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

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2019.09.26

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%

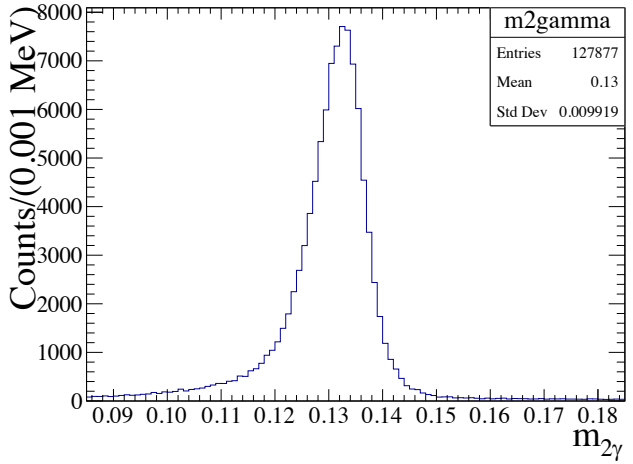
- 根据 e^+, μ^+, π^+, γ 数来决定是哪个 tag 道

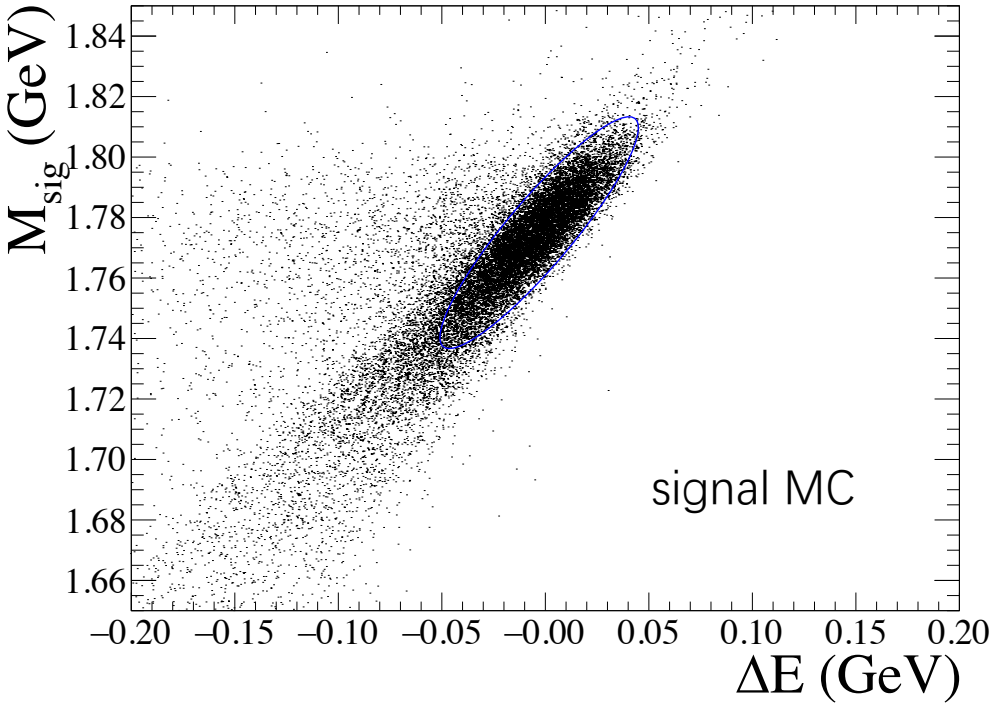
Event Selection

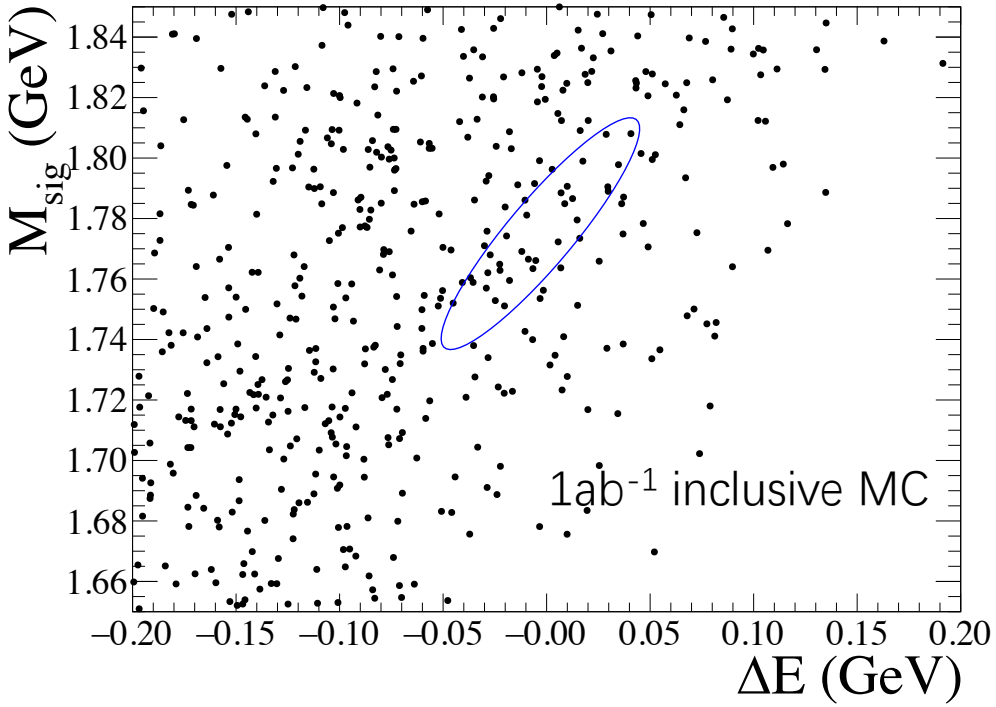
- Good charged tracks
  - nGood = 2, nCharge = 0
- Good photons
  - nGamma >= 1
  - Reconstruct π0 (see next page)
  - # of gamma left = 1 (signal gamma)
