Higgs to WW Measurements with CMS

Sarah Freed, Rice University

On behalf of the CMS Collaboration

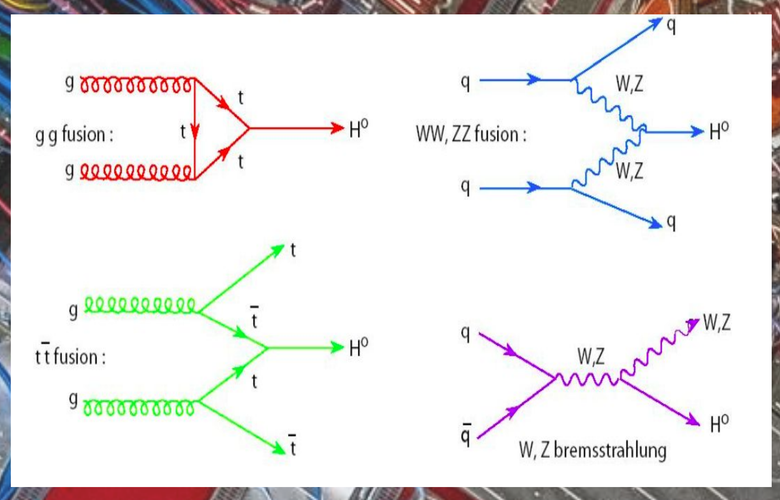
Posters @ LHCC, Winter 2019

arXiv: 1806.05246
CERN-EP-2018-141

Abstract

The latest set of results on Higgs decay to a W boson pair is presented. With a statistics of 36/fb collected by the CMS experiment at the LHC at 13 TeV center of mass energy, the Higgs to WW decay has been observed at CMS with more than 5 sigma for the first time, providing a significant contribution to the current fit of the Higgs boson couplings to fermions and vector bosons.

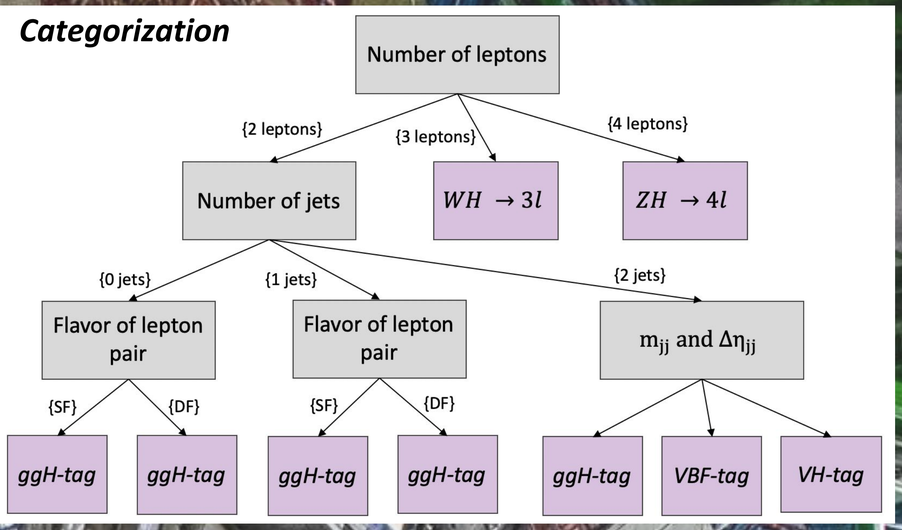
Motivation & Introduction



- $H \rightarrow WW$ has large branching fraction.

