

MILO VERMEULEN — 24-10-2019

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# TRACK CONTAMINATION AND ENERGY RECONSTRUCTION

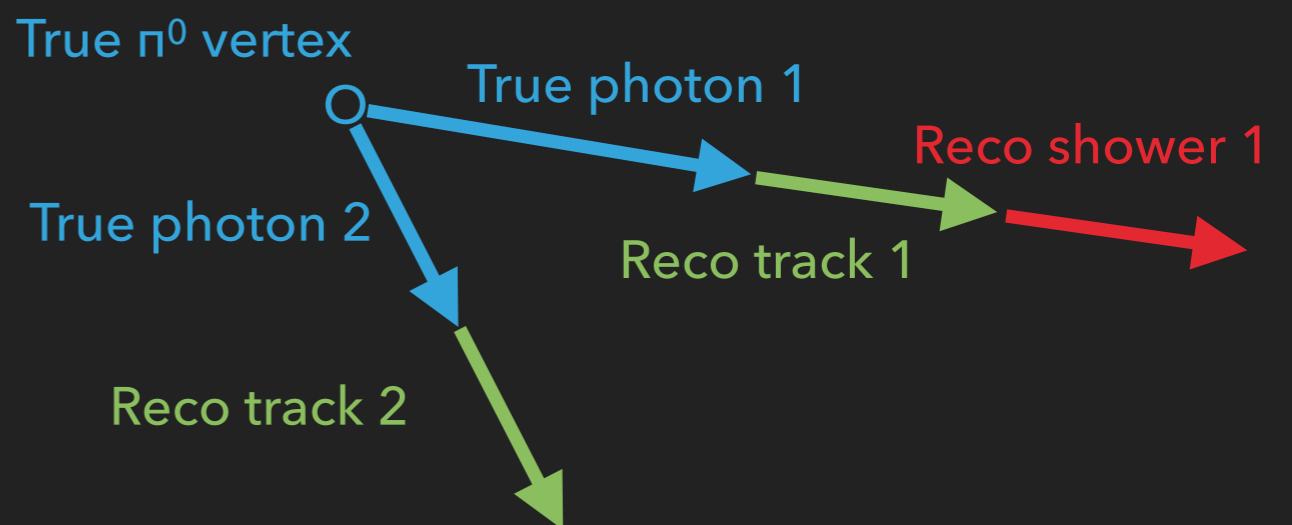
## BACKGROUND

- ▶  $\pi^0$  showers (and other showers) can be partially reconstructed as tracks

