$\tau \rightarrow \gamma\mu$ at STCF

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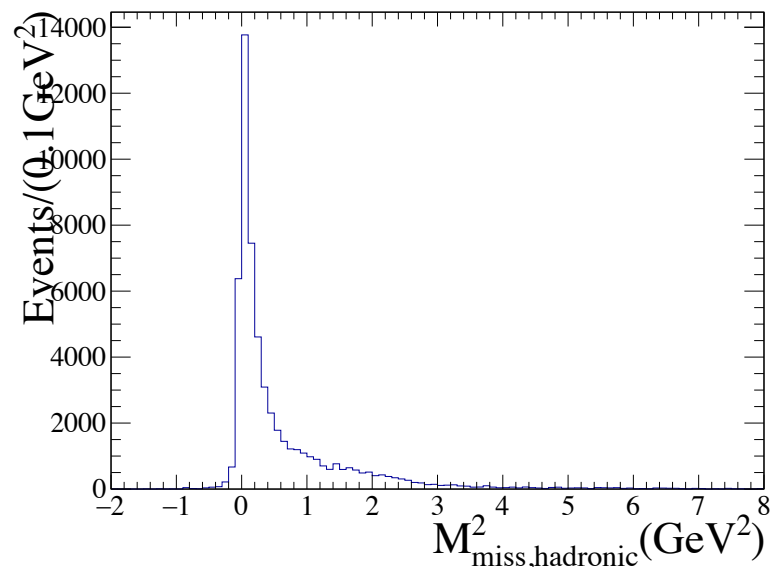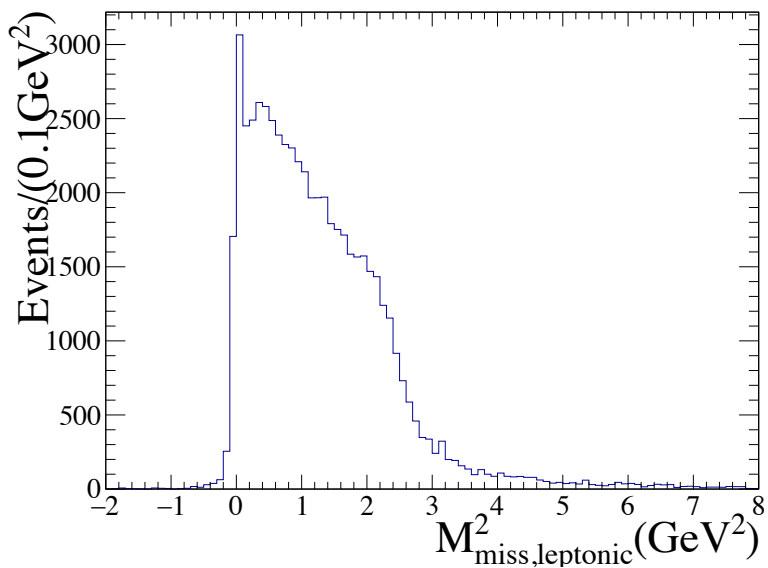