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Peer Review

# Review of: "Revisiting the Origin of Neutrino Flavour Transformations"

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The author believes that a neutrino emitted in beta decay cannot be in a superposition of mass eigenstates. His argument is quite convoluted, and it is difficult to say at what point it goes wrong. But it is easy to say that all experimental evidence to date is consistent with the fact that neutrinos are emitted in flavor eigenstates, which are admixtures of mass eigenstates, with coefficients given by the PMNS matrix. The author does not explain why the standard formalism works so well if it is wrong, nor does he explain how his proposed alternative could explain the observations quantitatively. He only gives a qualitative argument.

The author proposes an alternative explanation for neutrino oscillations that presumes the neutrino flavors are not conserved by Z boson interactions. This is contrary to the standard model of particle physics, which forbids flavor-changing neutral currents at tree level. He analyzes this proposal in a peculiar way, which should more properly be treated by computing one-loop diagrams and using a gauge and Lorentz invariant regulator, instead of an arbitrary function such as he introduces to remove UV divergences. A proper treatment would show that these kinds of exchanges cannot induce flavor oscillations; instead, they only contribute to wave function renormalization. The author neglects that his proposed new interactions would induce lepton-flavor violating decays at two loops and would thereby be severely constrained to much smaller values than the off-diagonal PMNS matrix elements.

In summary, the author solves a problem with neutrino oscillations that exists only in his mind, which is not motivated by any experimental data, and he does so in a way that is not consistent with standard principles of quantum field theory, where flavor eigenstates by definition have diagonal kinetic terms.



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## Declarations

**Potential competing interests:** No potential competing interests to declare.