



tau reconstruction in $e^+ e^- \rightarrow \tau^+ \tau^-$ at 500 GeV

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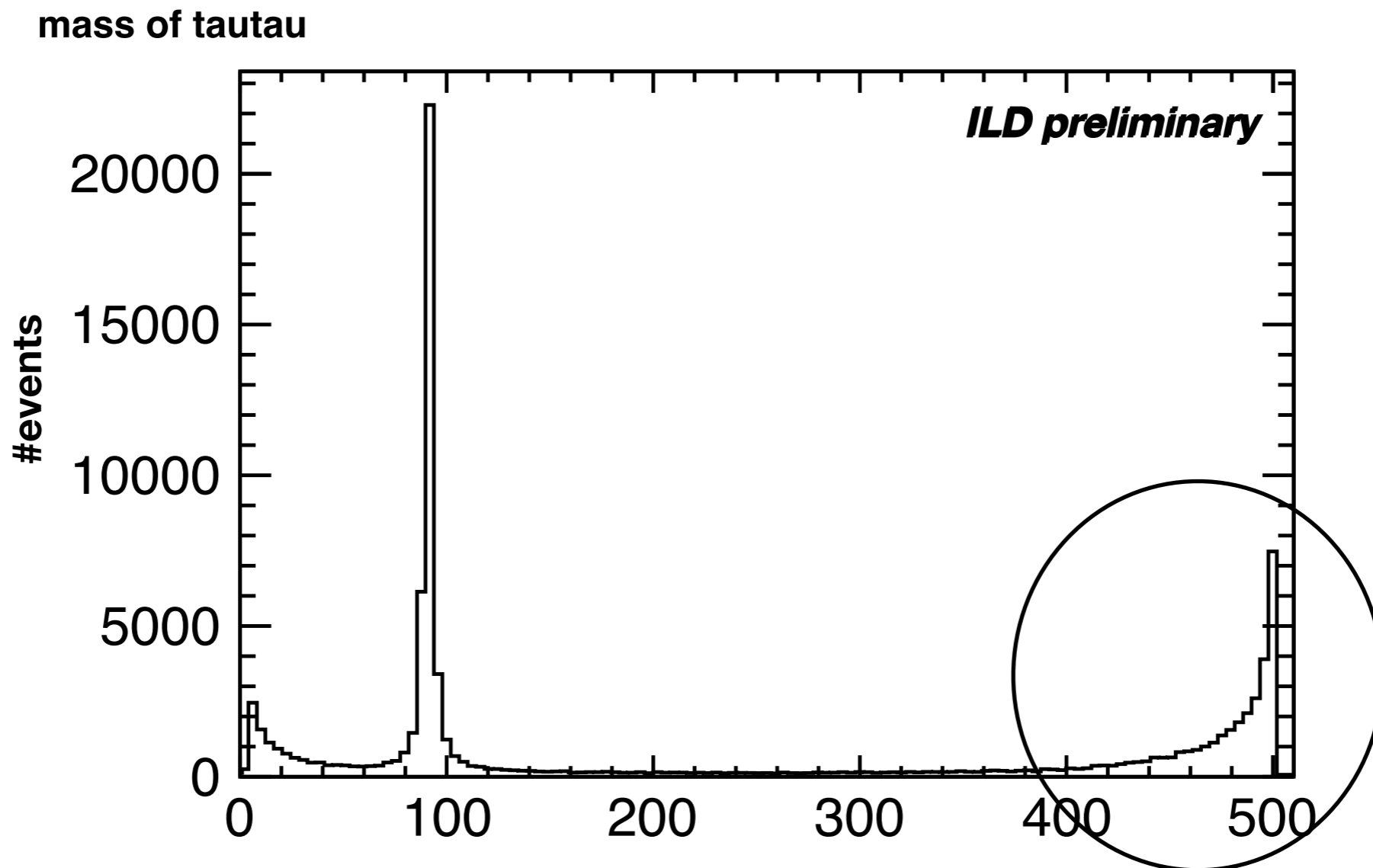
Outline

- Introduction
- method
- Result
- Summary

Introduction

The aim of this study:

find tau jets in $e+e- \rightarrow \tau \tau$

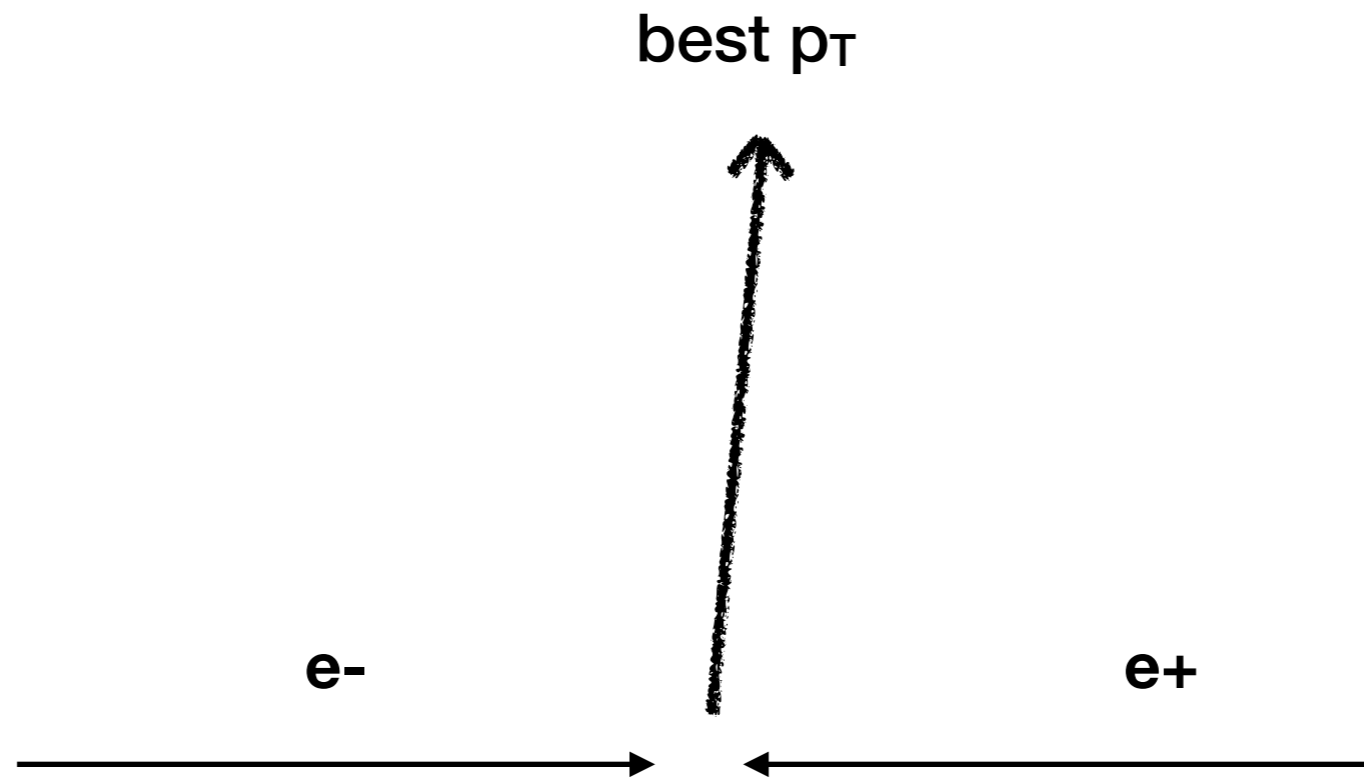


sample: 2f_Z_leptonic

**select tau-tau event with mass greater than 400 GeV
and reject $\mu\mu$ at the beginning of the process
using large and small ILD model**

Method

1: first τ seed(best p_T):
charged PFO with highest p_T

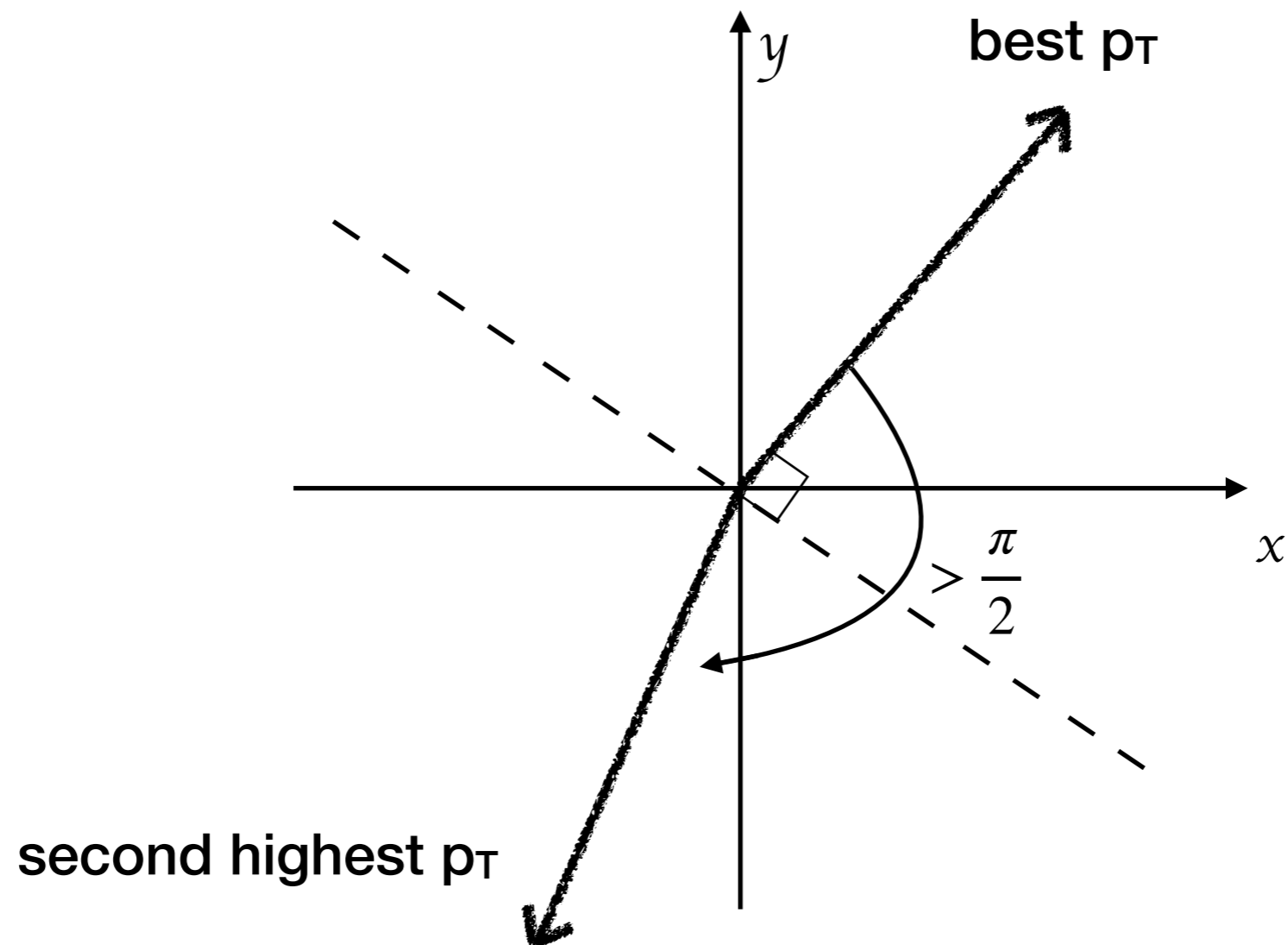


1:find best p_τ

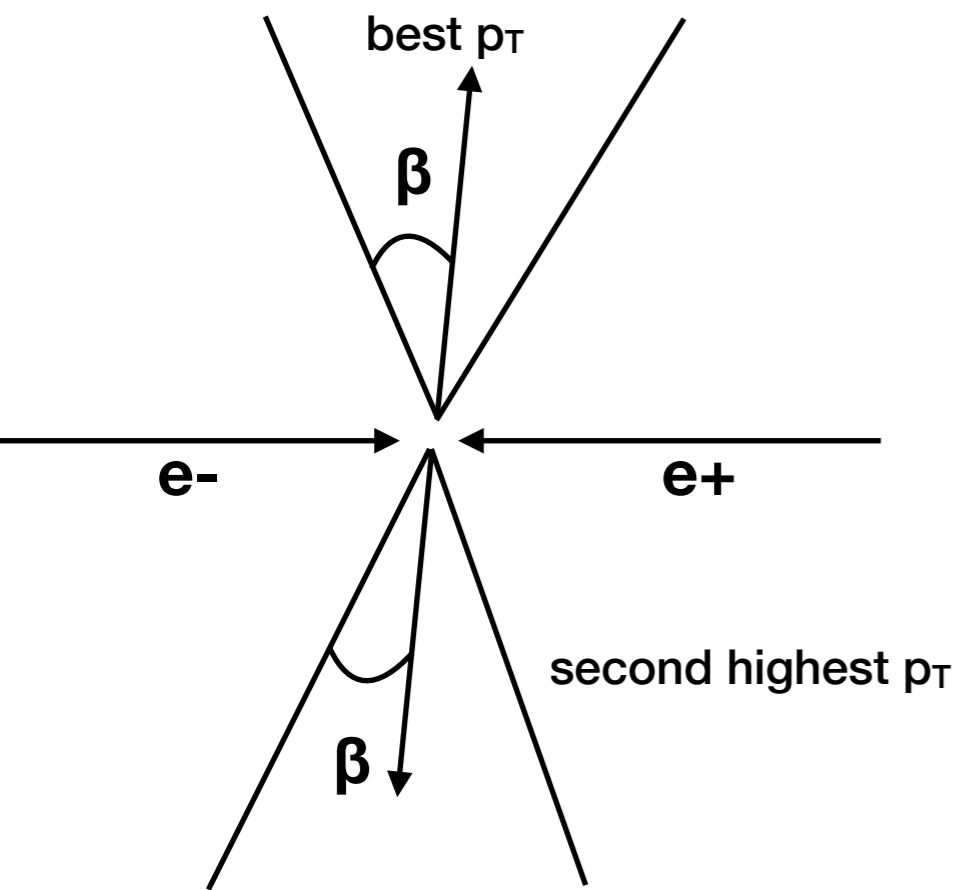
2:find second p_τ

second τ seed :

