# Study of $D^0/\overline{D}^0 \to \pi^+\pi^-\pi^0$

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#### Introduction

≻ I'm trying to select the process  $D^0/\overline{D}^0 \to \pi^+\pi^-\pi^0$  to check the performance of

PID and vertex fit.

- > The MC samples are updated to the new version, which are from  $e^+e^- \rightarrow Z \rightarrow b\overline{b}$ at  $\sqrt{s} = 91.2$  GeV,
  - /cefs/higgs/zhangkl/Production/25036/E91.2\_eebb/Reco/rec\_E91.2\_eebb\_\*.root
- > The version of CEPCSW is tdr.25.3.6, and I tried to get the truth distributions of photons from  $\pi^0$ .

#### Preliminary results

> The truth distributions of  $E_{\gamma}$  and  $\angle_{\gamma\gamma}$  from  $\pi^0$  in the process  $D^0/\overline{D}^0 \to \pi^+\pi^-\pi^0$ .



>I only required the energy of leading photon  $E_{\gamma 1} > 0.5$  GeV to suppress the possible backgrounds.

➤I also required that the open angle between 2 photons is less than 20 degree.

## Preliminary results

≻Cut 0: pid ok, opposite charge, vtx ok

≻Cut 1: pid ok, opposite charge, vtx ok, kine > 0,  $\chi^2_{vtx}$  < 4  $E_{\gamma 1}$  > 0.5 GeV,  $\angle_{\gamma \gamma}$  < 20°.

≻Cut 2: pid ok, opposite charge, vtx ok, kine > 0,  $\chi^2_{vtx}$  < 4  $E_{\gamma 1}$  > 1.0 GeV,  $\angle_{\gamma \gamma}$  < 10°.



All combinations of di-photon

> The selection criteria can suppress the di-photon background, which make the signal of  $\pi^0$  much significant.

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All combinations of  $\pi^+\pi^-\gamma\gamma$ 

≻ There is still no signal of  $D \rightarrow \pi^+ \pi^- \pi^0$  for both selection criteria.

## Position information of $\pi^0$

>We may use the position information to improve the selection criteria.

- ➤Currently, the 4 momentum of photon is reconstructed by the deposited energy and position of shower.
  - The direction of photon is the line connecting the IP and the position of shower.
- So the di-photon vertex is always at IP, which cannot help us to suppress backgrounds at current scenario.

#### Momentum distribution of $D^0$ candidates

> The momentum distribution of  $D^0$  candidates is shown as below.

≻We also plot the distributions of  $M_{\pi^+\pi^-\pi^0}$  for different momentum regions.



#### Truth $\pi^+\pi^-$ from $D^0$

≻In 25000  $Z \rightarrow b\overline{b}$  events, there are 396 truth  $\pi^+\pi^-$  vertex from  $D^0$  and 96089 reconstructed  $\pi^+\pi^-$  vertex.

 $\geq$  We use the truth  $\pi^+\pi^-$  vertex from  $D^0$  and the reconstructed  $\pi^0$ .



# Truth $\pi^0$

≻We use the combination of reco  $\pi^+\pi^-$  vertex(truth matched to D) and the truth  $\pi^0$ , where a clear D is found.



# Truth $\pi^0$

 $\succ$  We use the combination of reco  $\pi^+\pi^-$  vertex and the truth  $\pi^0$ , where a clear D is

found.



## Summary

> The current selection criteria can suppress the di-photon background a lot, which make the signal of  $\pi^0$  much significant.

 $\geq$  However, the current selection criteria cannot select signal of  $D^0 \rightarrow \pi^+ \pi^- \pi^0$ .

> There is no significant difference between the different momentum regions of  $D^0$  candidates.

≻A better  $\pi^0$  reconstruction algorithm is needed, which should give us the position information of  $\pi^0$ .

≻Besides, a truth link will be helpful for this study.

#### Backup

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Reco  $\pi^+\pi^-$  + truth  $\pi^0$