

Physics week challenge:

π^0 veto in E_{ECL}

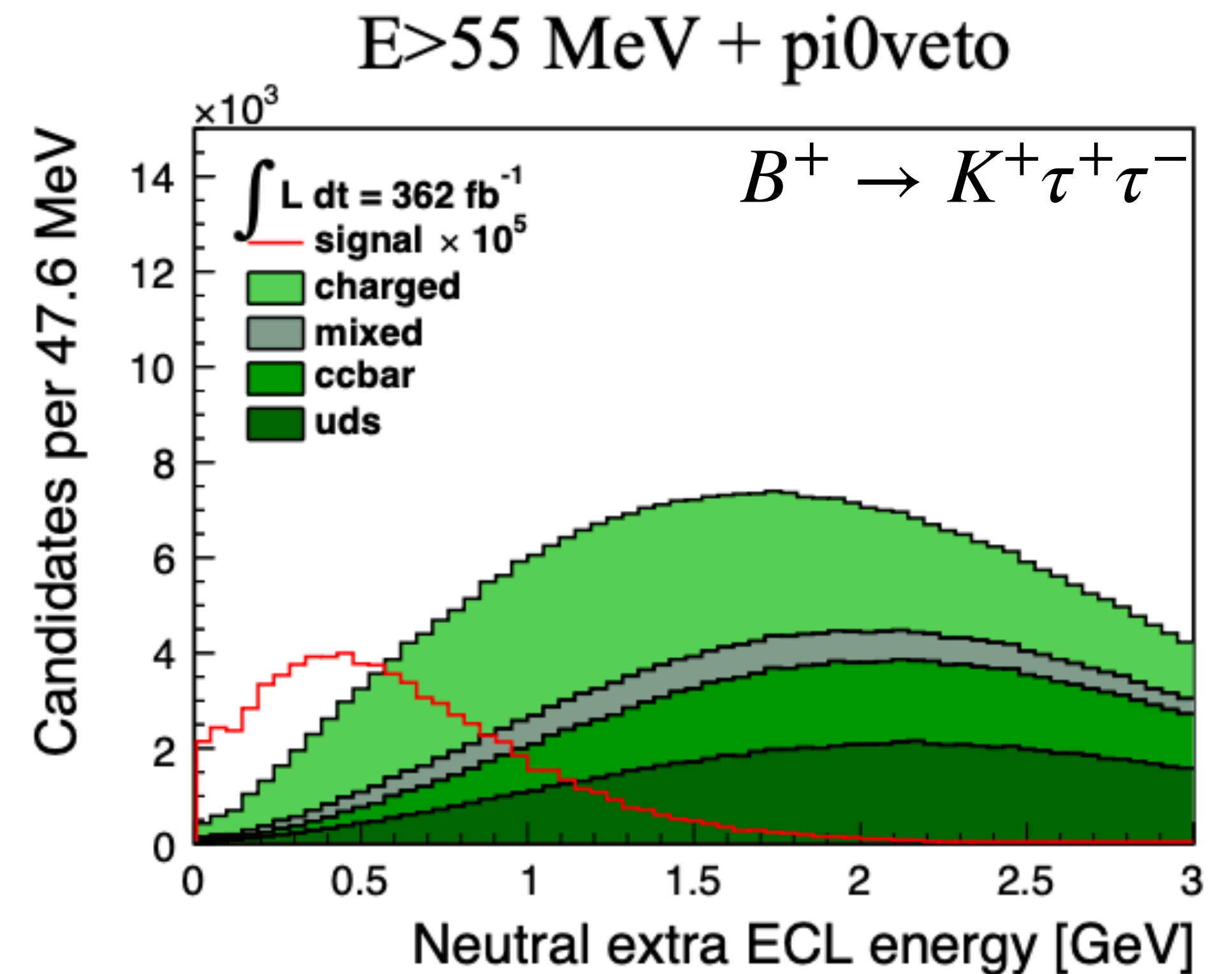
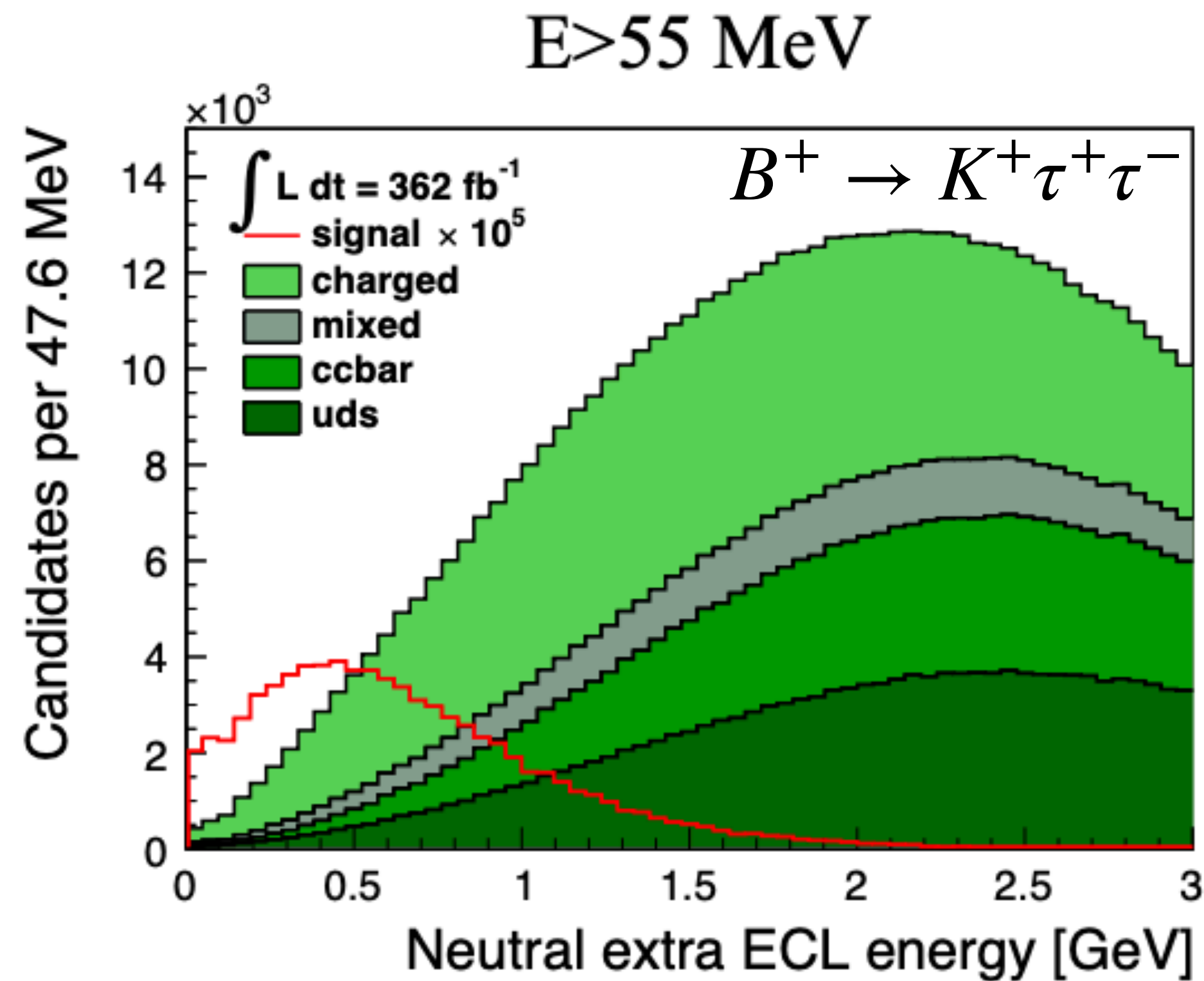
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Thanks Sebastiano, Sato-san, Gaetano, Meihong, Aman
for help and suggestions

