# HF noise study Run3

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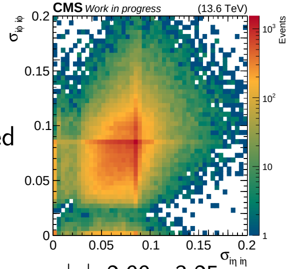
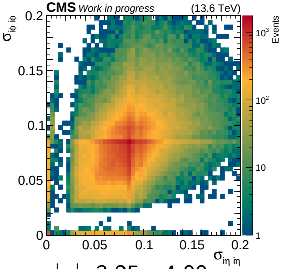
[1]Université Libre de Bruxelles, [2]Boston University

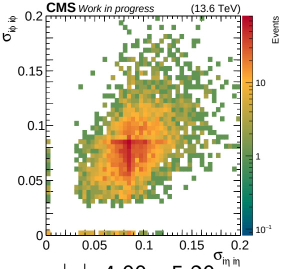
2nd August 2026

# 2024 Previous: $p_T^{\text{jet}} > 100$ GeV, $|\eta| > 3.00$

Physics-enriched region

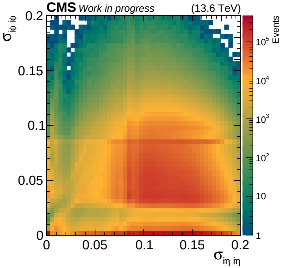


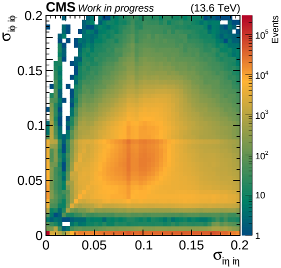



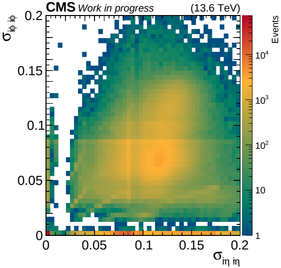




$|\eta|$: 2.99 - 3.25 $|\eta|$: 3.25 - 4.00 $|\eta|$: 4.00 - 5.20

Noise-enriched region



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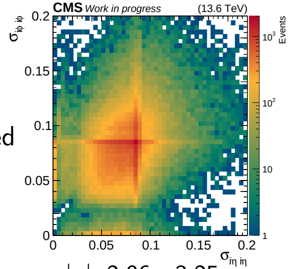


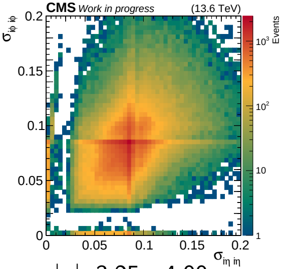


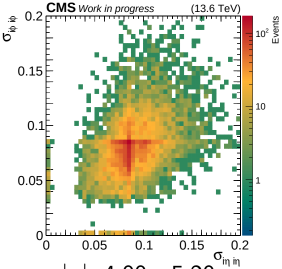


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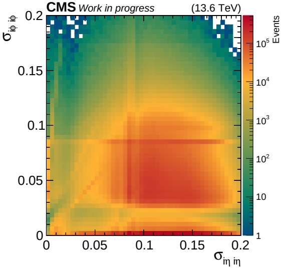


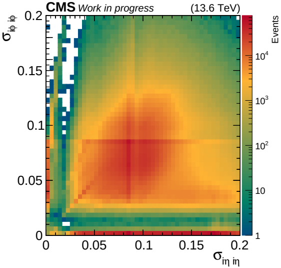


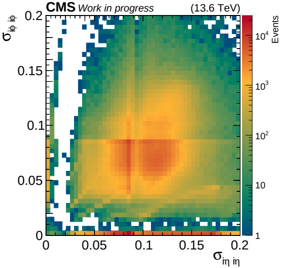

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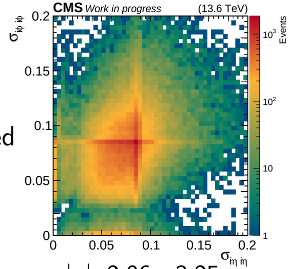