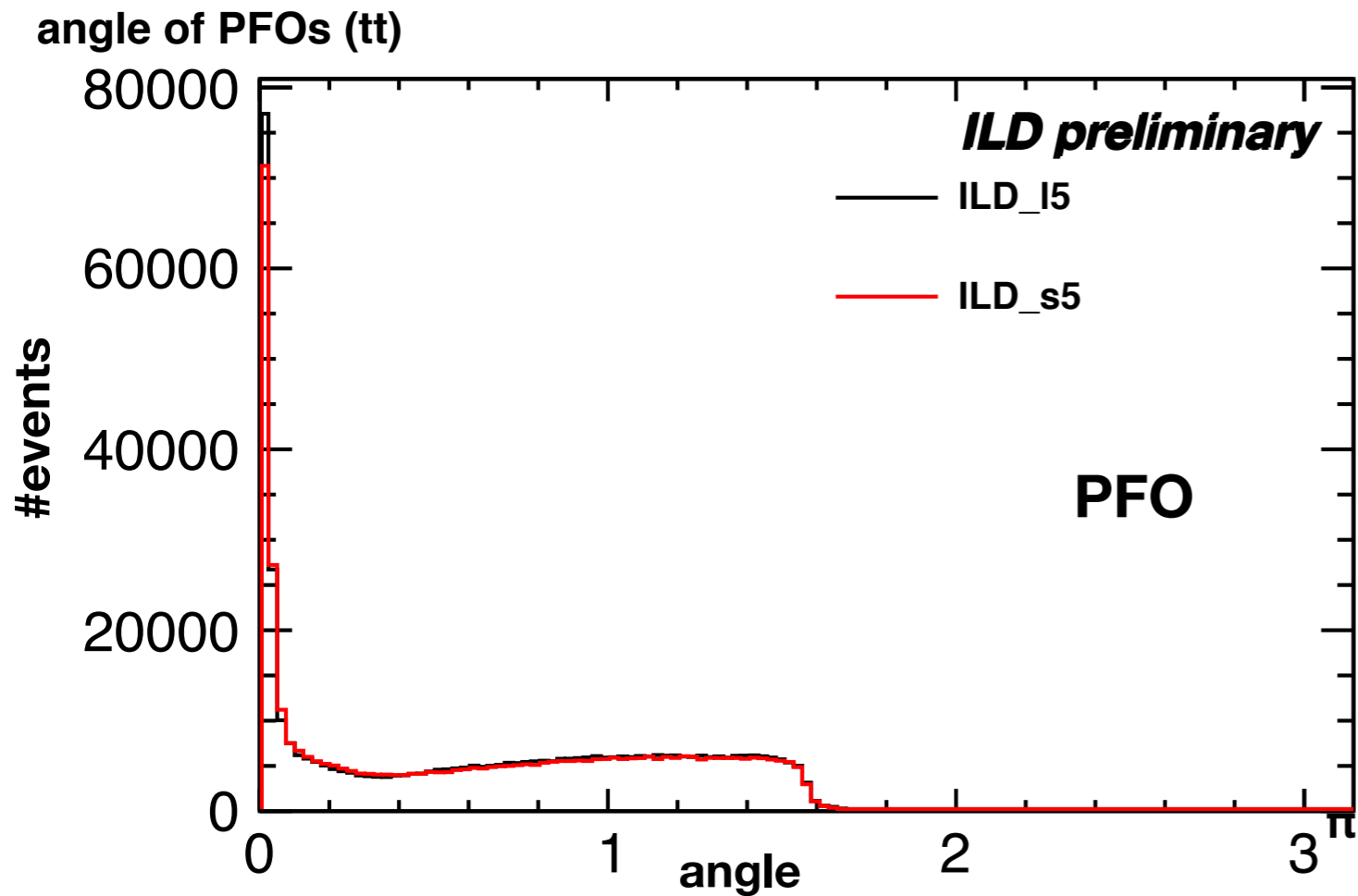
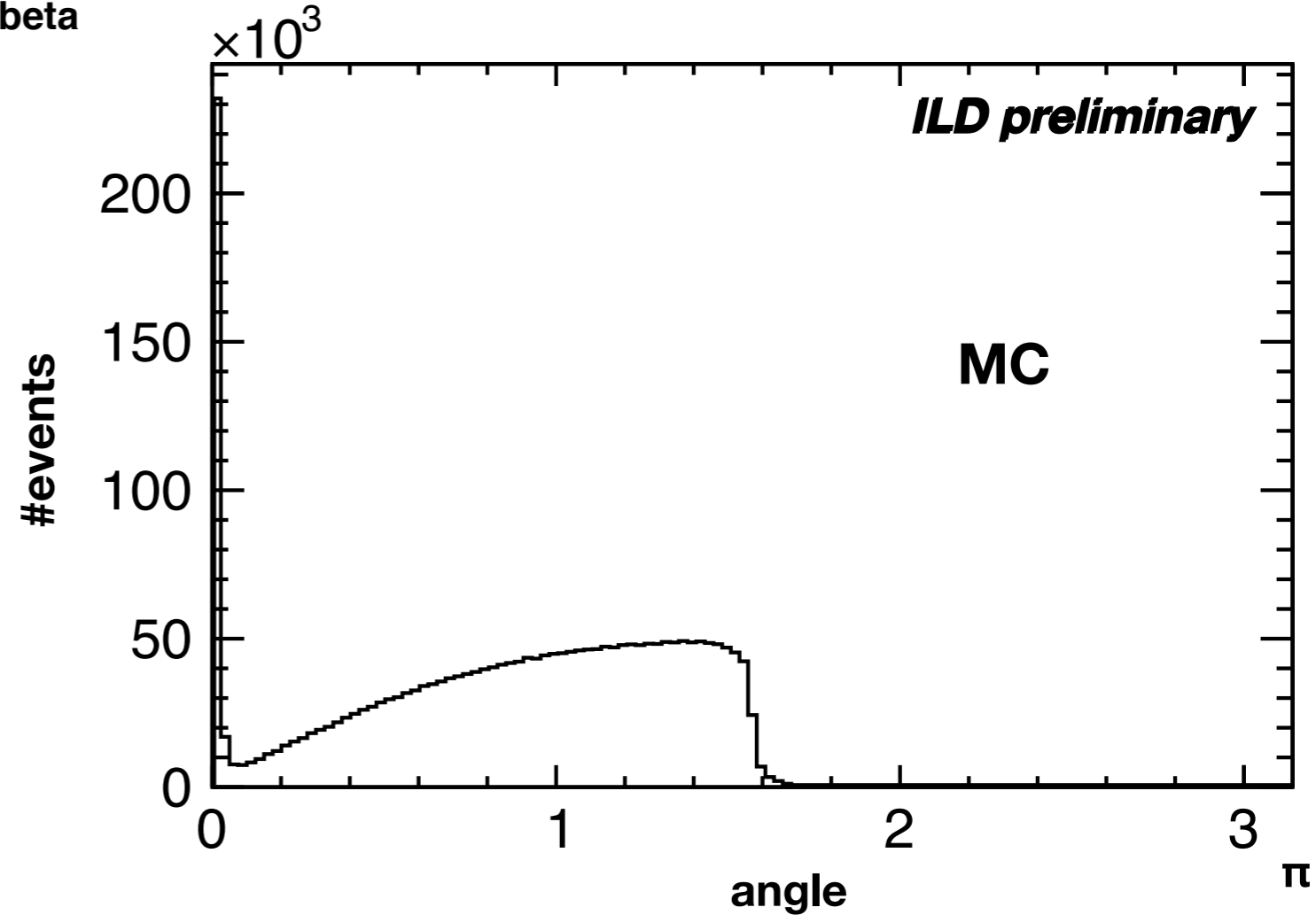
charged PFO with second largest p_τ and $\delta\phi > \pi / 2$



