

Progress Summary

Spin-Parity Constraint for $\Xi_c(2970)^+$

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Outline

- **Spin :**
 - **Helicity angle distribution for $\Xi_c(2970)^+ \rightarrow \Xi_c(2645)^0 \pi^+ / \Xi_c' \pi^+$ decays.**
 - **Angular correlation for $\Xi_c(2970)^+ \rightarrow \Xi_c(2645)^0 \pi_1^+ / \Xi_c' \pi^+ \rightarrow \Xi_c^+ \pi_2^- \pi_1^+ / \Xi_c^0 \gamma \pi^+$ decays.**
- **Parity :**
 - **Ratio of partial decay width between $\Xi_c(2970)^+ \rightarrow \Xi_c(2645)^0 \pi^+ / \Xi_c' \pi^+$ decays.**
- **For each item above, the followings are presented.**
 - **MC studies needed for the above.**
 - **Progress for each studies.**

Spin

- Observable :

- Helicity angle(θ_h) distribution in the decays

- $\Xi_c(2970)^+ \rightarrow \Xi_c(2645)^0 \pi_1^+ / \Xi_c(2970)^+ \rightarrow \Xi_c' \pi_1^+$

- Angular correlation(θ_c) in the decay in the decays

- $\Xi_c(2970)^+ \rightarrow \Xi_c(2645)^0 \pi_1^+ \rightarrow \Xi_c^+ \pi_2^- \pi_1^+ / \Xi_c(2970)^+ \rightarrow \Xi_c' \pi^+ \rightarrow \Xi_c^0 \gamma \pi^+$

- MC Studies needed :

- Efficiency study for each $\cos\theta_h, \cos\theta_c$ bin.

- $\Xi_c(2970)^+ \rightarrow \Xi_c(2645)^0 \pi^+ / \Xi_c(2970)^+ \rightarrow \Xi_c' \pi^+$

- Fitting parameters study for each $\cos\theta_h, \cos\theta_c$ bin.

- $\Xi_c(2970)^+ \rightarrow \Xi_c(2645)^0 \pi^+ / \Xi_c(2970)^+ \rightarrow \Xi_c' \pi^+$

θ_h : angle bet. **boost direction of $\Xi_c(2970)$ in CM frame**
and **boost direction of π_1 in $\Xi_c(2970)$'s rest frame.**
 θ_c : angle bet. **boost direction of $\Xi_c(2645)/\Xi_c'$ in $\Xi_c(2970)$'s rest frame**
and **boost direction of π_2/γ in $\Xi_c(2645)/\Xi_c'$'s rest frame.**

