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Implications of LHC data on 125 GeV Higgs-like boson for the Standard Model and its various extensions

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Recent data on 125 GeV Higgs-like boson at the LHC starts to constrain the electroweak symmetry breaking sector of the SM and its various extensions. If one imposes the local gauge symmetry of the Standard Model (SM) (SU(3)c×SU(2)L×U(1)Y) to the SM and any possible new physics scenarios, the SM Higgs properties will be modified by intrinsically two different ways: by new physics either coupling directly to the SM Higgs boson h, or affecting indirectly the SM Higgs properties through the mixing of h with a SM singlet scalar s. The models of two Higgs doublet, extra sequential and mirror fermions belong to the first category, whereas the models with a hidden sector dark matter, extra vector-like fermions and new charged vector bosons, which can enhance the diphoton rate of the SM Higgs-like resonance, belong to the second category. We perform a global fit to data in terms of the effective Lagrangian description of two interaction eigenstates of scalar bosons, a SM Higgs and a singlet scalar, and their mixing. This framework is more suitable to study singlet-extended scenarios discussed above compared to other approaches based on the Lagrangian of mass eigenstates. With fairly model-independent assumptions, the effective Lagrangian contains at most four free parameters still encompassing the majority of models in the literature. Interestingly, the SM gives the best fit if all data from ATLAS and CMS are used, whereas various singlet extensions can fit better to individual ATLAS or CMS data. Without further assumptions, an upper bound on the total width (or, non-standard branching ratio) is generically obtained. Furthermore, global fit based on our parameterization can be used to probe interactions of the singlet scalar if the singlet resides below 2mW.

Summary

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