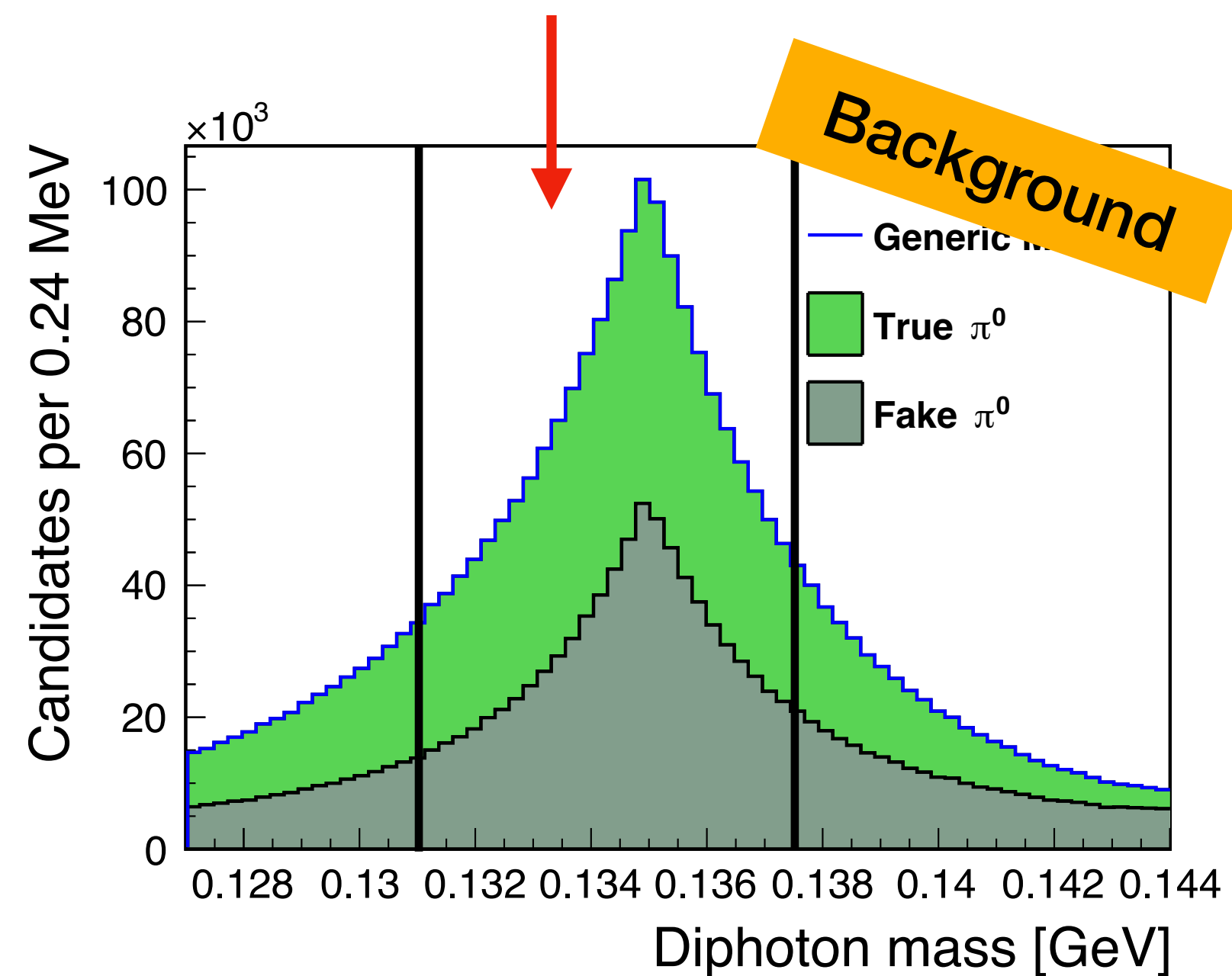
