Double Higgs Production in pp Collisions at √s= 14 Tev

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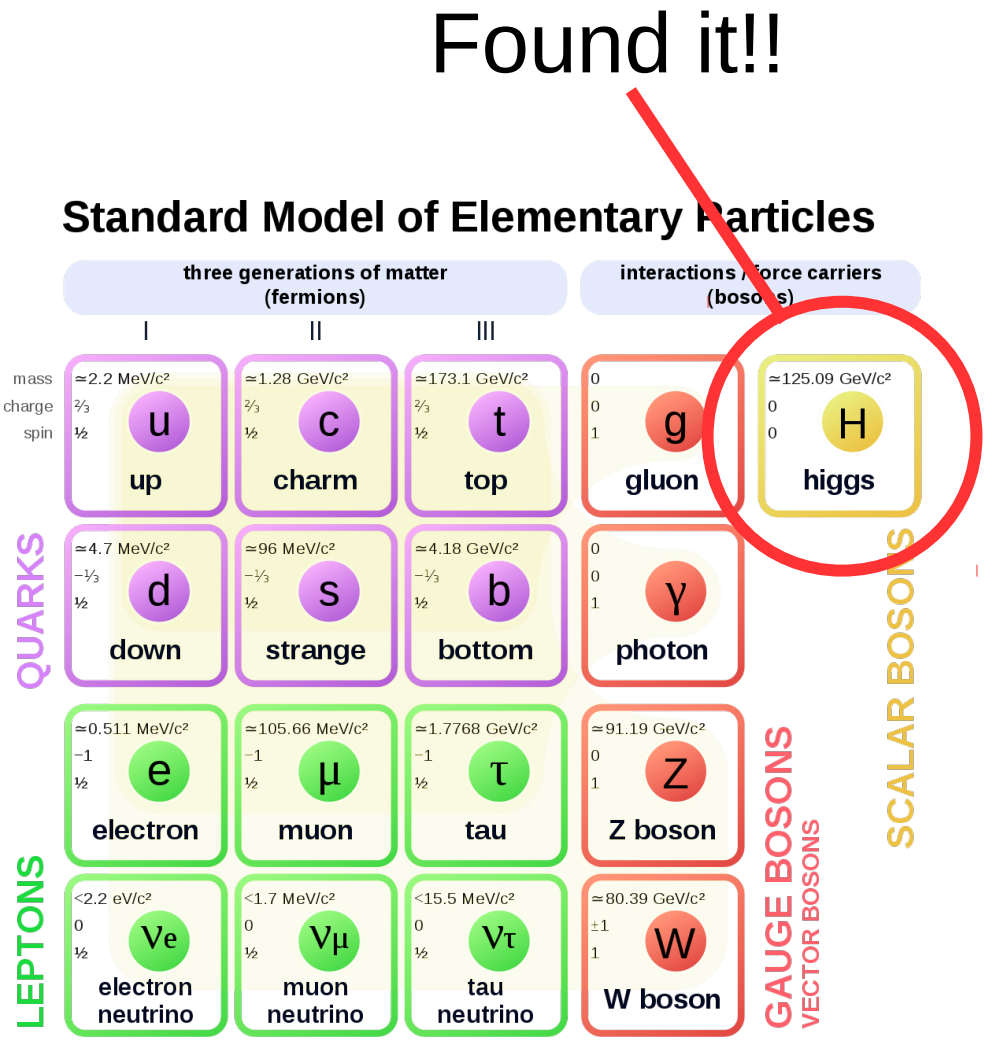
PHSX 861 Class Presentation
University of Kansas
December 5, 2019

Overview

- Background & Motivation
- Higgs Self-Coupling
  - Double Higgs Production
- Methods
- Analysis
  - Machine Learning Application (BDT)
- Summary

