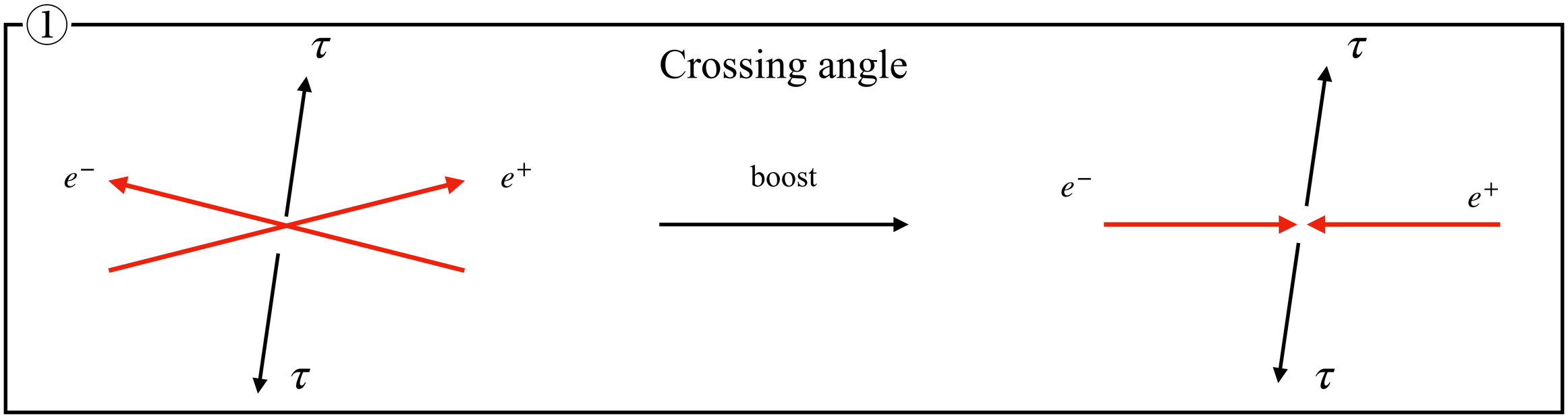
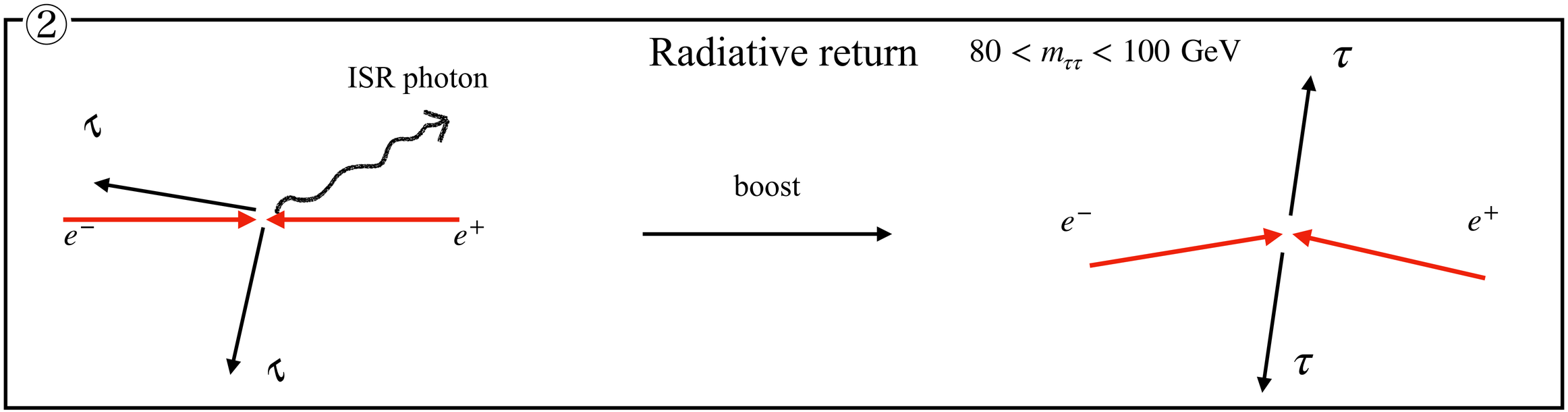
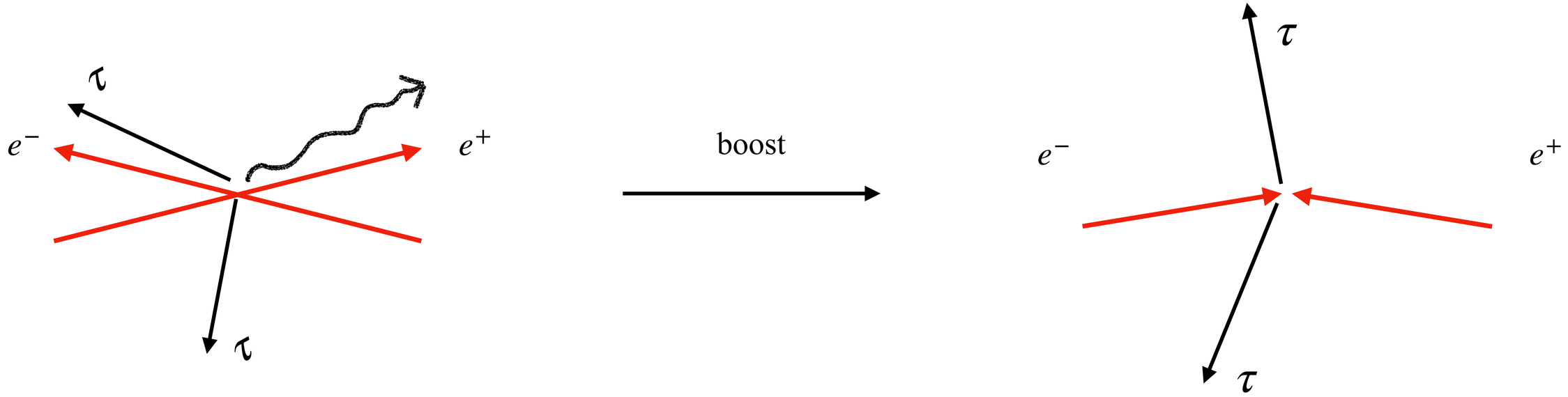
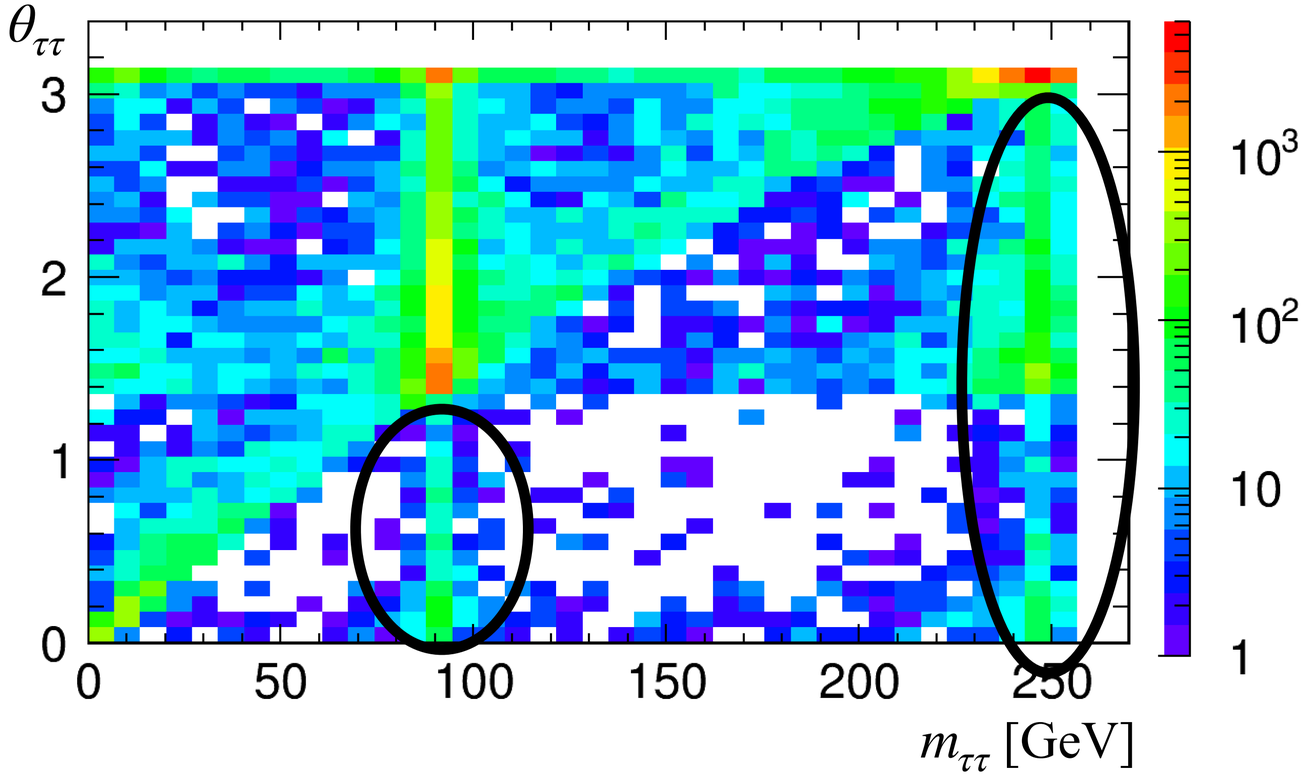
Two ways boost are needed.