Parity

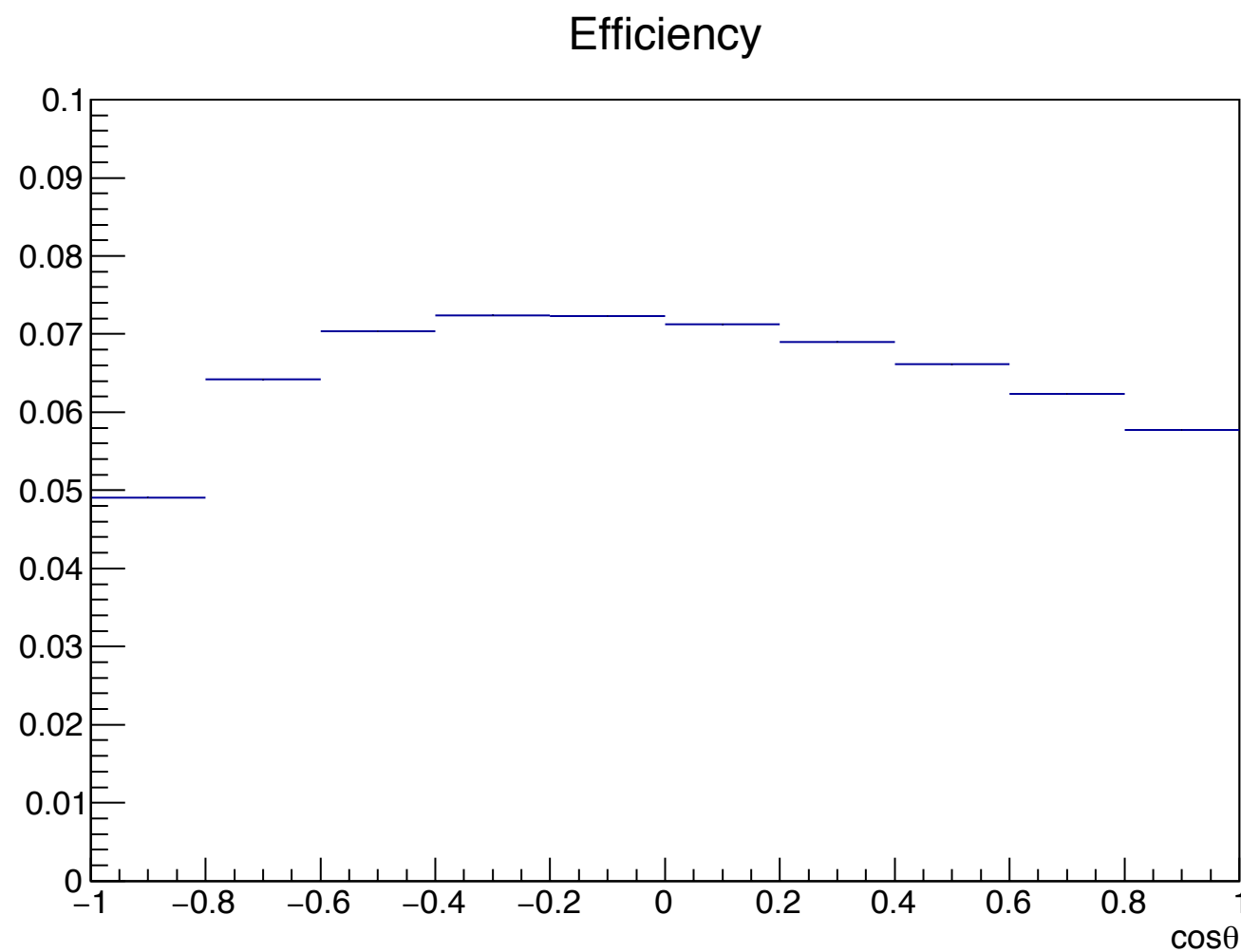
- **Observable :**
 - **Partial decay width for the following decays**
 - $\Xi_c(2970)^+ \rightarrow \Xi_c(2645)^0 \pi^+ / \Xi_c(2970)^+ \rightarrow \Xi_c' \pi^+$
- **MC Studies Needed :**
 - **Fitting parameters study for the $\Xi_c(2970)^+$ mass peak (regardless of $\cos\theta_h$)**
 - $\Xi_c(2970)^+ \rightarrow \Xi_c(2645)^0 \pi^+ / \Xi_c(2970)^+ \rightarrow \Xi_c' \pi^+$

MC Study List

- Efficiency study w.r.t. $\cos\theta_h$
 - $\Xi_c(2970)^+ \rightarrow \Xi_c(2645)^0 \pi^+$ (DONE, p. 6) / $\Xi_c(2970)^+ \rightarrow \Xi_c' \pi^+$ (Ongoing)
- Efficiency study w.r.t. $\cos\theta_c$
 - $\Xi_c(2970)^+ \rightarrow \Xi_c(2645)^0 \pi^+$ (Ongoing) / $\Xi_c(2970)^+ \rightarrow \Xi_c' \pi^+$ (Ongoing)
- Mass peak fitting regardless of $\cos\theta_h$
 - $\Xi_c(2970)^+ \rightarrow \Xi_c(2645)^0 \pi^+$ (DONE, p. 7) / $\Xi_c(2970)^+ \rightarrow \Xi_c' \pi^+$ (Ongoing)
- Mass peak fitting for each $\cos\theta_h$
 - $\Xi_c(2970)^+ \rightarrow \Xi_c(2645)^0 \pi^+$ (DONE, p. 8) / $\Xi_c(2970)^+ \rightarrow \Xi_c' \pi^+$ (Ongoing)
- Mass peak fitting for each $\cos\theta_c$
 - $\Xi_c(2970)^+ \rightarrow \Xi_c(2645)^0 \pi^+$ (Ongoing) / $\Xi_c(2970)^+ \rightarrow \Xi_c' \pi^+$ (Ongoing)