angle to first/second τ seed



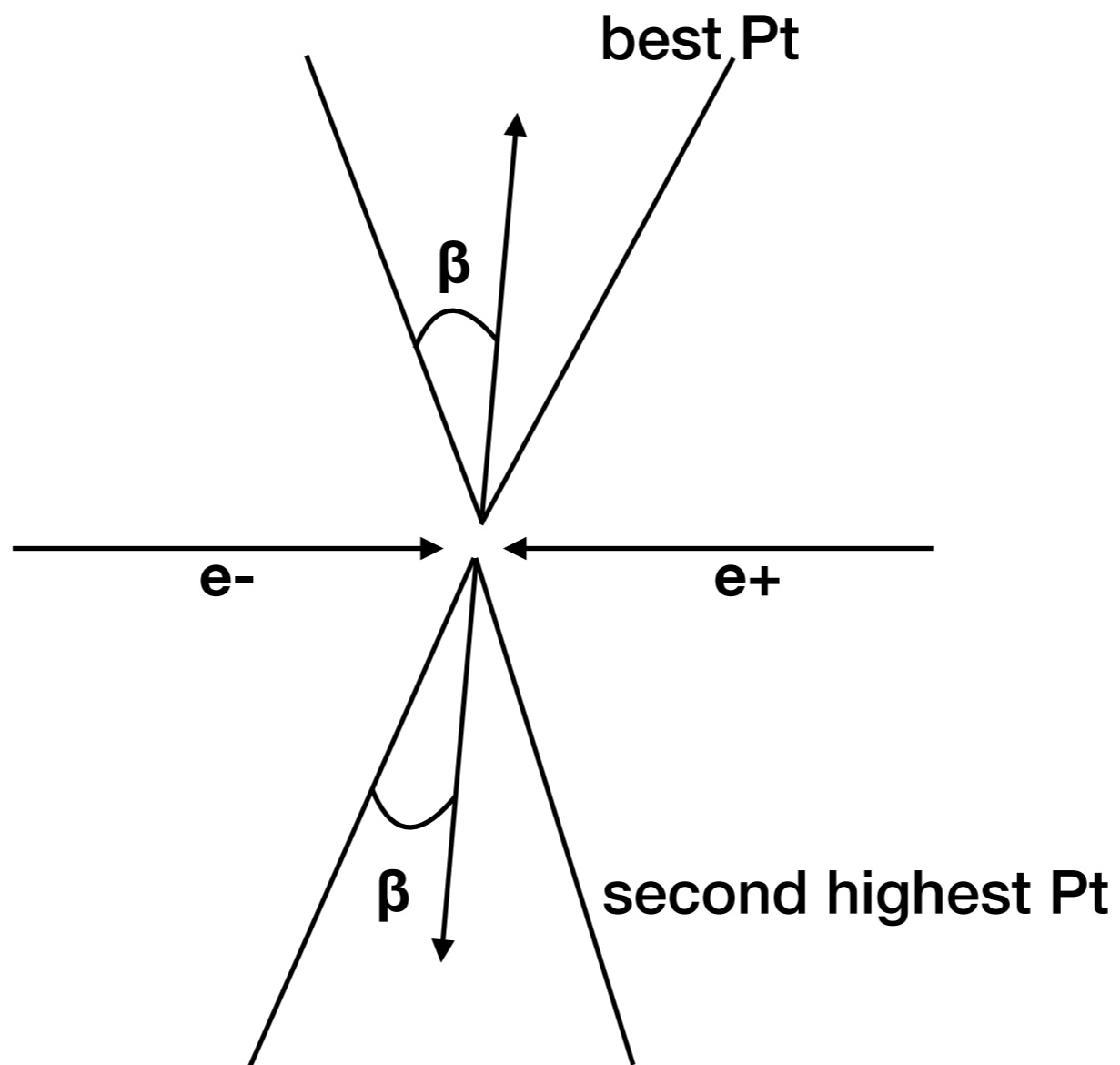
beta



**most particles are
in a range of $\beta < 0.1$ [rad]**

- 1:find best p_T
- 2:find second p_T
- 3:make cones

An angle of $\beta < 0.1$ rad relative to best/second Pt



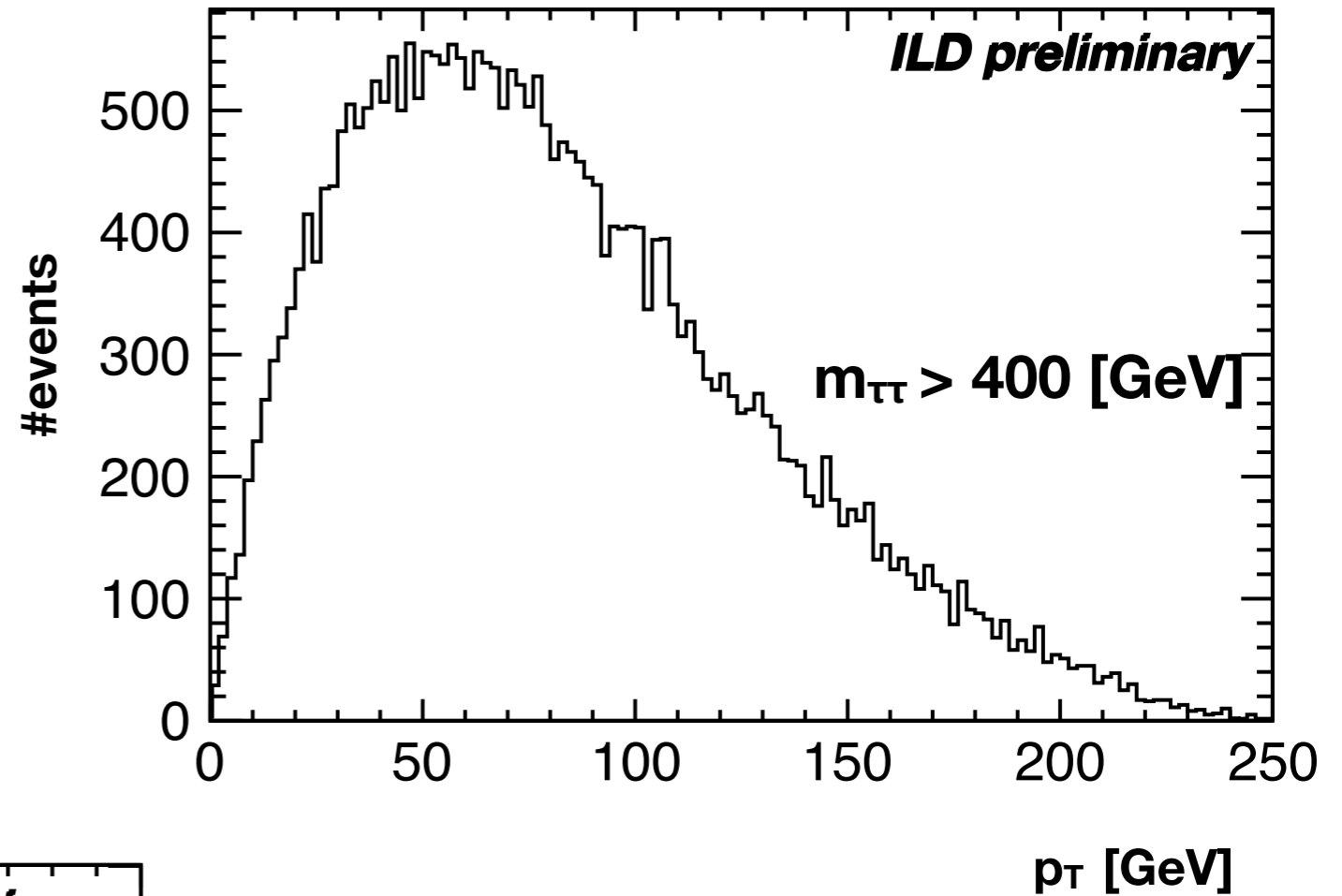
Result

highest Pt

test on MC truth
check on PFO level

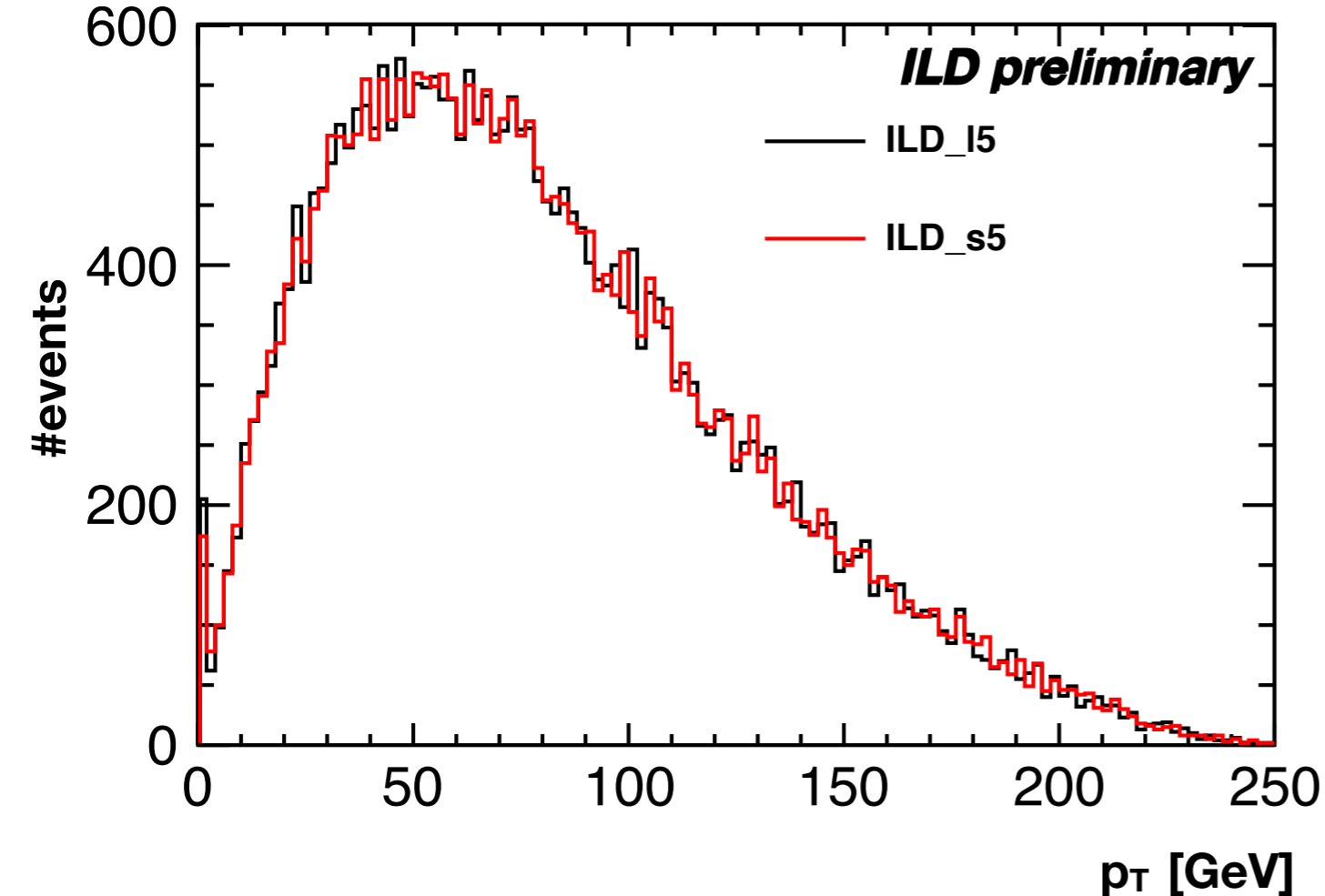
best Pt of MC (tt)

MC

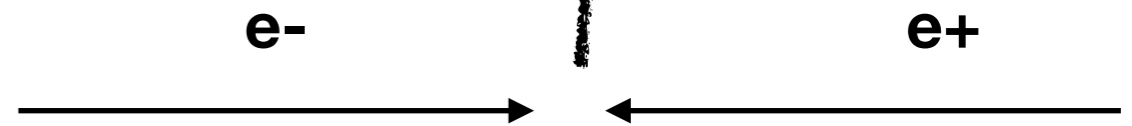


PFO

best Pt of PFOs (tt)



best p_T

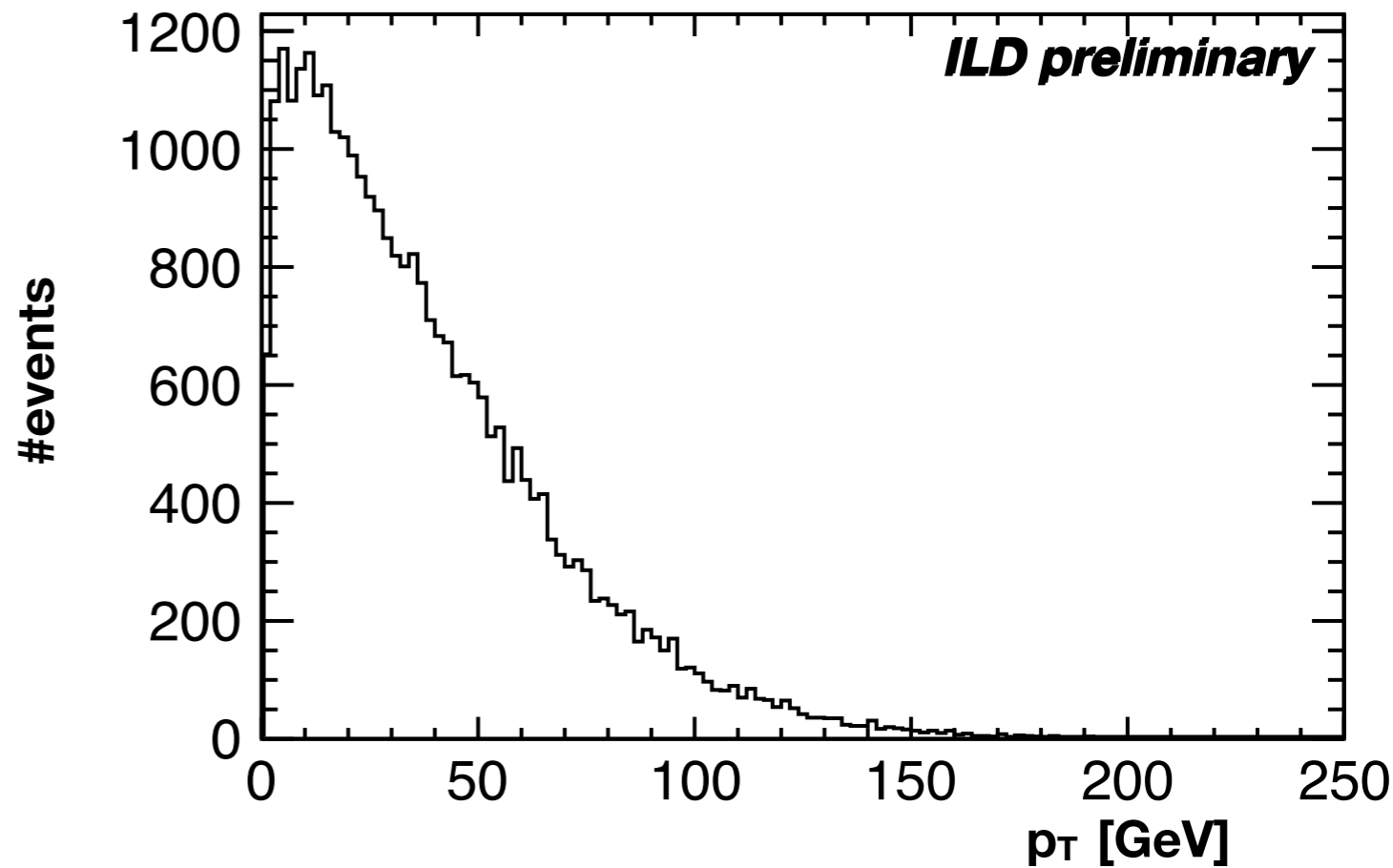


second Pt

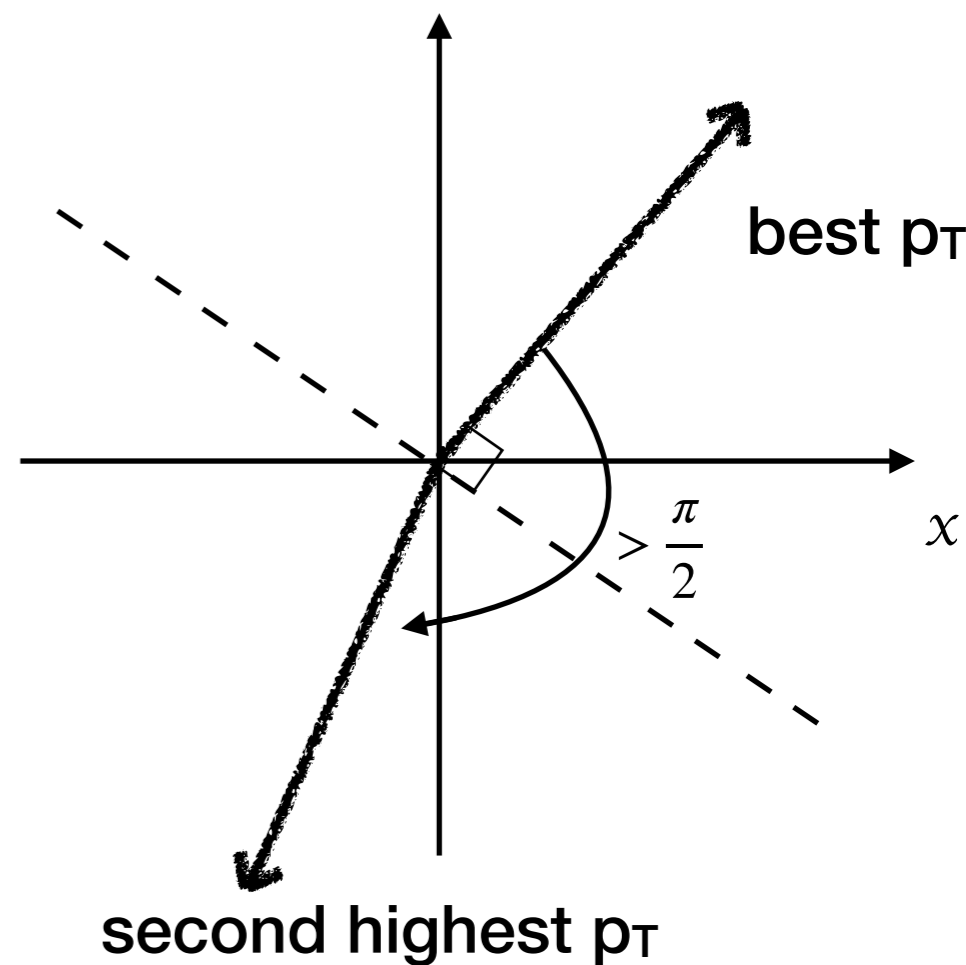
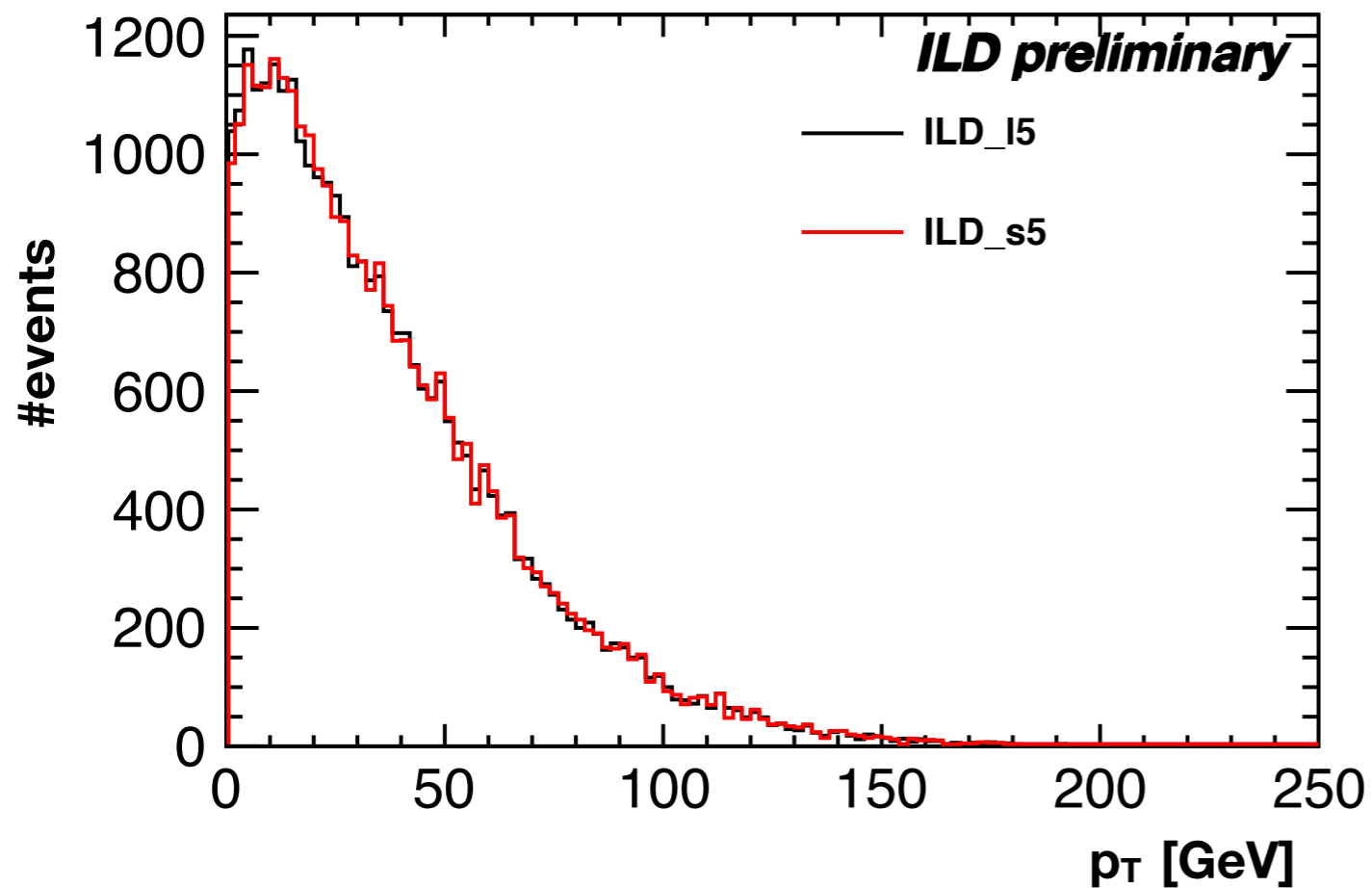
test on MC truth
check on PFO level

