Search for high mass Higgs bosons production in Final States with b-quarks at 13 TeV

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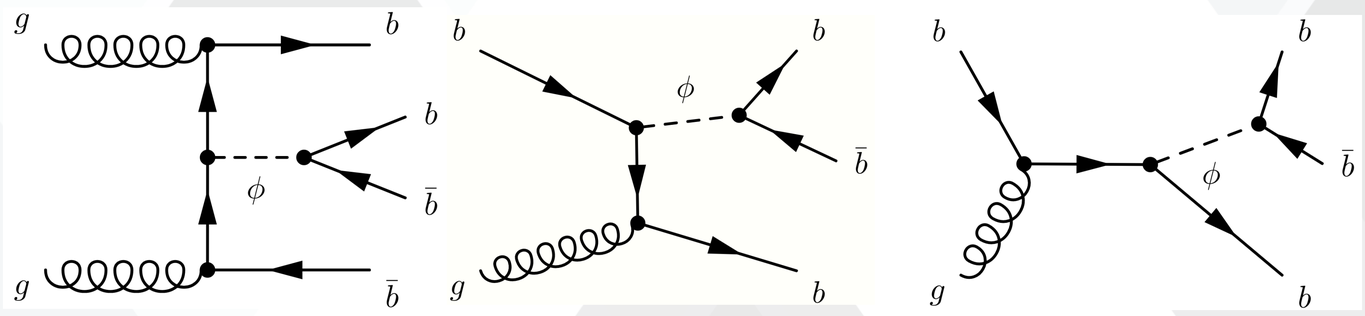
Abstract

A search for new Higgs bosons produced in association with bottom quarks and decaying into a bottom anti-bottom quark pair is performed with the CMS detector. The data collected for this analysis were recorded in proton-proton collisions at a centre-of-mass energy of 13 TeV in 2016, corresponding to an integrated luminosity of 35.7 fb^{-1}. No signal excess above the standard model background is observed. Stringent upper limits on the cross section times branching fraction are calculated for Higgs states with masses up to 1300 GeV at 95% confidence level. The results are also interpreted within various minimal supersymmetric model (MSSM) scenarios and in the context of the flipped two-higgs-doublet model (2HDM).

Motivation for measurement

- Search for degenerate heavy A and H bosons in higher mass region
- A/H decaying to a b-quark pair is a dominant channel in MSSM and H2DM
- Main background - QCD multijet production
- B-associated production
  - cross section enhanced up to ~$2\tan^2\beta$ in MSSM and 2HDM



Event Selection

- Dedicated triggers with two online b-tagged jets
- Event offline selection requires at least 2 jets to be b-tagged

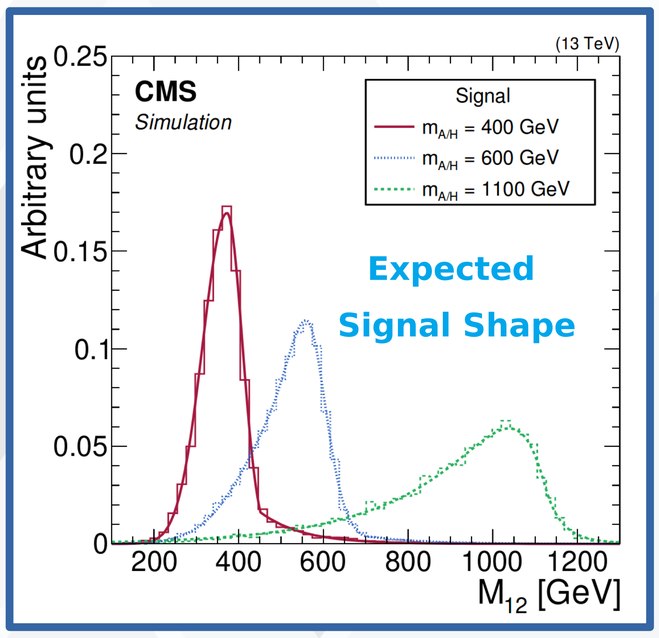
1st and 2nd jets
- p_T > 100 GeV
- $|\eta|$ < 2.2
- $|\eta_{12}|$ < 1.55
- ΔR_{12} > 1
- b tagging 1% fake rate

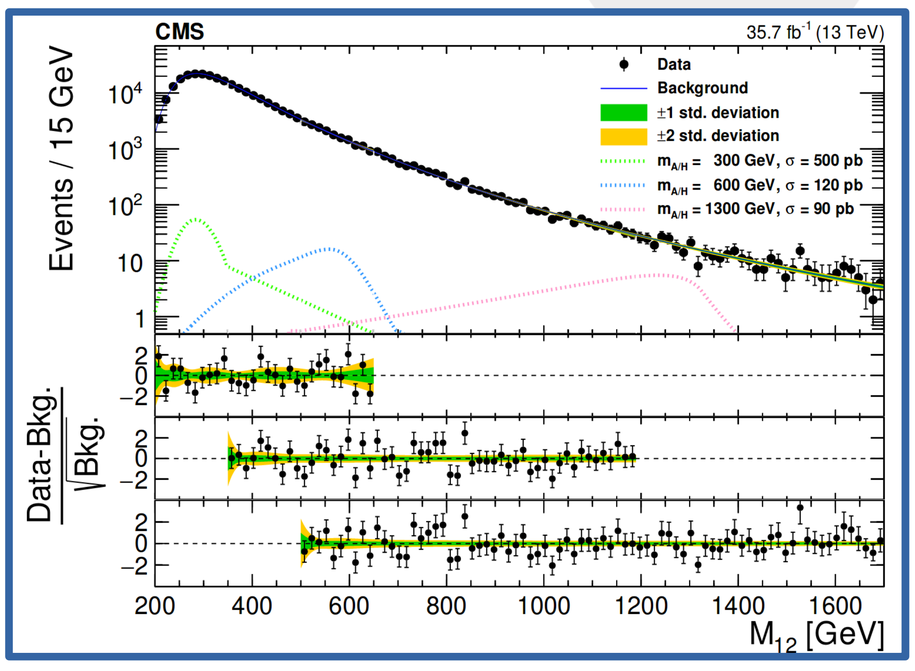
3rd jet
- p_T > 40 GeV
- $|\eta|$ < 2.2
- ΔR_{13} > 1 && ΔR_{23} > 1