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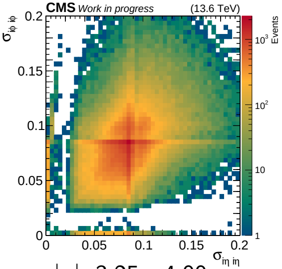
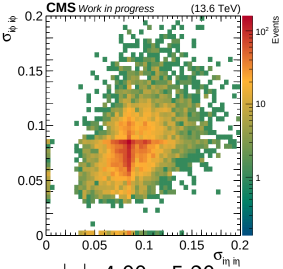
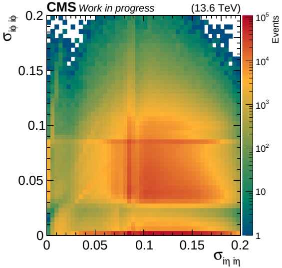


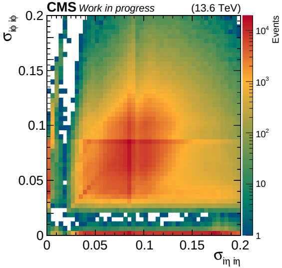

$|\eta|$: 3.25 - 4.00

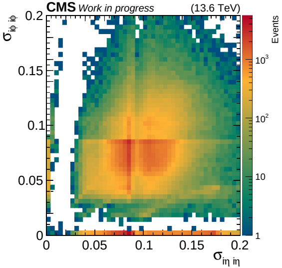



$|\eta|$: 4.00 - 5.20

Noise-enriched region



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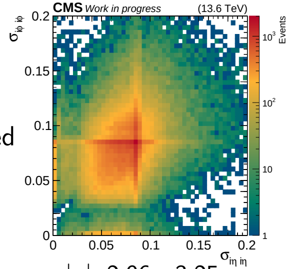


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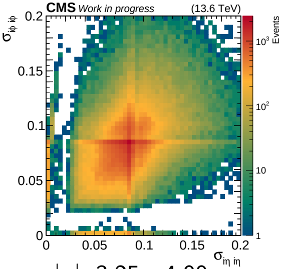


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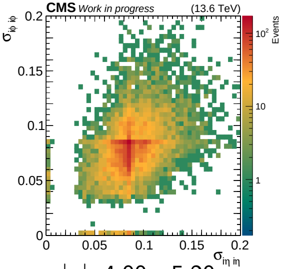
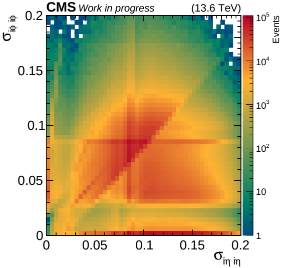
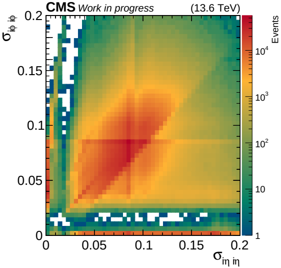
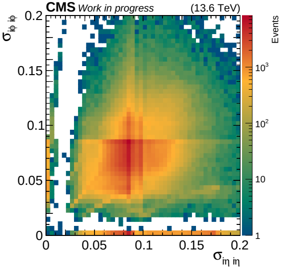



$|\eta|$: 4.00 - 5.20

Noise-enriched region



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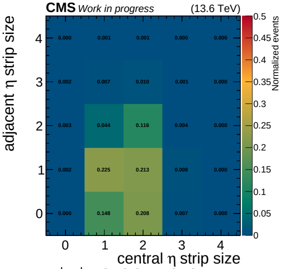


