# Trigger Efficiency with QCD events

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τ workshop

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# How to measure trigger efficiencies?

| | |
|---|---|
| **Using an independent sample** | • Study the efficiency of a trigger chain using events triggered with and orthogonal chain<br>  • e.g. study e or μ chains using events with high-$P_T$ tracks |
| **Tag and Probe** | • Using a single-object inclusive trigger, study di-object events: one selected online and one reconstructed. Then study the trigger response of the second object, that was not used for the online selection.<br>  • e.g. τ trigger efficiency from Z->ττ events. |
| **Bootstrap Method** | • The efficiency, $\varepsilon_B$, of a trigger chain B, with higher thresholds than a trigger chain A, can be determined in a sample of events triggered by A, $\varepsilon_{B\|A}$, provided that the efficiency of A, $\varepsilon_A$, is easily measurable; $\varepsilon_B = \varepsilon_{B\|A} \times \varepsilon_A$ |

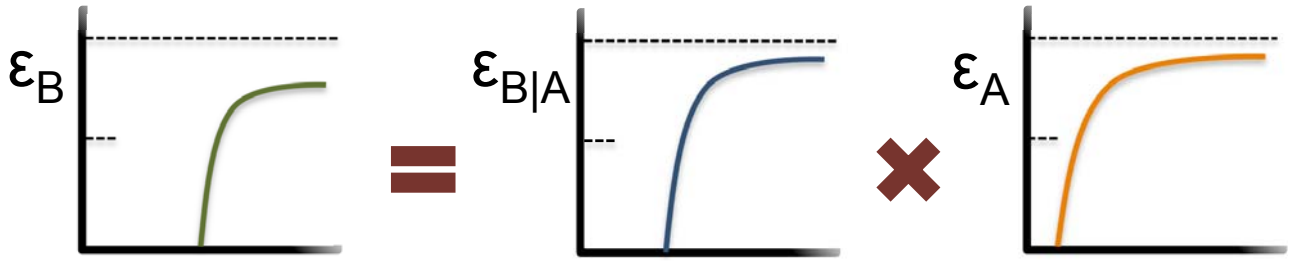
# 'Complicated' Triggers

How can we measure the efficiency of triggers like TAU50, or tau+met, or tau+met+jets?

- The 'Standard Candles', Ws and Zs, can't help; they will be used for measuring the efficiency of simpler triggers instead (e.g. TAU16I).
- It will be difficult to get enough statistics in 'signal' events for these complicated chains.
- There will be loads of QCD events, since the early data.

Is it possible to use QCD tau-like events in a bootstrap method for measuring the efficiencies of these trigger chains?

- Need to verify that the QCD events behave similar to the 'signal' events in trigger efficiency; Need to define what tau-like events to use.



# Efficiency Definition

**Choose a definition that could be used on data**

$$\epsilon = \frac{\#Good\ Reco\ \tau's\ passing\ Trigger\ requirements}{\#Good\ Reco\ \tau's}$$

## What is a 'Good Reco τ'?

Combinations of the definitions below have been used:

- Tight LL
- Loose LL
- tau1p3p w/ discriCut
- tau1p3p w/ efficNN

## Which are the 'Trigger Requirements'?

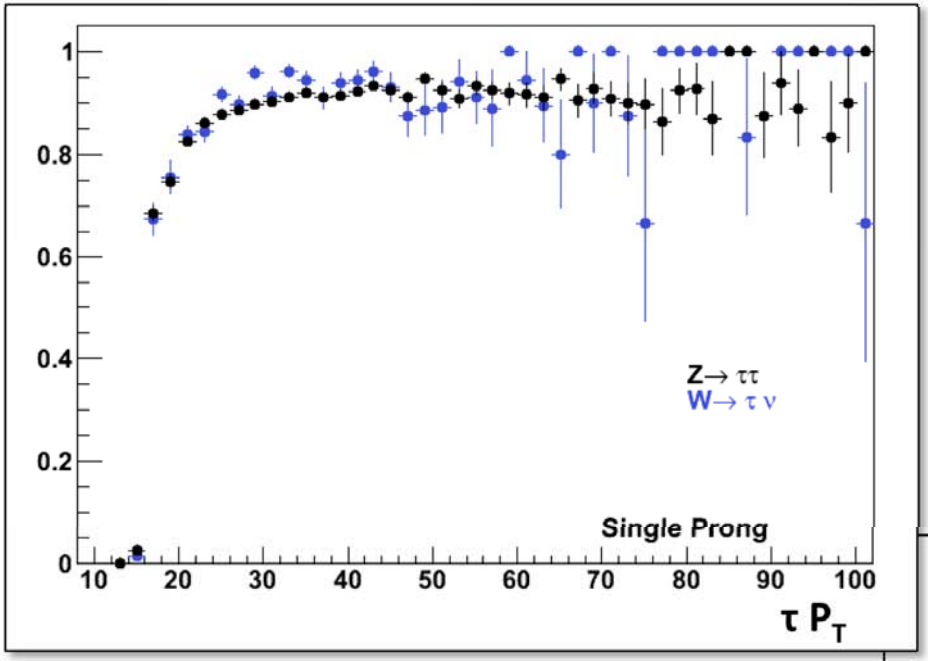
A 'Good Reco τ' goes in the numerator if it:

- passes the trigger chain
- matches the L1, L2 and EF taus in ΔR

1-prong and 3-prong τ's studied separately since they have different efficiencies

For these studies, used TTP Ntuples generated by Olya or Elizabeth (10TeV & 14TeV)