PFO

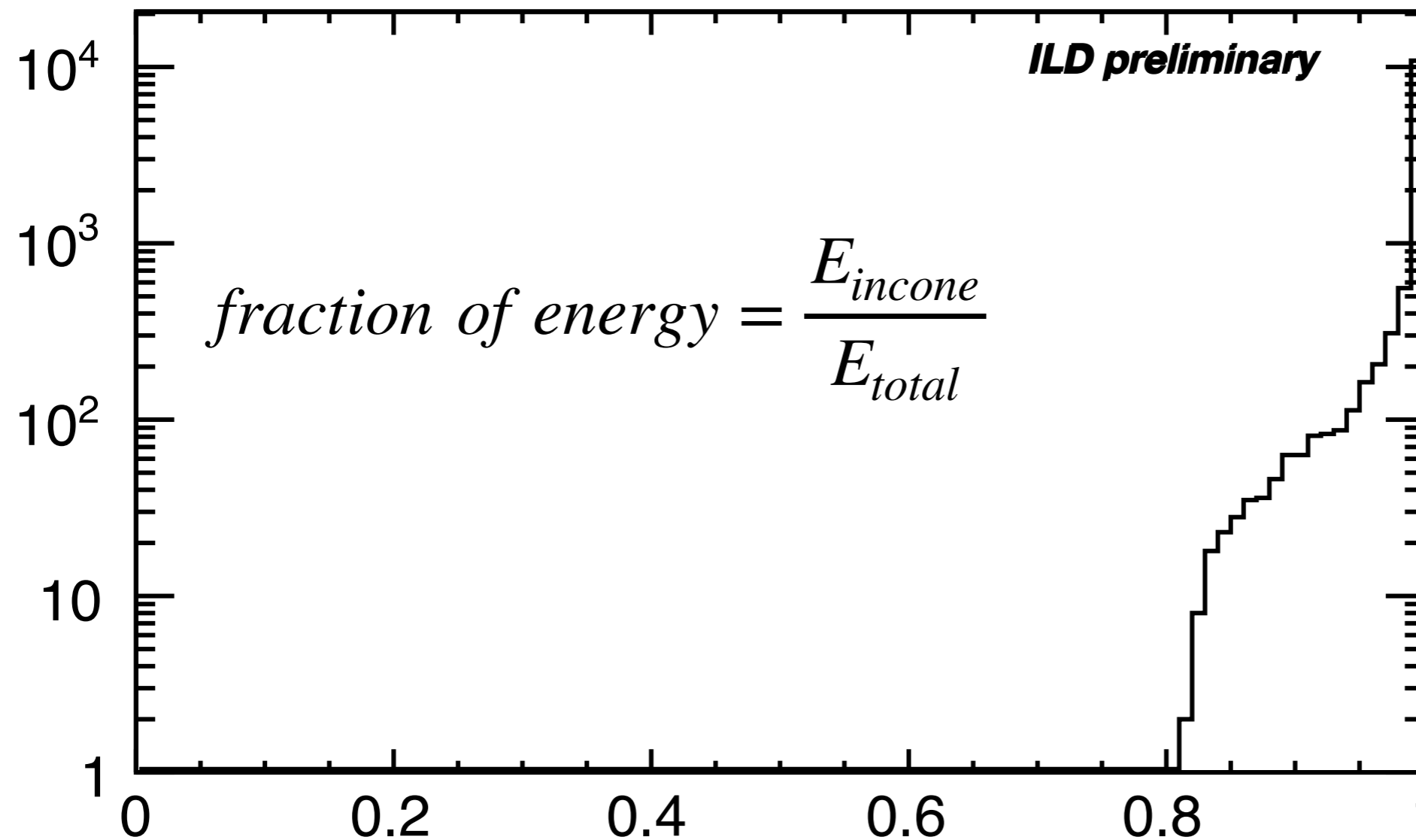
second Pt of MC (tt) MC



second Pt of PFOs (tt)



fraction of energy

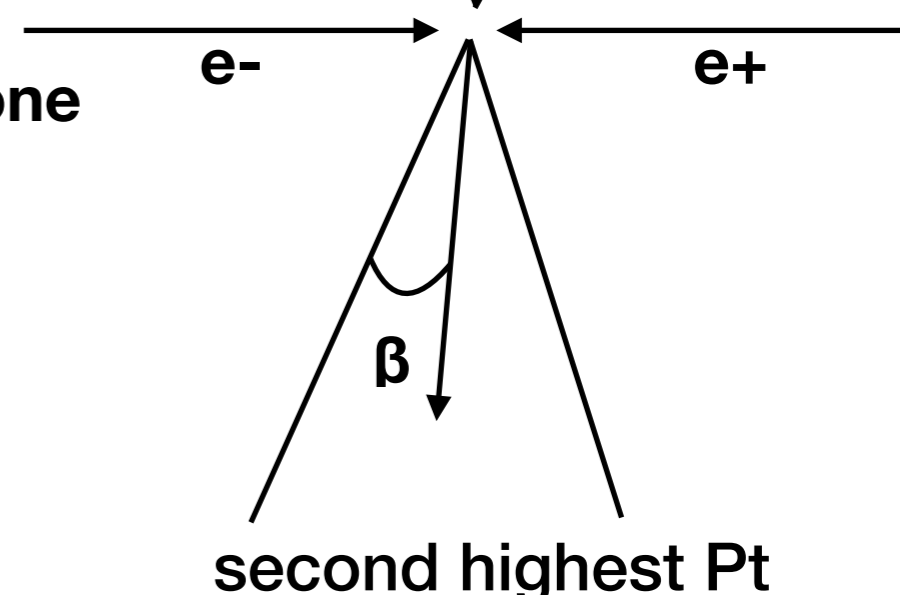


how much energy is inside cone

best Pt

E_{incone} : **sum of tau daughter's energy inside cone**

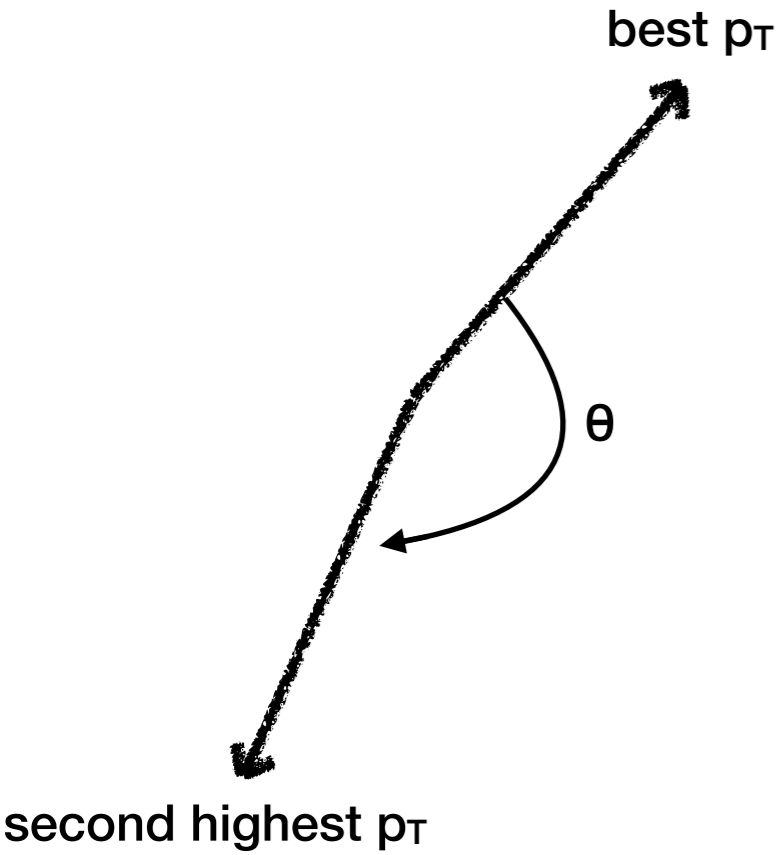
E_{total} : **sum of tau daughter's energy inside/outside cone**



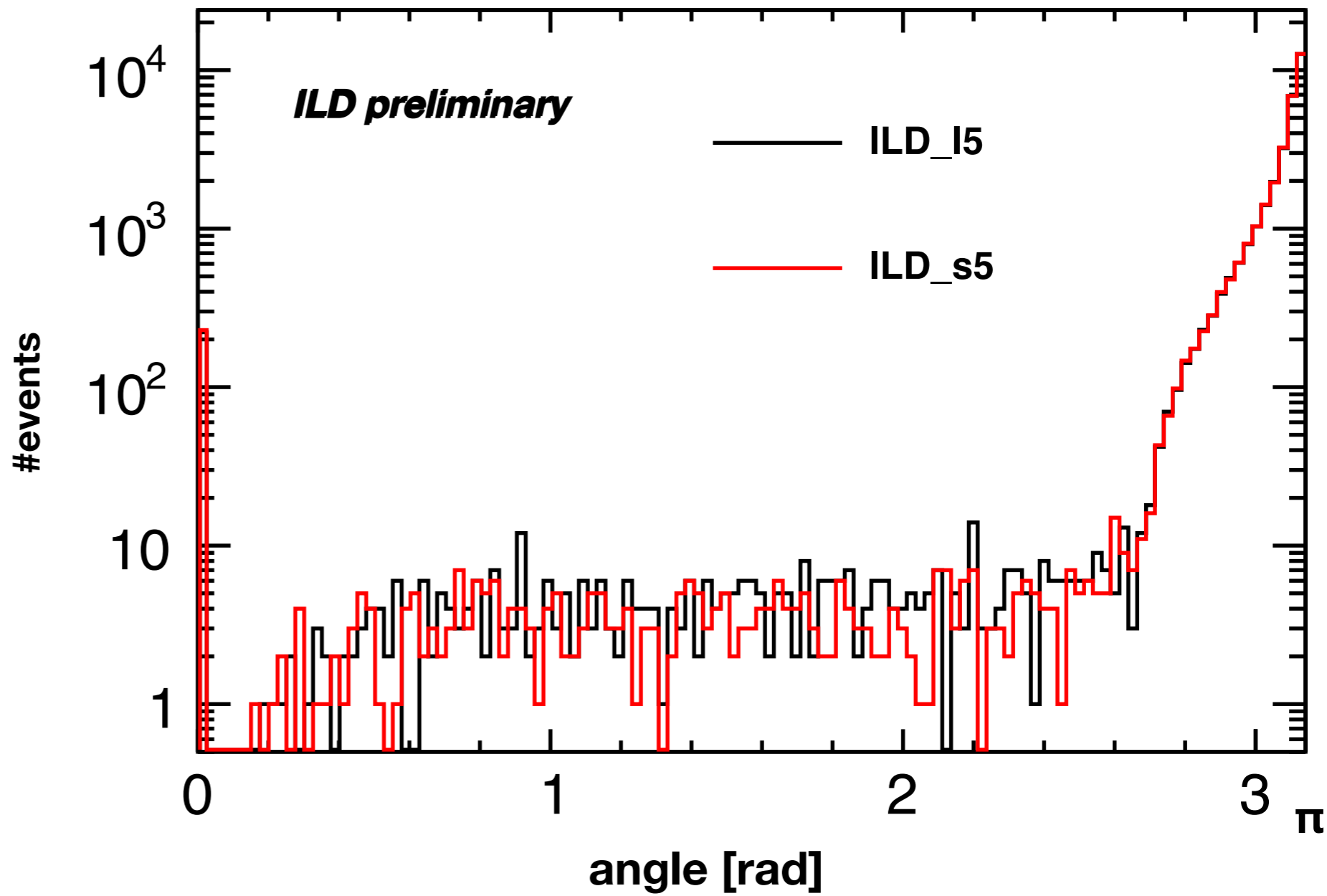
about 99% of energy is inside cone

This is PFO level

angle θ formed by first τ seed and second τ seed



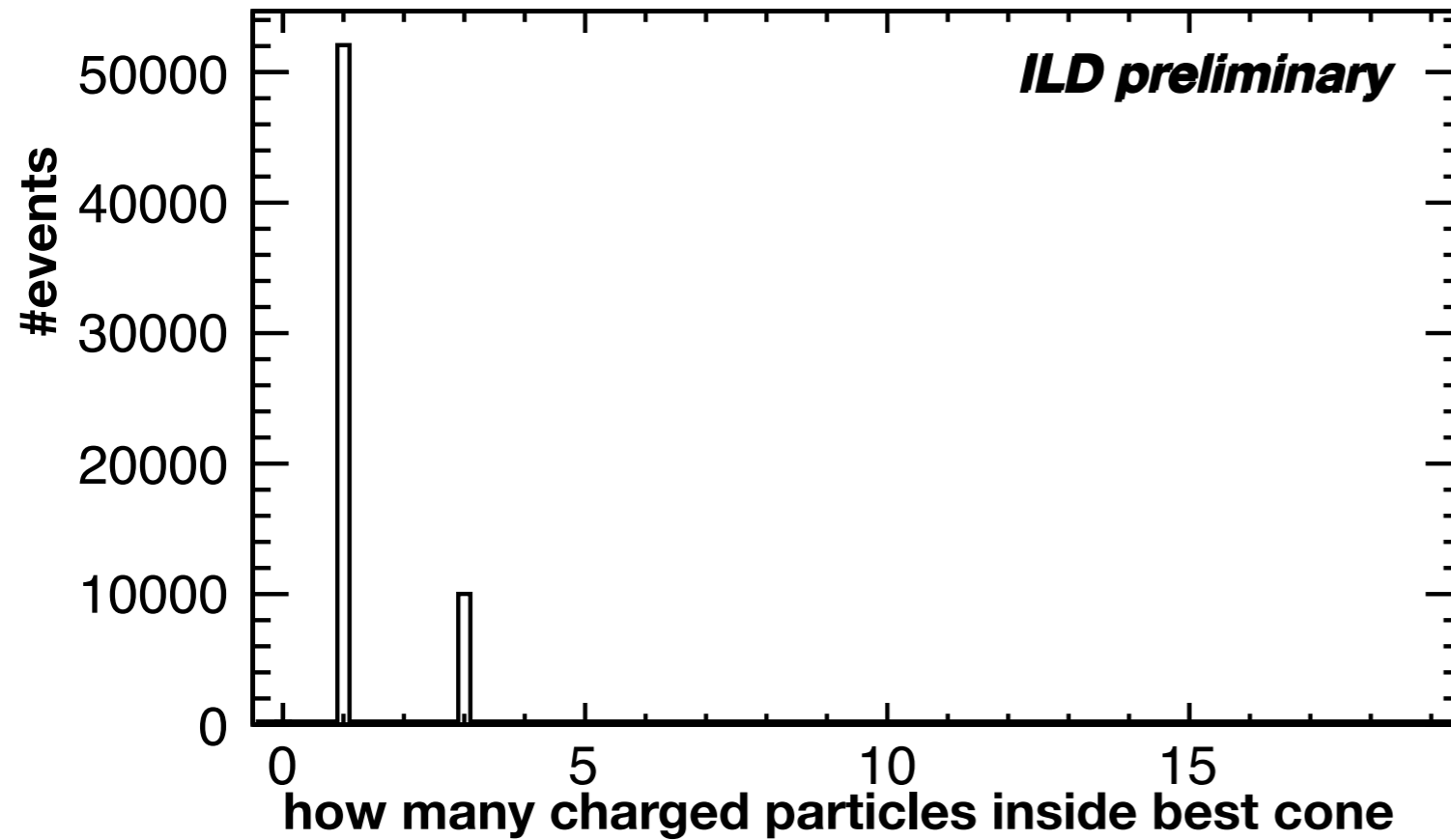
angle of PFOs (tt)