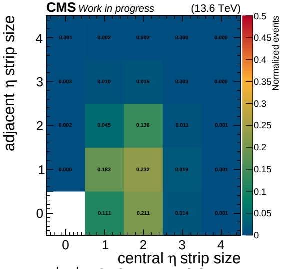


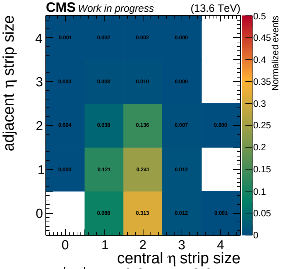


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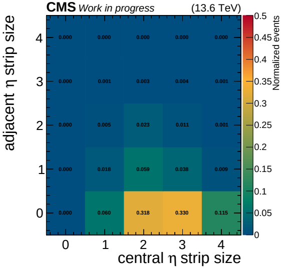
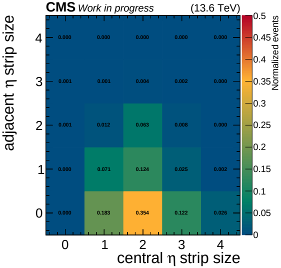
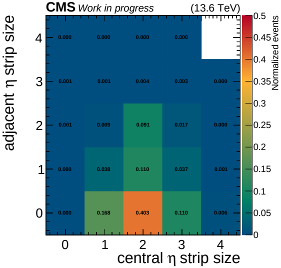
Noise-enriched region



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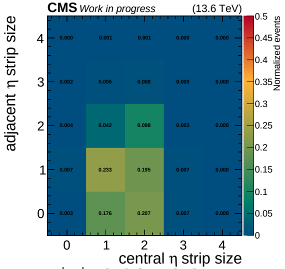


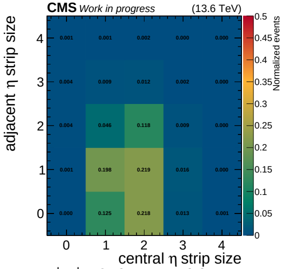


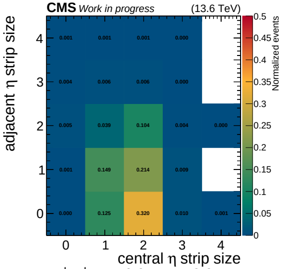


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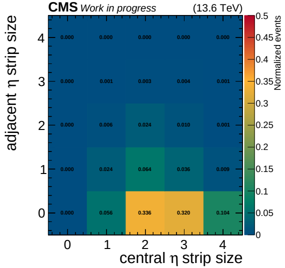


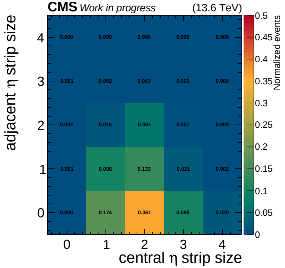


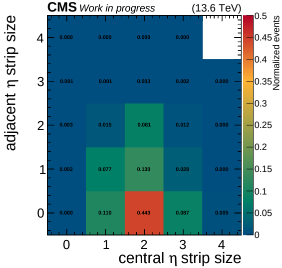

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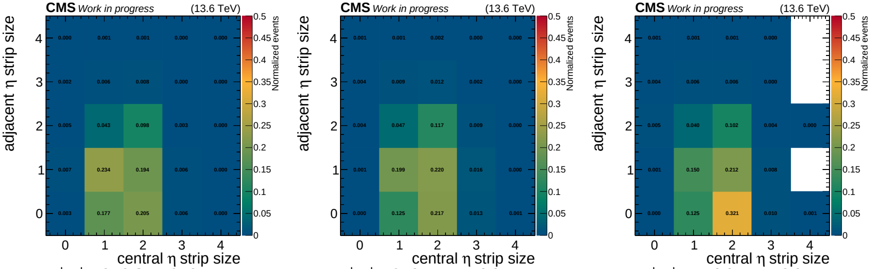


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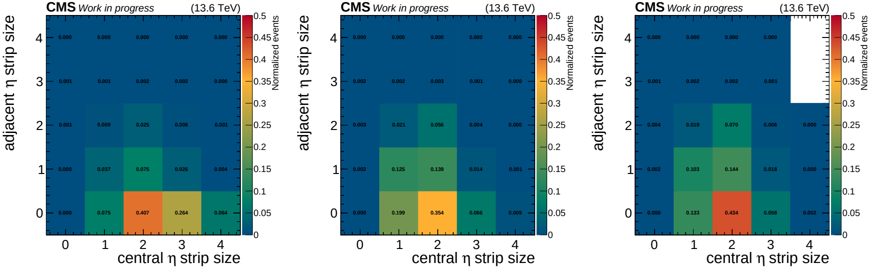

