Search for Heavy Higgs Boson in Fermionic Decay Channels with CMS

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on behalf of  *collaboration*

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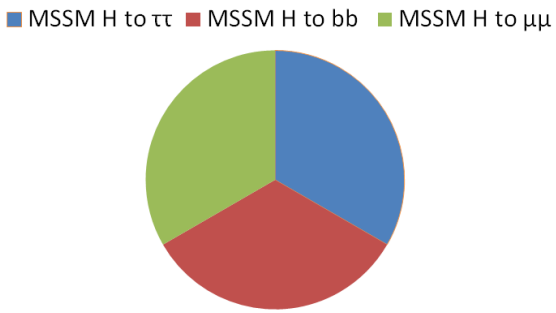
Outlines

MSSM Heavy Higgs Boson Searches

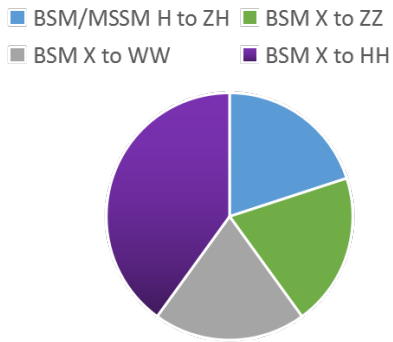
Minimal Supersymmetric Standard Model

- MSSM model was originally proposed around 1981, one of the originals, a nice review and another nice review.
- MSSM has become one of the benchmark scenarios for searches of an extended scalar sector, triggering studies of other phenomenological models beyond standard model.

via fermionic decays

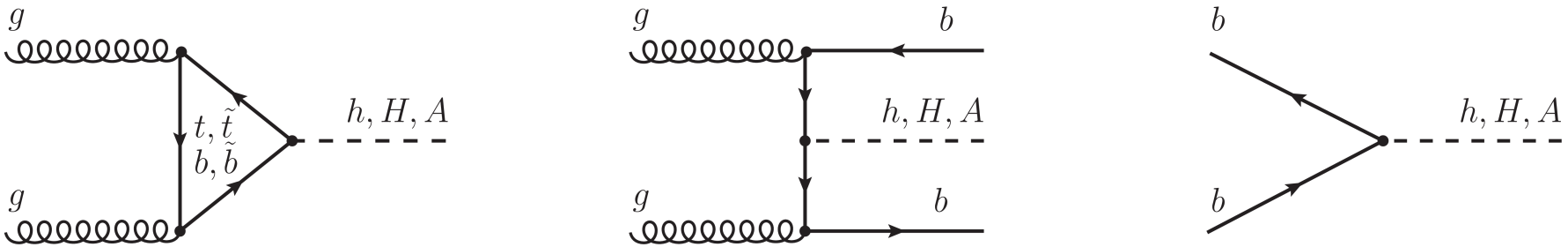


via bosonic decays



- Charged MSSM/BSM Higgs Boson search via $\tau\nu$, tb etc.

