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The cosmic muon-induced background for the LEGEND-1000 Alternative Site at LNGS

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The in-situ production of long-lived isotopes by cosmic muon interactions may generate a non-negligible background for the search for rare events in the deep subsurface, defining a minimum depth requirement. Monte Carlo studies for a GERDA-like experiment at LNGS-depth identified the delayed decay of $^{77(m)}$Ge as the dominant in-situ cosmogenic background in the search for the neutrinoless double-beta decay of ^{76}Ge [1,2], with a projected background index (BI) of 2.7×10^{-6} cts/(keV·kg·yr) after delayed coincidence rejection at $Q_{\beta\beta} = 2039$ MeV [2]. The future tone-scale LEGEND-1000 experiment requires a total BI from all individual contributions of $\leq 10^{-5}$ cts/(keV·kg·yr) [3,4]. Dedicated Monte Carlo simulation studies of the $^{77(m)}$Ge background for LEGEND-1000, including different mitigation strategies, were performed at the alternative LNGS site, as opposed to the SNOLAB baseline site. We will present the effects of passive and active measures to further reduce this background contribution to meet the overall background requirements.

[1] L. Pandola et al., Nucl. Instr. Methods A 570 (2007) 149
[2] C. Wiesinger et al., Eur. Phys. J. C (2018) 78:597
[3] AIP Conference Proceedings, Volume 1894, Issue 1, id.020027
[4] LEGEND-1000 pCDR. To be available at https://legend-exp.org/science/publications

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