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Reviving the keV neutrino: a novel production mechanism for sterile neutrino dark matter

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We propose a new production mechanism for keV sterile neutrino dark matter which does not rely on the oscillations between sterile and active neutrinos nor on the decay of additional heavier particles, and works without employing any new interactions for the sterile neutrinos beyond the standard Yukawa couplings. The dark matter neutrinos are instead produced out of thermal freeze-out, much like typical a WIMP. The challenge consists in balancing a large Yukawa coupling so that the sterile neutrinos thermalize in the early universe on the one hand, and a small enough Yukawa coupling such that they are stable on cosmological scales on the other. We solve this problem by implementing varying Yukawa couplings. We achieve this by using a three-sterile neutrino seesaw extension to the SM and embedding it in a Froggatt-Nielsen model with one single flavon. If the vev of the flavon changes during the electroweak phase transition, the effective Yukawa couplings of the fermions have different values before and after the phase transition, thus allowing for successful dark matter genesis. Additionally, the flavour structure and the origin of the light neutrino masses are explained by the interplay of the seesaw and Froggatt-Nielsen mechanisms.

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