ATLAS PUB Note

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hMSSM summary plots from direct and indirect searches

The ATLAS Collaboration

This note presents an update to the hMSSM summary plots. These plots summarize the interpretation of various HBSM analyses and the Higgs coupling combination in the hMSSM model. This version is an update of the plots released in September 2019.

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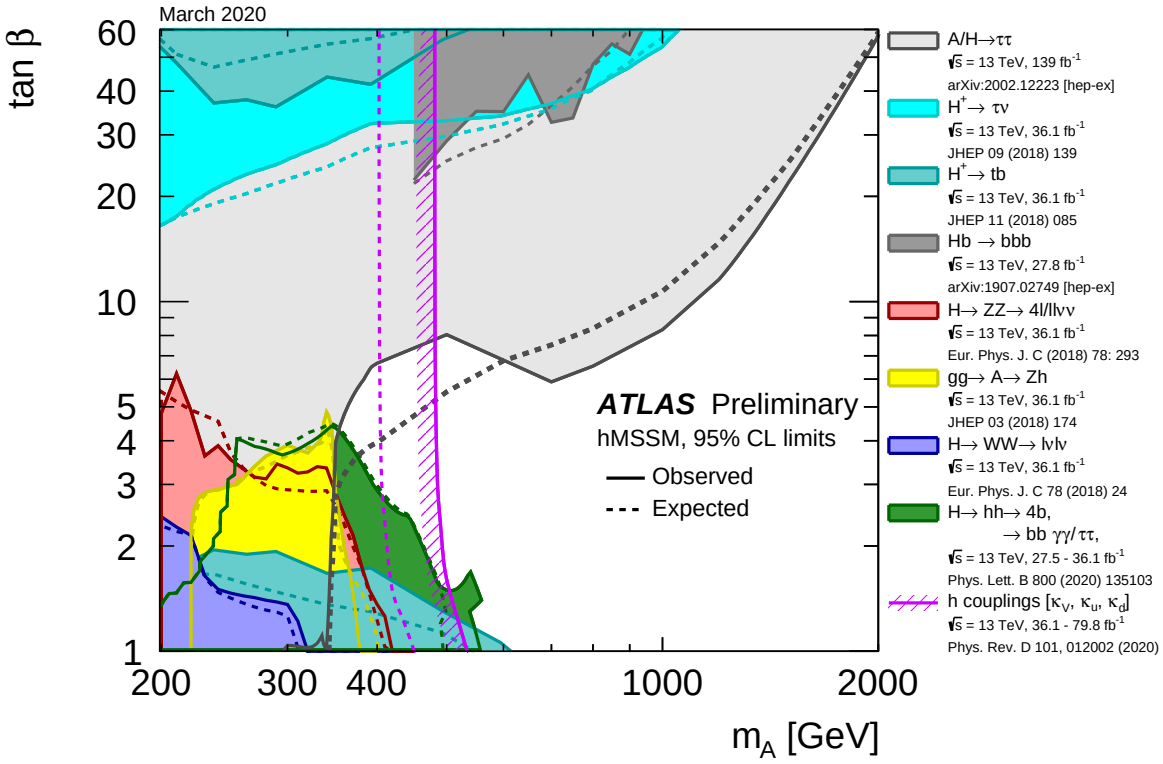

Figure 1: Regions of the $[m_A, \tan\beta]$ plane excluded in the hMSSM model via direct searches for heavy Higgs bosons and fits to the measured rates of observed Higgs boson production and decays. Limits are quoted at 95% CL and are indicated for the data (solid lines) and the expectation for the SM Higgs sector (dashed lines). The light shaded or hatched regions indicate the observed exclusions. The cross sections for the Higgs boson production in the hMSSM [1, 2] are calculated using up to NNLO QCD corrections for gluon-gluon fusion and b-associated production in the five-flavour scheme as implemented in `Sushi` [3–6]. For b-associated production a cross section in the four-flavour scheme is calculated as described in Refs. [7, 8] and the results are combined with the five-flavour scheme calculation following Ref. [9]. The Higgs boson widths and branching ratios have been calculated using `HDECAY` [10]. The procedure for the calculation of the cross sections and the branching ratios follows Ref. [11]. Discussion of the application of the hMSSM can be found in Ref. [12].