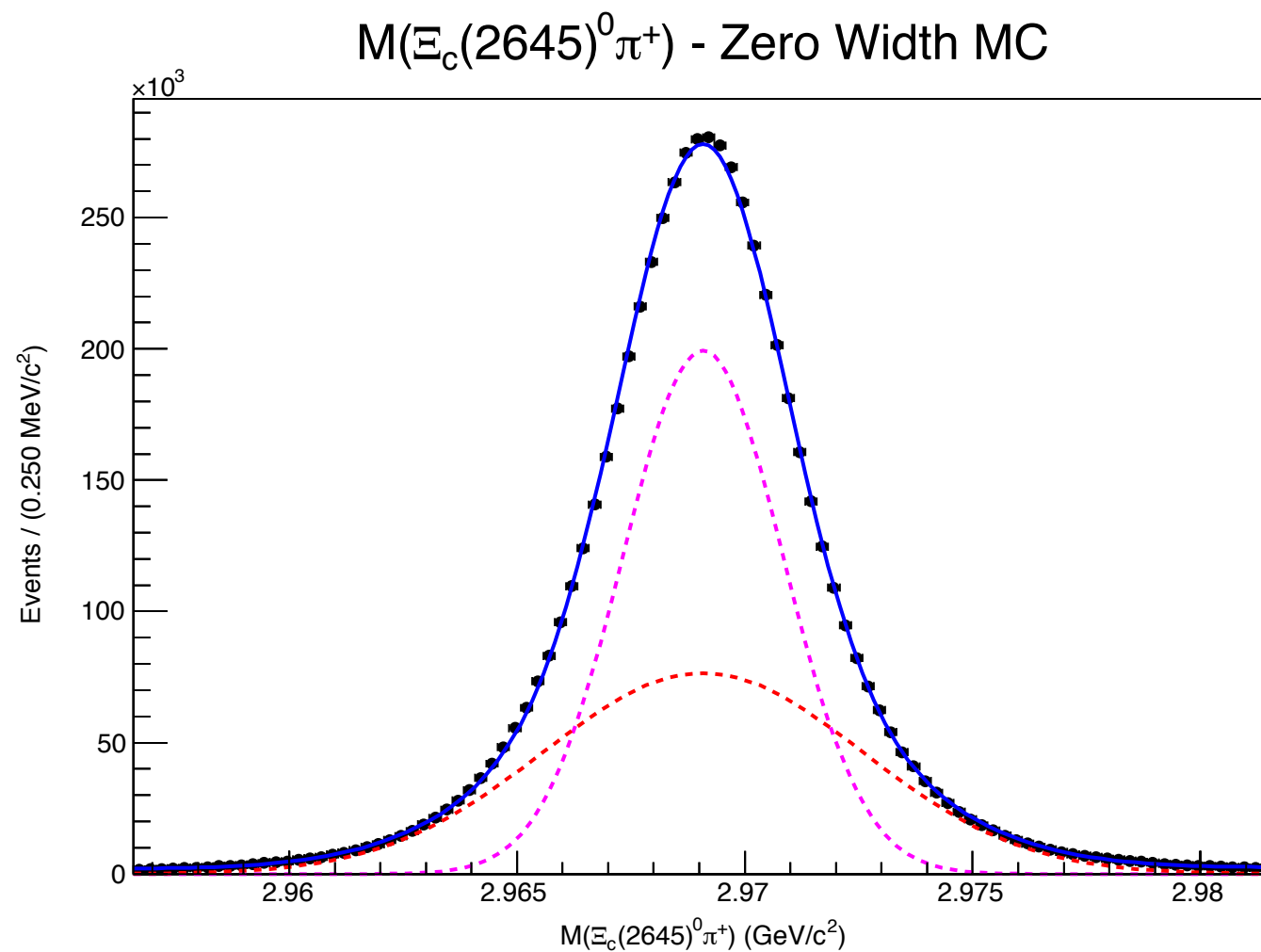
Efficiency for $\cos\theta_h$ bin

$$\Xi_c(2970)^+ \rightarrow \Xi_c(2645)^0 \pi^+$$



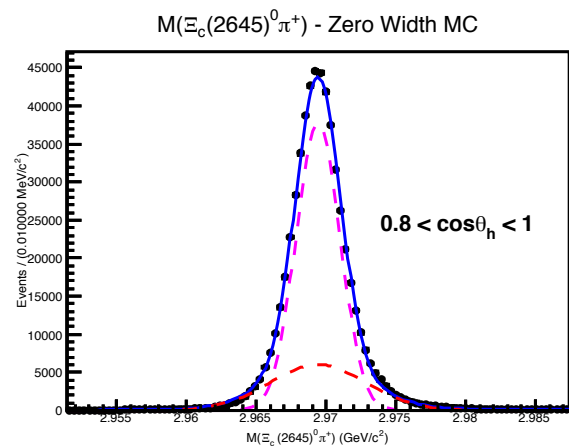
