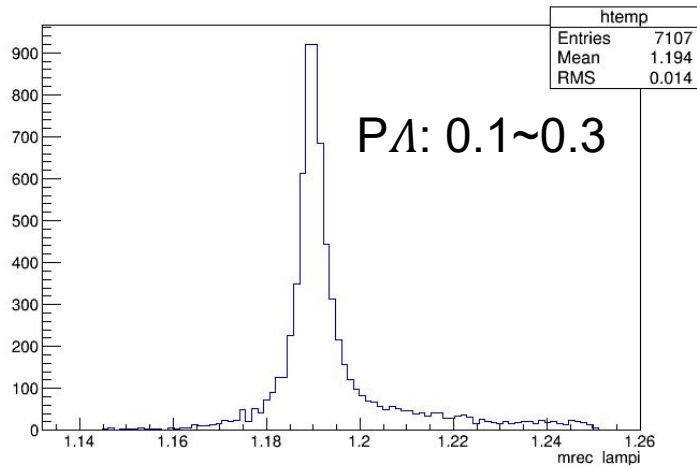
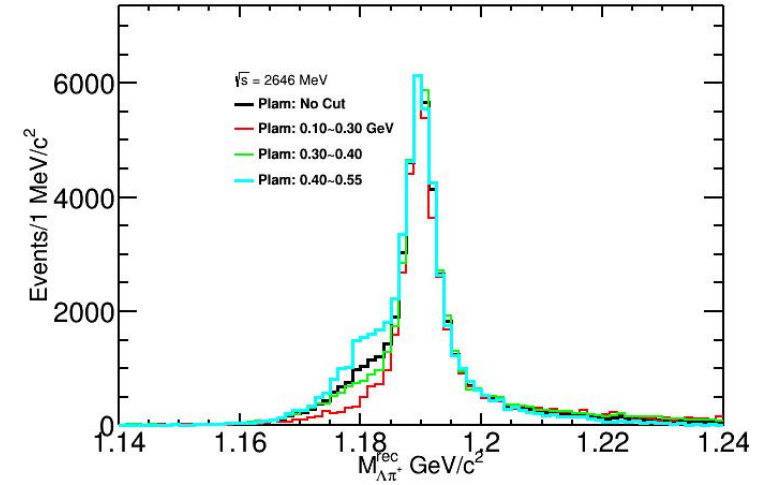
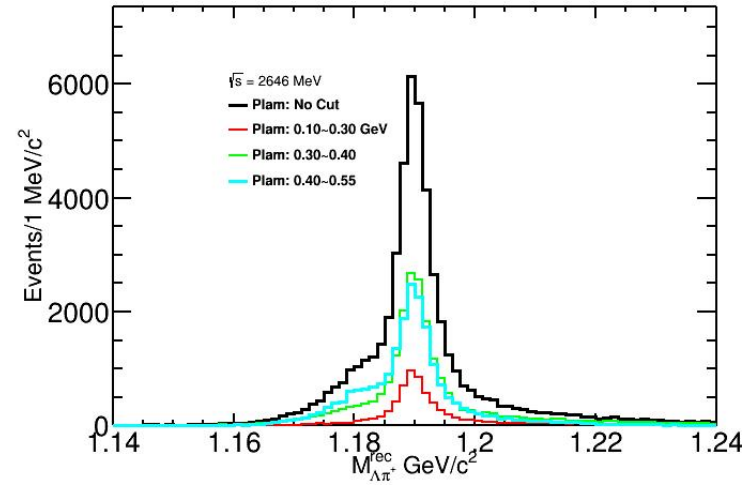
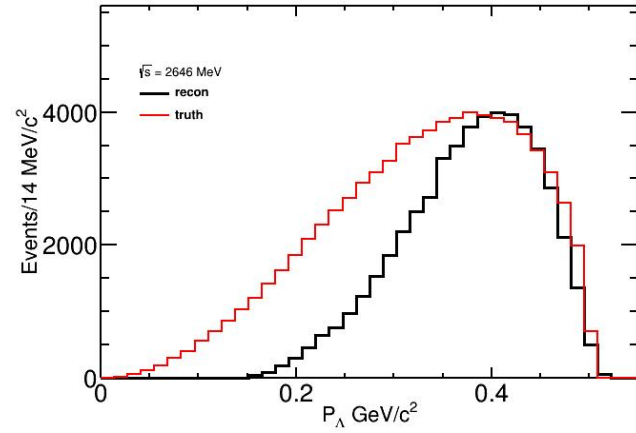




2.9000: $e^+e^- \rightarrow \Lambda\pi^+\bar{\Sigma}^-$



2.6464: $e^+e^- \rightarrow \Lambda\pi^+\bar{\Sigma}^-$



Distribution of $M_{\Lambda(\bar{\Lambda})}^{recoil}$ and $M_{\Lambda\pi}$

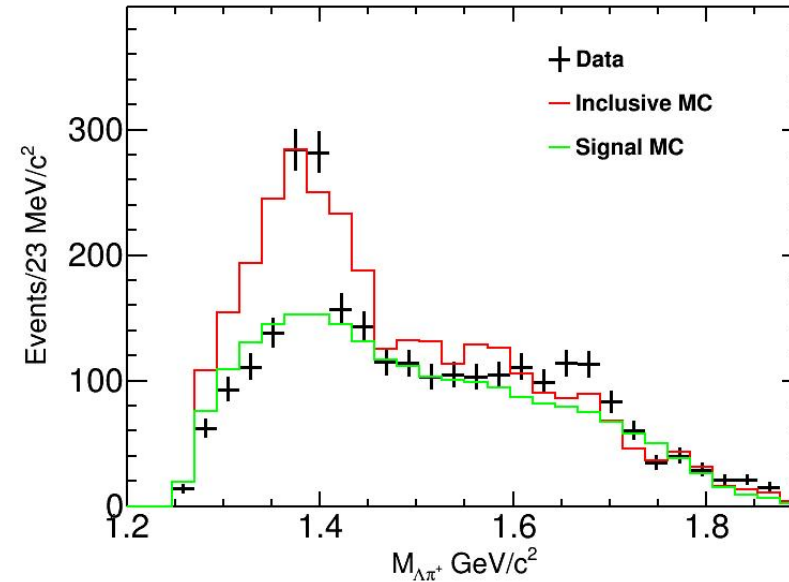
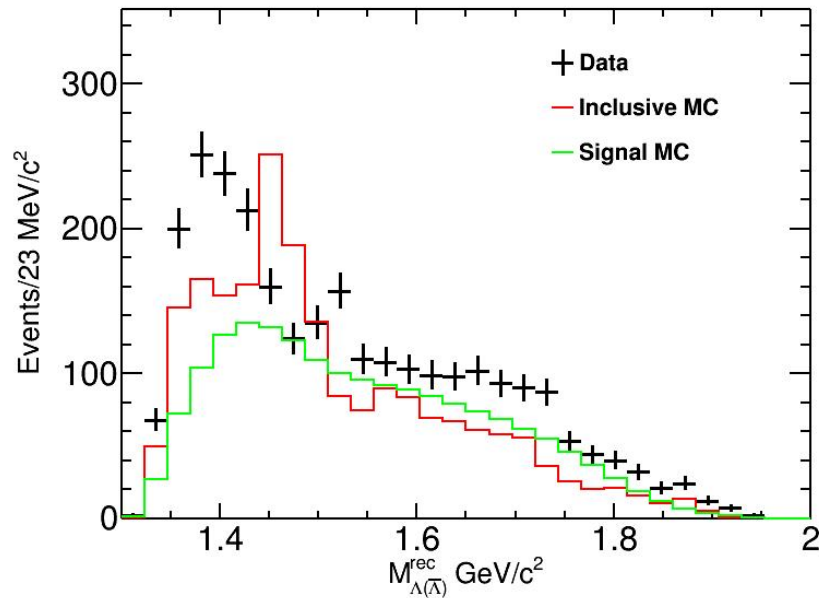
hadd all energy : 2644 ~ 3080 MeV