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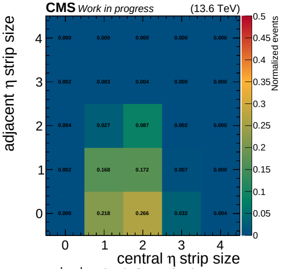


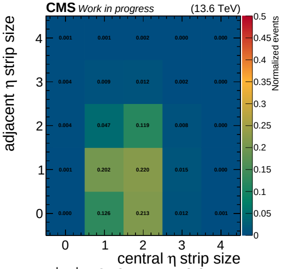


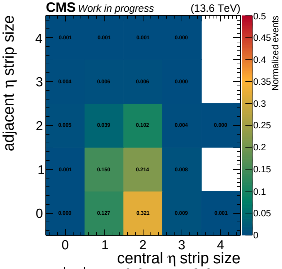


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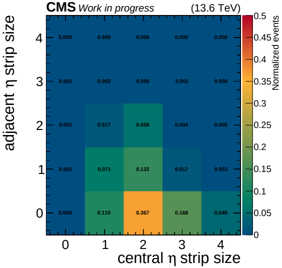


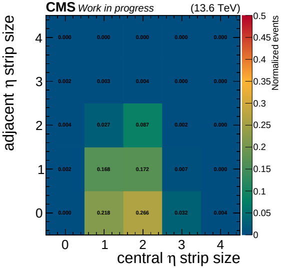


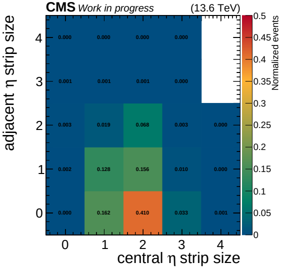

# HF cleaning cuts, efficiencies and SF's

Cleaning cuts for HF jets are defined as:

- $2.99 < |\eta| < 4.0$: $\sigma_{i\eta i\eta} - \sigma_{i\phi i\phi} < 0.02$ condition is required. The corner region, defined as $\sigma_{i\eta i\eta} < 0.02$ & $\sigma_{i\phi i\phi} < 0.02$ is also removed.
- $|\eta| > 4.0$: $\sigma_{i\eta i\eta} < 0.1 <$ & $\sigma_{i\phi i\phi} > 0.02$ condition is required.
- $|\eta| > 2.99$: $CSS_{HF} < 3$ is required.

$$\text{Efficiency (Data/MC)} = \frac{\text{(HF Jets with cleaning cuts) \& }(\texttt{PER selections})}{\texttt{Total HF Jets with PER selections}} \tag{1}$$

$$SF = \frac{\text{Data efficiency}}{\texttt{MC efficiency}} \tag{2}$$

$$\text{Noise-tagging Efficiency} = \frac{\text{(HF Jets with inverted cleaning cuts) \& }(\texttt{NER selections})}{\texttt{Total HF Jets with NER selections}} \tag{3}$$

$$\text{Mistag rate} = 1 \text{ - (Noise-tagging efficiency)} \tag{4}$$

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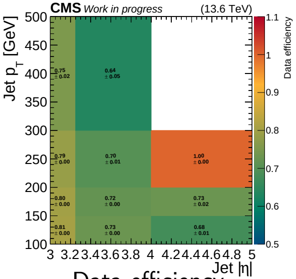
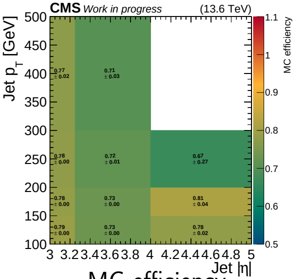
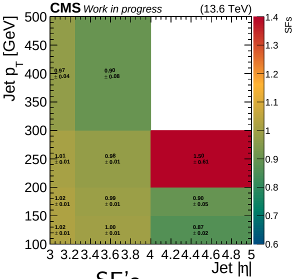