# Signal Efficiencies – 14TeV

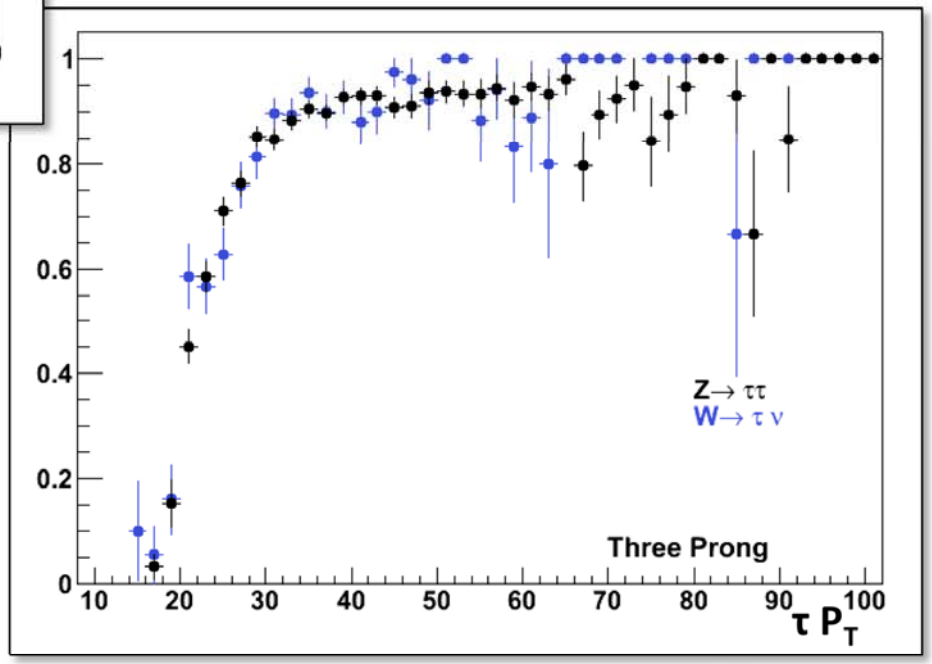



TTP12_1500, 14 TeV samples

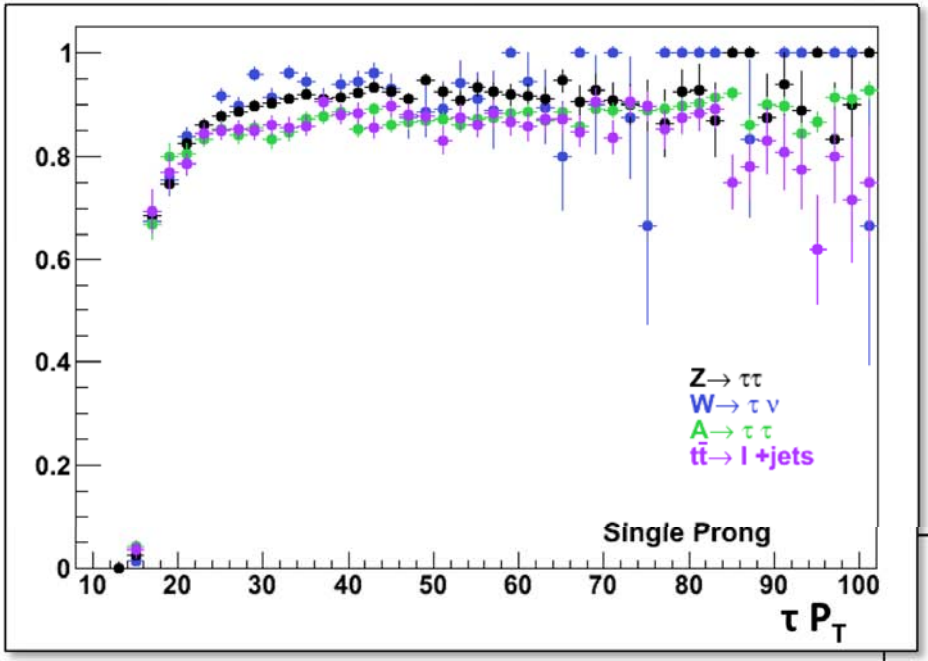
(Tight LL) && (tau1p3p EfficNN>0.3)

**TAU16I_Loose**

Ensuring a good agreement between the efficiency curves given by various 'signal' τ's.



# Signal Efficiencies – 14TeV



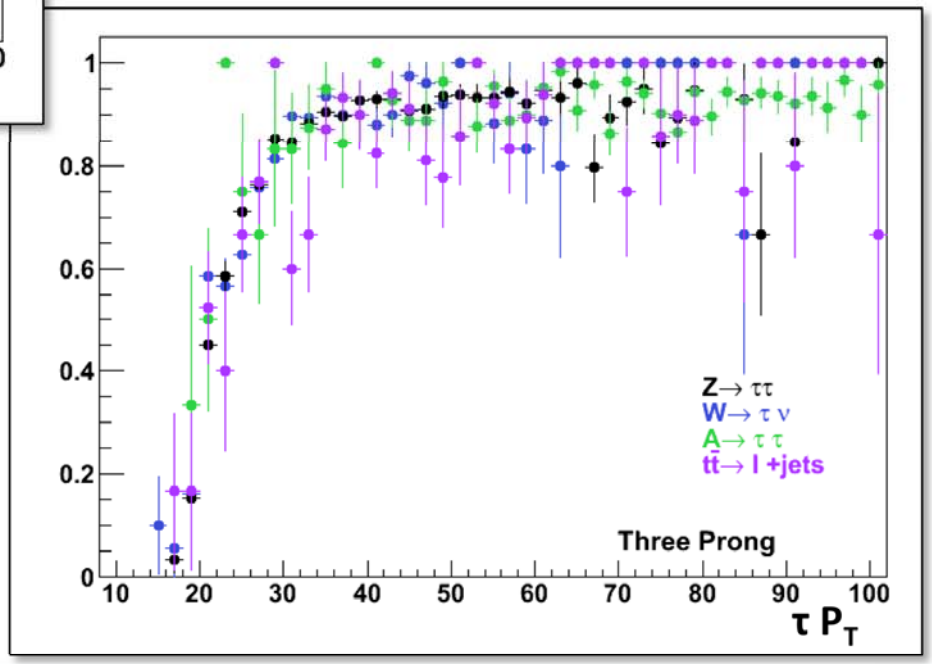

TTP12_1500, 14 TeV samples

(Tight LL) && (tau1p3p EfficNN>0.3)