- ▶ Valuable information is stored in these objects

- ▶ Photon direction
- ▶ Photon energy

- ▶ Better  $\pi^0$  identification and positioning

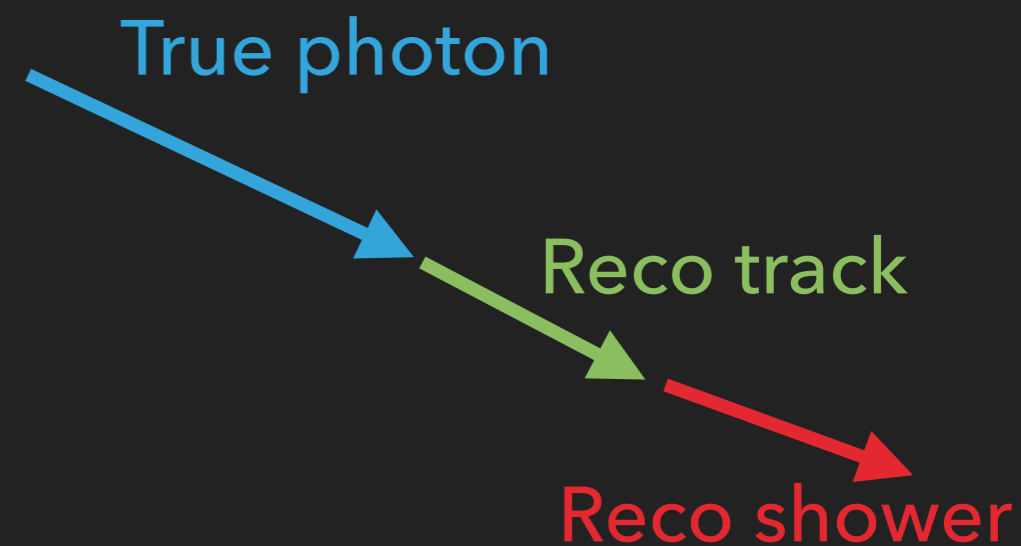
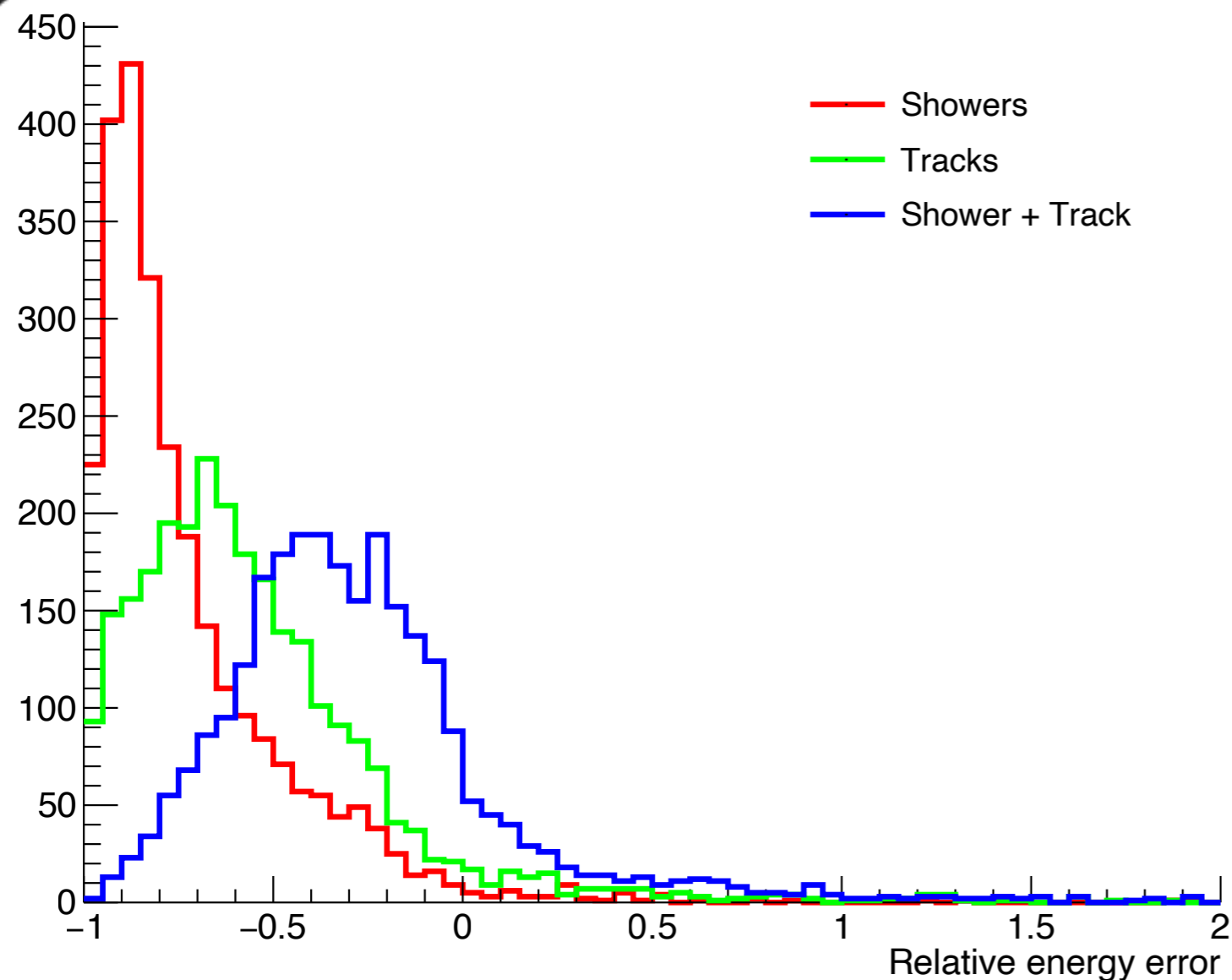