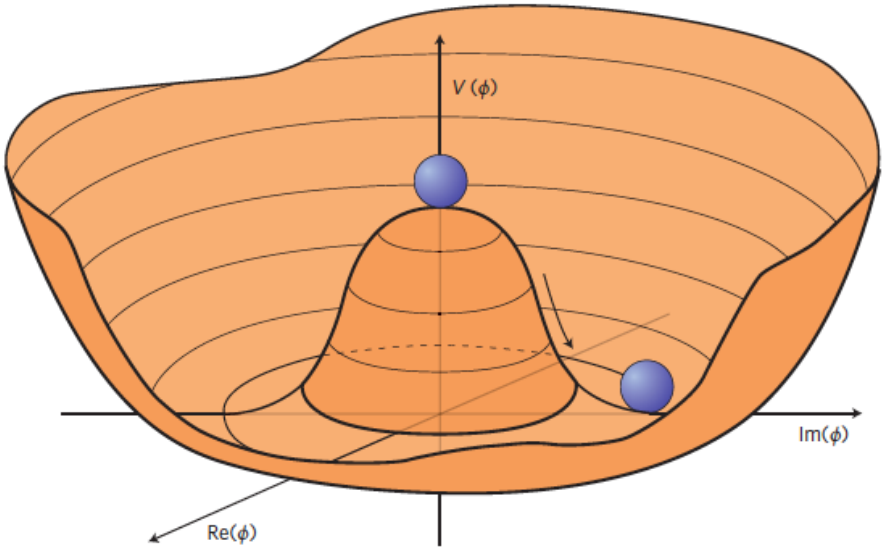
Background & Motivation

- Discover of Higgs by CMS and ATLAS opened doors to testing predictions made by the Standard Model (SM)
- Currently no deviation with predictions made by the standard model



Background & Motivation

- Most of the free parameters in SM are related to the Higgs (Yukawa coupling, vacuum expectation value, CKM values)
- Responsible for electroweak symmetry breaking resulting in mass generation of gauge bosons
- Of particular interest is the Higgs self-coupling interaction.
  - Probes Structure of Higgs potential



Higgs Self Coupling

$$\mathcal{L} \supset m_h^2 h^2 + k_3 \lambda_3^{SM} h^3 + \frac{1}{4} k_4 \lambda_4^{SM} h^4$$

SM Values of Higgs self-coupling

$$\lambda_3^{SM} = \frac{m_h^2}{2v^2} \qquad \lambda_4^{SM} = \frac{m_h^2}{8v^2}$$

Deviations from SM values

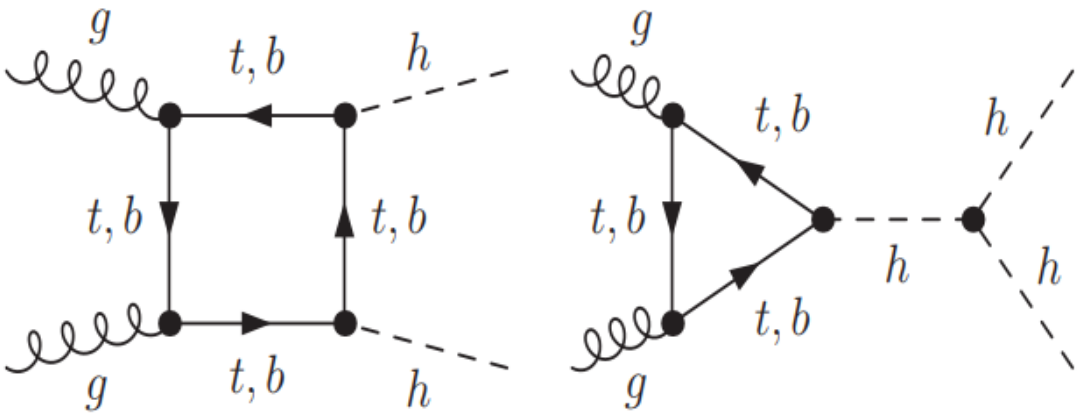
$$k_3 \qquad k_4$$

- Difficult to measure self-coupling due to small expected cross section
- Necessary to look at double Higgs production (*hh)* at LHC to study self-coupling in SM and any deviations (New Physics)

Higgs Pair Production

$$\mathrm{pp} \to gg \to hh$$

Accounts for 90 % Higgs pair production cross section.



$$\sigma^{\mathrm{SM}}_{\mathrm{ggF}}(pp \to HH) = 33.5^{+2.4}_{-2.8}\ \mathrm{fb\ at}\ \sqrt{s} = 13\ \mathrm{TeV}$$

