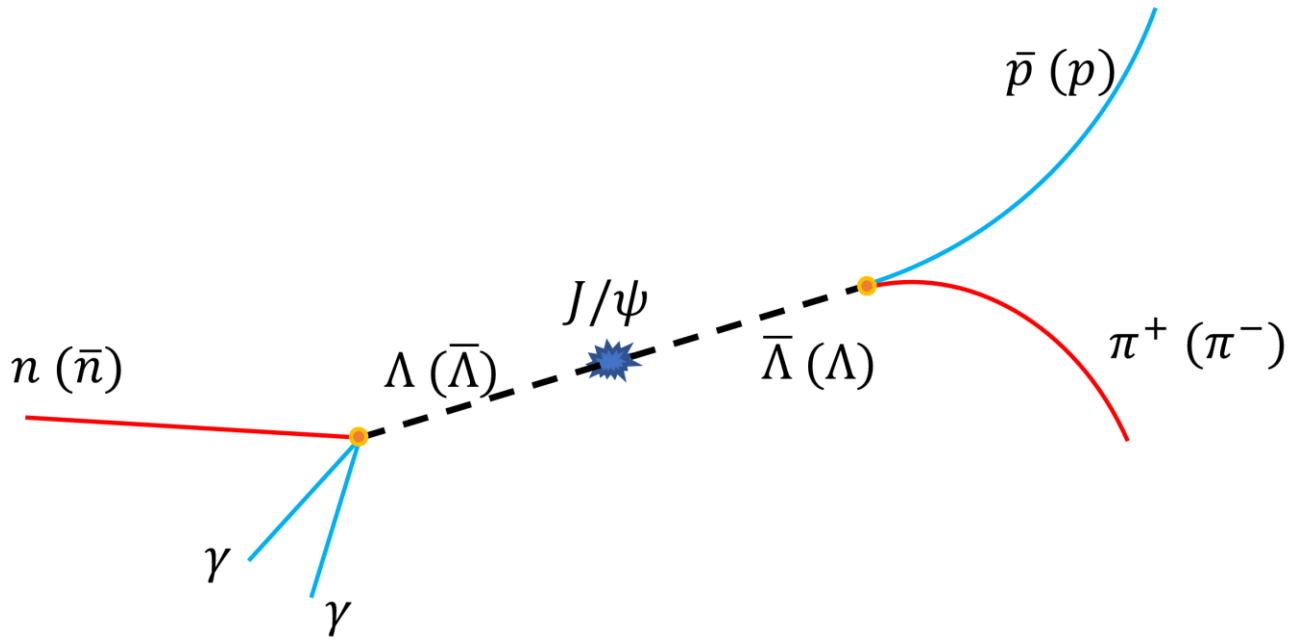
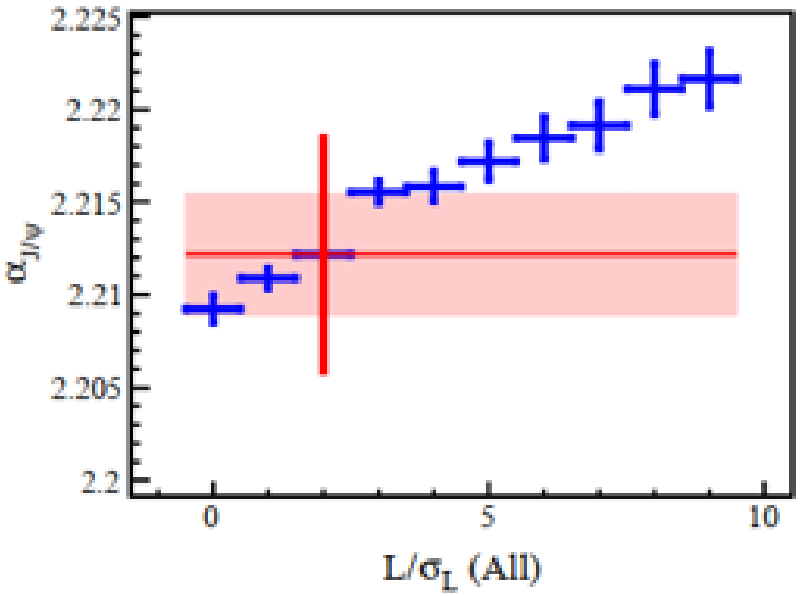
$$J/\psi \to \bar{\Lambda}(\to \bar{p}\pi^+)\Lambda(\to n\pi^0), \qquad Measure\ \alpha_0$$

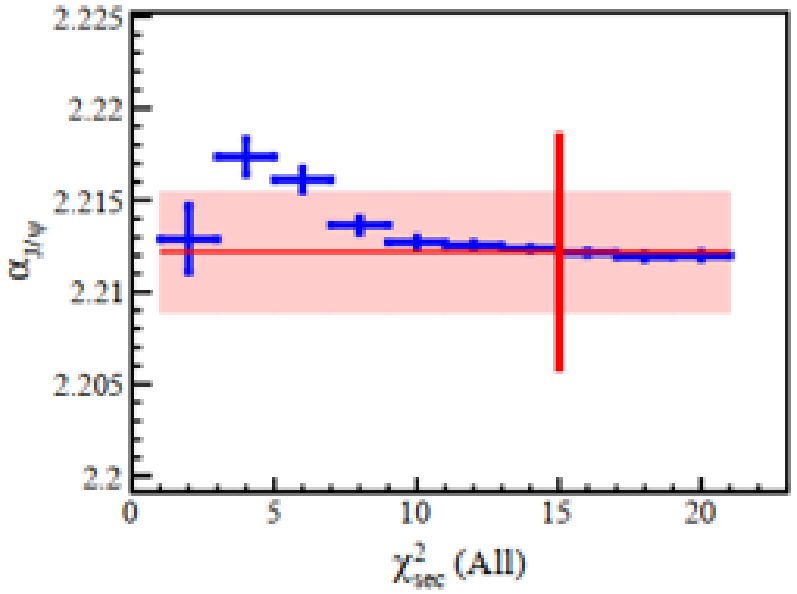
$$J/\psi \to \Lambda(\to p\pi^-)\bar{\Lambda}(\to \bar{n}\pi^0), \qquad Measure\ \bar{\alpha}_0$$

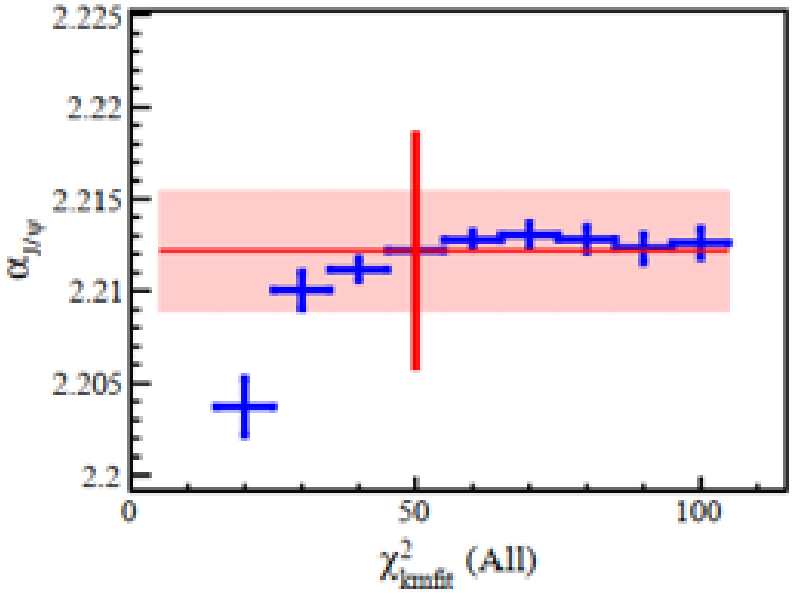
裴宇鹏

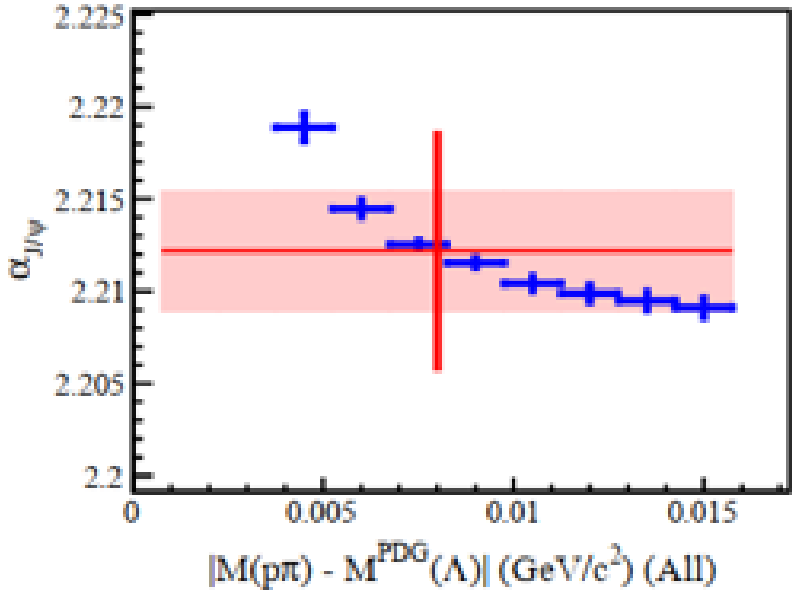


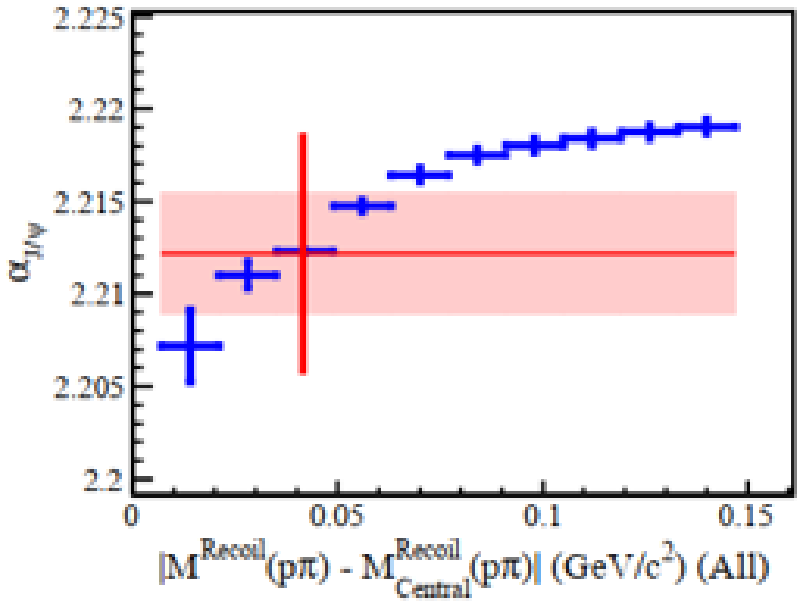
Question: Barlow Test of $\alpha_{J/\psi}$ is very Bad!





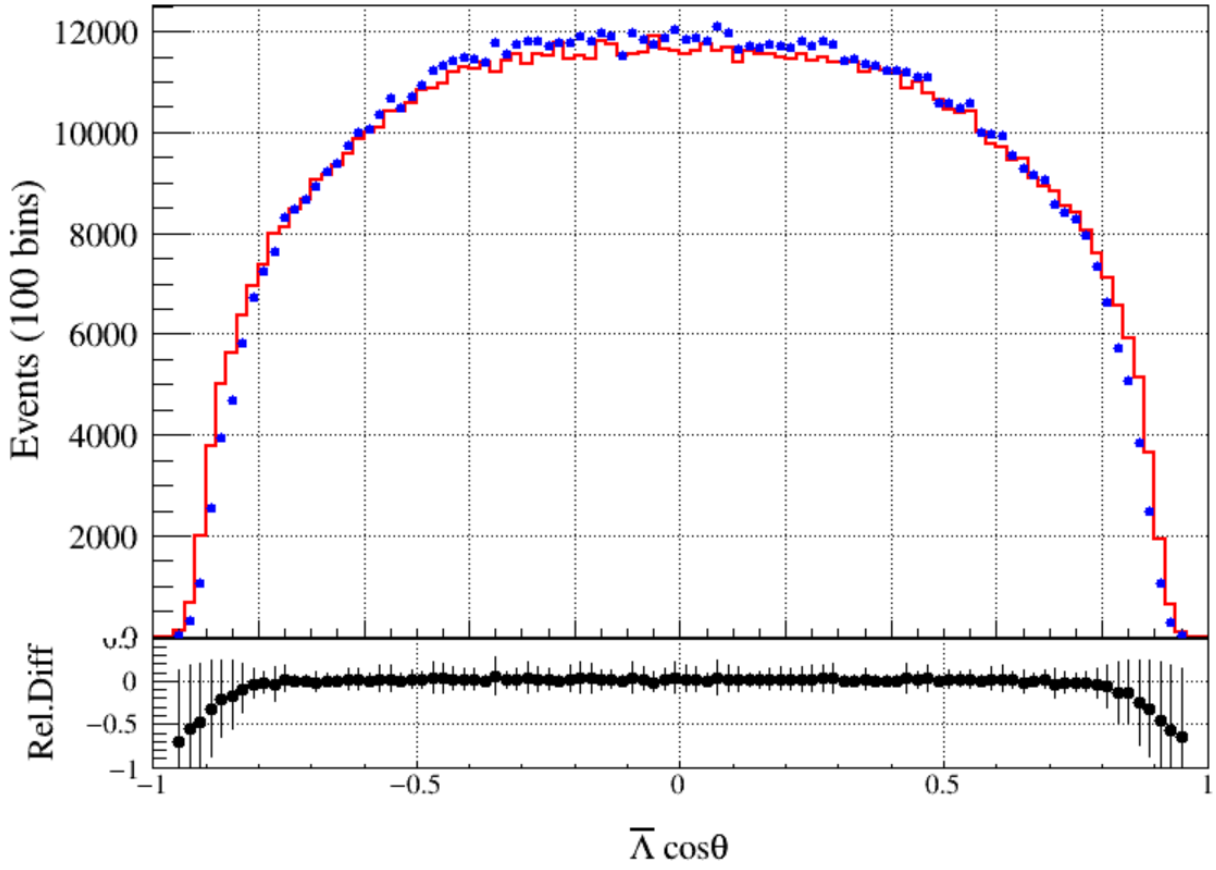




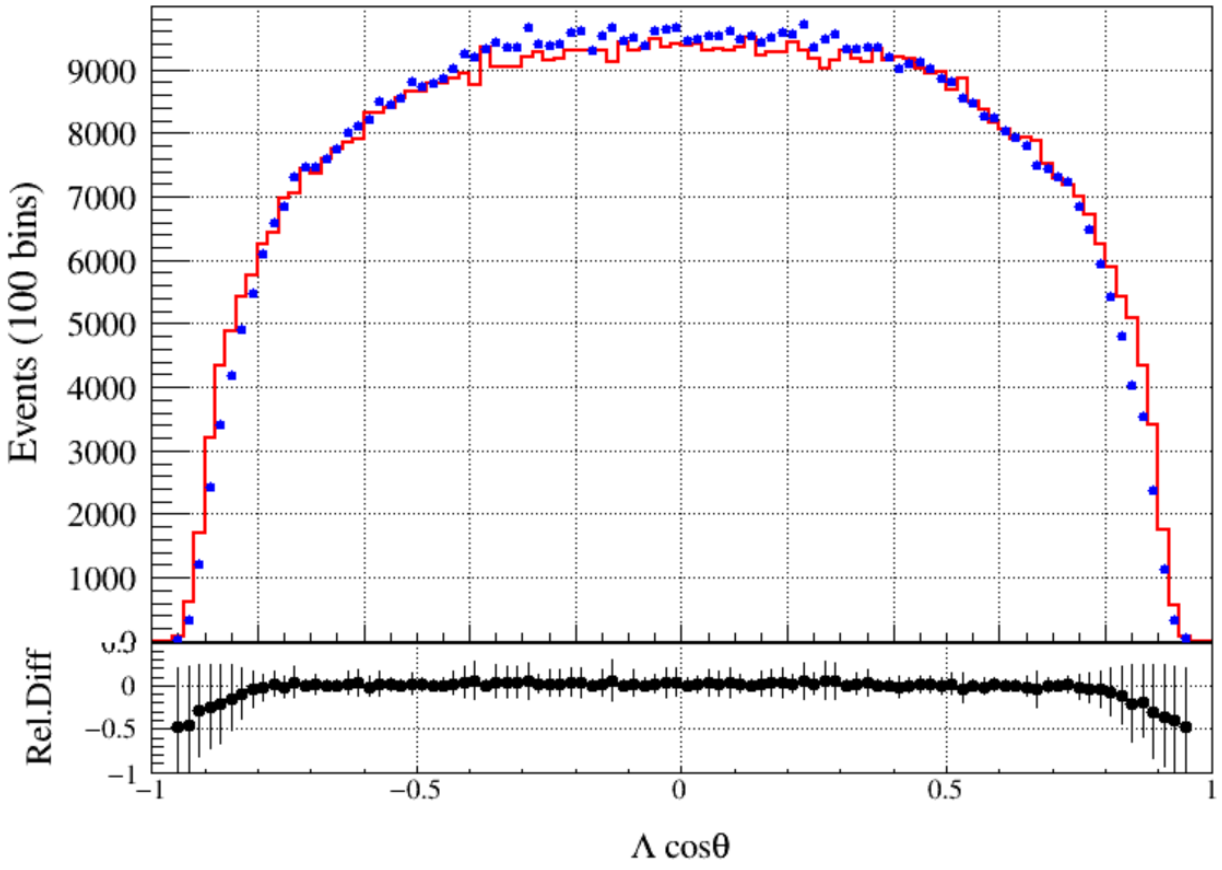


Distribution of $\cos\theta_{\Lambda}$

$J/\psi \to \bar{\Lambda}(\to \bar{p}\pi^{+})\Lambda(\to n\pi^{0})$



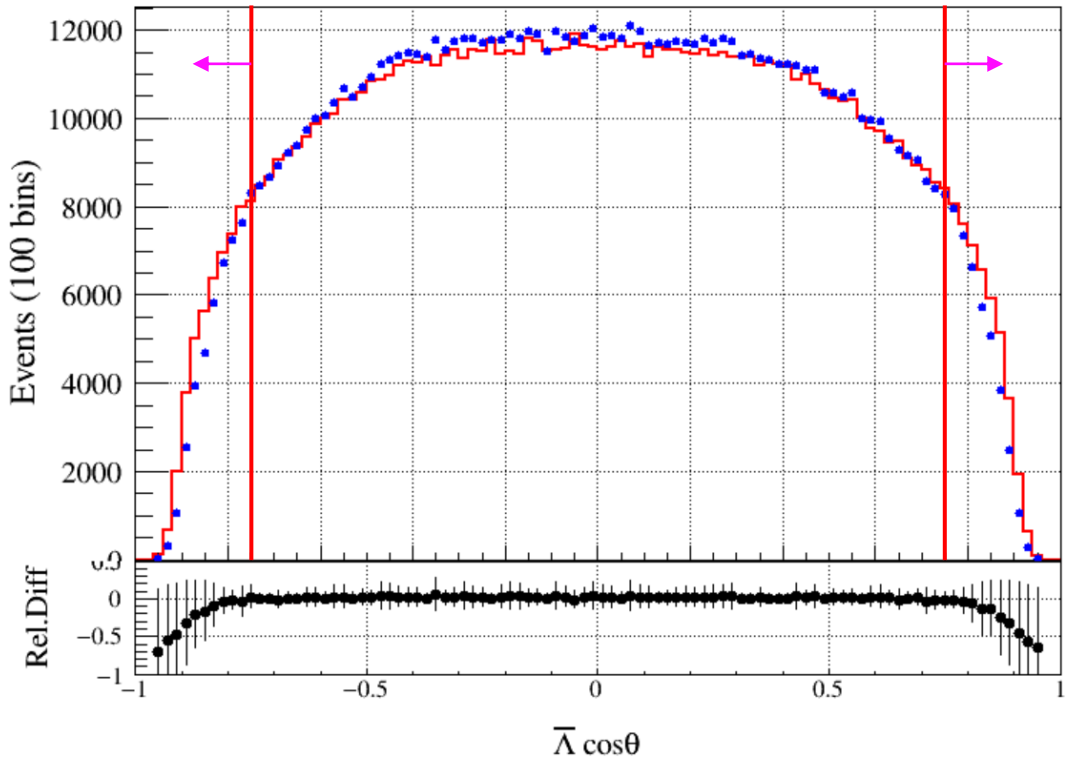
$J/\psi \to \Lambda(\to p\pi^{-})\bar{\Lambda}(\to \bar{n}\pi^{0})$

