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# Cannibal dark matter decoupled from standard model: cosmological constraints

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Dark Matter(DM), having no non-gravitational interaction with standard model(SM), residing in an internally thermalized sector decoupled from standard model may undergo number changing self-scatterings in the early universe. In the non-relativistic regime, these reactions, such as 3→2 process can make the DM temperature to cool at much slower rate than the standard non-relativistic matter due to cannibalism effect. As shown in the earlier studies, there are very strong constraints from structure formation if the cannibal phase takes place in the matter-dominated epoch. We show that, DM decoupled from SM undergoing cannibalism which freezes out at radiation-dominated epoch can be viable, satisfying all cosmological and theoretical constraints. We solve coupled Boltzmann equations for DM density and temperature to find present DM abundance for different DM self couplings. Then we evaluate cosmological constraints on these parameters from big-bang nucleosynthesis bounds on the relativistic degrees of freedom, CMB power spectrum and Lyman-$\alpha$ bounds on the free streaming length of DM and theoretical bounds on the upper limit of 3→2 annihilation cross-section from S-matrix unitarity. We find that, a scalar cannibal DM with mass range of around 90 eV to 600 TeV can produce the observed DM relic density and be consistent with all constraints when the initial DM temperature($T_{\rm DM}$) in lower than $T_{\rm SM}$, with $T_{\rm SM}/8000 \leq T_{\rm DM} \leq T_{\rm SM}/1.1$.

## Session

Astroparticle Physics and Cosmology

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