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Enhancing Sensitivities to Long-lived Particles with High Granularity Calorimeters at the LHC (12'+3')

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The search for long-lived particles (LLP) is an exciting physics opportunity in the upcoming runs of the Large Hadron Collider. In this paper, we focus on a new search strategy of using the High Granularity Calorimeter (HGCAL), part of the upgrade of the CMS detector, in such searches. In particular, we demonstrate that the high granularity of the calorimeter allows us to see “shower tracks” in the calorimeter, and can play a crucial role in identifying the signal and suppressing the background. We study the potential reach of the HGCAL using a signal model in which the Standard Model Higgs boson decays into a pair of LLPs, $h \rightarrow XX$. After carefully estimating the Standard Model QCD and the misreconstructed fake-track backgrounds, we give the projected reach for both an existing vector boson fusion trigger and a novel displaced-track-based trigger. In comparison with these previous searches, our new search shows enhanced sensitivity in complementary regions of the LLP parameter space. We also comment on many improvements can be implemented to further improve our proposed search.

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