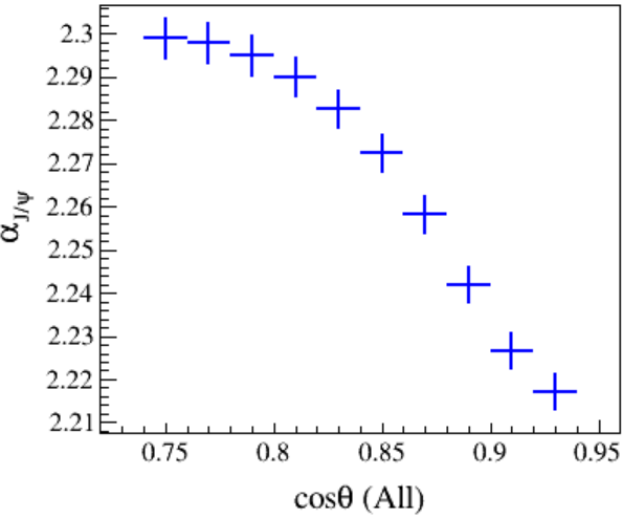


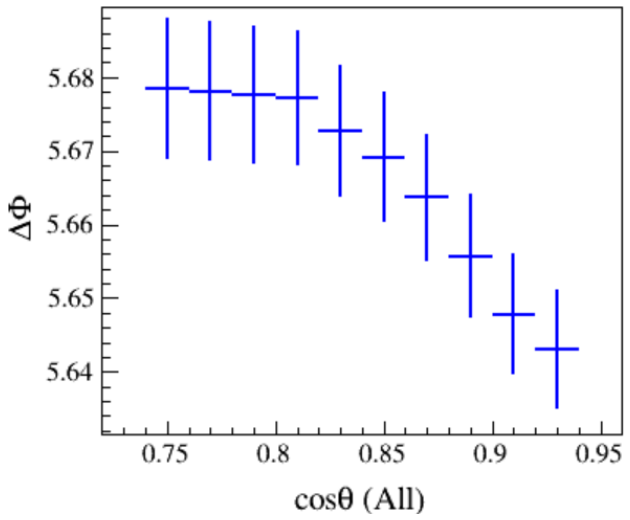
Barlow Test for $\cos\theta_{\bar{\Lambda}}$

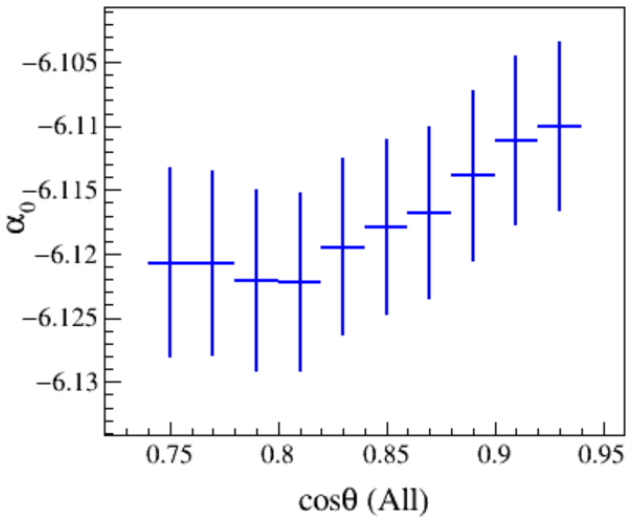
- Cut Value vary from **0.75** to **0.93** (interval of 0.02)
- Nominal value at 1.0
- Pink Box is the statistical uncertainty range at nominal cut
- Uncorrelated Error:

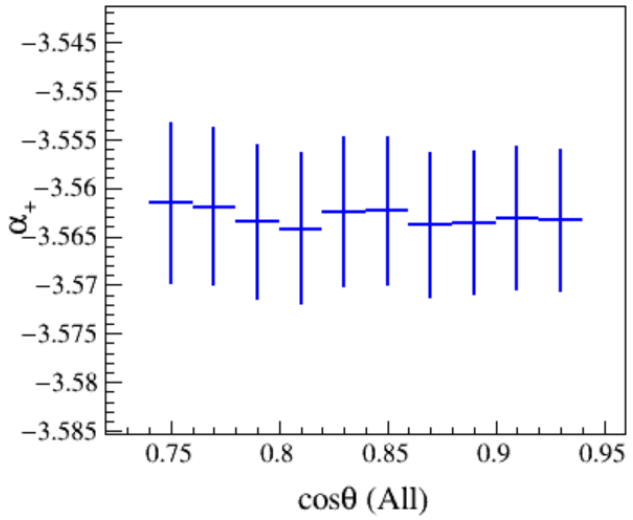
$$\sigma_{uncorr} = \sqrt{|\sigma_{\alpha}^{2} - \sigma_{\alpha}^{i\,2}|}$$











Check Outline

- Efficiency Check
  - Check efficiency of $\bar{\Lambda} \to \bar{p}\pi^+$ by $J/\psi \to \Lambda\bar{\Lambda} \to p\bar{p}\pi^+\pi^-$ control sample
  - Check efficiency of $\Lambda \to n\pi^0$ by $J/\psi \to \Lambda\bar{\Lambda} \to \bar{p}\pi^+ n\pi^0$ control sample
- Using $J/\psi \to \Lambda\bar{\Lambda} \to p\bar{p}\pi^+\pi^-$ to check some distributions
- Repeat the analysis code of Zhang Jianyu

Selection of $\bar{\Lambda} \to \bar{p}\pi^+$

- Tracking && PID
  - $V_r \leq 10cm,\ |V_z| \leq 30cm, |cos\theta| < 0.93$
  - **Proton**: $p > 0.5$ GeV/c && PID:
    Prob(p) > Prob(K/π)
  - **Pion**: $p < 0.5$ GeV/c && PID:
    Prob(π) > Prob(K/p)
  - nGood = 2
- $\bar{\Lambda}$ Reconstruction
  - Primary and Secondary vertex fit
  - $L/\sigma_L > 2.0$
  - $\chi^2_{sec} < 15$
  - $\left|M_{\bar{p}\pi^+} - 1.1157\right| < 0.008\ (GeV/c^2)$
  - $M^{recoil}_{\bar{p}\pi^+} \in [1.069, 1.152]\ GeV/c^2$

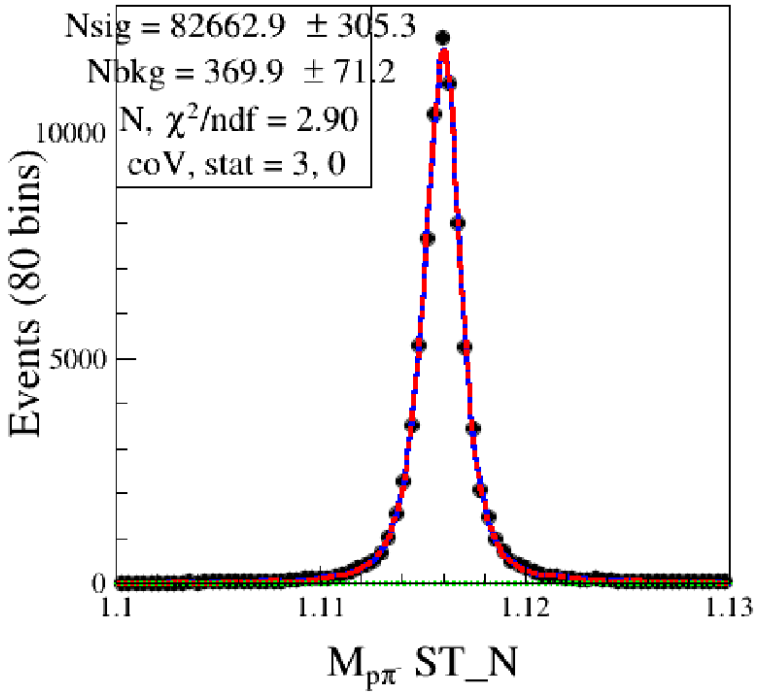
Selection of $\Lambda \to n\pi^0$

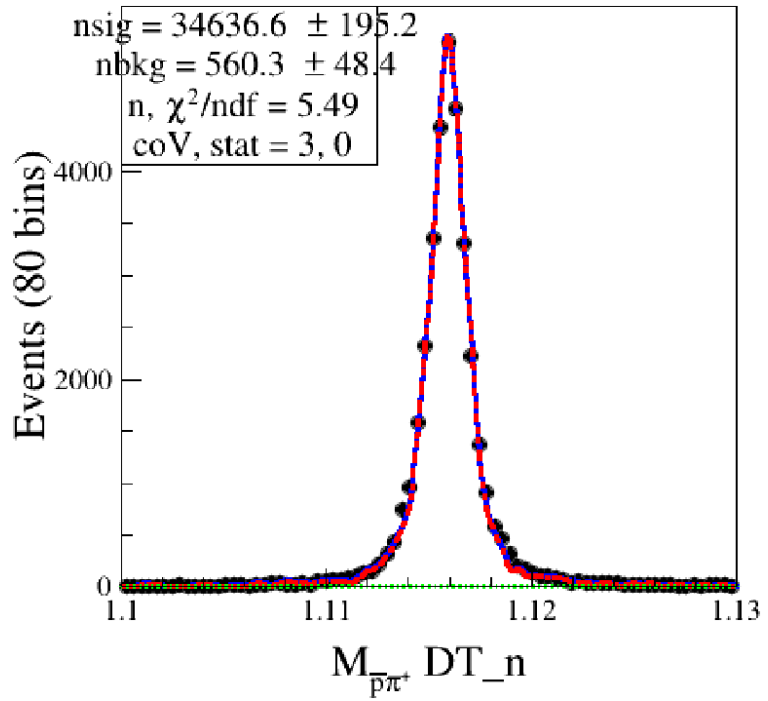
- Good Shower Selection
  - $|cos\theta| \leq 0.8\ ,\ E > 25MeV$ && $0.86 \leq |cos\theta| \leq 0.92\ , E > 50MeV$
  - $0 \leq TDC \leq 14$
  - Nshower ≥ 2
  - $Ang_{shower,ChgTrk} \geq 10°$ (for $\bar{p} \geq 20°$)
- 2C Kinematic fit
  - On the hypothesis of $\bar{\Lambda}n\gamma\gamma$, Loop all γ pairs, perform:
    - $75 < M_{\gamma\gamma} < 175$ (MeV/c^2)
    - $\frac{|E_1 - E_2|}{p_{\pi^0}} < 0.9$
    - $\theta_{\gamma,\Lambda} > 10°$, Λ direction is recoiled from $\bar{\Lambda}$
    - BDT Response > 0.15
  - $\bar{\Lambda}$ is from secondary vertex fit, Neutron is treated as a missing particle
  - Constrain $M_{n\pi^0} = M^{PDG}_{\Lambda}$ and $M_{\gamma\gamma} = M^{PDG}_{\pi^0}$
  - $\chi^2_{kmfit} < 50$
  - $M_n \in [0.90, 0.98] GeV/c^2$
  - Truth match for MC

Check the Efficiency of $\bar{\Lambda} \to \bar{p}\pi^+$

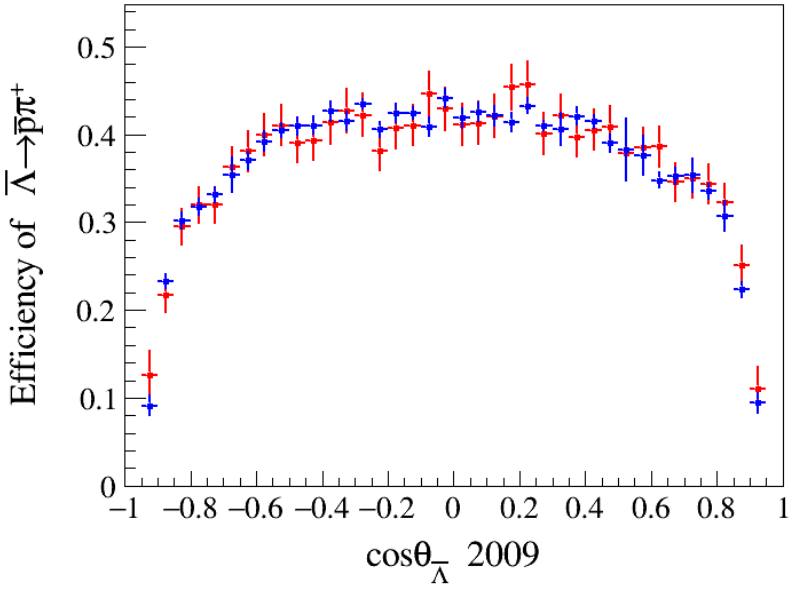
- Data && MC : $J/\psi \to \Lambda(\to p\pi^-)\bar{\Lambda}(\to \bar{p}\pi^+)$
- For Data:
  - ① Tag a Λ by $\Lambda \to p\pi^-$, extract the yields N by $M_{p\pi^-}$
  - ② Select a $\bar{\Lambda}$, extract the yields n by $M_{\bar{p}\pi^+}$
  - ③ Divide the sample into 40 bins in $\cos\theta_{\bar{\Lambda}}$
  - ④ $\epsilon(\bar{\Lambda} \to \bar{p}\pi^+) = n/N$
- MC just counts.

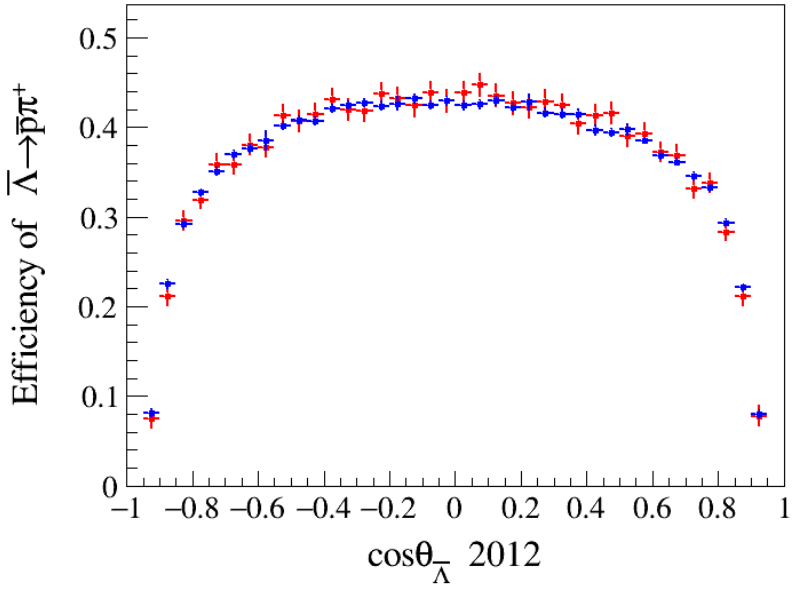
$$R(\bar{\Lambda} \to \bar{p}\pi^+) = \frac{\epsilon_{data}}{\epsilon_{MC}}$$