  Ideal for:
  - Precision measurement of Higgs production cross section
  - Studying subleading production modes
- Leptonic decay of W is cleanest channel
  - Different flavor (DF) is most sensitive
  - Same flavor (SF) also considered

Categorization



Analysis Strategy

- Categorization, as shown above, to increase sensitivity to VBF and VH production modes
- Distinguish between WW signal and background using property that WW production is dominated by on-shell W boson pairs
- Dilute top background: define jet multiplicity categories
- To reduce top background: veto b-tagged jets with $p_T > 20\ GeV$

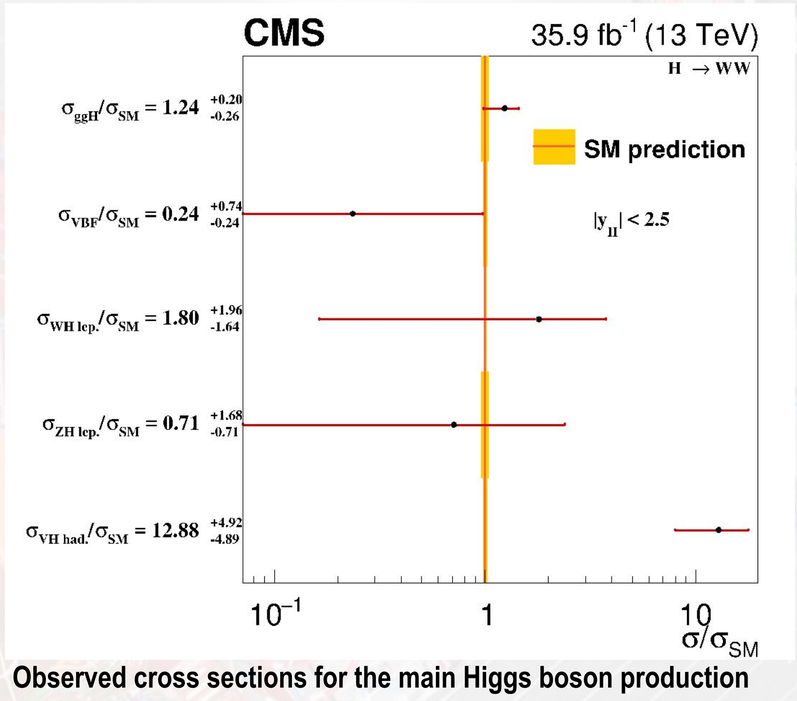
Baseline Selection

- Single or dilepton trigger
- At least 2 high-p_T lepton candidates with opposite sign
- Jets: $p_T > 30\ GeV$ (20 GeV for b-jets & $|\eta| < 4.7$ ($|\eta| < 2.4$ for b-jets)
- $e\mu$ final state:
- Electron (muon) with minimum $p_T > 13$ GeV (10 GeV)
- 1 lepton must have $p_T > 25\ GeV$
- SF final state:
- If leading lepton electron (muon): $p_T > 25\ GeV$ $(20\ GeV)$
- Subleading electron (muon): $p_T > 13\ GeV$ $(10\ GeV)$
- Additional selections depending on production mode