$$e^+e^- \rightarrow \Lambda\pi^+\bar{\Sigma}^-(\bar{\Lambda}\pi^-\Sigma^+)$$

$\Sigma(1385) \quad I(J^P) = 1(3/2^+)$

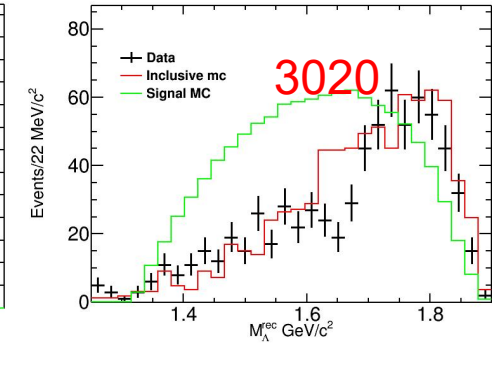
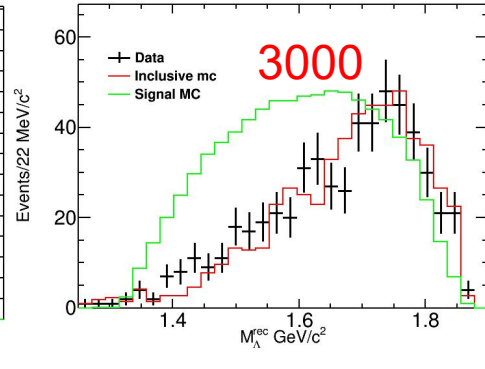
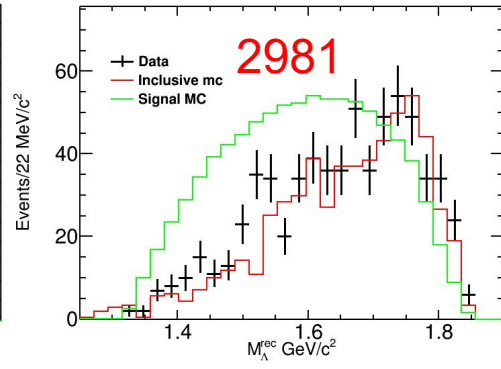
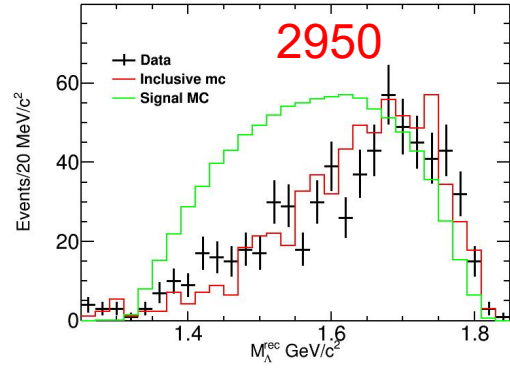
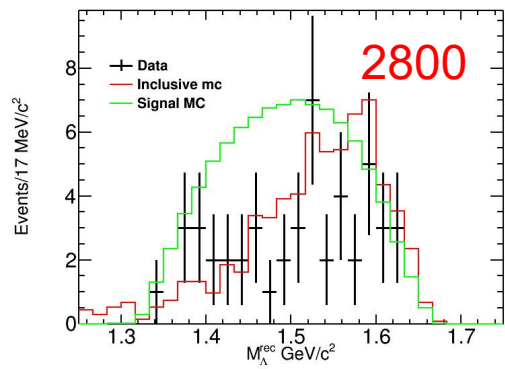
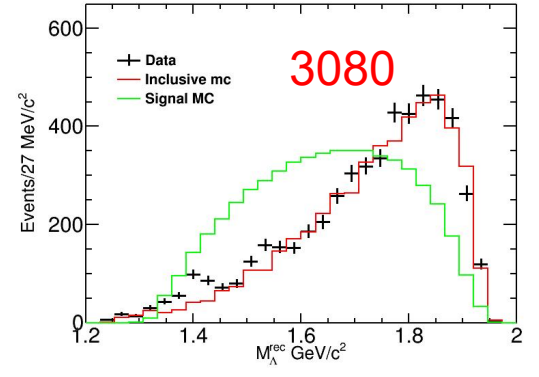
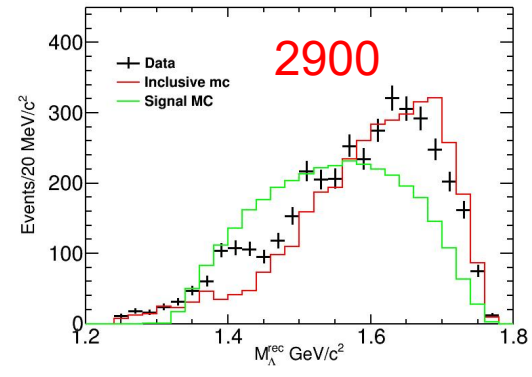
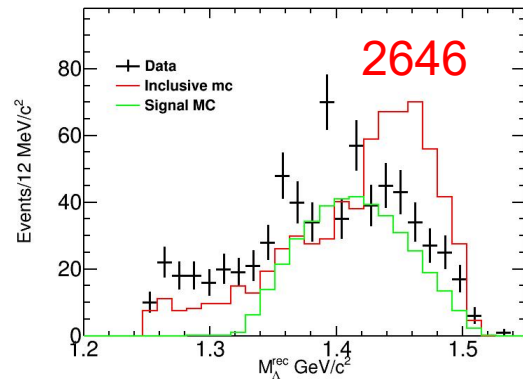
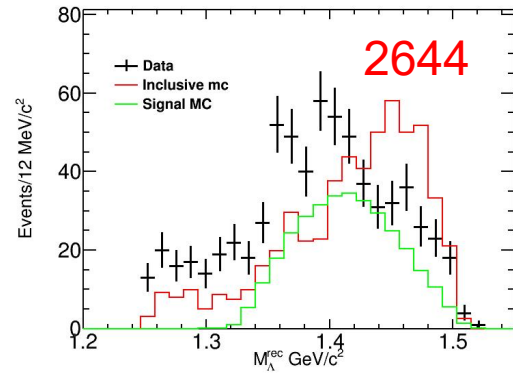
$$\Sigma_{(1385)} \rightarrow \Lambda\pi, \quad \Sigma_{(1385)} \rightarrow \Sigma\pi;$$

$$\Sigma_{(1385)} \rightarrow \Lambda\gamma, \quad \Sigma_{(1385)} \rightarrow \Sigma^+\gamma;$$