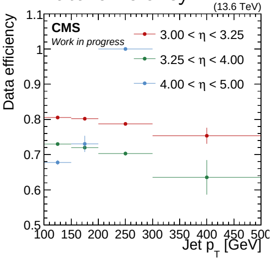



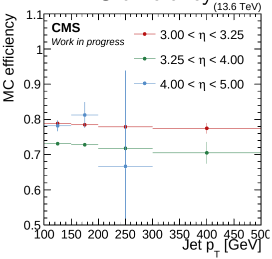



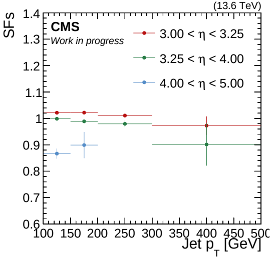

Data efficiency

MC efficiency

SF's



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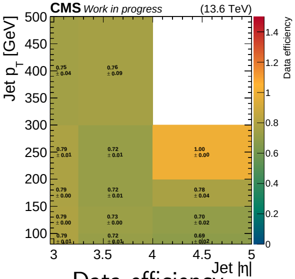
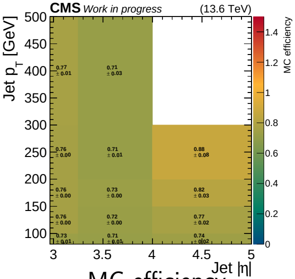
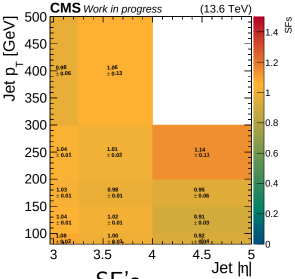


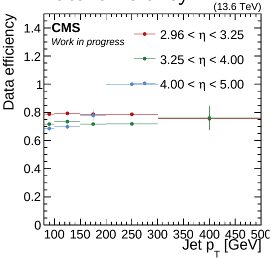



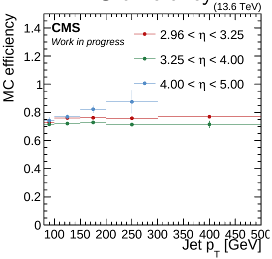



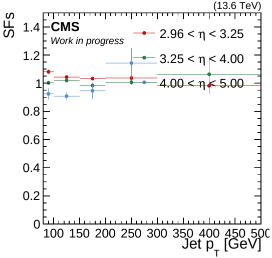

Data efficiency

MC efficiency

SF's



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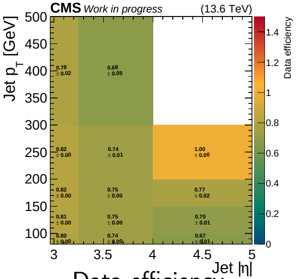
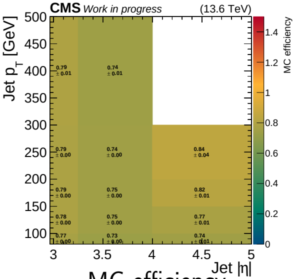
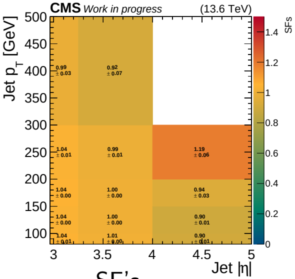


