بسمه تعالی

Final Exam of Modern Cosmology Name: Date: ۲۰۱۱/۰۱/۲۳

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۱) In the spherical collapse model when the initial peculiar velocity is non-zero do the following parts:

A) Assume that at $t = t_i$, $a = a_i$, there is a initial density contrast, δ_i at a sphere with initial radius $r_i = a_i\chi$ in the background of spatially flat universe and it is adiabatically evolved. Show that the total energy can be written as:

$$E = \frac{1}{2}H^2a^2\chi^2\left(1+\frac{v_p}{Ha\chi}\right)^2 - \frac{1}{2}\chi^2\Omega_0 a^{-(1+3w)}(1+\delta(a))\frac{H^2}{[\Omega_r a^{-4}+\Omega_0 a^{-3(1+w)}]}$$

Where v_p, H are peculiar velocity and Hubble parameter, respectively.

B) If $w = 0$ (parameter state), show that the collapse condition is

$$\delta_i > [\Omega_i]^{-1}\left(1+\frac{v_p(a_i)}{H_i a_i\chi}\right)^2 - 1$$

Where $\delta_i = \delta(a = a_i)$ and $\Omega_i = \Omega(a = a_i)$

C) If $w = 0$ show that the maximum radius reached by the shell is

$r_{max} = D^{-1}[1+\delta_i]r_i$

Where $D = (1+\delta_i) - [\Omega_i]^{-1}\left(1+\frac{v_p(a_i)}{H_i a_i\chi}\right)^2$

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۲) In the Newtonian approach for structure formation derive the behavior of Jeans length scale for $a < a_{eq}$, $a_{eq} < a < a_{b\gamma}$, $a_{b\gamma} < a < a_{ls}$ and $a > a_{ls}$. Compare your results with a characteristics scale of typical structure in the same interval. Where $a_{eq}, a_{b\gamma}, a_{ls}$ correspond to matter-Radiation equality, Baryon-Radiation equality and last scattering era, respectively

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۳) Derive the momentum conservation in general case for an ideal fluid.

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٤) What about vector perturbation in an expanding universe? What is its motivation in the early universe?

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٥) Calculate the cosmic variance for power spectrum of CMB random field?

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٦) How can construct the peculiar velocity field by using growth index. Explain all necessary conditions that you need.

موفق باشید

موحد

بسمه تعالی

Prefinal Exam of Modern Cosmology Name: Date: ۲۰۱۱/۰۱/۱۵

۱) Explain scale-invariant Harrison-Zeldovich spectrum in detail. Use the matter-dominant epoch and linear regime. What about Radiation era?

۲) Define the spectral, running index and tilt in the inflationary scenario.

۳) According to the Virial theorem, determine the mean of energy of a typical system which kinetic part of it's Hamiltonian consists on the free particle kinetic energy and governed by the following conservative force: $f \propto -Bq^{\alpha}$ in ۳-dimensions. Here q is generalized coordinate and B,α are constants.

٤) Write the cosmological constant problems in the context of standard model. Point out to some alternative dark-energy models.

موفق باشید

موحد