UNSTABLE DARK MATTER AND GALAXY FORMATION

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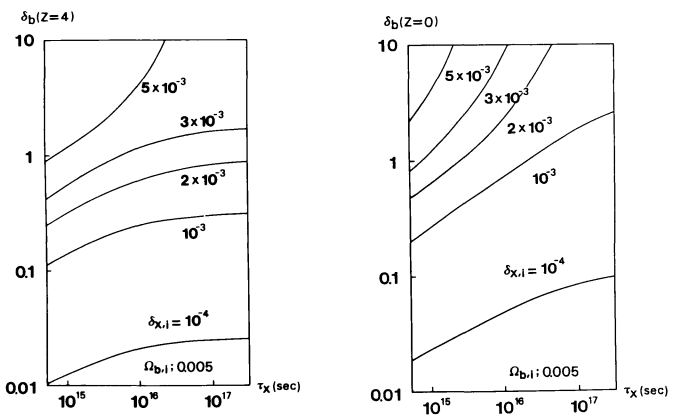
Recently cosmology with unstable particles has attracted much attention as a possible solution to several important problems in the present universe. In this scenario, however, nonlinear structures in the universe would not easily form since their binding energy would decrease gradually in the course of the decay of unstable particles. Thus this scenario is stringently constrained by the galaxy formation problem. In order to obtain the constraints quantitatively, we carried out numerical calculations of the evolution of density perturbations after the time of recombination. Universe is assumed to consist of three components; unstable X-particles, its non-radiative decay product (massless particles) and baryons. Initial conditions are specified by the density contrast of X-particles $\delta_{X,i}$ and the baryon density parameter $\Omega_{b,i}$. Resultant baryon density contrast at Z = 4 (epoch of galaxy formation) and Z = 0 (present) is shown below for $\Omega_{b,i} = 0.005$.

The amplitude of $\delta_{X,i}$ at recombination is constrained from an isotropy of cosmic microwave background radiation. The resultant constraints for adiabatic perturbations are as follows; $\delta_{X,i} < (10^{-3} \sim 10^{-1})$ for galaxies and clusters of galaxies and $\delta_{X,i} < (10^{-4} \sim 10^{-3})$ for superclusters. Thus from the results shown in the figures, we conclude that the adiabatic perturbations can account for the formation of galaxies and clusters of galaxies if τ_X(decay life of X-particles) > 10^{15}sec. This is based on the rapid growth of density perturbations in a nonlinear stage. The formation of supercluster size objects, however, is very difficult in this scenario for any values of τ_X.



References
Suto,Y., Kodama,H. and Sato,K.: 1985, Phys. Lett. 157B,259.
Suto,Y., Kodama,H. and Sato,K.: 1985, submitted to MNRAS.

J. Kormendy and G. R. Knapp (eds.), Dark Matter in the Universe, 497.