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An Exploratory study of Higgs-boson pair production

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Higgs-boson pair production is well known being capable to probe the trilinear self-coupling of the Higgs boson, which is one of the important ingredients of the Higgs sector itself. Pair production then depends on the top-quark Yukawa coupling gS,Pt, Higgs trilinear coupling λ3H, and a possible dim-5 contact-type ttHH coupling gS,Ptt, which may appear in some higher representations of the Higgs sector. We take into account the possibility that the top-Yukawa and the ttHH couplings involved can be CP violating. We calculate the cross sections and the interference terms as coefficients of the square or the 4th power of each coupling (gS,Pt,λ3H,gS,Ptt) at various stages of cuts, such that the desired cross section under various cuts can be obtained by simply inputting the couplings. We employ the HH→γγbb¯ decay mode of the Higgs-boson pair to investigate the possibility of disentangle the triangle diagram from the box diagram so as to have a clean probe of the trilinear coupling at the LHC. We found that the angular separation between the b and b¯ and that between the two photons is useful. We obtain the sensitivity reach of each pair of couplings at the 14 TeV LHC and the future 100 TeV pp machine. We also comment on using the bb¯τ+τ− decay mode.

Summary

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