1 Plots and results used in them

Figures 1-4 show – using different axis ranges – the expected and/or observed limits at 95% CL in the hMSSM of the following analyses:

- Search for heavy Higgs bosons decaying into two tau leptons with the ATLAS detector using pp collisions at $\sqrt{s}$=13 TeV. [13]
- Search for charged Higgs bosons decaying via $H^{\pm} \to \tau^{\pm}\nu_{\tau}$ in the τ+jets and τ+lepton final states with 36 fb^{-1} of pp collision data recorded at $\sqrt{s}$ = 13 TeV with the ATLAS experiment. [14]
- Search for charged Higgs bosons decaying into top and bottom quarks at $\sqrt{s}$ = 13 TeV with the ATLAS detector. [15]

- Search for heavy neutral Higgs bosons produced in association with b-quarks and decaying to b-quarks at $\sqrt{s}$ = 13 TeV with the ATLAS detector. [16]
- Search for heavy ZZ resonances in the $\ell^+\ell^-\ell^+\ell^-$ and $\ell^+\ell^-\nu\bar{\nu}$ final states using proton-proton collisions at $\sqrt{s}$ = 13 TeV with the ATLAS detector. [17]
- Search for heavy resonances decaying into a W or Z boson and a Higgs boson in final states with leptons and b-jets in 36 fb^{-1} of $\sqrt{s}$ = 13 TeV pp collisions with the ATLAS detector[18]
- Search for heavy resonances decaying into WW in the $e\nu\mu\nu$ final state in pp collisions at $\sqrt{s}$ = 13 TeV with the ATLAS detector. [19]
- Combination of searches for Higgs boson pairs in pp collisions at $\sqrt{s}$ =13 TeV with the ATLAS detector. [20]
- Combined measurements of Higgs boson production and decay using up to 80 fb^{-1} of proton–proton collision data at $\sqrt{s}$ = 13 TeV collected with the ATLAS experiment' [21]

