

**DISCUSSION ON EXPERIMENTAL ASPECTS:
FIDUCIAL DEFINITIONS &
OBSERVABLES WITH POOR EXPERIMENTAL RESOLUTION**

**based on the discussion between
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within the CMS Collaboration**

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On the fiducial XS measurements...

GOALS:

- Decoupling of the experimental and theoretical uncertainties (to a high degree)
- **Low model dependance** of the measurement results

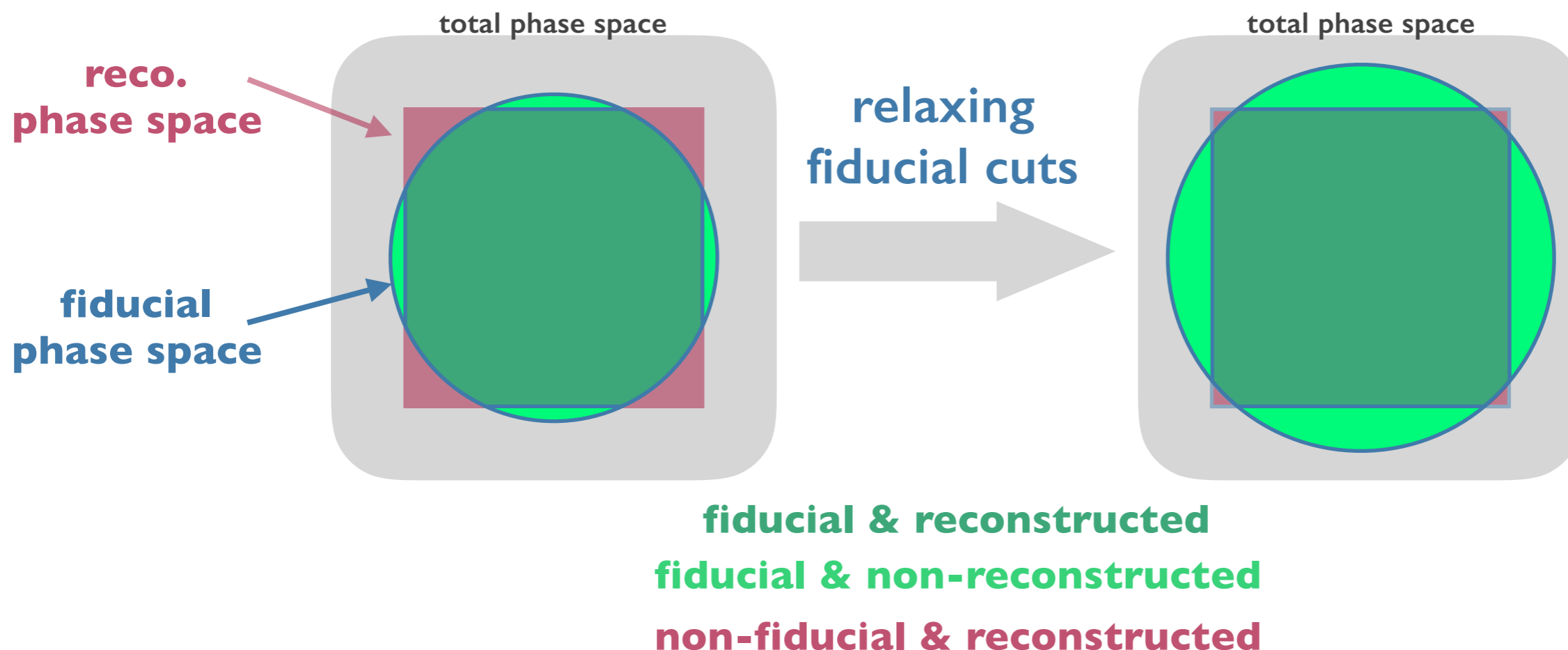
TYPICAL APPROACH:

- Define the fiducial phase space by **matching closely the fiducial cuts to the selection requirements** used to define the signal region.
- This is straightforward for observables with good experimental resolution, but...

On the fiducial phase space...

FOR DISCUSSION:

- How to define the fiducial phase space when observables used to define the signal region have **poor experimental resolution** (missing E_T , jet p_T , etc.)?
 - Effects of migration of signal events can be large
- Can we benefit from e.g. relaxing the requirements on those observables?



On the fiducial phase space...

