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Sign of the hZZ coupling and implication for new physics

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The magnitudes of the couplings of the scalar resonance at 125 GeV with the SM particles are found to be consistent with those of the SM Higgs boson. However, the signs are not experimentally determined in most of the cases, a prime example being that with the Z-boson pair. In other words, κ_Z^h, the ratio of the couplings of the actual 125 GeV resonance with ZZ and that of the SM Higgs boson with the same, is consistent with both $+1$ and -1, the latter being the "wrong-sign". We argue that the wrong-sign hZZ coupling will necessitate the intervention of new physics below $\mathcal{O}(620)$ GeV to safeguard the underlying theory from unitarity violation. The strength of the new nonstandard couplings can be derived from the unitarity sum rules, which are comparable to the SM-Higgs couplings in magnitude. Thus the strong limits from the direct searches at the LHC can help us rule out the existence of such nonstandard particles with unusually large couplings thereby disfavoring the possibility of a wrong-sign hZZ coupling.

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