Contribution ID: **862** Type: **Parallel Talk**

Imprint of quark flavor violating SUSY in h(125) decays at future lepton colliders

Thursday, 7 July 2022 16:00 (15 minutes)

We study the Higgs boson decays h -> c cbar, b bbar, b sbar, photon photon and gluon gluon in the Minimal Supersymmetric Standard Model (MSSM) with general quark flavor violation (QFV), identifying the h with the Higgs boson with a mass of 125 GeV. We compute the widths of the h decays to c cbar, b bbar, b sbar (s bbar) at full one-loop level in the MSSM with QFV. For the h decays to photon photon and gluon gluon we compute the widths at NLO QCD level. We perform a systematic MSSM parameter scan respecting all the relevant constraints, i.e. theoretical constraints from vacuum stability conditions and experimental constraints, such as those from K- and B-meson data and electroweak precision data, as well as limits on Supersymmetric (SUSY) particle masses and the 125 GeV Higgs boson data from LHC experiments. From the parameter scan, we find the followings:
(1) DEV(h -> c cbar) and DEV(h -> b bbar) can be very large simultaneously: DEV(h -> c cbar) can be as large as about +/-60% and DEV(h -> b bbar) can be as large as about +/-20%. Here DEV(h -> X Y) is the deviation of the decay width Gamma(h -> X Y) in the MSSM from the SM prediction: DEV(h -> X Y) = Gamma(h -> X Y)_MSSM / Gamma(h -> X Y)_SM - 1.
(2) The QFV decay branching ratio BR(h -> b sbar / bbar s) can be as large as about 0.2% in the MSSM. It is almost zero in the SM. The sensitivity of ILC(250 + 500 + 1000) to this decay BR could be about 0.1% at 4 sigma signal significance.
(3) DEV(h -> photon photon) and DEV(h -> gluon gluon) can be large simultaneously: DEV(h -> photon photon) can be as large as about + 4% and DEV(h -> gluon gluon) can be as large as about -15%.
(4) There is a very strong correlation between DEV(h -> photon photon) and DEV(h -> gluon gluon). This correlation is due to the fact that the stop-loop (stop-scharm mixture loop) contributions dominate the two DEVs.
(5) The deviation of the width ratio Gamma(h -> photon photon)/Gamma(h -> gluon gluon) in the MSSM from the SM value can be as large as about +20%.
(6) All of these large deviations in the h decays are due to large scharm-stop mixing and large stop/scharm involved trilinear couplings T_U23, T_U32, T_U33 and large sstrange-sbottom mixing and large sstrange/sbottom involved trilinear couplings T_D23, T_D32, T_D33.
(7) Future lepton colliders such as ILC, CLIC, CEPC and FCC-ee can observe such large deviations from SM at high signal significance.
(8) In case the deviation pattern shown here is really observed at the lepton colliders, then this would strongly suggest the discovery of QFV SUSY (MSSM with QFV).

This work is the update of the papers shown below and contains many new findings.
Phys. Rev. D 91 (2015) 015007 [arXiv:1411.2840 [hep-ph]]
JHEP 1606 (2016) 143 [arXiv:1604.02366 [hep-ph]]
IJMP A34 (2019) 1950120 [arXiv:1812.08010 [hep-ph]]
PoS(EPS-HEP2021)594, 2021 [arXiv:2111.02713 [hep-ph]].

In-person participation

No

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Presenter: HIDAKA, Keisho

Session Classification: Higgs Physics

Track Classification: Higgs Physics