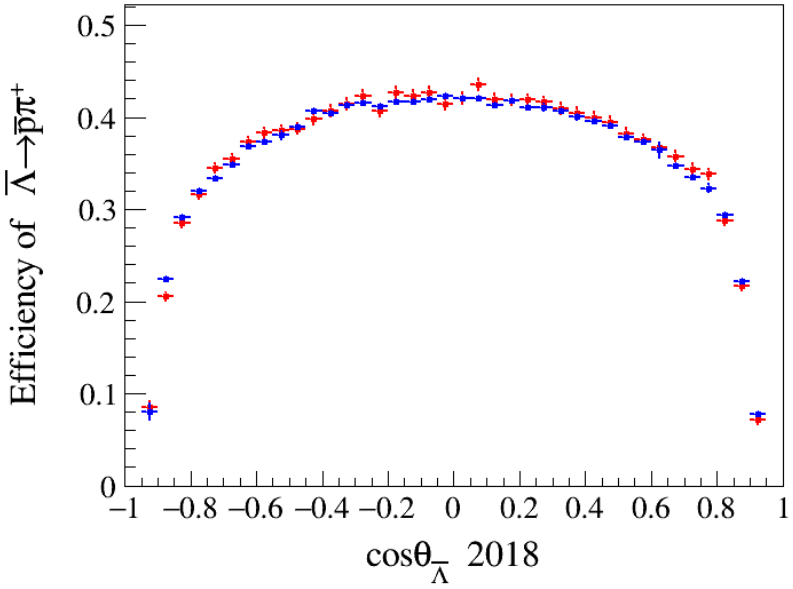


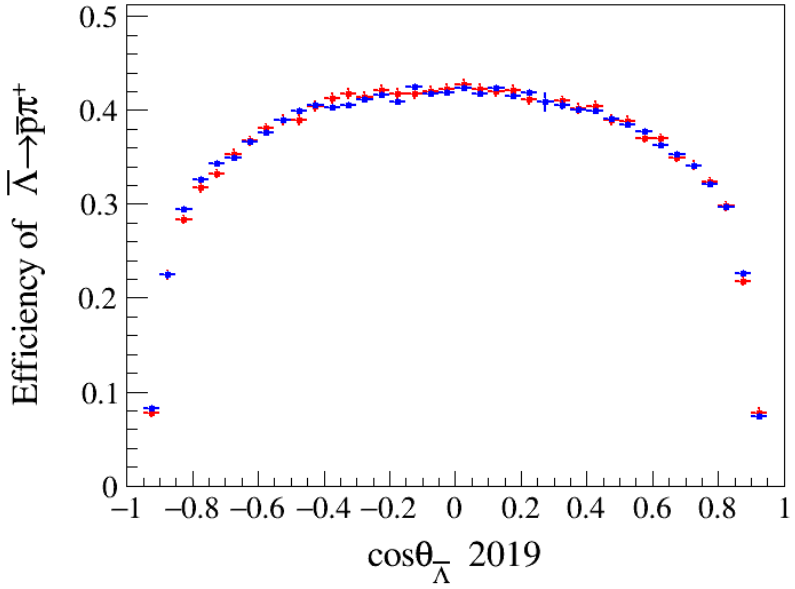


Efficiency of $\epsilon(\overline{\Lambda} \to \bar{p}\pi^+)$



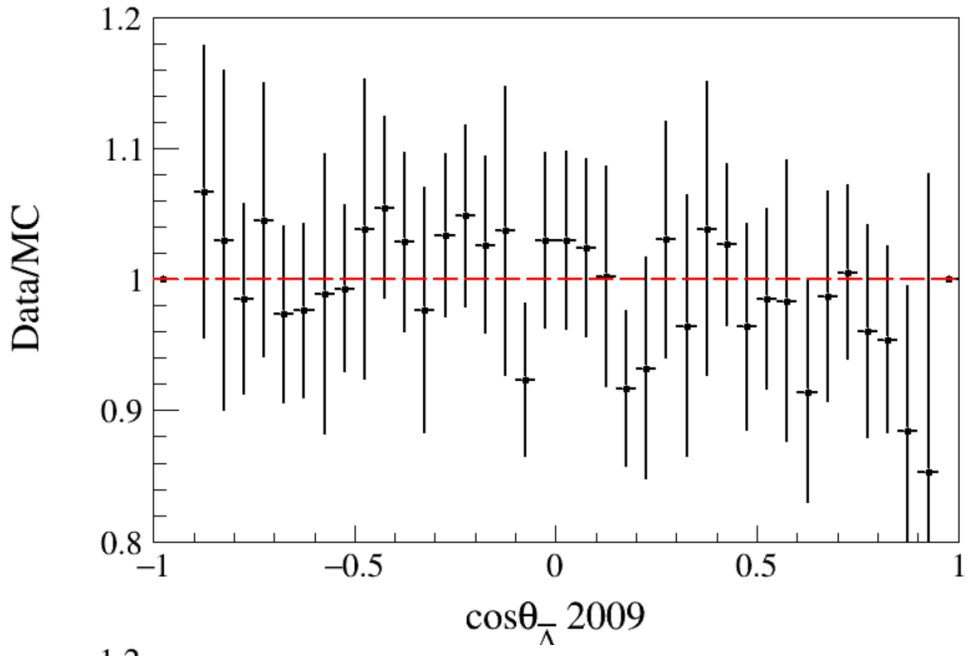


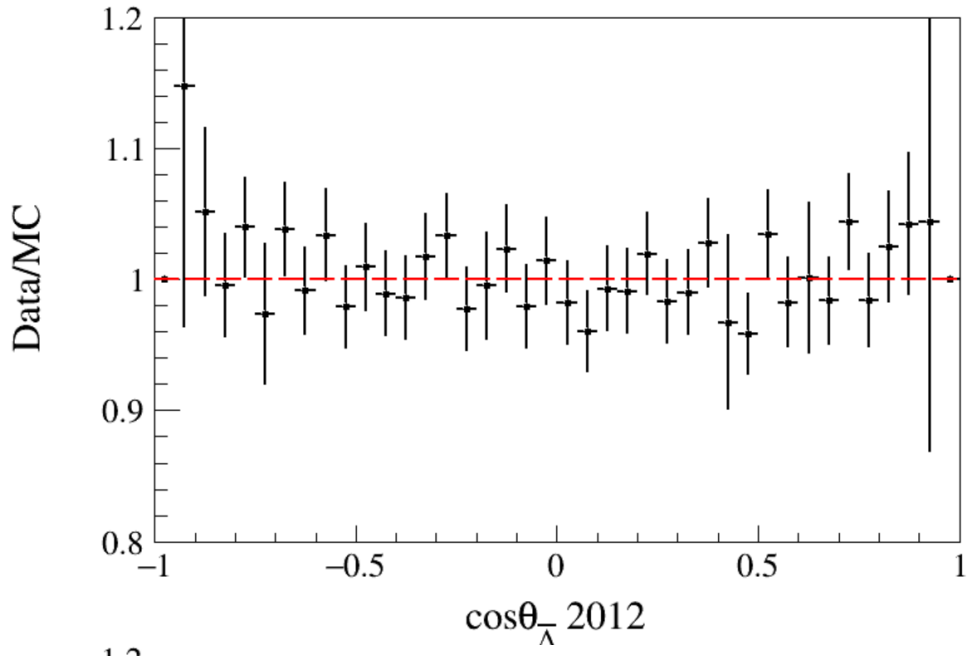


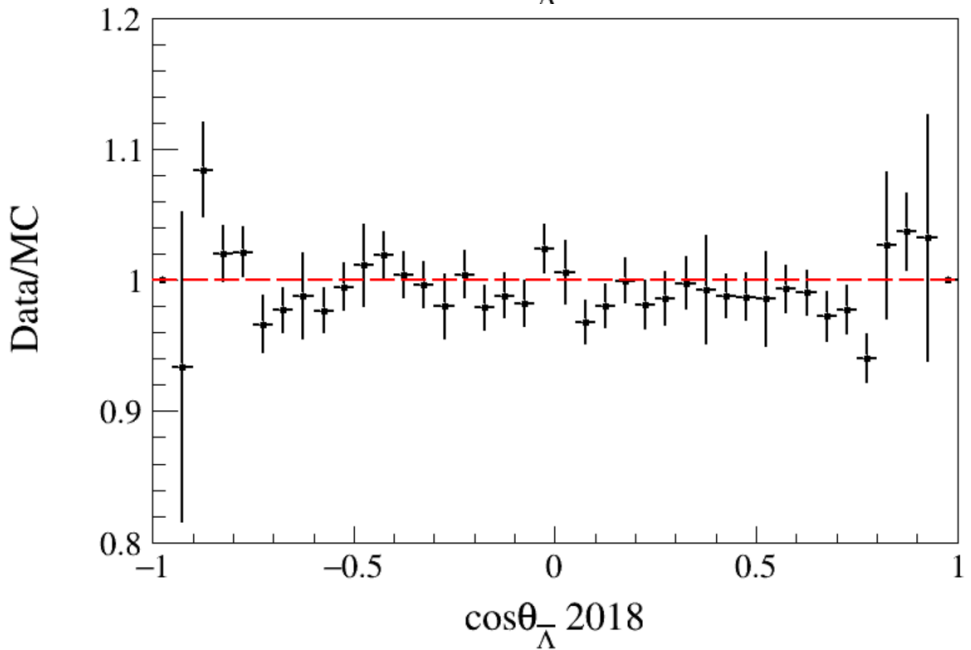


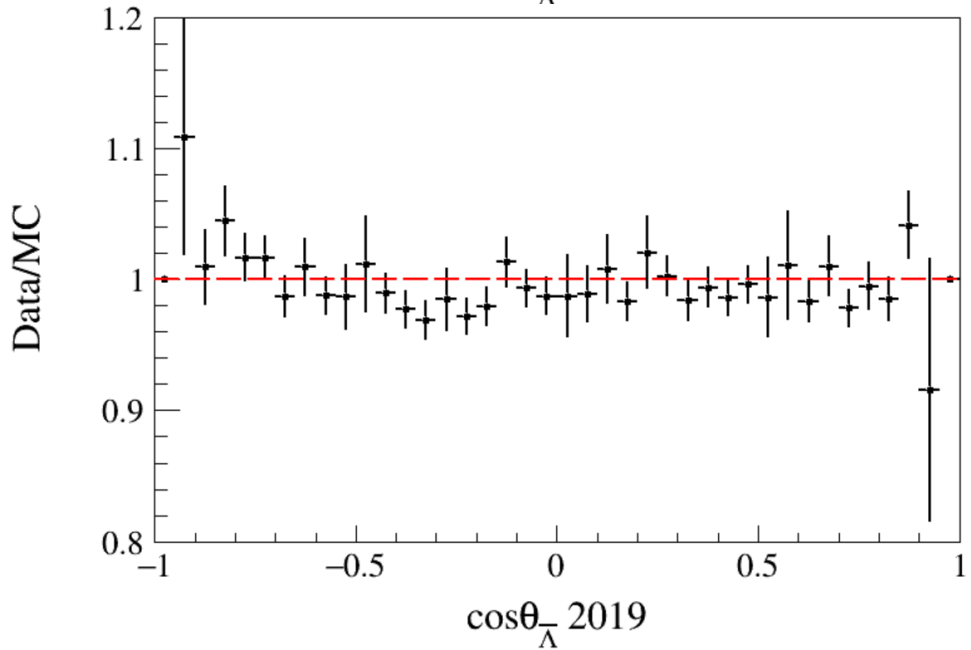
MC
Data

Results of $R(\bar{\Lambda} \to \bar{p}\pi^+)$





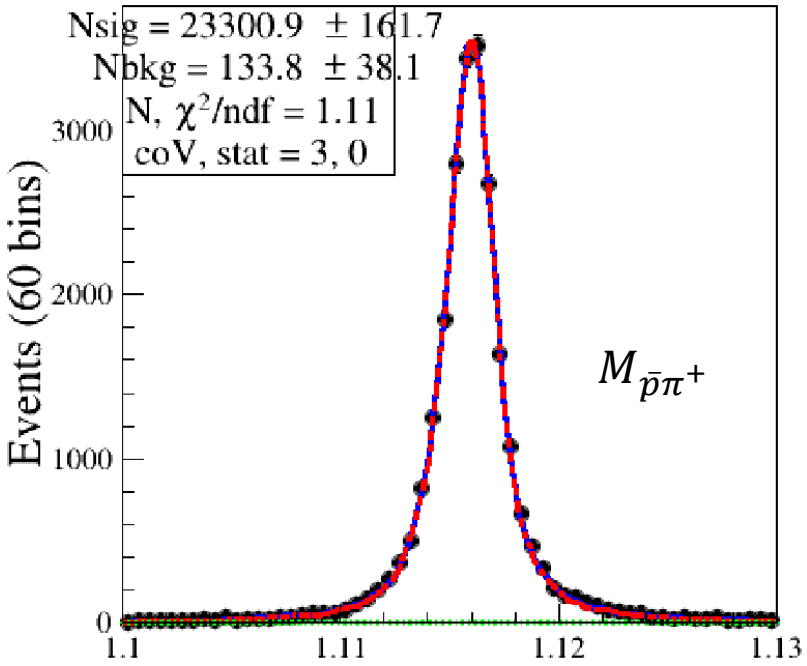


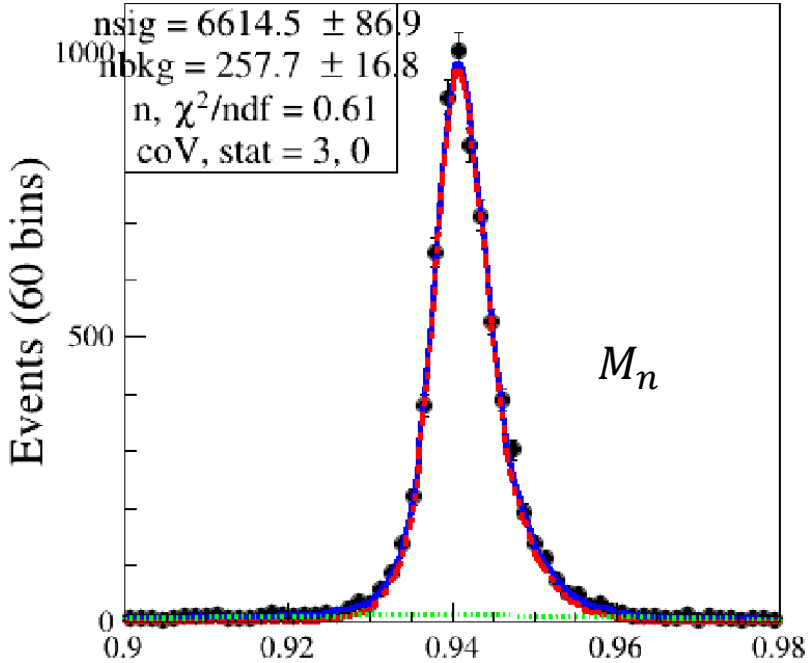


Check the Efficiency of $\Lambda \to n\pi^0$

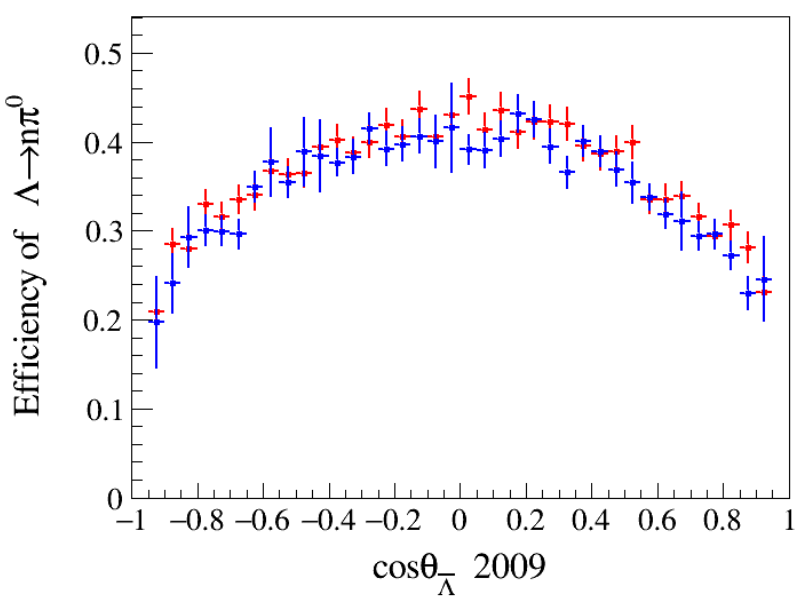
- Data && MC : $J/\psi \to \bar{\Lambda}(\to \bar{p}\pi^+)\,\Lambda(\to n\pi^0)$
- For Data:
  - ① Tag a Λ by $\bar{\Lambda} \to \bar{p}\pi^+$, extract the yields N by $M_{\bar{p}\pi^+}$
  - ② Select a Λ, extract the yields n by $M_{\bar{p}\pi^+}$
  - ③ Divide the sample into 40 bins in $\cos\theta_{\bar{\Lambda}}$
  - ④ $\epsilon(\Lambda \to n\pi^0) = n/N$
- MC just counts

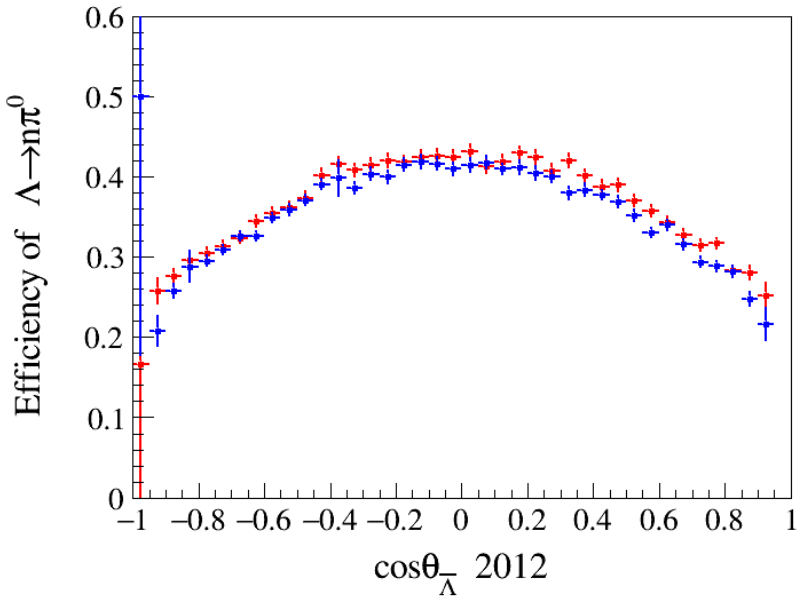
$$R(\Lambda \to n\pi^0) = \frac{\epsilon_{data}}{\epsilon_{MC}}$$

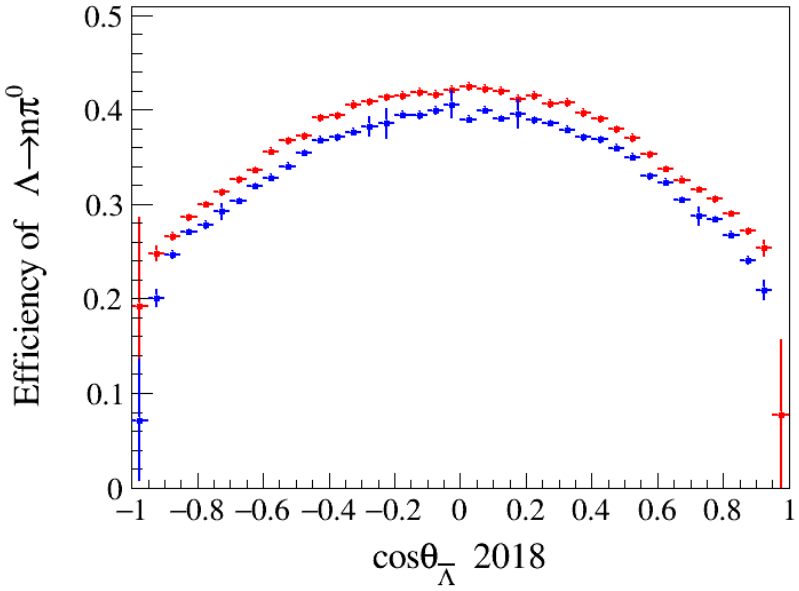


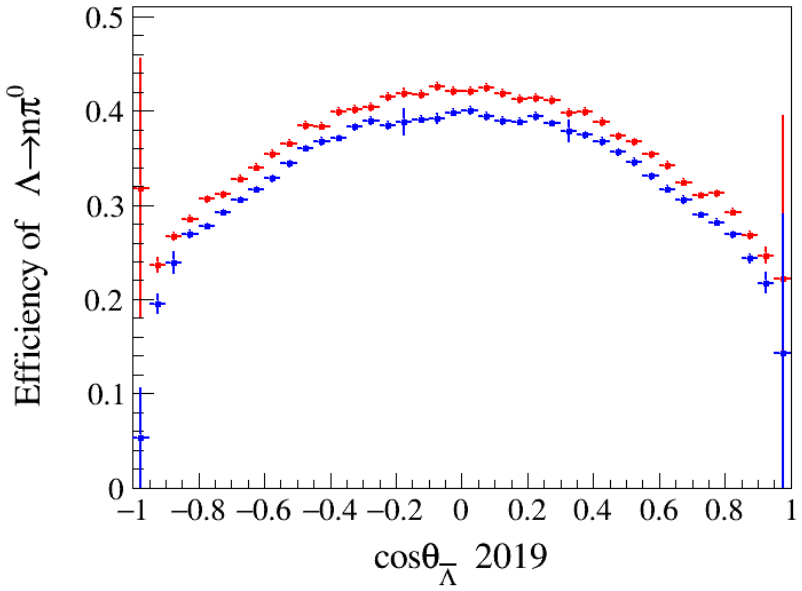


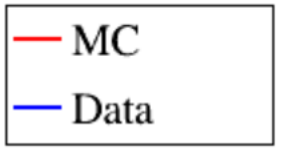
Efficiency of $\epsilon(\Lambda \to n\pi^0)$