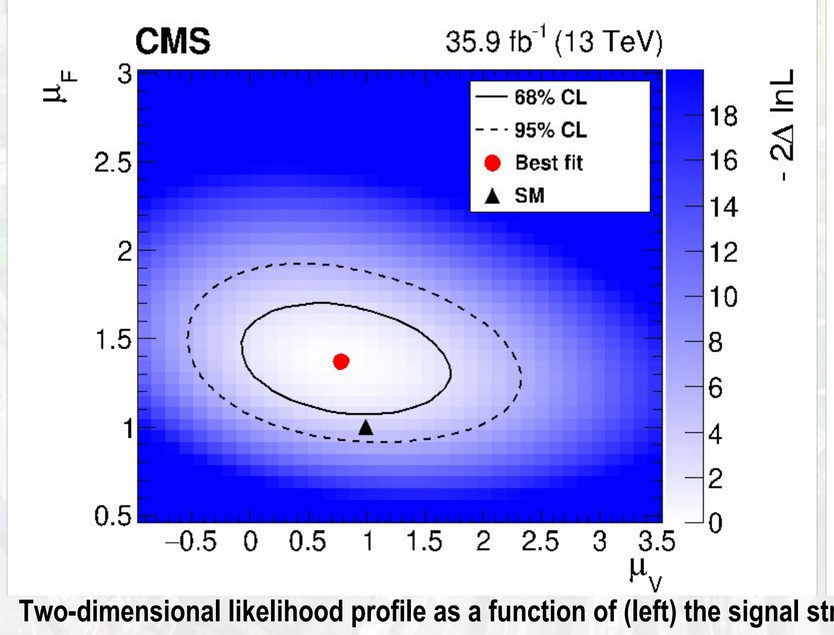
Results

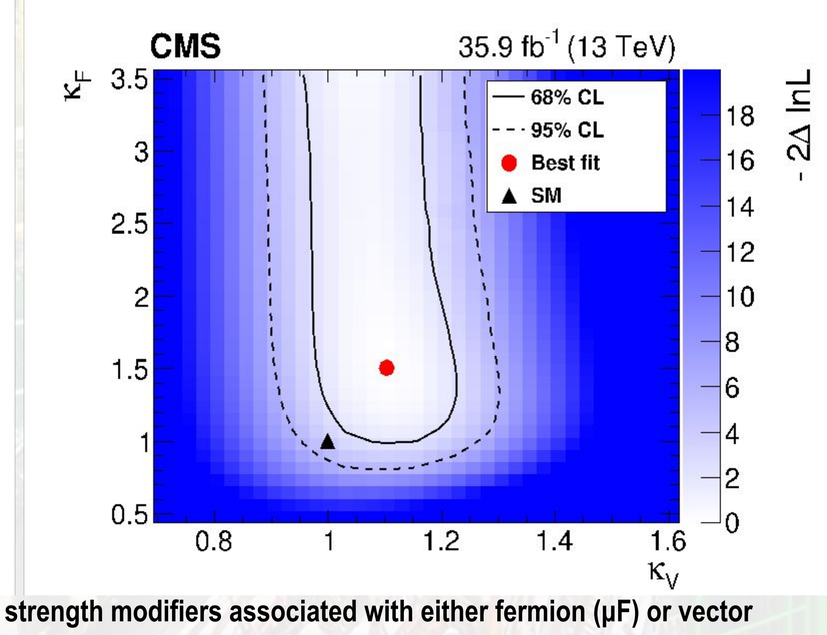
$$\sigma/\sigma_{SM} = \mu = 1.28^{+0.18}_{-0.17} = 1.28 \pm 0.10\,(stat) \pm 0.11^{+0.10}_{-0.07}(syst)$$

Observed significance = 9.1 s.d.