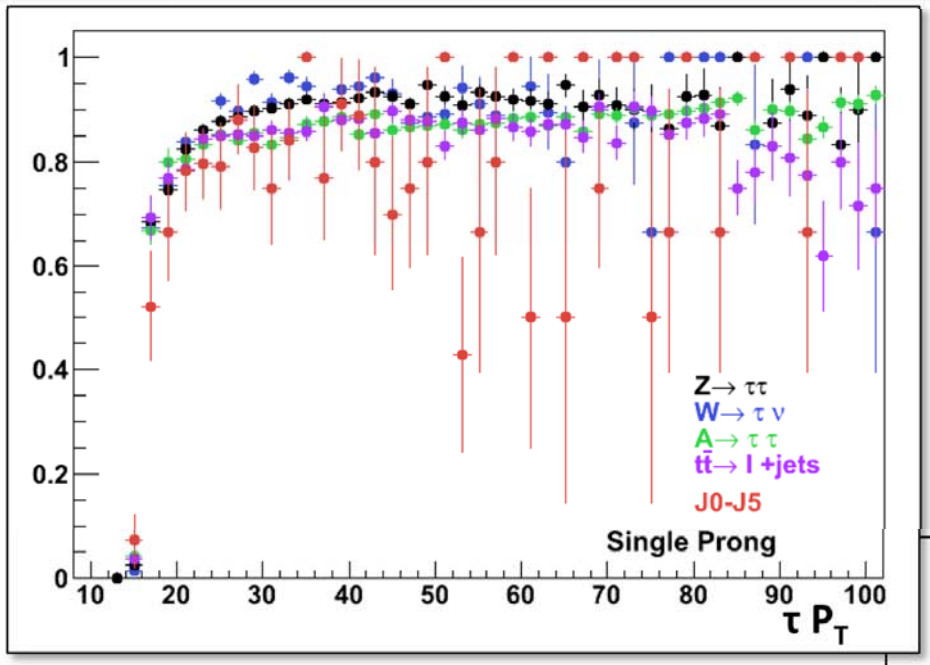
**TAU16I_Loose**

Ensuring a good agreement between the efficiency curves given by various 'signal' τ's.

*Note, there is no truth matching –> not negligible probability of picking up fakes.*



# Signal Efficiencies vs Jets

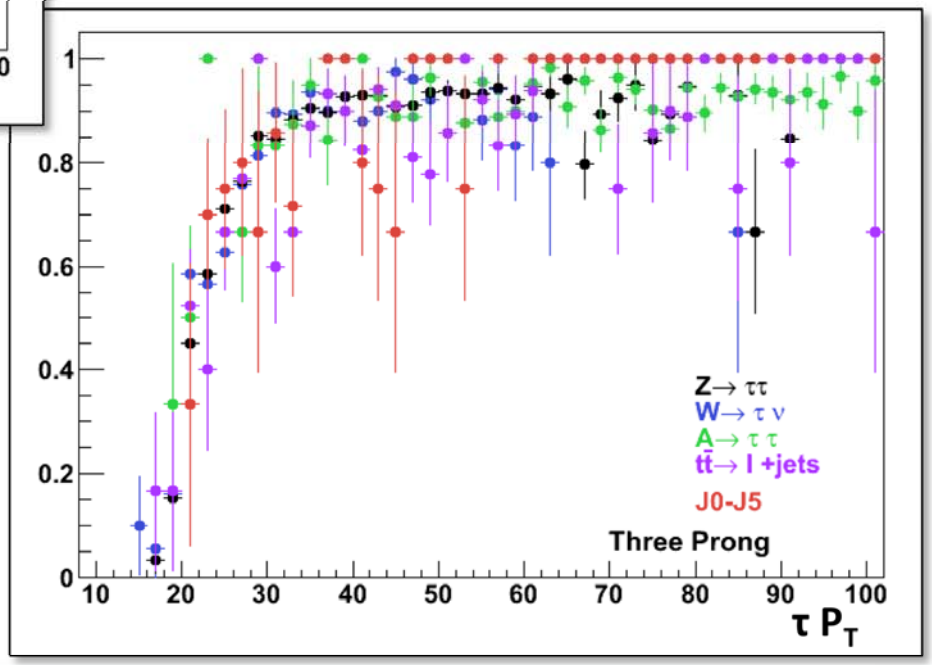



TTP12_1500, 14 TeV samples

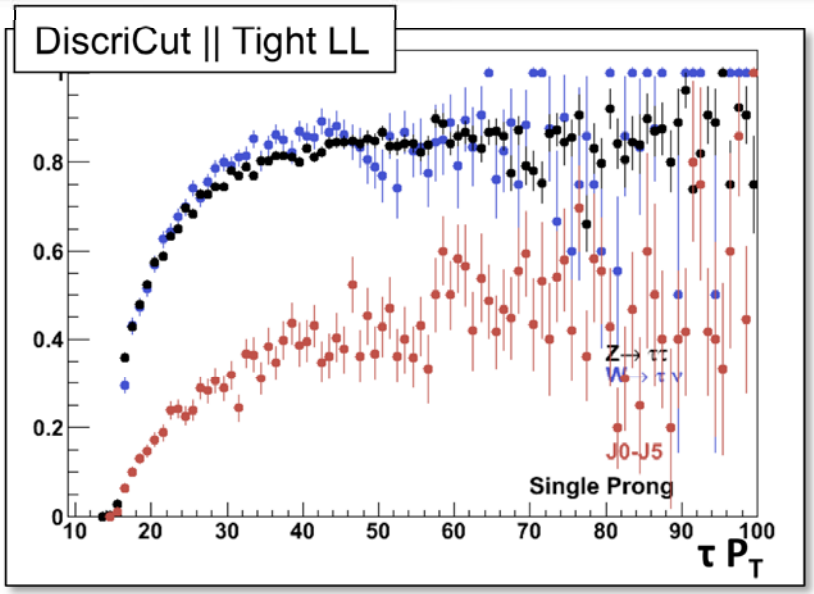
(Tight LL) && (tau1p3p EfficNN>0.3)

**TAU16I_Loose**

Using *very tight* τ reco, the dijets fake rate is in fair agreement with the signal efficiency curves.



