Probing long-lived particles at Higgs factories

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We study displaced vertex signatures of long-lived particles (LLPs) from exotic Higgs decays in the context of a Higgs-portal model and a neutral-naturalness model at the circular electron positron collider (CEPC) and future circular collider $e^+e^-$ (FCC-ee). Such two models feature two representative mass ranges for LLPs, which show very different behavior in their decay signatures. The Higgs-portal model contains a very light sub-GeV scalar boson stemming from a singlet scalar field appended to the Standard Model. Such a light scalar LLP decays into a pair of muons or pions, giving rise to a distinctive signature of collimated muon-jet or pion-jet, thanks to the sub-GeV mass. On the other hand, the neutral-naturalness model, e.g., folded supersymmetry, predicts the lightest mirror glueball of mass $\mathcal{O}(10)$ GeV, giving rise to long decays with a large transverse impact parameter because of the relatively large mass. Utilizing such distinct characteristics to remove the background, we estimate the sensitivities of searches for light scalar bosons and mirror glueballs at the CEPC and FCC-ee. We find either complementary or stronger coverage compared to the previous results in the similar contexts.

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