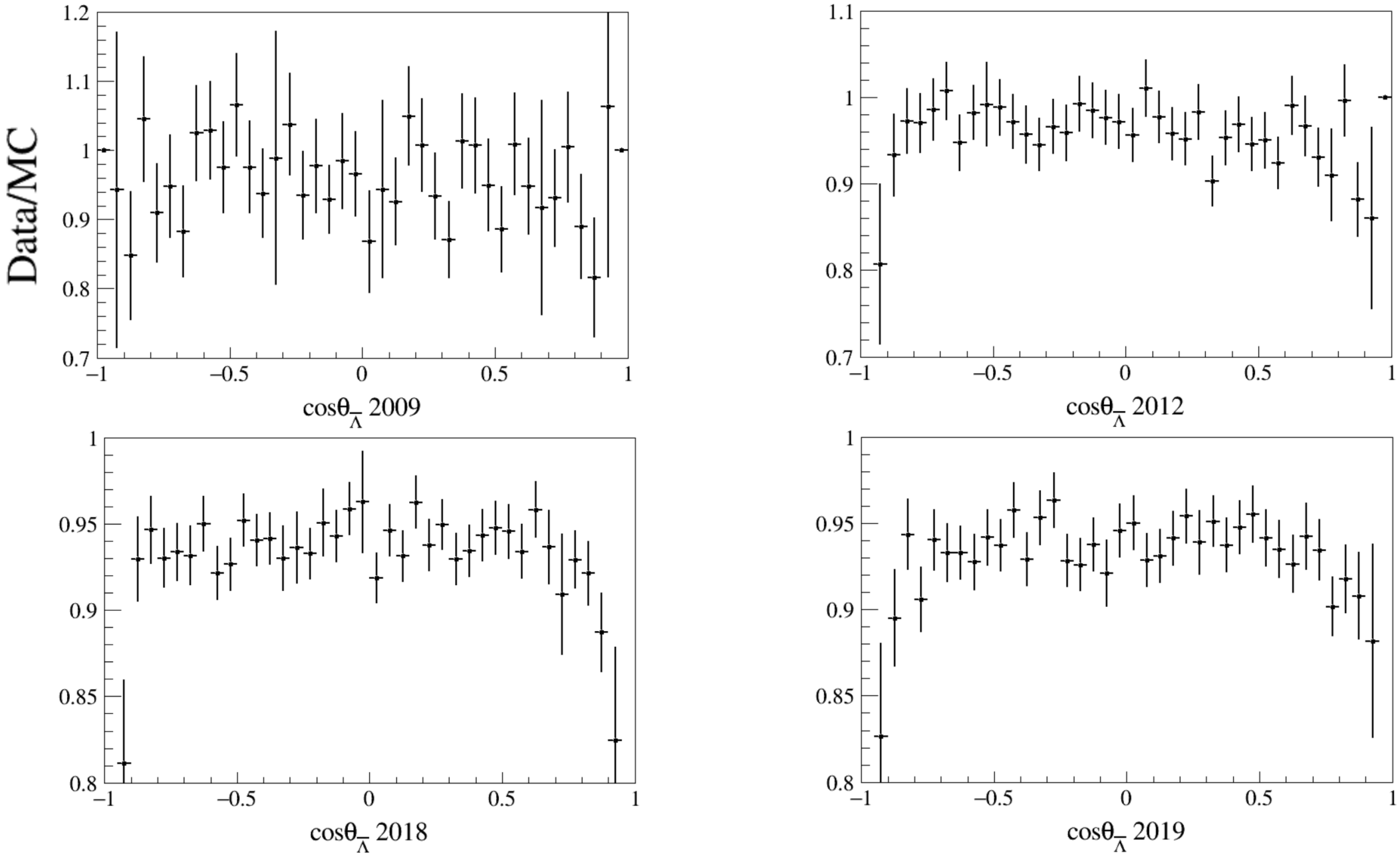




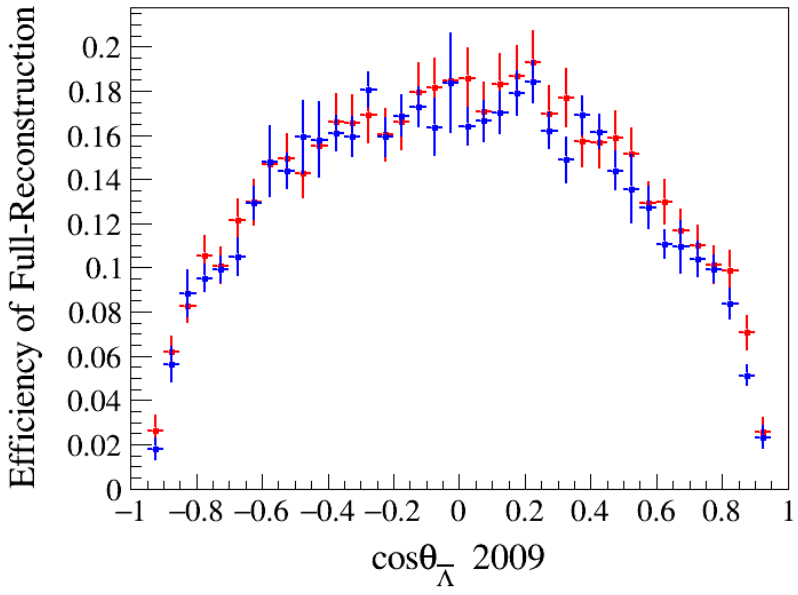


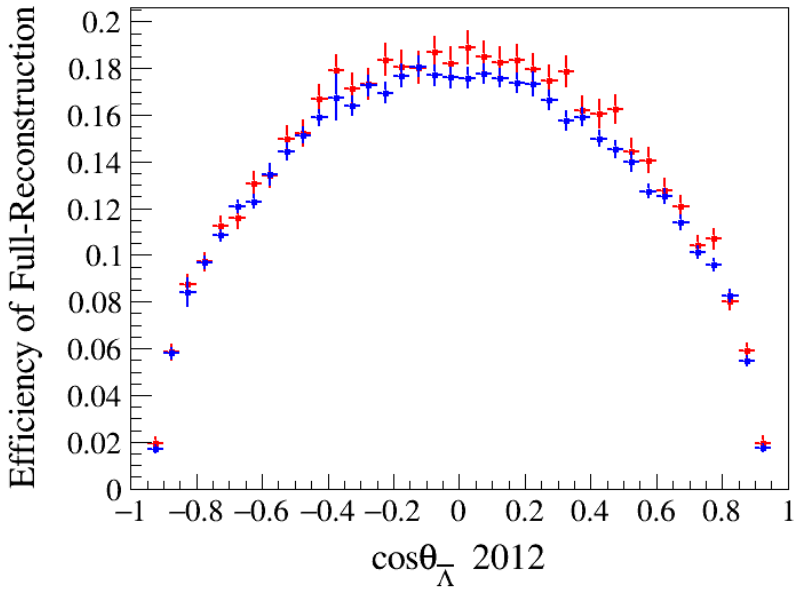


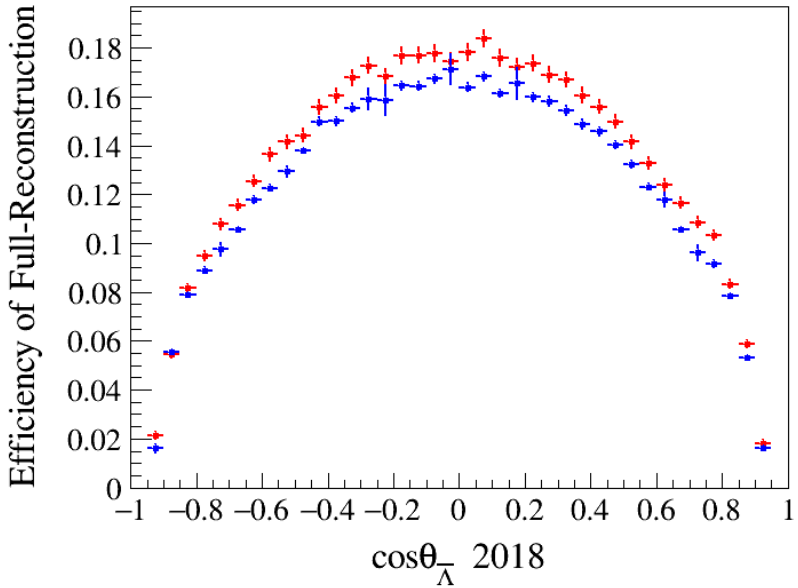
Results of $R(\Lambda \to n\pi^0)$

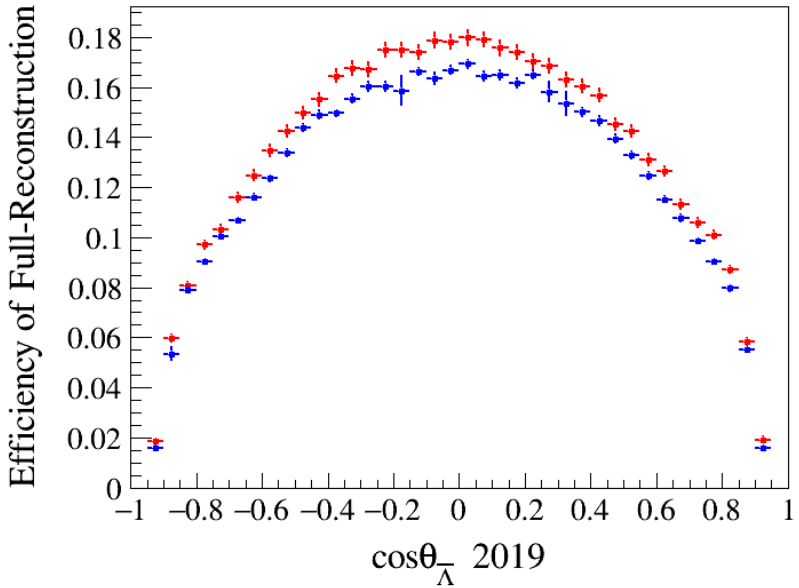


Efficiency of $\epsilon(\Lambda \to n\pi^0) \times \epsilon(\bar{\Lambda} \to \bar{p}\pi^+)$



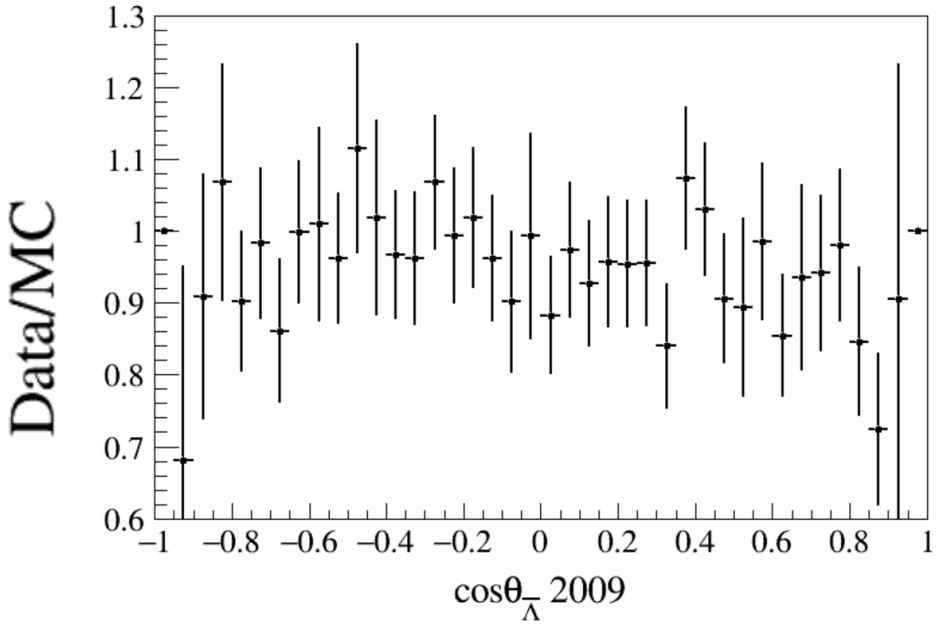


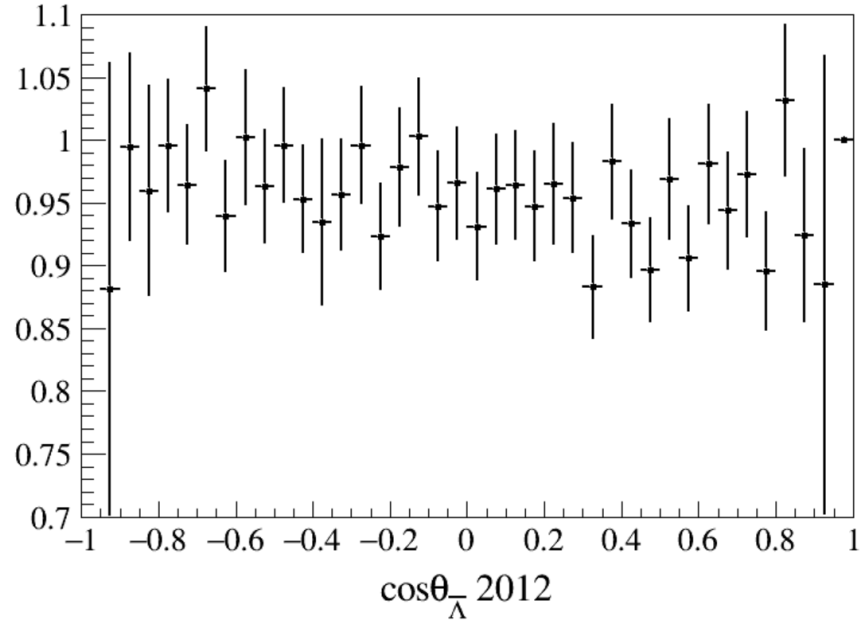


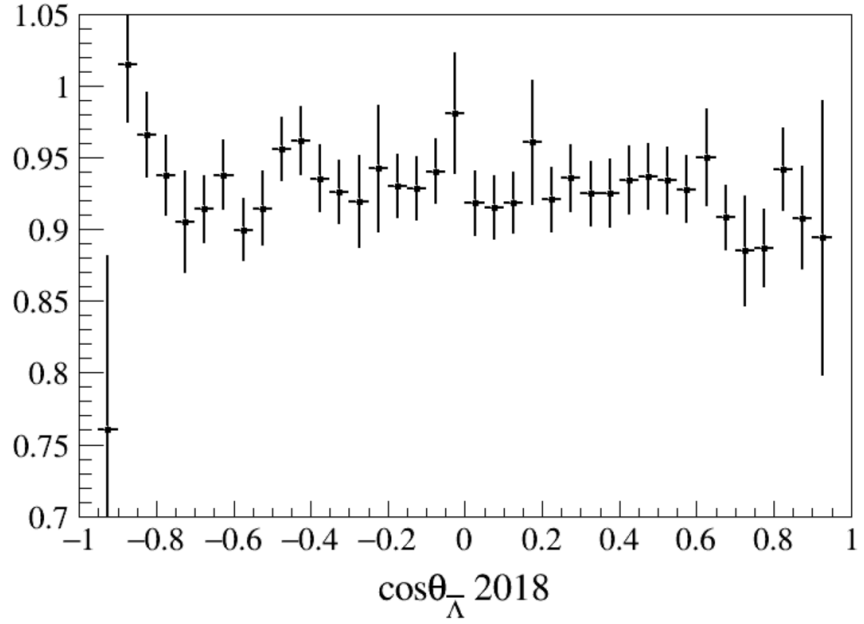


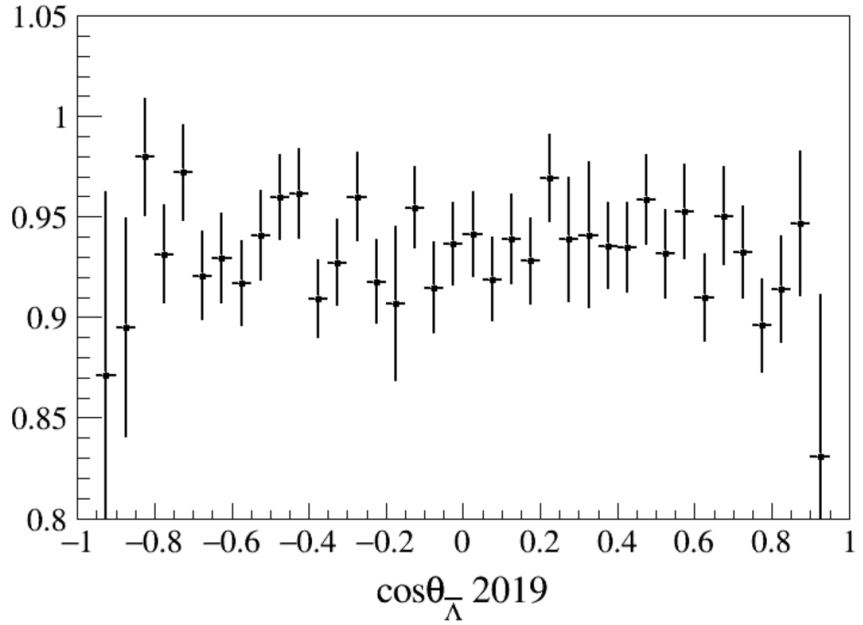
MC
Data

Results of $R(\overline{\Lambda} \to \bar{p}\pi^+) \times R(\Lambda \to n\pi^0)$









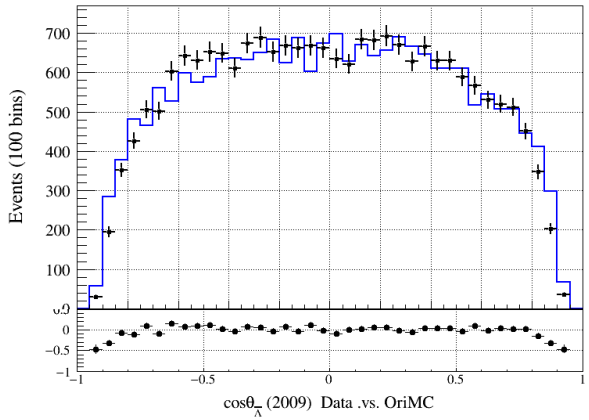
A Correction on data

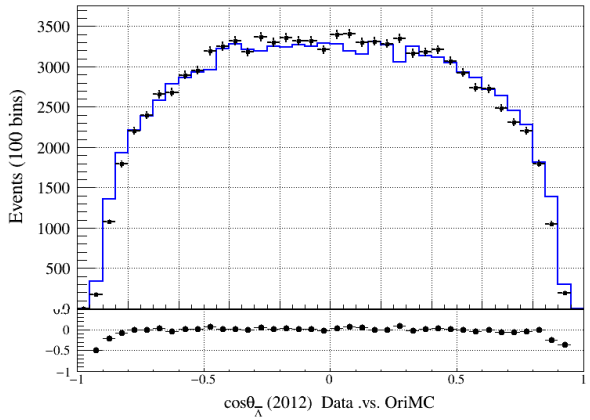
- Efficiency Ratio :

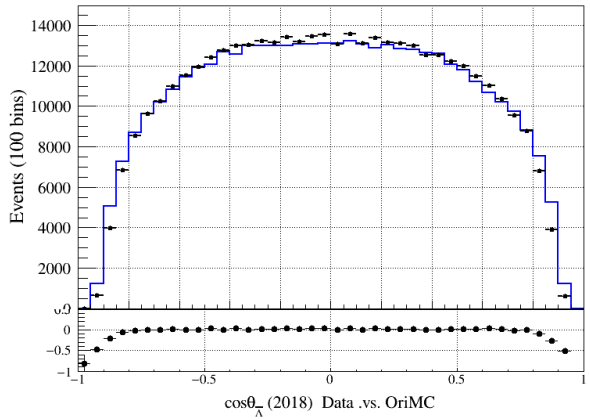
$$R = R(\overline{\Lambda} \to \bar{p}\pi^{+}) \times R(\Lambda \to n\pi^{0})$$

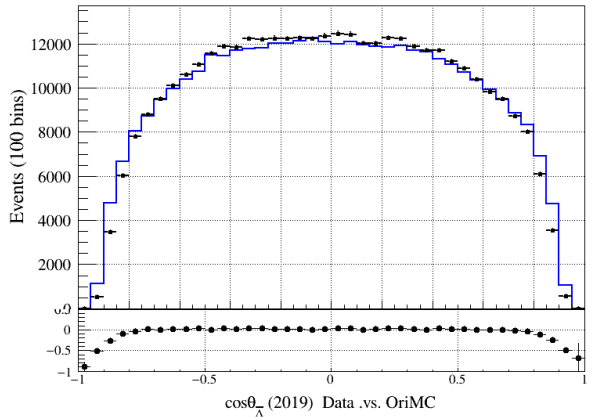
- Big difference still exists between data and MC

