



# Tau Reconstruction Performance and Decay Mode Finding Studies

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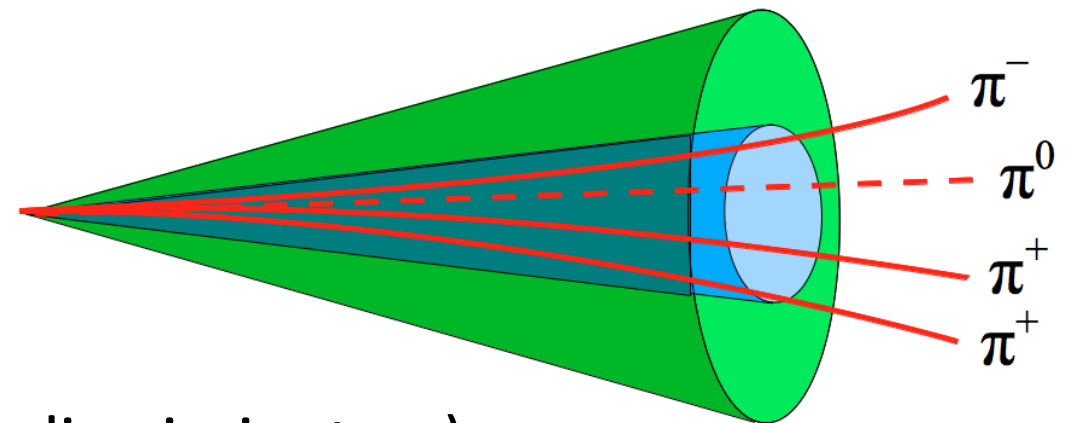
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# Reconstruction Challenges

- About 2/3 of taus decay hadronically.
  - Typically to 1 or 3 charged mesons + up to 2 neutral pions
- Some event objects can be incorrectly identified as taus.
  - Quark-gluon jets
  - Electrons, muons
- Certain requirements are imposed (via discriminators) to prevent these improper reconstructions.