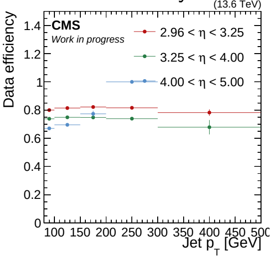



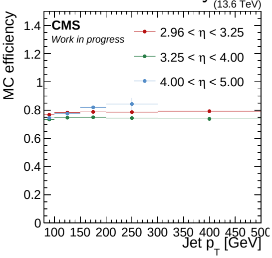



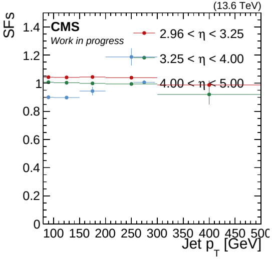

Data efficiency

MC efficiency

SF's



# Noise-tagging eff., mistag rate, TF's

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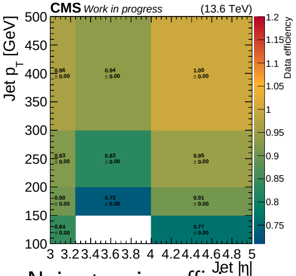
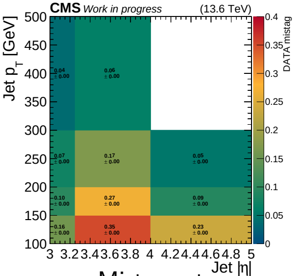
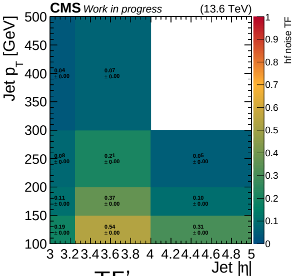


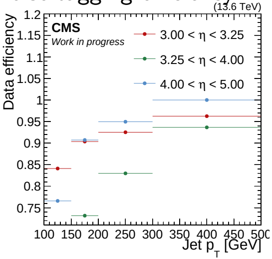



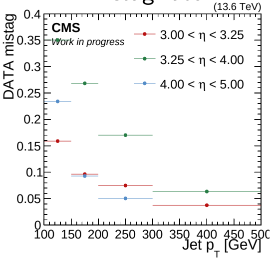



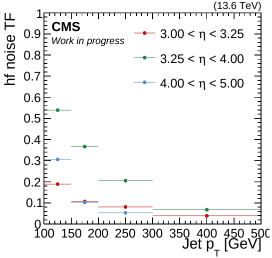

Noise-tagging efficiency

Mistag rate

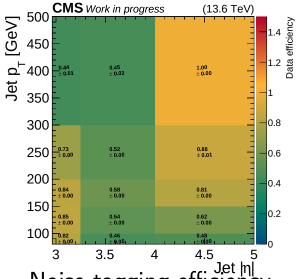
TF's



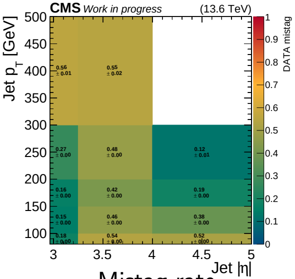



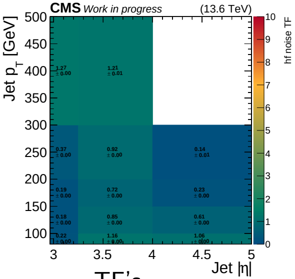
# 2024 Latest: $\Delta\phi(\text{jet1, MET}) < \pi - 0.2$ (ASC module), $p_T^{jet} > 80$ GeV, $|\eta| > 2.964$



