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Search for events with one displaced vertex from long-lived neutral particles decaying into hadronic jets in the ATLAS muon spectrometer in pp collisions at $\sqrt{s} = 13$ TeV

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A search for events with one displaced vertex from long-lived particles using data collected by the ATLAS detector at the Large Hadron Collider is presented, using $140 f b^{-1}$ of proton-proton collision data at \sqrt{s} = 13 TeV recorded in 2015-2018. The search employs techniques for reconstructing vertices of long-lived particles decaying into hadronic jets in the muon spectrometer displaced between 3 m and 14 m from the primary interaction vertex. The observed number of events is consistent with the expected background and limits for several benchmark signals are determined. A scalar-portal model and a Higgs-boson-portal baryogenesis model are considered. A dedicated analysis channel is employed to target Z-boson associated long-lived particle production, including an axion-like particle and a dark photon model. For the Higgs boson model, branching fractions above 1% are excluded at 95% confidence level for long-lived particle proper decay lengths ranging from 5 cm to 40 m. For the photo-phobic axion-like particle model considered, this search produces the strongest limits to date for proper decay lengths greater than O(10) cm.

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