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Analysis of final state lepton polarization-dependent observables in Higgs decay into a lepton pair and a photon in the SM at loop level

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Recently, the CMS and ATLAS collaborations have announced the results for Higgs decay into a lepton pair and a photon, through subprocess H->Zγ. This semi-leptonic Higgs decay receives loop induced resonant as well as non-resonant contributions. To probe further features coming from these contributions, we argue that the polarization of the final state leptons is also an important parameter. We show that the contribution from the interference of resonant and non-resonant terms plays an important role when the polarization of final state lepton is taken into account, which is negligible in the case of unpolarized leptons. For this purpose, we have calculated the polarized decay rates and the longitudinal, normal and transverse polarization asymmetries. We find that these asymmetries purely come from the loop contributions and are helpful to further investigate the resonant and non-resonant nature of this decay proess. We observe that for final state electron, the longitudinal decay rate is highly suppressed around 60 GeV region when the final lepton spin is -1/2, dramatically increasing the corresponding lepton polarization asymmetries. Furthermore, we analyze another observable, the ratio of decay rates of different lepton flavours. Therefore, the precise measurements of these observables at CMS and ATLAS can provide a fertile ground to test not only the Standard Model (SM) but also to examine the signatures of possible new physics (NP) beyond the SM.

Keyword-1

Higgs Decay

Keyword-2

Polarization Asymmetry

Keyword-3

Yukawa Coupling

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