$\tau \to \gamma\mu$ at STCF

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Double Tag

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

- 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 80.78%

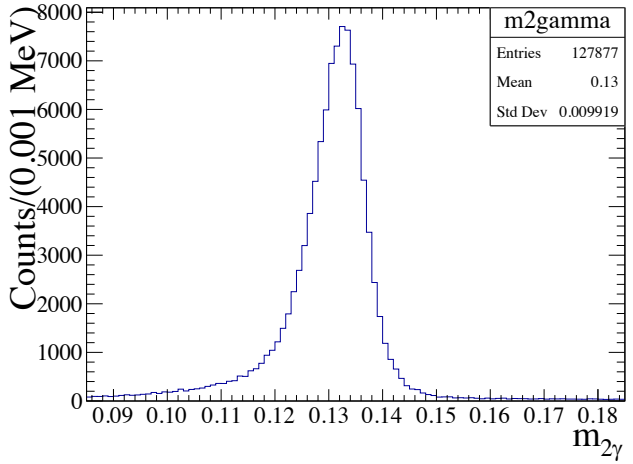
- 根据 e^+, μ^+, π^+, γ 数来决定是哪个 tag 道

Event Selection

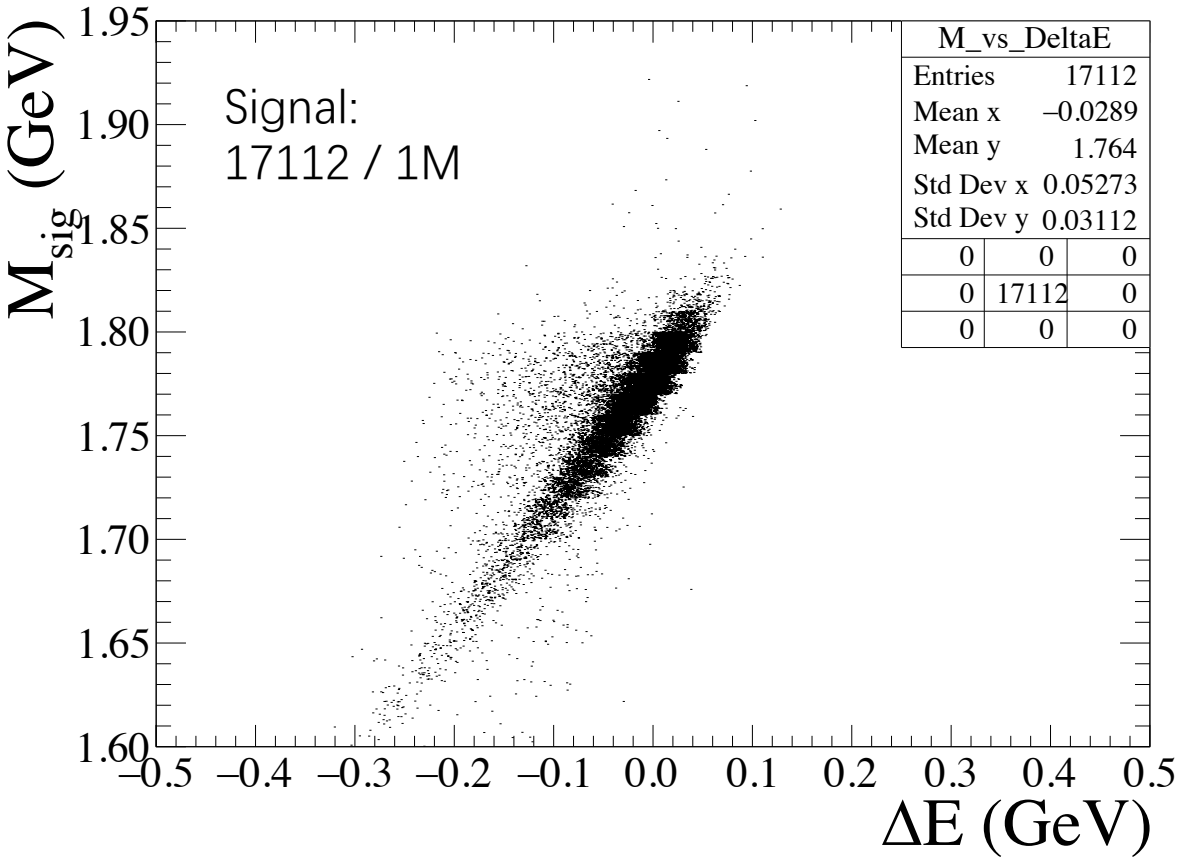
- Good charged tracks
  - nGood = 2, nCharge = 0
- Good photons
  - nGamma >= 1
  - Reconstruct π0 (see next page)
  - # of gamma left = 1 (signal gamma)
  - E_gamma,sig in [1.2, 1.65]GeV
- PID
  - N(mu-) = 1
    N(e+) + N(mu+) + N(pi+) = 1
- P_mu,sig in [0.45, 1]GeV
- E_tag_visible <= 1.2 GeV
- $M_{miss,leptonic}^2$ in [0.45, 2.8] GeV^2
  $M_{miss,hadronic}^2$ <= 1 GeV^2
- $-0.9 <= \cos\theta\gamma\mu_{,sig} <= -0.37$