# Overview

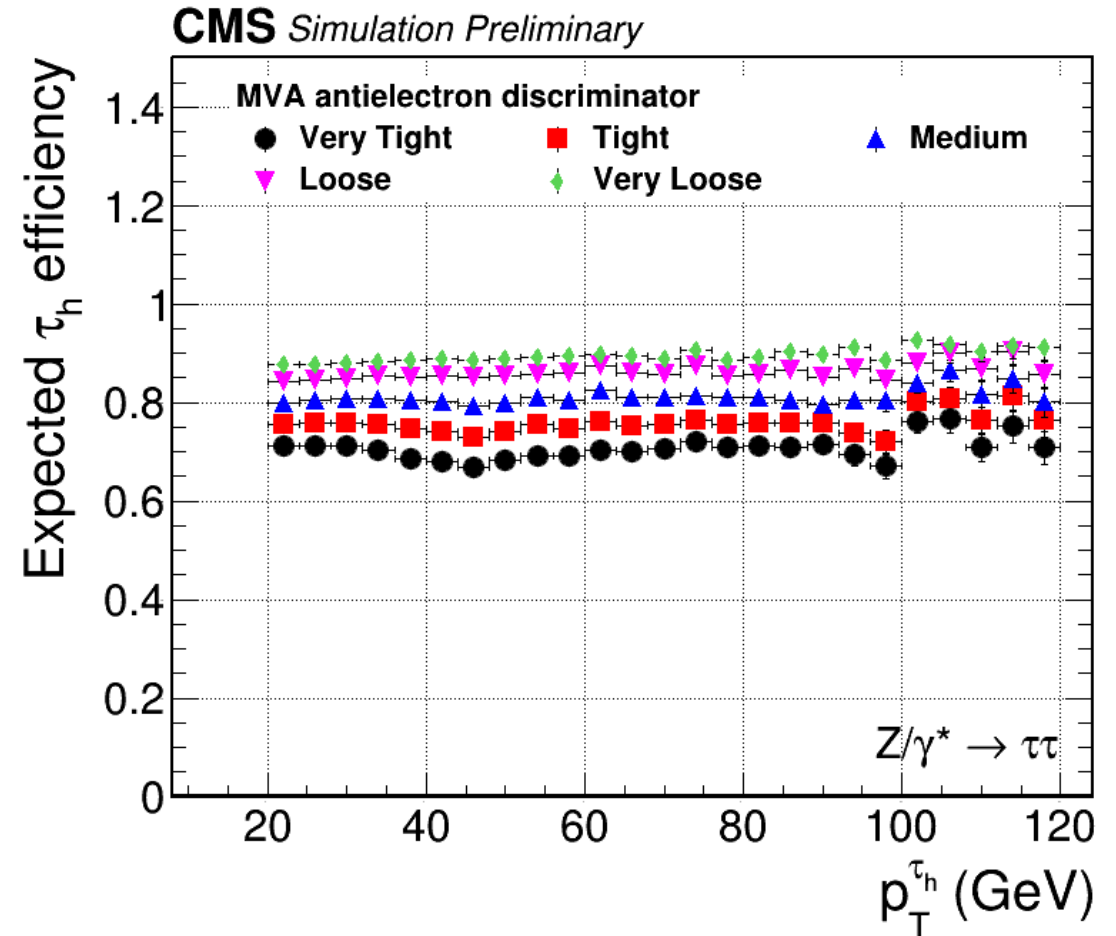
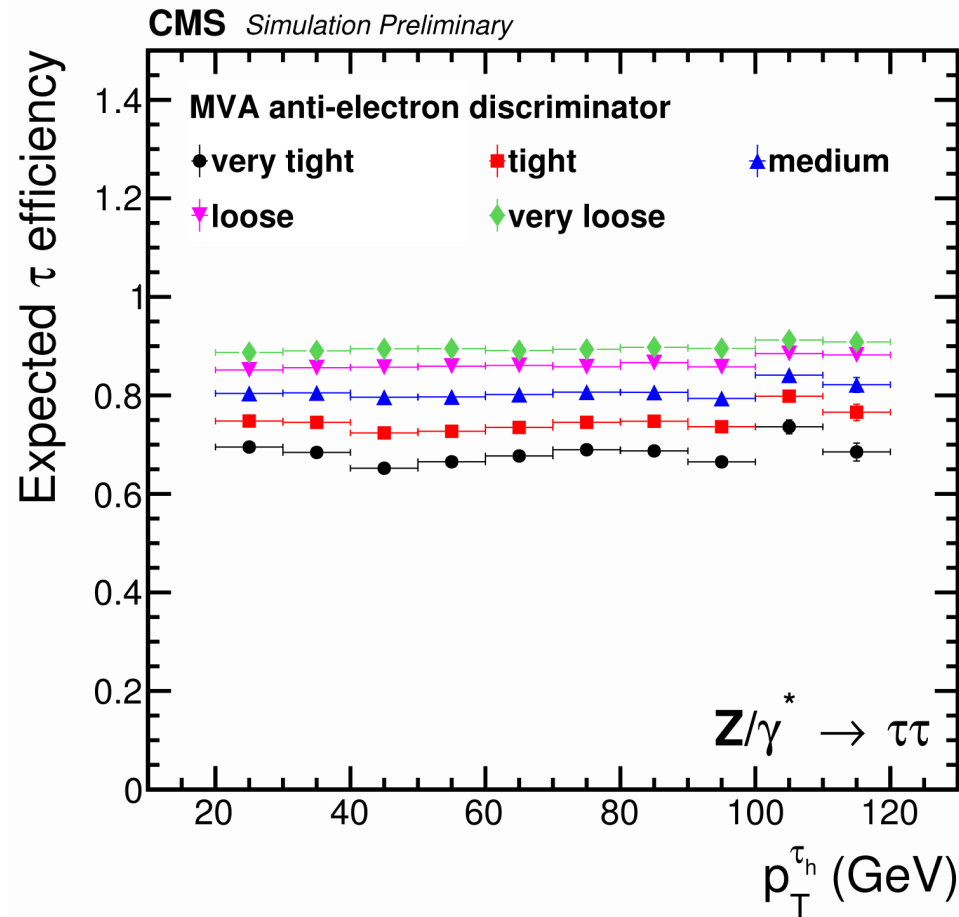
- A comparison of antielectron discriminators between CMSSW 7\_6\_x and 8\_0\_10
- Analysis of the new tau decay mode finding (“2 prong” taus)



