Search for the resonant production of two Higgs bosons in the final state with two photons and two bottom quarks

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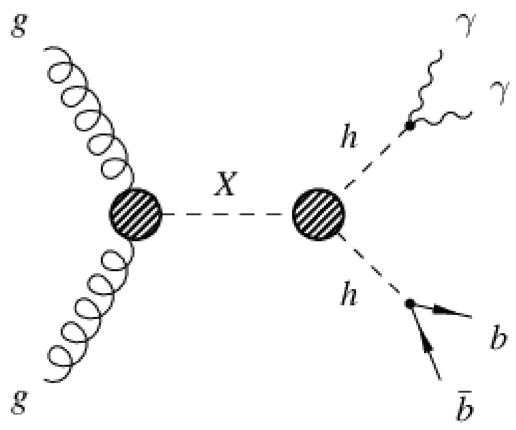
Production of diHiggs

Measuring all the properties of the Higgs boson includes the two ways the Higgs couples to itself.

- At 8 TeV p-p center-of-mass energy, the SM cross section is about 10 fb.
- Sensitivity to SM production is foreseen in about 15 years.



With CMS 2012 data, diHiggs production is motivated by several BSM models.

- WED feature the Radion (spin 0) and Graviton (spin 2)
- 2HDM and (N)MSSM feature a heavy Higgs

Here, a search is performed for a resonance between 260 and 1100 GeV which decays to the final state H(gg) (high resolution) + H(bb) (high BR).

Signal extraction

Signal will appear as an excess on the dijet, diphoton, and 4-body mass spectra.

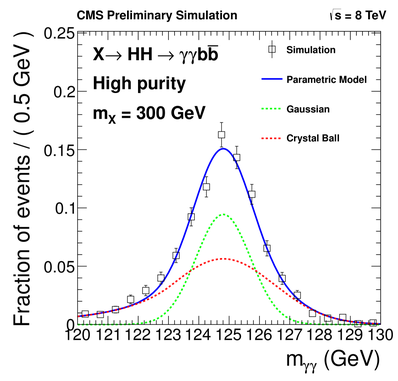
- For low-mass (mX < 400 GeV), a fit is performed to the diphoton spectrum.
- For high-mass (mX > 400 GeV), a fit is performed to the 4-body mass spectrum.
- In both cases, mass windows are placed on the two spectra which are not fit.

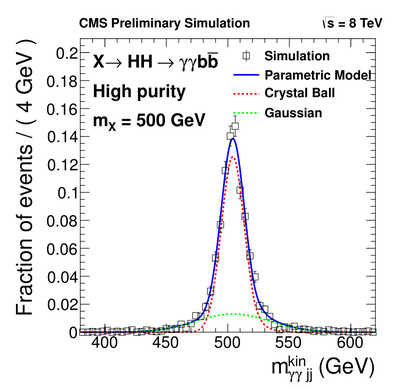
In the high-mass analysis, a kinematic fit is used to constrain the Mjj mass to 125 GeV. This is propagated to the 4-body mass.

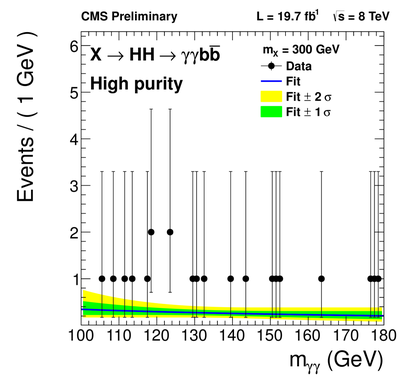
The high purity category drives the analysis due to a high signal-to-background ratio, but as shown it has very few events in data.

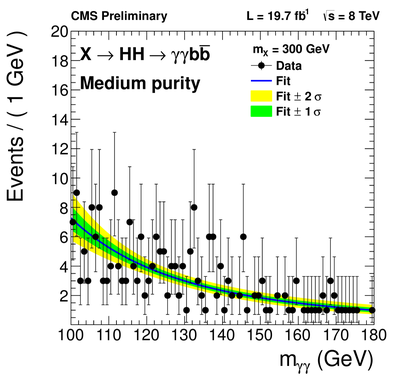
Systematics are computed but have a 2% effect on the final limits. With 2012 data, this analysis is statistically-limited.

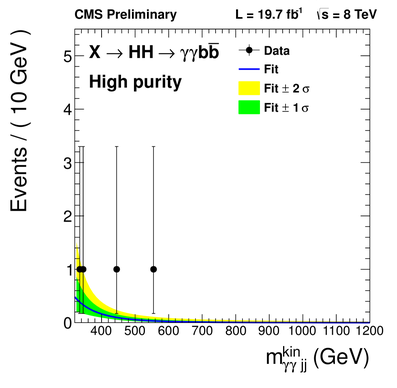
In the low mass analysis, SM Higgs production mimics the signal on the Mgg spectrum. This is quantified with MC and subtracted during limit setting. The effect is 3% on the final limits.