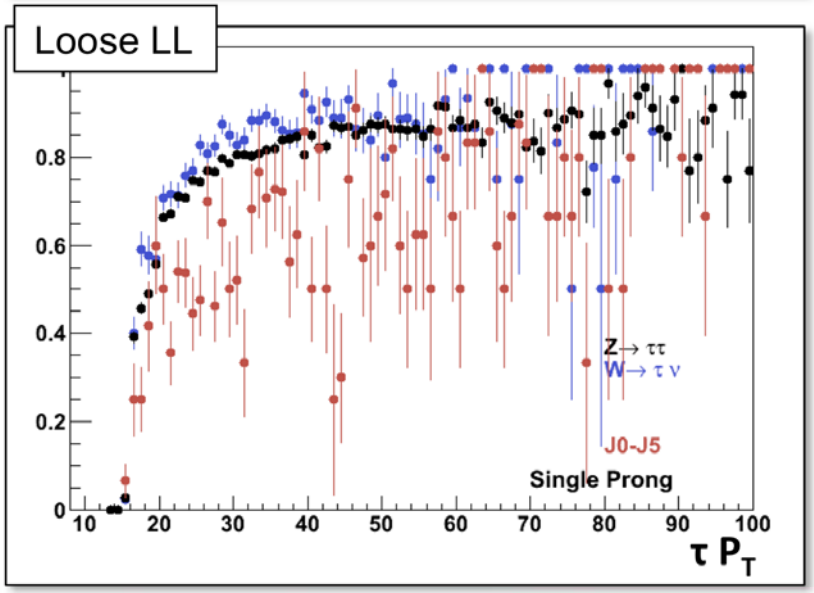
# τ Reco selection – Single Prong

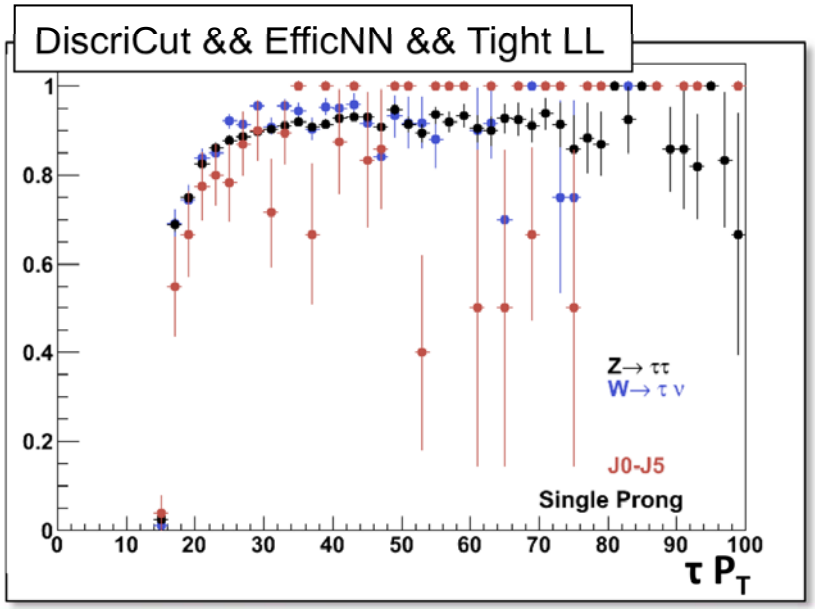



TTP12_1500, 14 TeV samples

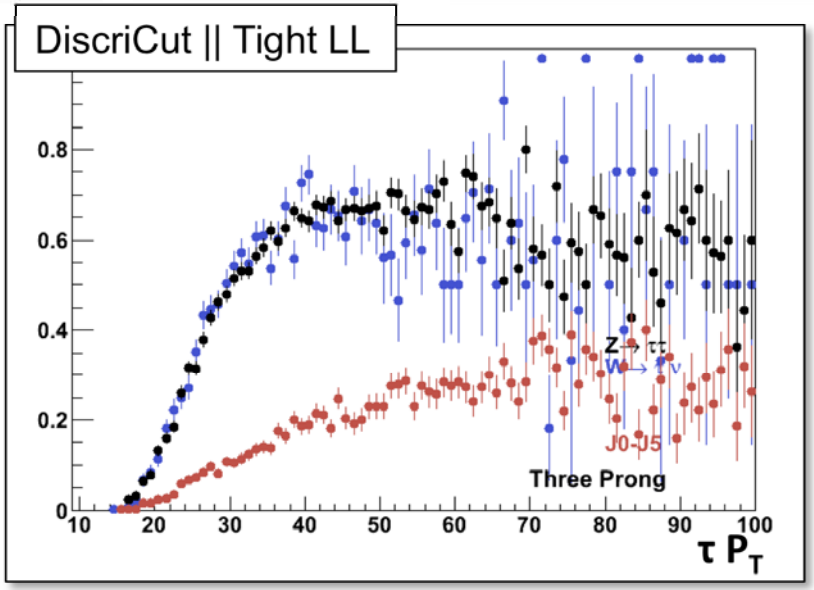
Other various τ Reconstruction combinations, give jets efficiency curves worse or poorer in statistics.