# Tau Efficiencies Under Anti-e Discriminators

## CMSSW 7\_6\_x

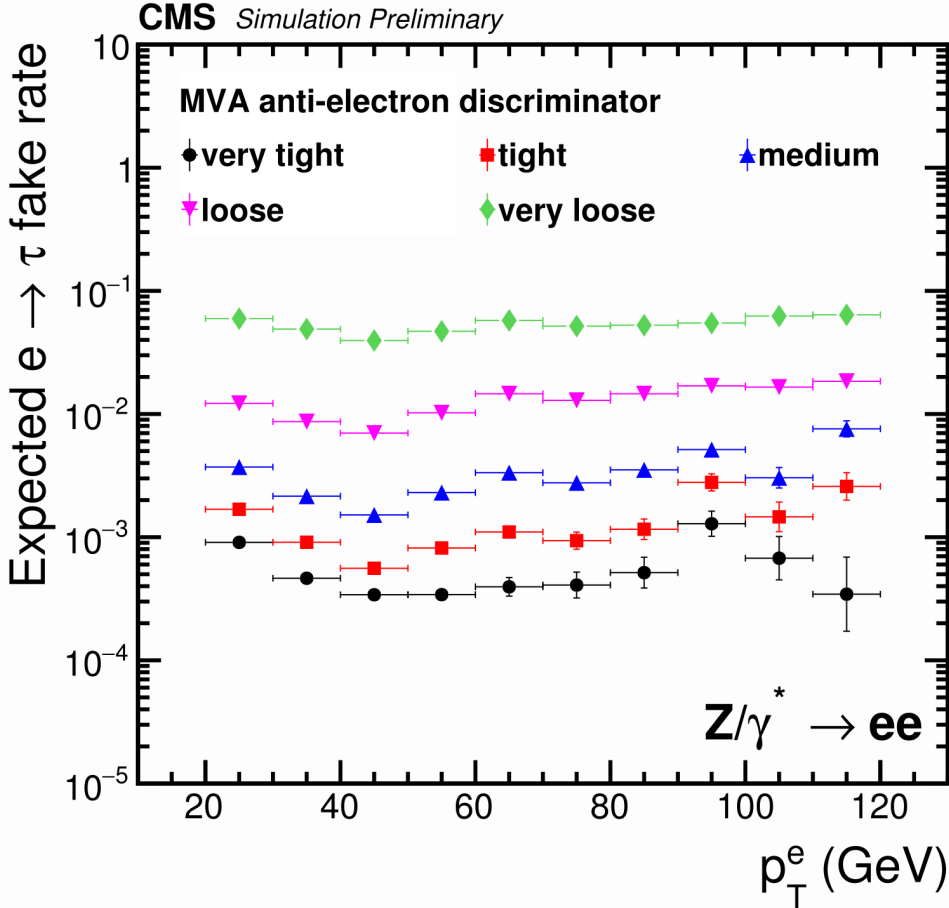
## CMSSW 8\_0\_10



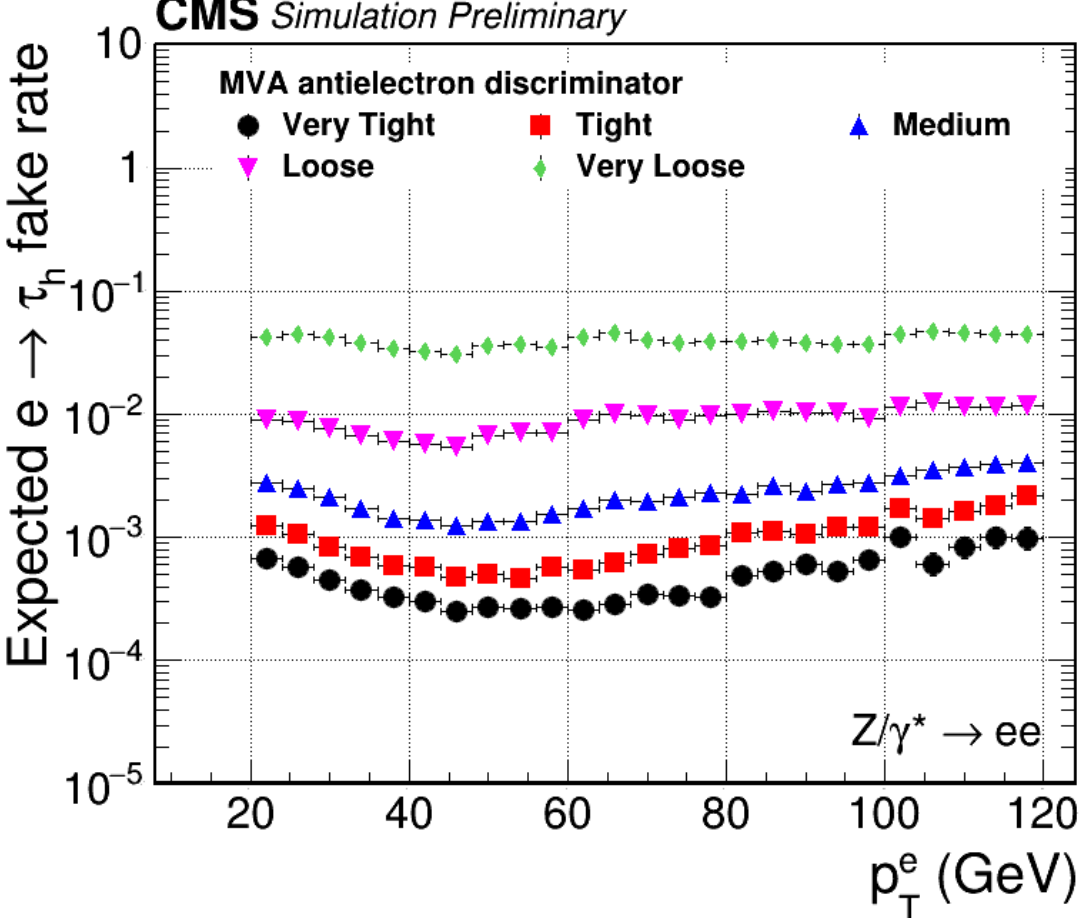


# Electron to Tau Fake Rates

## CMSSW 7\_6\_x



## CMSSW 8\_0\_10





■ Run 1:

- 1 prong
- 1 prong +  $\pi_0$ s
- 3 prong

