

Long-lived Sterile Neutrinos at the LHC in Effective Field Theory

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We study the prospects of a displaced-vertex search of sterile neutrinos at the Large Hadron Collider (LHC) in the framework of the neutrino-extended Standard Model Effective Field Theory. The production and decay of sterile neutrinos can proceed via the standard active-sterile neutrino mixing in the weak current, as well as via higher-dimensional operators arising from potentially new, decoupled physics. We study scenarios where sterile neutrinos are predominantly produced via rare charm and bottom mesons decays at LHC experiments. If sterile neutrinos are long-lived, their decay can lead to displaced vertices which can be reconstructed. We investigate the search sensitivities for the ATLAS/CMS detector, the future far-detector experiments: AL3X, ANUBIS, CODEX-b, FASER, MATHUSLA, and MoEDAL-MAPP, and at the proposed fixed-target experiment SHiP. We focus on HNL production and decay from dimension-six operators involving quarks in the ν SMEFT Lagrangian and perform simulations to determine the potential reach of high-luminosity LHC experiments in probing these EFT operators.

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