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Phenomenology of the minimal inverse seesaw mechanism with Abelian flavour symmetries

We study the phenomenology of the minimal $(2, 2)$ inverse-seesaw model supplemented with Abelian flavour symmetries. To ensure maximal predictability, we establish the most restrictive flavour patterns which can be realised by those symmetries. This setup requires adding an extra scalar doublet and two complex scalar singlets to the Standard Model, paving the way to implement spontaneous CP violation. It is shown that such CP-violating effects can be successfully communicated to the lepton sector through couplings of the scalar singlets to the new sterile fermions. The Majorana and Dirac CP phases turn out to be related, and the active-sterile neutrino mixing is determined by the active neutrino masses, mixing angles and CP phases. We investigate the constraints imposed on the model by the current experimental limits on lepton flavour-violating decays, especially those on the branching ratio BR$(\mu \to e\gamma)$ and the capture rate CR$(\mu - e, \mathrm{Au})$. The prospects to further test the framework put forward in this work are also discussed in view of the projected sensitivities of future experimental searches sensitive to the presence of heavy sterile neutrinos. Namely, we investigate at which extent upcoming searches for $\mu \to e\gamma$, $\mu \to 3e$ and $\mu - e$ conversion in nuclei will be able to test our model, and how complementary will future high-energy collider and beam-dump experiments be in that task.

Primary authors: Prof. JOAQUIM, Filipe Rafael (CFTP/IST, U. Lisboa); Mr BRITO CÂMARA, Henrique (CFTP/IST, U. Lisboa); Mr GONZÁLEZ FELIPE, Ricardo (ISEL, CFTP/IST)

Presenter: Mr BRITO CÂMARA, Henrique (CFTP/IST, U. Lisboa)

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