Beyond The Standard Model: The Neutrino Mass Problem

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The Standard Model is one of the most precise and well tested theories of physics. It is a renormalizable, Lorentz-invariant quantum field theory which is characterized by a gauge symmetry $SU(3)_C \; x \; SU(2)_L \; x \; U(1)_Y$ and has successfully described the properties of almost every elementary particle. However, the Standard Model is an incomplete theory as it predicts neutrinos should be massless; nevertheless neutrino oscillations provide the strongest evidence that neutrino masses are indeed non-zero. [1] The nature of their mass and the mechanism that generates it are open problems that require an extension of the Standard Model. Despite experimental evidence shows that only left-handed neutrinos are found (as they interact due to weak force), [2] right-handed neutrinos are needed to extend the model and explain why their masses are so small. We will review one of these mechanisms, the Seesaw Type I, which explains the mass of neutrinos by the introduction of heavy right-handed neutrinos. [3]–[5]

Keywords: standard model, neutrino oscillations, seesaw mechanism

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