■ New decay modes in Run-2:

- 3 prong +  $\pi_0$ s
- 2 prong
- 2 prong +  $\pi_0$ s

} →  $\pi_0$ s do not contribute to the tau isolation anymore → higher efficiency

↓  
To account for tracking inefficiencies

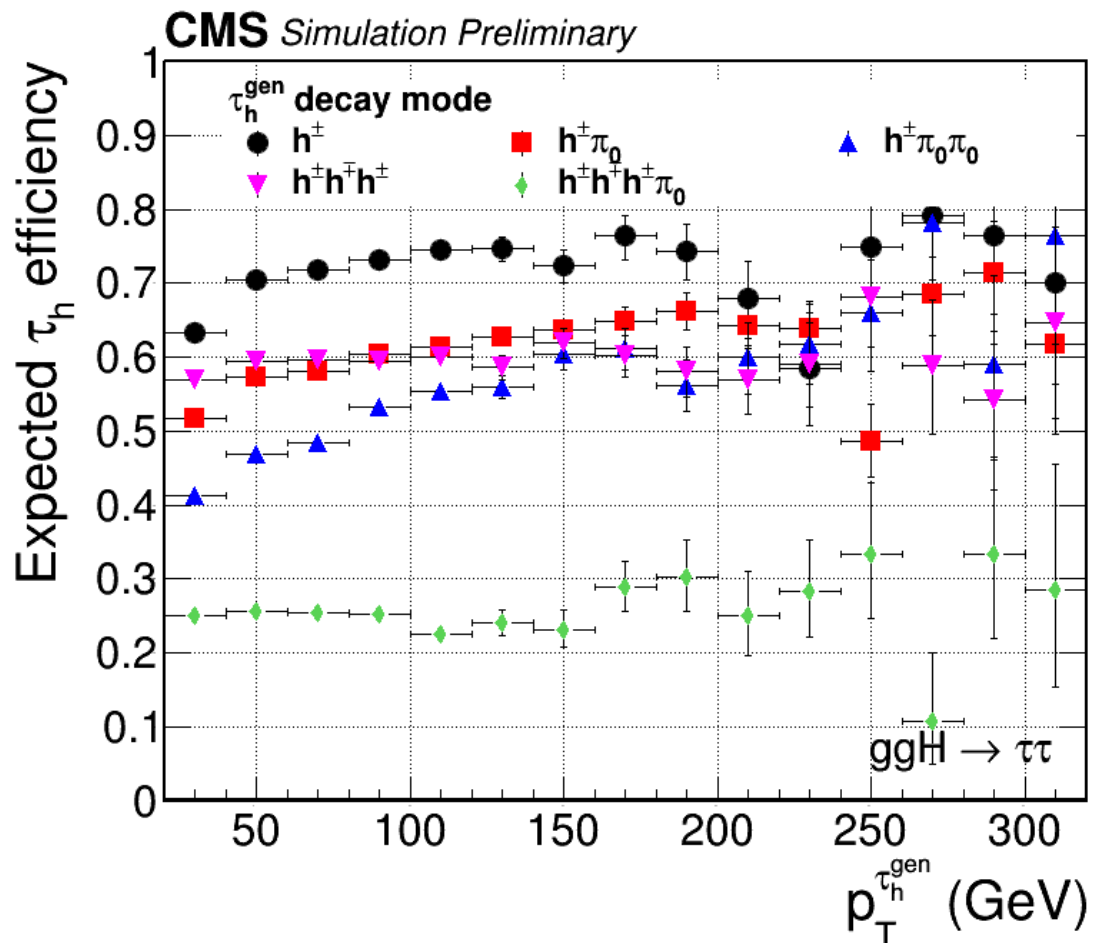
- “Old” and “new” decay modes supported in Run-2

