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Threshold effects on the massless neutrino in the canonical seesaw mechanism

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In this talk, we revisit the one-loop renormalization group equations (RGEs) among nondegenerate seesaw scales, i.e., threshold effects in the canonical seesaw mechanism, which have been obtained for more than two decades. Different from the previous work only focusing on the Weinberg operator, we derive the complete one-loop RGEs of all three dimension-five operators in the Standard Model effective field theory with right-handed neutrinos (νSMEFT) and apply them to threshold effects in the canonical seesaw mechanism. We find some contributions from the Weinberg operator to its Wilson coefficient, the neutrino Yukawa coupling matrix, and the Higgs quartic coupling absent in the previous calculations. Based on the updated one-loop RGEs, we derive the RGE of the effective neutrino mass matrix's determinant without any approximation. Then, for the first time, we provide a strict proof that the one-loop RG running effects among non-degenerate seesaw scales can not generate a non-zero mass for the initial massless neutrino in the minimal type-I seesaw mechanism or in the canonical one with a rank-degenerate neutrino Yukawa coupling matrix. One has to include two- or higher-loop corrections to achieve a non-zero mass for the massless neutrino

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