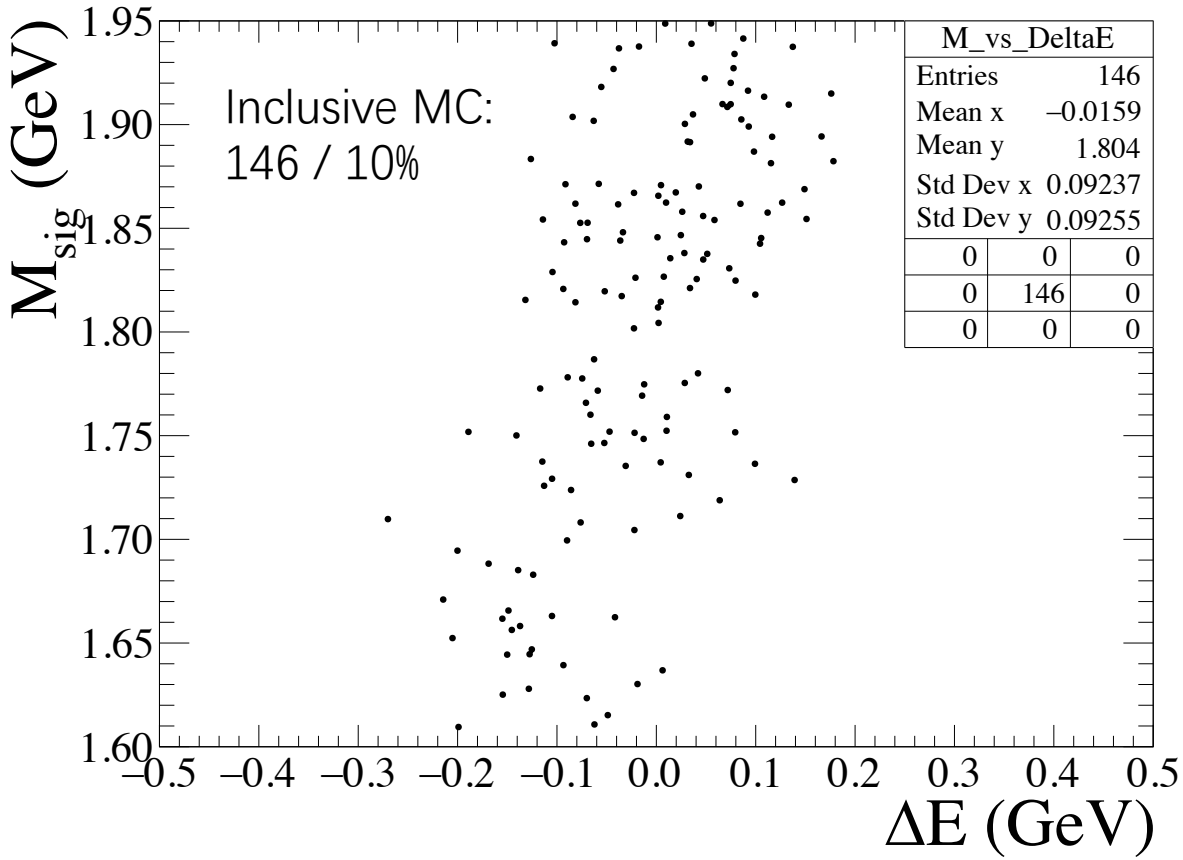
Reconstruct π0

- 确定质量窗：
  - 将 signal MC 的光子两两组合，按与 π0 质量接近程度排序
  - 根据 truth 信息得到 pi0 数目
  - 选取相应数量的不重复的组合，根据其分布，
    确定质量窗 [0.12 GeV, 0.14 GeV]
- 重建 pi0：
  - 将光子两两组合，按与 π0 质量接近程度排序
  - 选取在质量窗内的、不重复的组合，作为重建的 pi0