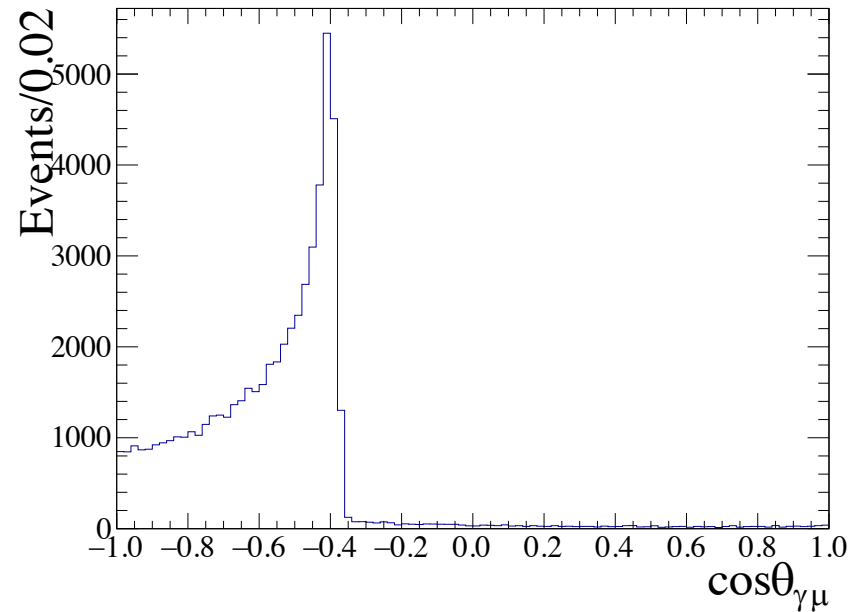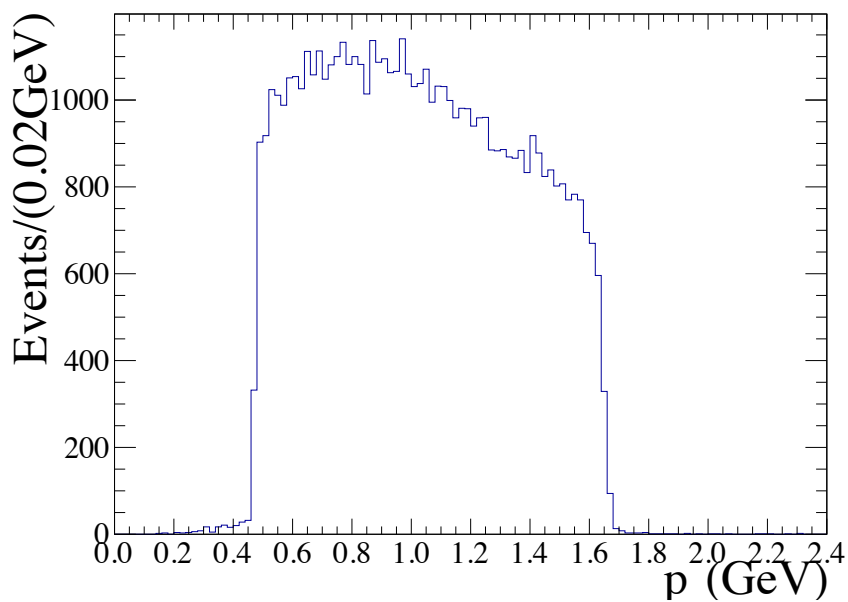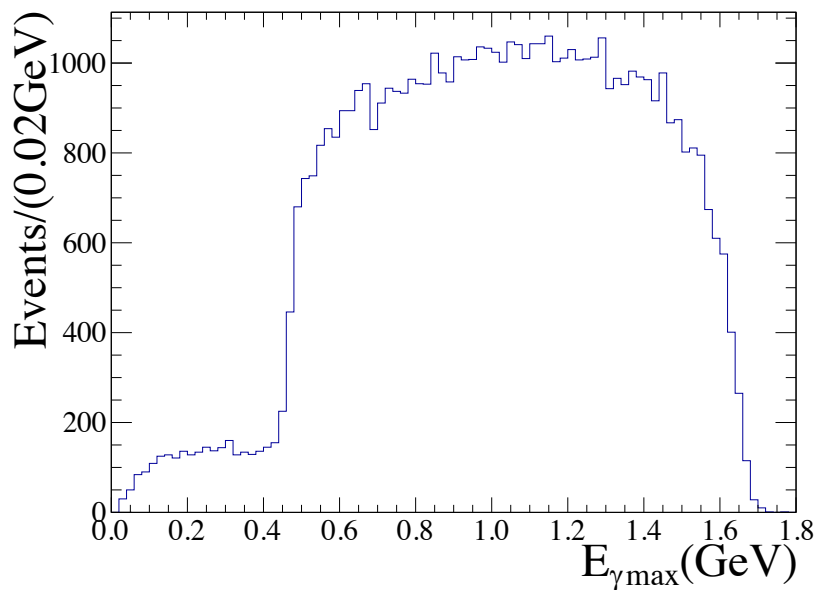
Double Tag

