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Although the freeze-out of the dark matter (DM) number density depends on the evolution of the DM temperature, their co-evolution remains largely unexplored; it is usually assumed that the DM and standard model (SM) sectors have the same temperature. On the other hand, when the DM particles pair-annihilate with one DM particle in the final state (semi-annihilate), there is no guarantee that the kinetic equilibrium between the DM and SM sectors is maintained. Assuming only the semi-annihilation and self-interaction of DM particles, I will illustrate the non-trivial co-evolution of DM temperature and number density, and give the possibility that the density fluctuations may be suppressed at the sub-galactic scales like keV-scale warm dark matter but with GeV-scale DM in this scenario.

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