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## Decay rates of the Higgs boson to two photons and Z plus photon in $Z_2$ -symmetric Two Higgs Doublet Models

Motivated by experimental hints on possible deviations from the SM predictions for the SM-like scalar boson loop induced decays, the analysis of the decay rates of the Higgs boson to two photons and Z plus photon in the framework of  $Z_2$ -symmetric Two Higgs Doublet Models is presented. Results are given for the model with spontaneous  $Z_2$  violation (the so-called Mixed Model) and the exactly  $Z_2$ -symmetric Inert Doublet Model (IDM). Within IDM we give a thorough analysis of the two photon and Z plus photon rates, taking into account a wide set of constraints, including also the condition for the existence of the Inert vacuum, which significantly reduces the viable parameter space. It assures that the energy of the Inert minimum is lower than that of a coexisting one. We analyze the consequences of deviations from SM predictions in respective channels for the masses of the charged and neutral scalars (in particular the Dark Matter candidate), and their couplings to the Higgs boson. As one of the results we find that an enhancement of the two photon decay rate at the level of 1.2 or greater implies the following bounds:  $62.5 \text{ GeV} < M_{\{DM\}} < 154 \text{ GeV}$ ,  $70 \text{ GeV} < M_{\{H^+\}} < 154 \text{ GeV}$ . Based on the article: B. Świeżewska, M. Krawczyk, "Diphoton rate in the Inert Doublet Model with a 125 GeV Higgs boson", arXiv:1212.4100v3 [hep-ph].

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