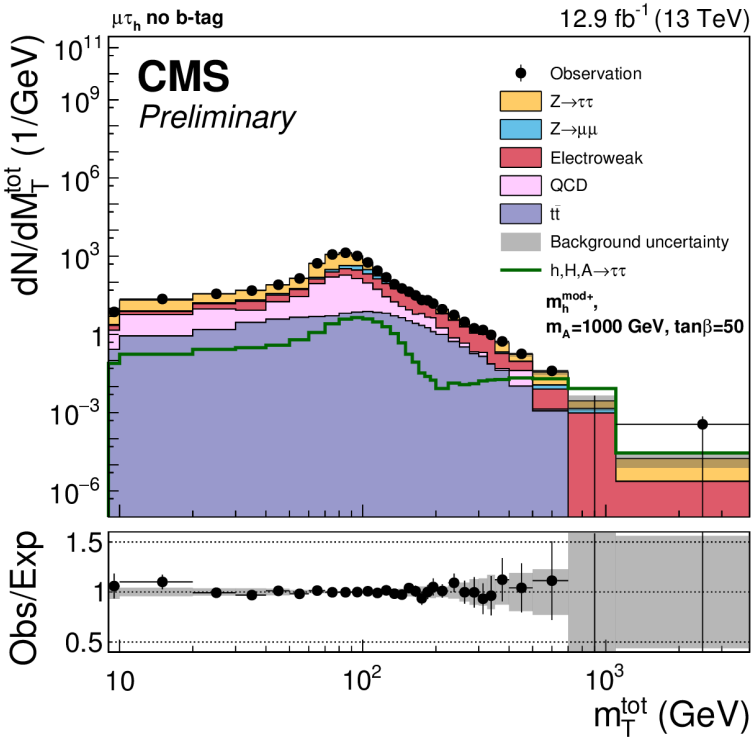
Neutral MSSM Higgs Boson Searches



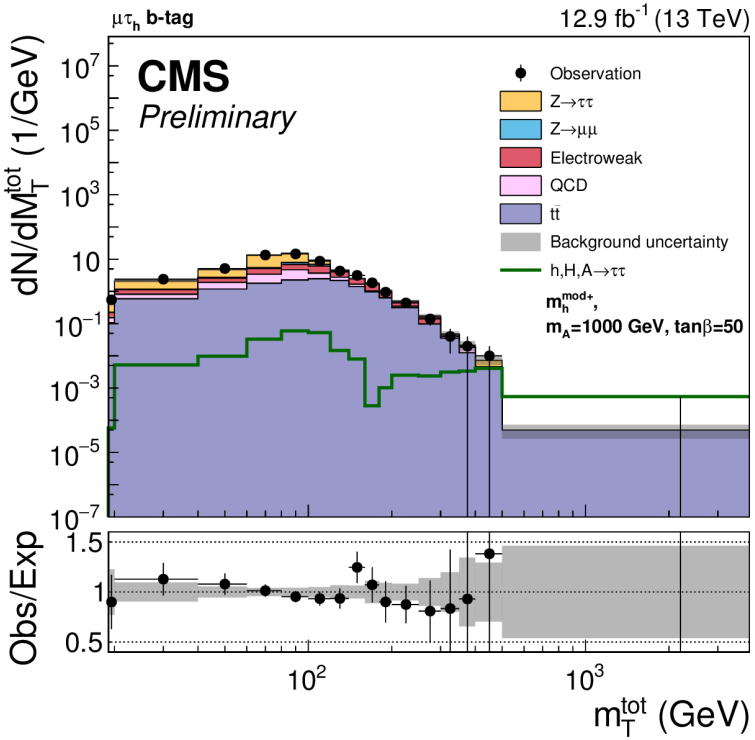
- Left: leading order MSSM Higgs Boson production with gluon fusion process.
- Middle: leading order MSSM b associated Higgs Boson production.
- Right: additional leading order MSSM Higgs Boson production with five-flavor scheme.

Outlines

Neutral MSSM Higgs Boson Search via $\tau\tau$



(a)



(b)

CMS-PAS-HIG-16-037

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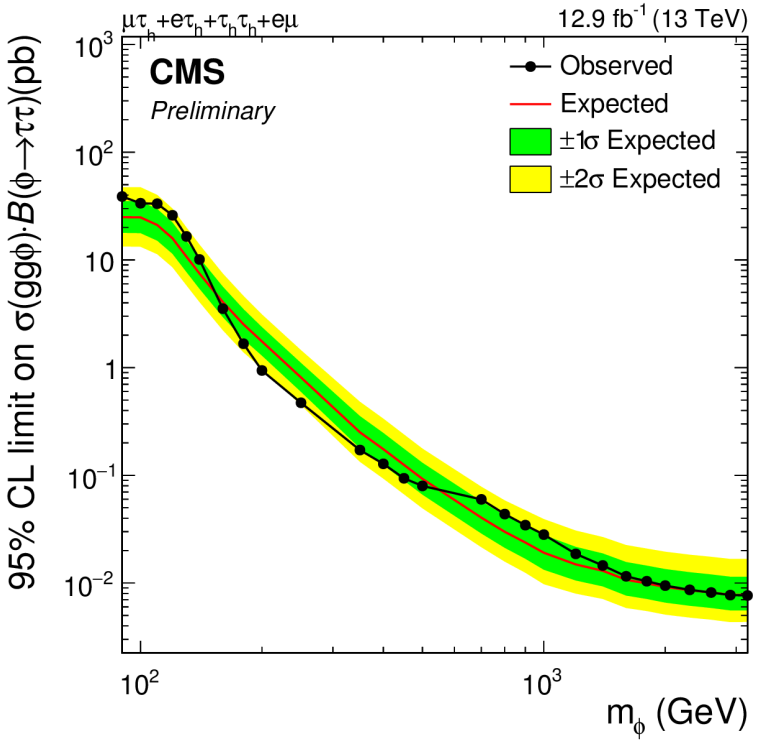
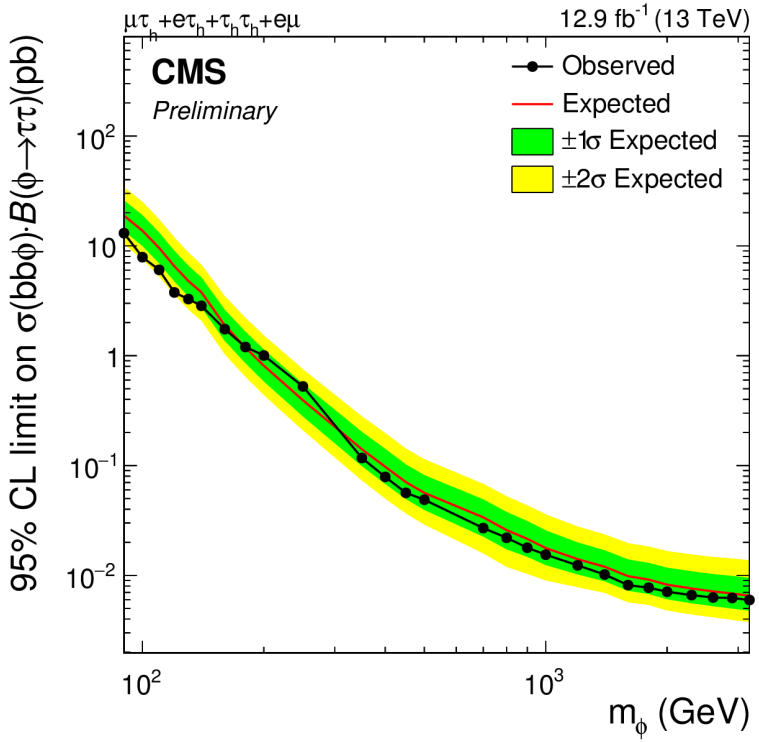
- MSSM Higgs Boson search via $\tau\tau$ decay mode has been re-investigated with four final states $\mu\tau_h$, $e\tau_h$, $e\mu$ and $\tau_h\tau_h$.