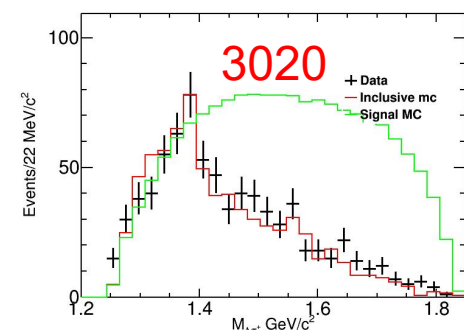
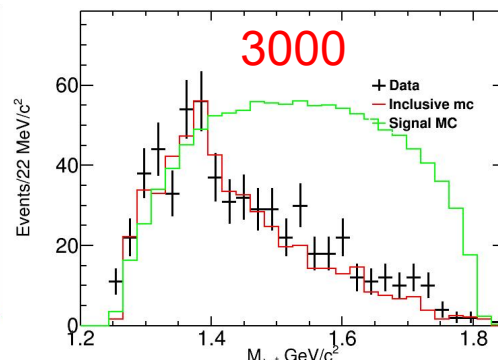
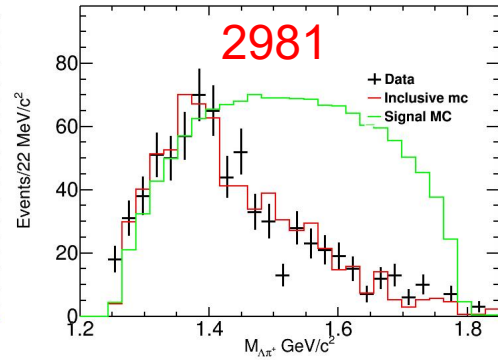
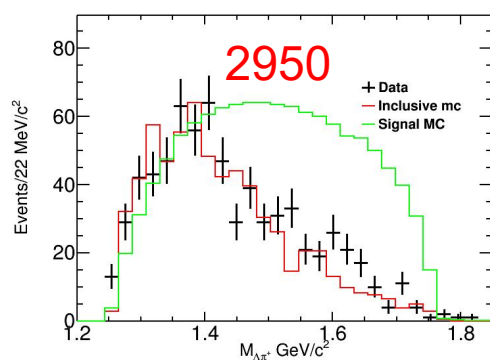
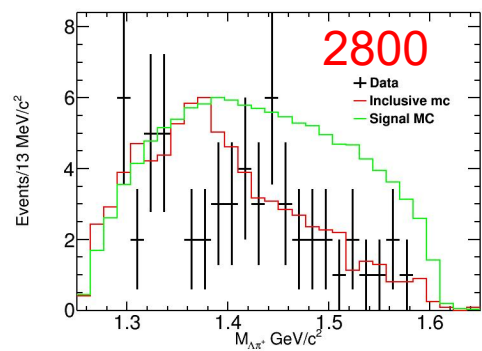
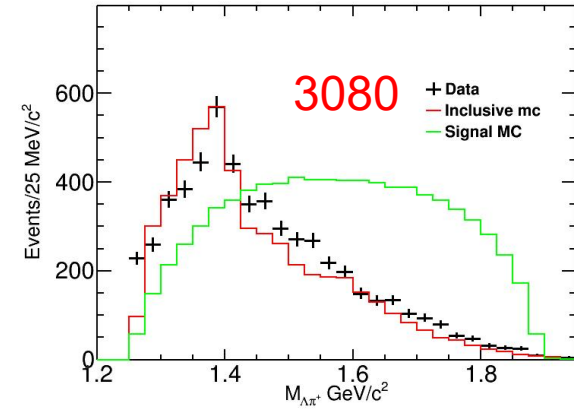
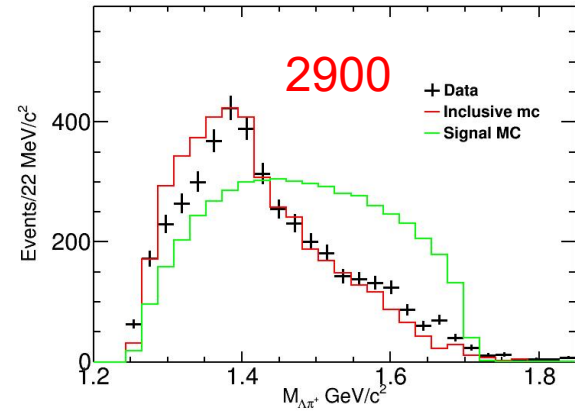
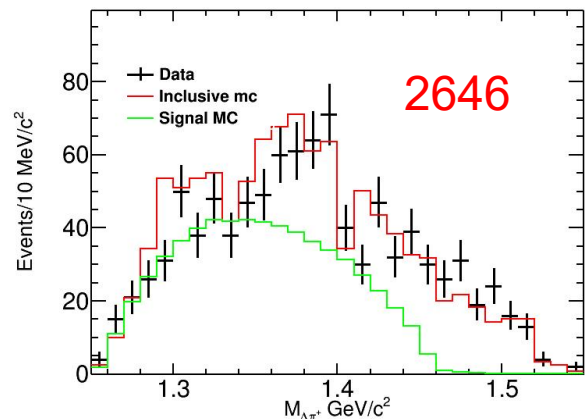
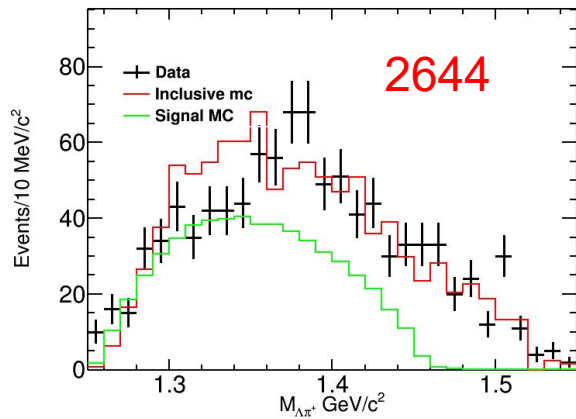


✓ a peaking around 1.4 GeV

$M_{\Lambda(\bar{\Lambda})}^{\text{recoil}}$



$M_{\Lambda\pi}$



Distribution of $M_{\Lambda(\bar{\Lambda})}^{recoil}$ and $M_{\Lambda\pi}$

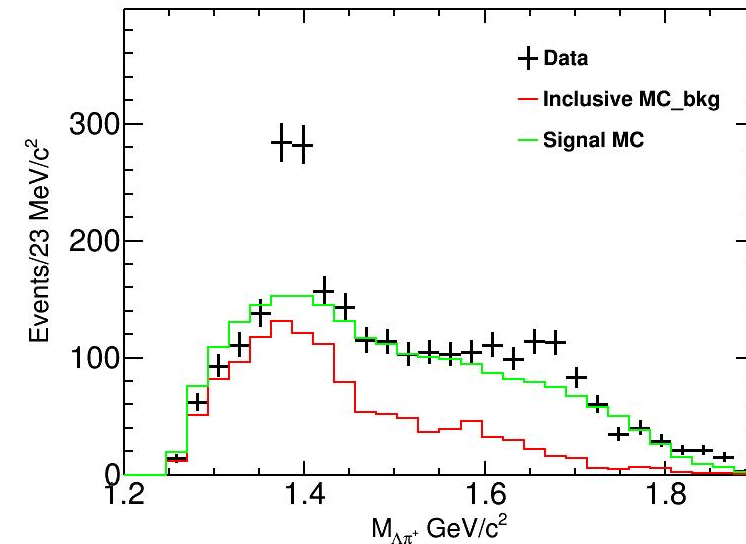
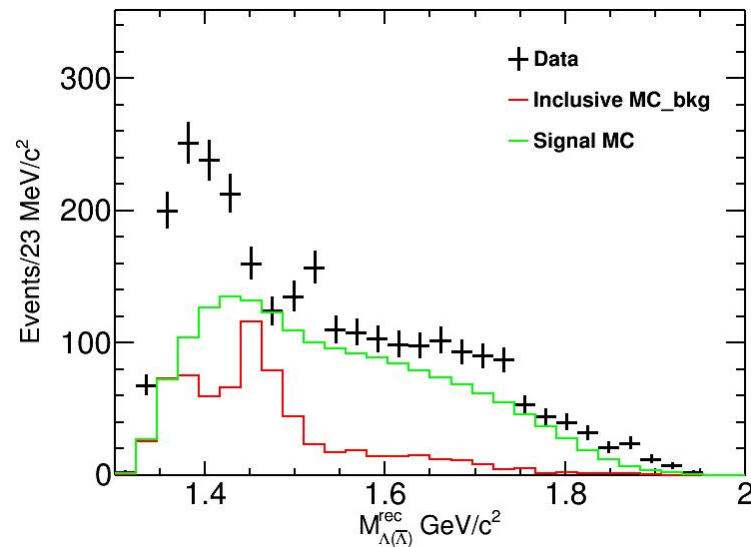
hadd all energy : 2644 ~ 3080 MeV

$\Sigma(1385) \quad I(J^P) = 1(3/2^+)$

$$e^+e^- \rightarrow \Lambda\pi^+\bar{\Sigma}^-(\bar{\Lambda}\pi^-\Sigma^+)$$

$$\Sigma_{(1385)} \rightarrow \Lambda\pi, \quad \Sigma_{(1385)} \rightarrow \Sigma\pi;$$

$$\Sigma_{(1385)} \rightarrow \Lambda\gamma, \quad \Sigma_{(1385)} \rightarrow \Sigma^+\gamma;$$



✓ a peaking around 1.4 GeV

Distribution of $M_{\Lambda(\bar{\Lambda})}^{recoil}$ and $M_{\Lambda\pi}$

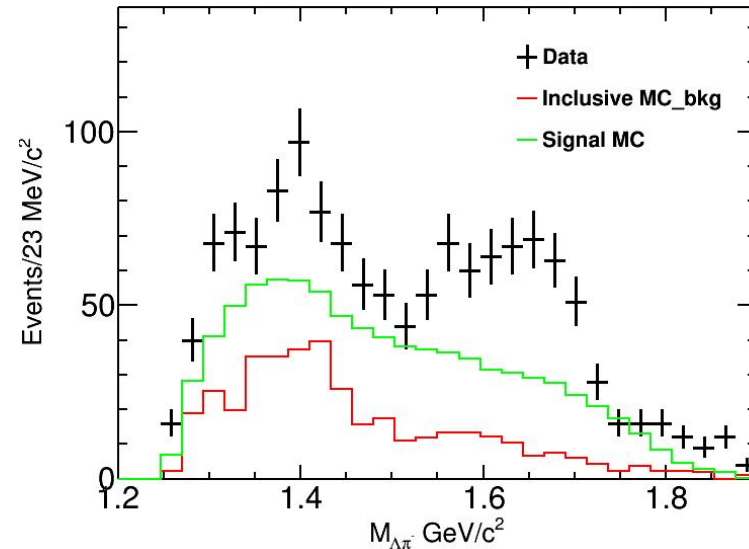
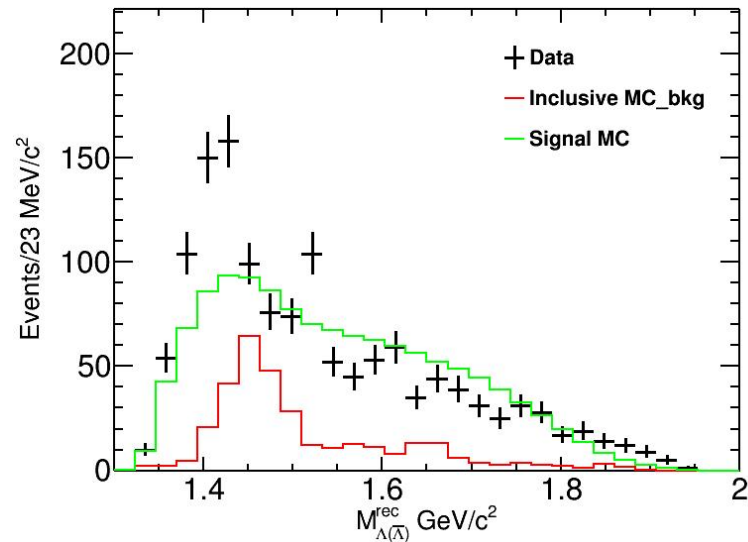
hadd all energy : 2644 ~ 3080 MeV