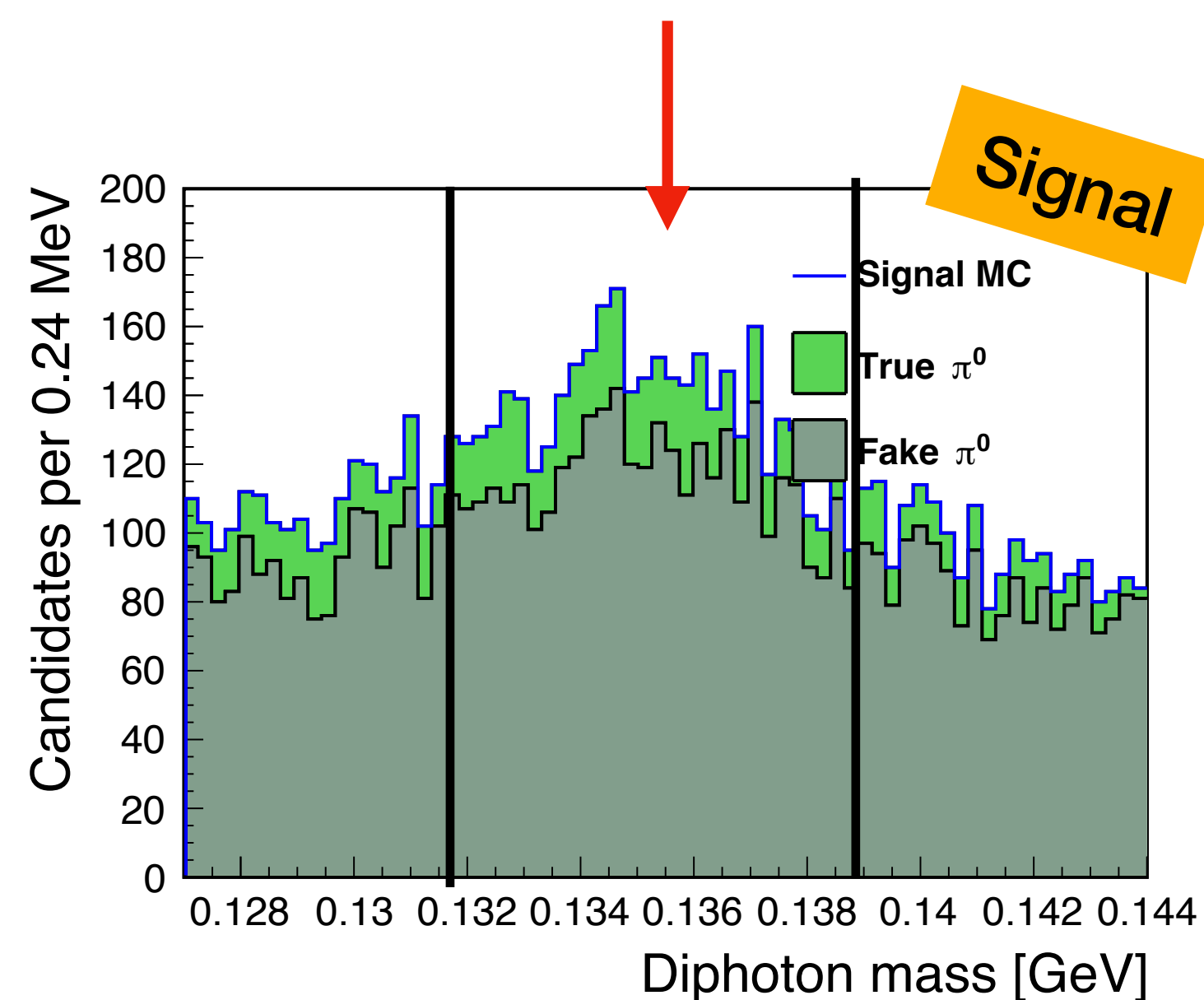
Extra ECL energy (E_{ECL})