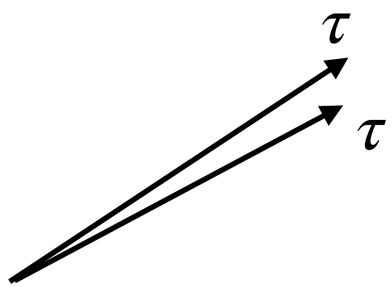






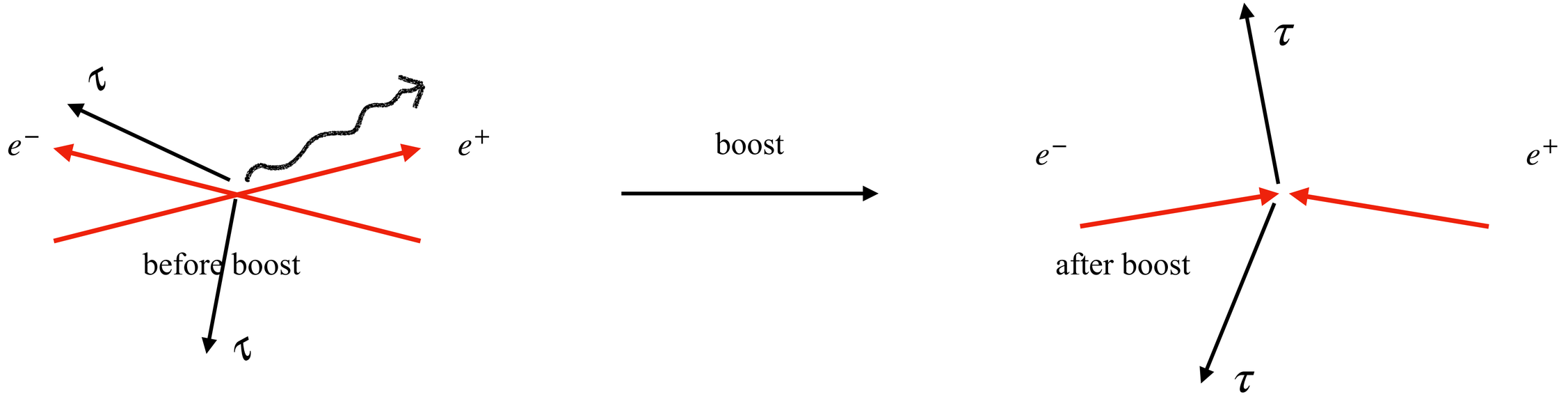
ISR photon boost after boosted into **NO** Crossing angle frame