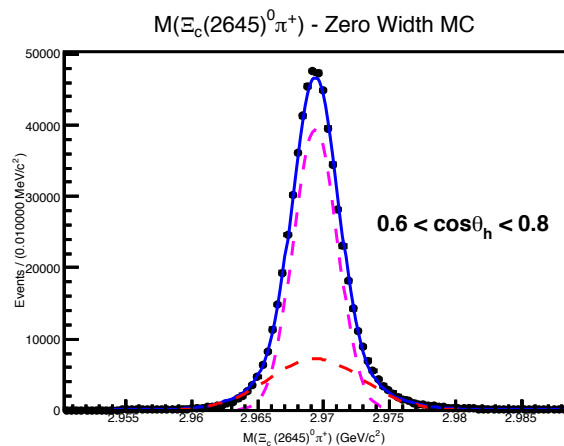
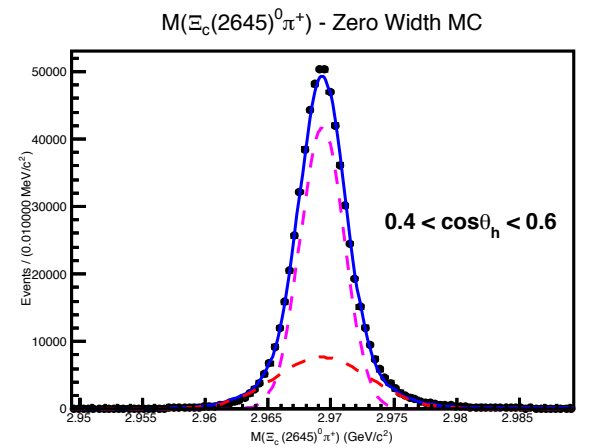
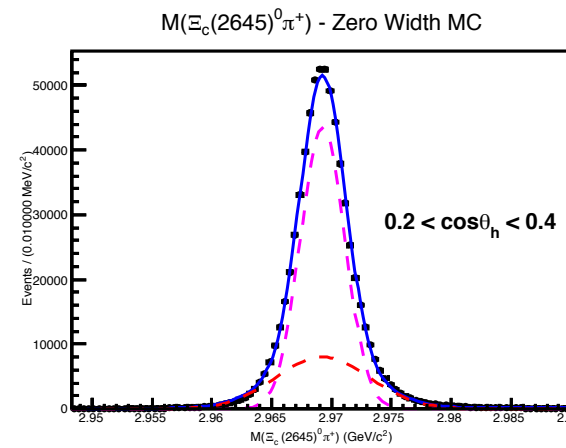
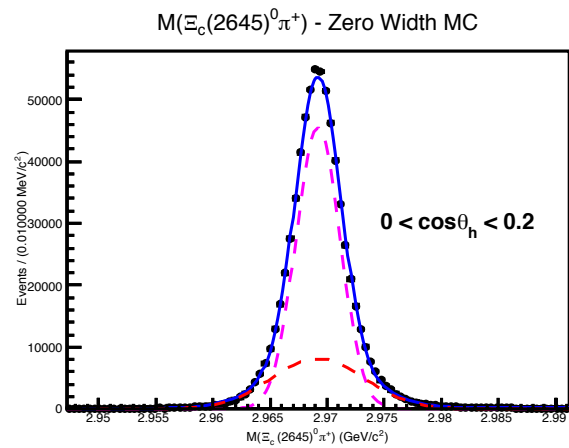
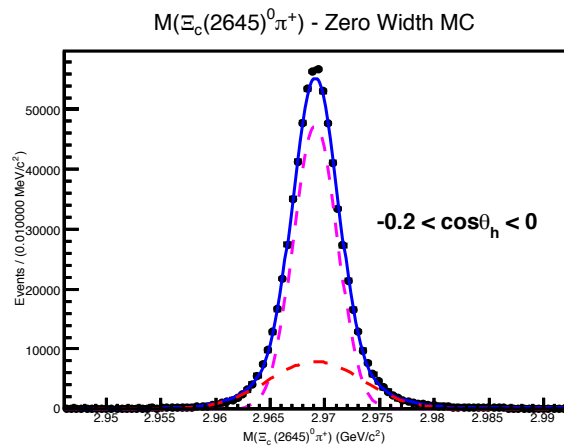