first τ seeds and second τ seeds are almost back-to-back

best cone

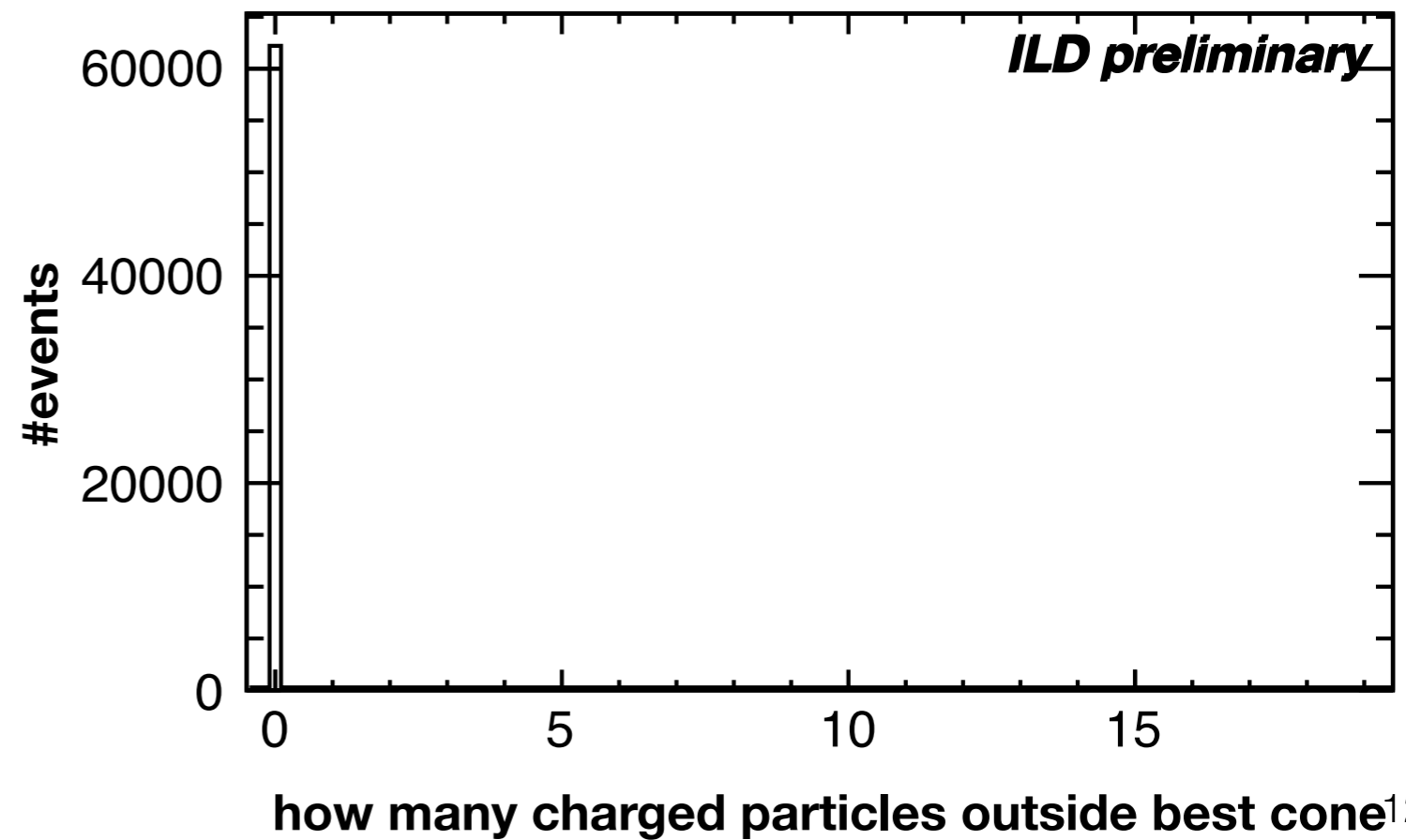
charged particle inside best cone



This is MC level

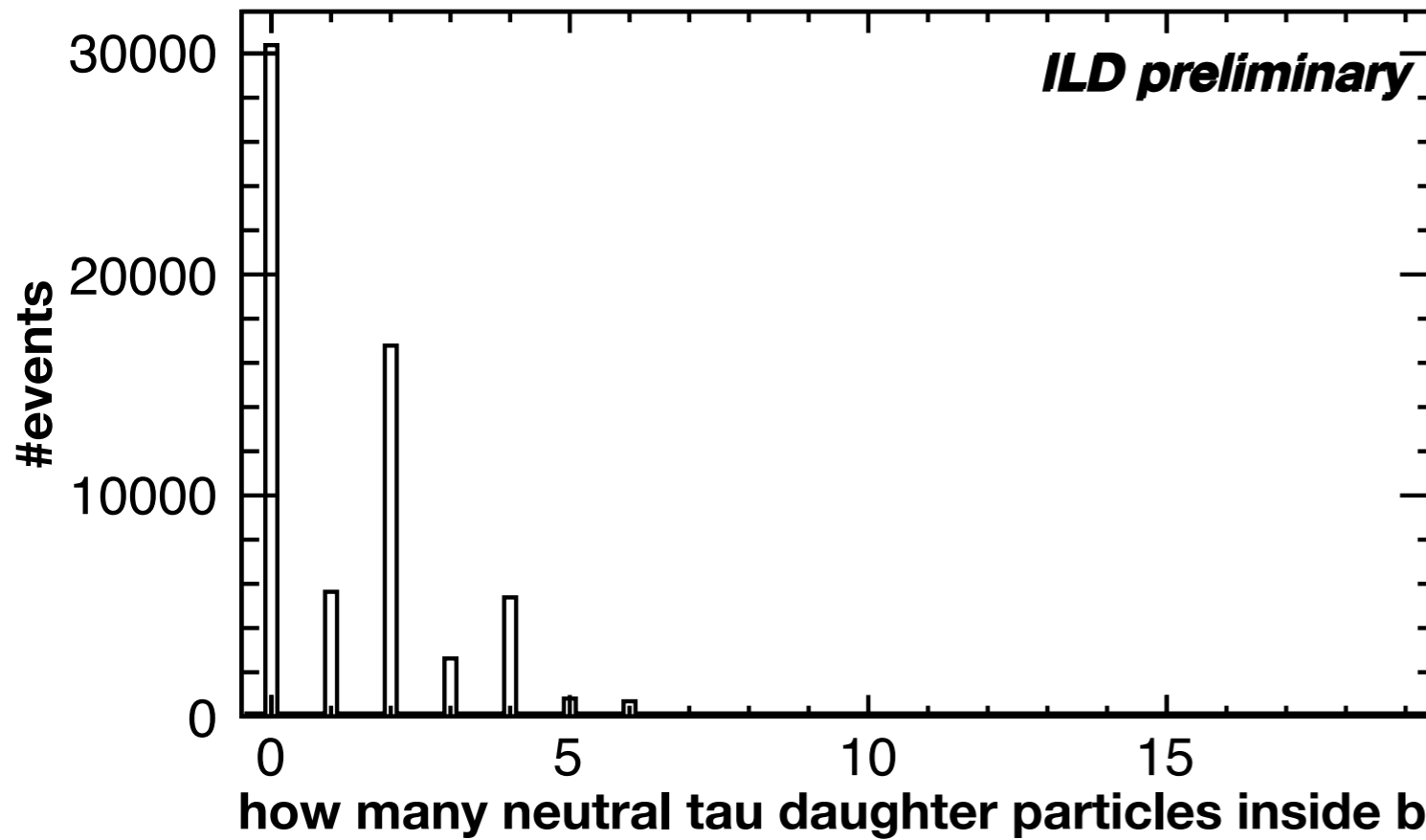
**all charged tau daughters
are inside best cone**