$\Sigma(1385) \quad I(J^P) = 1(3/2^+)$

$$e^+e^- \rightarrow \Lambda\pi^-\bar{\Sigma}^+(\bar{\Lambda}\pi^+\Sigma^-)$$

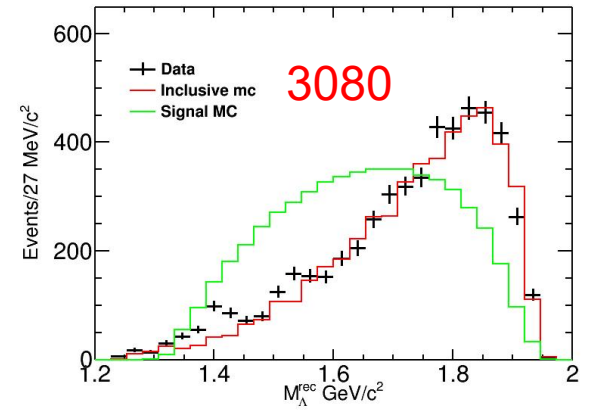
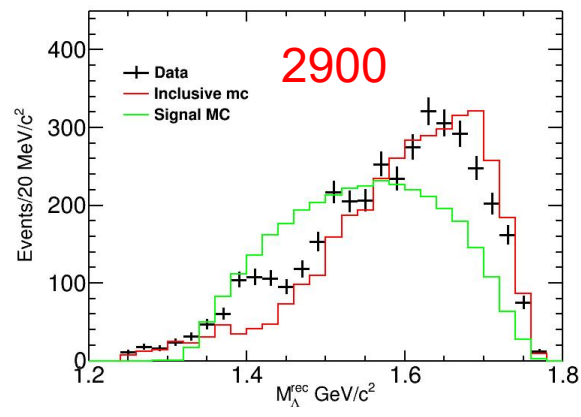
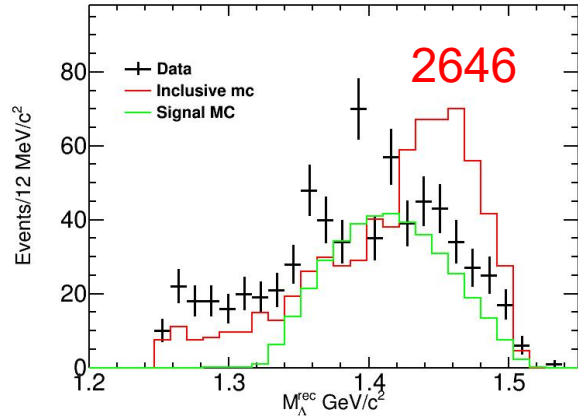
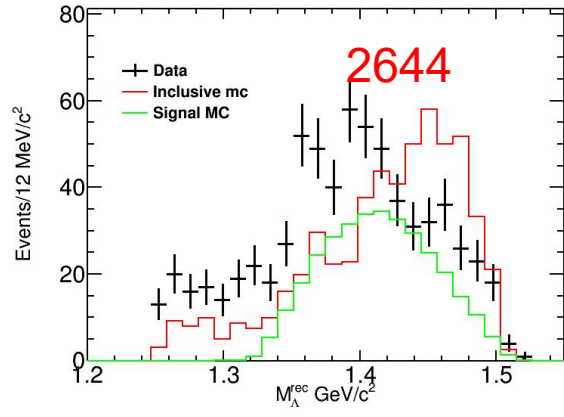
$$\Sigma_{(1385)} \rightarrow \Lambda\pi, \Sigma_{(1385)} \rightarrow \Sigma\pi;$$

$$\Sigma_{(1385)} \rightarrow \Lambda\gamma, \Sigma_{(1385)} \rightarrow \Sigma^+\gamma;$$

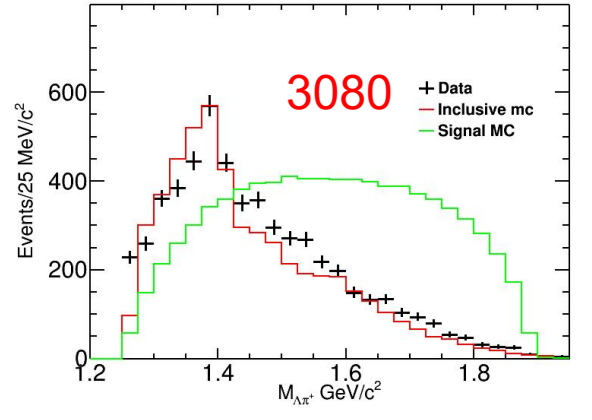
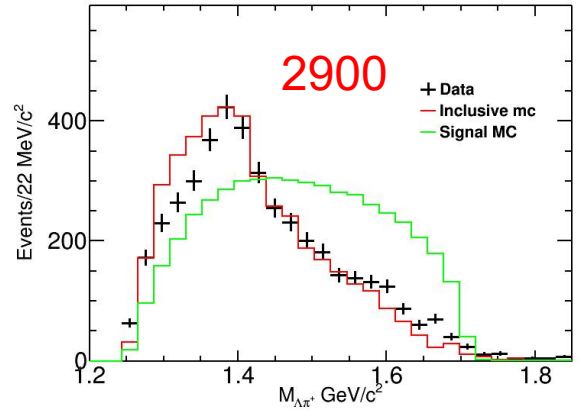
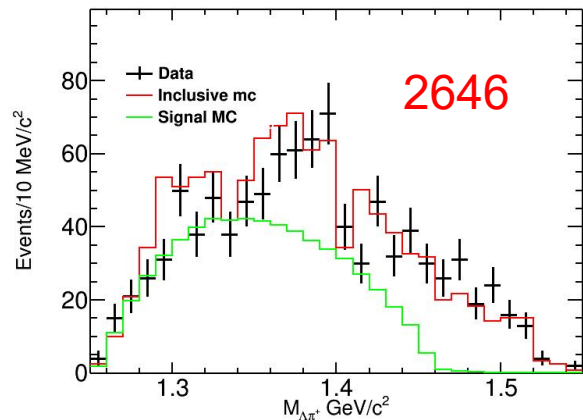
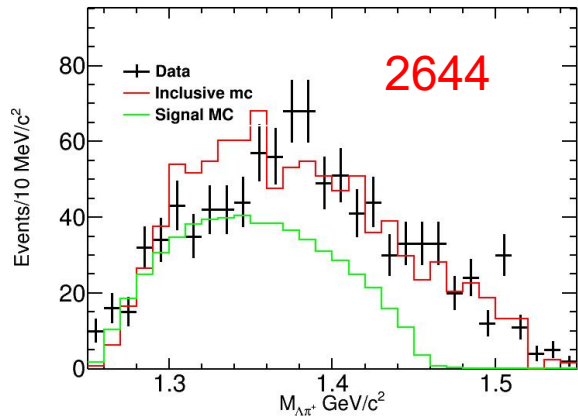


