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Cosmological bounds of sterile neutrinos in a $SU(3)_C \otimes SU(3)_L \otimes SU(3)_R \otimes U(1)_N$ model as dark matter candidates

We study sterile neutrinos in an extension of the standard model, based on the gauge group $SU(3)_C \otimes SU(3)_L \otimes SU(3)_R \otimes U(1)_N$, and use this model to illustrate how to apply cosmological limits to thermalized particles that decouple while relativistic. These neutrinos, N_{aL}, can be dark matter candidates, with a keV mass range arising rather naturally in this model. We analyse the cosmological limits imposed by N_{eff} and dark matter abundance on these neutrinos. Assuming that these neutrinos have roughly equal masses and are not CDM, we conclude that the N_{eff} experimental value can be satisfied in some cases and the abundance constraint implies that these neutrinos are hot dark matter. With this information, we give upper bounds on the Yukawa coupling between the sterile neutrinos and a scalar field, the possible values of the VEV of this scalar field and lower bounds to the mass of one gauge boson of the model, U_L. Also, these Hot Dark Matter sterile neutrinos should have an impact on the neutrino mass sum measured in cosmology, $\sum m_\nu < 0.23$ eV, and we verify that this bound is satisfied in the model.

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