Neutral MSSM Higgs Boson Search via $\tau\tau$



(a)



(b)

CMS-PAS-HIG-16-037

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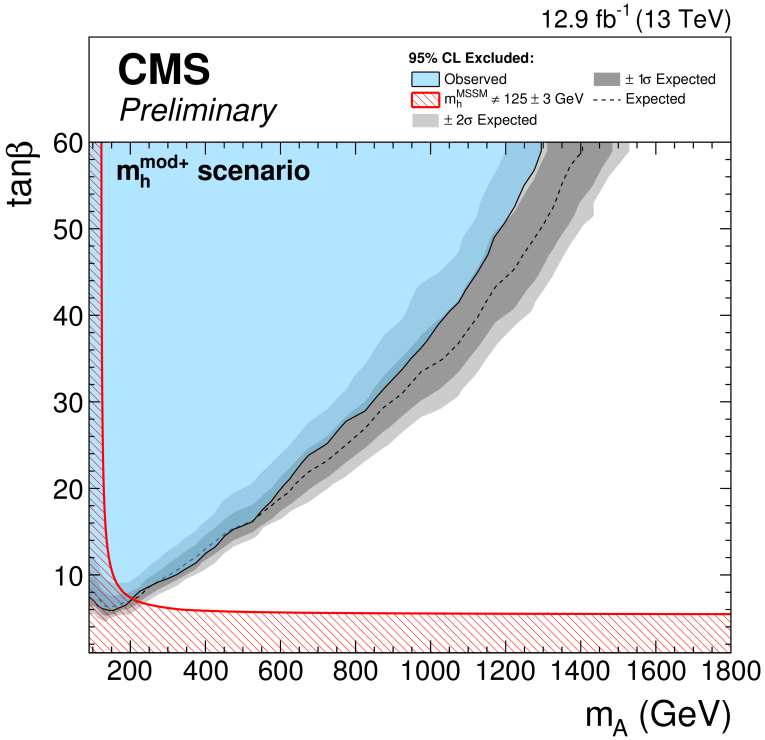
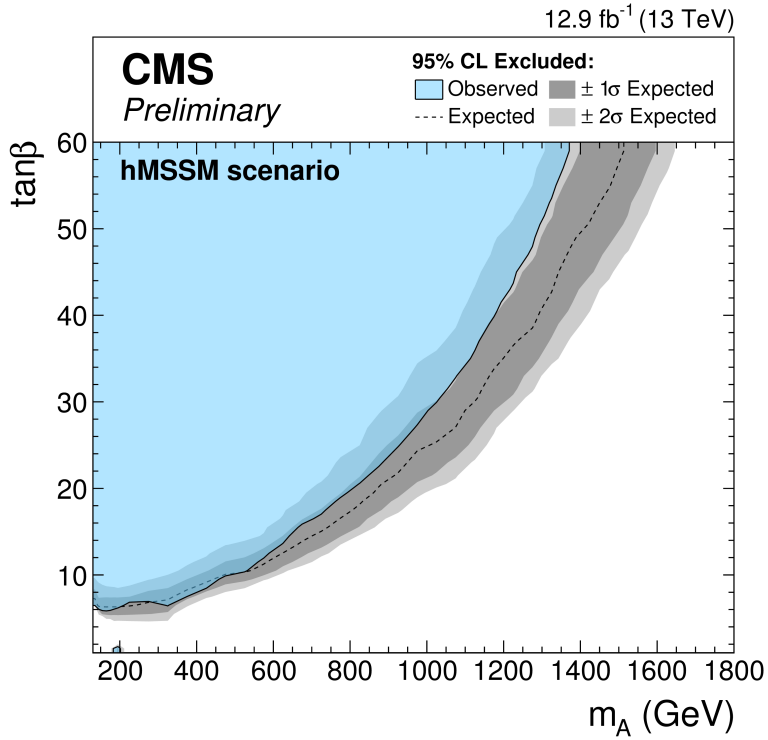
- The model independent limits which is targeting the the gluon fusion with or without the b-associated production process.