- Extra ECL energy: residual energy left in ECL after full reconstruction of $\Upsilon(4S)$
- The most important discriminating variable of missing energy analyses
- Any event with π^0 in the rest of the events of $\Upsilon(4S)$ is a background



Challenge: π^0 veto in E_{ECL}

- π^0 reconstruction: combination of two photons in the rest of event and a mass constraint fit
- **Contaminated with beam backgrounds and hadronic split-offs.**
- Best candidate selection on π^0 mass biases fake π^0 s towards true π^0 mass and removes signal that has no π^0 .



Selection	#Signal	#Background
Without pi0 veto	78110	3963043
With pi0 veto	74152	2162321

Reduction 5 % 45 %

Goal: find an unbiased way to select true π^0

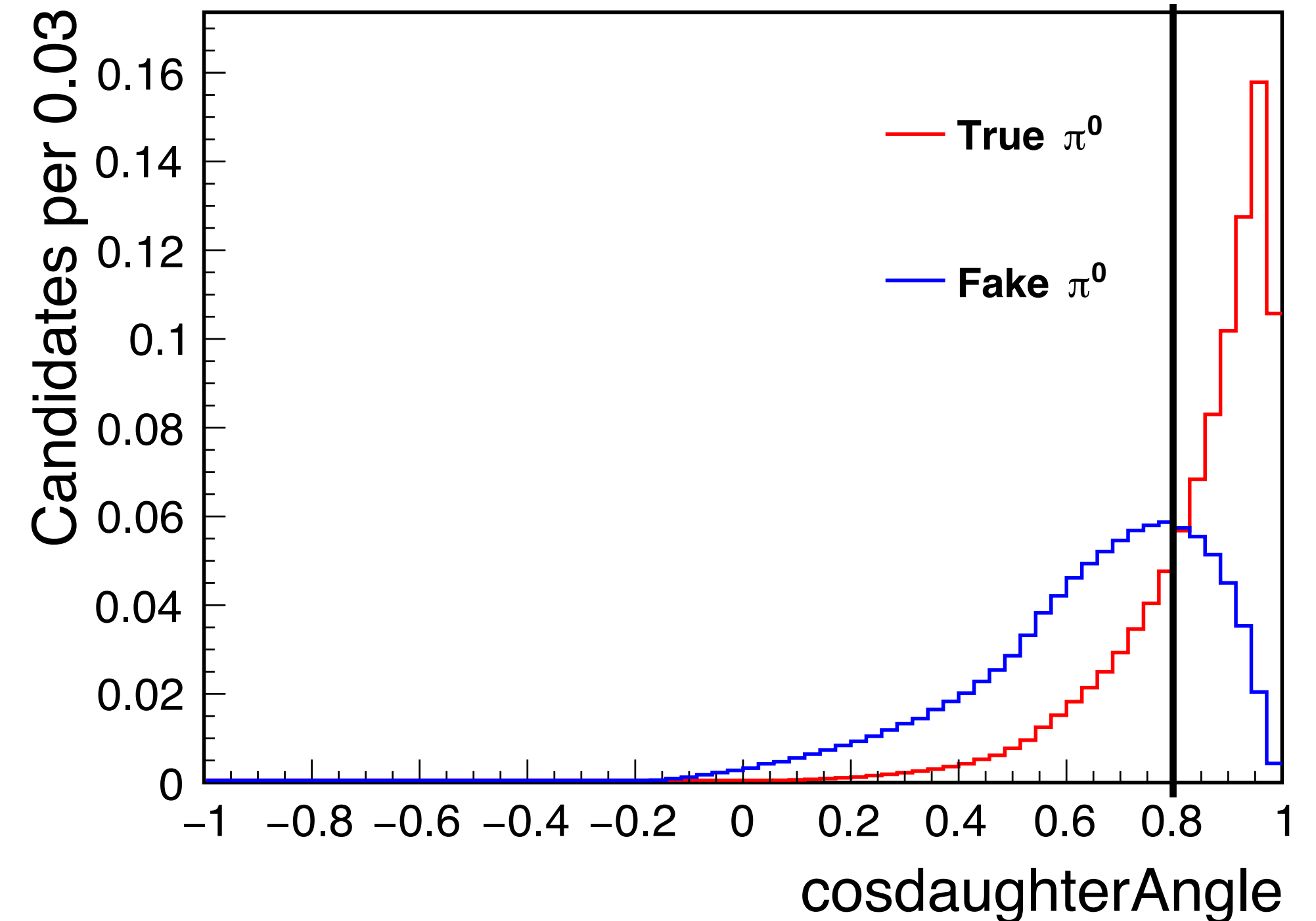
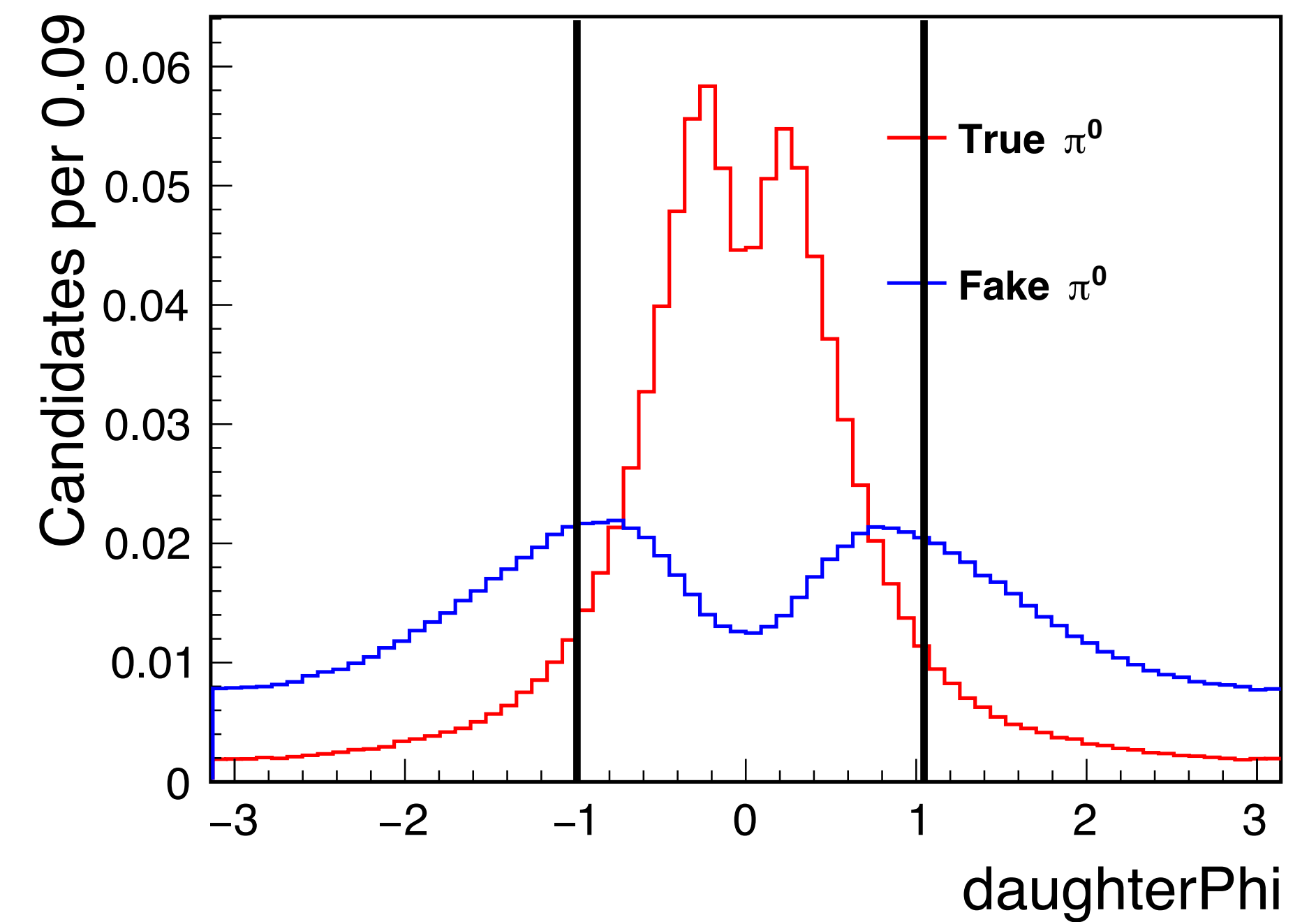
π^0 reconstruction in ROE