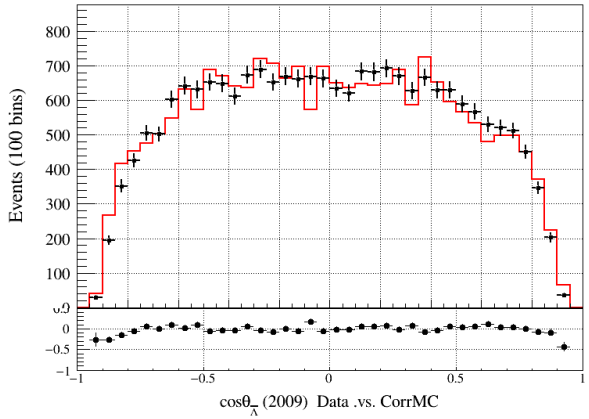
Data
Orignal MC
Corrected MC

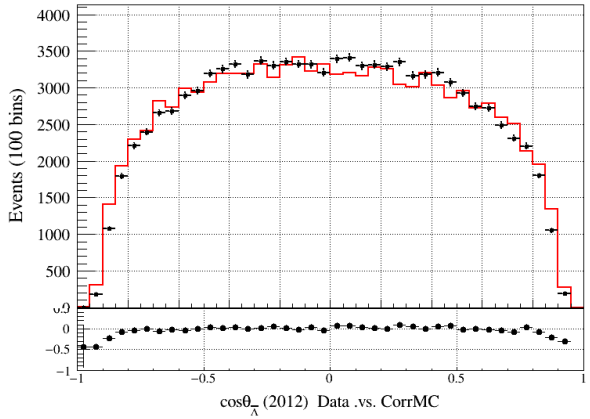


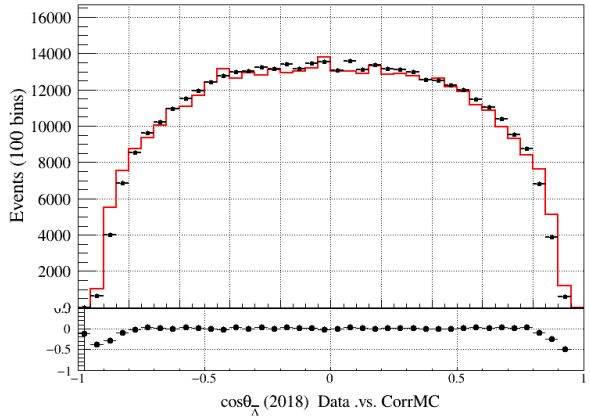


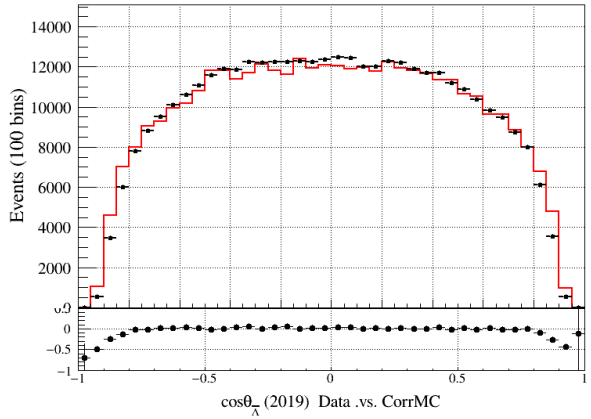








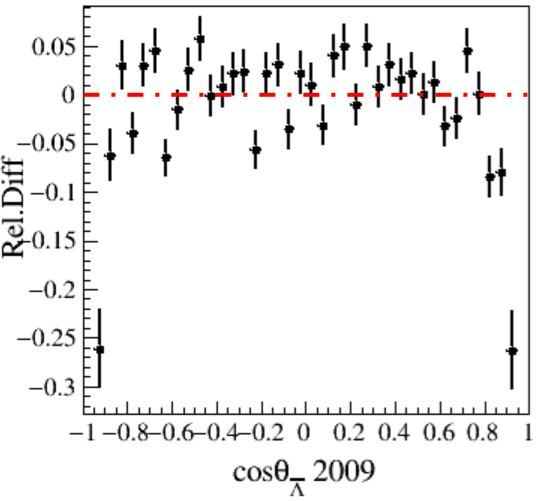


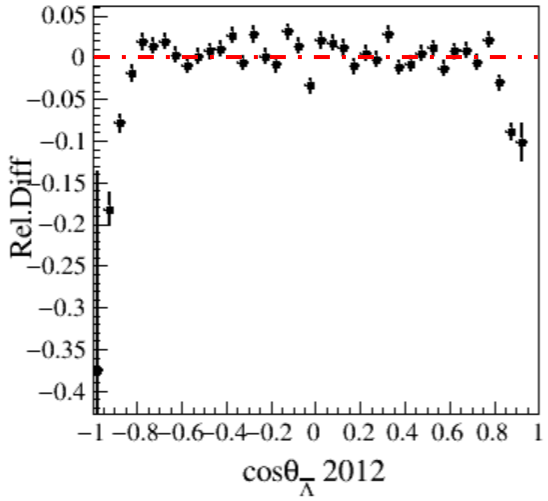


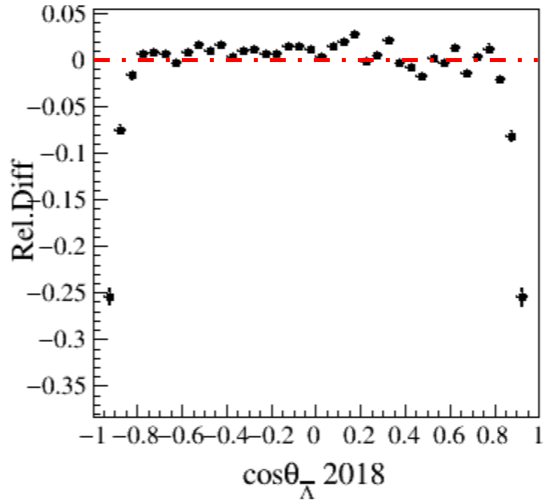
Distribution Check of ST and DT

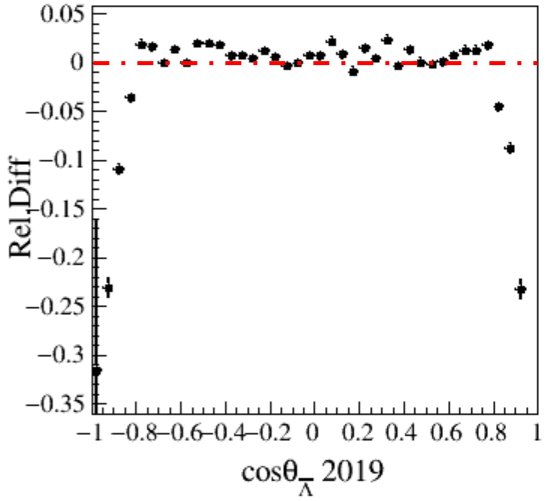
$$Diff = \frac{Data - MC}{MC}$$

$J/\psi \to \bar{\Lambda}(\to \bar{p}\pi^+)\,\Lambda(\to \text{anything})$

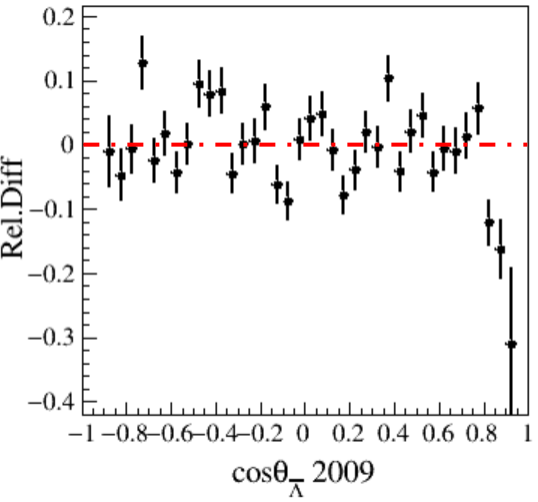


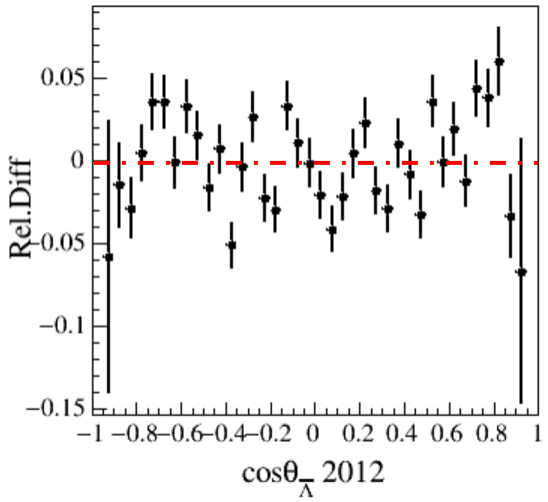


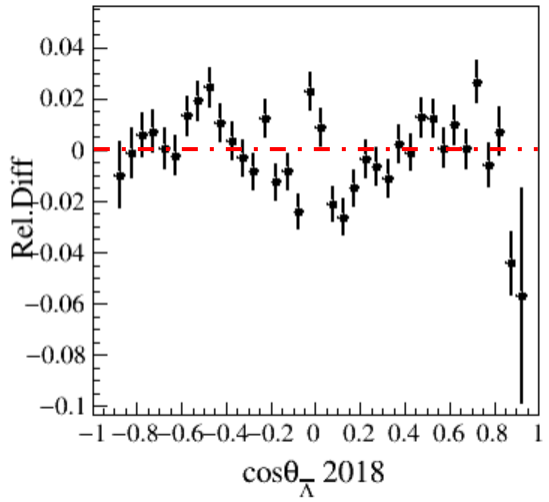


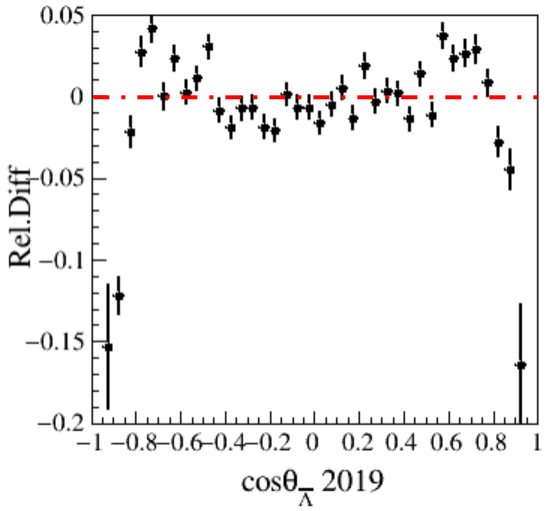


$J/\psi \to \bar{\Lambda}(\to \bar{p}\pi^+)\,\Lambda(\to p\pi^-)$



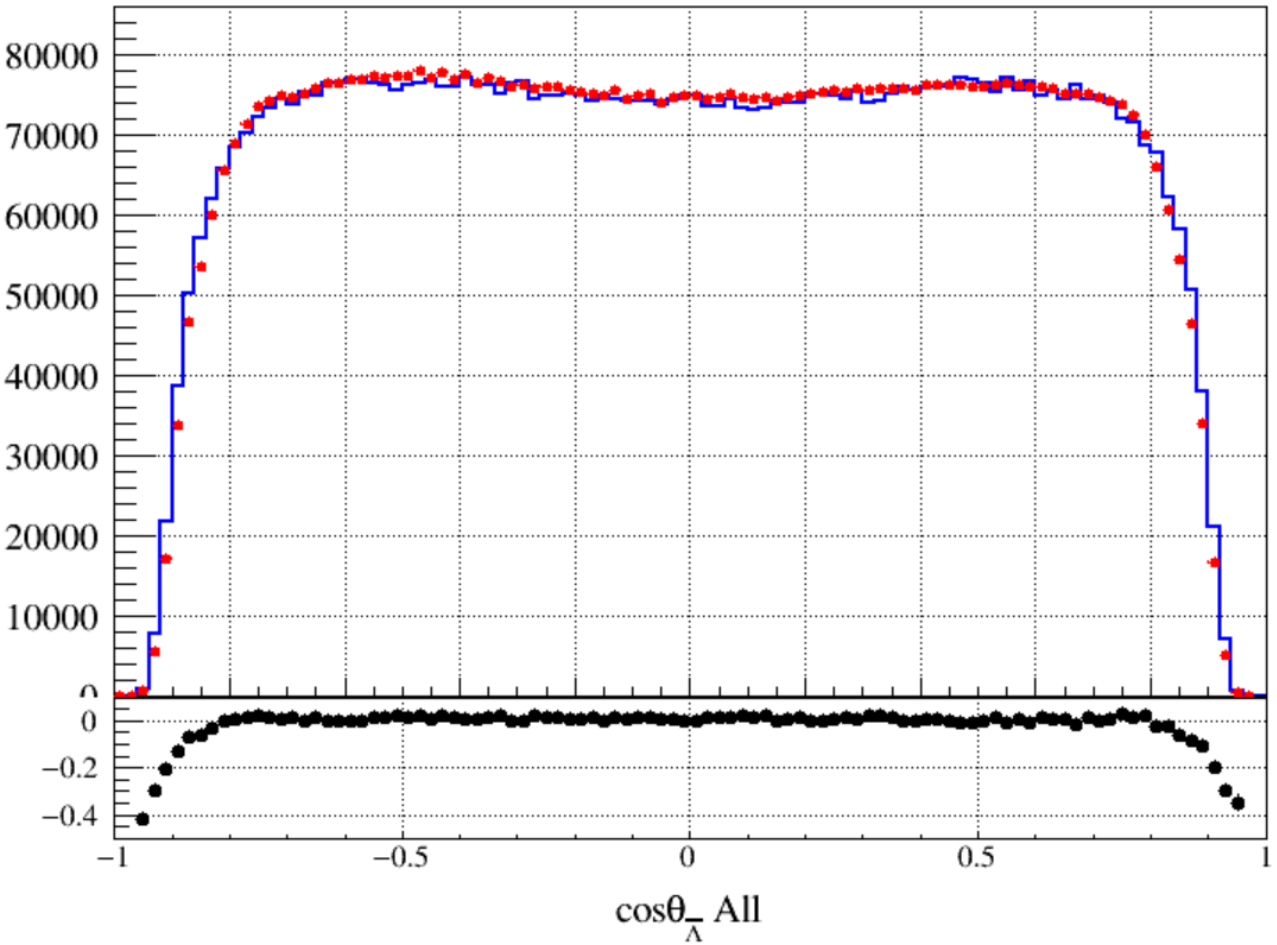




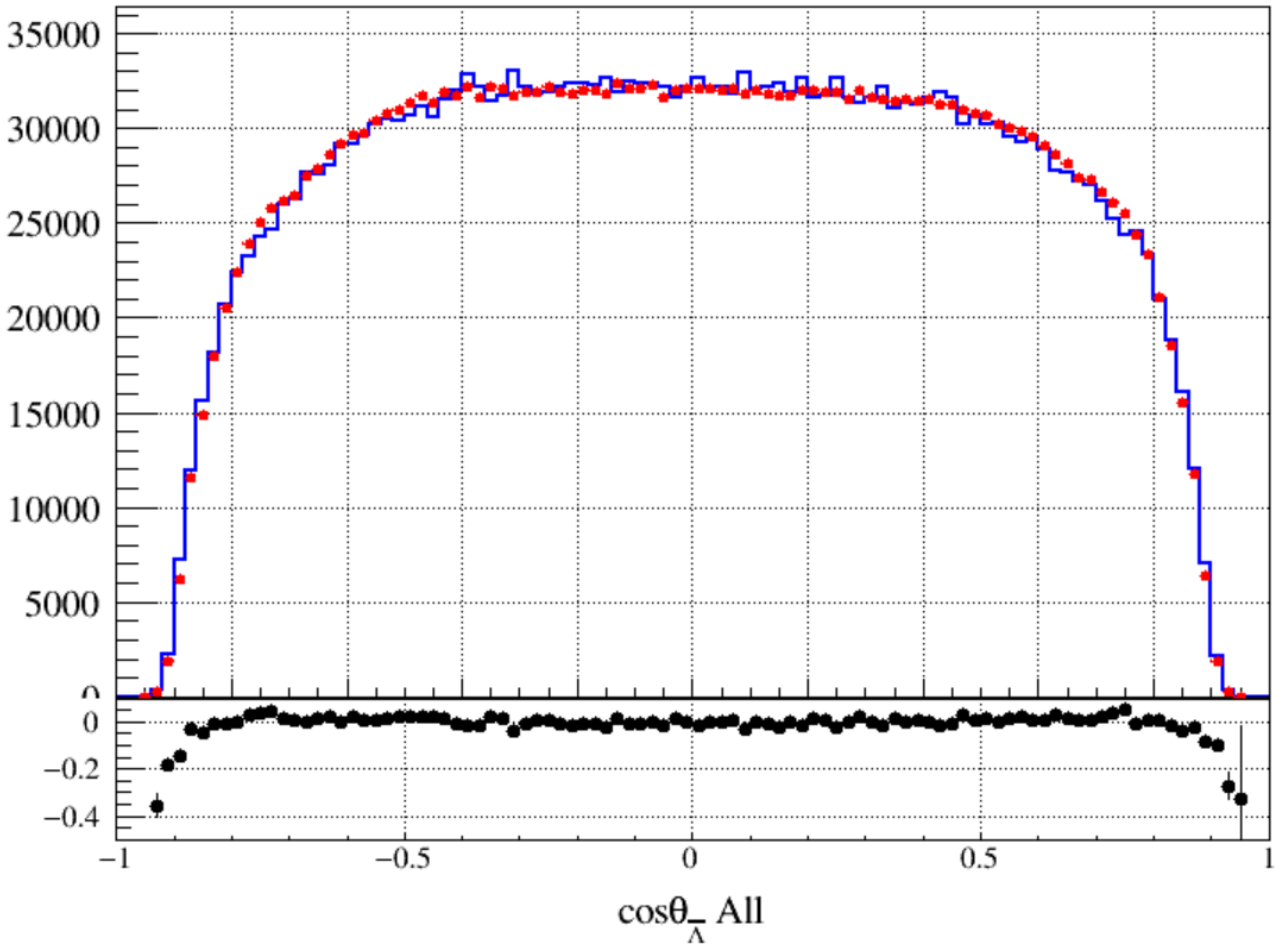


Compare between ST && DT

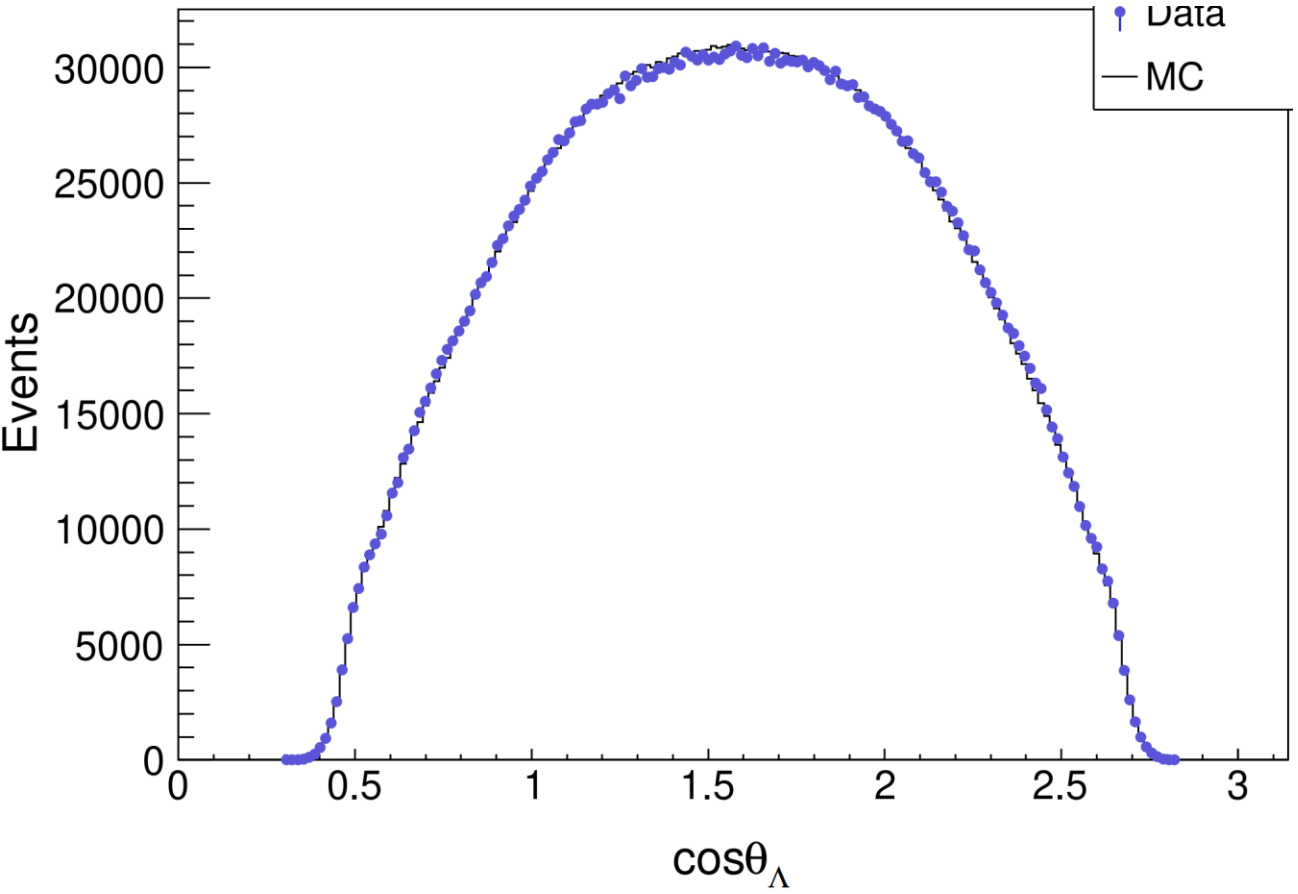
$J/\psi \to \bar{\Lambda}(\to \bar{p}\pi^+)\Lambda(\to \text{anything})$