Neutral MSSM Higgs Boson Search via $\tau\tau$





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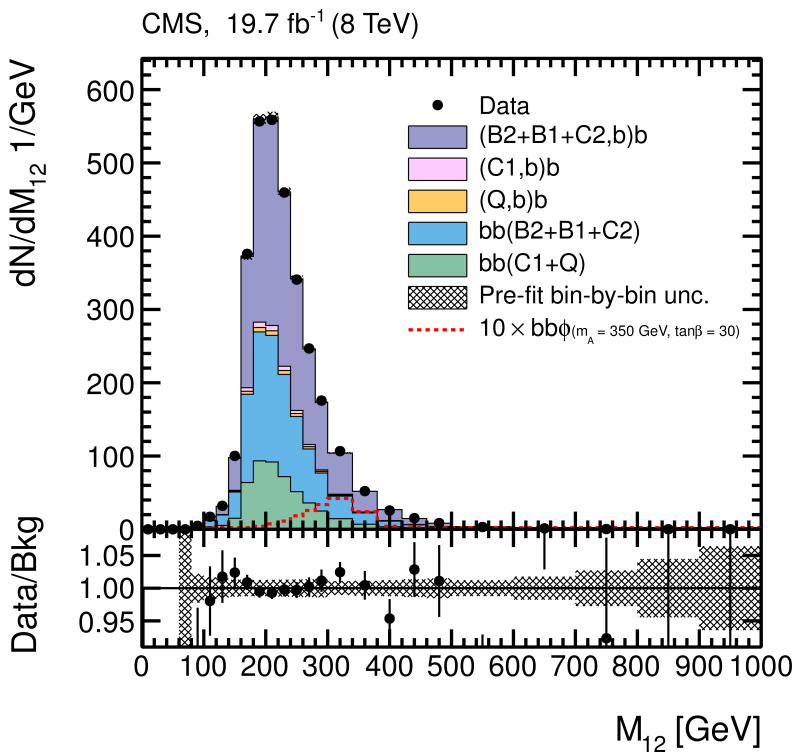
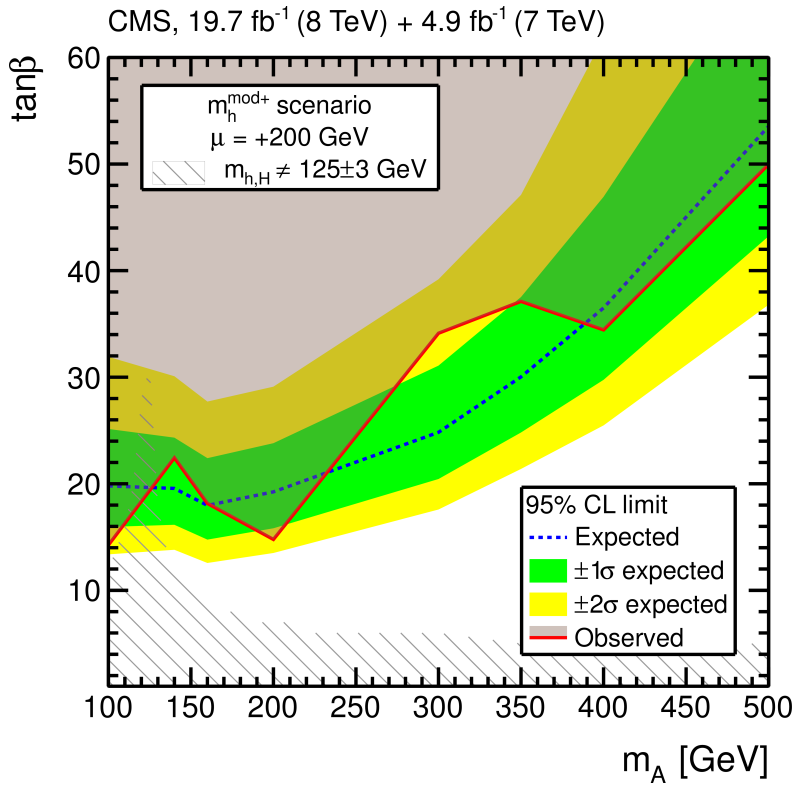
- Intepretion of the 2016 measurement results within two MSSM benchmark senarios, m_h^{mod+} and hMSSM.