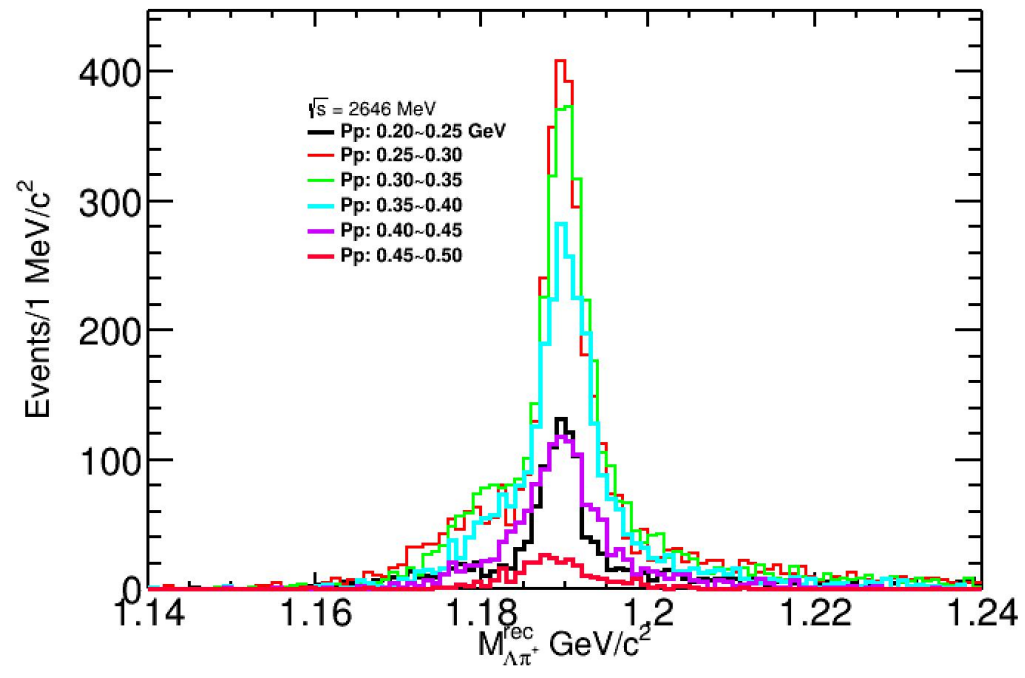
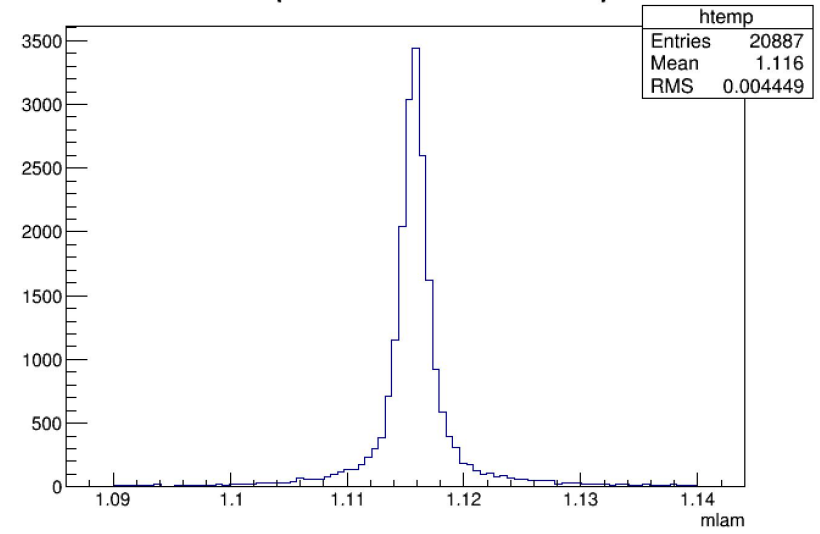
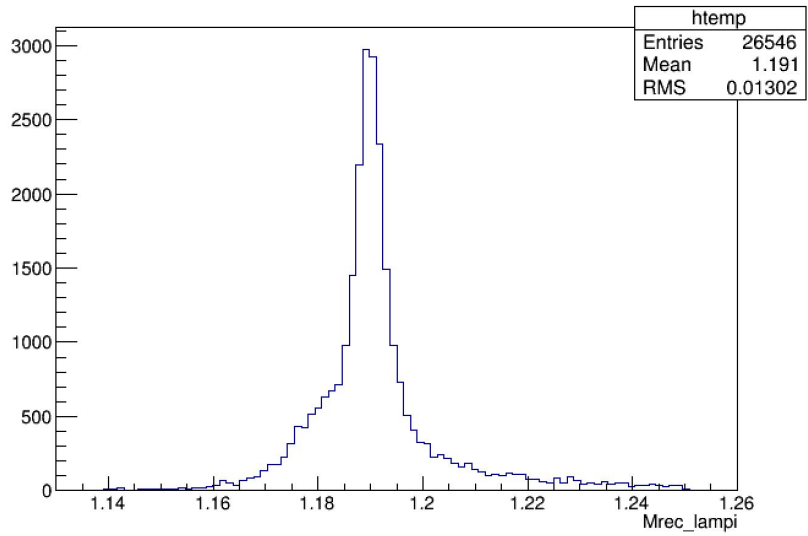
✓ a peaking around 1.4 GeV

$M_{\Lambda(\bar{\Lambda})}^{\text{recoil}}$

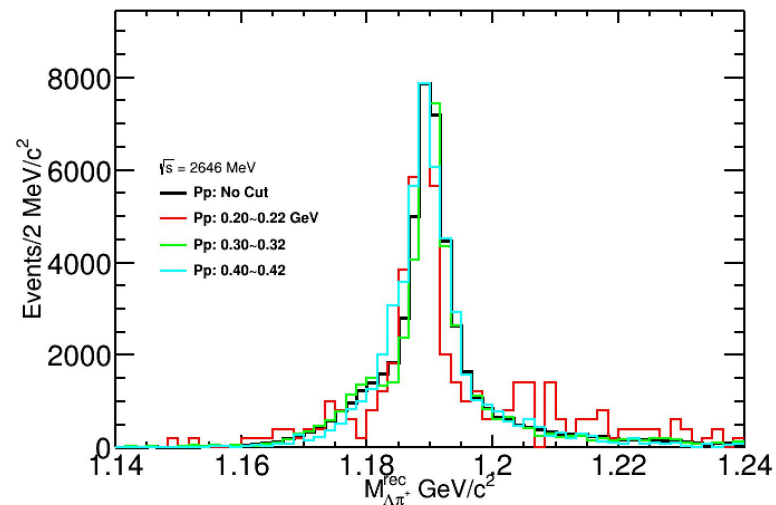
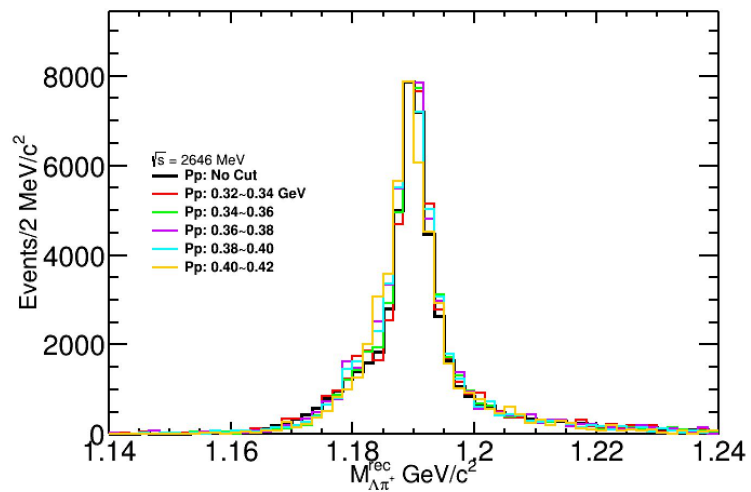
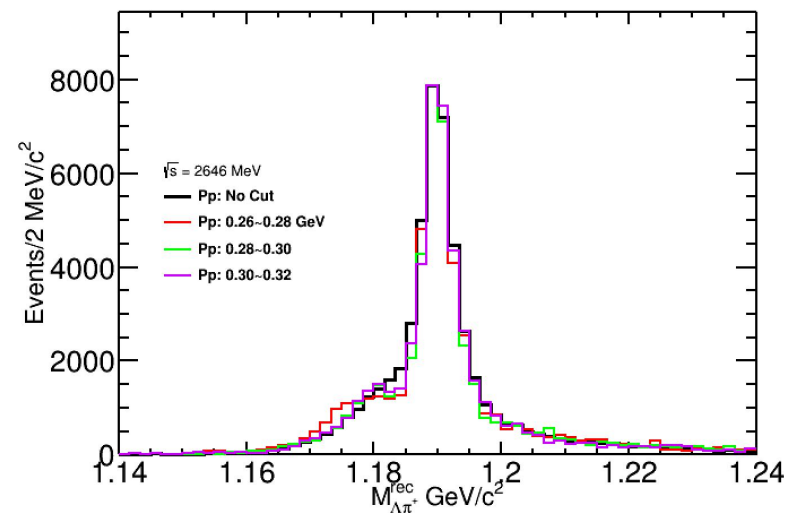
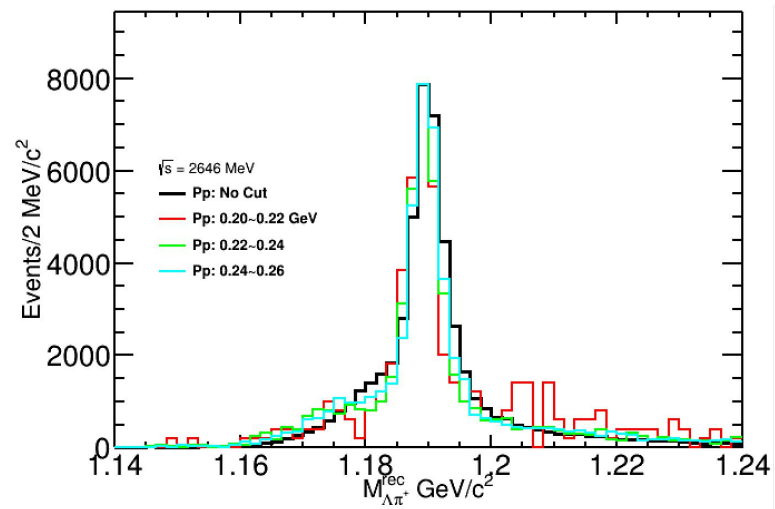
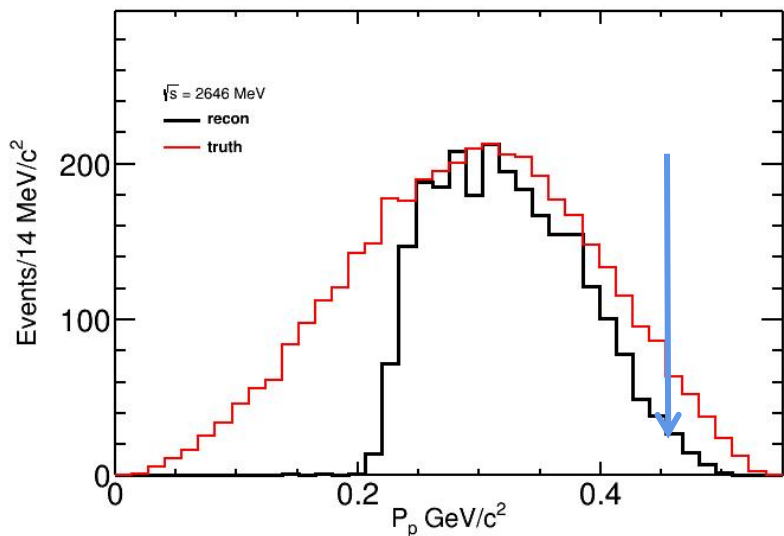