charged particle outside best cone



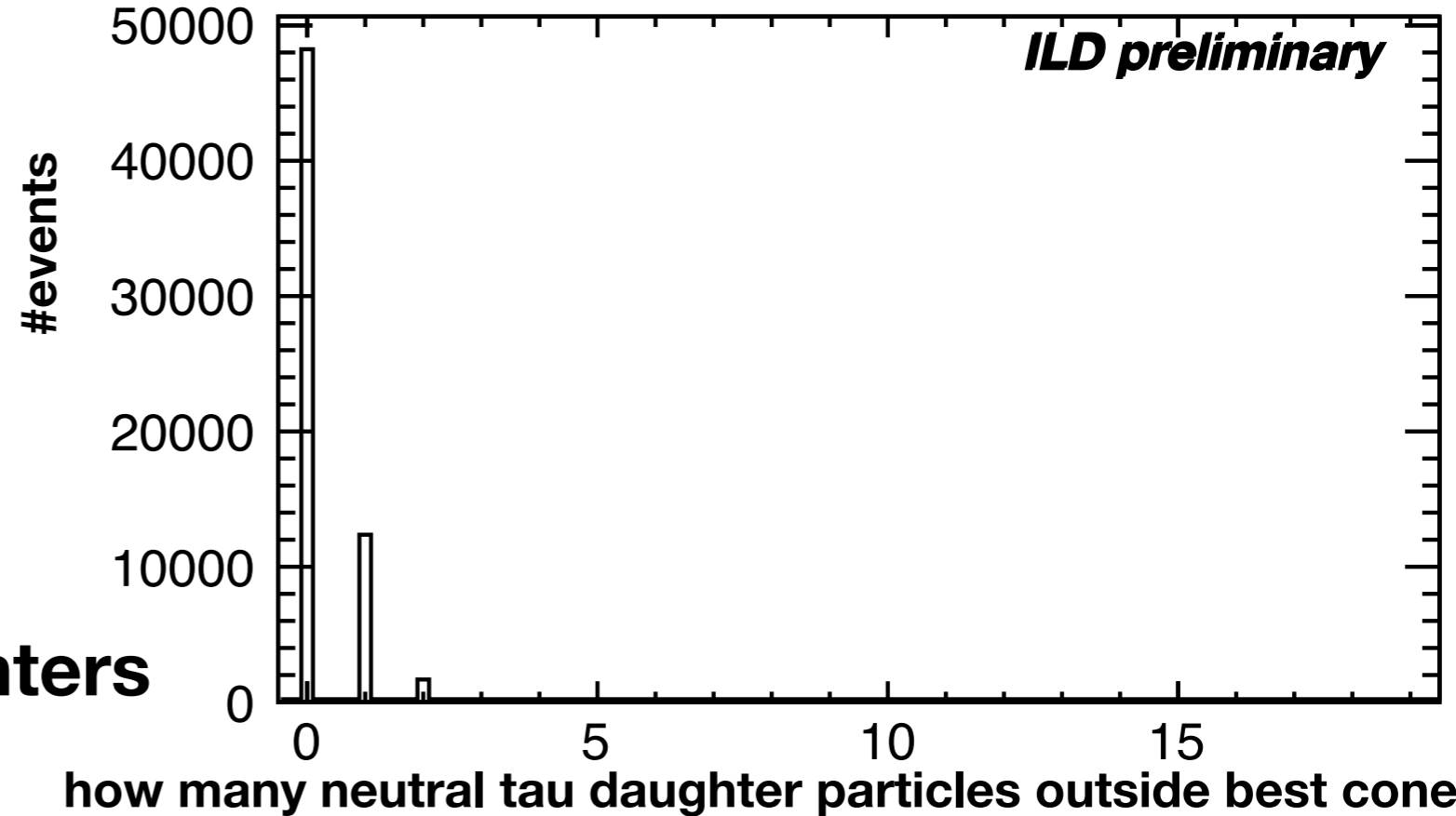
best cone

neutral particle inside best cone



This is MC level

neutral particle outside best cone



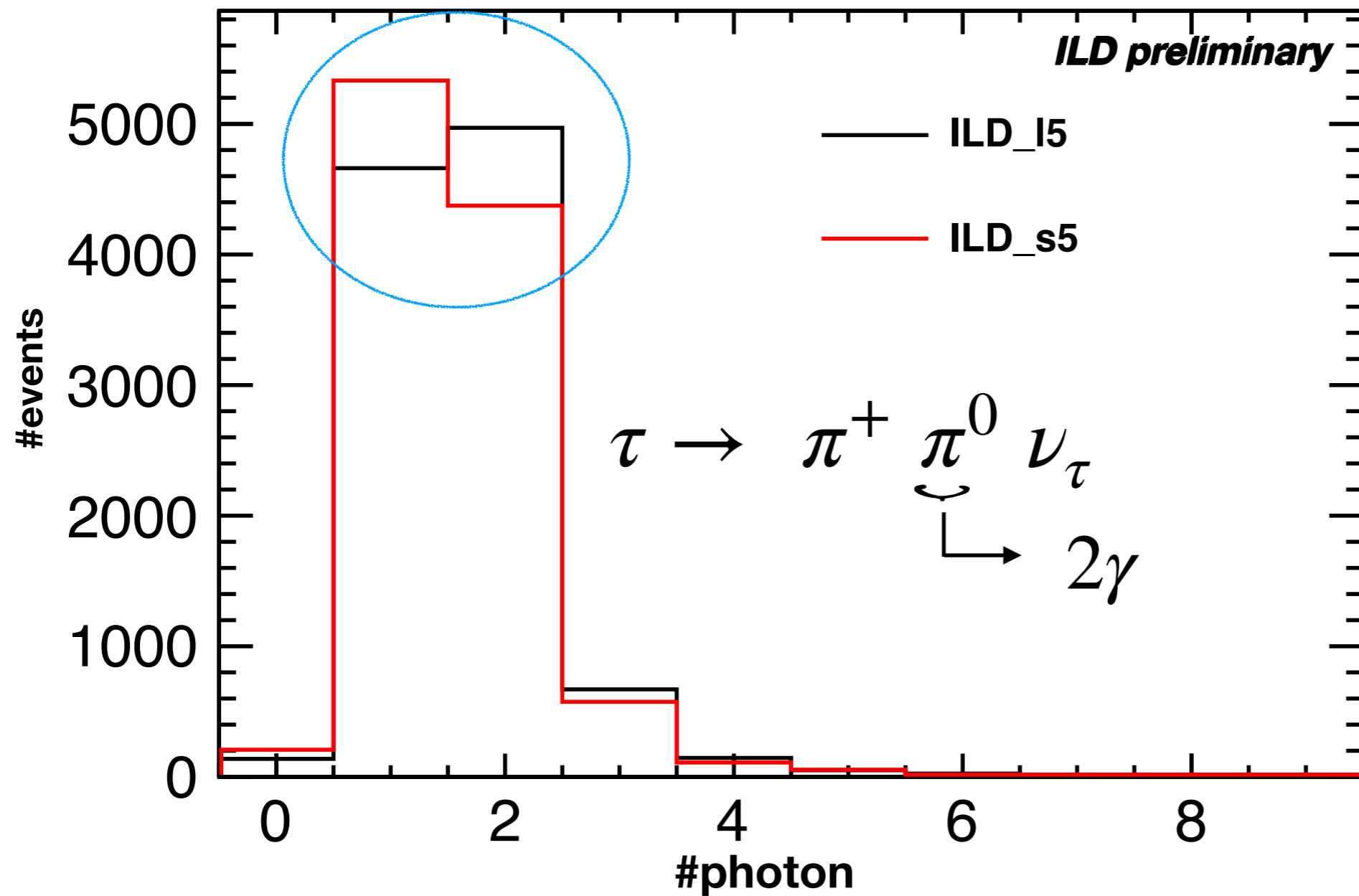
neutral tau daughters
are mostly photon

sometimes neutral tau daughters
are outside cone

Comparison between Large and Small ILD model

This is PFO level

2 photon decay



#photon = 2

Large model : ~5,000 events

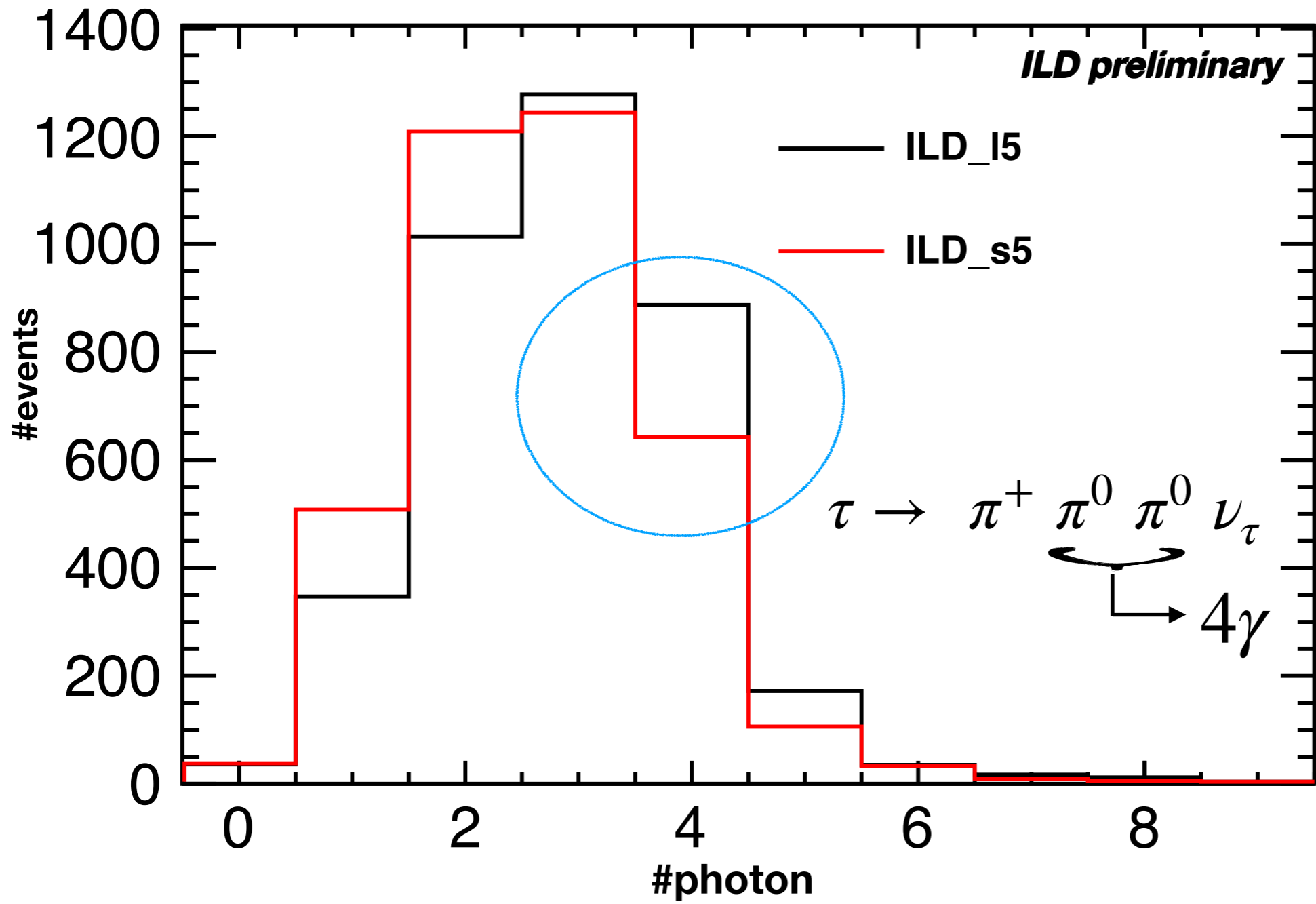
Small model : ~4,400 events

Large model is better than small model

Comparison between Large and Small ILD model

This is PFO level

4 photon decay



#photon = 4

Large model : ~900 events
Small model : ~650 events

Large model is better than small model

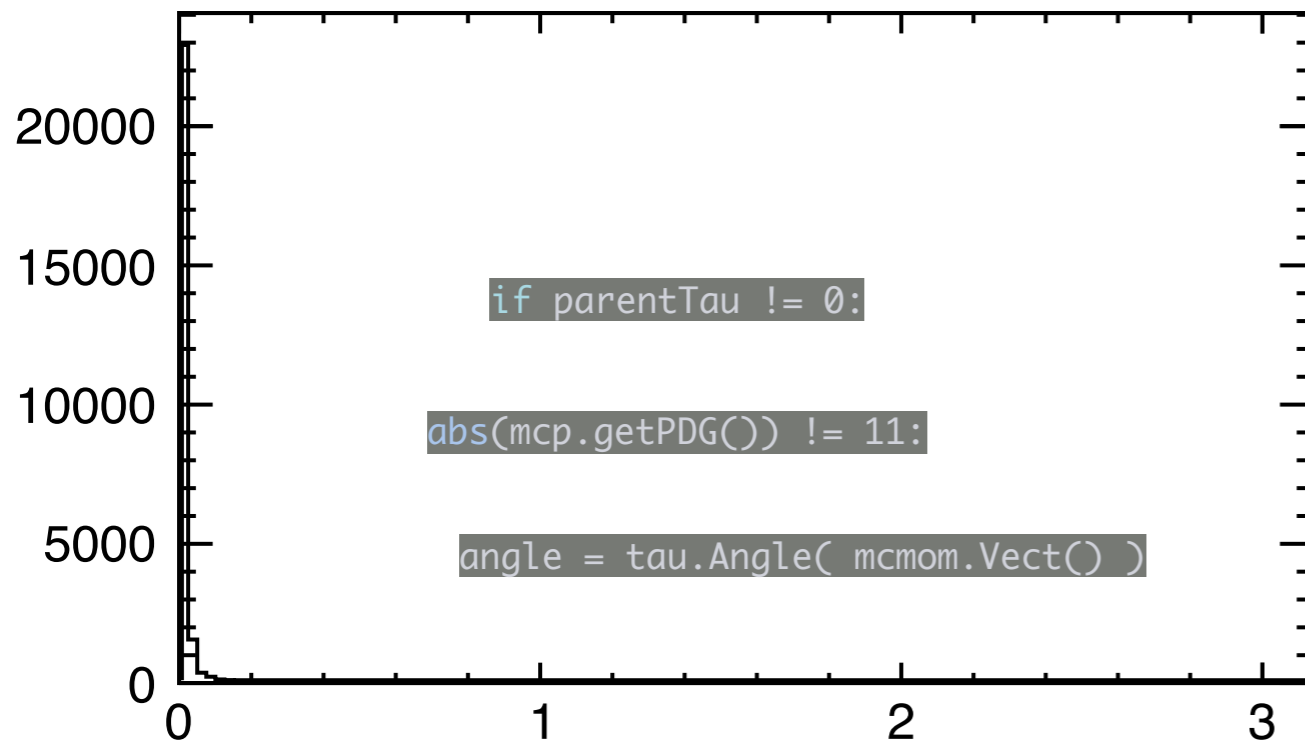
Summary

- **I simulated $e^+ e^- \rightarrow \tau^+ \tau^-$ and found tau jets in the process**
- **About 99% of energy is inside cone**
 - Inside cone
 - ◎ **all charged tau daughters are inside best cone**
 - ◎ **neutral tau daughters are mostly photon and sometimes neutral tau daughters are outside cone**
- **I compared Large model with Small model**
 - **Large model is better than Small model**

