ZH spin-off analysis

Measuring ZH as a first step towards HH

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Partikeldagarna, November 24, 2020

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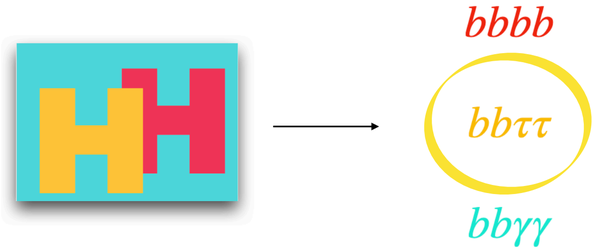
Outline

- Motivation/Introduction
- ZH and HH
- Strategy

Motivation



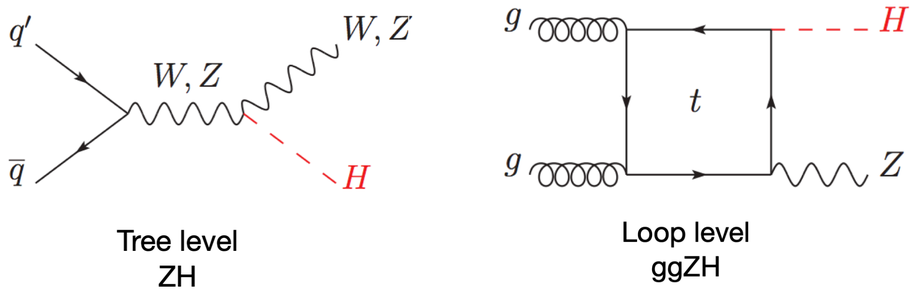
No evidence of SM-like HH production is expected until the HL-LHC 😕

💡 → Searching and finding evidence of ZH as a first step towards HH

✦ Modify $bb\tau\tau$ analysis slightly to target ZH instead of HH

✦ The goal is only to measure ZH but to probe HH!

- VH is the most relevant Higgs boson production mechanism after ggF and VBF at the LHC



- **The goal is to use ZH as a stepping stone for HH thanks to its larger cross-section**

pdg $\sigma_{ZH} = 0.88\,\text{pb}$ **at 13 TeV**

while $\sigma_{HH}^{\text{SM,ggF}} = 0.03105\,\text{pb}$

- ZH is a background in our HH searches

- How is the $bb\tau\tau$ final state most likely to occur in ZH production?

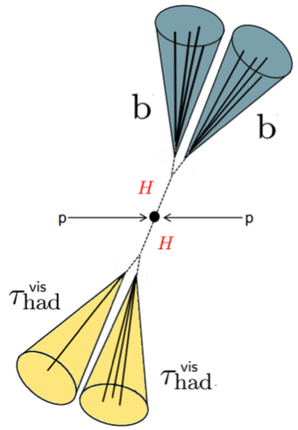
H decays

- $H \to bb$ 58 %
- $H \to \tau\tau$ 6.3 %

Z decays

- $Z \to bb$ 15.1 %
- $Z \to \tau\tau$ 3.4 %

- $\text{BR}(Z \to bb)(H \to \tau\tau) = 9.5 \times 10^{-3}$
- $\text{BR}(Z \to \tau\tau)(H \to bb) = 1.95 \times 10^{-2}$



Strategy

- Leave triggers unchanged with respect to HH analysis
- Evaluate ZH selection efficiency after preselection (*)
- Train an MVA with similar characteristics as HH but using the ZH as signal
- Set upper limits on ZH with full Run-2 dataset
- Observation of the signal could be reached with a combination of $bb\tau\tau$ and $bb\gamma\gamma$ by adding the Run-3 dataset

ATLAS work in progress

* Expected signal region event yields for HH vs. ZH

- $HH \rightarrow bb\tau\tau$ 4.8
- $Z(\tau\tau)H(bb)$ **14.6**
- $Z(bb)H(\tau\tau)$ 6.4