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Unlocking the Light(er) Sterile Neutrino Sector: Matter Effects and Mass Ordering

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Future long-baseline experiments will be able to probe hitherto unexplored regions of sterile neutrino parameter space for masses ranging from meV to eV. We present an analytic calculation of the neutrino conversion probability $P(\nu_\mu \rightarrow \nu_e)$ in the presence of sterile neutrinos, with exact dependence on Δm_{41}^2 and matter effects. We further express the neutrino conversion probability as a sum of terms of the form $\sin(x)/x$, thus allowing a physical understanding of matter effects and their possible resonance-like behavior. We focus on the identification of sterile mass ordering (sign of Δm_{41}^2) at DUNE. The conversion probability obtained reveals the complex interplay between sterile and matter contributions. We perform numerical calculations of DUNE's sensitivity to sterile mass ordering over a broad range of sterile neutrino masses. Our analytic expressions enable us to explain the dependence of this sensitivity on Δm_{41}^2 values for all mass ordering combinations.

Submitted on behalf of a Collaboration?

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