15 April 2026 **Quiz number 7**

Phenomenology of Physics Beyond the Standard Model

FS 2026

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Higgs boson in SM and MSSM

Consider the Higgs boson production in proton-proton collisions at the LHC.

- What are the main production mechanisms of the SM Higgs boson ? Sketch the diagram for the gluon-gluon fusion and write the factorisation formula for the cross section.
- Looking at Figure 1, what are the main effects on the light Higgs boson production cross sections due the MSSM increasing $\tan\beta$? What is the reason for this ? Do you expect effects also in the decay widths such as $\Gamma(h \to \gamma\gamma)$ for example?
- Looking at Figure 2, at which limit of the MSSM phase space $(\tan\beta, M_A)$ the experiments are pointing at ? In this limit, are the corrections to the Higgs boson couplings due to the MSSM expected to be large?

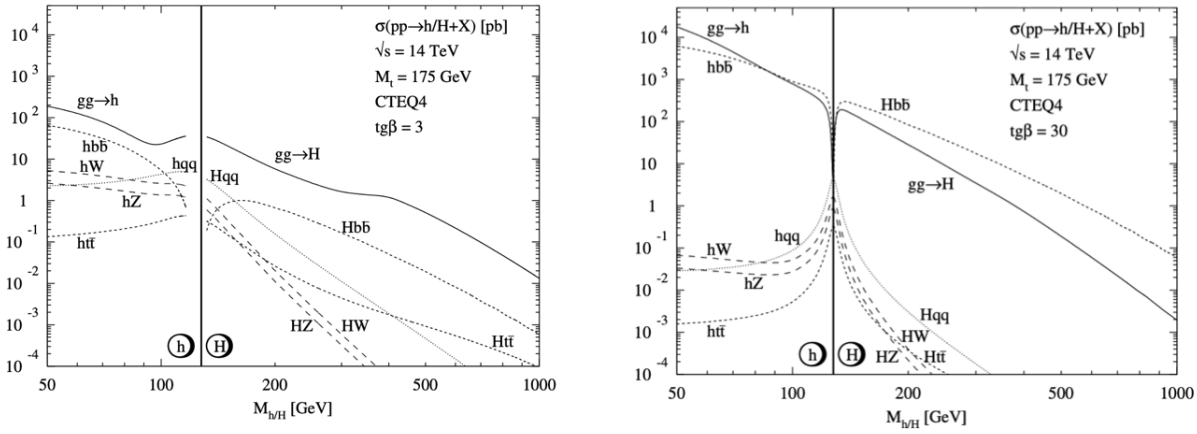


Figure 1: Higgs boson production cross sections in the MSSM for $\tan\beta = 3$ (left) and $\tan\beta = 30$ (right) [1]

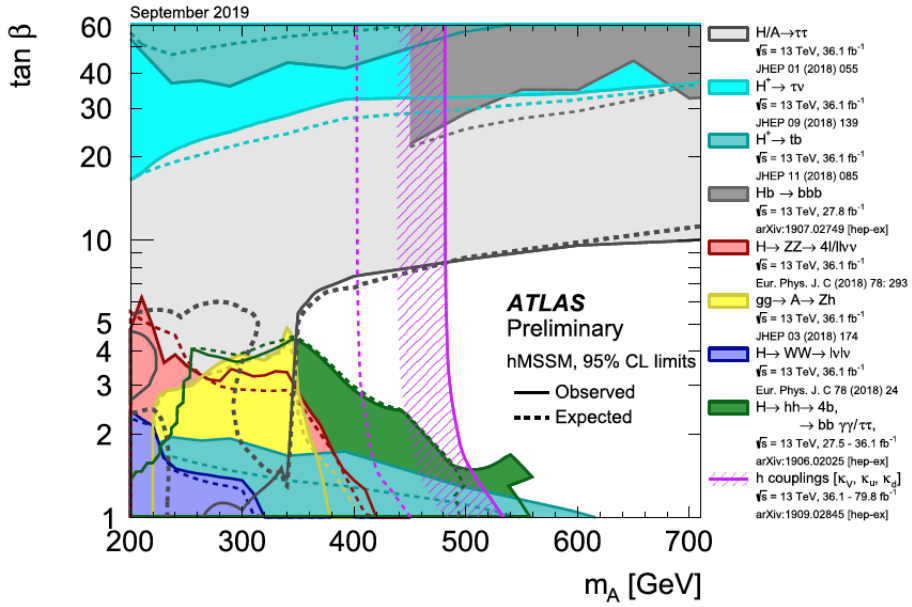


Figure 2: Exclusion limits for the MSSM from direct and indirect searches of additional Higgs bosons [2]

References

[1] Michael Spira. "MSSM Higgs boson production at the LHC". In: *International Workshop on Quantum Effects in the Minimal Supersymmetric Standard Model*. Nov. 1997, pp. 125–136. arXiv: hep-ph/9711407.

[2] *HBSM working group hMSSM summary plots*. Tech. rep. All figures including auxiliary figures are available at https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/PUBNOTES/ATL-PHYS-PUB-2019-034. Geneva: CERN, Sept. 2019. URL: https://cds.cern.ch/record/2689745.