## SAMPLE

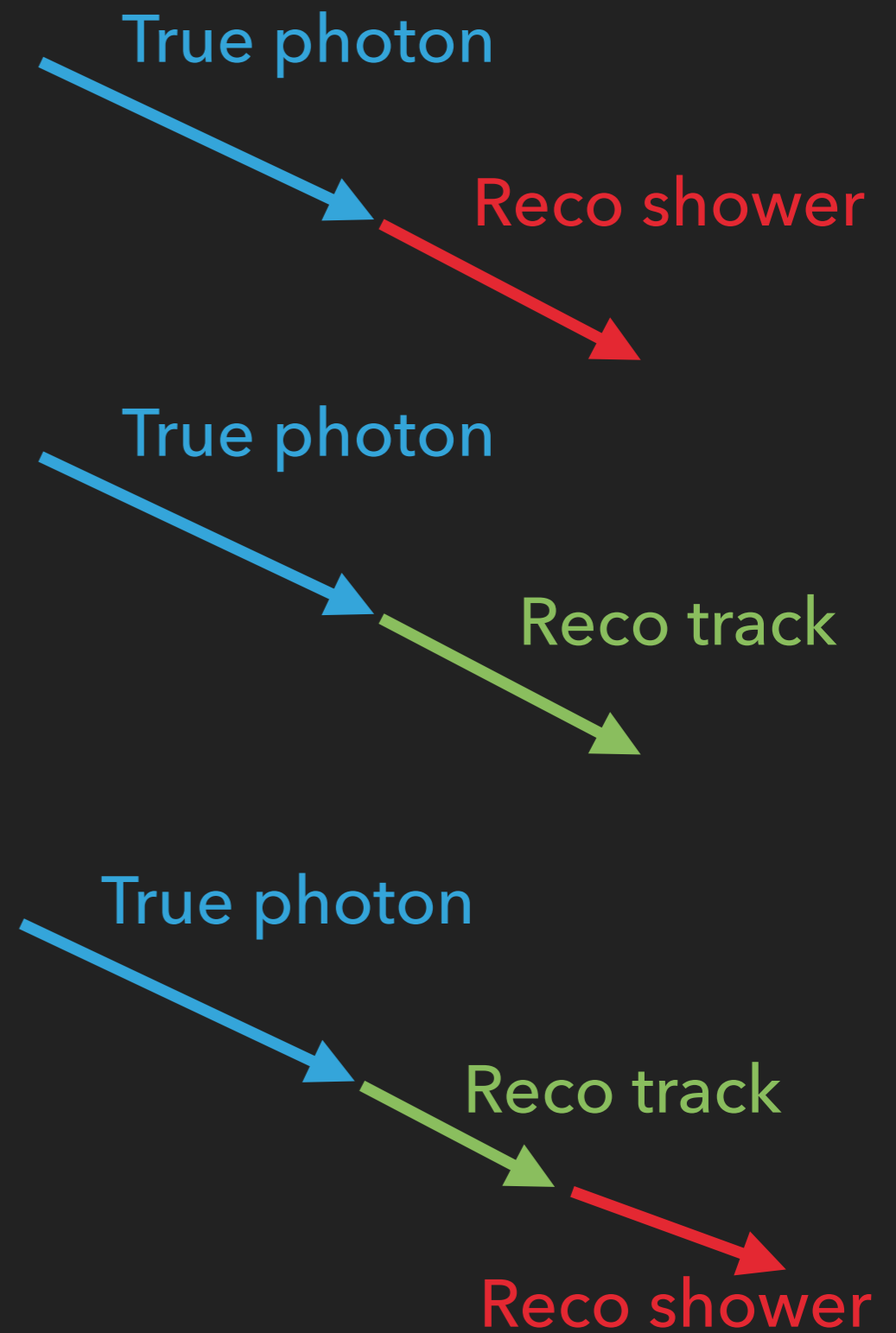
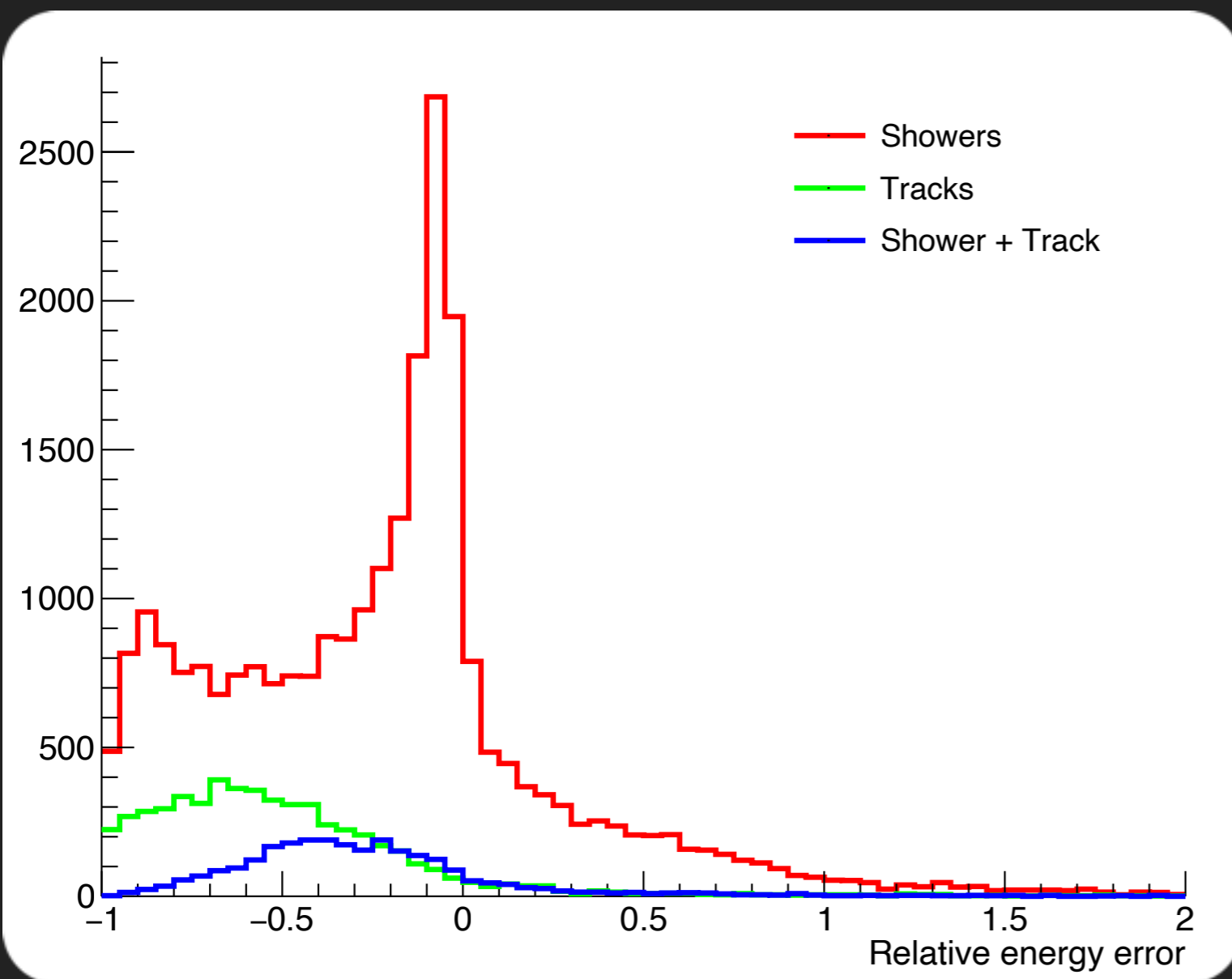
- ▶ 30,000 2 GeV single  $\pi^+$  events in ProtoDUNE
- ▶ More information on the sample and general introduction to track contamination:  
<https://indico.fnal.gov/event/22063/contribution/1/material/slides/0.pdf>