  - E_gamma,sig in [0.4, 1.6]GeV
- PID
  - N(mu-) = 1
    N(e+) + N(mu+) + N(pi+) = 1
- P_mu,sig in [0.45, 1.6]GeV
- E_tag_visible <= 1.2 GeV
- $M_{miss,leptonic}^2$ in [0.45, 2.8] GeV^2
  $M_{miss,hadronic}^2$ <= 1 GeV^2
- $-0.9 <= \cos\theta_{\gamma\mu,sig} <= -0.37$
- cuts on cosθ between sig tracks and tag tracks

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







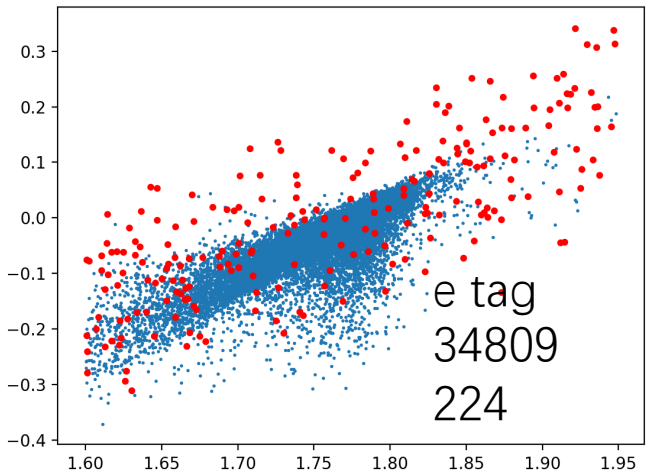
Use e tag only, because too much background for other tag modes.