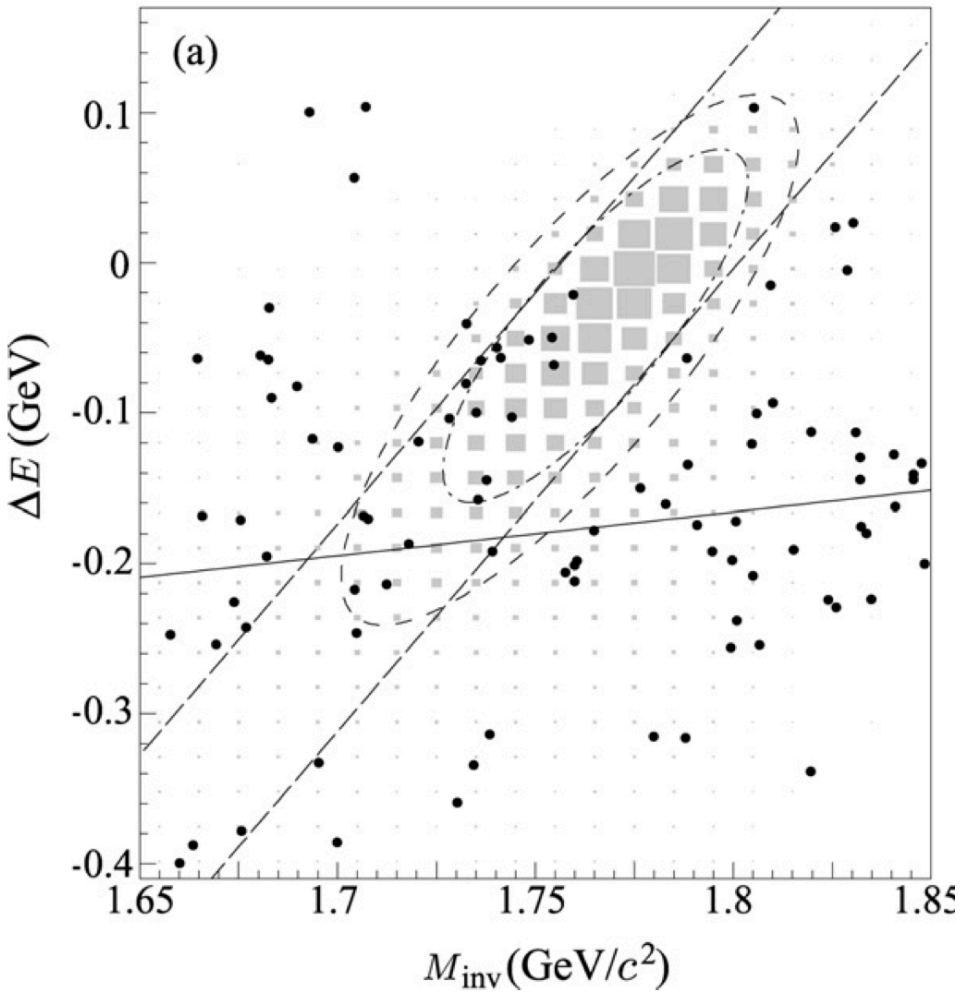


Result


Signal:
17112 / 1M
M_vs_DeltaE
Entries 17112
Mean x –0.0289
Mean y 1.764
Std Dev x 0.05273
Std Dev y 0.03112
0 0 0
0 17112 0
0 0 0
M_{sig} (GeV)
ΔE (GeV)


Inclusive MC:
146 / 10%
M_vs_DeltaE
Entries 146
Mean x –0.0159
Mean y 1.804
Std Dev x 0.09237
Std Dev y 0.09255
0 0 0
0 146 0
0 0 0
M_{sig} (GeV)
ΔE (GeV)