$M_{\Lambda\pi}$

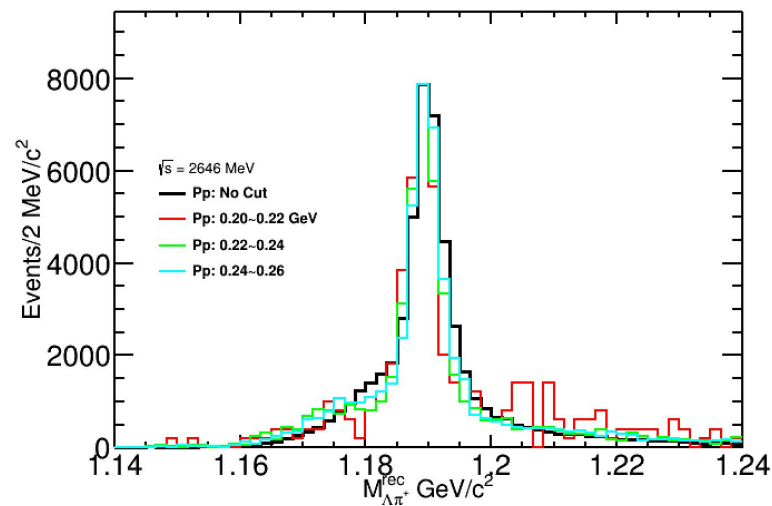
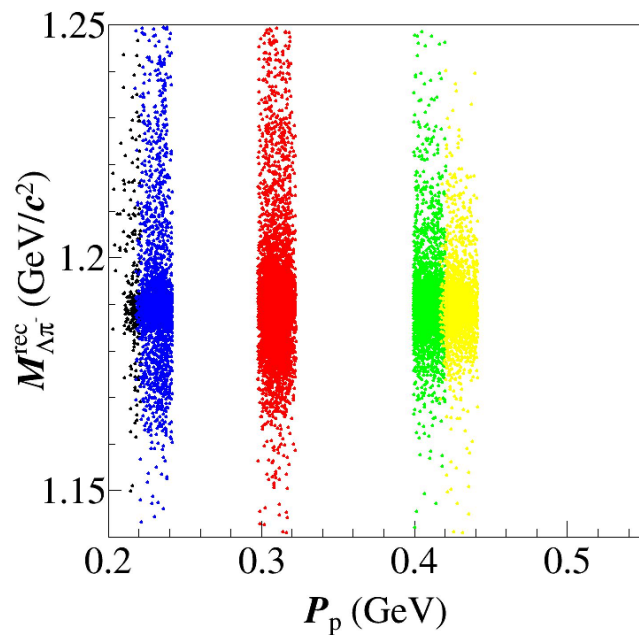
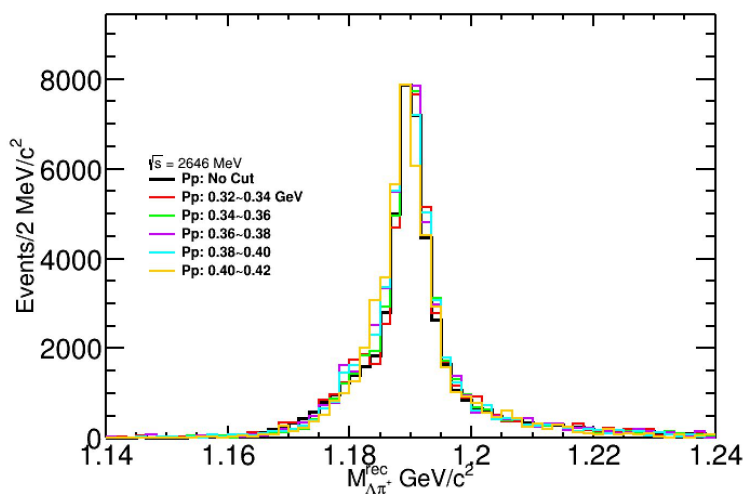
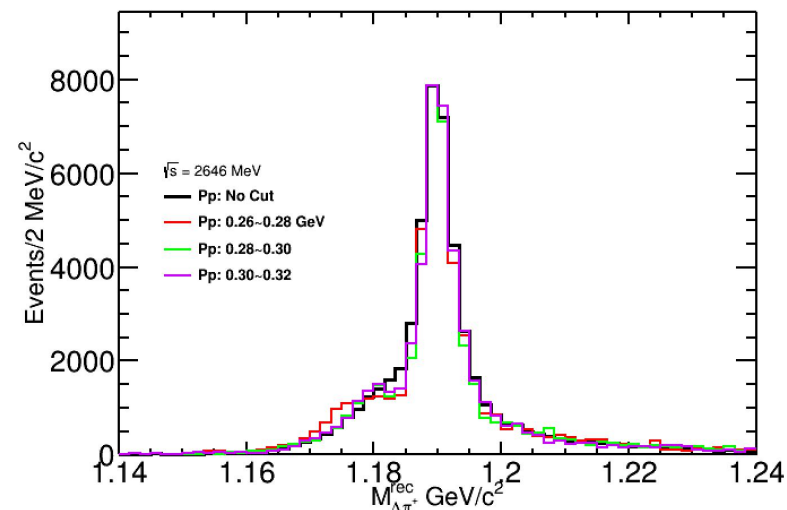
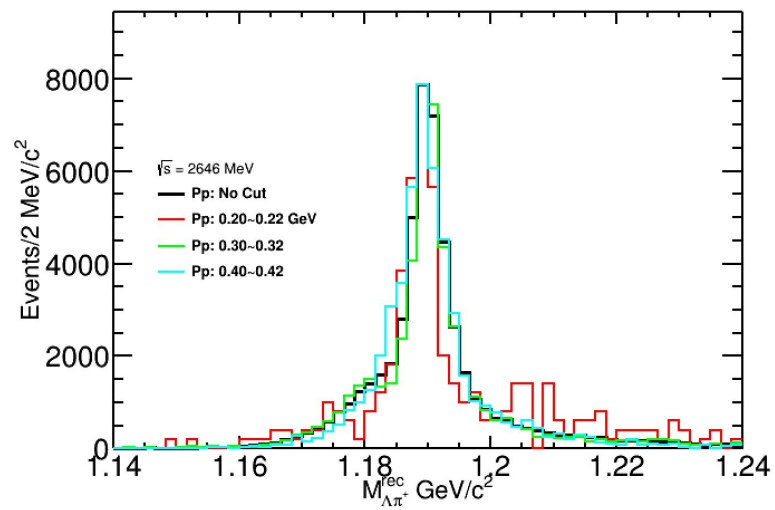
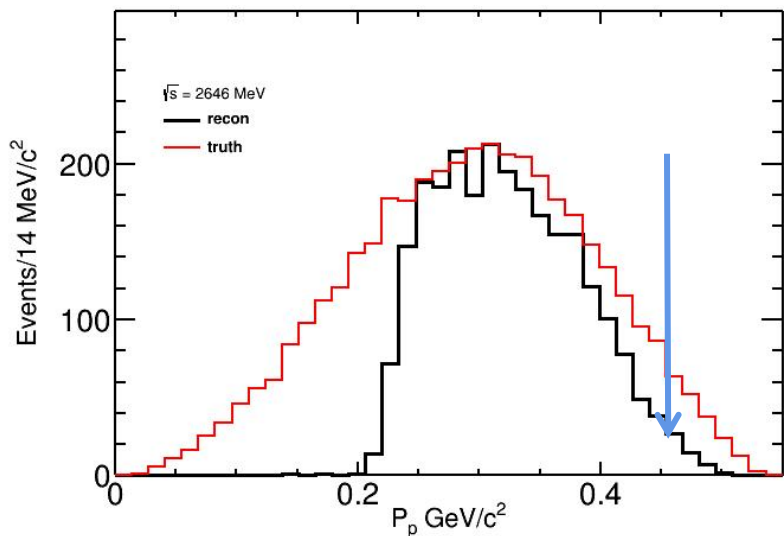




