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Exploring invisible neutrino decay at P2SO experiment

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The small mass of neutrinos enables the possibility of rapid neutrino decay in beyond Standard Model scenarios. If the final state involves an active neutrino, it is called a visible decay, whereas decay into a lighter sterile state is known as invisible decay. This study explores the effects of the invisible decay of the ν_3 state into a sterile neutrino and a Majoron, within the framework of the P2SO experiment. We analyze both the probability and event rates, taking into account the decay parameter. Using the P2SO setup, we can exclude $\tau_3/m_3 < 2.11 \times 10^{-11} s/eV$ at a 3σ confidence level, which offers slightly better bound than the MOMENT and ESSnuSB experiments, but is not as strong as the limits
provided by DUNE and T2HK. Furthermore, we evaluate the impact of neutrino decay on CP violation (CPV) and θ_{23} octant sensitivities as functions of τ_3/m_3, observing that decay reduces the CPV sensitivity in the P2SO experiment.

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