

Title: Implications of the LHC two-photon signal for two-Higgs-doublet models

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Abstract: We study the implications for two-Higgs-doublet models of the recent announcement at the LHC giving a tantalizing hint for a Higgs boson of mass 125 GeV decaying into two photons. We require that the experimental result be within a factor of 2 of the theoretical standard model prediction, and analyze the type I and type II models as well as the lepton-specific and flipped models, subject to this requirement. It is assumed that there is no new physics other than two Higgs doublets. In all of the models, we display the allowed region of parameter space taking the recent LHC announcement at face value, and we analyze the $W+W^-$, ZZ , (b) over \bar{b} , and $\tau(+)\tau(-)$ expectations in these allowed regions. Throughout the entire range of parameter space allowed by the $\gamma\gamma$ constraint, the numbers of events for Higgs decays into WW , ZZ , and b (\bar{b}) are not changed from the standard model by more than a factor of 2. In contrast, in the lepton-specific model, decays to $\tau(+)\tau(-)$ are very sensitive across the entire $\gamma\gamma$ -allowed region.

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