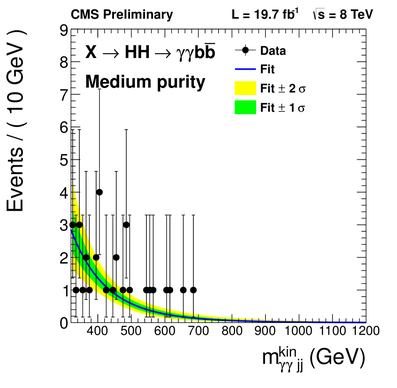








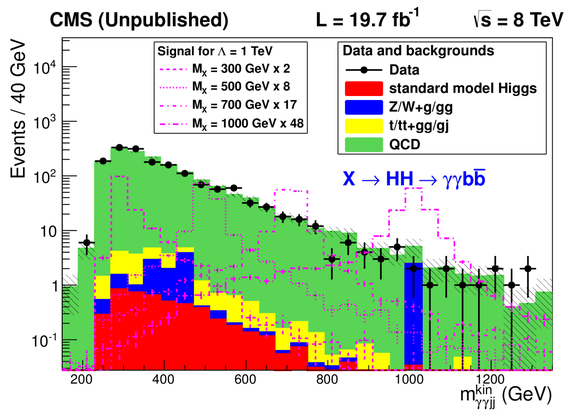




Analysis objects

The analysis starts with asymmetric double photon triggers used in the SM H(gg).

- From this, two photons chosen which satisfy kinematic criteria and ID requirements (photon shower shape and isolation).
- Next, two jets are identified which satisfy kinematic criteria and ID requirements (pileup and HCAL noise).
- The analysis is categorized based on the number of b-jets as identified by the CMS CSV algorithm.
  - The high purity category has at least 2 b-tags.
  - The medium purity category has 1 b-tag.



Results and outlook

Radion with a scale parameter of 1 TeV is observed (expected) to be excluded for mX < 0.97 (0.88) TeV.

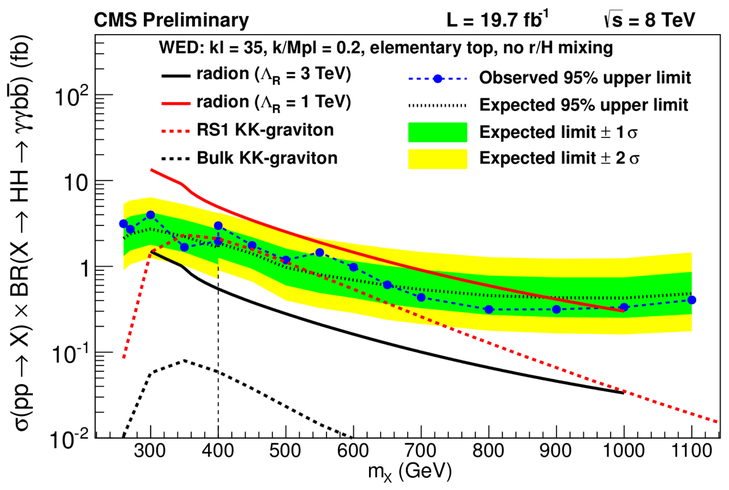
Since the analysis is spin-independent, theory curves from both spin hypotheses are overlaid.

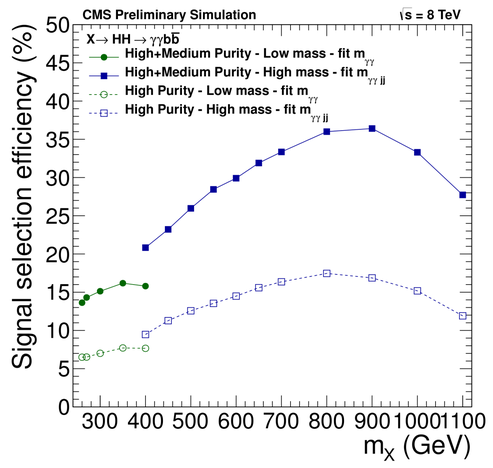
The model-independent signal efficiency is also shown.

- The signal efficiency increases due to better efficiencies in photon and jet reconstruction.
- The efficiency decreases as jets from the H(bb) decay merge.

The long-term outlook centers on the measurement of the Higgs self-coupling.

- H(gg)H(bb) is the best final state for this measurement.
- In the coming months, we will look at studying nonresonant diHiggs production in 2012 data coming from both the SM and from anomalous couplings.

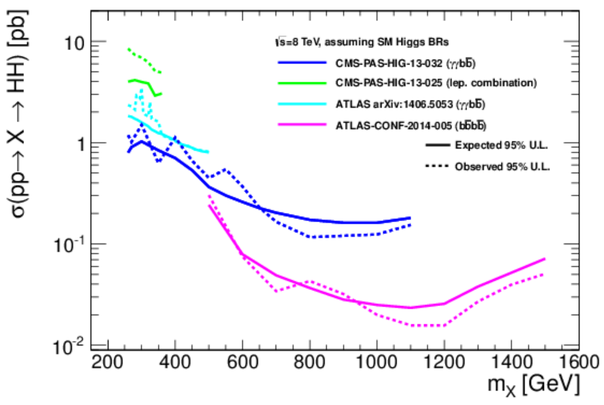




Comparison of results

This result (CMS-PAS-HIG-13-032) is one of four results searching for diHiggs resonant production. The plot to the right compares this result with that from ATLAS, and it offers a comparison between this final state and the 4b final state.

Although all of the information public, neither CMS nor ATLAS do not endorse the plot.



Acknowledgments

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