# ENERGY RECONSTRUCTION

▶ Relative error of reconstructed energy:  $\frac{E_r - E_\gamma}{E_\gamma}$



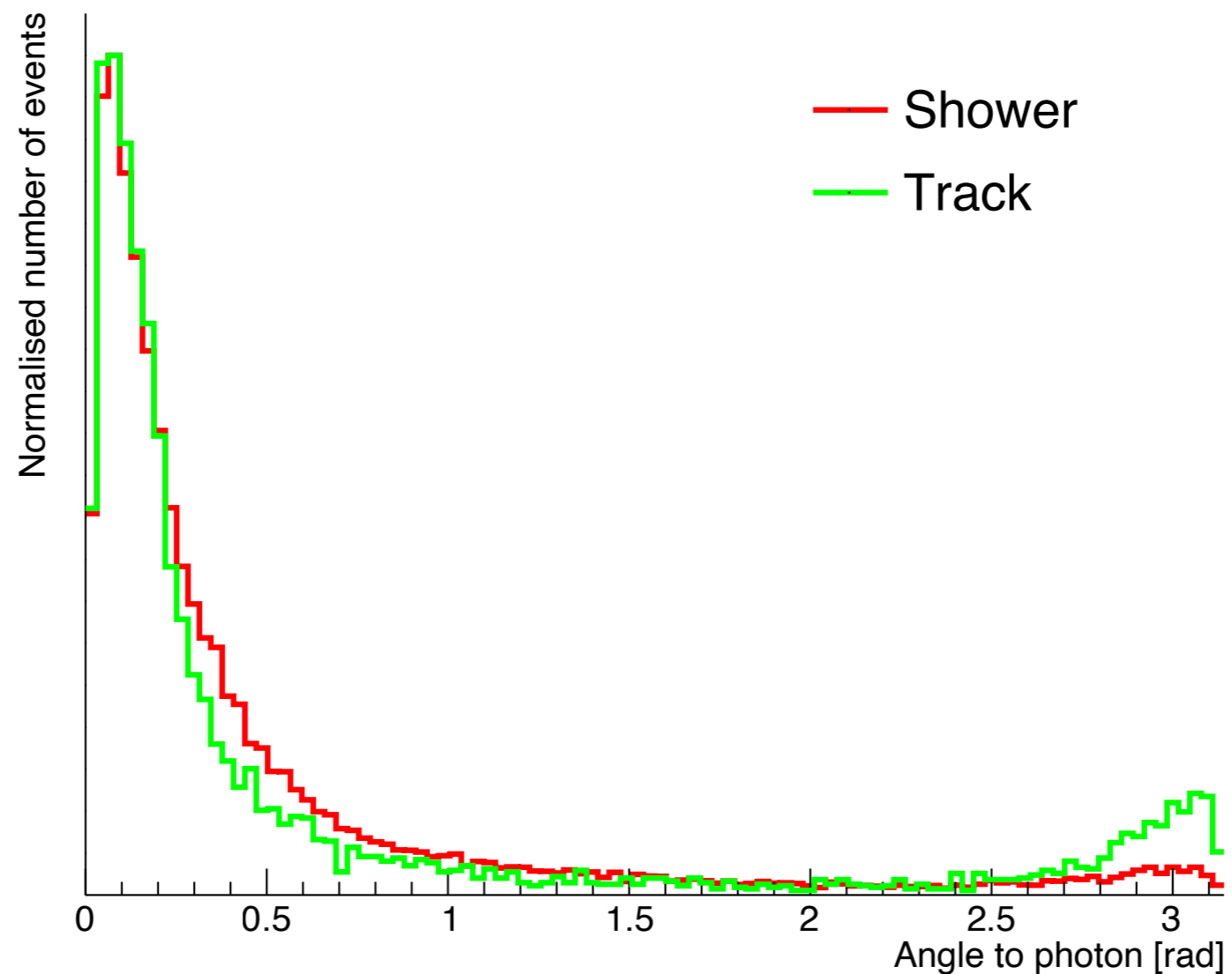
