

HNLs from Heavy ALP decays at Neutrino Facilities

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Heavy neutral leptons (HNL) are among the hypothetical ingredients behind nonzero neutrino masses. If sufficiently light, they can be produced and detected in fixed-target-like experiments. We show that if the HNLs belong to a richer – but rather generic – dark sector, their production rate can deviate dramatically from expectations associated to the standard-model weak interactions. In this work, we postulate that the dark sector contains an axion-like particle (ALP) that naturally decays into HNLs. Since ALPs mix with the pseudoscalar hadrons, the HNL flux might be predominantly associated to the production of neutral mesons (e.g. π^0 , η) as opposed to charge hadrons (e.g. π^{\pm} , K^{\pm}). In this case, the physics responsible for HNL production and decay are not directly related and experiments like DUNE might be sensitive to HNLs that are too weakly coupled to the standard model to be produced via weak interactions, as is generically the case of HNLs that play a direct role in the type-I seesaw mechanism.

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