Outlines

Neutral MSSM Higgs Boson Search via $b\bar{b}$

JHEP11(2015)071



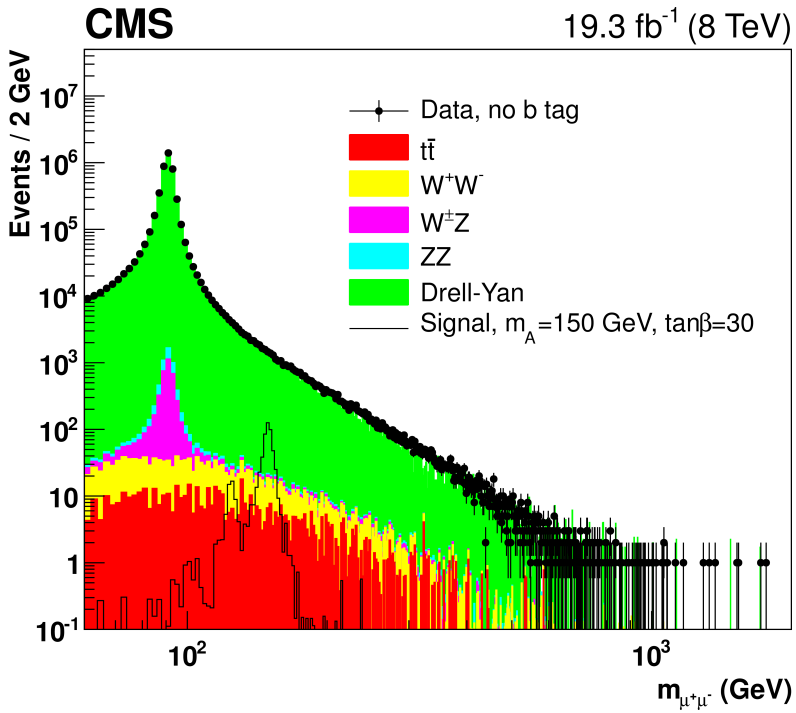


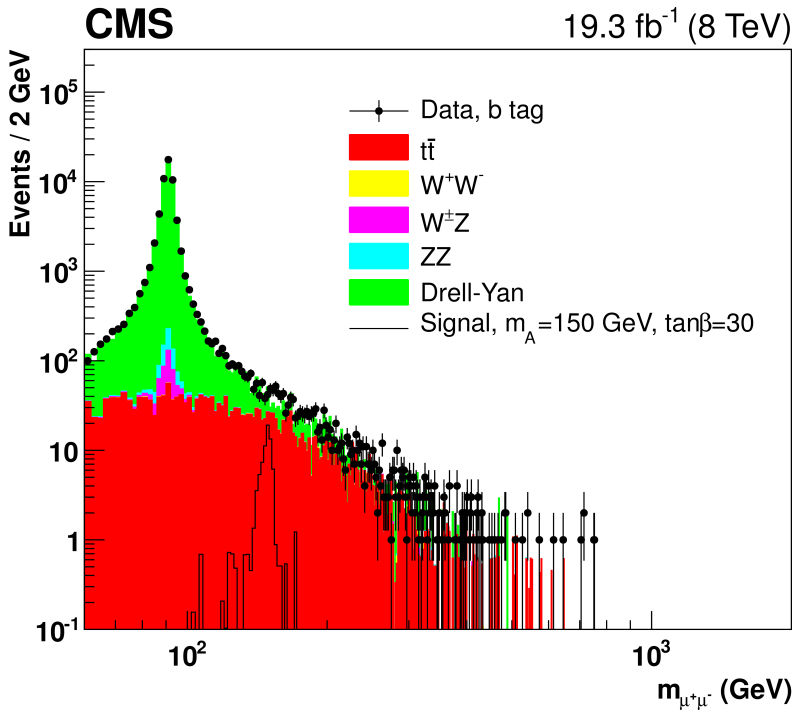
- Left: mass spectrum of two leading jets of b associated decay.
- Right: Upper limit with m_A to 500 GeV with 7TeV and 8TeV data. Parameter spaces of several MSSM scenarios have been further constrained.

Outlines

Neutral MSSM Higgs Boson Search via $\mu\mu$

PLB752(2016)221





- $M_{\mu\mu}$ without/with b associated decay mode are provided.

