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Search for exotic decays of the Higgs boson to long-lived particles in pp collisions at $\sqrt{s}=13$ TeV using displaced vertices in the ATLAS inner detector

A novel search for exotic decays of the Higgs boson to pairs of long-lived neutral particles, each decaying to a bottom quark pair, is performed using 139 fb⁻¹ of $\sqrt{s}=13$ TeV proton-proton collision data collected with the ATLAS detector at the LHC. Events consistent with the production of a Higgs boson in association with a leptonically decaying Z boson are analyzed. Long-lived particle (LLP) decays are reconstructed from inner detector tracks as displaced vertices with high mass and track multiplicity relative to Standard Model processes. The analysis selection requires the presence of at least two displaced vertices, effectively suppressing Standard Model backgrounds. The residual background contribution is estimated using a data driven technique. No excess over Standard Model predictions is observed, therefore upper limits are set on the branching ratio of the Higgs boson to LLPs. Branching ratios of 10% are excluded at a 95% confidence level for LLP mean proper lifetimes $c\tau$ as small as 4 mm and as large as 110 mm. For LLP masses below 40 GeV, these results represent the most stringent constraint in this lifetime regime.

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Collaboration / Activity

ATLAS

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