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## Neutrino Phenomenology in Scoto-Seesaw mechanism with Modular $A_4$ Symmetry

In this work, we study a hybrid scoto-seesaw mechanism based on modular  $A_4$  symmetry, which has many interesting phenomenological implications. In this scoto-seesaw framework, the type-I seesaw mechanism generates the atmospheric mass square difference ( $\Delta m^2_{\rm atm}$ ) at the tree level. Additionally, the scotogenic contribution plays a crucial role in obtaining the other mass square difference ( $\Delta m^2_{\rm sol}$ ) at loop level, providing a clear understanding of the two distinct mass square differences observed in neutrino oscillations. The non-trivial transformations of Yukawa couplings under the  $A_4$  modular symmetry facilitate the exploration of neutrino phenomenology, offering a specific flavor structure for the mass matrix. This model not only makes predictions regarding neutrino mass ordering, mixing angles, and CP phases, but it also yields precise predictions for  $\Sigma m_i$  as well as  $|m_{ee}|$ . Specifically, the model predicts  $\Sigma m_i$  within the range of (0.073, 0.097) eV and  $|m_{ee}|$  in (3.15, 6.66)×10<sup>-3</sup> eV. Furthermore, our model shows promise in addressing lepton flavor violations, such as  $l_{\alpha} \to l_{\beta} \gamma$ ,  $l_{\alpha} \to 3 l_{\beta}$ , all while remaining consistent with current experimental limits.

## Field of contribution

Theory

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