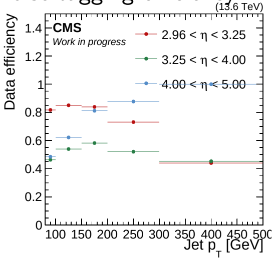

Noise-tagging efficiency

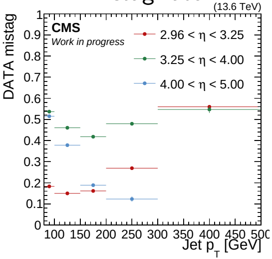


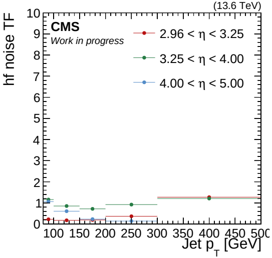

Mistag rate



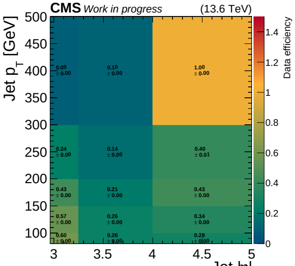

TF's



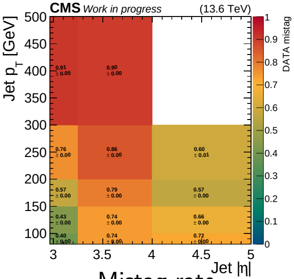



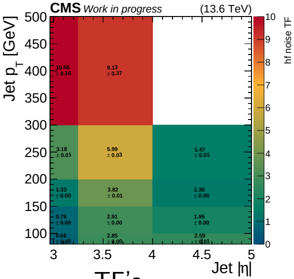
# 2024 Latest: $\Delta\phi(\text{jet1, MET}) < \pi - 0.2$ (HFNoiseVeto module), $p_T^{jet} > 80$ GeV, $|\eta| > 2.964$



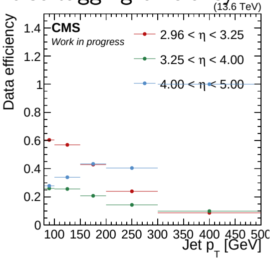

Noise-tagging efficiency

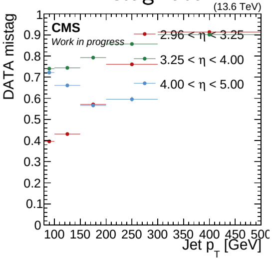


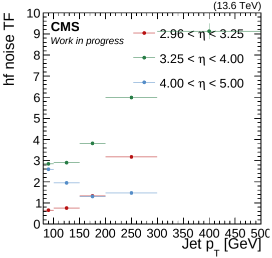

Mistag rate




TF's



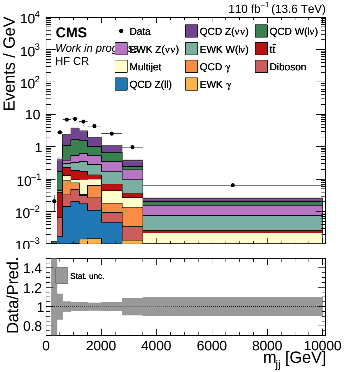



# HF noise estimate in SR

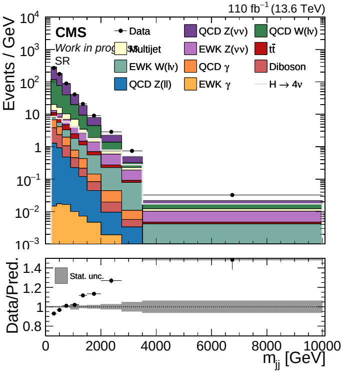
- HF CR is defined with the same selections as SR but with inverted HF-cleaning cuts. Also leading/subleading jet-$p_t > 80$ GeV & $|\eta| > 3$.
- Noise template in VBF SR is estimated from the template in HF CR using $[p_T, \eta]$ dependent transfer factors, defined as the relative probability for a noise event to pass the HF shape cuts relative to failing them.

$$N^{\text{SR}}_{\text{noise}} = \frac{P(\text{pass} \mid \text{noise})}{P(\text{fail} \mid \text{noise})} \times \left(N^{\text{CR}}_{\text{data}} - N^{\text{CR}}_{\text{MC}}\right)$$

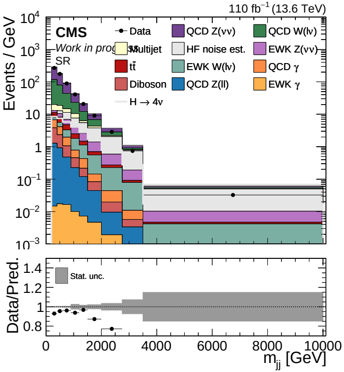
# 2024: Veto + TF's from HFNoiseVeto module




