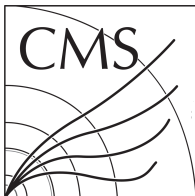


# Adding Tau Leptons to TTTT X-Section Measurement

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# INTRODUCTION

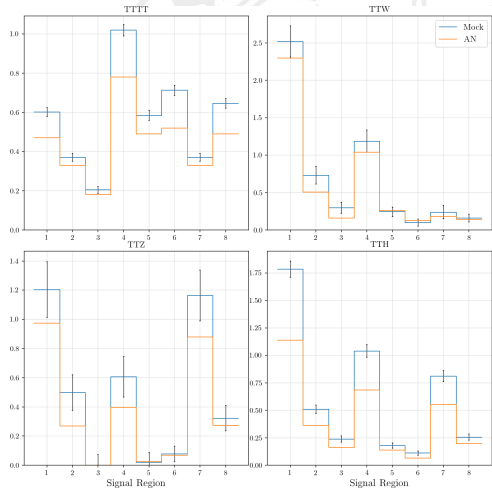
- ▶ **Goal:** Investigate how the TTTT cross-section measurement could be improved by adding taus to the lepton selection.
- ▶ To avoid the work of modifying the existing analysis loop to include taus, a simple “mock”<sup>1</sup> analysis was implemented from scratch which attempts to replicate the main features of the real analysis.
- ▶ Runs on same CMS4 nTuples as existing analysis.
- ▶ some text

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<sup>1</sup>[https://github.com/cfangmeier/FTAnalysis/tree/tau\\_studies/studies/tau](https://github.com/cfangmeier/FTAnalysis/tree/tau_studies/studies/tau)

# MOCK ANALYSIS 2016 YIELDS

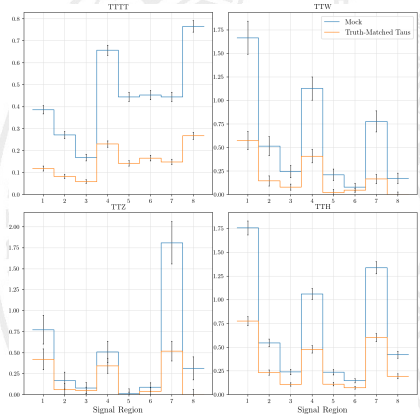
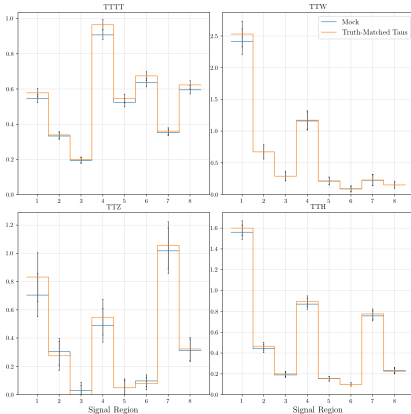
- ▶ Attempt to replicate AN yields with mock analysis using only electrons and muons
- ▶ Generally overestimate yield (wrt analysis note) by 30-50%
- ▶ But shapes tend to match, so go ahead and add taus to make a comparison.



## TAU SELECTION

- ▶ Taus to be considered in the SS pair must pass the following requirements
  - ▶ Pass the ID: `byTightIsolationMVArun2v1DBdR03oldDMwLT`
  - ▶ Have  $P_T > 20\text{GeV}$
  - ▶ Isolated ( $dR > 0.4$ ) from any electrons or muons that pass their respective selection criteria
- ▶ Generator-Level taus used in truth-matching must:
  - ▶ Be flagged as prompt (ie. `tas::genps_fromHardProcessDecayed()==1`)
  - ▶ Decay hadronically ( $\tau^\pm \rightarrow \pi^\pm \{\pi_0\}$ ,  $\tau^\pm \rightarrow \pi^\pm \pi^\pm \pi^\mp \{\pi_0\}$ )
- ▶ A reconstructed tau is considered truth-matched if it is within  $dR < 0.3$  of a generator-level tau
- ▶ Otherwise taus are treated exactly the same as electrons and muons in the SS-pair construction/Z-Veto/Jet-Cleaning.

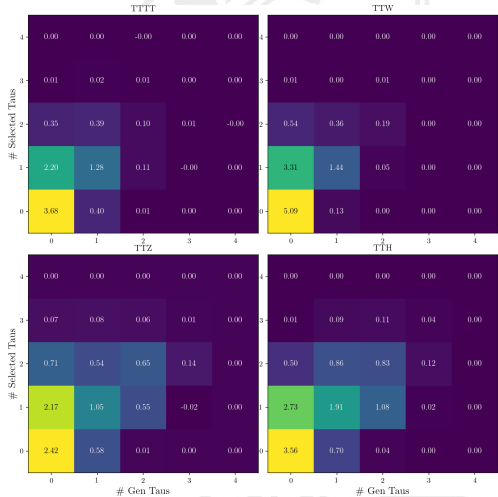
# YIELDS/TRUTH MATCHING



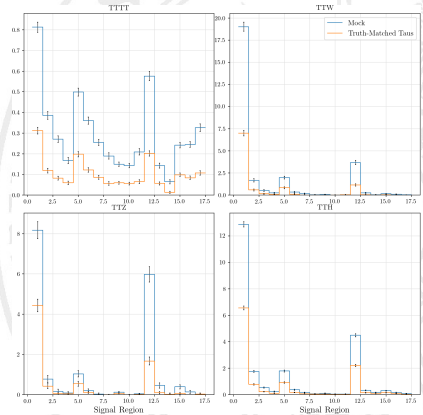
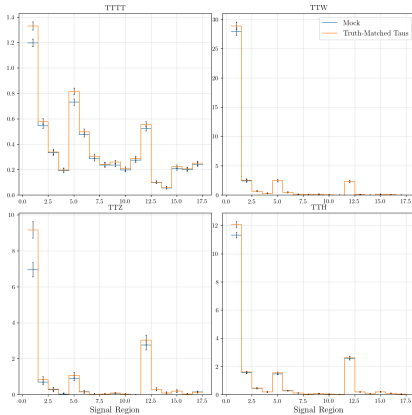
- ▶ Above figures show yields when there are zero selected taus(left) or one selected tau(right).
- ▶ Orange Lines show yields when the tau is required to be truth-matched.

# CROSS-CHECKING TRUTH MATCHING

- ▶ Previous slide indicates  $\approx 30 - 40\%$  of taus are fakes.
- ▶ Figure shows the yields for events in any SR broken down by # of generator-level taus and # of selected taus.
- ▶ The figure on the right corroborates the previous slide; In TTTT, for example, only about 40% of events with 1 selected tau have 1 or more real taus.



# RESULTS WITH EXPANDED BINNING



► Ongoing investigation of more fine binning<sup>2</sup>.

<sup>2</sup>[https://github.com/cfangmeier/FTAnalysis/blob/tau\\_studies/studies/tau/Yield.C#L261](https://github.com/cfangmeier/FTAnalysis/blob/tau_studies/studies/tau/Yield.C#L261)

## CONCLUSIONS

some text

