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Enhancement of the HWZ vertex in the three scalar doublet model

Content :

We compute one-loop induced trilinear vertices with physical charged Higgs bosons $H^\pm$ and ordinary neutral gauge bosons, i.e., $H^\pm W^\mp Z$ and $H^\pm W^\mp \gamma$, in the model with two active plus one inert scalar doublet fields under a $Z_2(\text{unbroken})\times \tilde{Z}_2(\text{softly-broken})$ symmetry. The Z_2 and $\tilde{Z}_2$ symmetries are introduced to guarantee the stability of a dark matter candidate and to forbid the flavour changing neutral current at the tree level, respectively.
The dominant form factor F_Z of the $H^\pm W^\mp Z$ vertex can be enhanced by non-decoupling effects of extra scalar boson loop contributions. We find that, in such a model, $|F_Z|^2$ can be one order of magnitude larger than that predicted in two Higgs doublet models under the constraints from vacuum stability, perturbative unitarity and the electroweak precision observables.
In addition, the branching fraction of the $H^\pm \to W^\pm Z$ $(H^\pm \to W^\pm \gamma)$ mode can be of order 10~(1)\% level when the mass of the $H^\pm$ is below the top quark mass.
Such a light $H^\pm$ is allowed by the so-called Type-I and Type-X Yukawa interactions which appear under the classification of the $\tilde{Z}$ charge assignment of the quarks and leptons.
We also calculate the cross sections for the processes $H^\pm \to W^\pm Z$ and $H^\pm \to W^\pm \gamma$ onset by the top quark decay $t\to H^\pm b$ and electroweak $H^\pm$ production at the LHC.

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