**TAU16I_Loose**



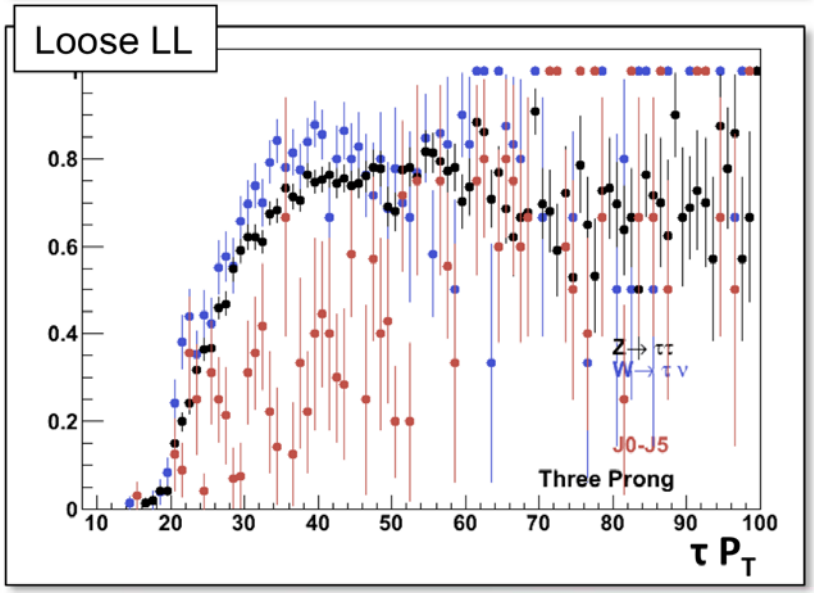
# τ Reco selection – Three Prong

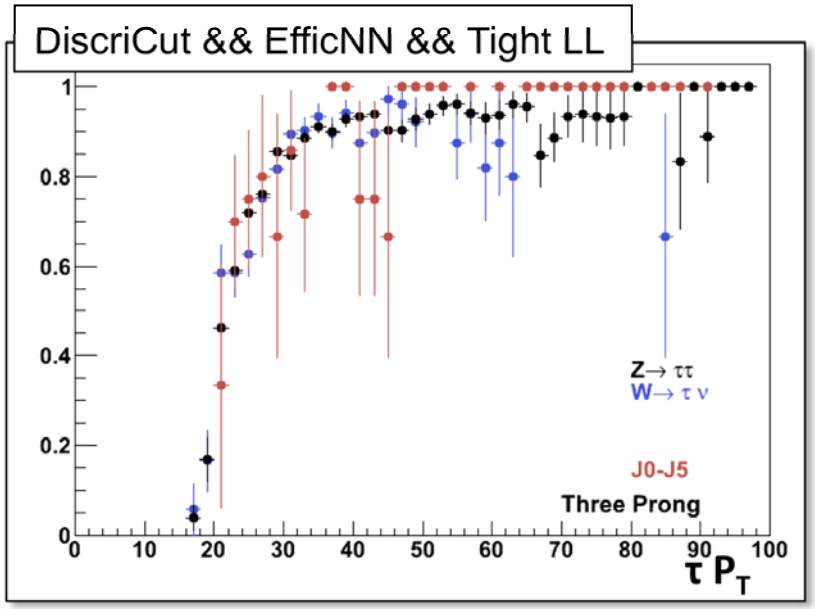



TTP12_1500, 14 TeV samples

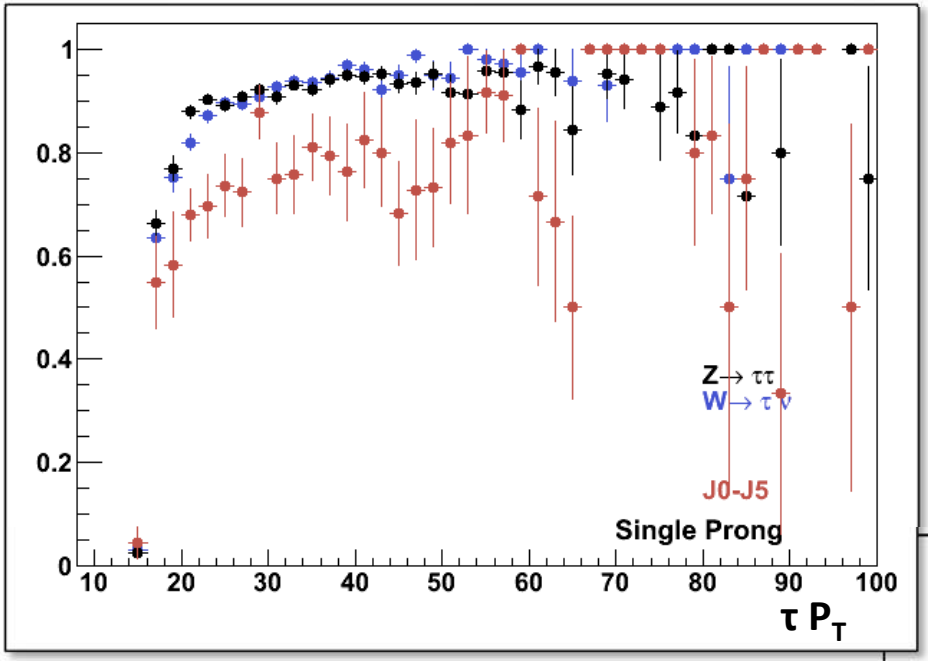
Various τ Reconstruction combinations, give jets efficiency curves worse or poorer in statistics.