Current photon selection for π^0 candidates:

1. $E > 55$ MeV
2. ECL barrel only region
3. $\text{minC2TDist} > 20$ cm

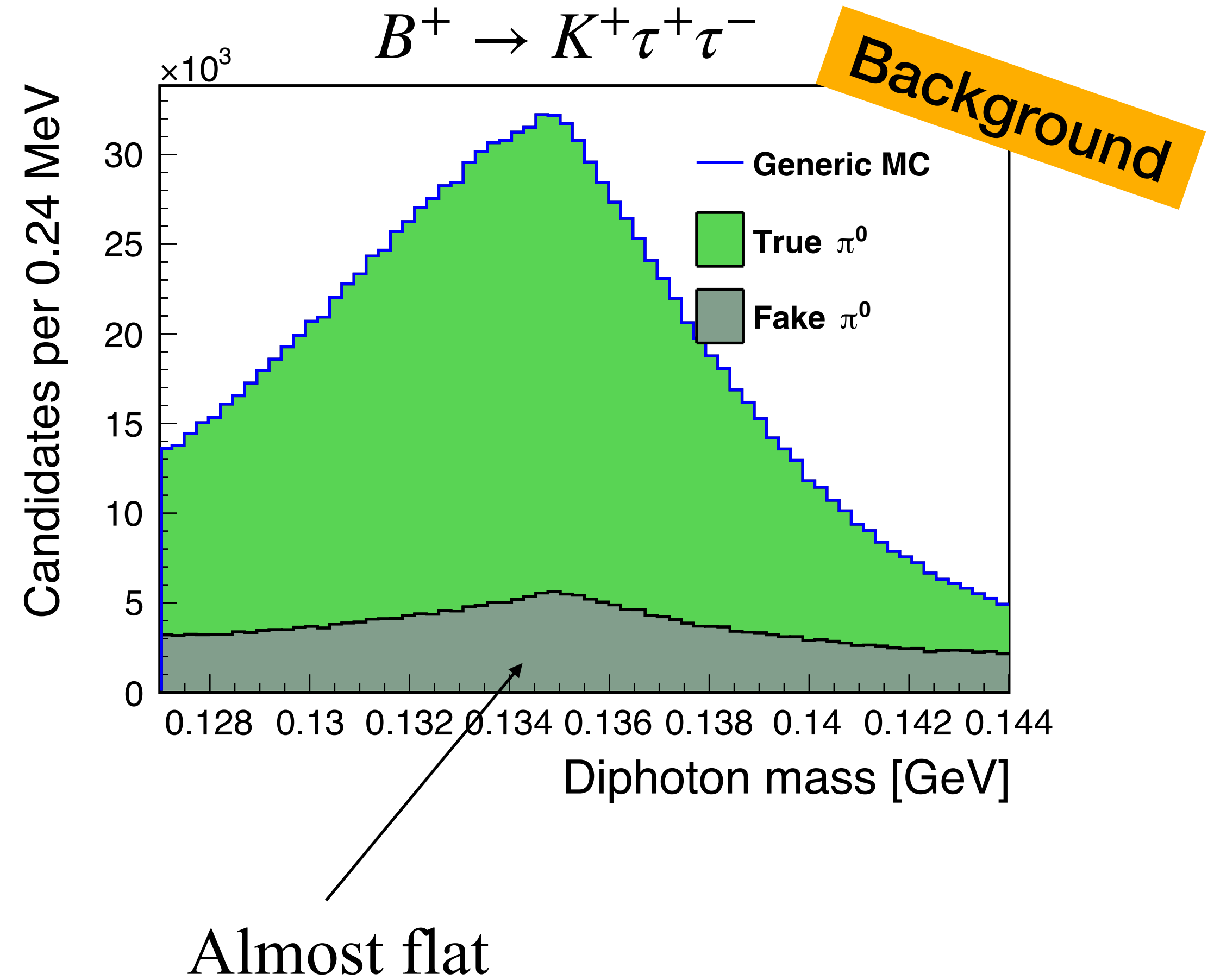
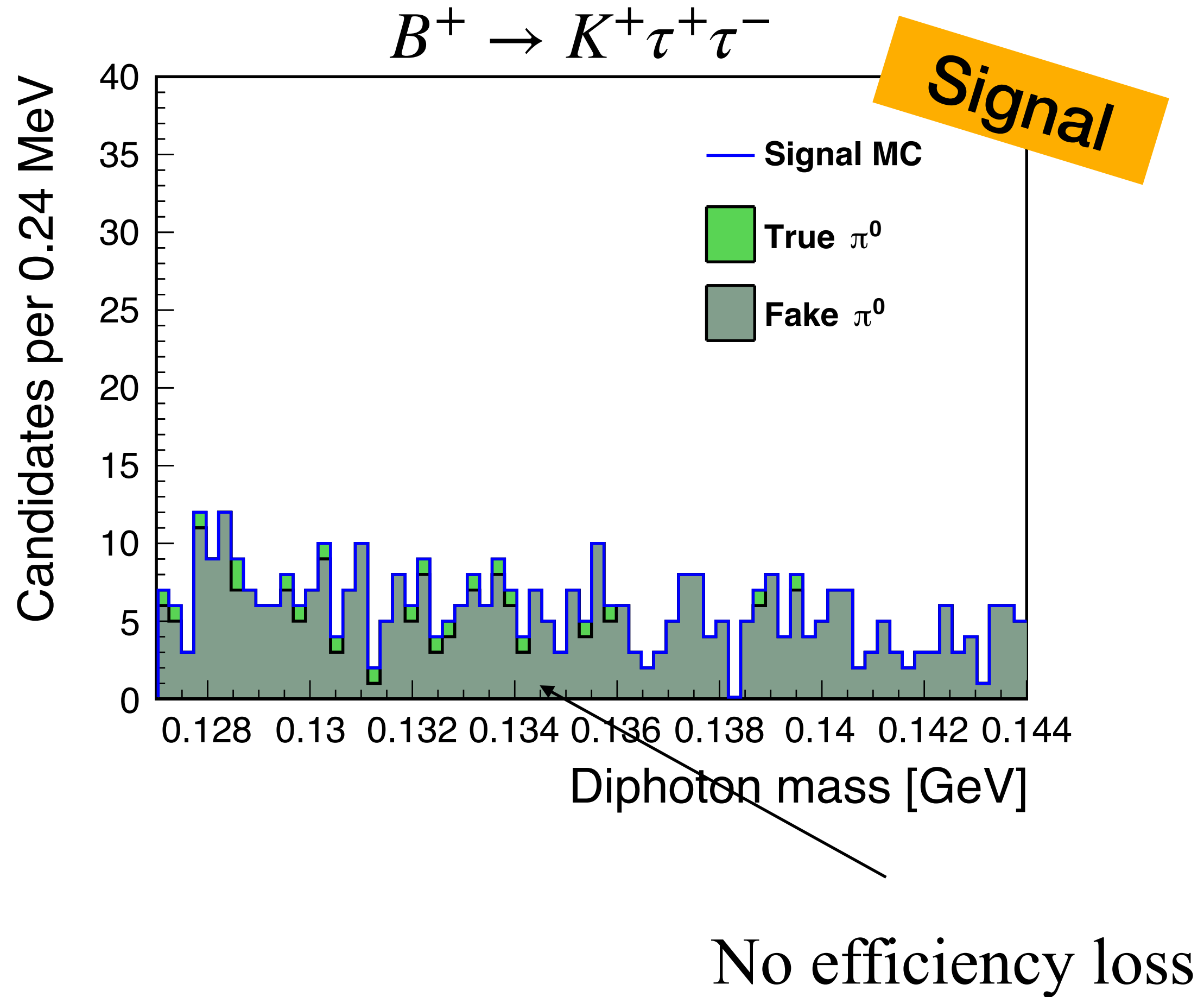
Current π^0 selections:

1. $\phi_{\text{daughter}} \in [-1, 1]$
2. Cosine of daughterAngle > 0.8



π^0 veto

Best candidate selection based on χ^2 of the fit



Signal efficiency loss: $\sim 0\%$
Background rejection: $\sim 33\%$

$B^+ \rightarrow K^+ \tau^+ \tau^-$ ntuples

Samples you can use:

Signal MC: /gpfs/group/belle2/users2022/debjit/physicsweek2023/ktautau_signal.root

Generic MC (MC15rd LS1 \times 4): /gpfs/group/belle2/users2022/debjit/physicsweek2023/ktautau_bkg.root

Include 25 ROE clusters per event sorted with highest energy: “gamma_<#>_<variable>”

Eg: Second highest energetic photon in an event: gamma_2_E

Recommended ROE mask:

1. $E > 55$ MeV
2. $0.296706 < \text{clusterTheta} < 2.61799$
3. $\text{minC2TDist} > 30$ cm