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Neutrino oscillations revisited

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A new Quantum Field Theory (QFT) formalism for neutrino oscillations in a vacuum is proposed. The neutrino emission and detection are identified with the charged-current vertices of a single second-order Feynman diagram for the underlying process, enclosing neutrino propagation between these two points. The critical point of this approach is the definition of the space-time setup typical for neutrino oscillation experiments, implying macroscopically large but finite volumes of the source and detector separated by a sufficiently large distance, L. The L-dependent master formula for the charged lepton production rate is derived, which provides the QFT basis for analyzing neutrino oscillations. It is demonstrated that our QFT formula coincides with the conventional one under some assumptions for some particular choice of the underlying process. Further, techniques are developed for constructing amplitudes of neutrino-related processes in terms of the neutrino mass matrix, with no reference to the neutrino mixing matrix. The proposed approach extensively uses Frobenius covariants within the framework of Sylvester's theorem on matrix functions. It is maintained that fitting experimental data in terms of the neutrino mass matrix can provide better statistical accuracy in determining the neutrino mass matrix compared to methods using the neutrino mixing matrix at intermediate stages.

Submitted on behalf of a Collaboration?

No

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