Search for ttH production in multileptons final states at 13 TeV

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Introduction

A measurement of the ttH production in final states with electrons, muons or hadronic τs. The ttH production process is one of the only handles available to measure the Higgs coupling. Only probe of the tH coupling at tree level.

Event selection and main backgrounds

- Very reduce signal compared to other SM processes with leptons in the final state
- 6 categories are defined depending on the number of light leptons (l) and hadronic τs
  - 1l + 2τs
  - 2lss (two same-sign leptons)
  - 2l+ 1 τ
- Lepton identification is performed using a BDT discriminant to reject non-prompt leptons
- Additional jet and b-jet multiplicity requirements are applied in the different categories
- Main backgrounds are
  - ttZ and ttW production: estimated with MC simulations
  - Mis-identified leptons: estimated with data-driven methods
    - Using a loose-to-tight method
    - Transfer factors derived in data control region

Signal extraction

- Signal is further discriminated from background using MVA techniques
- Separate BDT discriminants are trained in each region against ttH and ttZ and ttW separately
- Input variables are
  - Multivariate hadronic top decay and Higgs decay taggers
  - Matrix element techniques
  - Other kinematic variables
- Discriminators against ttH and ttZ + ttW combined into a single score using a likelihood discriminator
- Optimal choice of bin multiplicity obtained with a recursive application of the l-means algorithm

Event categorization

- Further categorization in 2lss and 3l regions
- Categories are built in lepton flavor, charge and b-jet multiplicity

Results and conclusions

- Results show evidence for ttH production in multilepton final states
- Measured signal strength of
  \[ \mu = 1.23^{+0.45}_{-0.43} \]
  corresponding to 3.2 σ above the background-only hypothesis
- Result in agreement with SM expectations

References

[1] Evidence for associated production of a Higgs boson with a top quark pair in final states with electrons, muons, and hadronically decaying τ leptons at \( \sqrt{s} = 13 \) TeV. arXiv:1803.05485