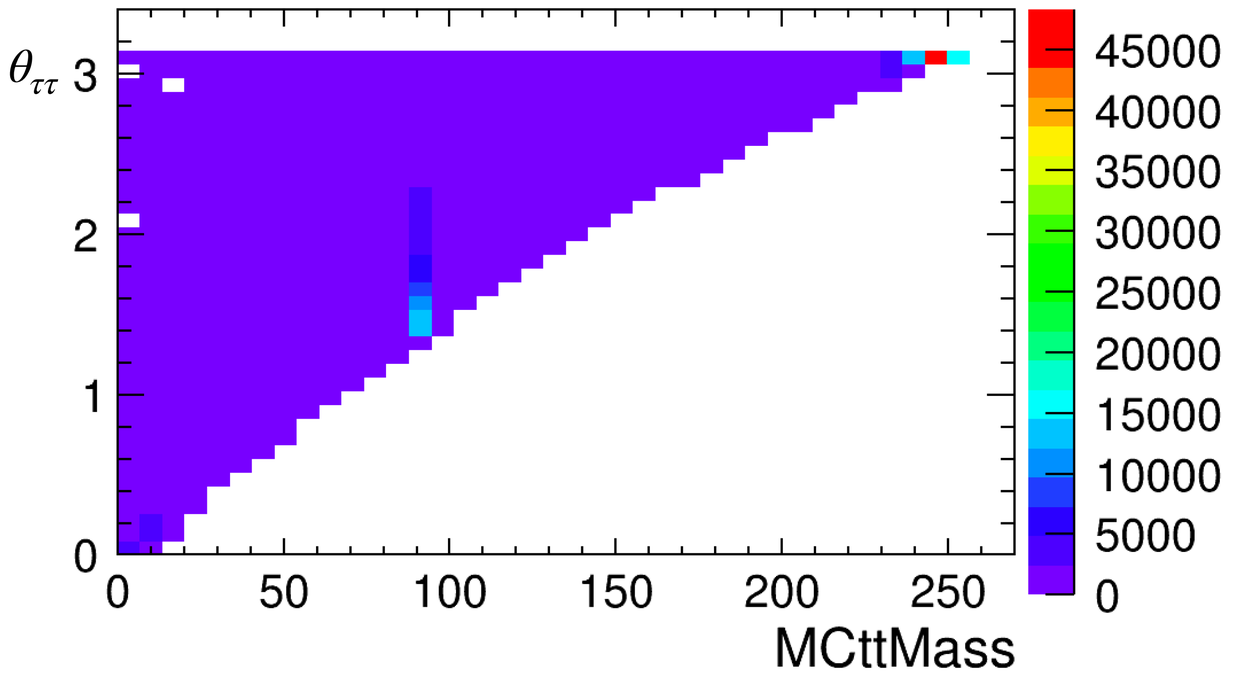


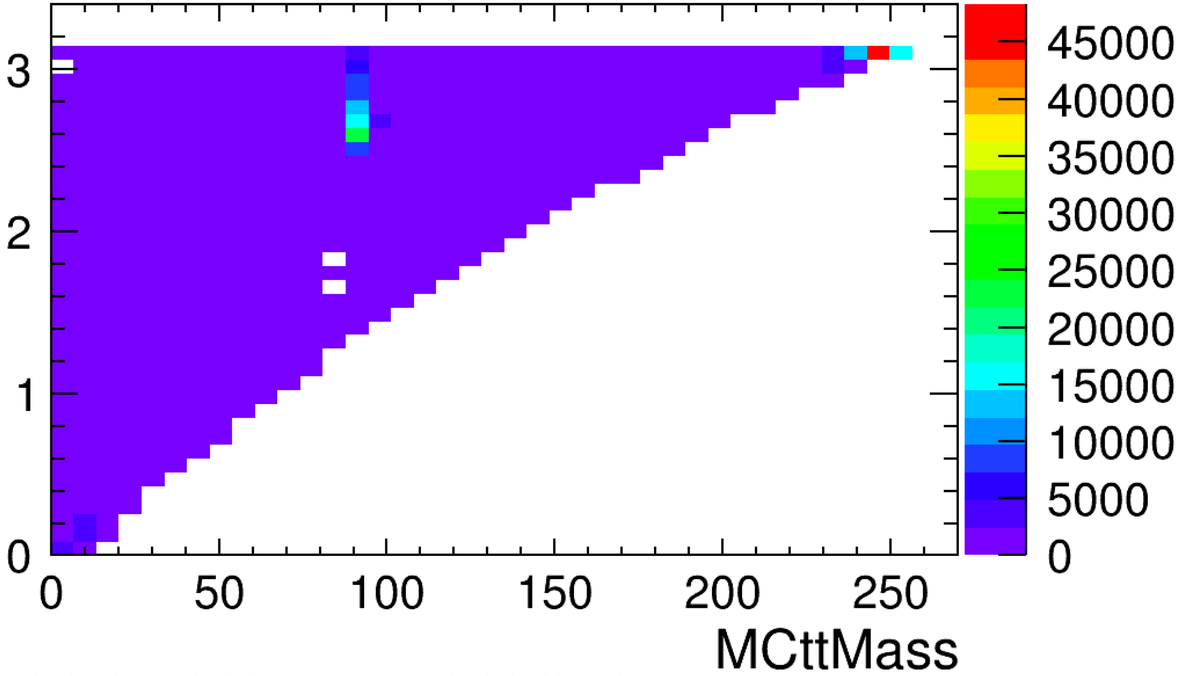
$\tau - \tau$ is collinear and have high $m_{\tau\tau}$?