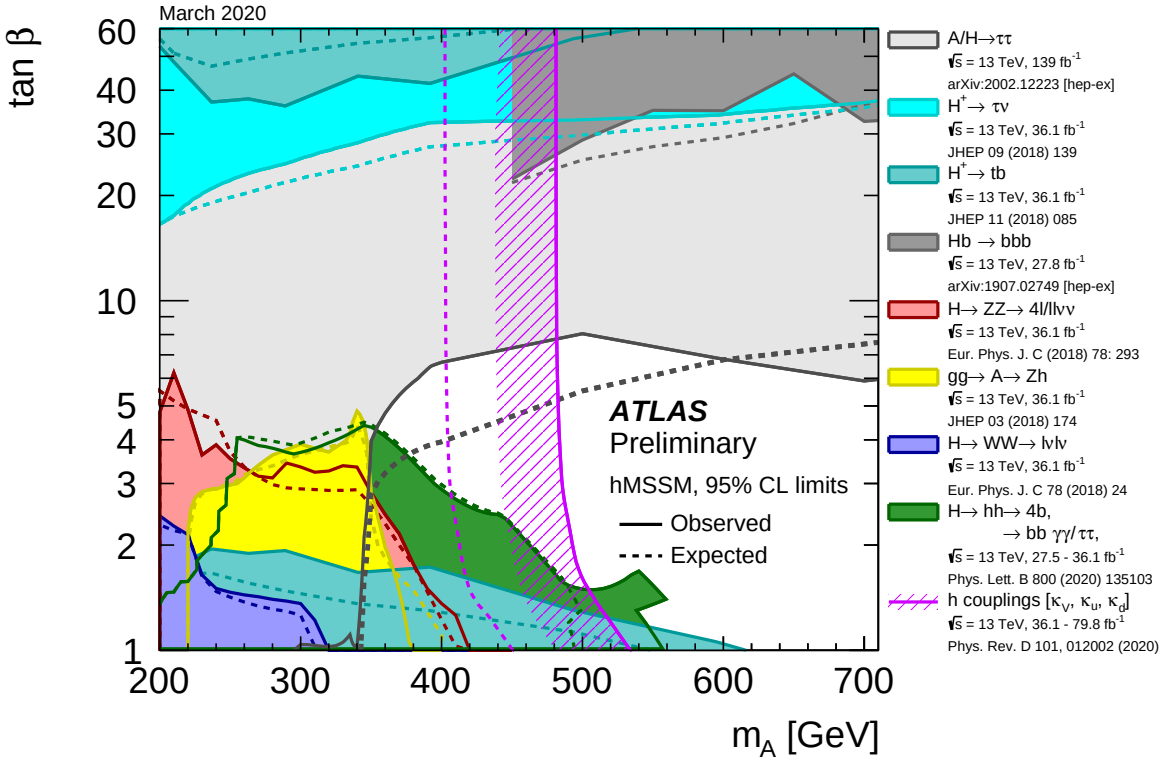

Figure 2: Regions of the $[m_{\mathrm{A}}, \tan\beta]$ plane excluded in the hMSSM model via direct searches for heavy Higgs bosons and fits to the measured rates of observed Higgs boson production and decays. Limits are quoted at 95% CL and are indicated for the data (solid lines) and the expectation for the SM Higgs sector (dashed lines). The light shaded or hatched regions indicate the observed exclusions. The cross sections for the Higgs boson production in the hMSSM [1, 2] are calculated using up to NNLO QCD corrections for gluon-gluon fusion and b-associated production in the five-flavour scheme as implemented in `Sushi` [3–6]. For b-associated production a cross section in the four-flavour scheme is calculated as described in Refs. [7, 8] and the results are combined with the five-flavour scheme calculation following Ref. [9]. The Higgs boson widths and branching ratios have been calculated using `HDECAY` [10]. The procedure for the calculation of the cross sections and the branching ratios follows Ref. [11]. Discussion of the application of the hMSSM can be found in Ref. [12].

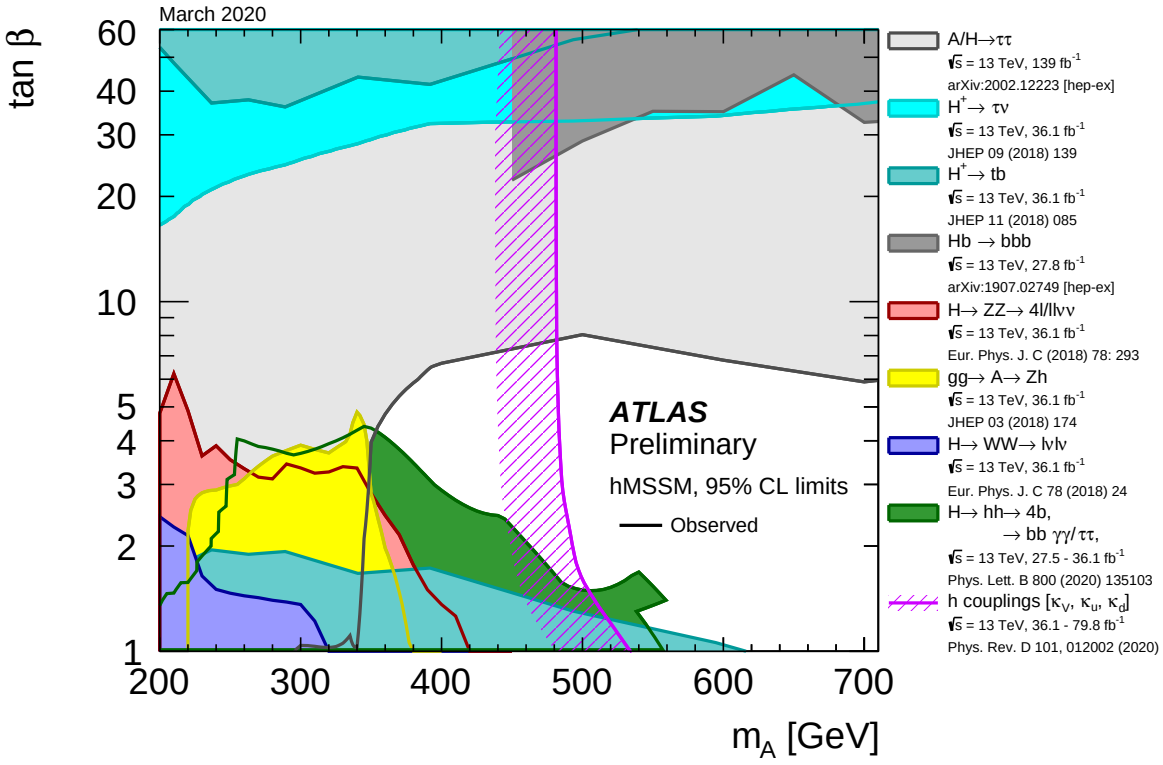

Figure 3: Regions of the $[m_{\mathrm{A}}, \tan\beta]$ plane excluded in the hMSSM model via direct searches for heavy Higgs bosons and fits to the measured rates of observed Higgs boson production and decays. Limits are quoted at 95% CL and are indicated for the data (solid lines and shaded or hatched regions). The cross sections for the Higgs boson production in the hMSSM [1, 2] are calculated using up to NNLO QCD corrections for gluon-gluon fusion and b-associated production in the five-flavour scheme as implemented in `Sushi` [3–6]. For b-associated production a cross section in the four-flavour scheme is calculated as described in Refs. [7, 8] and the results are combined with the five-flavour scheme calculation following Ref. [9]. The Higgs boson widths and branching ratios have been calculated using `HDECAY` [10]. The procedure for the calculation of the cross sections and the branching ratios follows Ref. [11]. Discussion of the application of the hMSSM can be found in Ref. [12].

