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Constraining non-standard neutrino interactions with neutral current events at long-baseline oscillation experiments

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We explore, for the first time, {\textit{neutral-current}} events at long-baseline experiments to constrain vector and axial-vector neutrino non-standard interactions (NSI) with quarks. We leverage the flavor dependence of NSIs to perform an oscillation analysis in the neutral-current channel. We first introduce a framework to parametrize the effect of NSI on the cross section. Then, as an example, we analyze NOvA neutral-current data which provides significantly improved constraints on the axial-vector NSI parameters $\varepsilon^A_{\mu\mu}$, $\varepsilon^A_{\tau\tau}$ and $\varepsilon^A_{e\mu}$. This is highly complementary to constraints from SNO data, which, differently from long-baseline neutral current data, is not sensitive to isospin conserving NSIs $\varepsilon^A_u = \varepsilon^A_d$. Additionally, we disfavor large values of the diagonal vectorial NSI $\varepsilon^V_{\mu\mu}$ and
\varepsilon_{\tau\tau}^V$ which originate from the LMA-Dark solution. We also highlight the complementarity between NSI searches at oscillation experiments using charged current and neutral current channels.

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