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2HDM Neutral Scalars under the LHC

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Two Higgs Doublet Models (2HDM) provide a simple framework for new physics models with an extended Higgs sector. The current LHC results, including both direct searches for additional non-Standard Model (SM) Higgs bosons, as well as precision measurements of the SM-like Higgs couplings, already provide strong constraints on the 2HDM parameter spaces. In this paper, we examine those constraints for the neutral scalars in the Type-I and Type-II 2HDM. In addition to the direct search channels with SM final states: H/A $\longrightarrow$ ff, VV, Vh, hh, we study in particular the exotic decay channels of H/A $\longrightarrow$ AZ/HZ once there is a mass hierarchy between the non-SM Higgses. We found that H/A $\longrightarrow$ AZ/H Z channel has unique sensitivity to the alignment limit region which remains unconstrained by conventional searches and Higgs precision measurements. This mode also extends the reach at intermediate tan beta for heavy mA that are not covered by the other direct searches.

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