HF CR

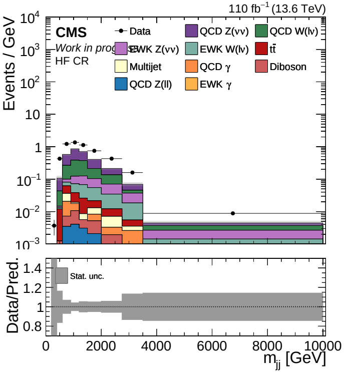



SR

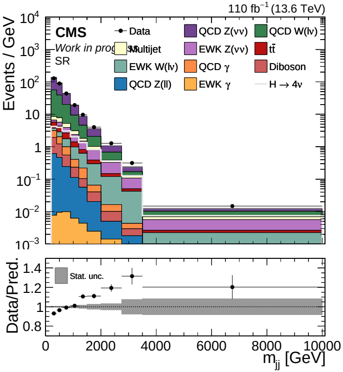



SR with HF estimate

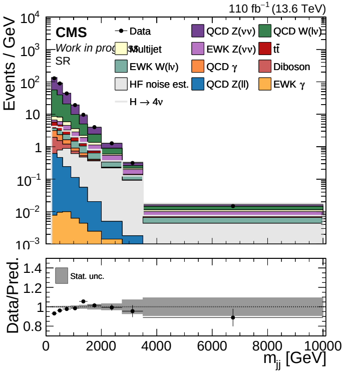
# 2024: Veto + TF's from ASC module




HF CR

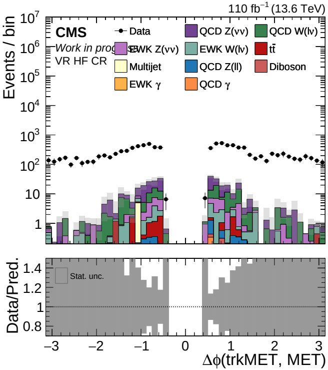



SR

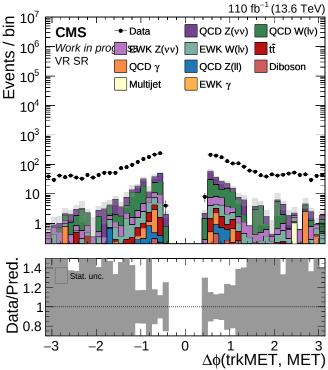



SR with HF estimate

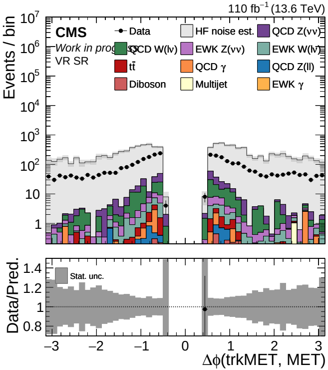
# 2024 VR: Veto + TF's from HFNoiseVeto module




VR HF CR

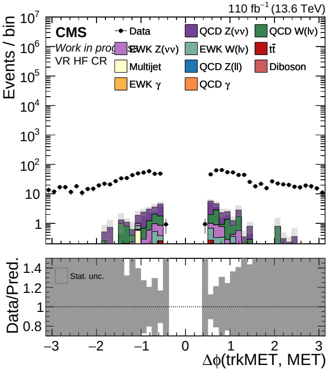



VR SR

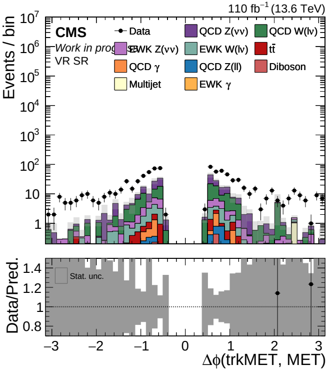



VR SR with HF estimate

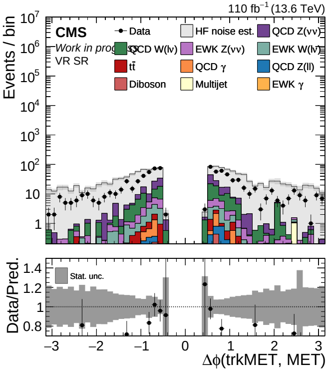
# 2024 VR: Veto + TF's from ASC module




VR HF CR




VR SR




VR SR with HF estimate

# Backup