# ENERGY RECONSTRUCTION



## DIRECTION RECONSTRUCTION

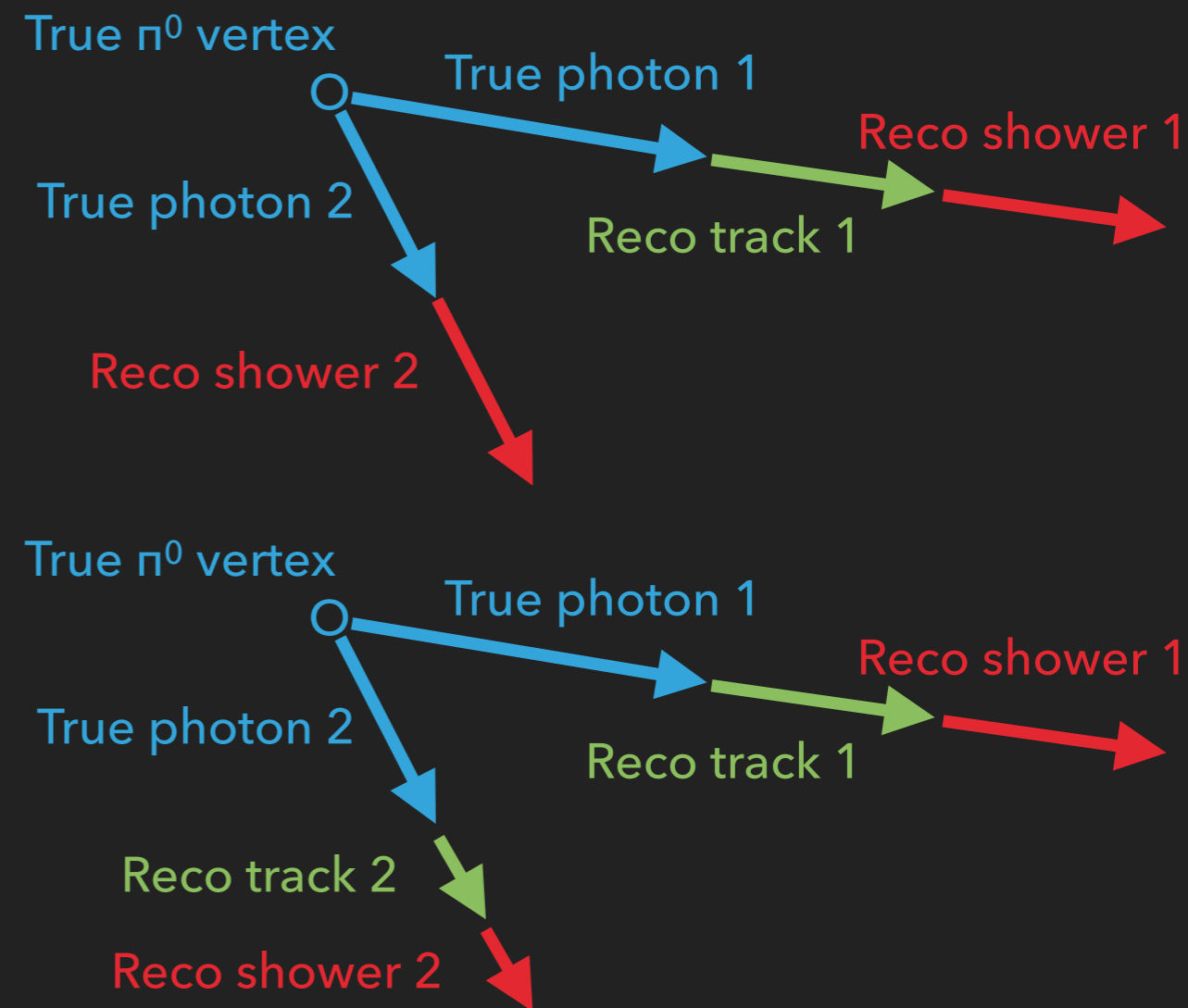
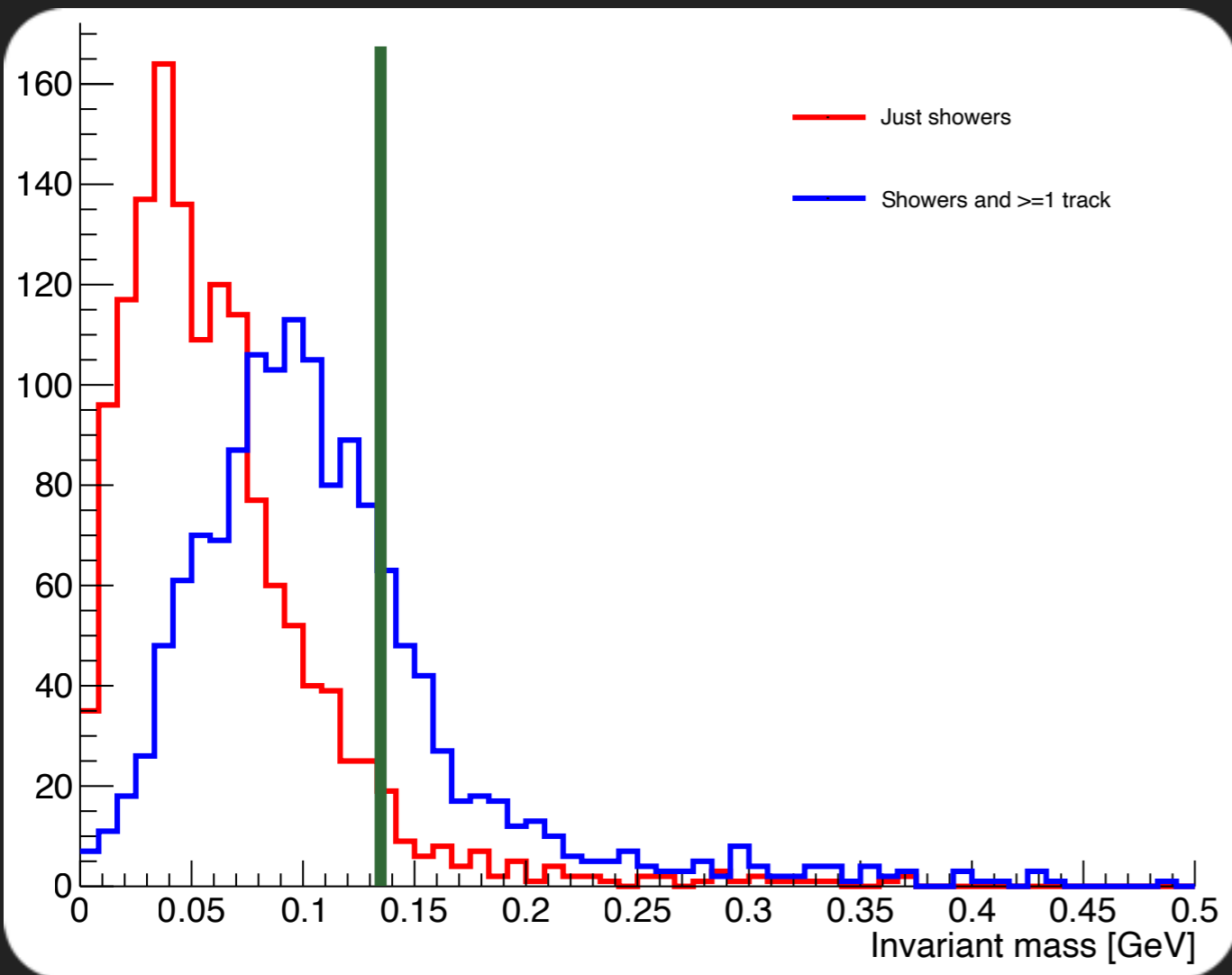


