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Mass-degenerate NMSSM Higgs bosons and the effects of quantum interference

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The next-to-minimal supersymmetric Standard Model (NMSSM) contains two additional singlet-like Higgs bosons, one scalar and one pseudoscalar, besides the three neutral ones of the MSSM. A signature of either of these new Higgs bosons at the Large Hadron Collider (LHC) can prove crucial for establishing the non-minimal nature of supersymmetry. However, their masses are essentially free parameters of the theory, and it is possible for the singlet-like scalar to be almost mass-degenerate with the 125 GeV SM-like Higgs boson. When the mass difference between the two of them is comparable to the sum of their decay widths, their propagators can mutually interfere quantum mechanical. Thus, when calculating the cross section for a process with Higgs bosons as mediators, the complete Higgs propagator matrix ought to be taken into account. We performed a detailed analysis of the impact of the interference effects on the production of photon pairs with an invariant mass near 125 GeV in gluon fusion at the LHC. We found that these effects can become sizeable, which invalidates the commonly adopted approach of narrow-width approximation. Furthermore, there also exists the possibility of the new scalar being nearly mass-degenerate, alternatively, with the heavy MSSM-like scalar. When these scalars are very heavy, their partial decay widths in the di-photon channel are negligible. We, therefore, used the tau-tau decay channel instead, for investigating the interference effects for such heavy Higgs bosons also. We have found that, whether the mass-degenerate scalar pairs are light or heavy, owing to the poor mass resolutions of their respective final states, the LHC might not have sensitivity to the interference effects.

Parallel Session

Electroweak, Top and Higgs Physics

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