**TAU16I_Loose**



# Signal Efficiencies – 10TeV

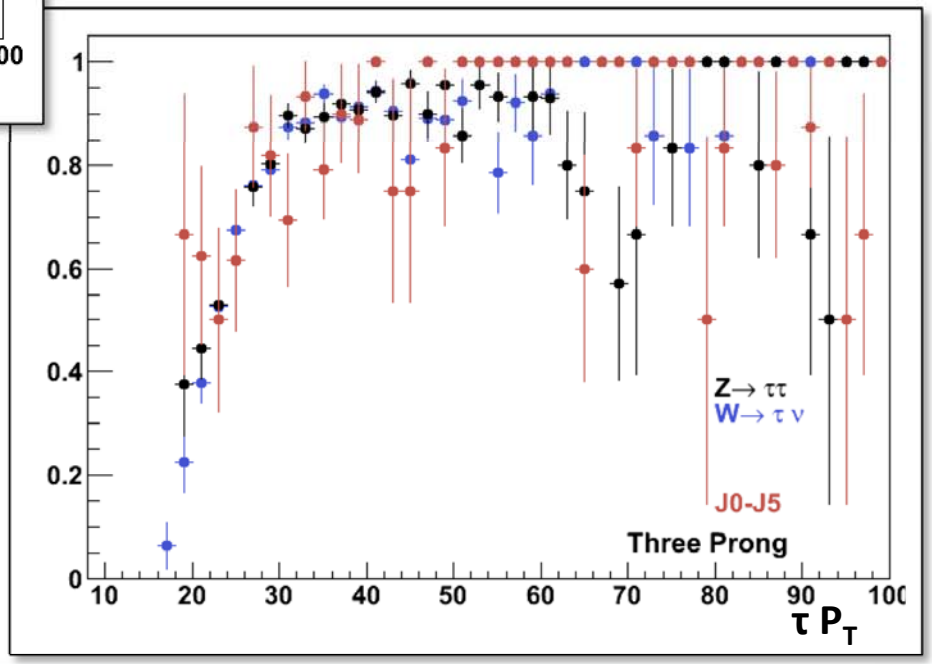



TTP12b, 10 TeV samples

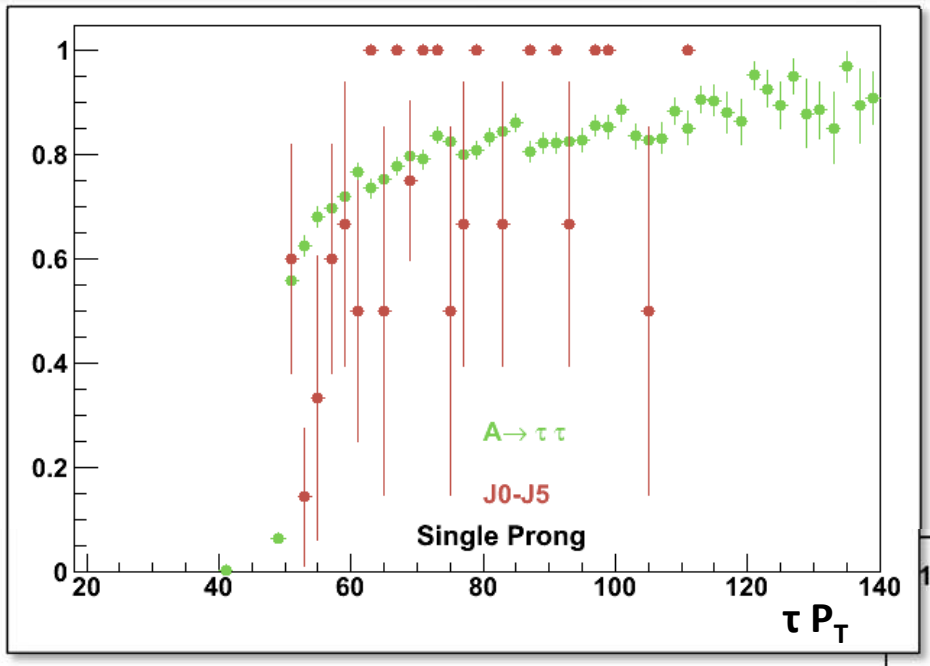
(Tight LL) && (tau1p3p EfficNN>0.3)

**TAU16I_Loose**

For 10TeV samples, Single Prong trend for dijets looks pretty lower – consistent with other τ reco selection.