need to investigate the reason



ISR photon boost after boosted into **NO** Crossing angle frame





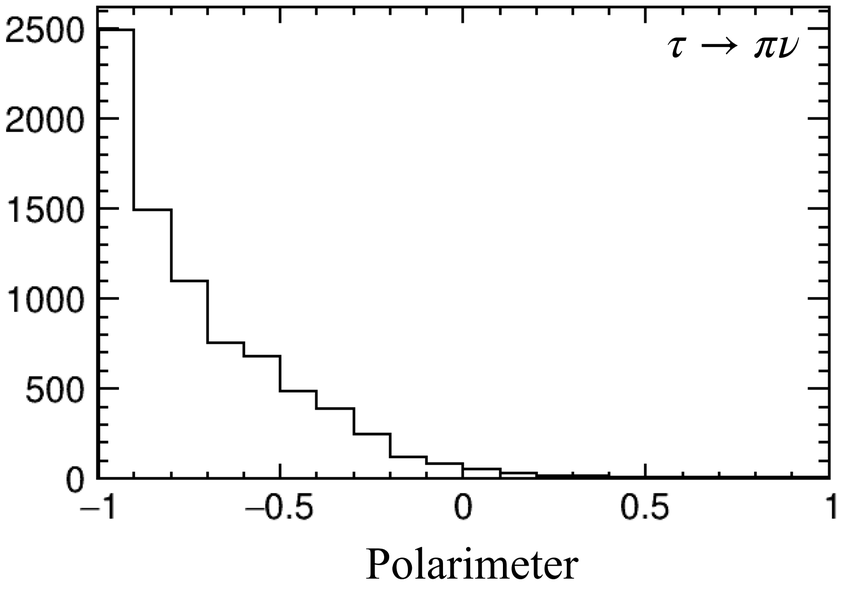
some global variables are not initialised..

