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Searches for ultra long-lived particles with MATHUSLA

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The observation of neutral long-lived particles (LLPs) at the LHC would reveal novel physics beyond the Standard Model. LLP signatures are well motivated and can appear in many theoretical constructs that address the Hierarchy Problem, Dark Matter, Neutrino Masses and the Baryon Asymmetry of the Universe. With the current experimental program at colliders, no search strategy will be able to observe the decay of neutral LLPs with masses above ∼GeV and lifetimes at the limit set by Big Bang Nucleosynthesis (BBN), $c\tau$ $\sim 10^7$-10^8 m. To fill this gap, we propose the MATHUSLA detector (MAssive Timing Hodoscope for Ultra-Stable neutraL pArticles), which would be constructed on the surface above CMS in time for the High-Luminosity LHC operations. The large area of MATHUSLA, ˜100m x 100m x 30 m, would also allow it to make important contributions also to cosmic ray physics. The detector would be composed of several layers of solid plastic scintillator, with wavelength-shifting fibers connected to silicon photomultipliers, monitoring an empty air-filled decay volume. In this talk, we will report on the analysis of data collected by a test stand installed on the surface above the ATLAS detector, our ongoing background studies, our R&D efforts, and plans for the MATHUSLA construction.

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