# Signal Efficiencies – 14TeV

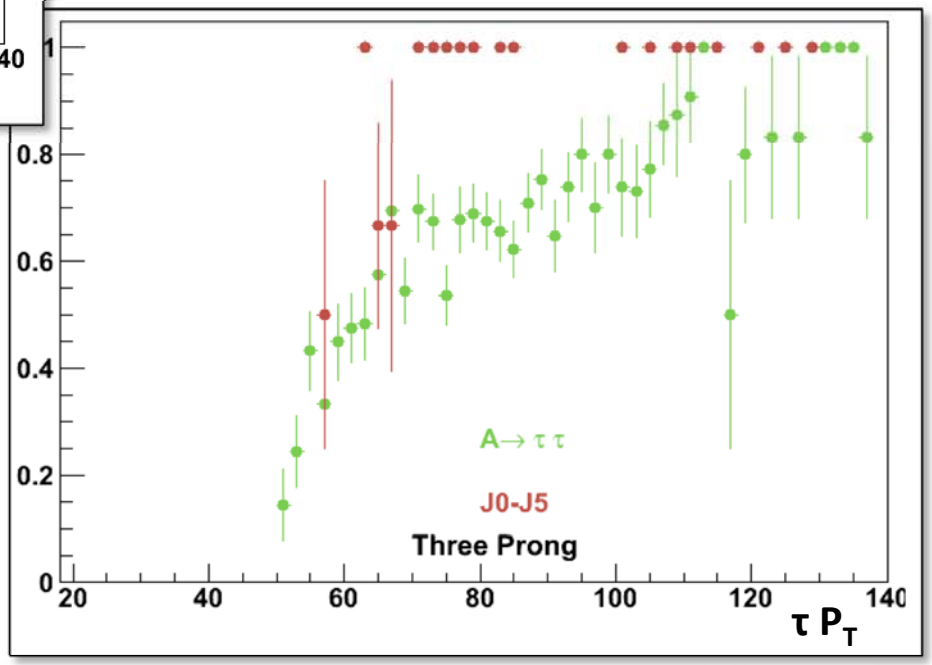



TTP12_1500, 14 TeV samples

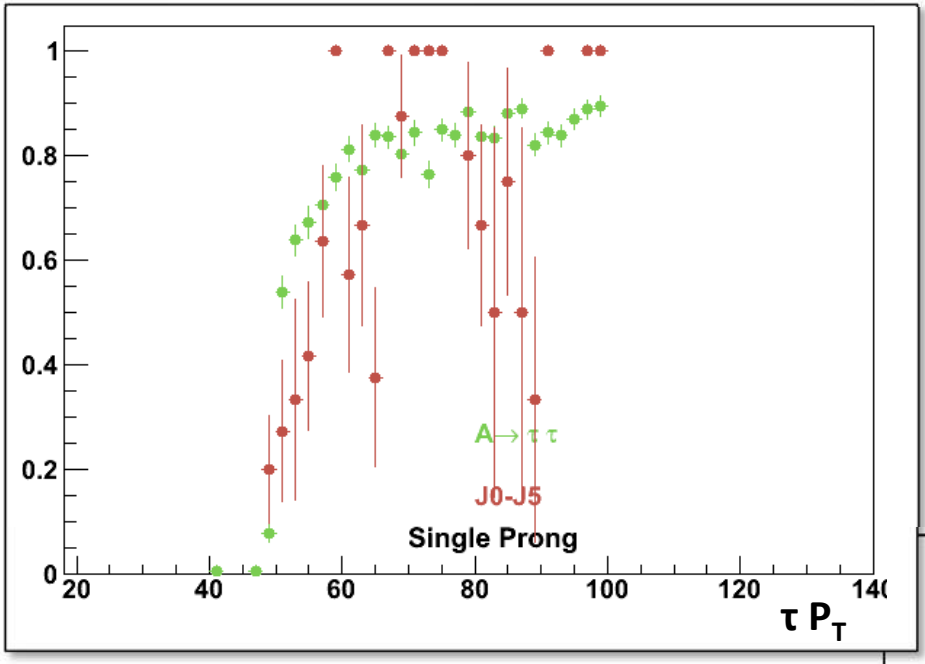
(Tight LL) && (tau1p3p EfficNN>0.3)

**TAU50**

The agreement between dijets fake rate and A->ττ efficiency curve is promising – but missing statistics.



# Signal Efficiencies – 10TeV

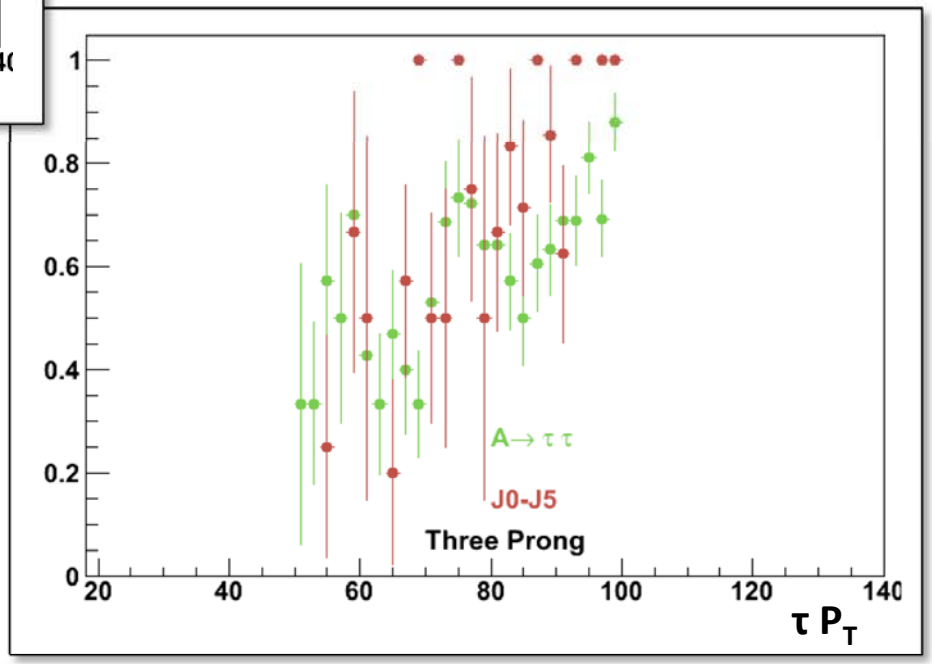



TTP12b, 10 TeV samples

(Tight LL) && (tau1p3p EfficNN>0.3)

**TAU50**

For 10TeV samples, Single Prong trend for dijets still looks lower – and still miss statistics.