Criteria for relaxing the cuts:

- Various criteria used in practice, based on different assumptions/approximations.
- One possibility: choose the cut that **minimizes the model dependence**
 - **Arbitrariness**: in the definition and assessment of model dependence
 - **Complexity**: requires performing analysis for multiplets of cuts and models

Naive example:

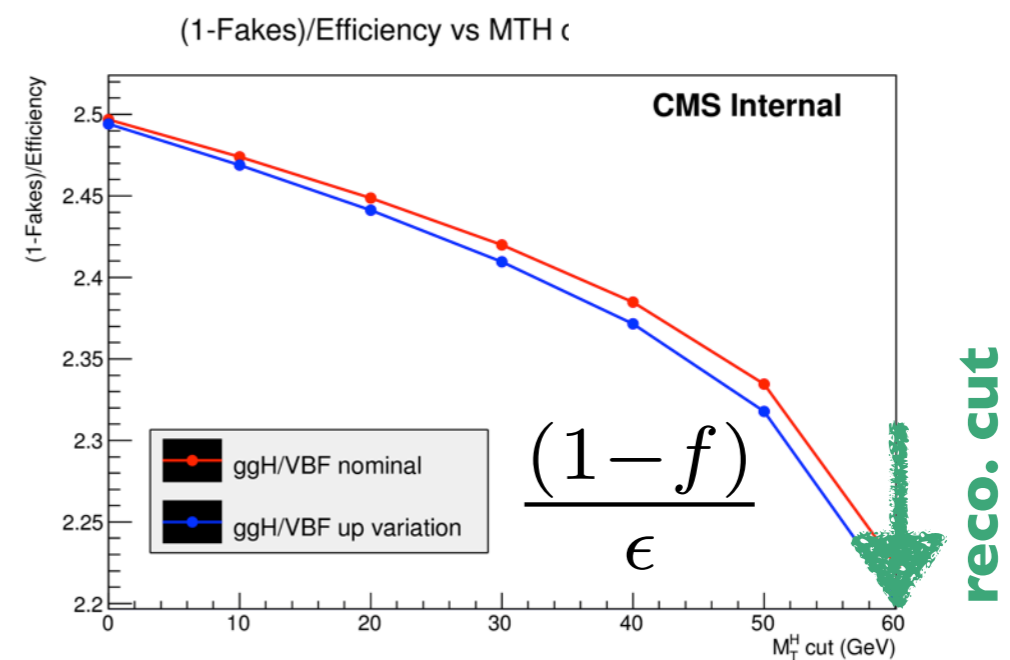
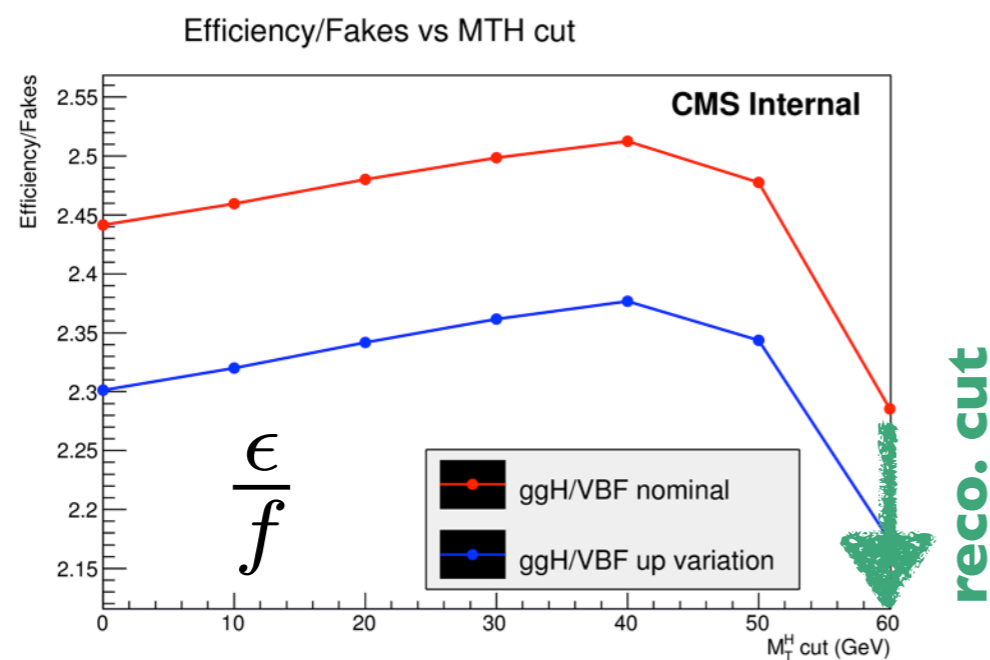
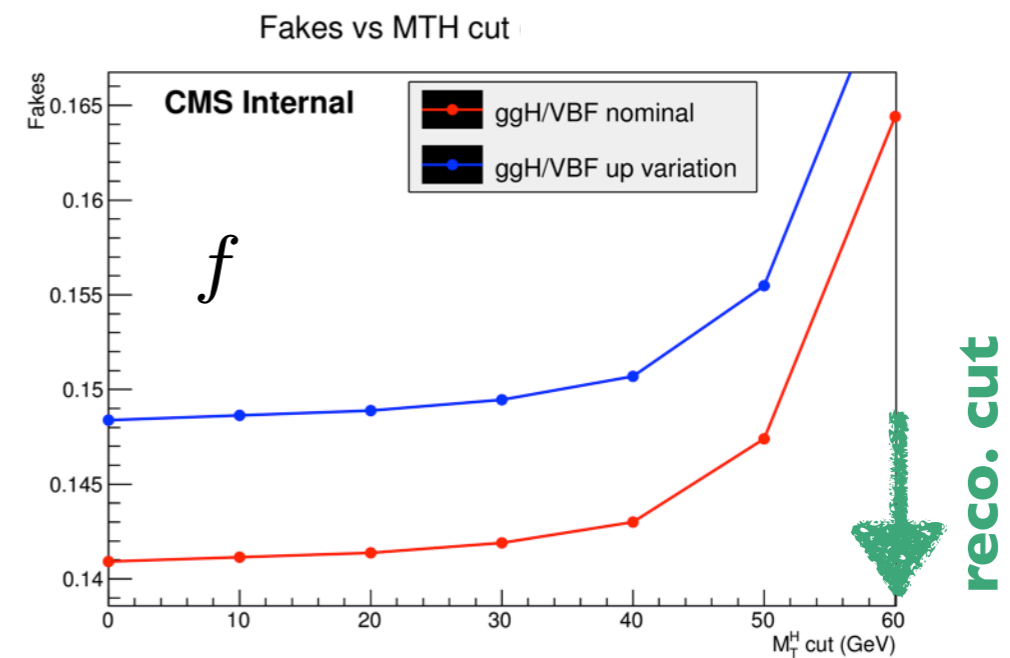
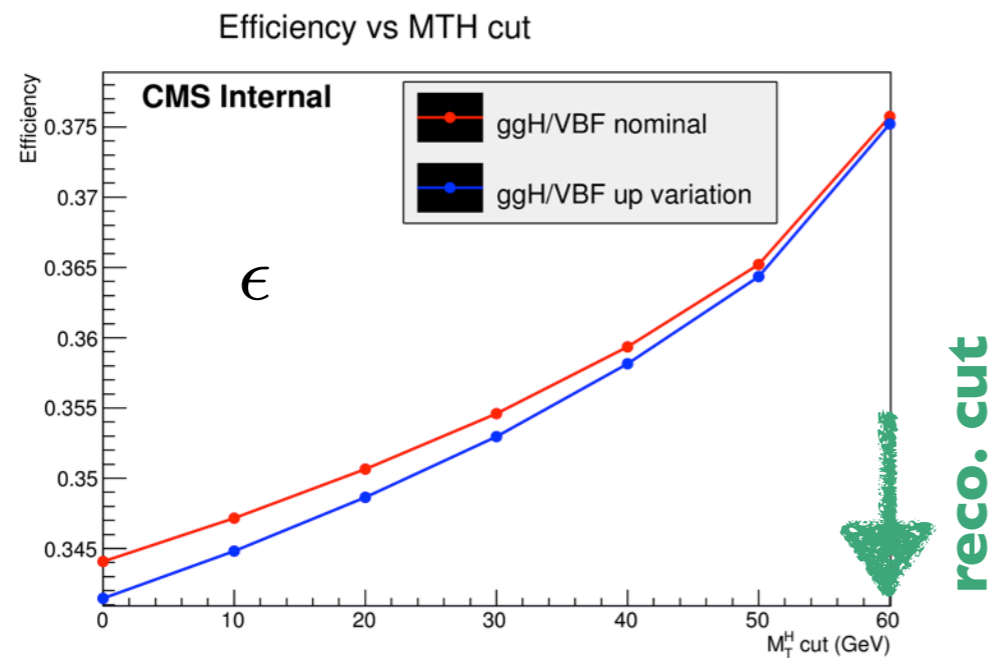
- Observed events (N_T), fiducial signal efficiency (ϵ), x-section (σ), fraction of out-of-fiducial events (f) $N_T = [\epsilon/(1 - f)] \cdot \sigma \cdot \mathcal{L}$
- Simple propagation of the systematic uncertainty on ϵ and f (model dependence)

$$\Delta\sigma \sim \frac{(1-f)}{\epsilon} \cdot \left[\frac{\Delta\epsilon}{\epsilon} \right] \oplus \frac{f}{\epsilon} \cdot \left[\frac{\Delta f}{f} \right]$$

- Can we determine an optimal cut by minimizing individual terms in the total uncer.?