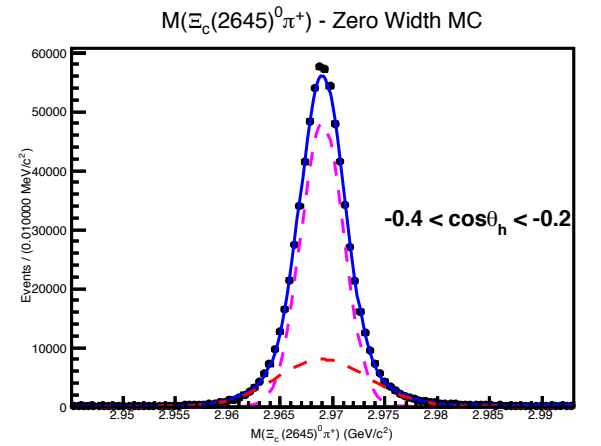
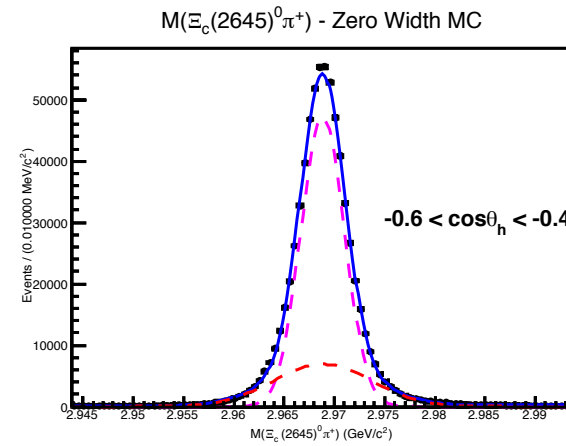
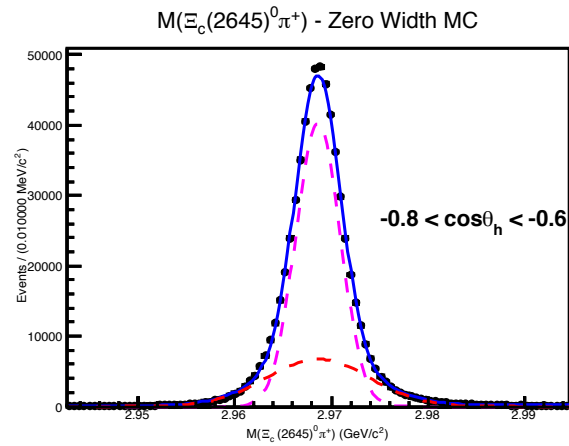
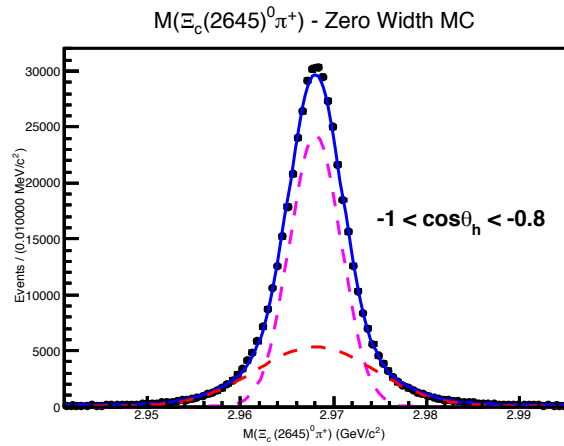
Fitting Parameters

