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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 $g_{S,Pt}$, Higgs trilinear coupling λ_{3H} , and a possible dim-5 contact-type $t\bar{t}HH$ coupling $g_{S,Pt,t}$, which may appear in some higher representations of the Higgs sector. We take into account the possibility that the top-Yukawa and the $t\bar{t}HH$ 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 ($g_{S,Pt,t}, \lambda_{3H}, g_{S,Pt,t}$) 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 $HH \rightarrow \gamma\gamma b\bar{b}$ 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 $b\bar{b} \tau^+\tau^-$ decay mode.

Summary

Primary author: CHEUNG, Kingman (Academia Sinica (TW))

Co-authors: Dr LU, Chih-Ting (National Tsing Hua University); LEE, Jae Sik (Chonnam National University); CHANG, Jung (National Center for Theoretical Sciences, Physics Division)

Presenter: CHANG, Jung (National Center for Theoretical Sciences, Physics Division)

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