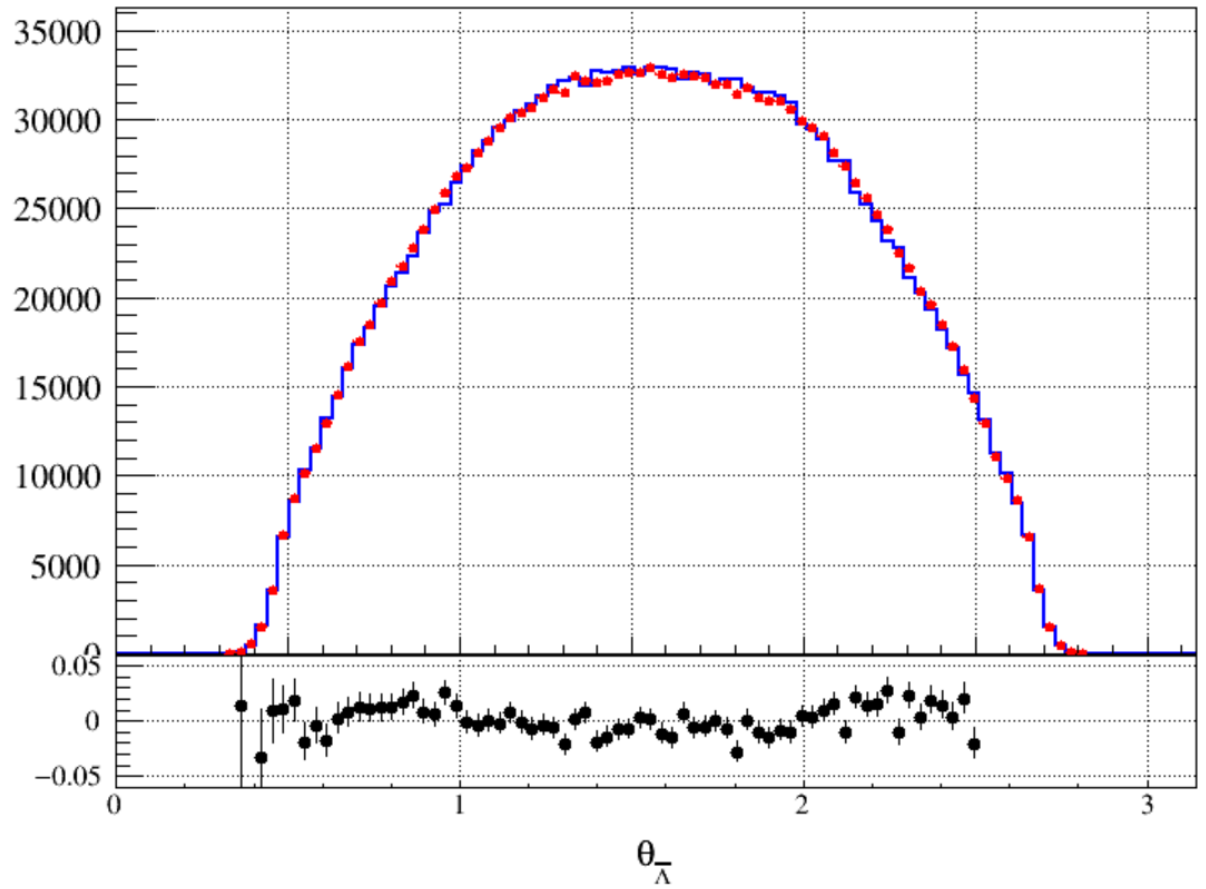


$J/\psi \to \bar{\Lambda}(\to \bar{p}\pi^+)\,\Lambda(\to p\pi^-)$

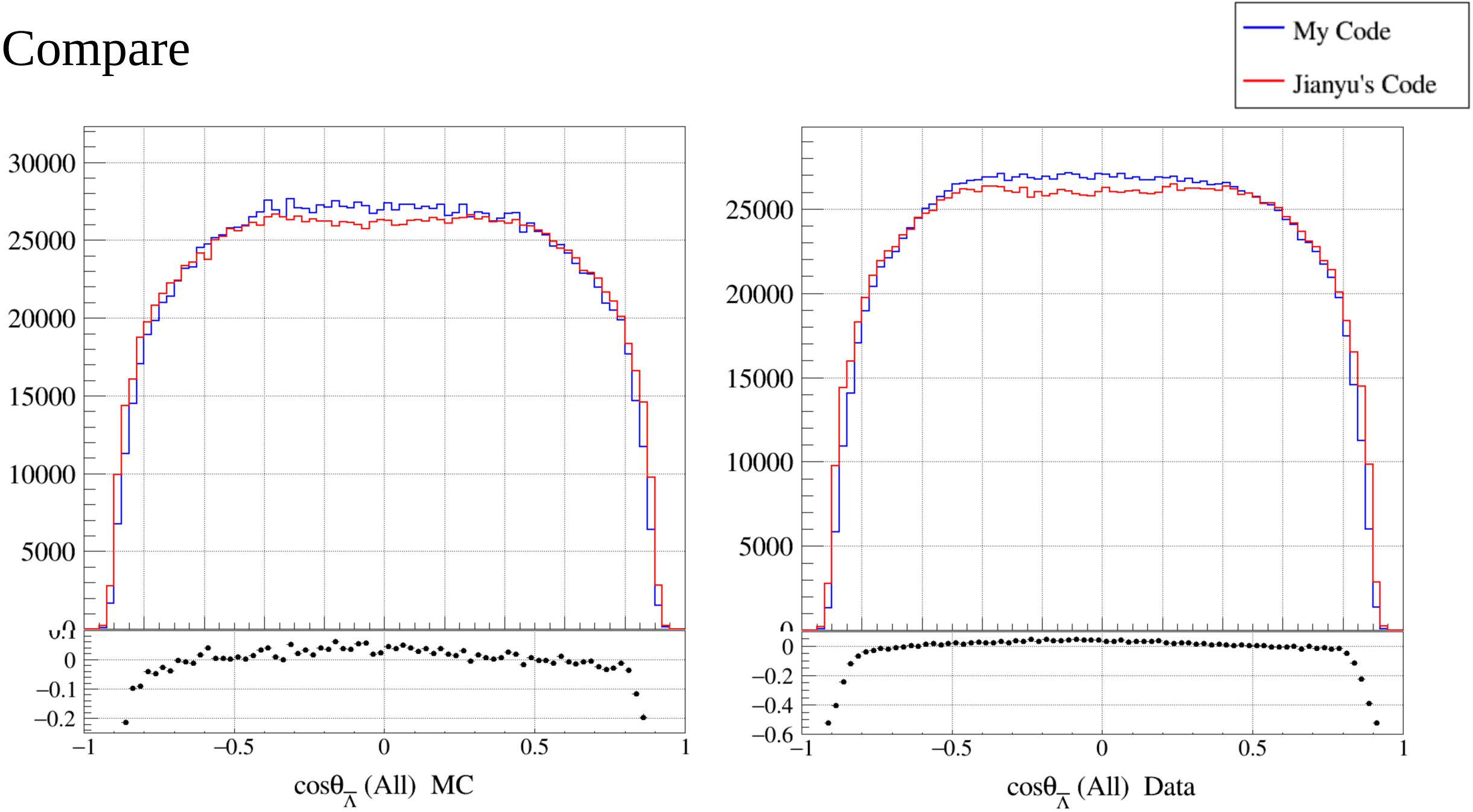


Repeat Jian Yu's code



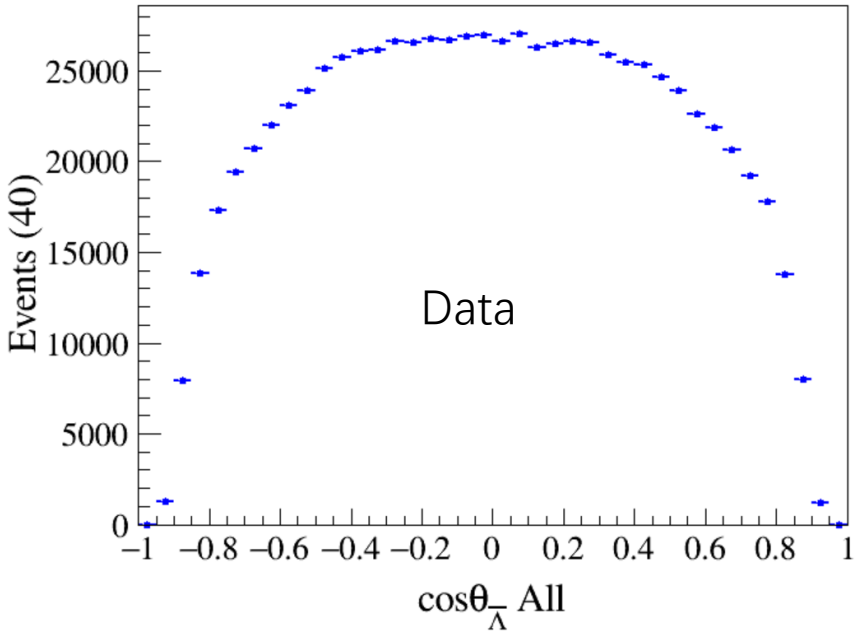


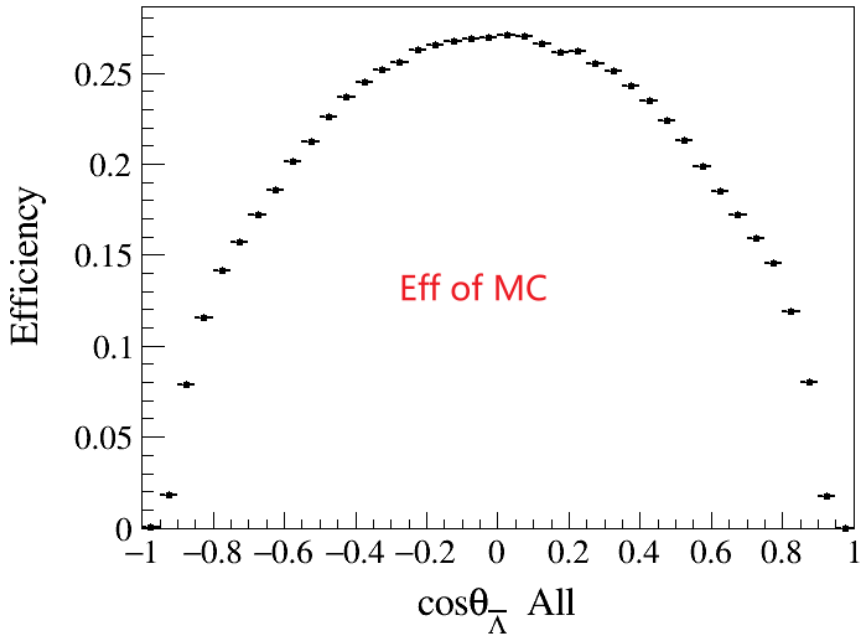
Compare


My Code
Jianyu's Code
30000
25000
20000
15000
10000
5000
0
0
−0.1
−0.2
−1
−0.5
0
0.5
1
cosθ_Λ (All) MC
25000
20000
15000
10000
5000
0
0
−0.2
−0.4
−0.6
−1
−0.5
0
0.5
1
cosθ_Λ (All) Data

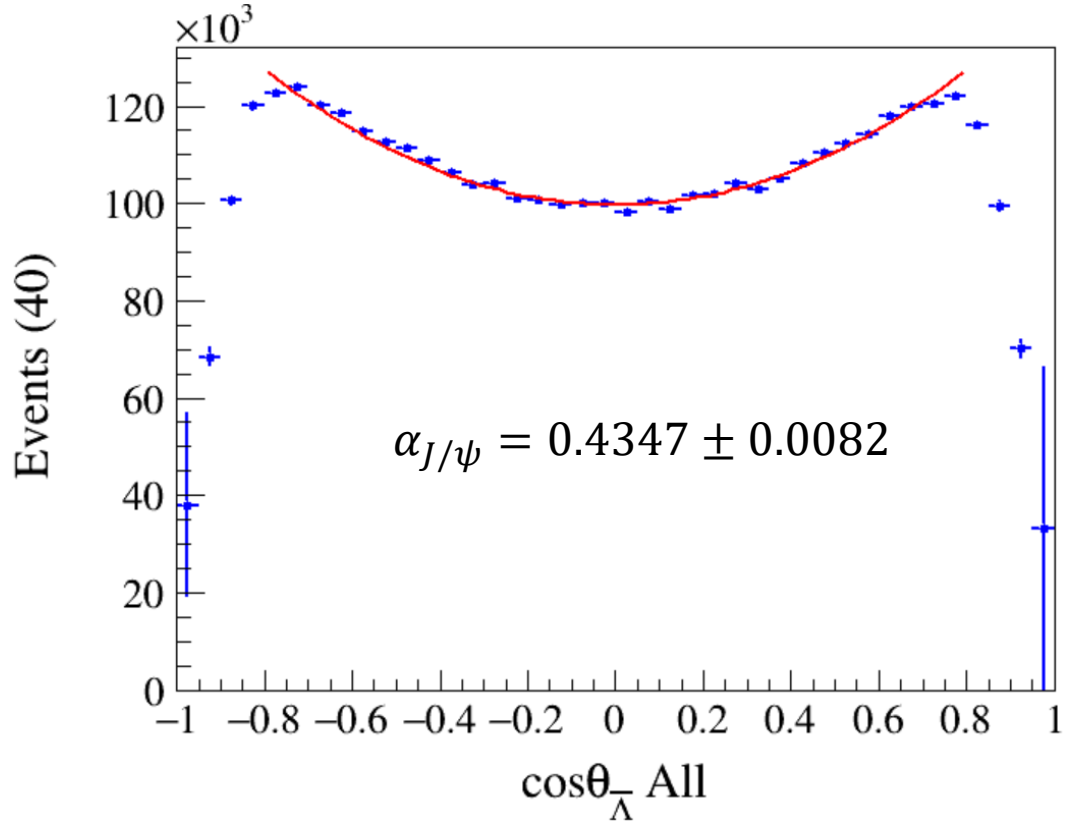
Backup

Fit Range: [-0.8, 0.8]





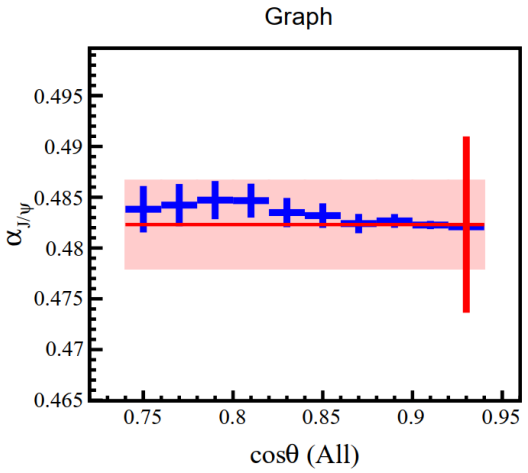
$$\frac{dN}{d\cos\theta} \propto 1 + \alpha_{J/\psi}\cos^2\theta$$

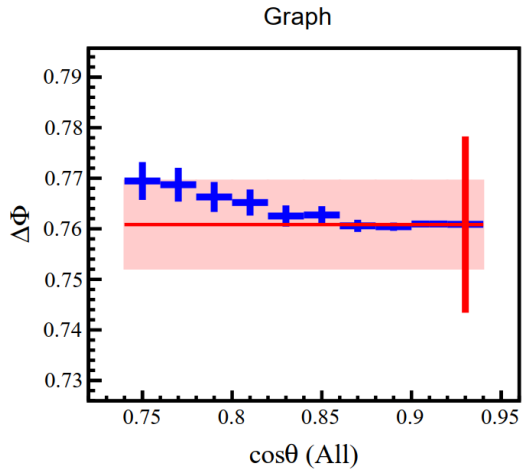


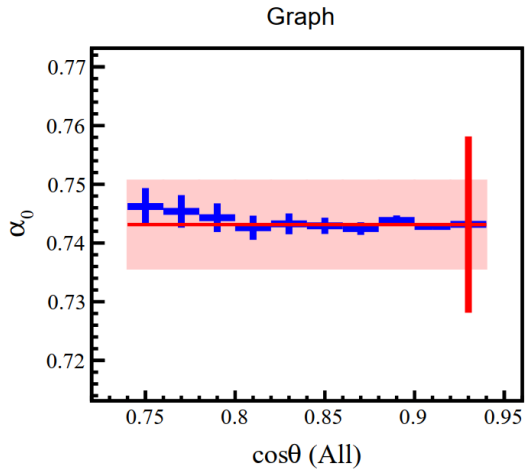
FCN=82.01 FROM MIGRAD	STATUS=CONVERGED	44 CALLS	45 TOTAL
	EDM=1.05755e-07	STRATEGY= 1	ERROR MATRIX ACCURATE

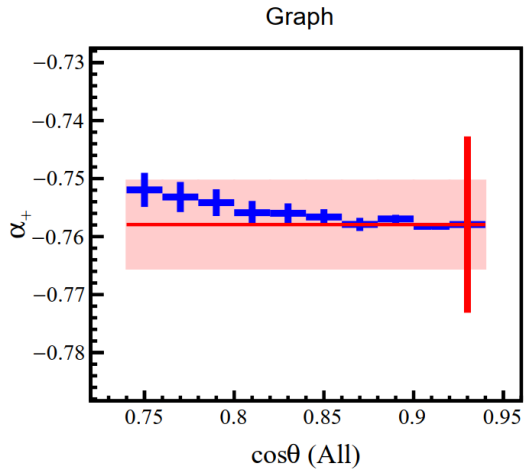
EXT PARAMETER NO.	NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
1	p0	4.34747e-01	8.15079e-03	2.41142e-05	-3.33203e-02
2	p1	9.97326e+04	1.80550e+02	5.34124e-01	1.21923e-06