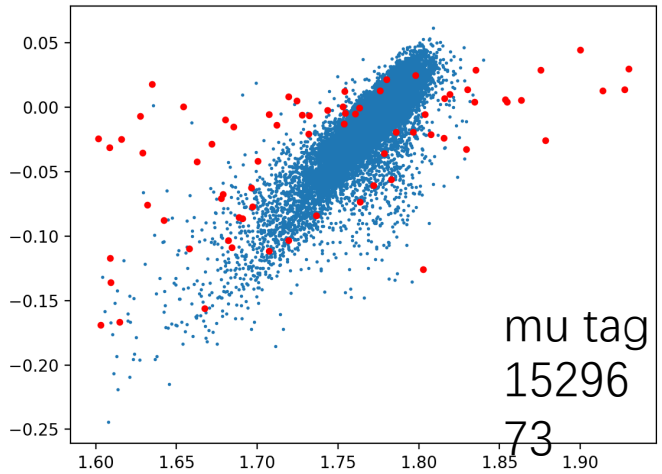
Efficiency: 17.82%(Br) × 5.71%(event selection) = 1.02%

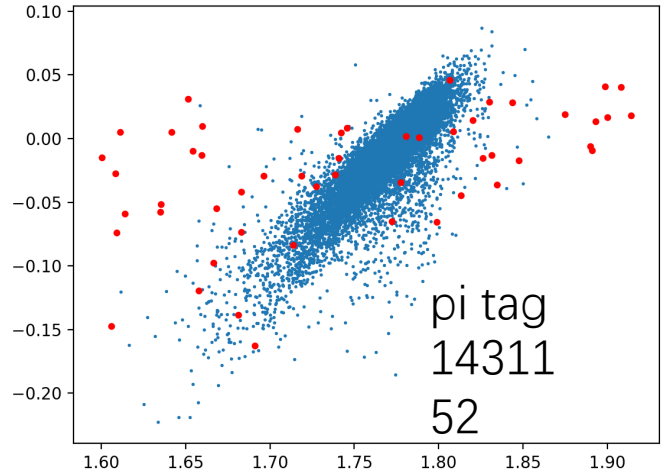
UL ~ 8×10^{-7}

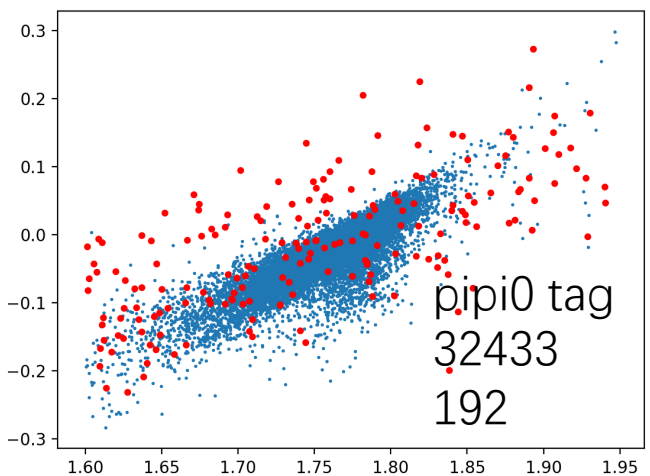
Neutral Network

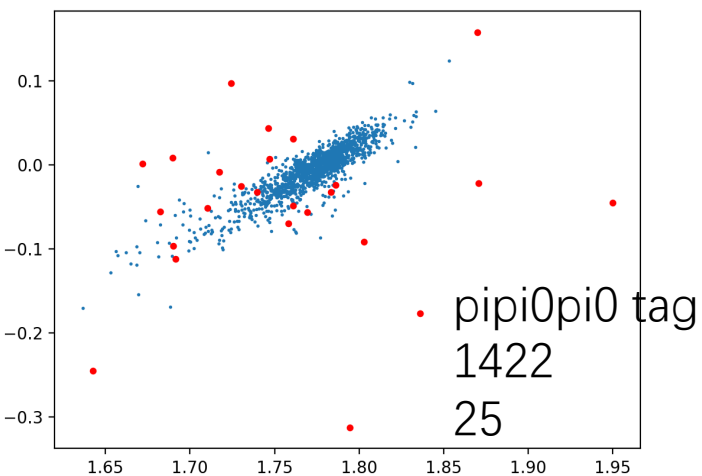
- inputs:
  - E of tracks
  - p of tracks
  - cosθ of tracks
  - cosθ between tracks
- 1 hidden layer with 10 hidden units (can be adjusted)
- 1 output, $\in [0, 1]$


e tag
34809
224


mu tag
15296
73


pi tag
14311
52


pipi0 tag
32433
192


pipi0pi0 tag
1422
25