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Understanding backgrounds of ultra long-lived particle searches with the MATHUSLA test stand

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Long-lived particles (LLPs) are a feature of many theories beyond the Standard Model and would be generically produced in exotic decays of the Higgs boson. No known search strategy with current experiments will be able to observe the decay of neutral LLPs with masses above ~ 1 GeV at lifetimes near the upper limit of $c\tau \sim 10^7$ m set by effects on Big Bang nucleosynthesis. The proposed MATHUSLA experiment would search for these ultra long-lived particles by implementing existing technology into a new detector at ground level above one of the interaction points of the LHC by the start of high luminosity runs in 2026. A small-scale MATHUSLA test stand was installed on the surface above the ATLAS detector during part of its operation in 2017 and 2018. We describe this test stand, designed to study the background rates of downward-going muons originating from cosmic rays and upward-going muons created in LHC pp collisions, as well as the ability of tracking to distinguish between these two sources, and present the initial results.

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