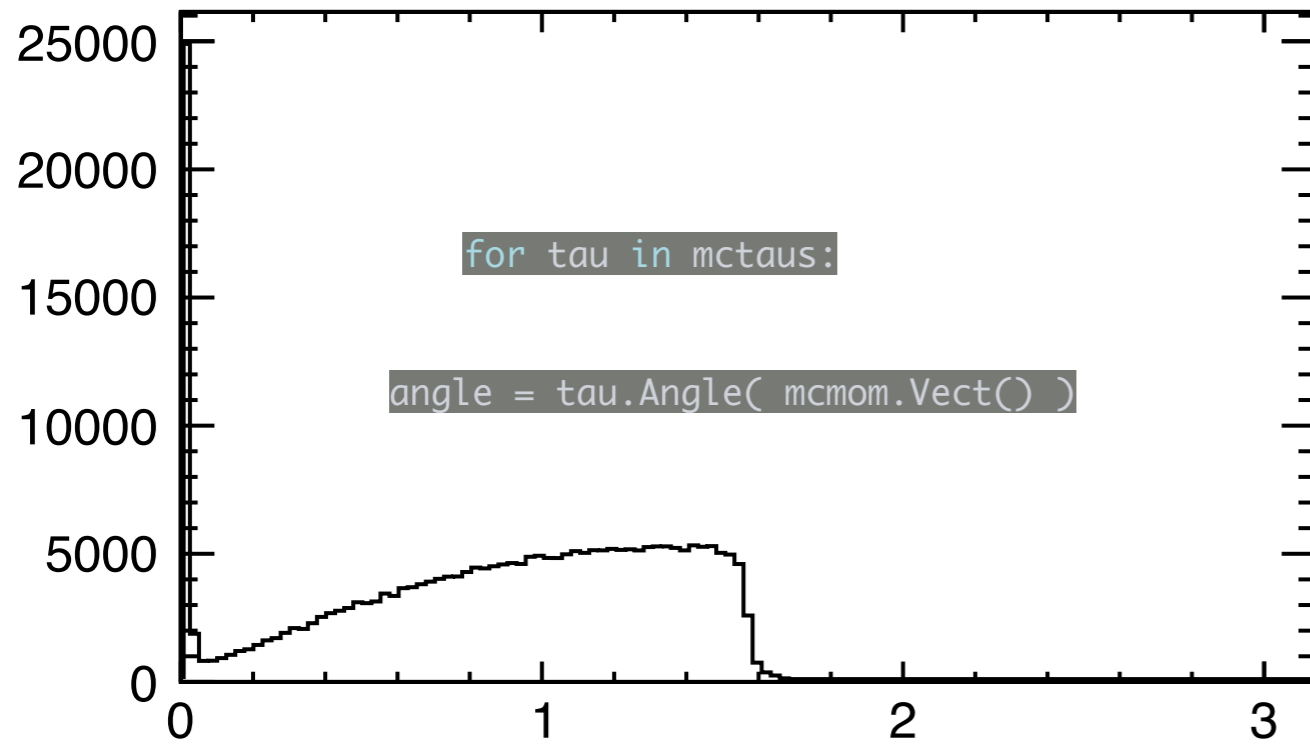
Backup

angle to first/second τ seed

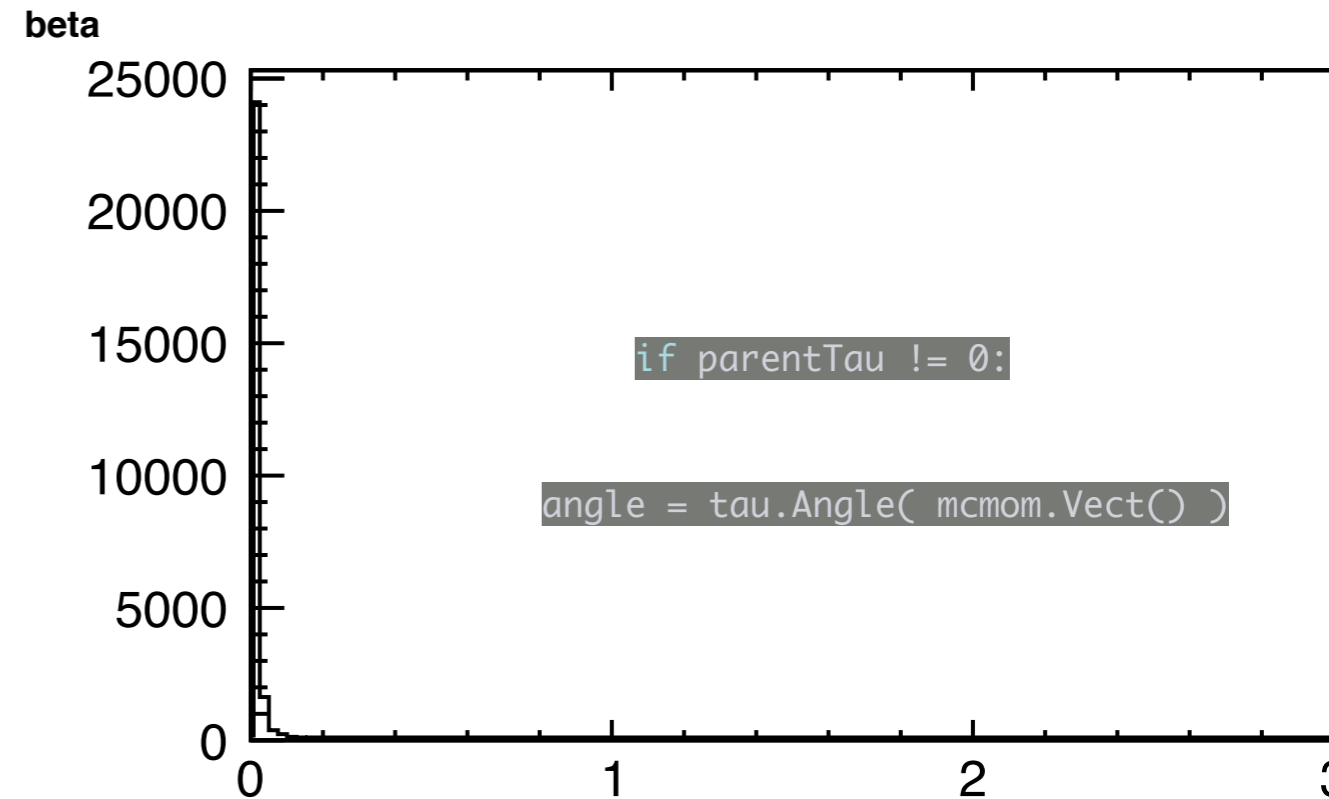
beta from tau not electron



beta no cut



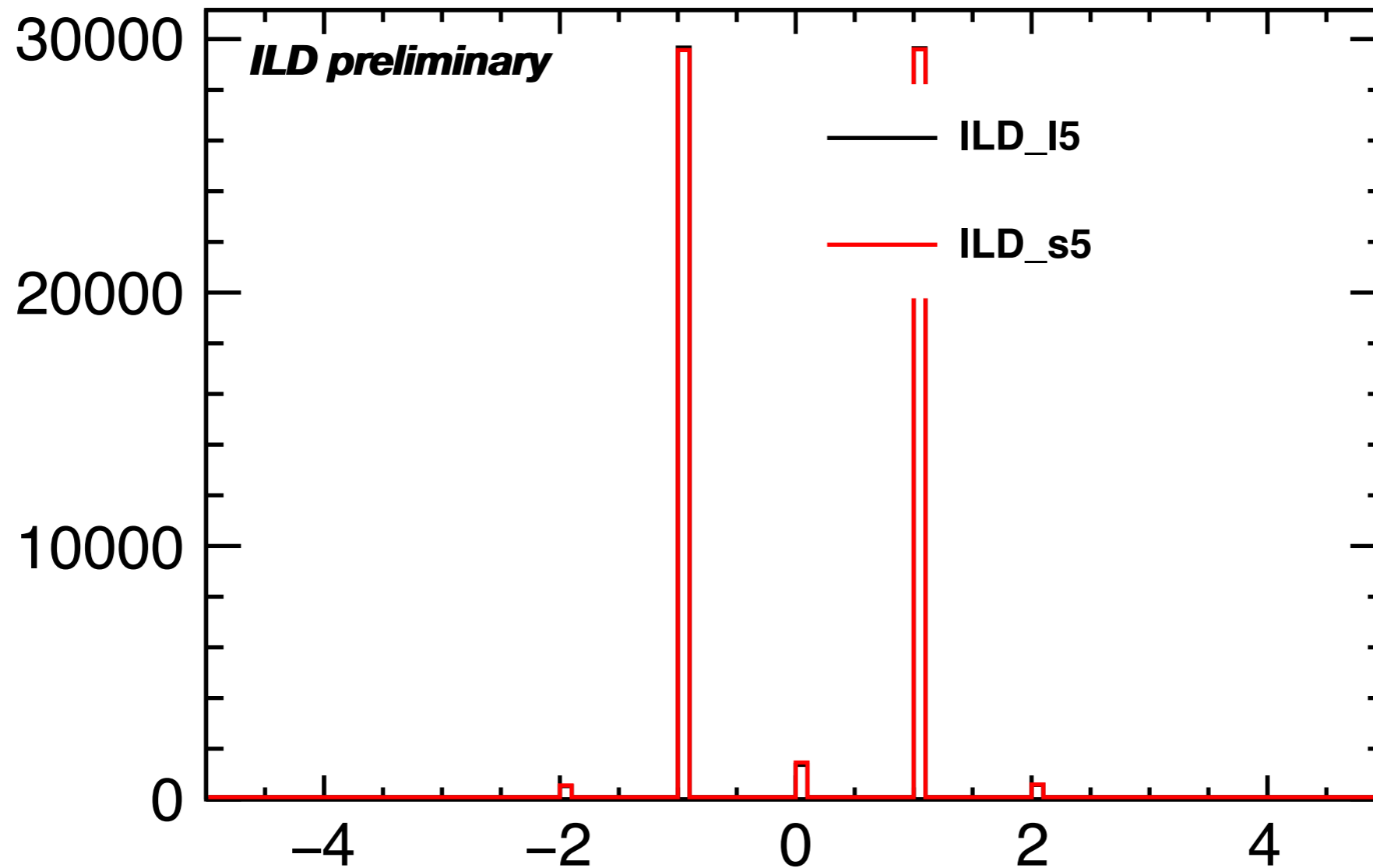
beta from tau no cut



inside best/second cone

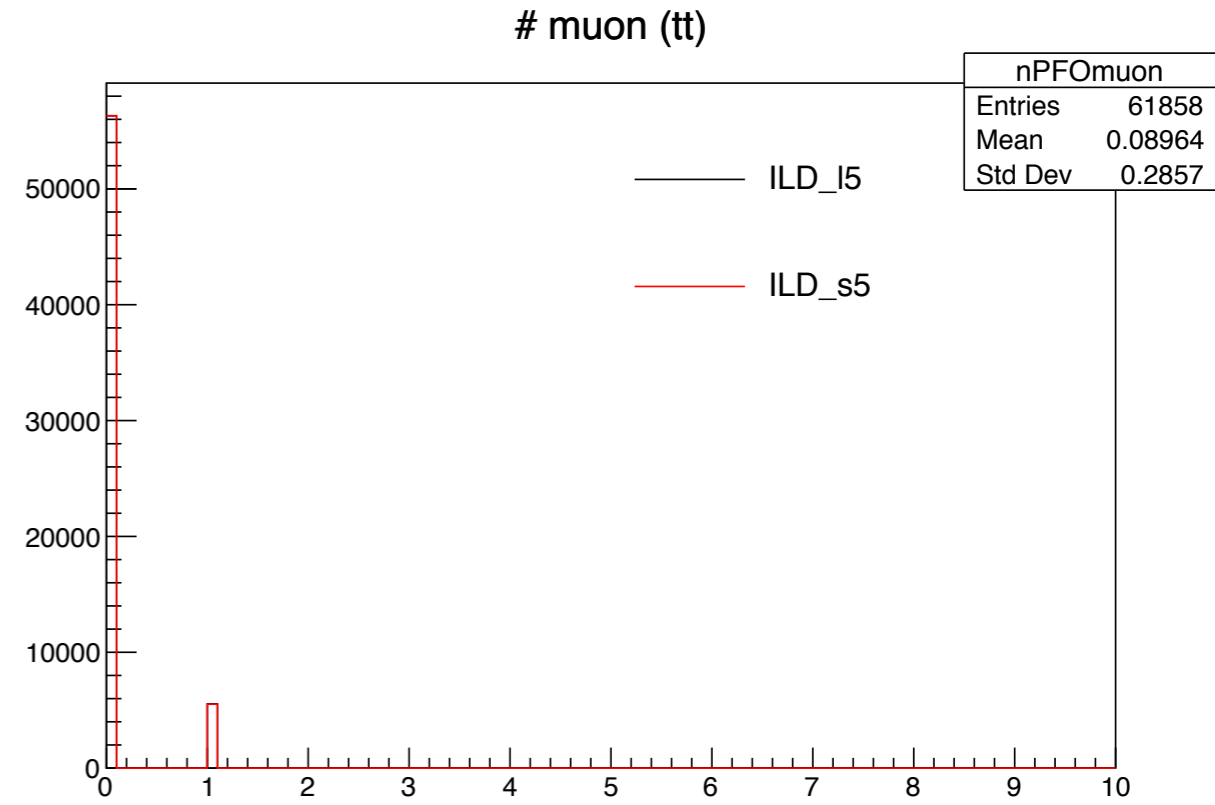
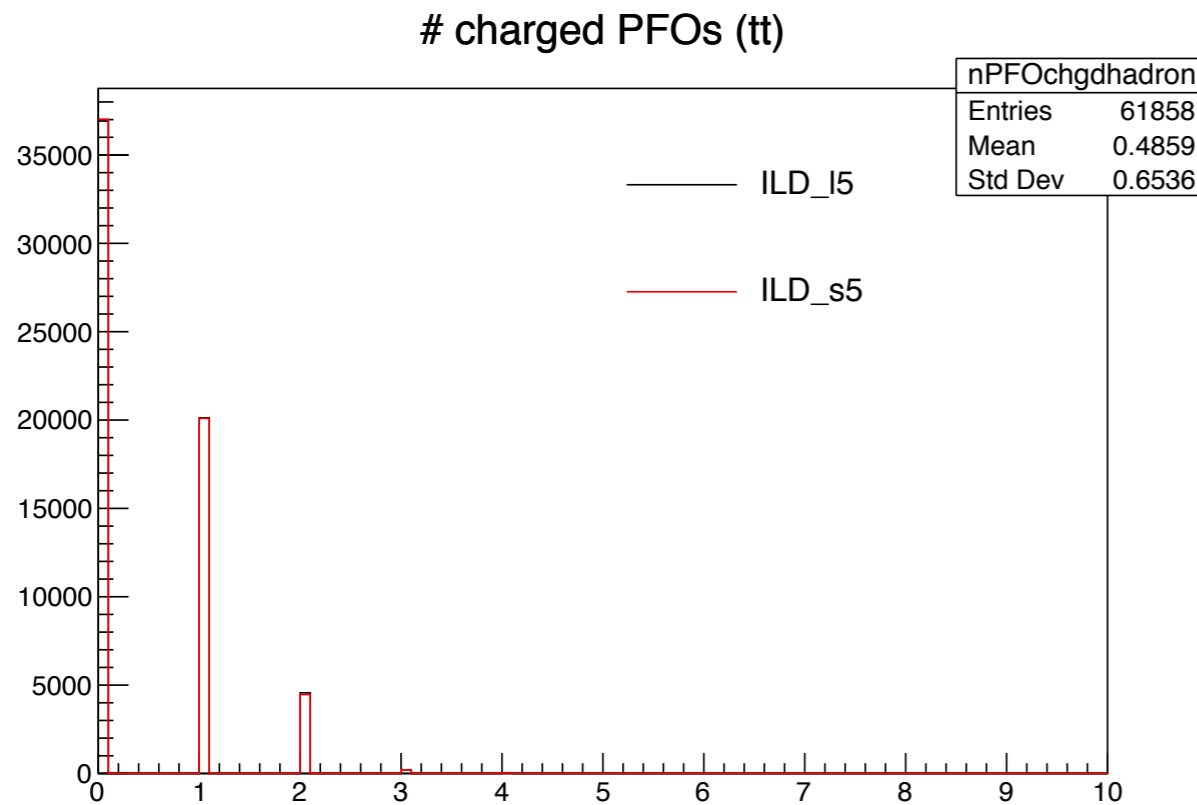
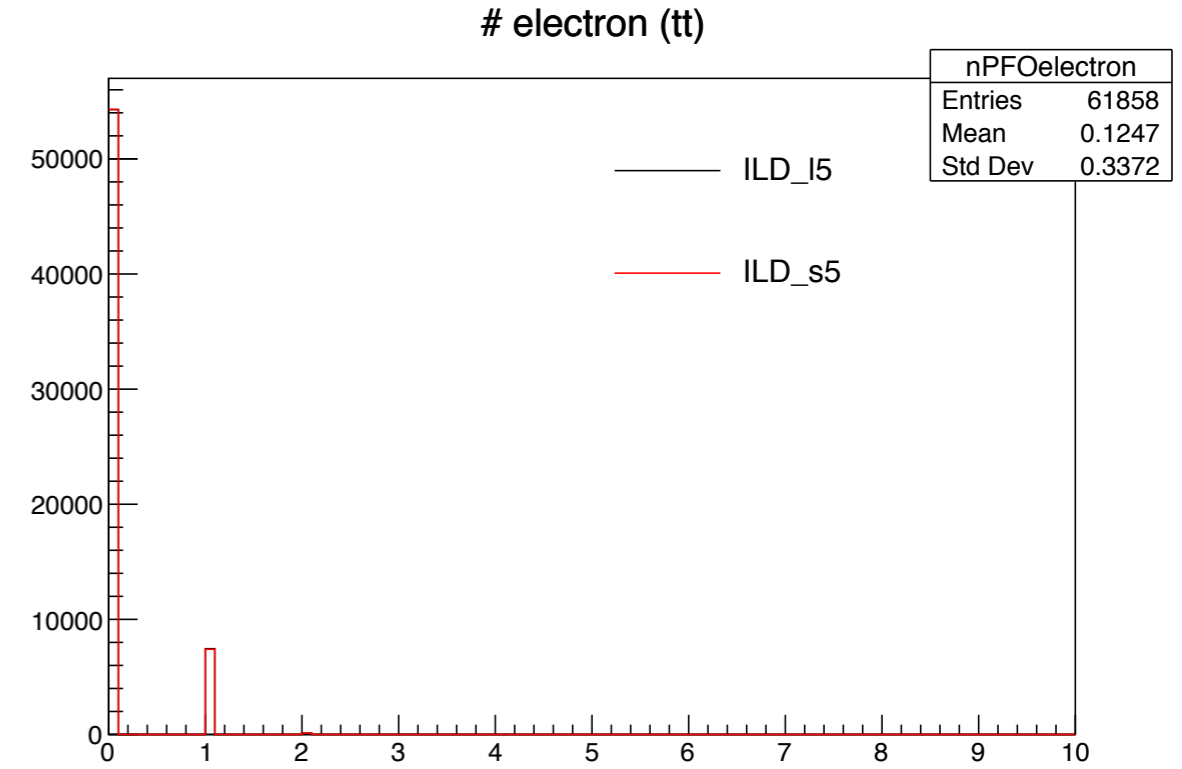
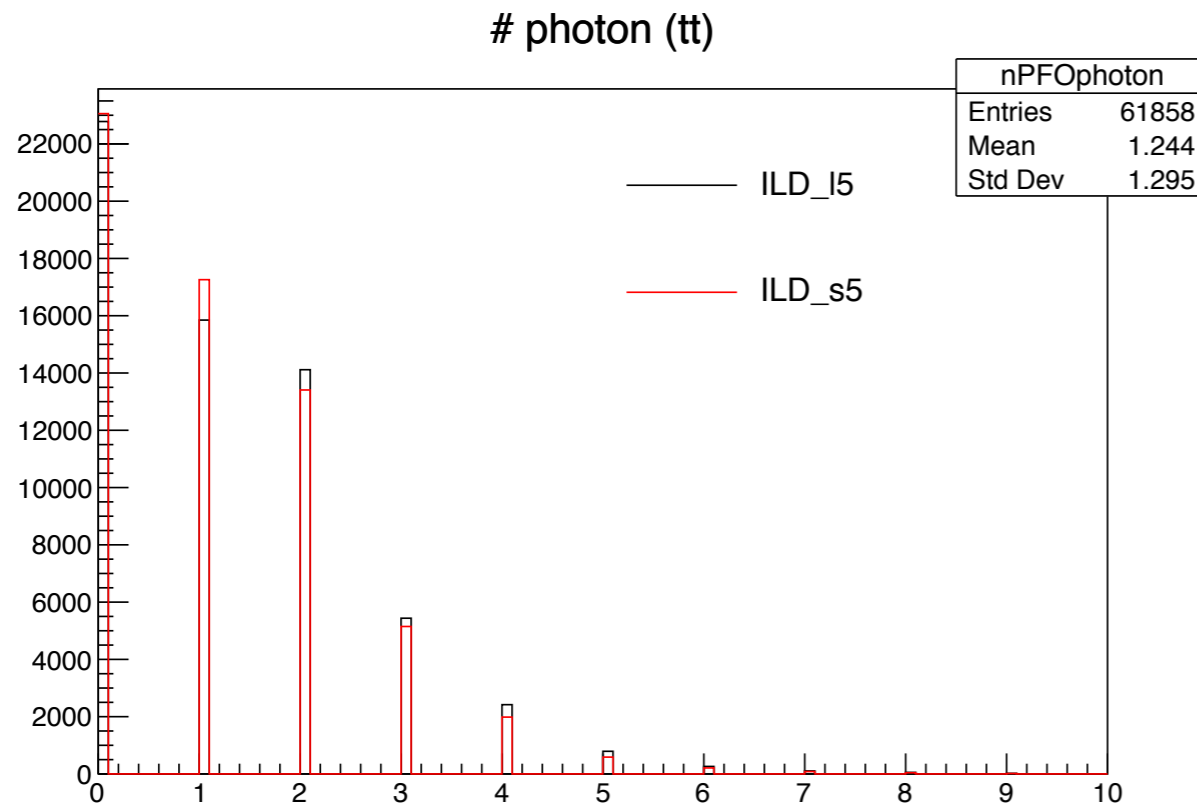
This is PFO level

total charge (tt)