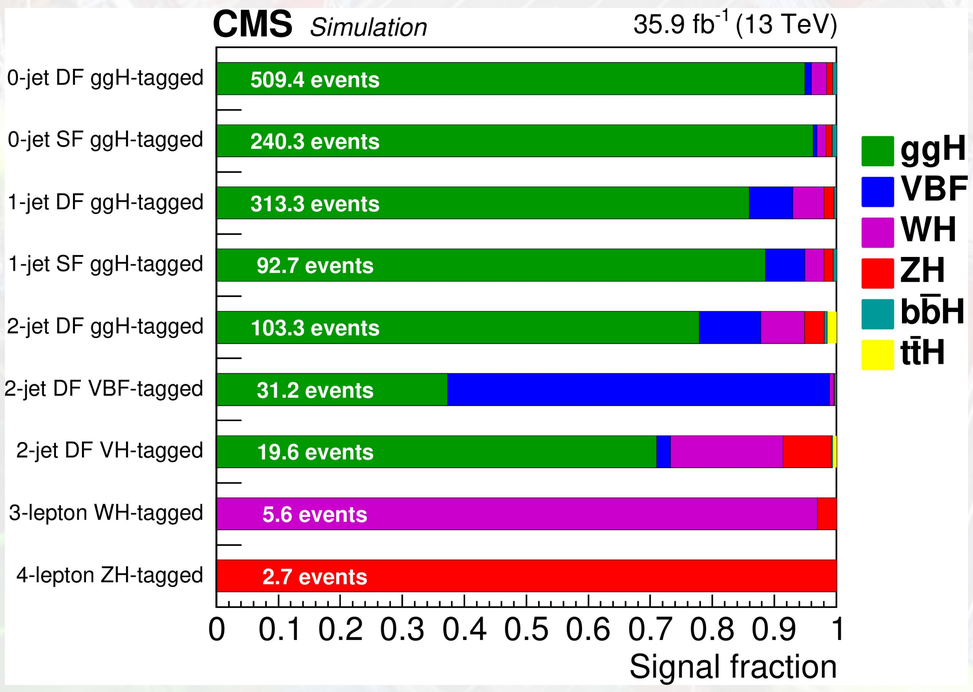


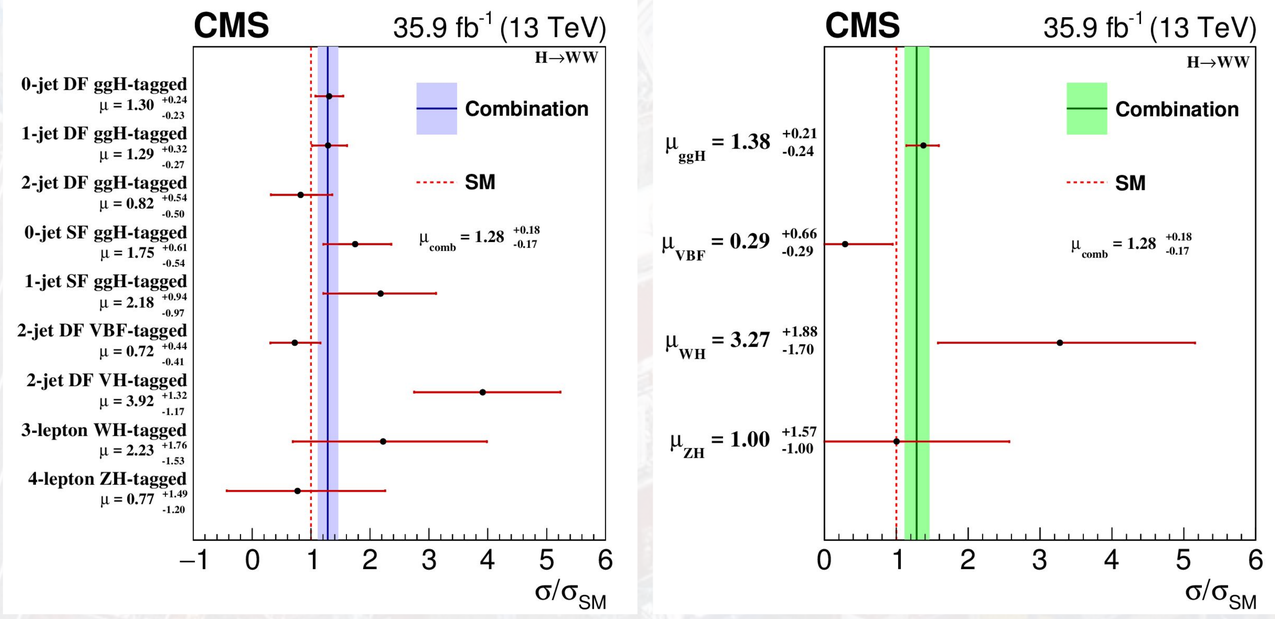
Observed cross sections for the main Higgs boson production modes, normalized to the SM predictions.





Two-dimensional likelihood profile as a function of (left) the signal strength modifiers associated with either fermion (μF) or vector boson (μV) couplings, and (right) the coupling modifiers associated with either fermion (κF) or vector boson (κV) vertices, using the κ-framework parametrization.





(Left) Observed signal strength modifiers for each category used in the combination. (Right) Observed signal strength modifiers corresponding to the main SM Higgs boson production mechanisms, for a Higgs boson with a mass of 125.09 GeV.

References

1. Measurements of properties of the Higgs boson decaying to a W boson pair in pp collisions at √s = 13 TeV, CMS Collaboration, CMS PAS HIG-16-042, arXiv:1806.05246, Submitted to Phys. Lett. B