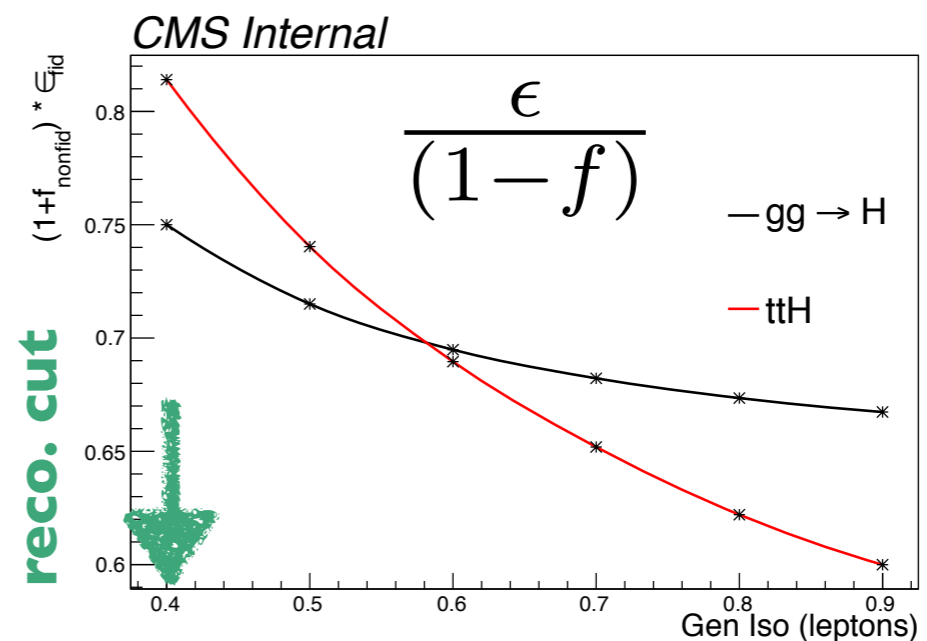
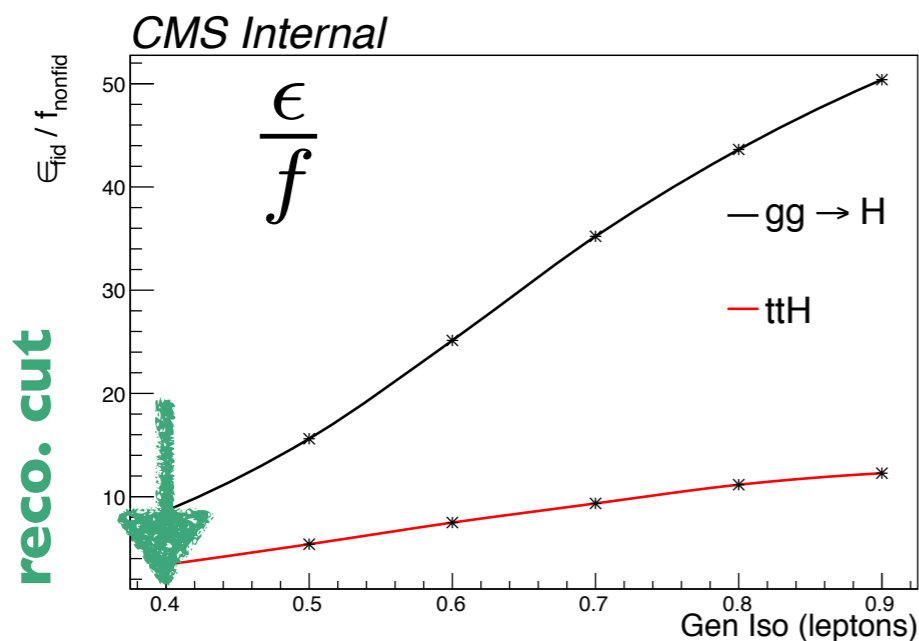
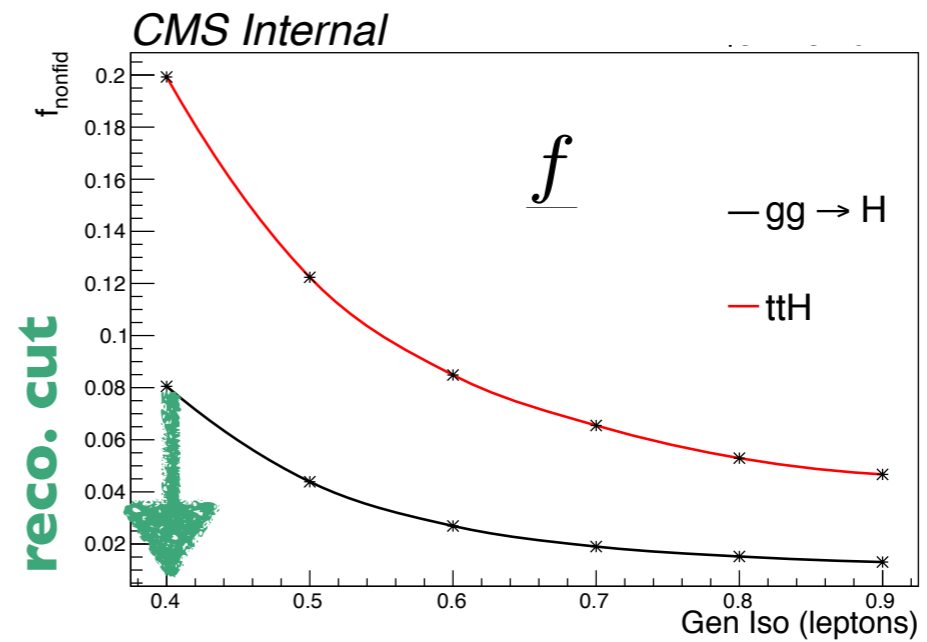
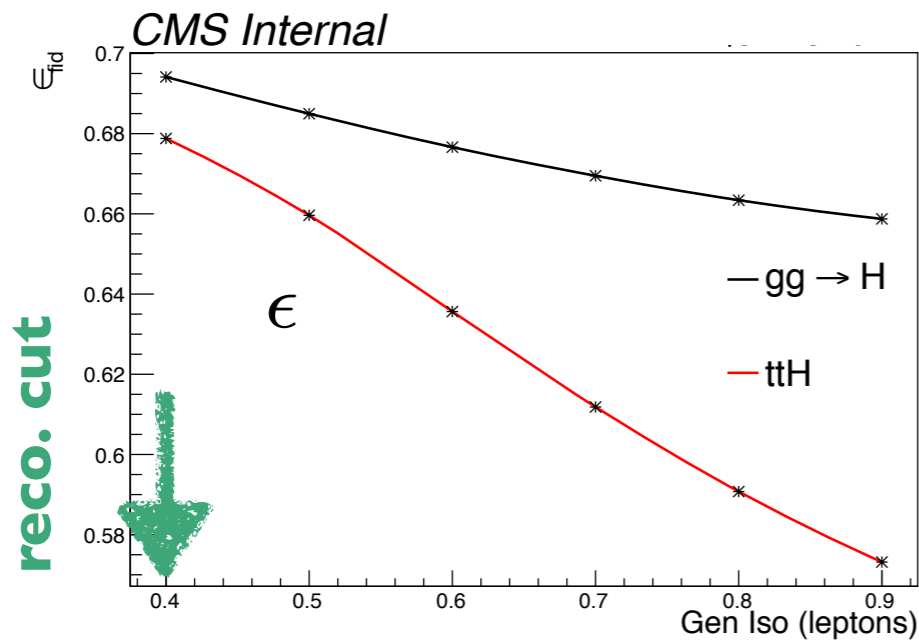
Example observable - $H \rightarrow WW$ analysis

- Dependence of fiducial efficiency (ϵ), fraction of out-of-fiducial events (f), and similar quantities on **transverse di-lepton mass** in the $H \rightarrow WW \rightarrow 2l2\nu$ events for 2 production models: SM and model with large VBF component.



Example observable - $H \rightarrow ZZ$ analysis

- Dependence of fiducial efficiency (ϵ), fraction of out-of-fiducial events (f), and similar quantities on **lepton isolation** in the $H \rightarrow ZZ \rightarrow 4l$ events for 2 alternative models: **pure $gg \rightarrow H$** and **pure ttH** production.



Instead of summary...

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