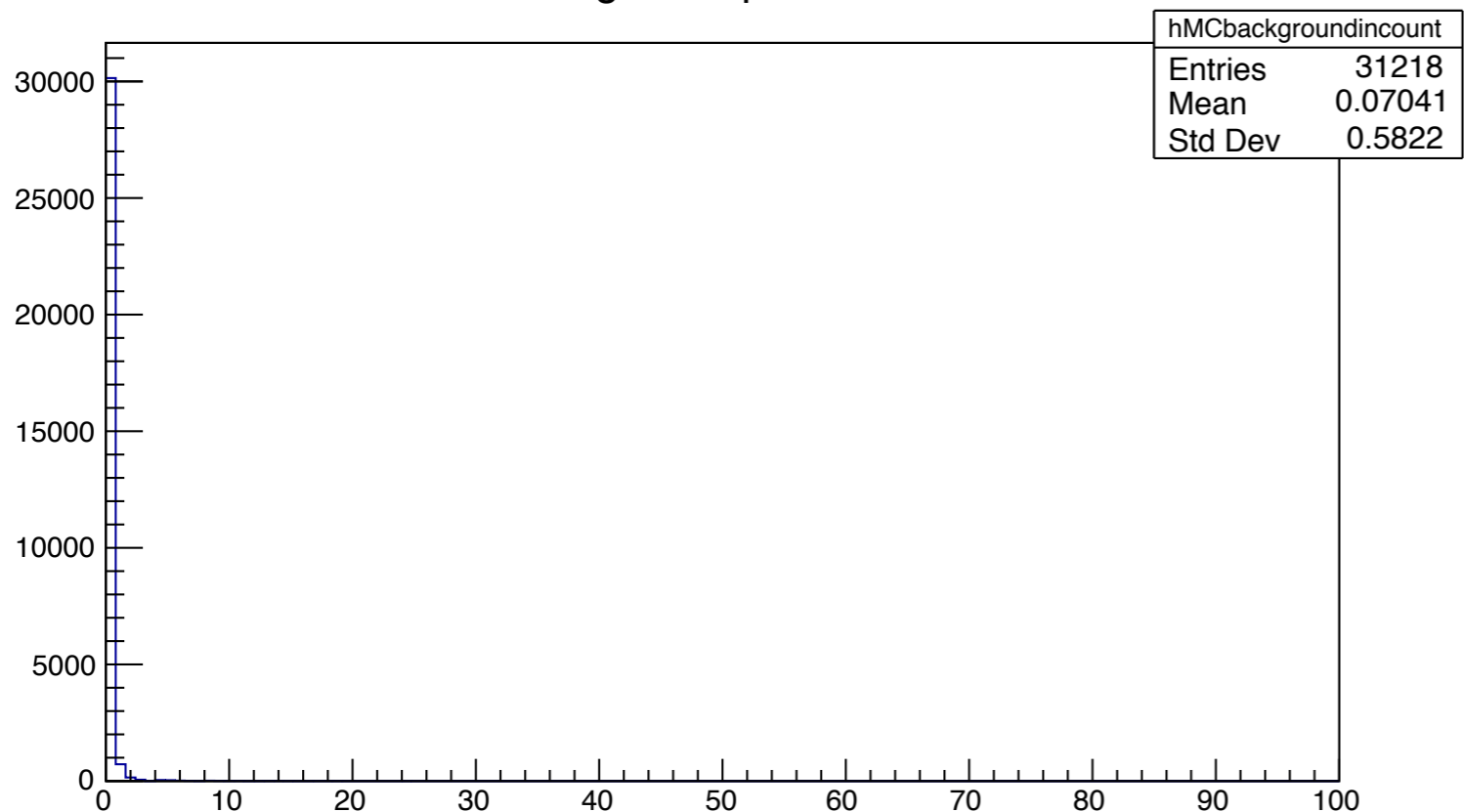
inside best/second cone

This is PFO level



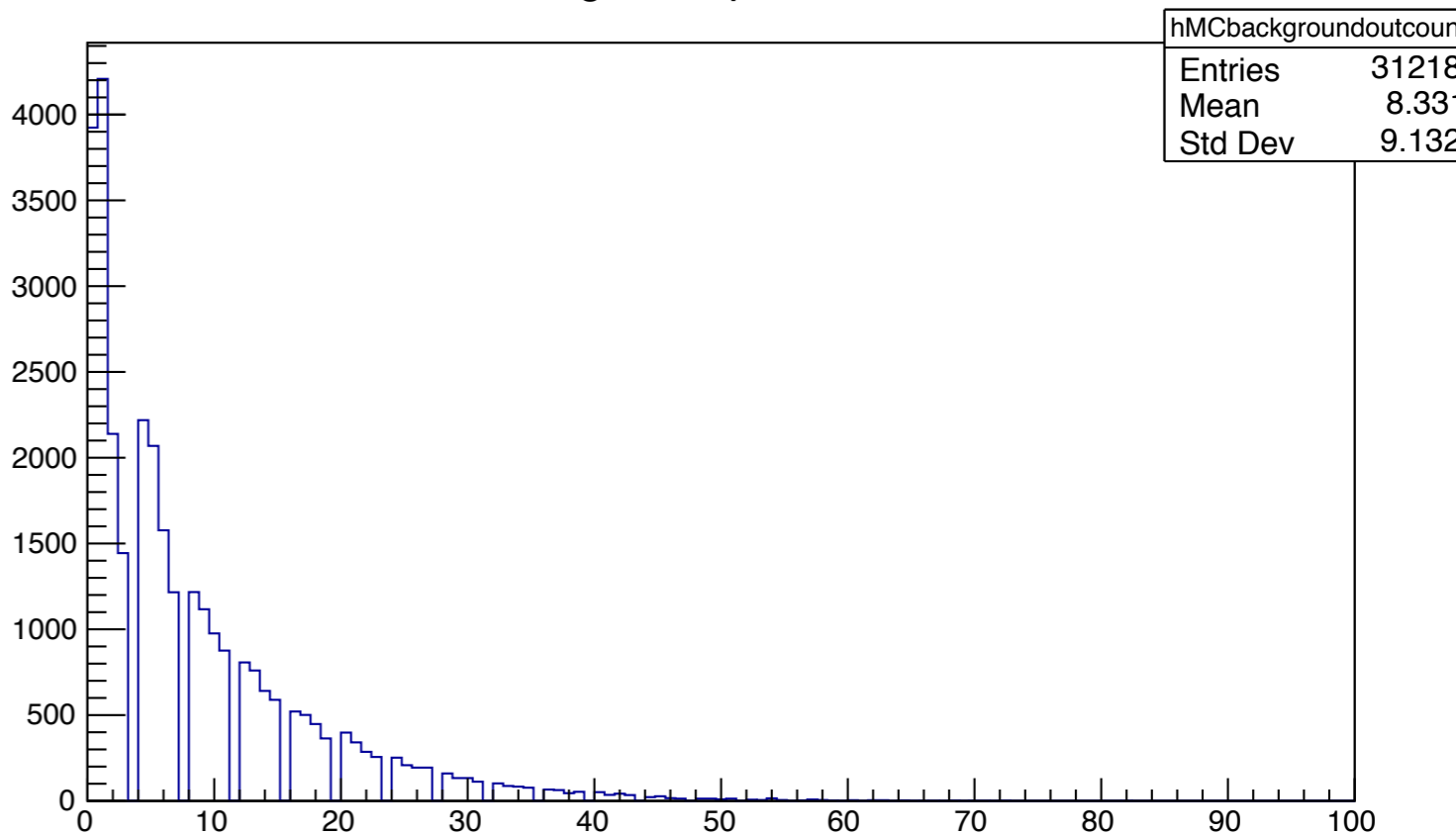
background particle

of background particle in cone



This is MC level

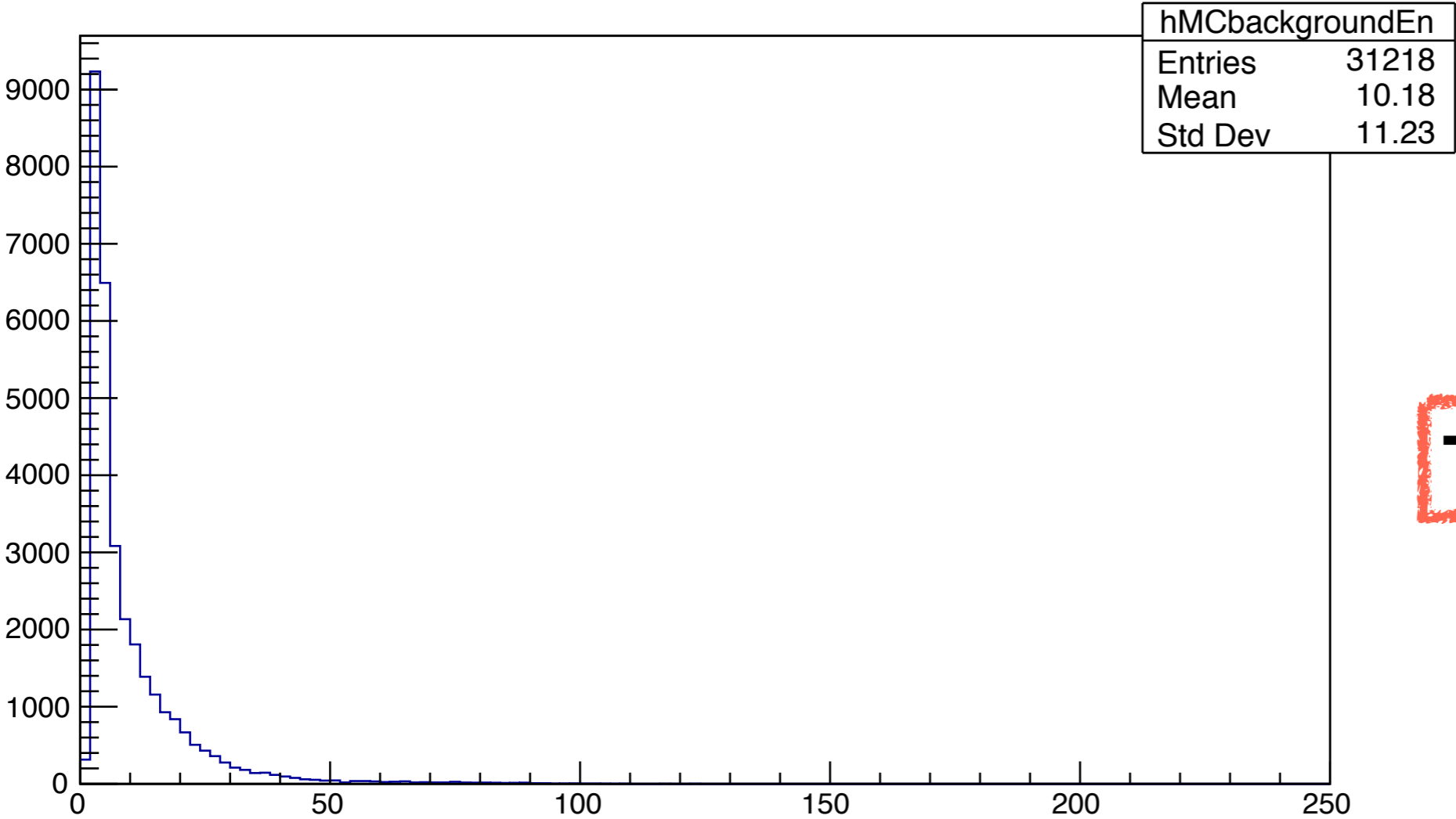
of background particle out cone



**almost all of background particles
are outside cone**

background particle

En of background



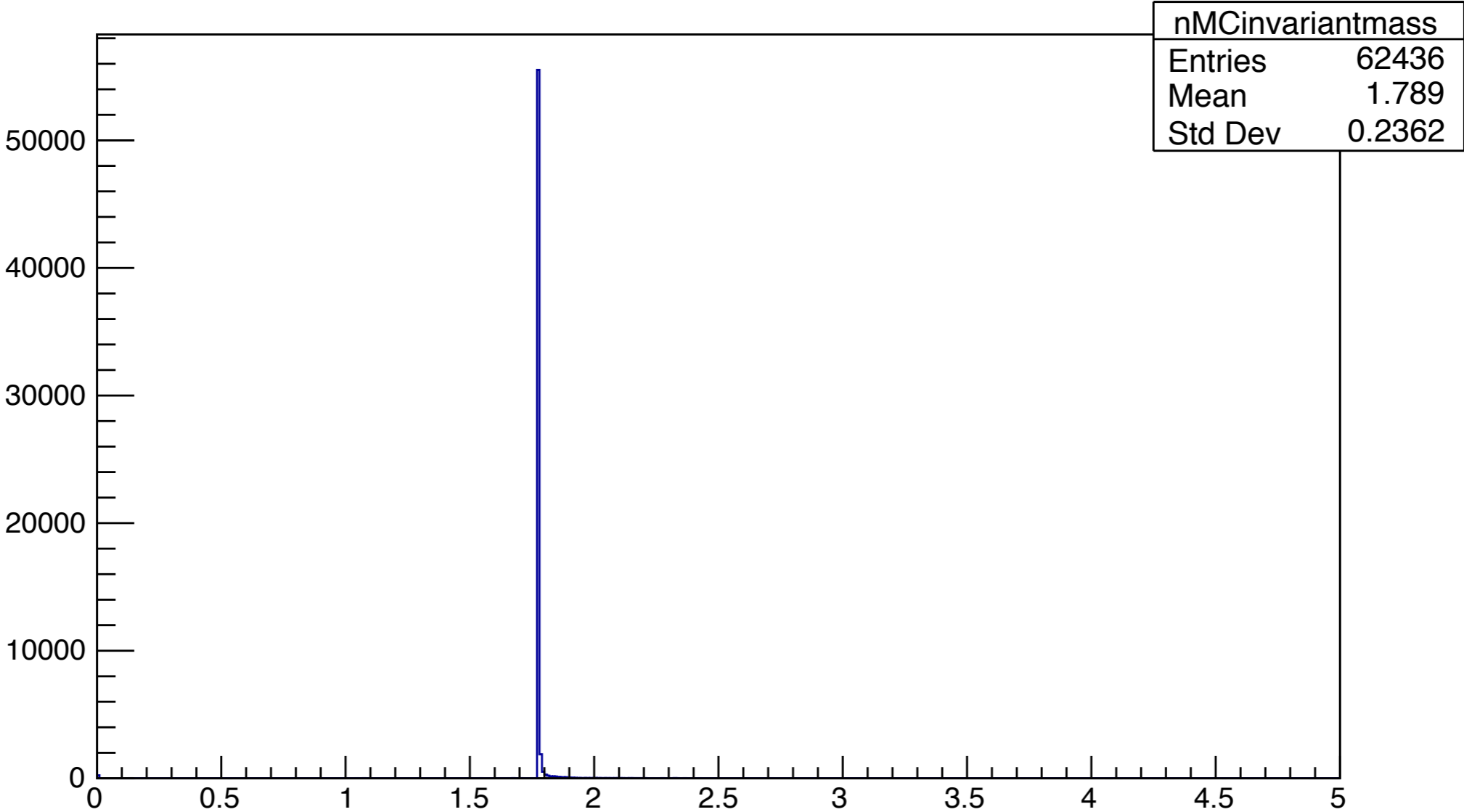
This is MC level

**almost all of background particles
are outside cone**

backup

This is MC level

invariant mass (tt)



backup

This is MC level

mass of 2-photon