- signal side: $\tau^- \rightarrow \gamma\mu^-$

- tag side: τ^+
  - $e^+ \nu_e \bar{\nu}_\tau$
  - $\mu^+ \nu_\mu \bar{\nu}_\tau$
  - $\pi^+ \bar{\nu}_\tau$
  - $\pi^+ \pi^0 \bar{\nu}_\tau$
  - $\pi^+ \pi^0 \pi^0 \bar{\nu}_\tau$
  - total tag efficiency ~80%

- 根据 $e^+, \mu^+, \pi^+, \gamma$ 数来决定是哪个 tag 道

Event selection

- good charged tracks
  - nGood = 2, nCharge = 0
  - n(mu−) = 1
    n(e+) + n(mu+) + n(pi+) = 1

- good photons
  - nGamma >= 1
  - gamma with max energy is regarded as signal gamma
  - 0.4 <= Eγmax <= 1.7 GeV

- 0.4 <= Pμ <= 1.7 GeV
- cosθγμ <= −0.3
- $M_{miss,leptonic}^2$ <= 5
  $M_{miss,hadronic}^2$ <= 3

Event selection (signal MC)

ditau inclusive MC

rowNo	decay tree (decay initial-final states)	iDcyTr	iDcyIFSts	nEtrs	nCEtrs
1	$Z0 \to \tau^+\tau^-, \tau^+ \to \bar{\nu}_\tau \pi^0 \pi^+, \tau^- \to \mu^- \bar{\nu}_\mu \nu_\tau$ $(Z0 \to \mu^- \bar{\nu}_\mu \nu_\tau \bar{\nu}_\tau \pi^+ \gamma\gamma)$	2	1	1041067	1041067
2	$Z0 \to \tau^+\tau^-, \tau^+ \to \bar{\nu}_\tau \pi^0 \pi^+, \tau^- \to \nu_\tau \pi^0 \pi^-$ $(Z0 \to \nu_\tau \bar{\nu}_\tau \pi^+ \pi^- \gamma\gamma\gamma\gamma)$	0	0	1006668	2047735
3	$Z0 \to \tau^+\tau^-, \tau^+ \to \bar{\nu}_\tau \pi^0 \pi^+, \tau^- \to \nu_\tau \pi^-$ $(Z0 \to \nu_\tau \bar{\nu}_\tau \pi^+ \pi^- \gamma\gamma)$	4	3	612825	2660560
4	$Z0 \to \tau^+\tau^-, \tau^+ \to \bar{\nu}_\tau \pi^0 \pi^+, \tau^- \to \nu_\tau \pi^0 \pi^0 \pi^-$ $(Z0 \to \nu_\tau \bar{\nu}_\tau \pi^+ \pi^- \gamma\gamma\gamma\gamma\gamma\gamma)$	9	8	496501	3157061
5	$Z0 \to \tau^+\tau^-, \tau^+ \to \bar{\nu}_\tau \pi^0 \pi^0 \pi^+, \tau^- \to \mu^- \bar{\nu}_\mu \nu_\tau$ $(Z0 \to \mu^- \bar{\nu}_\mu \nu_\tau \bar{\nu}_\tau \pi^+ \gamma\gamma\gamma\gamma)$	5	4	468113	3625174
6	$Z0 \to \tau^+\tau^-, \tau^+ \to \bar{\nu}_\tau \pi^0 \pi^0 \pi^+, \tau^- \to \nu_\tau \pi^0 \pi^-$ $(Z0 \to \nu_\tau \bar{\nu}_\tau \pi^+ \pi^- \gamma\gamma\gamma\gamma\gamma\gamma)$	15	8	411322	4036496
7	$Z0 \to \tau^+\tau^-, \tau^+ \to \bar{\nu}_\tau \pi^0 \pi^0 \pi^+, \tau^- \to \nu_\tau \pi^-$ $(Z0 \to \nu_\tau \bar{\nu}_\tau \pi^+ \pi^- \gamma\gamma\gamma\gamma)$	1	0	276358	4312854
8	$Z0 \to \tau^+\tau^-, \tau^+ \to \bar{\nu}_\tau \pi^0 \pi^0 \pi^+, \tau^- \to \nu_\tau \pi^0 \pi^0 \pi^-$ $(Z0 \to \nu_\tau \bar{\nu}_\tau \pi^+ \pi^- \gamma\gamma\gamma\gamma\gamma\gamma\gamma\gamma)$	22	9	188686	4501540