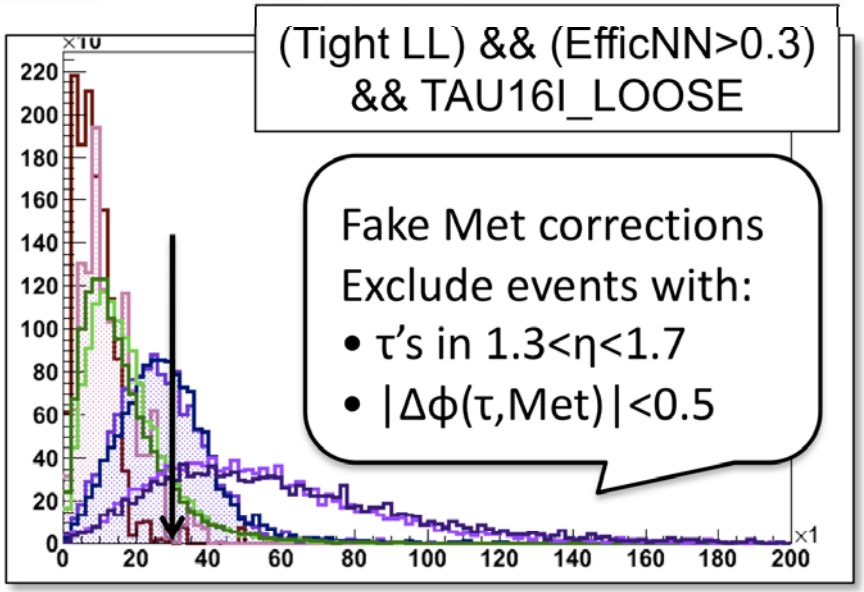
# Missing $E_T$

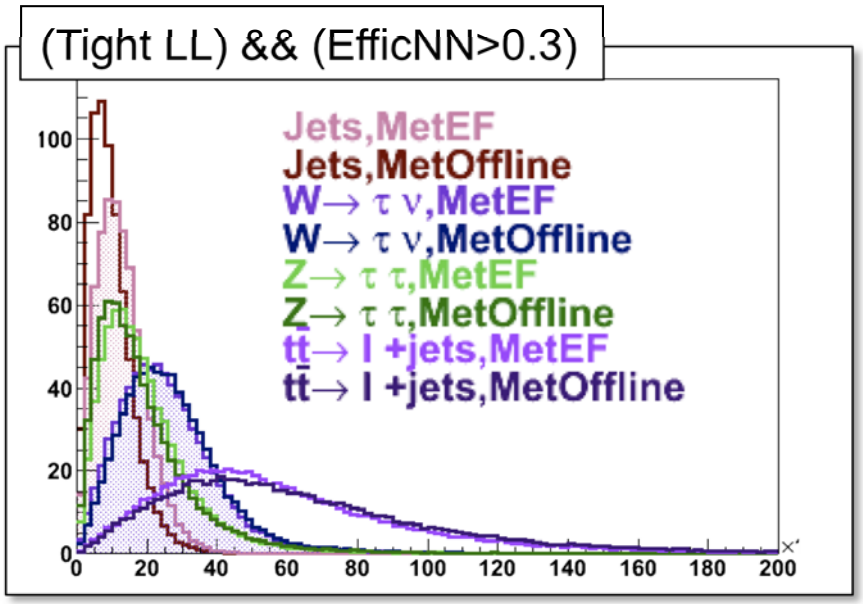
**MET EF**

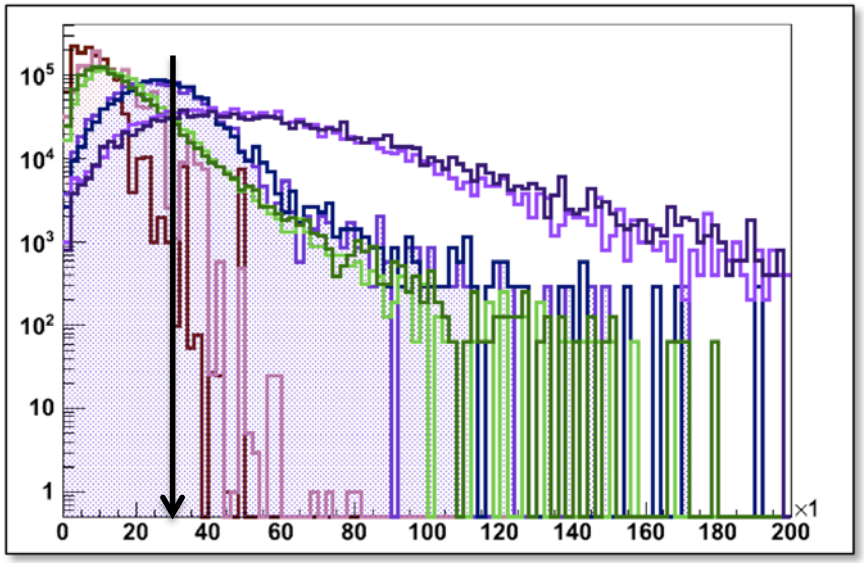
- from calorimeter cells with EM and HAD samplings scaled

**MET Final**

- H1-style calibrated MET + muon + cryostat corrections

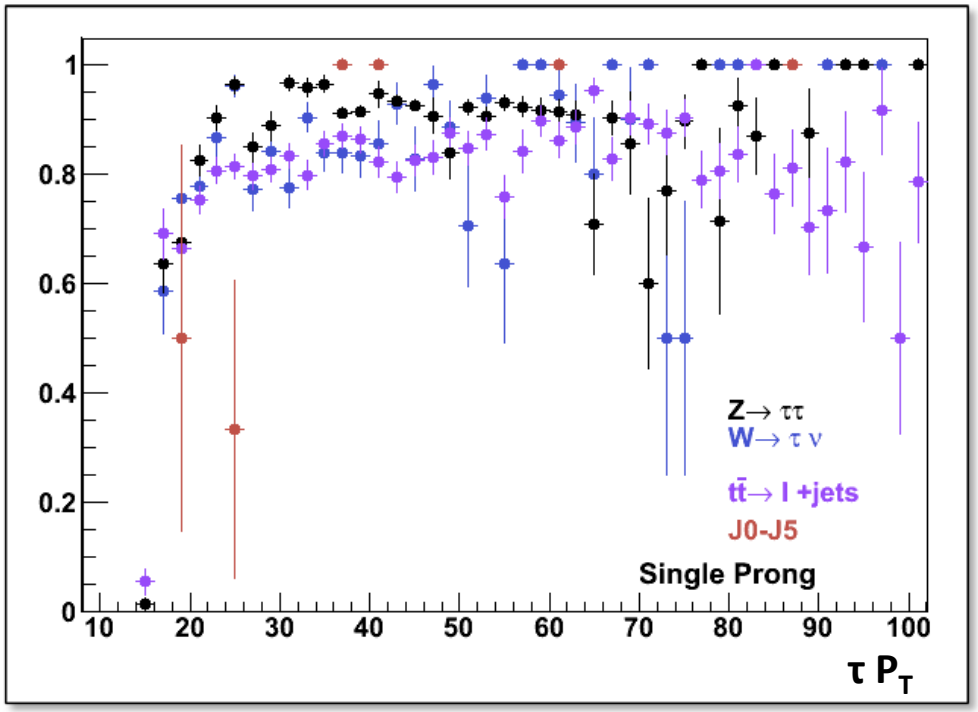


# TAU16I+MET30

$$\epsilon = \frac{\#Good\ Reco\ \tau's\ passing\ TAU16I\_Loose\ with\ EF\ MET{>}30GeV}{\#Good\ Reco\ \tau's\ with\ Offline\ MET{>}30GeV}$$




TTP12_1500, 14 TeV samples

(Tight LL) && (tau1p3p EfficNN>0.3)

No conclusion can be drawn about the dijet samples – not too many events surviving. Same for three prong case.

Fair agreement between the efficiency curves for signal processes.

# Conclusions

Measuring on data the trigger efficiencies of certain trigger chains will be a challenge

Could we use τ-like events for this purpose?

In order to do so, we need to make sure the signal efficiency curves match the dijet ones

Results for TAU50 look very promising

Some brainstorming is still needed for TAU16I+MET30