Triple-b-tag signal region (SR)
3rd jet b-tagged
OR
Reversed-b-tag control region (CR)
3rd jet light flavour

Signal Model

- Signal reconstructed from the invariant mass of the leading two b-jets M_{12}
- Monte Carlo: Pythia 8 LO + Madgraph 5 NLO for the corrections
- Signal masses: $M_{A/H}$ = [300;1300]
  - Sensitive starting from $M_{A/H}$ = 300 GeV, because of the high p_T trigger threshold





Background Model fitted to data

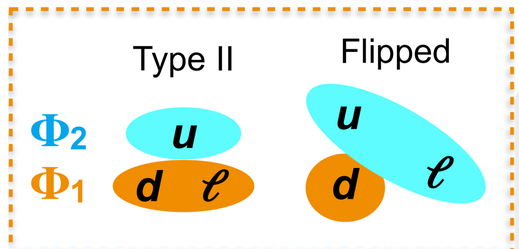
- Data-driven parametric approach developed in the CR
- CR chosen to have shape of m_{12} similar to SR
- Subrange division designed to reduce bias uncertainty
  - Optimized to improve sensitivity limits

References

[1] CMS Collaboration arXiv:submit/2280100
[2] CMS Collaboration PLB 722 (2013) 207
[3] CMS Collaboration JHEP 11 (2015) 071
[4] ATLAS Collaboration arXiv:1712.06518

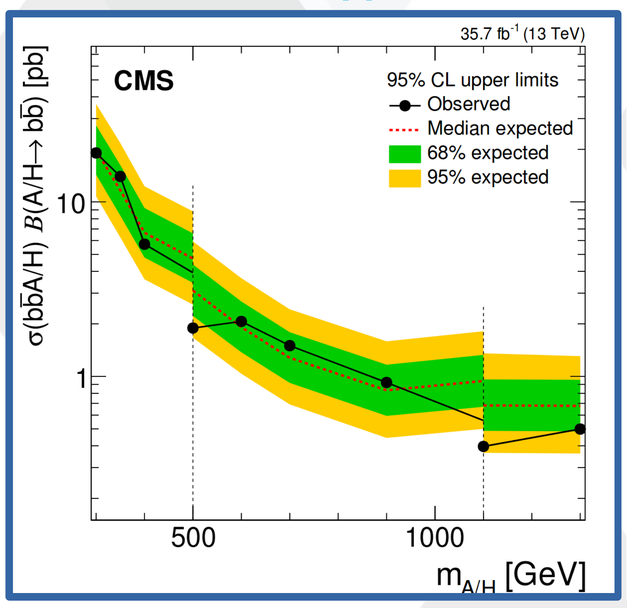
Results

- No signal excess above SM background observed
- Model-independent upper limits on cross-section times branching fraction at 95% confidence level

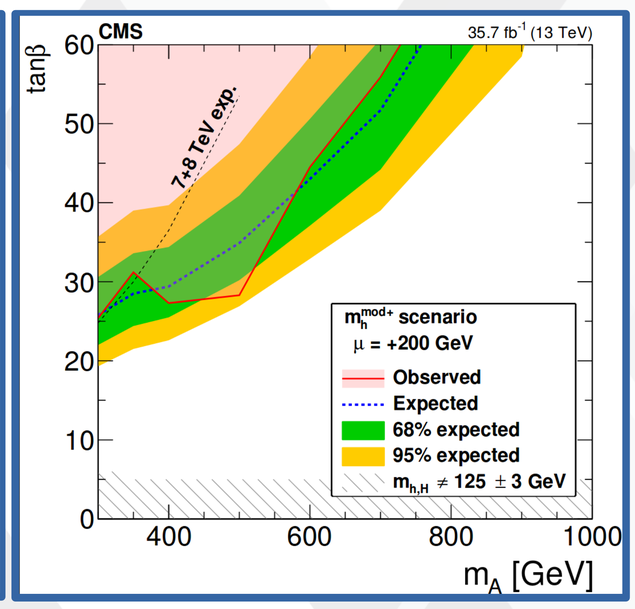


- Cross-section limits are translated to exclusion limits on tanβ vs m_A in various MSSM scenarios and also on tanβ vs cos(β-α) in the context of 2HDM type-II (MSSM-like) and in the flipped model
  - achieved the best sensitivity in this channel to date
  - unique limits for low cos(β-α) of the flipped model complementary to A→Zh measurements[4]

Cross-section upper limits



MSSM (m_h^{mod+} scenario)



2HDM (flipped model)