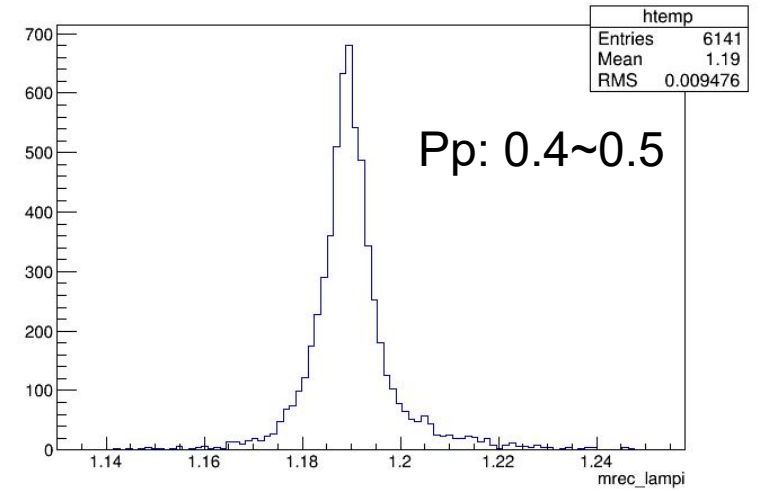
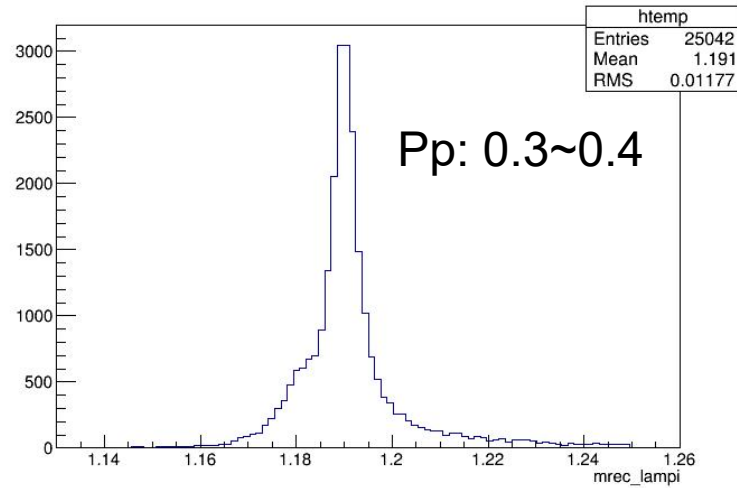
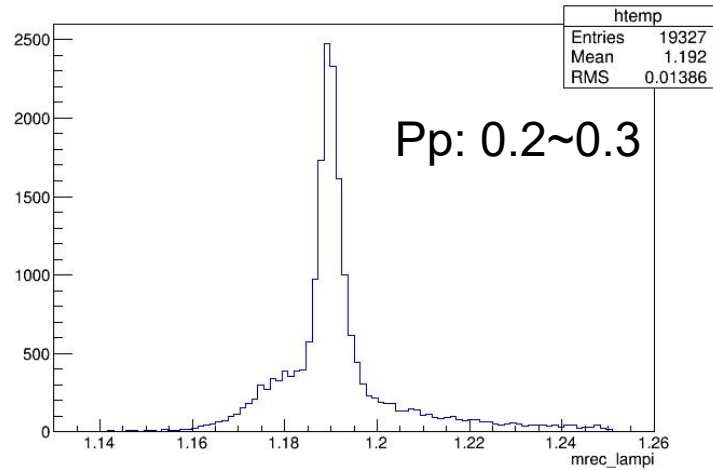
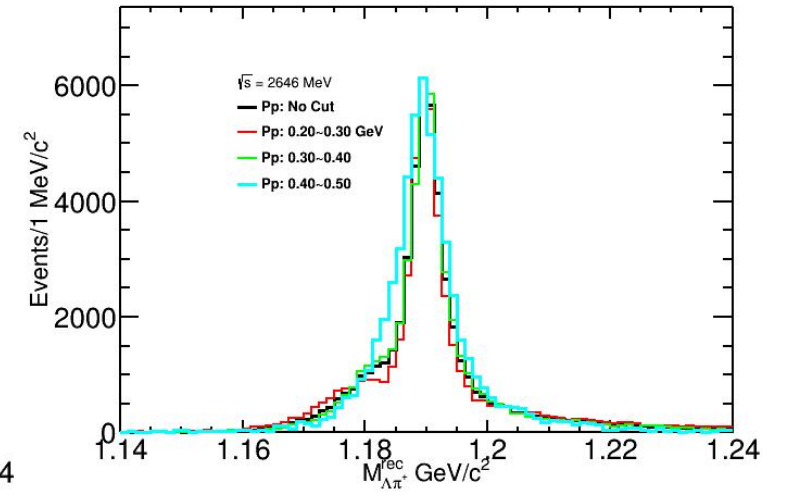
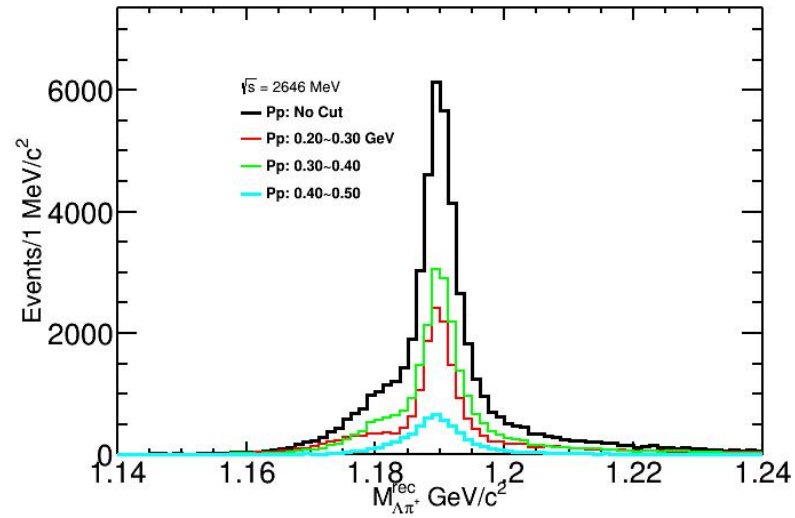
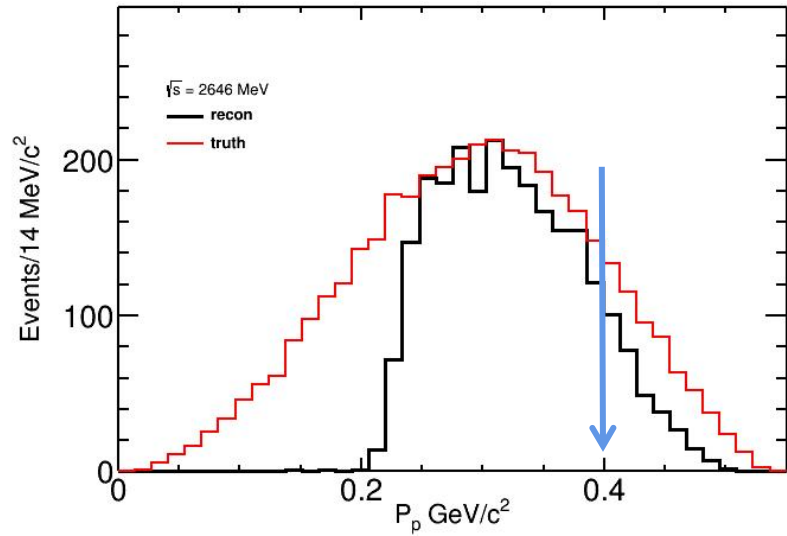
2.6464: $e^+e^- \rightarrow \Lambda\pi^+\bar{\Sigma}^-$