- ▶ Difference angle between photon and shower/track direction



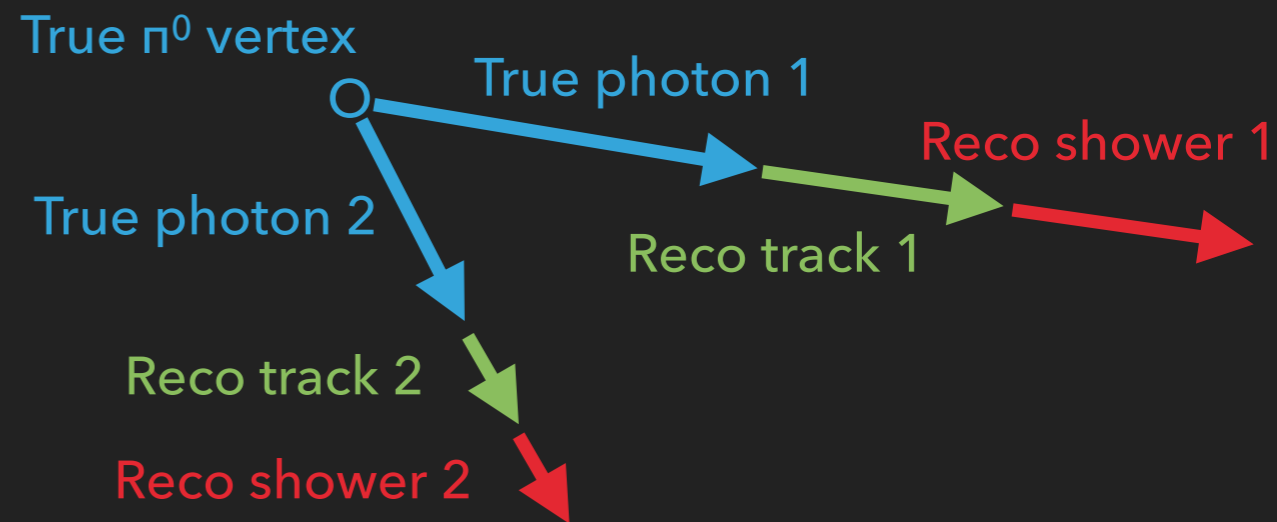
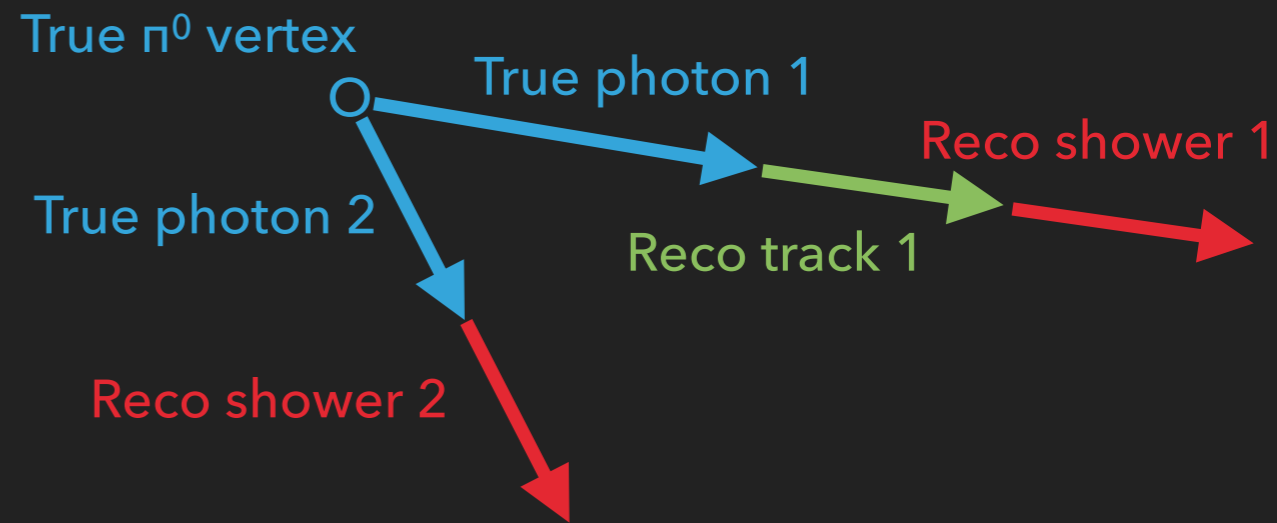
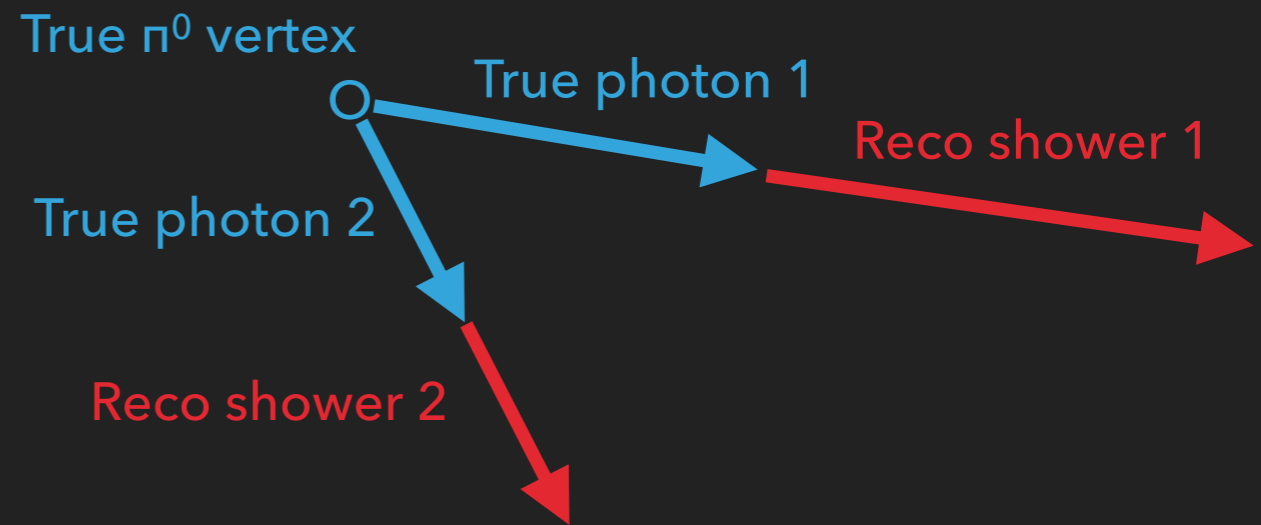
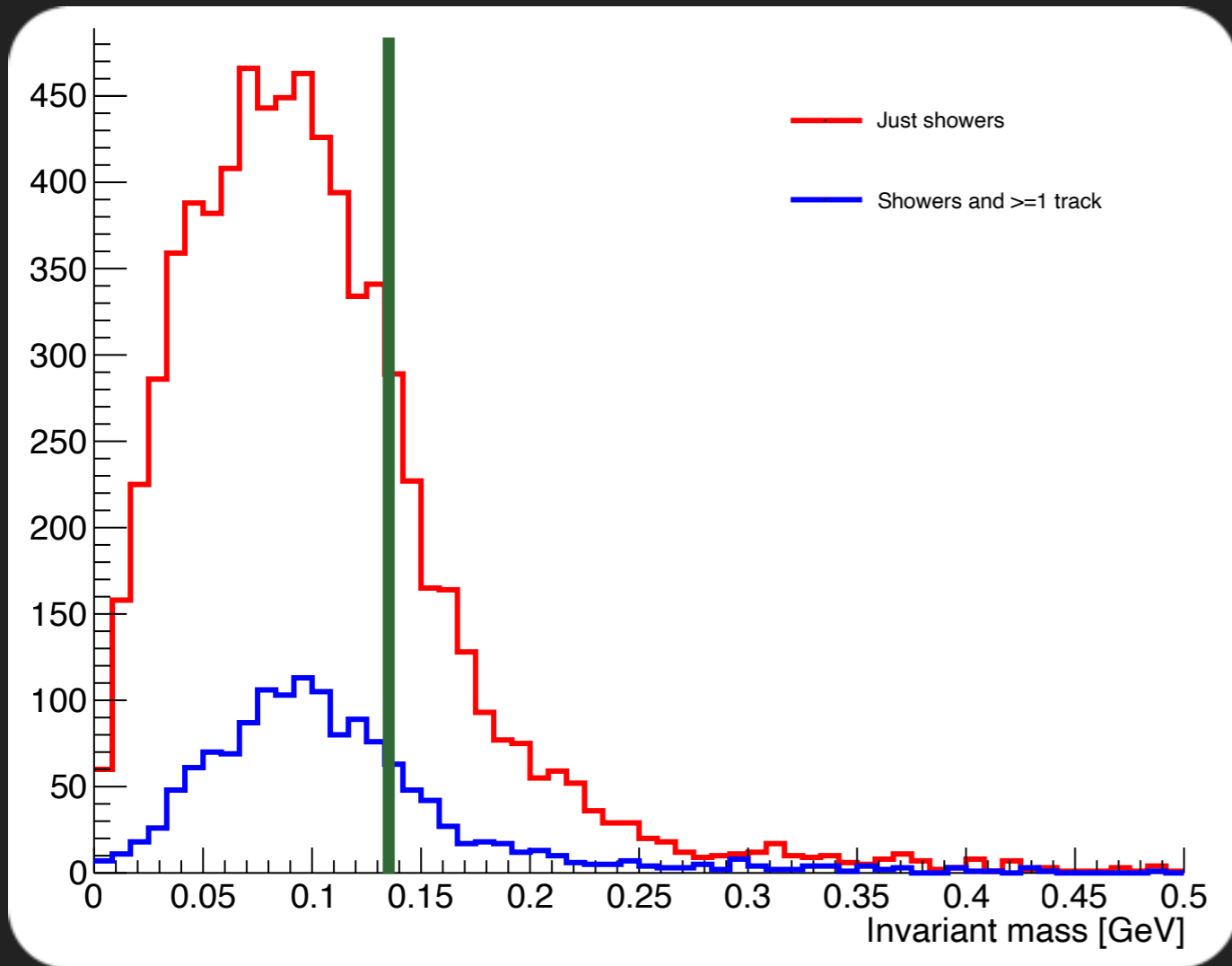
# $\pi^0$ INVARIANT MASS

▶ 
$$m_{\pi}^2 = 2E_{\gamma 1}E_{\gamma 2} \left( 1 - \cos(\theta_{\gamma 1 \gamma 2}) \right)$$



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- ▶ Including tracks provides definite improvements
- ▶ Overall  $\pi^0$  reconstruction still depends heavily on two-shower signature
- ▶ Next steps:
  - ▶ Determine energy loss into secondary tracks/showers
  - ▶ Go into finding  $\pi^0$  reconstruction without MC info