Neutral MSSM Higgs Boson Search via $\mu\mu$

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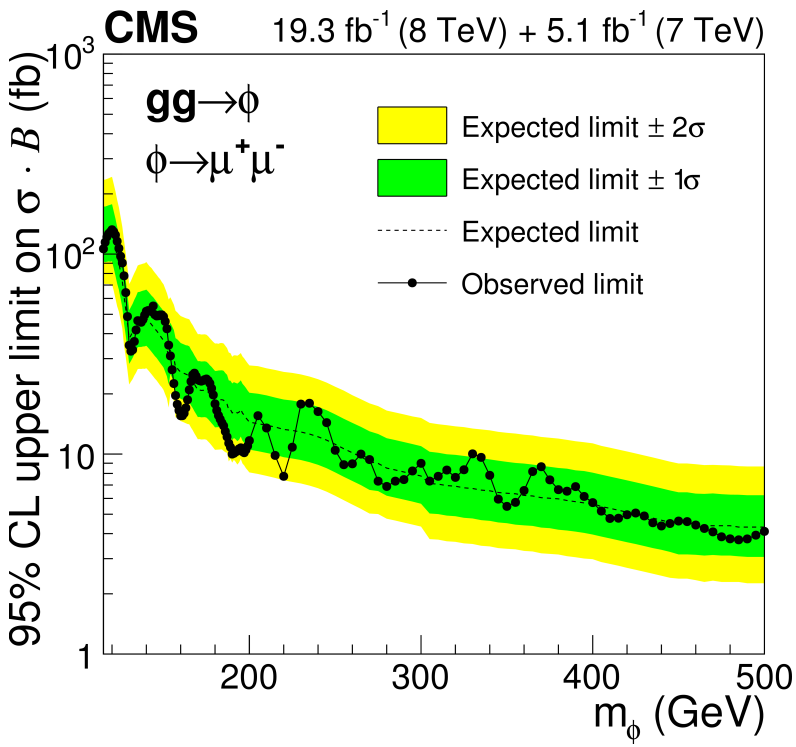
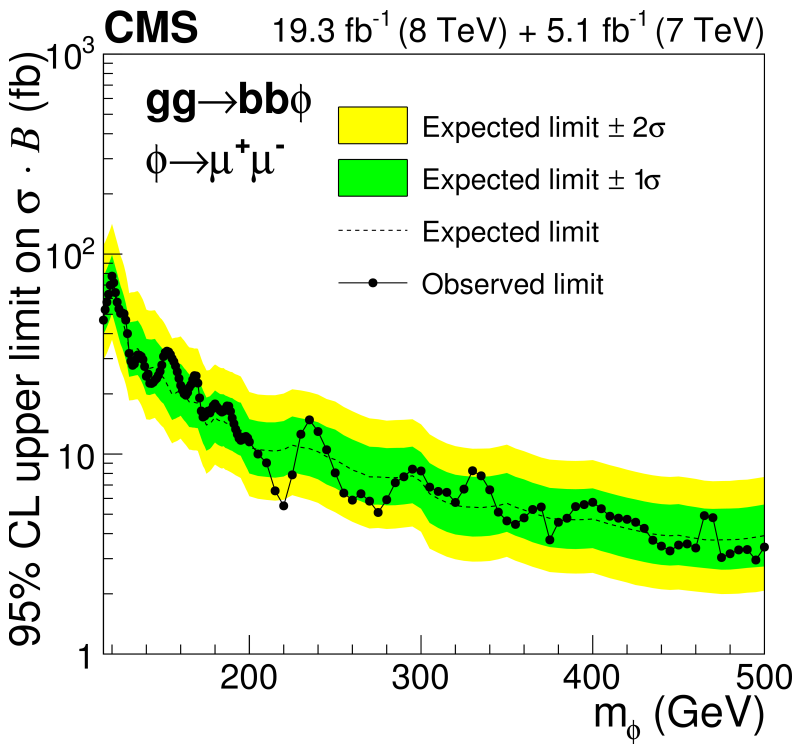
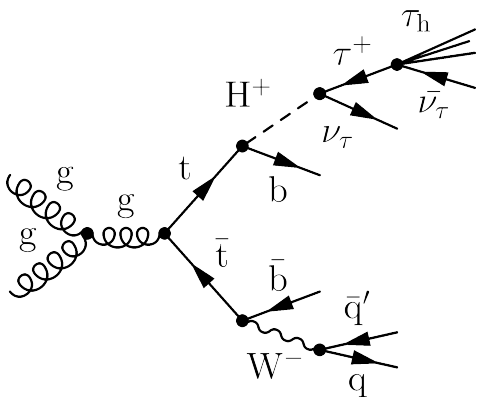


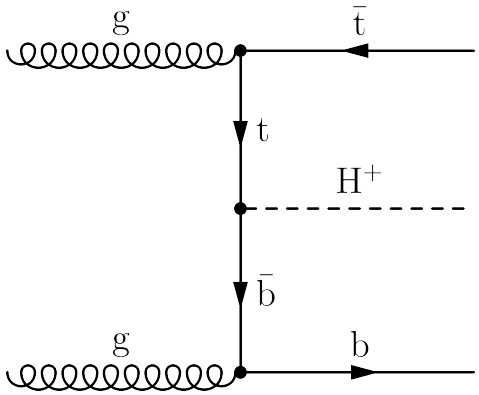


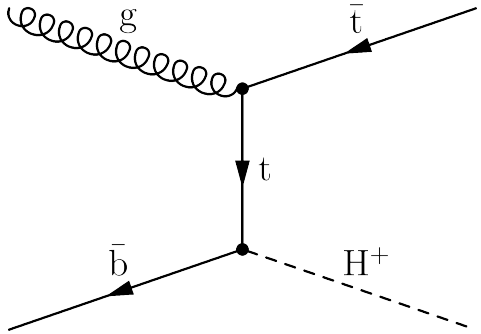
- No obvious new structures without/with b jet association.