$$\Xi_c(2970)^+ \rightarrow \Xi_c(2645)^0 \pi^+$$



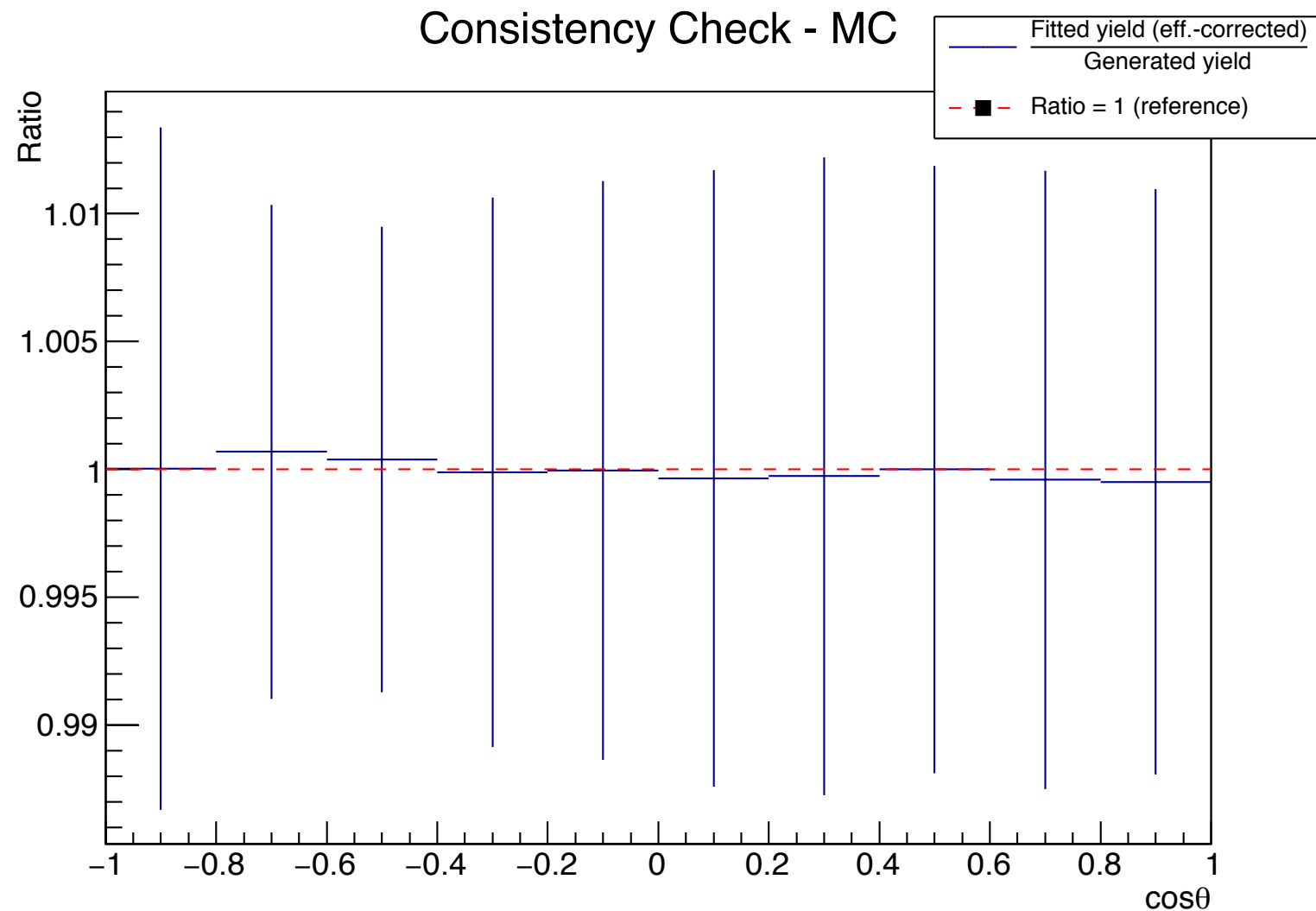
Fitting Parameters

$\Xi_c(2970)^+ \rightarrow \Xi_c(2645)^0 \pi^+ / \cos\theta_h$ bin



Consistency

$$\Xi_c(2970)^+ \rightarrow \Xi_c(2645)^0 \pi^+$$



- **Ratio = Fitted yield (eff.-corrected) / Generated yield ~ 1**
- **Error $\sim 1\%$**

Total 100M events were generated.

Summary

- **Status summary :**
 - MC studies needed for $\Xi_c(2970)^+ \rightarrow \Xi_c(2645)^0 \pi^+$ are almost done.
 - MC sample for $\Xi_c(2970)^+ \rightarrow \Xi_c'^0 \pi^+$ is ready and under code development.
- **Wishful scenario for the future :**
 - Finishing all the MC studies. **+ Belle Note**
 - Reporting at Charm group meeting.
 - Calling for referee committee.
 - Opening the box.