MC

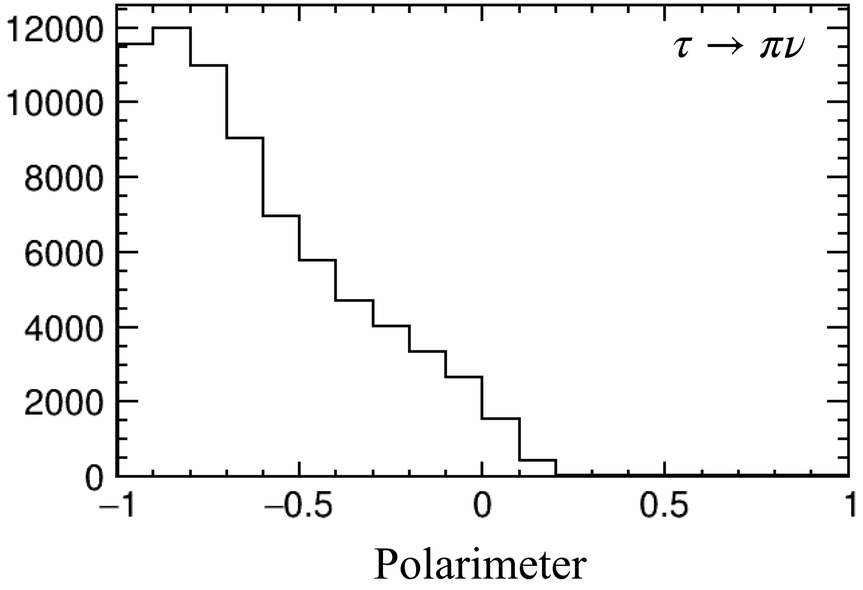
$80 < m_{\tau\tau} < 100$ GeV

E_ν

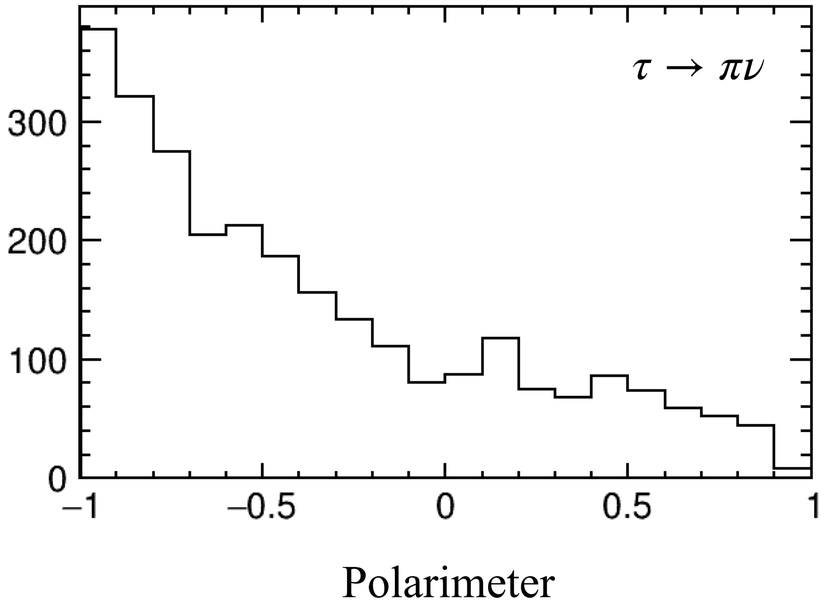
Cone method

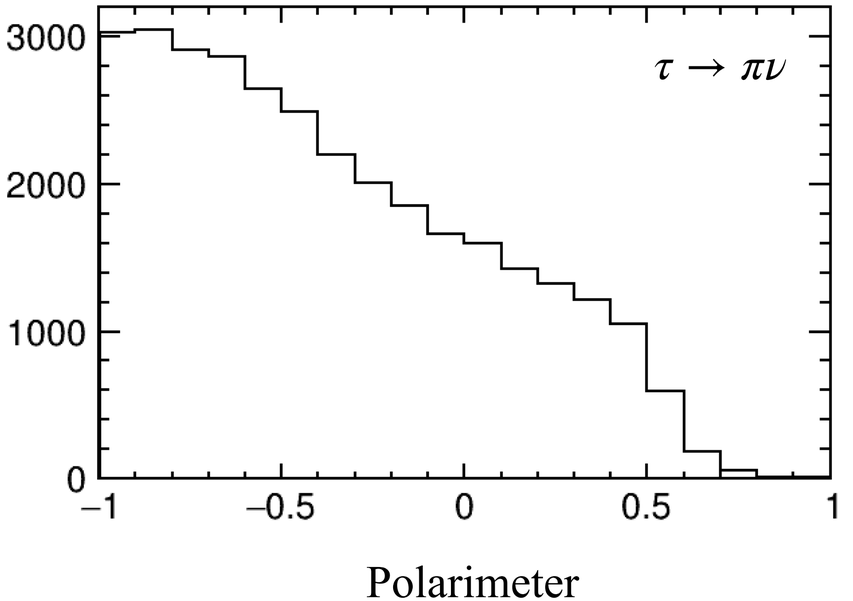


Midpoint method



$E_{\mathrm{CM}}/2 - E^{\tau}_{\mathrm{vis}}$





$(E_{\mathrm{CM}} - E_{\mathrm{ISR}})/2 - E^{\tau}_{\mathrm{vis}}$

MC linked PFO

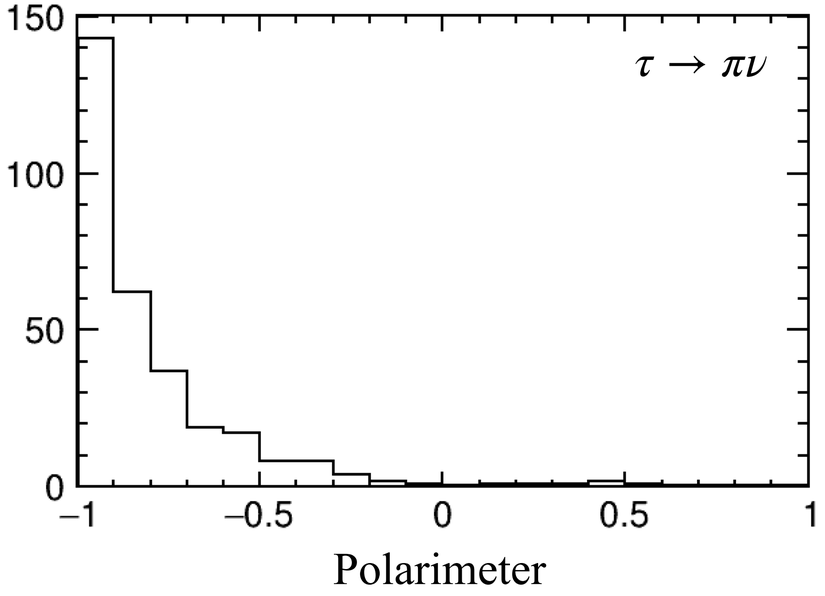
$80 < m_{\tau\tau} < 100$ GeV

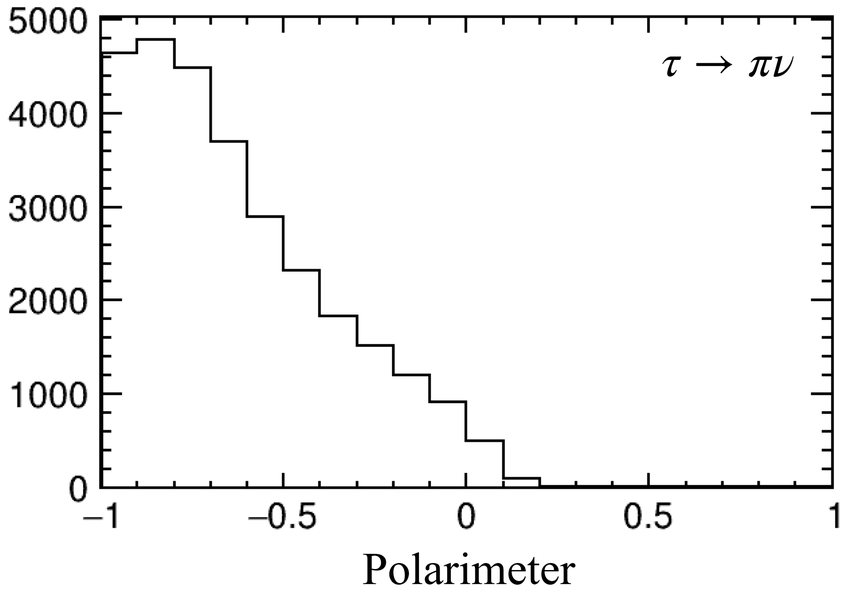
Cone method

Midpoint method

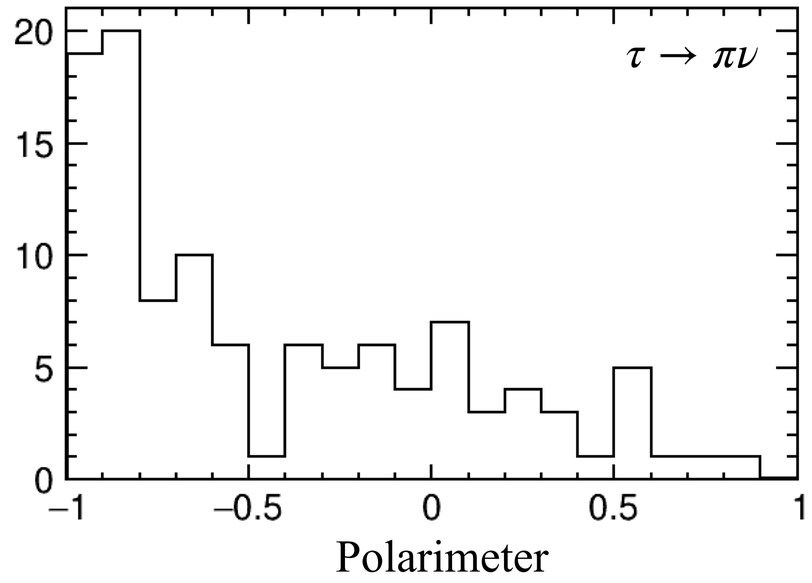
E_ν

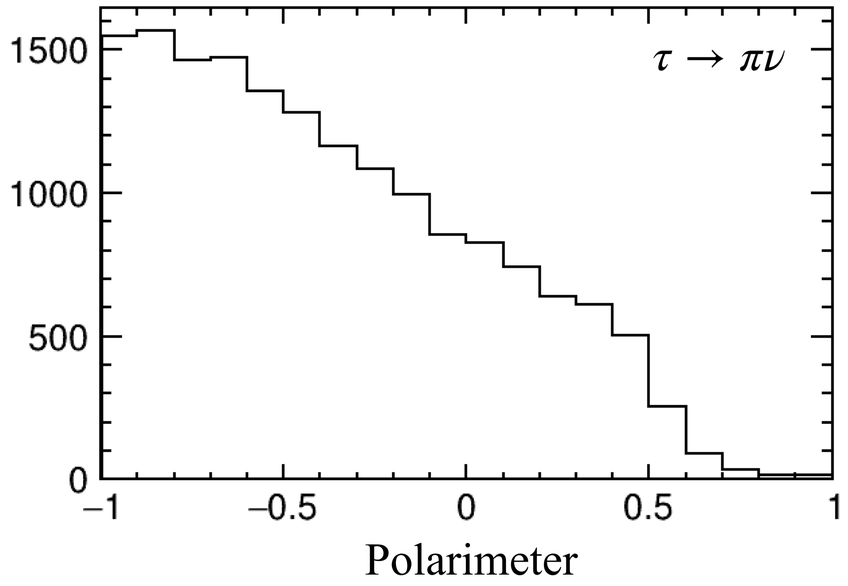
$E_{\mathrm{CM}}/2 - E^{\tau}_{\mathrm{vis}}$



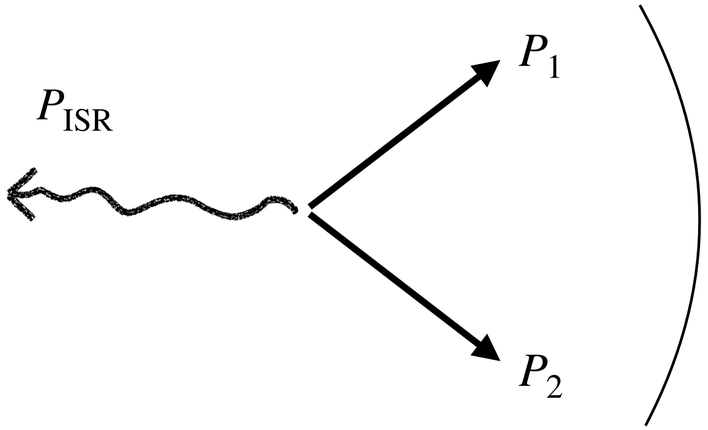


$(E_{\mathrm{CM}} - E_{\mathrm{ISR}})/2 - E^{\tau}_{\mathrm{vis}}$





$80 < m_{\tau\tau} < 100$ GeV

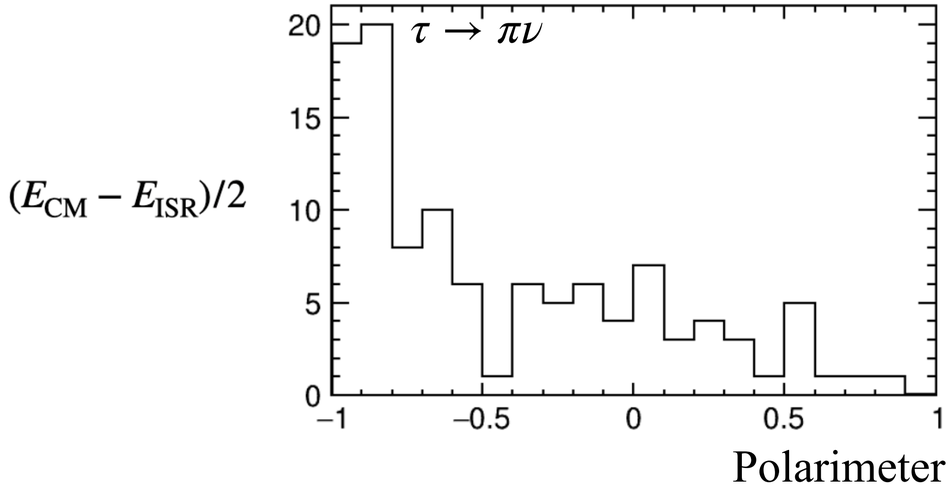


$\hat{E}_{\mathrm{CM}} = \sqrt{\hat{s}}$: mass of $P_1 + P_2$ system

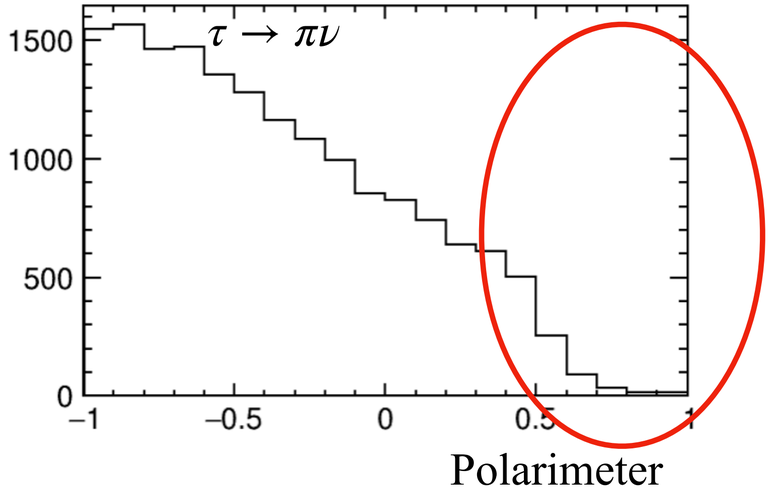