Decay mode	Resonance	BR[%]
$\tau^- \rightarrow e^- \bar{\nu}_e \nu_\tau$		17.8
$\tau^- \rightarrow \mu^- \bar{\nu}_\mu \nu_\tau$		17.4
$\tau^- \rightarrow h^- \nu_\tau$		11.5
$\tau^- \rightarrow h^- \pi^0 \nu_\tau$	$\rho(770)$	26.0
$\tau^- \rightarrow h^- \pi^0 \pi^0 \nu_\tau$	$a_1(260)$	10.8
$\tau^- \rightarrow h^- h^+ h^- \nu_\tau$	$a_1(260)$	9.8
$\tau^- \rightarrow h^- h^+ h^- \pi^0 \nu_\tau$		4.8
Other hadronic modes		1.8

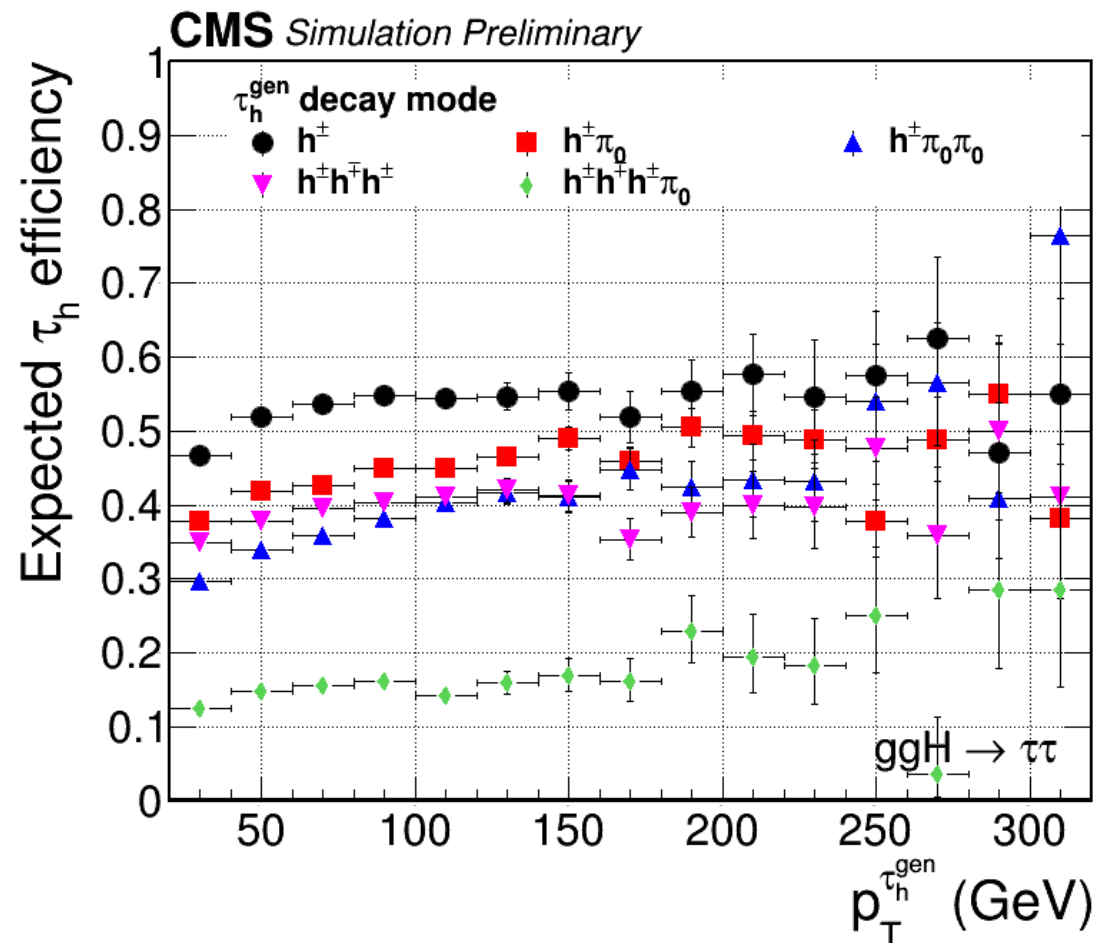


# Tau Efficiencies by Decay Mode

## Loose Isolation



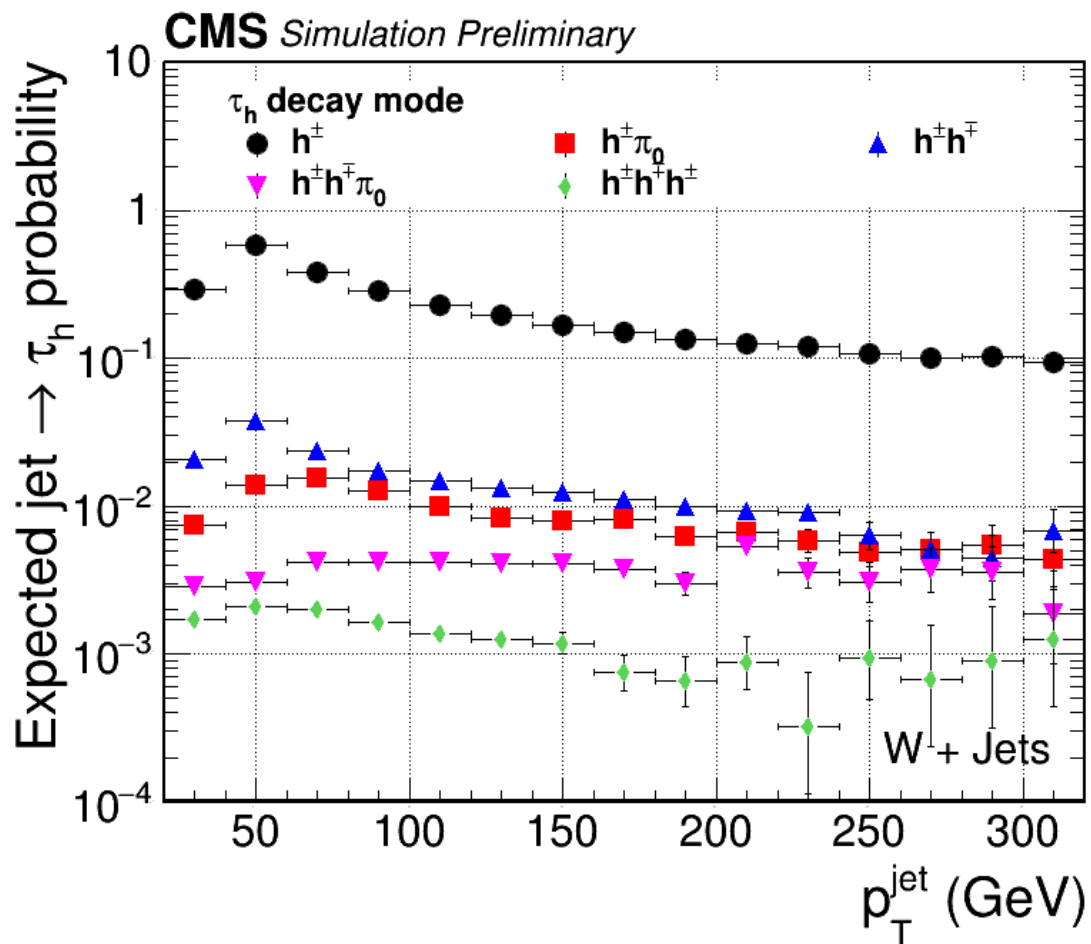
## Tight Isolation



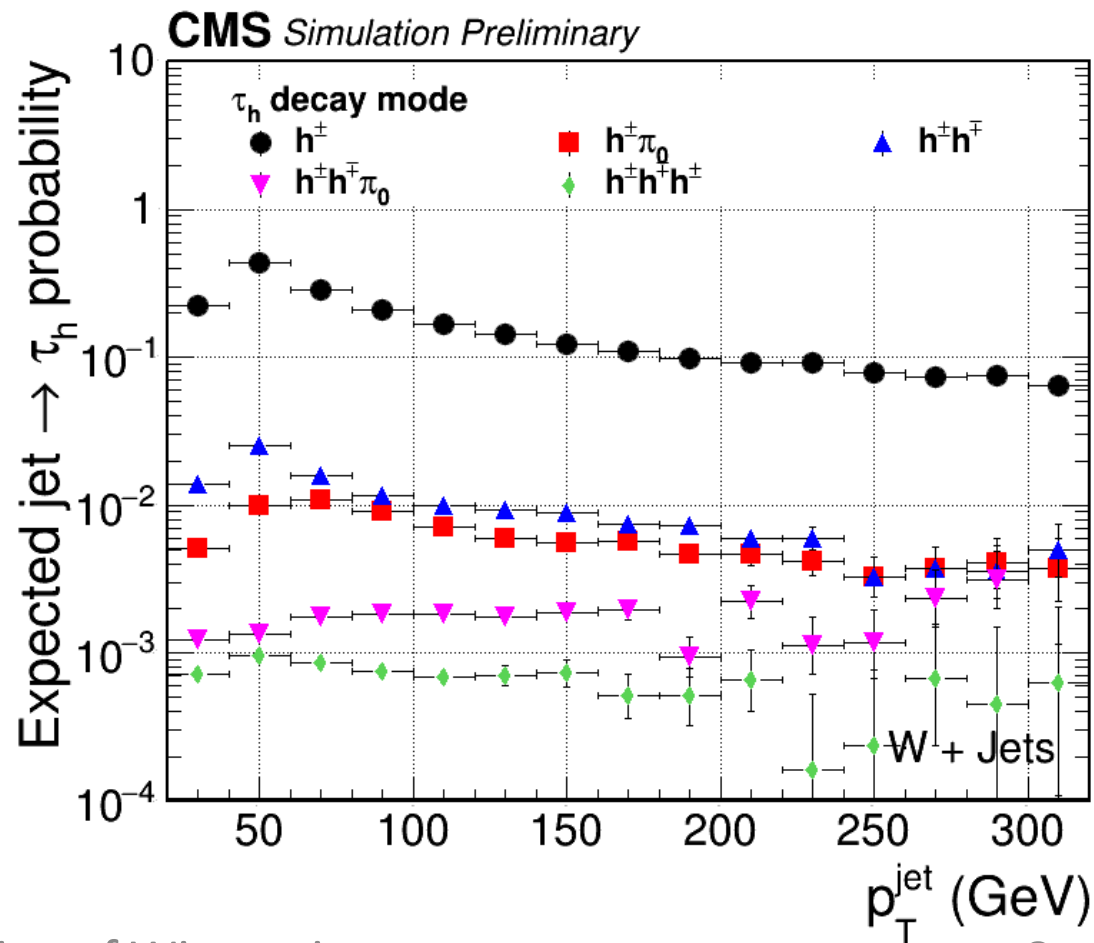


# Jet to Tau Fake Rates

## Loose Isolation



## Tight Isolation







# Goals

- Compare reconstructed decay modes with generator-level decay modes
- Understand what happens to the third track for “2 prong” reconstructed taus
- Use this information to improve efficiencies and fake rates