Charged MSSM Higgs Search

Charged MSSM Higgs Search

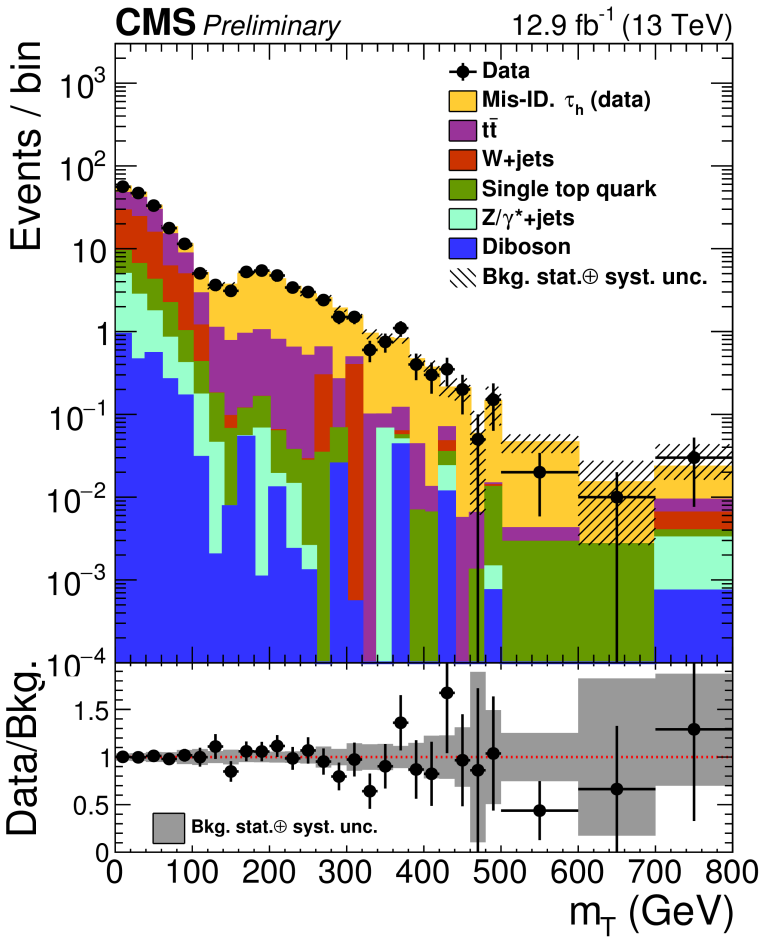


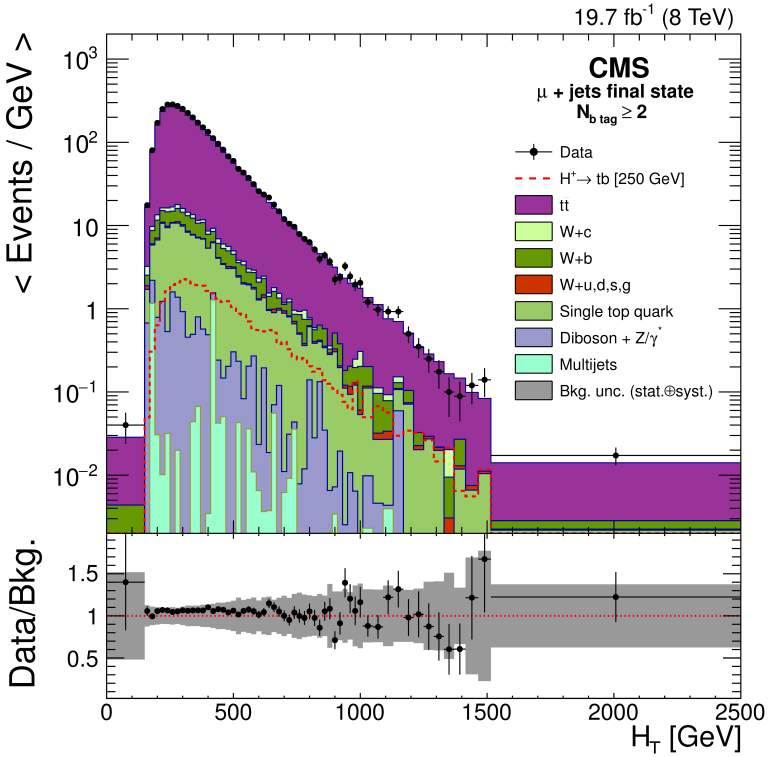




- Production Diagrams for Charged Higgs with four-flavour scheme (Left and Middle) and five flavour scheme (Right).
- When $m_H \leq (m_t - m_b)$ charged Higgs to $\tau\nu$ is in the decay of the top for the mass region (Left).
- When $m_{H^\pm}$ is above the $(m_t - m_b)$ threshold, the $H^\pm \rightarrow tb$ is expected to be the dominated decay mode.

