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Testing anomalous H–W couplings and Higgs self-couplings via double and triple Higgs production at e+e– colliders

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In the present work we study the implications at the future e^+e^- colliders of the modified interaction vertices WWH, $WWHH$, HHH and $HHHH$ within the context of the non-linear effective field theory given by the Electroweak Chiral Lagrangian. These vertices are given by four parameters, a, b, κ_3 and κ_4, respectively, that are independent and without any constraint from symmetry considerations in this non-linear effective Lagrangian context, given the fact the Higgs field is a singlet. This is in contrast to the Standard Model, where the vertices are related by $V^{\rm SM}_{WWH} = vV^{\rm SM}_{WWHH}$ and $V^{\rm SM}_{HHH} = vV^{\rm SM}_{HHHH}$, with $v = 246$ GeV. We investigate the implications of the absence of these relations in the Electroweak Chiral Lagrangian case. We explore the sensitivity to these Higgs anomalous couplings in the two main channels at these colliders: double and triple Higgs production (plus neutrinos). Concretely, we study the access to a and b in $e^+e^- \to HH\nu\bar{\nu}$ and the access to κ_3 and κ_4 in $e^+e^- \to HHH\nu\bar{\nu}$. Our study of the beyond the Standard Model couplings via triple Higgs boson production at e^+e^- colliders is novel and shows for the first time the possible accessibility to the quartic Higgs self-coupling.

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