$\hat{s} = (P_1 + P_2)^2$

$\hat{E}_{\mathrm{CM}} \neq E_{\mathrm{CM}} - E_{\mathrm{ISR}}$

Cone method



Midpoint method



$80 < m_{\tau\tau} < 100$ GeV

$$P_{\mathrm{ISR}} = \frac{E_{\mathrm{CM}}}{2}\bar{\beta}$$

where

$$\bar{\beta}(X_1, X_2) = \sqrt{1 - 2(X_1 + X_2) + (X_1 - X_2)^2}$$

with

$$\begin{cases} X_1 \equiv \left(\dfrac{m_{\mathrm{ISR}}}{E_{\mathrm{CM}}}\right)^2 = 0 & \because m_{\mathrm{ISR}} = 0 \\ X_2 \equiv \left(\dfrac{\hat{E}_{\mathrm{CM}}}{E_{\mathrm{CM}}}\right)^2 \end{cases}$$

$$\rightarrow \bar{\beta} = 1 - \left(\frac{\hat{E}_{\mathrm{CM}}}{E_{\mathrm{CM}}}\right)^2$$

$$P_{\mathrm{ISR}} = E_{\mathrm{ISR}} = \frac{E_{\mathrm{CM}}}{2}\left[1 - \left(\frac{\hat{E}_{\mathrm{CM}}}{E_{\mathrm{CM}}}\right)^2\right] \quad \rightarrow \quad \hat{E}_{\mathrm{CM}} = E_{\mathrm{CM}}\sqrt{1 - \frac{E_{\mathrm{ISR}}}{E_{\mathrm{CM}}/2}}$$

