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Possible indications for new Higgs bosons in the reach of the LHC: N2HDM and NMSSM interpretations

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In several searches for additional Higgs bosons at the LHC, in particular the CMS search in the $pp \rightarrow \phi \rightarrow t\bar{t}$ channel and the ATLAS search in the $pp \rightarrow \phi \rightarrow \tau^+\tau^-$ channel, a local excess at the level of 3σ or above has been observed at a mass scale of $m_\phi \approx 400$ -GeV. We investigate to what extent a possible signal in those channels could be accommodated in the Next-to-Two-Higgs-Doublet Model (N2HDM) or the Next-to Minimal Supersymmetric Standard Model (NMSSM). In a second step we furthermore analyse whether such a model could be compatible with both a signal at ≈ 400 -GeV and at ≈ 96 -GeV, where the latter possibility is motivated by observed excesses in searches for the $b\bar{b}$ final state at LEP and the di-photon final state at CMS. The analysis for the N2HDM reveals that the observed excesses at ≈ 400 -GeV in the observed excesses at ≈ 400 -GeV in the $pp \rightarrow \phi \rightarrow t\bar{t}$ and $pp \rightarrow \phi \rightarrow \tau^+\tau^-$ channels point towards different regions of the parameter space, while one such excess and an additional Higgs boson at ≈ 96 -GeV could simultaneously be accommodated. In the context of the NMSSM an experimental confirmation of a signal in the $t\bar{t}$ final state would favor the alignment-without-decoupling limit of the model, where the Higgs boson at ≈ 125 -GeV could be essentially indistinguishable from the Higgs boson of the SM. In contrast, a signal in the $\tau^+\tau^-$ channel would be correlated with significant deviations of the properties of the Higgs boson at ≈ 125 -GeV from the ones of a SM Higgs boson that could be detected with high-precision coupling measurements.

First author

Sven Heinemeyer

Email

Sven.Heinemeyer@cern.ch

Collaboration / Activity

theory

Primary authors: HEINEMEYER, Sven (IFCA (CSIC, Santander)); WEIGLEIN, Georg (T (Phenomenology)); BIEKOETTER, Thomas (T (Phenomenology)); SCHWANENBERGER, Christian (CMS (CMS Fachgruppe TOP)); GROHSJEAN, Alexander (CMS (CMS Fachgruppe TOP))

Presenter: BIEKOETTER, Thomas (T (Phenomenology))

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