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The mu-tau reflection symmetry of Majorana neutrinos in a cross seesaw system

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In the canonical seesaw framework flavor mixing and CP violation in weak charged current interactions of light and heavy Majorana neutrinos are correlated with each other and described respectively by the 3×3 matrices U and R. We show that the very possibility of $\left|U_{\mu i}\right| = \left|U_{\tau i}\right|$ (for $i = 1, 2, 3$), which is strongly indicated by current neutrino oscillation data as a good approximation, automatically leads to a novel relation $\left|R_{\mu i}\right| = \left|R_{\tau i}\right|$ (for $i = 1, 2, 3$). We show that behind these two sets of equalities and the experimental evidence for leptonic CP violation lies a minimal flavor symmetry: the overall neutrino mass term keeps invariant when the left-handed neutrino fields transform as $\nu_{e\rm L} \to (\nu_{e\rm L})^c$, $\nu_{\mu\rm L} \to (\nu_{\tau\rm L})^c$, $\nu_{\tau\rm L} \to (\nu_{\mu\rm L})^c$ and the right-handed neutrino fields undergo an arbitrary unitary CP transformation. Such a generalized μ-τ reflection symmetry, together with the fact that all the active-sterile flavor mixing angles in R are expected to be considerably smaller than the active flavor mixing angles in U, provides an intriguing illustration of the emergence of a cross seesaw system for both neutrino masses and flavor mixing effects of Majorana neutrinos.

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