⬇

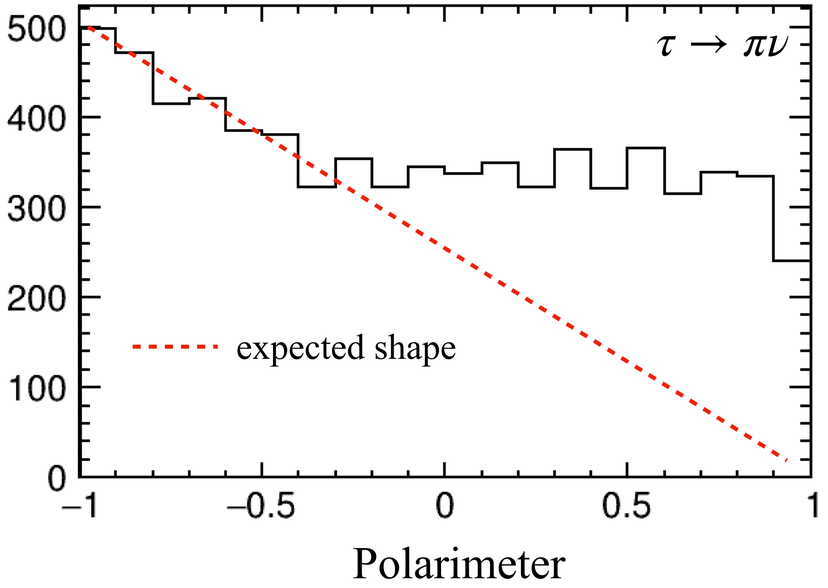
$$\hat{E}_{\tau} = \frac{\hat{E}_{CM}}{2} = \frac{E_{\mathrm{CM}}}{2}\sqrt{1 - \frac{E_{ISR}}{E_{\mathrm{CM}}/2}}$$

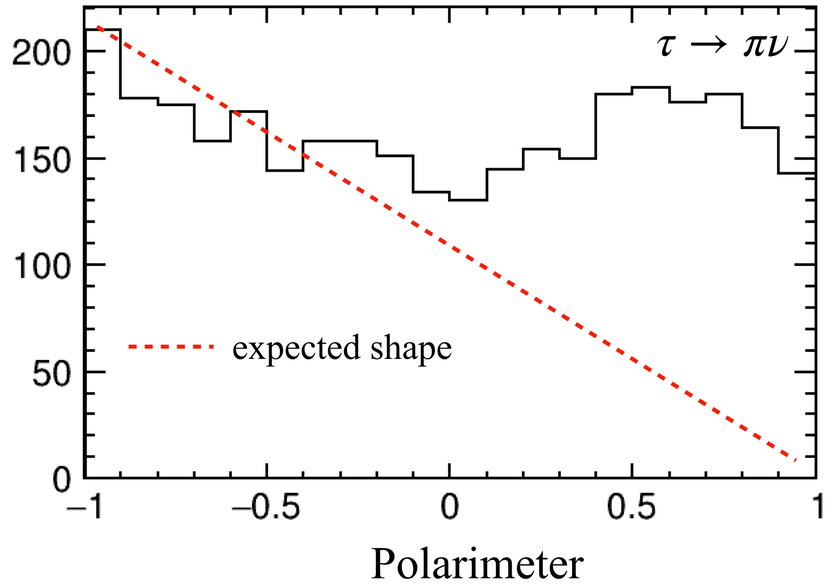
$$\hat{E}_{\mathrm{CM}} \neq E_{\mathrm{CM}} - E_{\mathrm{ISR}}$$

$$\hat{E}_\tau = \frac{\hat{E}_{CM}}{2} = \frac{E_{\mathrm{CM}}}{2}\sqrt{1 - \frac{E_{ISR}}{E_{\mathrm{CM}}/2}}$$

neutrino energy

$$E_\nu = \frac{E_{\mathrm{CM}}}{2}\sqrt{1 - \frac{E_{ISR}}{E_{\mathrm{CM}}/2}} - E^{\tau}_{\mathrm{vis}}$$