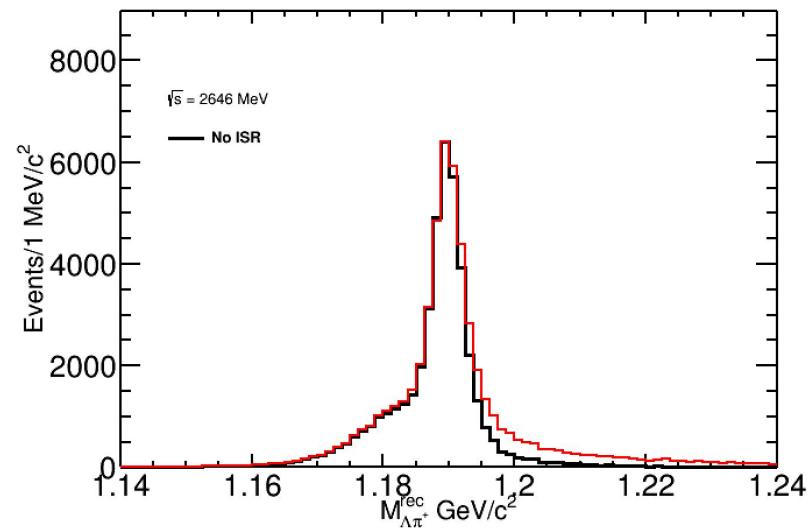
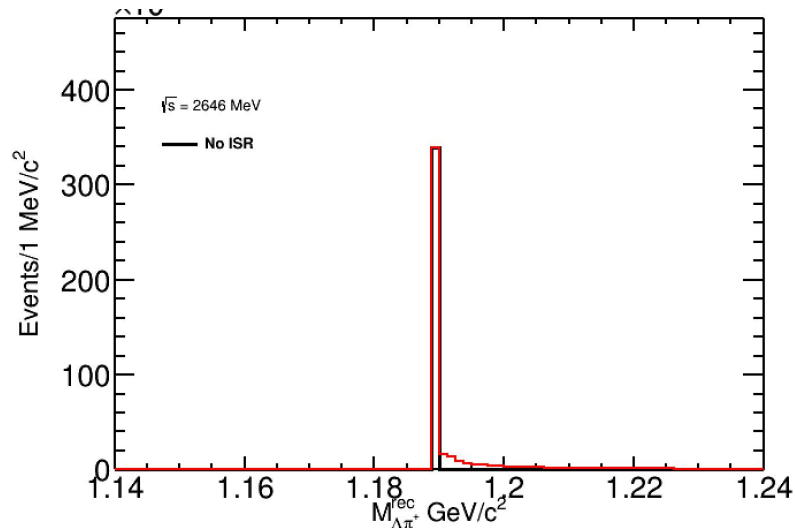
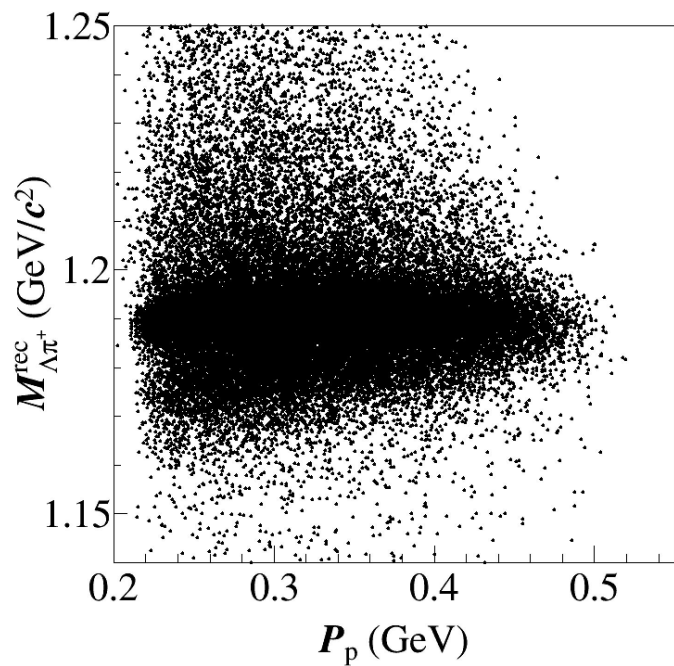
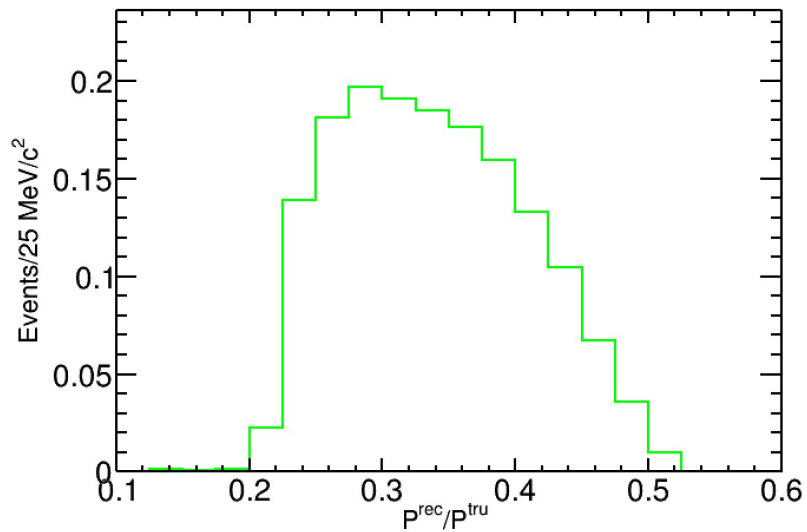
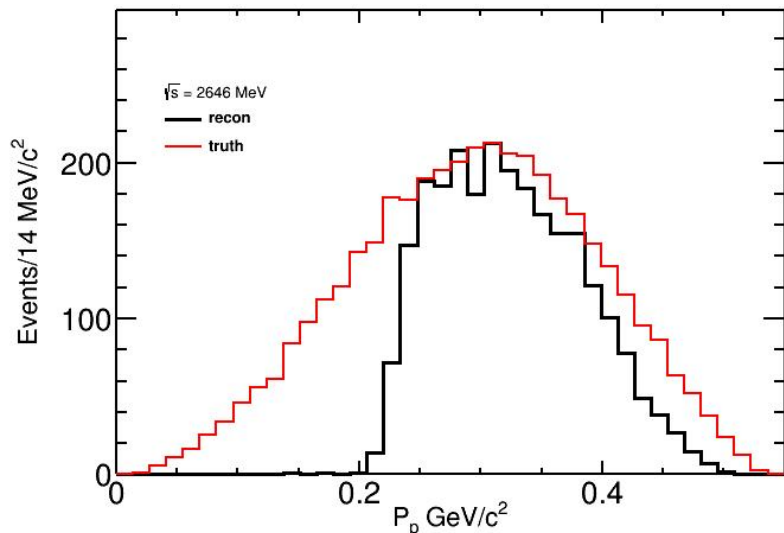
2.6464: $e^+e^- \rightarrow \Lambda\pi^+\bar{\Sigma}^-$



2.6464: $e^+e^- \rightarrow \Lambda\pi^+\bar{\Sigma}^-$



2.6464: $e^+e^- \rightarrow \Lambda\pi^+\bar{\Sigma}^-$



2.6464: $e^+e^- \rightarrow \Lambda\pi^+\bar{\Sigma}^-$

