

In the name of God

Department of Physics
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ADVANCED TOPICS IN MODERN COSMOLOGY

Exercise Set 13

(Date Due: 1393/02/30)

1. Solve problem 7.1 (Physical Foundation of Cosmology, V. Mukhanov)
2. Solve problem 7.4 (Physical Foundation of Cosmology, V. Mukhanov)
3. For scalar, vector and tensor perturbations, derive following equations:

$$\nabla^2 \Psi - 3\mathcal{H}(\Psi' + \mathcal{H}\Phi) = 4\pi G a^2 \delta \widetilde{T}_0^0$$

$$(\Psi' + \mathcal{H}\Phi)_{;i} = 4\pi G a^2 \delta \widetilde{T}_i^0$$

$$[\Psi'' + \mathcal{H}(2\Psi + \Phi)' + (2\mathcal{H}' + \mathcal{H}^2)\Phi + \frac{1}{2}\nabla^2(\Phi - \Psi)]\delta_{ij} - \frac{1}{2}(\Phi - \Psi)_{;ij} = -4\pi G a^2 \delta \widetilde{T}_j^i$$

$$\nabla^2 V_i = 16\pi G a^2 \delta \widetilde{T}_i^{0 \text{ Vector}}$$

$$(V_{i,j} + V_{j,i})' + 2\mathcal{H}(V_{i,j} + V_{j,i}) = -16\pi G a^2 \delta \widetilde{T}_j^i \text{ Vector}$$

$$h''_{ij} + 2\mathcal{H}h'_{ij} - \nabla^2 h_{ij} = -16\pi G a^2 \delta \widetilde{T}_j^i \text{ Tensor}$$

Good luck, Movahed