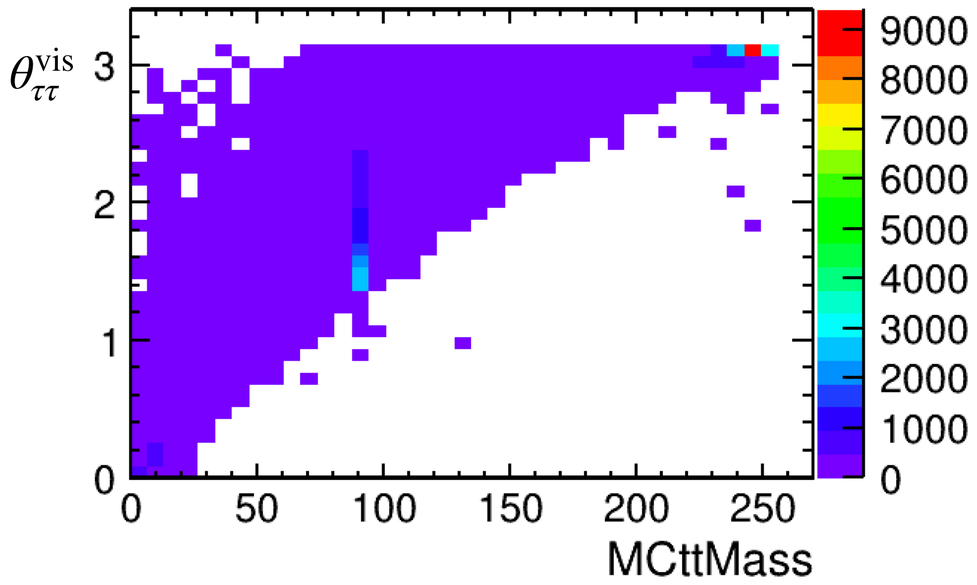
Different from expectation…

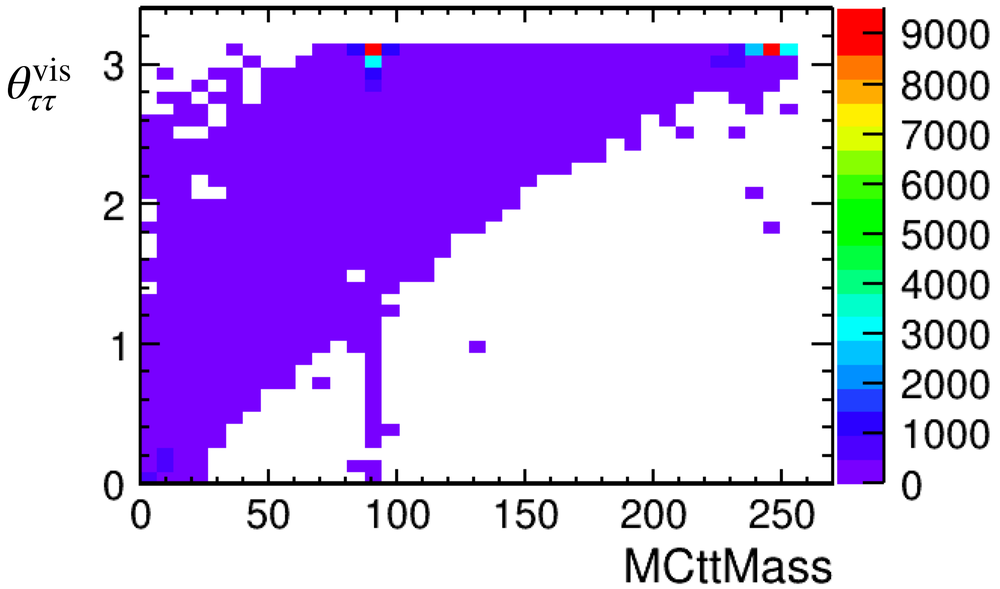
boost into $\tau - \tau$ rest frame after ISR photon emission

before boost

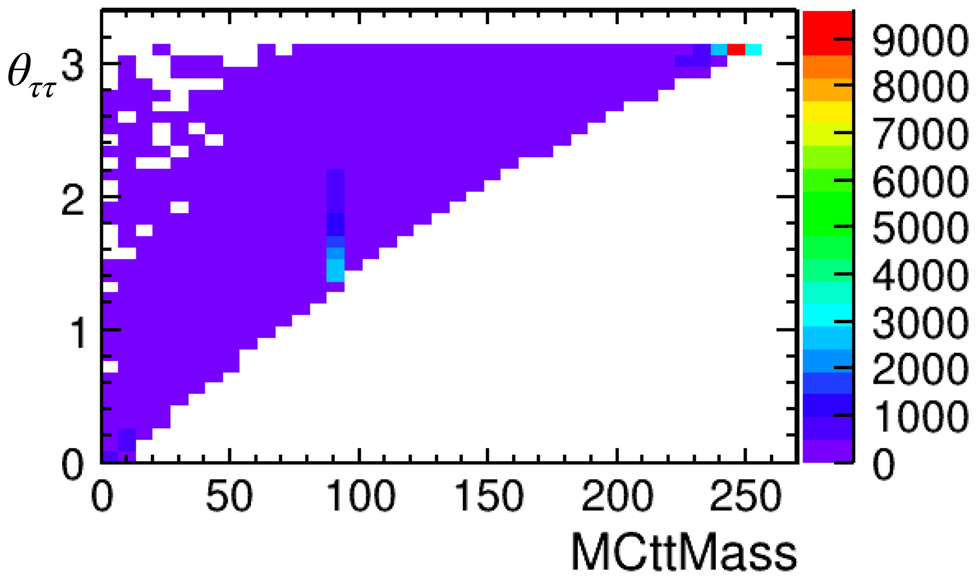
after boost

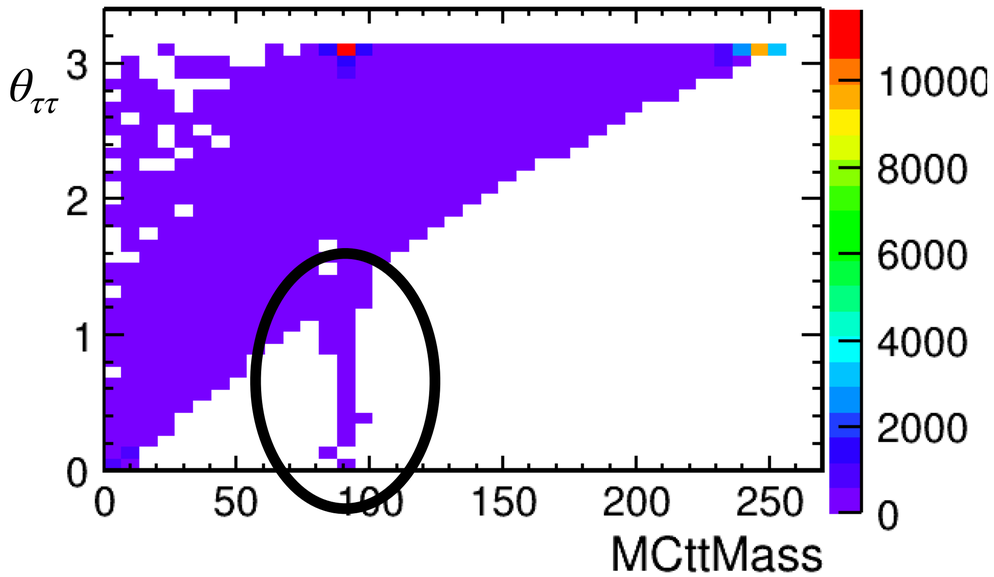
MC vis tau daughter





MC tau





boost is wrong?