rowNo	decay tree (decay initial-final states)	iDcyTr	iDcyIFSts	nEtrs	nCEtrs
1	$Z0 \to \tau^+\tau^-, \tau^+ \to \bar{\nu}_\tau\pi^0\pi^+, \tau^- \to \mu^-\bar{\nu}_\mu\nu_\tau$ $(Z0 \to \mu^-\bar{\nu}_\mu\nu_\tau\bar{\nu}_\tau\pi^+\gamma\gamma)$	18	18	32	32
2	$e^+e^- \to Z0\gamma^I, Z0 \to \tau^+\tau^-, \tau^+ \to \bar{\nu}_\tau\pi^0\pi^+, \tau^- \to \mu^-\bar{\nu}_\mu\nu_\tau$ $(e^+e^- \to \mu^-\bar{\nu}_\mu\nu_\tau\bar{\nu}_\tau\pi^+\gamma^I\gamma\gamma)$	12	12	19	51
3	$Z0 \to \tau^+\tau^-, \tau^+ \to e^+\nu_e\bar{\nu}_\tau\gamma^f, \tau^- \to \mu^-\bar{\nu}_\mu\nu_\tau$ $(Z0 \to e^+\nu_e\mu^-\bar{\nu}_\mu\nu_\tau\bar{\nu}_\tau\gamma^f)$	10	10	16	67
4	$e^+e^- \to Z0\gamma^I\gamma^I, Z0 \to \tau^+\tau^-, \tau^+ \to \bar{\nu}_\tau\pi^0\pi^+, \tau^- \to \mu^-\bar{\nu}_\mu\nu_\tau$ $(e^+e^- \to \mu^-\bar{\nu}_\mu\nu_\tau\bar{\nu}_\tau\pi^+\gamma^I\gamma^I\gamma\gamma)$	13	13	7	74
5	$e^+e^- \to e^+\gamma^I\gamma^I\gamma^I$ $(e^+e^- \to e^+\gamma^I\gamma^I\gamma^I)$	0	0	6	80
6	$e^+e^- \to e^+\gamma^I\gamma^I$ $(e^+e^- \to e^+\gamma^I\gamma^I)$	1	1	5	85
7	$e^+e^- \to e^+\gamma^I$ $(e^+e^- \to e^+\gamma^I)$	2	2	5	90
8	$e^+e^- \to \mu^+\mu^-\gamma^I\gamma^I\gamma^I\gamma^I$ $(e^+e^- \to \mu^+\mu^-\gamma^I\gamma^I\gamma^I\gamma^I)$	5	5	4	94
9	$e^+e^- \to \mu^+\mu^-\gamma^I\gamma^I$ $(e^+e^- \to \mu^+\mu^-\gamma^I\gamma^I)$	6	6	4	98
10	$e^+e^- \to Z0\gamma^I, Z0 \to \tau^+\tau^-, \tau^+ \to e^+\nu_e\bar{\nu}_\tau\gamma^f, \tau^- \to \nu_\tau\pi^-$ $(e^+e^- \to e^+\nu_e\nu_\tau\bar{\nu}_\tau\pi^-\gamma^I\gamma^f)$	15	15	4	102
11	$e^+e^- \to \mu^+\mu^-\gamma^I\gamma^I\gamma^I$ $(e^+e^- \to \mu^+\mu^-\gamma^I\gamma^I\gamma^I)$	4	4	4	106
12	$e^+e^- \to Z0\gamma^I, Z0 \to \tau^+\tau^-, \tau^+ \to e^+\nu_e\bar{\nu}_\tau\gamma^f, \tau^- \to \mu^-\bar{\nu}_\mu\nu_\tau$ $(e^+e^- \to e^+\nu_e\mu^-\bar{\nu}_\mu\nu_\tau\bar{\nu}_\tau\gamma^I\gamma^f)$	24	24	4	110
13	$e^+e^- \to Z0\gamma^I, Z0 \to \tau^+\tau^-, \tau^+ \to \bar{\nu}_\tau\pi^0\pi^+, \tau^- \to \nu_\tau\pi^-$ $(e^+e^- \to \nu_\tau\bar{\nu}_\tau\pi^+\pi^-\gamma^I\gamma\gamma)$	21	21	3	113
14	$Z0 \to \tau^+\tau^-, \tau^+ \to \bar{\nu}_\tau\pi^0\pi^+, \tau^- \to \nu_\tau\pi^-$ $(Z0 \to \nu_\tau\bar{\nu}_\tau\pi^+\pi^-\gamma\gamma)$	17	17	2	115
15	$Z0 \to \tau^+\tau^-, \tau^+ \to \bar{\nu}_\tau\pi^0\pi^+, \tau^- \to e^-\bar{\nu}_e\nu_\tau$ $(Z0 \to e^-\bar{\nu}_e\nu_\tau\bar{\nu}_\tau\pi^+\gamma\gamma)$	23	23	2	117
16	$e^+e^- \to Z0\gamma^I\gamma^I, Z0 \to \tau^+\tau^-, \tau^+ \to e^+\nu_e\bar{\nu}_\tau\gamma^f, \tau^- \to \mu^-\bar{\nu}_\mu\nu_\tau$ $(e^+e^- \to e^+\nu_e\mu^-\bar{\nu}_\mu\nu_\tau\bar{\nu}_\tau\gamma^I\gamma^I\gamma^f)$	20	20	2	119
17	$e^+e^- \to Z0\gamma^I, Z0 \to \tau^+\tau^-, \tau^+ \to \bar{\nu}_\tau\pi^0\pi^+, \tau^- \to \nu_\tau\pi^0\pi^-$ $(e^+e^- \to \nu_\tau\bar{\nu}_\tau\pi^+\pi^-\gamma^I\gamma\gamma\gamma\gamma)$	36	36	2	121



- Belle, Physics Letters B 666 (2008) 16–22
- similar problem
- fit data with MC shape to get N