

# Emerging Photon Jets in the Hadronic Calorimeter: A Novel Signature of Neutral Long-Lived Particles at the LHC

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We propose a new collider signature for neutral long-lived particles (LLPs): an emerging photon jet in the hadronic calorimeter (HCAL), from LLP decays to photons with no ECAL activity or tracks. Using the ultra-light fermiophobic Higgs  $h_f$  in the Type-I 2HDM as a benchmark, we study

$$pp \rightarrow H^\pm h_f \rightarrow W^\pm h_f h_f$$

where one  $h_f$  decays in the ECAL and the other in the HCAL. Fast simulation shows this signature enables discovery-level sensitivity at the HL-LHC and opens a new direction in LLP searches.

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