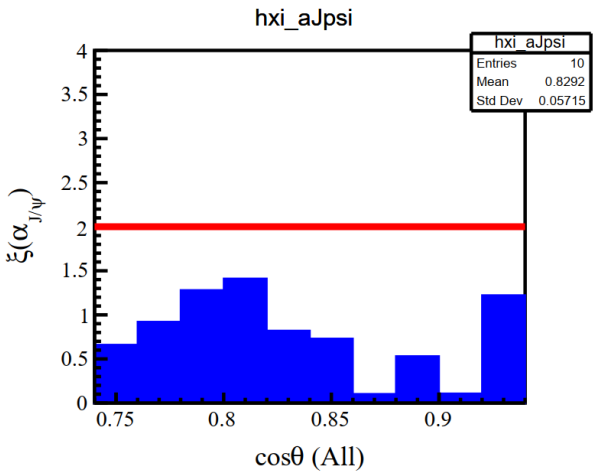
Check code by MC

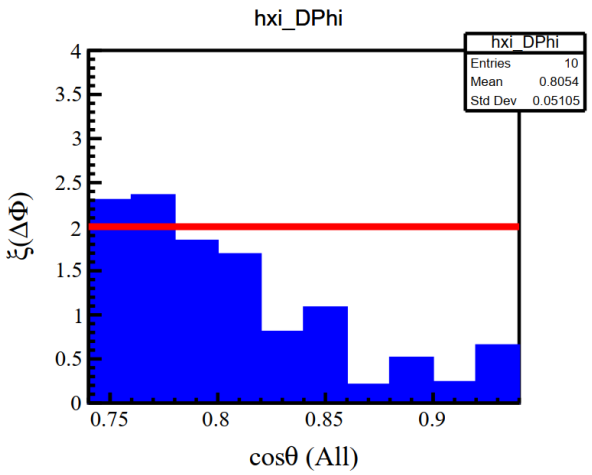


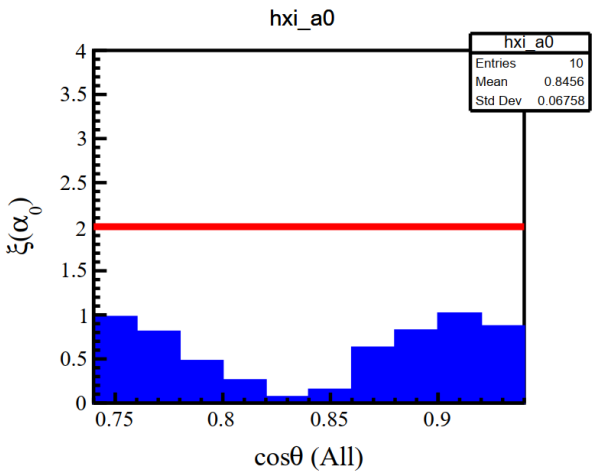


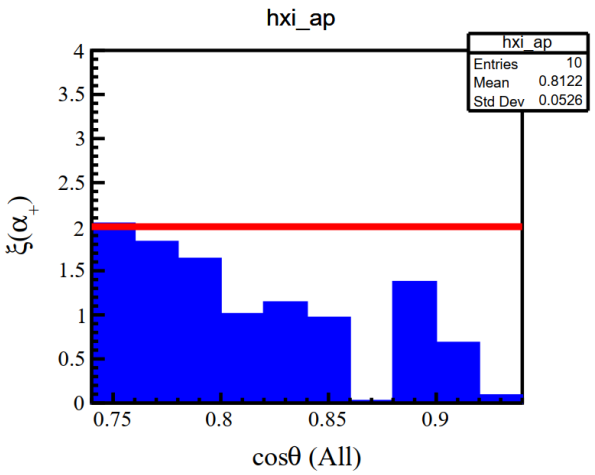




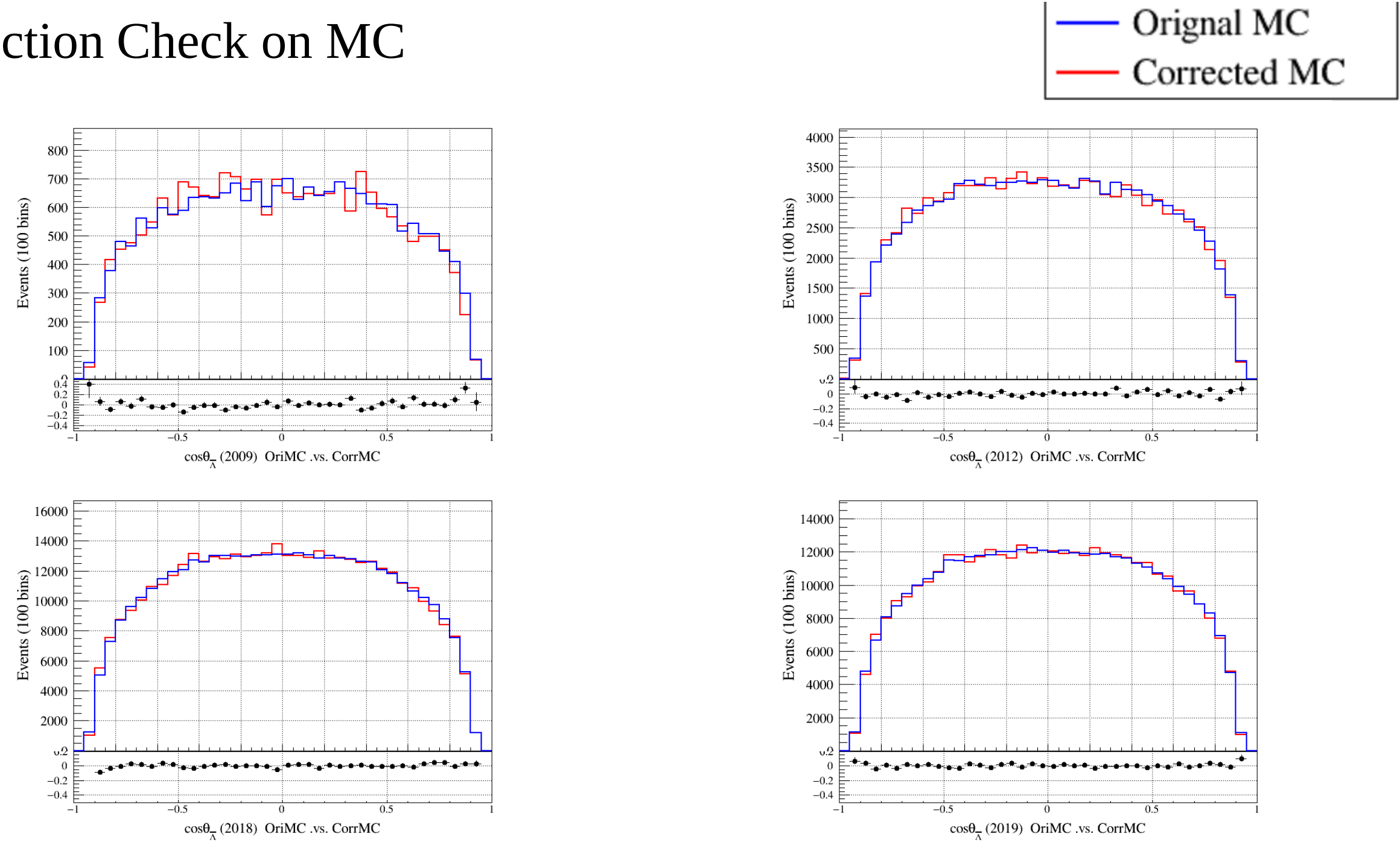




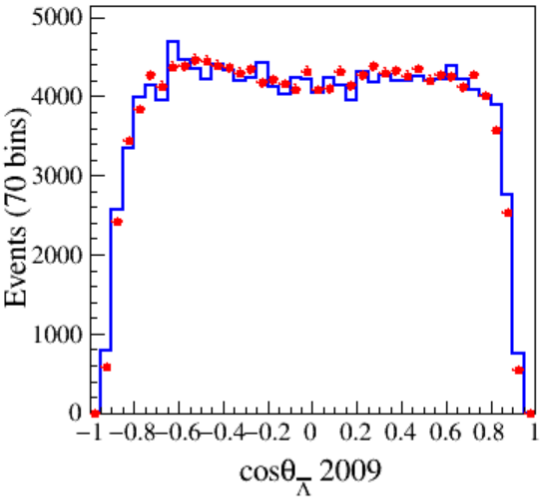


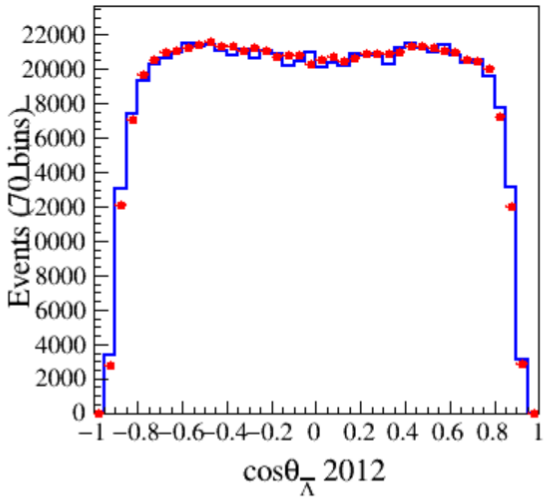


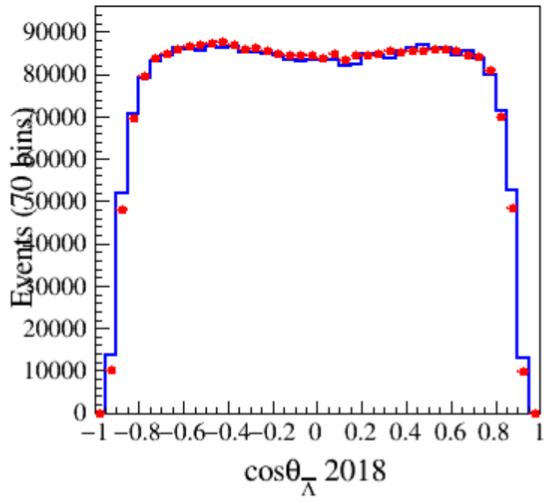
Correction Check on MC

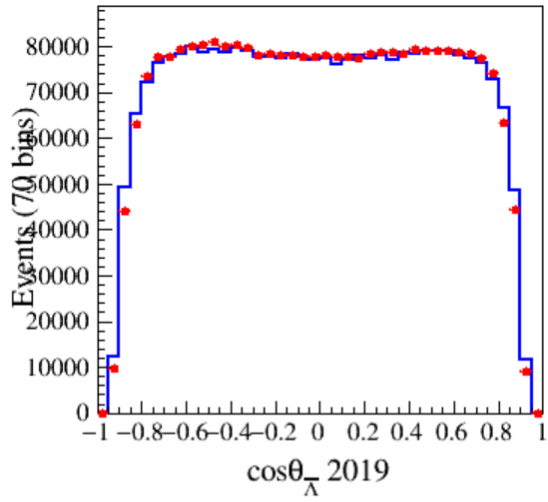


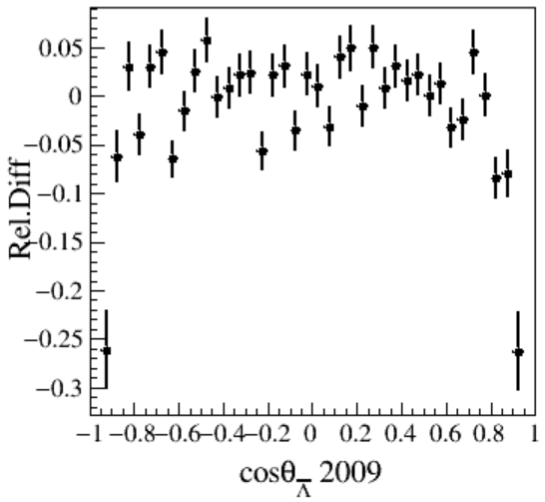
ST of $J/\psi \to \bar{\Lambda}(\to \bar{p}\pi^+)\Lambda(\to \text{anything})$

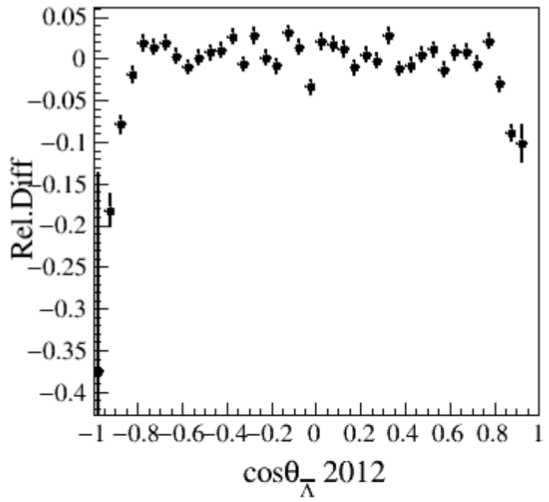


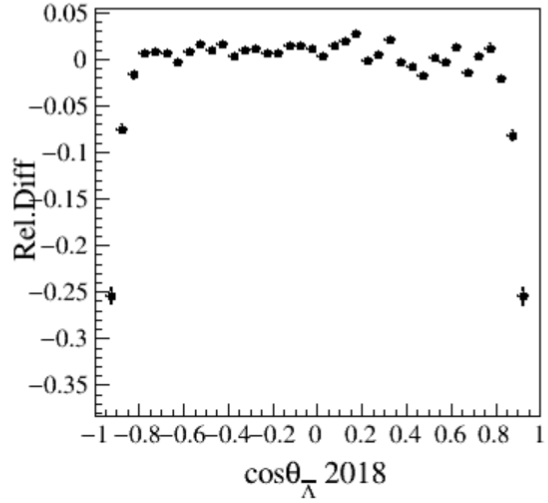


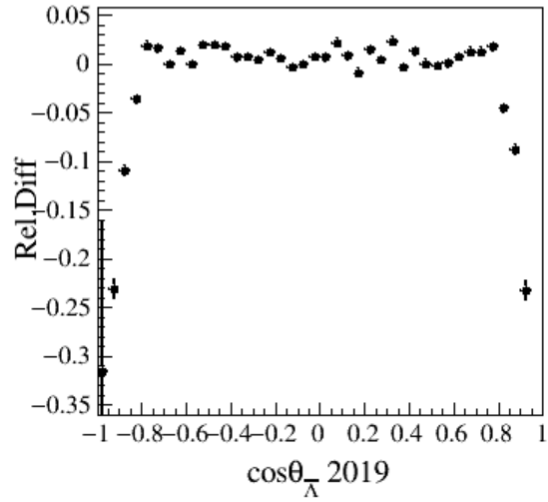




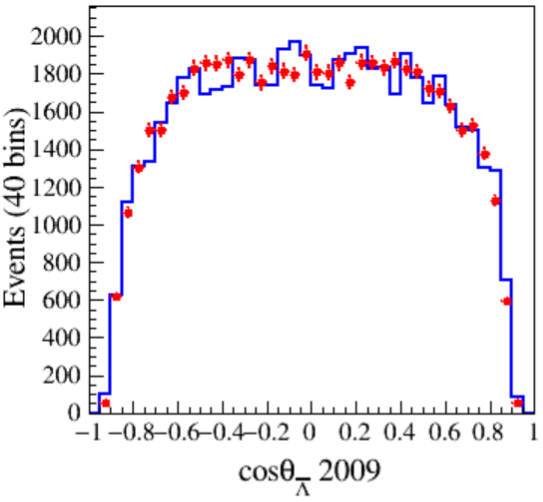


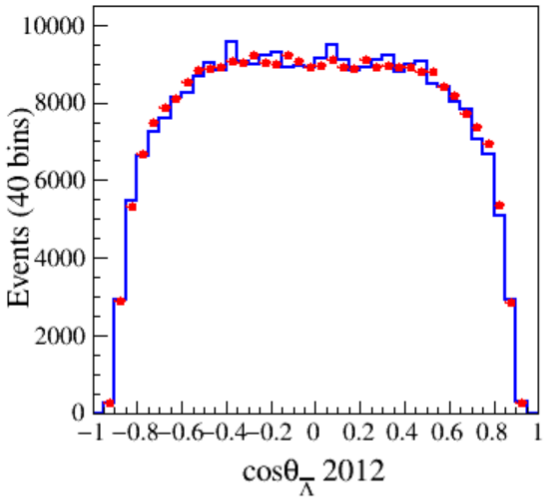


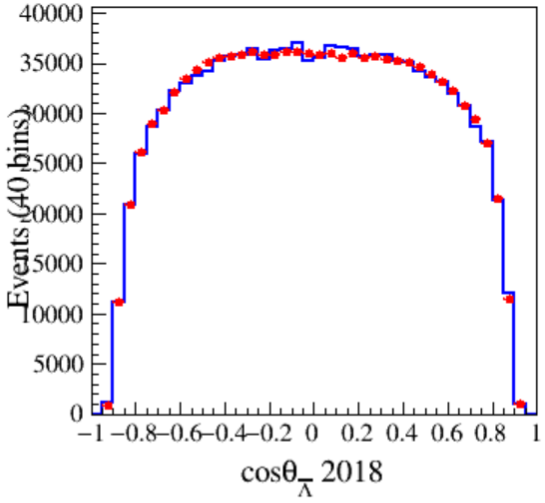


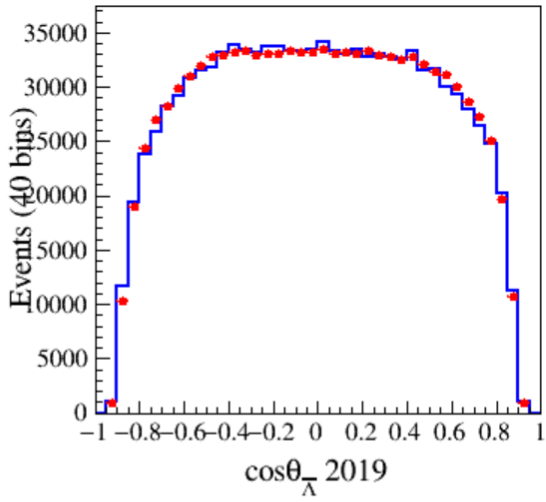


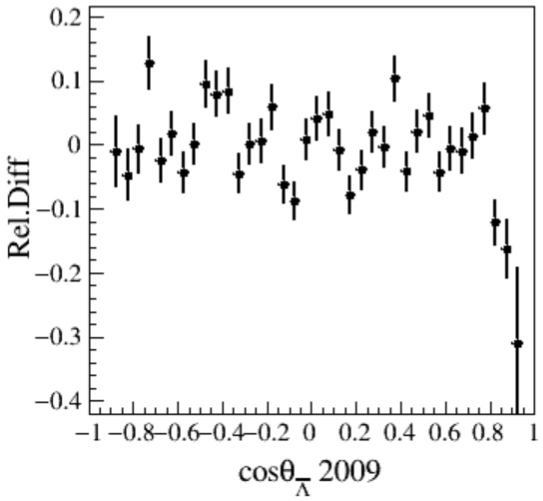
DT of $J/\psi \to \bar{\Lambda}(\to \bar{p}\pi^+)\,\Lambda(\to p\pi^-)$

