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Search for long-lived particles using displaced vertices and missing transverse momentum in proton-proton collisions at $\sqrt{s} = 13$ TeV

A search for the production of long-lived particles in proton-proton collisions at a center-of-mass energy of 13 TeV at the CERN LHC is presented. The search is based on data collected by the CMS experiment in 2016–2018, corresponding to a total integrated luminosity of 137 fb⁻¹. This search is designed to be sensitive to long-lived particles with mean proper decay lengths between 0.1 and 1000 mm, whose decay products produce a final state with at least one displaced vertex and missing transverse momentum. A machine learning algorithm, which improves the background rejection power by more than an order of magnitude, is applied to improve the sensitivity. The observation is consistent with the standard model background prediction, and the results are used to constrain split supersymmetry (SUSY) and gauge-mediated SUSY breaking models with different gluino mean proper decay lengths and masses. This search is the first CMS search that shows sensitivity to hadronically decaying long-lived particles from signals with mass differences between the gluino and neutralino below 100 GeV. It sets the most stringent limits to date for split-SUSY models and gauge-mediated SUSY breaking models with gluino proper decay length less than 6 mm.

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