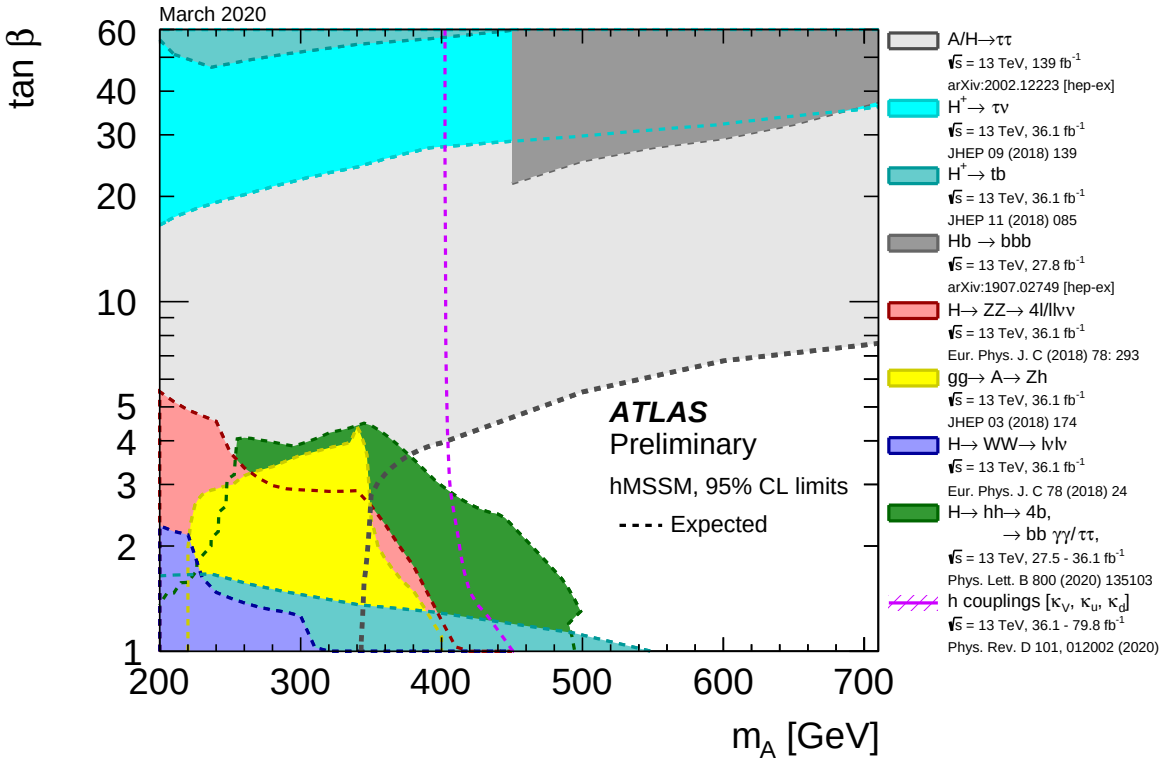

Figure 4: Regions of the $[m_{\mathrm{A}}, \tan\beta]$ plane excluded in the hMSSM model via direct searches for heavy Higgs bosons and fits to the measured rates of observed Higgs boson production and decays. Expected limits are quoted at 95% CL and are indicated for the expectation for the SM Higgs sector (dashed lines and shaded regions). The cross sections for the Higgs boson production in the hMSSM [1, 2] are calculated using up to NNLO QCD corrections for gluon-gluon fusion and b-associated production in the five-flavour scheme as implemented in `Sushi` [3–6]. For b-associated production a cross section in the four-flavour scheme is calculated as described in Refs. [7, 8] and the results are combined with the five-flavour scheme calculation following Ref. [9]. The Higgs boson widths and branching ratios have been calculated using `HDECAY` [10]. The procedure for the calculation of the cross sections and the branching ratios follows Ref. [11]. Discussion of the application of the hMSSM can be found in Ref. [12].

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