

ALP-ine quests at the LHC: hunting axion-like particles via peaks and dips in top-antitop-quark production

We present an analysis of the sensitivity of LHC searches for a new spin-0 particle decaying into top-antitop-quark ($t\bar{t}$) final states to generic axion-like particles (ALPs) coupled to top quarks and gluons. As a first step, we derive new limits on the effective ALP Lagrangian in terms of the respective Wilson coefficients based on the results of a CMS search using 35.9 fb^{-1} of data, collected at $\sqrt{s} = 13 \text{ TeV}$.

Making use of the invariant $t\bar{t}$ mass distribution and angular correlations of leptons, we then investigate how an ALP, featuring an additional explicit coupling to gluons in its effective Lagrangian, can be distinguished from an extended Higgs sector pseudoscalar boson that exclusively couples to gluons via a top-quark loop. Focusing on the mass of 400 GeV, motivated by a local 3.5σ excess observed in the CMS search, we present prospects for the sensitivity to an ALP using the data collected during Run 2 as well as the high-luminosity phase of the LHC.

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