Search for Standard Model VH→b̅b̅ with the ATLAS detector at √s=13 TeV

Overview

- In Run-1 of the LHC, a particle consistent with the Standard Model (SM) Higgs boson was observed with mass m_H=125 GeV.
- Coupling of Higgs to bosonic and leptonic sectors of the SM has been observed.
- Aim to observe evidence of coupling to the quark sector.
- Analysis conducted using 36.1 fb^{-1} of Run-2 data.

Why VH→Vb̅b̅?

- Expected branching ratio H→b̅b̅ = 58%, largest decay mode [1]
- Search for associated production with leptonic vector boson decay (V=W/Z) to reduce QCD background and provide handle for triggering (right)
- ~5% of all Higgs production at LHC
- Run-1 ATLAS observed (expected) significance of 1.4 (2.6) standard deviations (s.d.) [2]

Event Selection

- 0-, 1- and 2-lepton channels for each leptonic decay of V (Z→νν, W→fv, Z→ff)
- Higgs candidate selected from exactly 2 "b-tagged" jets

Multivariate Analysis Techniques

- Dijet invariant mass, m_bb̅, is most powerful single discriminant
- Combine several discriminating variables into a Boosted Decision Tree (BDT)
- 10-15% improvement in expected signal sensitivity
- Separate training for each fit region
- Most sensitive region corresponds to highest BDT output
- Postfit BDT output in 0-, 1- and 2-lepton, 2-tag 2-jet regions

Statistical Analysis

- Binned maximum likelihood fit to measure signal strength μ = σ / σ_SM
- Significance measured as standard deviations (s.d.) from background-only hypothesis
- Cross-check MVA VH→Vb̅b̅ analysis
- MVA VZ→Vb̅b̅
- Dijet cut-based mass VH→Vb̅b̅
- Background subtracted μ(bb̅) from cut-based fit (right)

Results

- Combined MVA VH signal strength: μ=1.20±0.39
  - 3.5 (3.0) s.d. obs. (exp.)
- Cross-checked with dijet cut-based fit: μ=1.30±0.43
  - 3.5 (2.0) s.d. obs. (exp.)
- Cross-checked with fit to MVA based SM VZ→Vb̅b̅:
  - μ=1.11±0.24
  - 5.8 (5.3) s.d. obs. (exp.)
- Combination of Run 1+2 MVA fit: μ=0.90±0.27
  - 3.6 (4.0) s.d. obs. (exp.)

Conclusions

Search for SM VH→b̅b̅ has been conducted with 36.1 fb^{-1} of Run-2 data at √s=13 TeV:
- Evidence for H→b̅b̅ observed at 3.5 s.d. level
- Measured combined Run 1+2 MVA signal strength of μ=0.90±0.27

References

1. LHC Higgs Cross Section Working Group
2. arXiv:1406.2622
3. ATLAS-CONF-2017-041