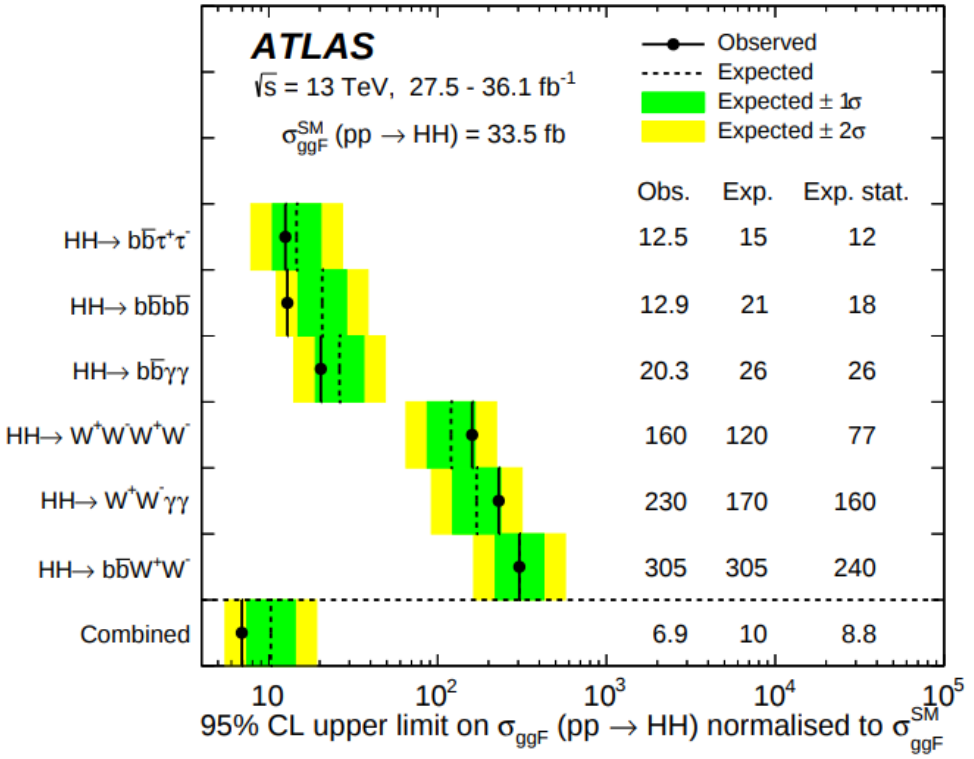
Higgs Pair Production

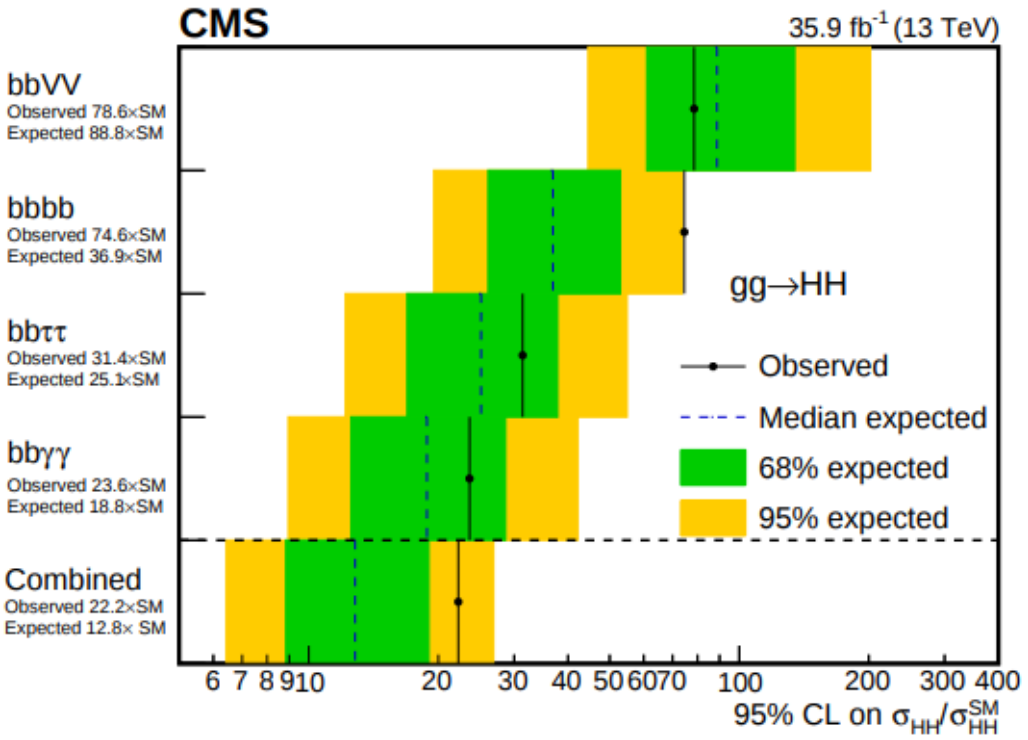
- Can be studied through many different decay channels

$$hh \to b\bar{b}b\bar{b},\ b\bar{b}\gamma\gamma,\ b\bar{b}\tau\tau,\ b\bar{b}W^+W^-/ZZ$$

- Our study focuses on

$$hh \to bbll \text{ from } h \to b\bar{b} \text{ and } h \to W^+W^- \to l\nu_l l'\nu_{l'}$$





Higgs Pair Production - (*bbll)*

- Our decay channel has large SM background from

$$pp \rightarrow t\bar{t}$$

- Analysis of kinematic distribution of system with two leptons and two b-jets is promising tool.
  - This is based on differences in topology for signal and background events

Signal	Background
$h \rightarrow \mathrm{WW} \rightarrow l\nu l\nu$	$t\bar{t} \rightarrow b\mathrm{W}b\mathrm{W} \rightarrow bl\nu bl\nu$