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Distinguishing between axion-like particles and pseudoscalar Higgs bosons at the LHC: a case study in top-antitop quark final states

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Axion-like particles (ALPs) are gauge-singlet under the Standard Model (SM) and appear in many well-motivated extensions of the SM. Since they arise as pseudo-Nambu-Goldstone bosons of an approximate axion shift-symmetry, the masses of ALPs can naturally be much smaller than the energy scale of the underlying UV model, making them an attractive target for the Large Hadron Colloder (LHC) and the future High-Luminosity LHC (HL-LHC). In this talk, we present a method for determining the nature of a possible signal in searches for ALPs produced via gluon-fusion and decaying into top-antitop-quark ($t\bar{t}$) final states in proton-proton scattering at $\sqrt{s} = 13$ TeV. Such a signal has the potential to explain a local $3.5\,\sigma$ excess in resonant $t\bar{t}$ production at a mass scale of approximately 400 GeV, observed by the CMS collaboration in LHC Run-II data. In particular, we investigate how ALP production can be distinguished from the production of pseudoscalar Higgs bosons as they arise in models featuring a second Higgs doublet, making use of the invariant $t\bar{t}$ mass distribution and angular correlations sensitive to $t\bar{t}$ spin correlation. Furthermore, comparisons to existing experimental bounds from the LHC are presented and discussed.

Collaboration / Activity

None

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