9	$Z0 \to \tau^+\tau^-, \tau^+ \to \bar{\nu}_\tau \pi^0 \pi^0 \pi^0 \pi^+, \tau^- \to \mu^- \bar{\nu}_\mu \nu_\tau$ $(Z0 \to \mu^- \bar{\nu}_\mu \nu_\tau \bar{\nu}_\tau \pi^+ \gamma\gamma\gamma\gamma\gamma\gamma)$	6	5	76784	4578324
10	$Z0 \to \tau^+\tau^-, \tau^+ \to e^+ \nu_e \bar{\nu}_\tau, \tau^- \to \nu_\tau \pi^0 \pi^-$ $(Z0 \to e^+ \nu_e \nu_\tau \bar{\nu}_\tau \pi^- \gamma\gamma)$	11	10	73827	4652151
11	$Z0 \to \tau^+\tau^-, \tau^+ \to \mu^+ \nu_\mu \bar{\nu}_\tau, \tau^- \to \nu_\tau \pi^0 \pi^-$ $(Z0 \to \mu^+ \nu_\mu \nu_\tau \bar{\nu}_\tau \pi^- \gamma\gamma)$	33	24	60930	4713081
12	$Z0 \to \tau^+\tau^-, \tau^+ \to \bar{\nu}_\tau \pi^0 \pi^0 \pi^0 \pi^+, \tau^- \to \nu_\tau \pi^0 \pi^-$ $(Z0 \to \nu_\tau \bar{\nu}_\tau \pi^+ \pi^- \gamma\gamma\gamma\gamma\gamma\gamma\gamma\gamma)$	12	9	58971	4772052
13	$Z0 \to \tau^+\tau^-, \tau^+ \to \bar{\nu}_\tau \pi^+, \tau^- \to \nu_\tau \pi^0 \pi^-$ $(Z0 \to \nu_\tau \bar{\nu}_\tau \pi^+ \pi^- \gamma\gamma)$	23	3	58190	4830242
14	$Z0 \to \tau^+\tau^-, \tau^+ \to \bar{\nu}_\tau \pi^+, \tau^- \to \nu_\tau \pi^0 \pi^0 \pi^-$ $(Z0 \to \nu_\tau \bar{\nu}_\tau \pi^+ \pi^- \gamma\gamma\gamma\gamma)$	28	0	50346	4880588
15	$Z0 \to \tau^+\tau^-, \tau^+ \to e^+ \nu_e \bar{\nu}_\tau, \tau^- \to \nu_\tau \pi^0 \pi^0 \pi^-$ $(Z0 \to e^+ \nu_e \nu_\tau \bar{\nu}_\tau \pi^- \gamma\gamma\gamma\gamma)$	24	17	50135	4930723
16	$Z0 \to \tau^+\tau^-, \tau^+ \to \mu^+ \nu_\mu \bar{\nu}_\tau, \tau^- \to \nu_\tau \pi^0 \pi^0 \pi^-$ $(Z0 \to \mu^+ \nu_\mu \nu_\tau \bar{\nu}_\tau \pi^- \gamma\gamma\gamma\gamma)$	16	13	48587	4979310
17	$Z0 \to \tau^+\tau^-, \tau^+ \to \bar{\nu}_\tau \pi^0 \pi^+, \tau^- \to e^- \bar{\nu}_e \nu_\tau$ $(Z0 \to e^- \bar{\nu}_e \nu_\tau \bar{\nu}_\tau \pi^+ \gamma\gamma)$	48	30	42398	5021708

ditau inclusive MC

- main bkg:
  - $\tau^- \to \mu^- \bar{\nu}_\mu \nu_\tau$
  - π^- mis-identified as signal μ^-
  - tag gamma mis-identified as signal gamma
  - gamma from π^0 from τ^- mis-identified as signal gamma

- current cuts on signal side are weak. possible solutions:
  - reconstruct pi0
  - require exactly one gamma in signal side
  - kinematic fit imposing energy and momentum conservation on signal side and hadronic tag side