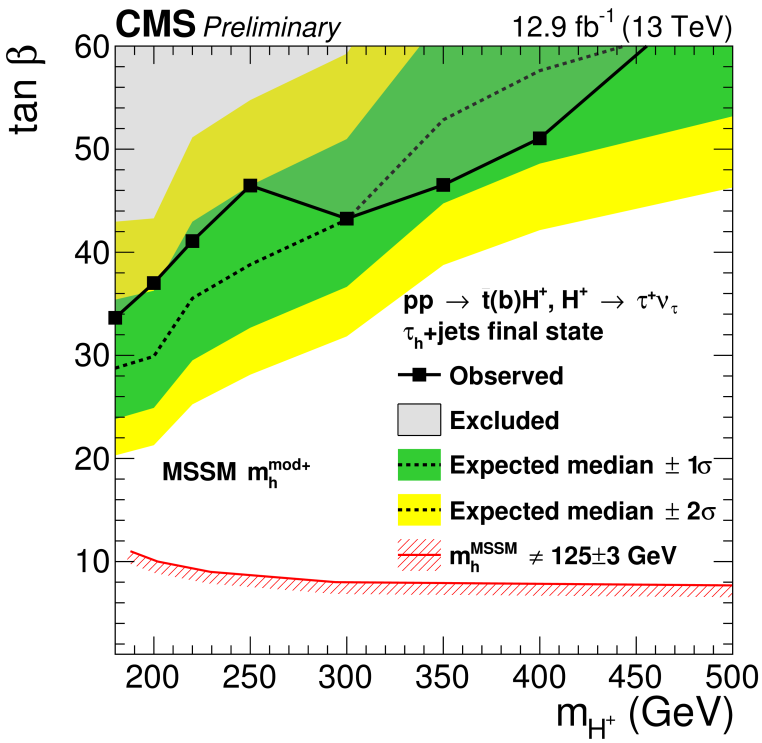
Charged MSSM Higgs Search

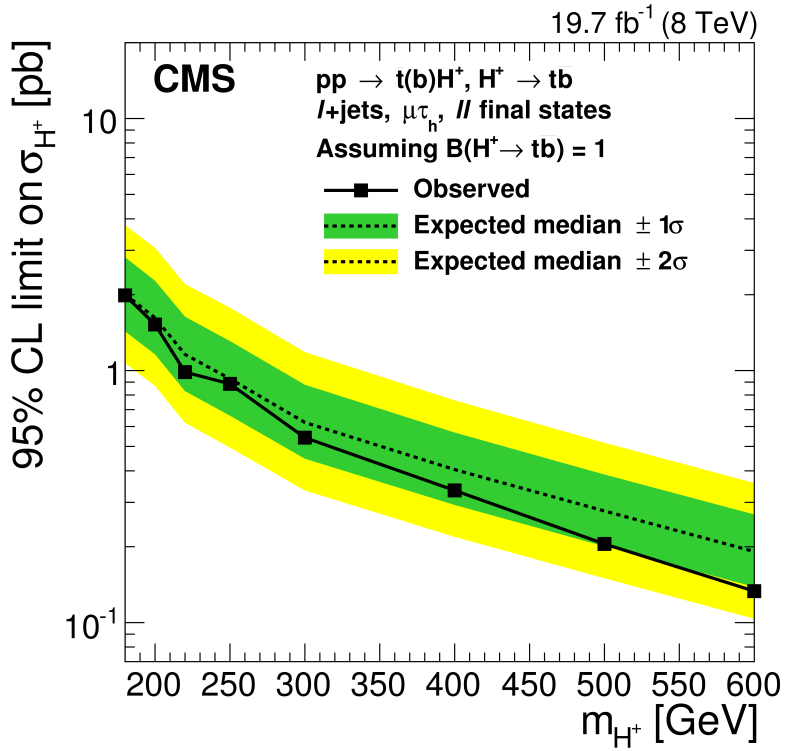




- Measurements of $H^{\pm} \to \nu\tau$ (CMS-PAS-HIG-16-031) and $H^{\pm} \to tb$ (JHEP 11(2015) 018) have been performed.
- No excess was observed.

Charged MSSM Higgs Search

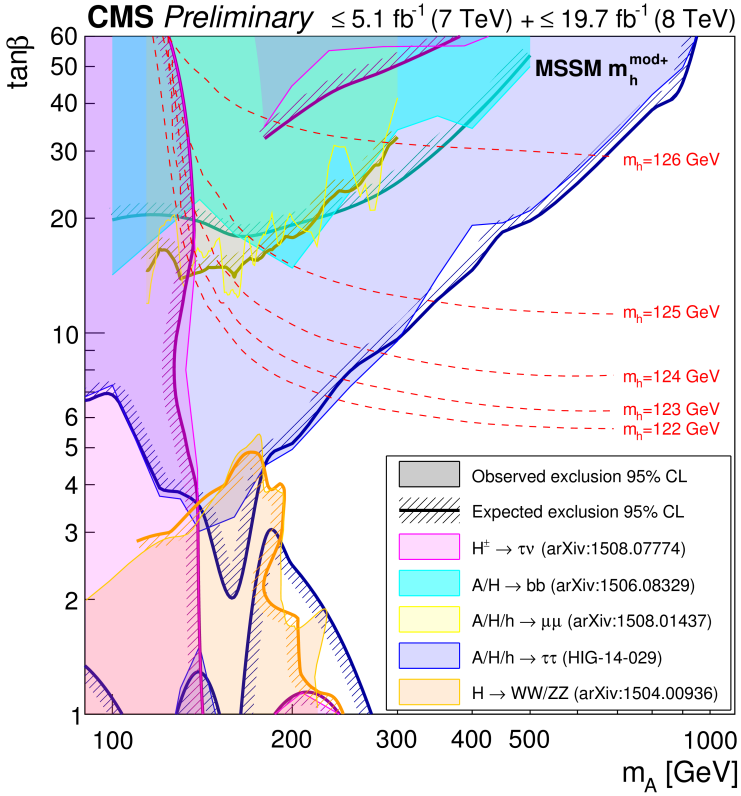




- Measurements of $H^{\pm} \to \nu\tau$ and $H^{\pm} \to tb$ have been performed.
- Limits are also set on the parameter spaces of several other MSSM scenarios.

Outlines

Summary of RunI Search



- A summary of CMS RunI additional heavy Higgs Boson search
  - CMS-PAS-HIG-16-007
- Di-fermions processes have sensitivity of the high $tan\beta$ region.
- Di-bosons processes have sensitivity to low $tan\beta$ region.

Summary and Outlook

- Heavy Higgs Boson searches motivated by the predictions of MSSM models and beyond have become a focusing of RunII CMS experiment after the discovery of the Higgs Boson compatible with Standard Model one.
- New results of fermionic decay mode with around 12.9 fb^{-1} data accumulated in 2016 have been shown along with the Run-I reviews. With current statistics, no hint for new physics was shown yet.
- More decay modes both for additional neutral Higgs Boson and charged Higgs Boson are expected to be explored with 2016 and 2017 data.

Thanks for your attention!