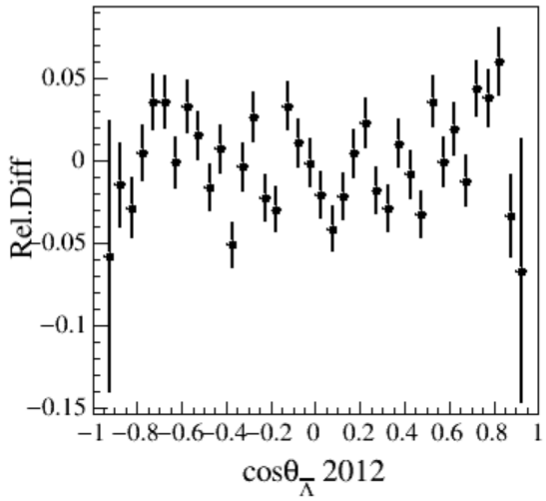


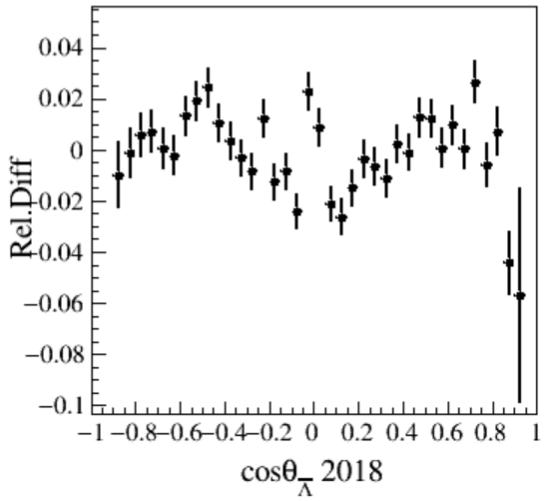


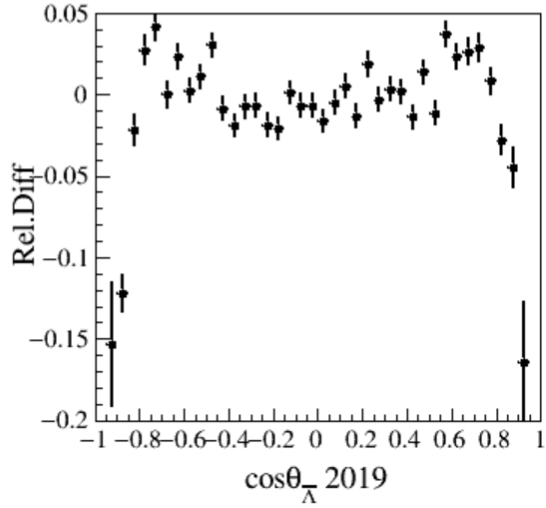




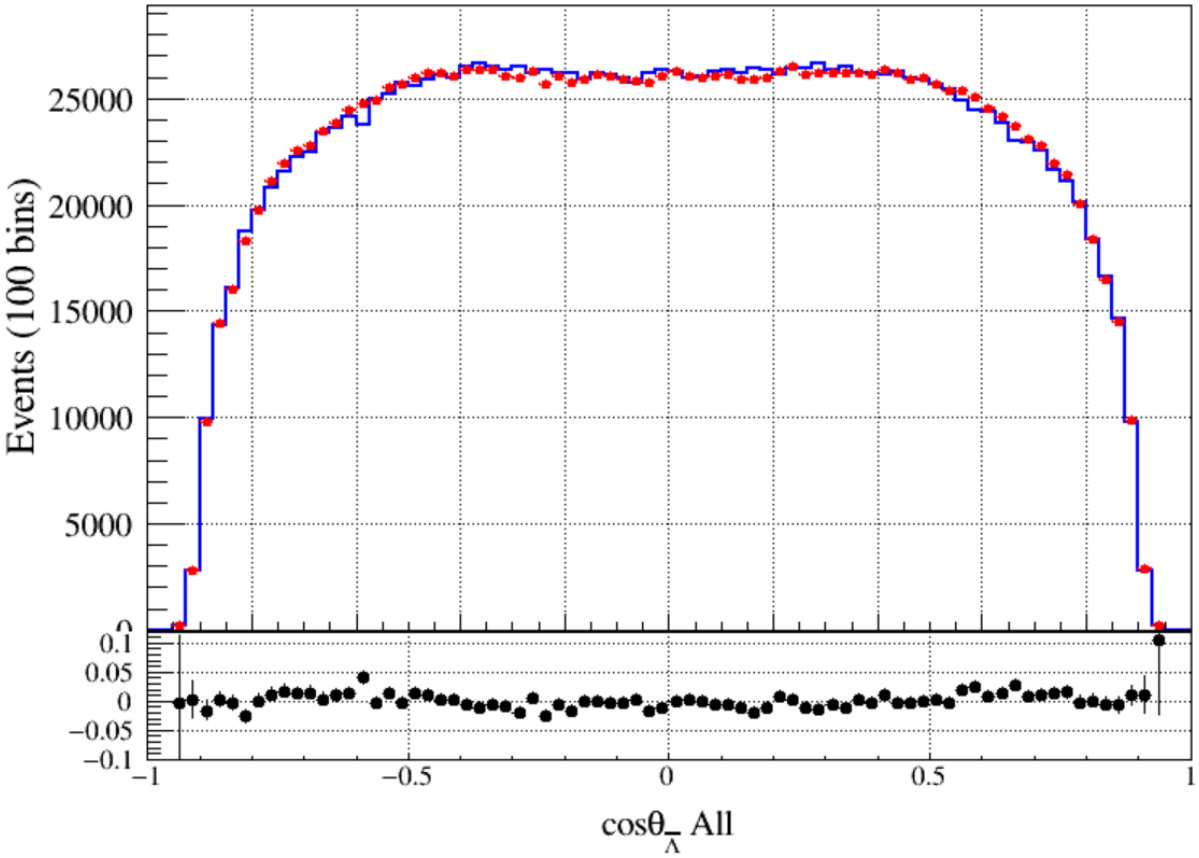


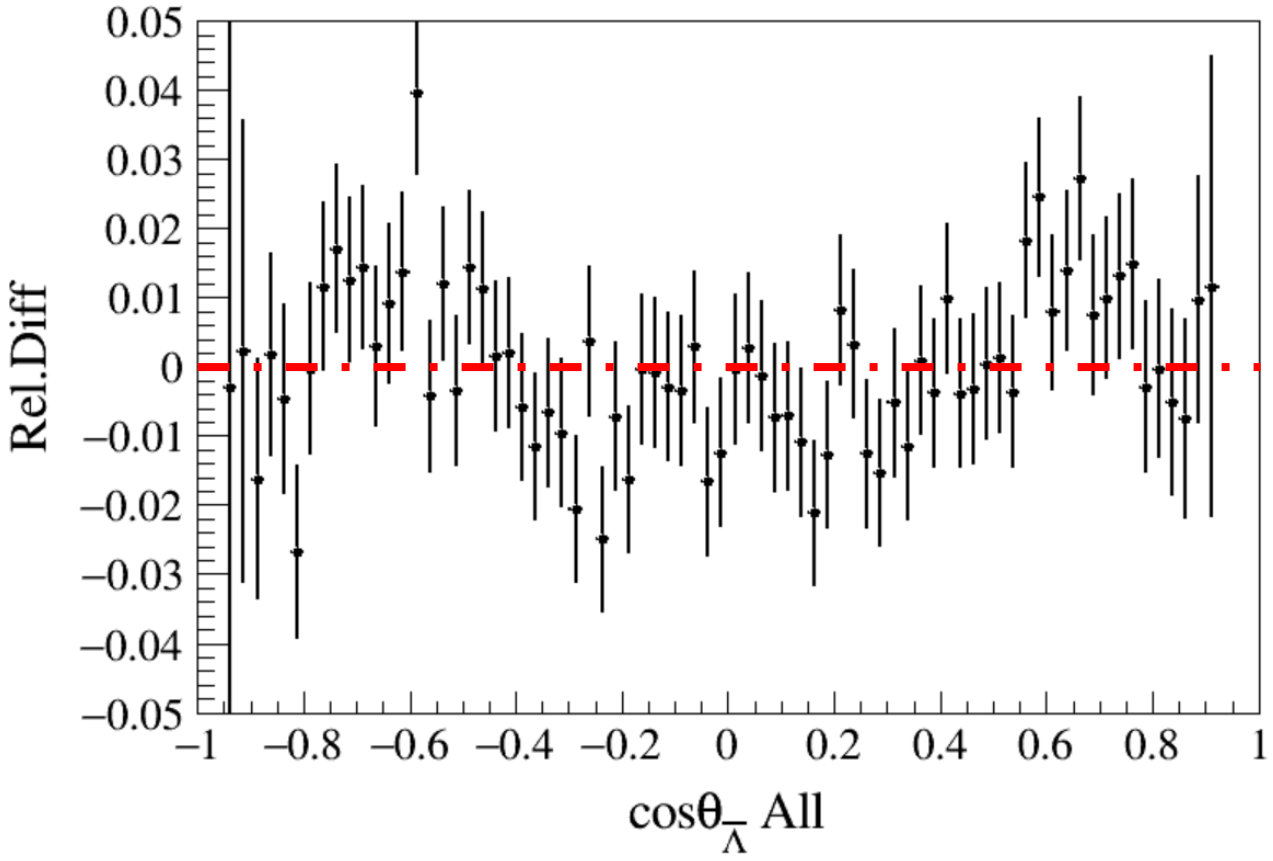






Repeat Jian Yu's code

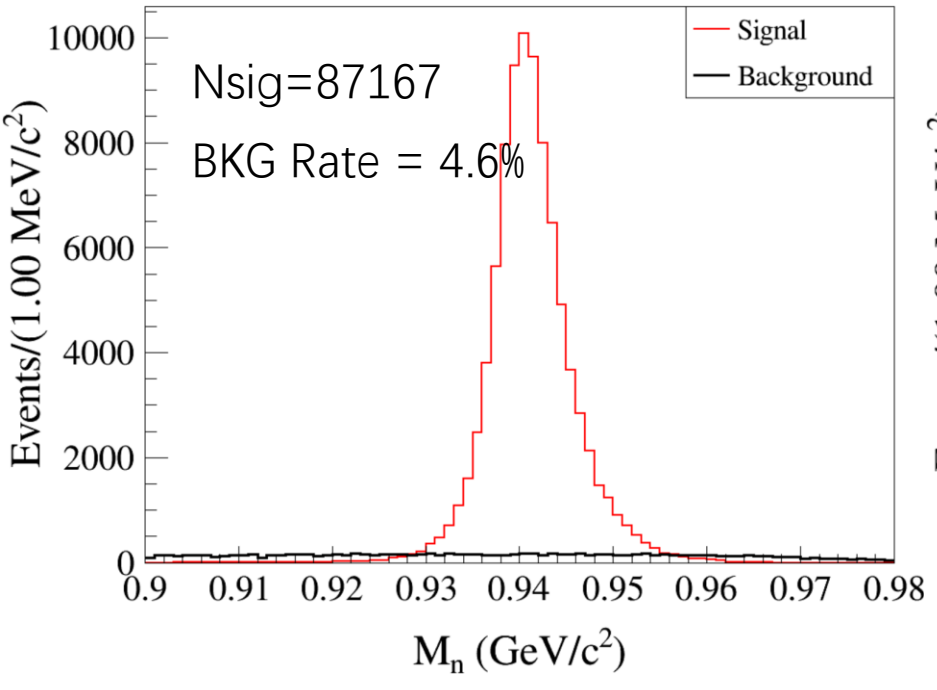


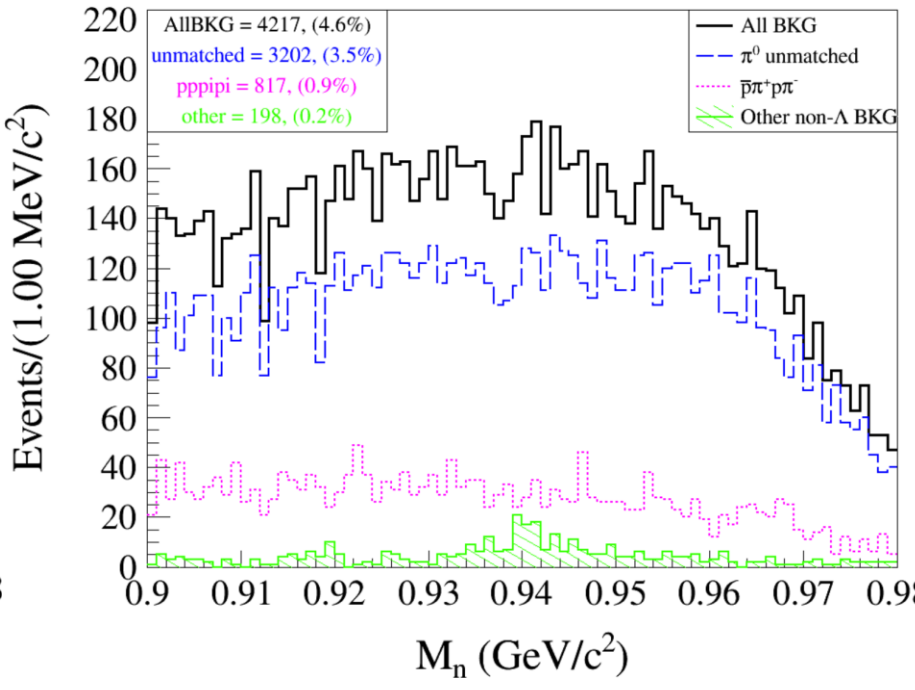


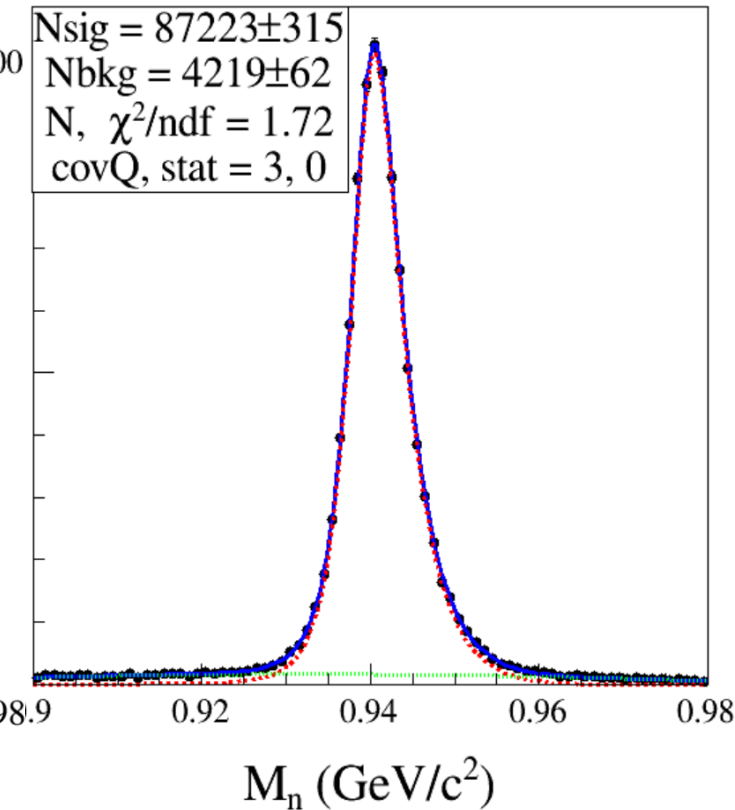
nGood >= 2

decay tree	decay final state	iDcyTr	nEtr	nCEtr
$J/\psi \to \Lambda\bar{\Lambda}, \Lambda \to \pi^0 n, \bar{\Lambda} \to \pi^+\bar{p}$	$\pi^0\pi^+ n\bar{p}$	0	96722	96722
$J/\psi \to \Lambda\bar{\Lambda}, \Lambda \to \pi^- p, \bar{\Lambda} \to \pi^+\bar{p}$	$\pi^+\pi^- p\bar{p}$	1	2153	98875
$J/\psi \to \Lambda\bar{\Lambda}, \Lambda \to \pi^0 n, \bar{\Lambda} \to \pi^+\bar{p}, \pi^0 \to e^+e^-\gamma^F$	$e^+e^-\pi^+ n\bar{p}\gamma^F$	5	70	98945
$J/\psi \to \Lambda\bar{\Lambda}\gamma, \Lambda \to \pi^0 n, \bar{\Lambda} \to \pi^+\bar{p}$	$\pi^0\pi^+ n\bar{p}\gamma$	6	60	99005
$J/\psi \to \Lambda\bar{\Sigma}^0, \Lambda \to \pi^0 n, \bar{\Sigma}^0 \to \bar{\Lambda}\gamma, \bar{\Lambda} \to \pi^+\bar{p}$	$\pi^0\pi^+ n\bar{p}\gamma$	12	46	99051
$J/\psi \to \eta_c\gamma, \eta_c \to \Lambda\bar{\Lambda}, \Lambda \to \pi^0 n, \bar{\Lambda} \to \pi^+\bar{p}$	$\pi^0\pi^+ n\bar{p}\gamma$	14	41	99092
$J/\psi \to \Sigma^0\bar{\Sigma}^0, \Sigma^0 \to \Lambda\gamma, \bar{\Sigma}^0 \to \bar{\Lambda}\gamma, \Lambda \to \pi^0 n, \bar{\Lambda} \to \pi^+\bar{p}$	$\pi^0\pi^+ n\bar{p}\gamma\gamma$	9	29	99121
$J/\psi \to \Lambda\bar{\Lambda}, \Lambda \to \pi^0 n, \bar{\Lambda} \to \pi^+\bar{p}\gamma^f$	$\pi^0\pi^+ n\bar{p}\gamma^f$	4	28	99149
$J/\psi \to \Lambda\bar{\Lambda}, \Lambda \to n\gamma, \bar{\Lambda} \to \pi^+\bar{p}$	$\pi^+ n\bar{p}\gamma$	7	26	99175
$J/\psi \to \bar{\Lambda}\Sigma^0, \bar{\Lambda} \to \pi^+\bar{p}, \Sigma^0 \to \Lambda\gamma, \Lambda \to \pi^0 n$	$\pi^0\pi^+ n\bar{p}\gamma$	24	12	99187
$J/\psi \to \Lambda\bar{\Lambda}, \Lambda \to \pi^0 n, \bar{\Lambda} \to \pi^+\bar{p}, \pi^0 \to e^+e^-\gamma^F\gamma^f$	$e^+e^-\pi^+ n\bar{p}\gamma^F\gamma^f$	16	8	99195

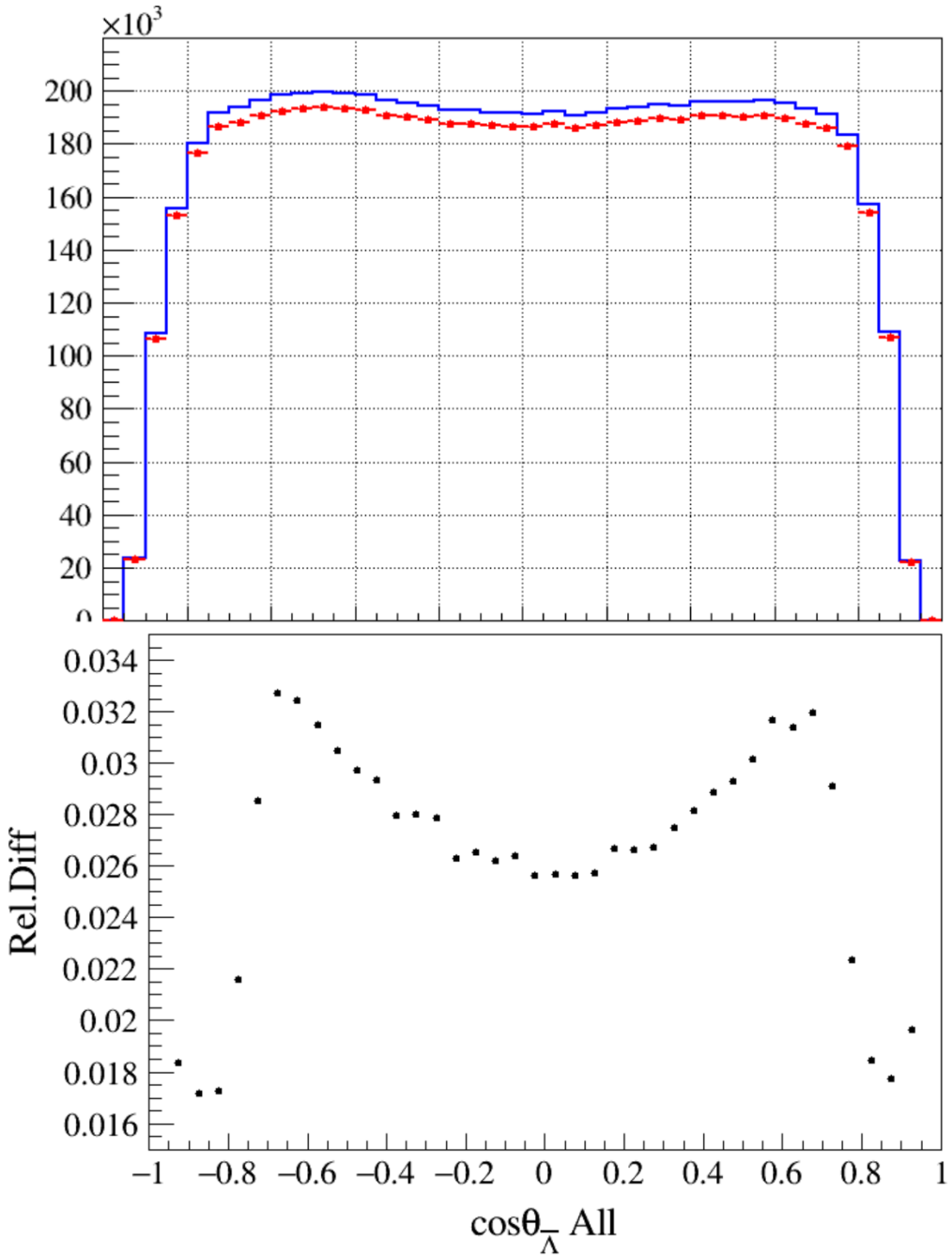
	Nsig	Nbkg
Input	87167	4217
Output	87223 ± 315	4219 ± 62







$J/\psi \to \bar{\Lambda}(\to \bar{p}\pi^+)\Lambda(\to \text{anything})$



Red: nGood == 2

Blue: nGood >= 2