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Cosmology

Pre-class reading 6

1) Evolution of baryon and dark matter densities:

For dark matter, which is a collision-less, pressure-less fluid, perturbations grow with time reduced by a Hubble drag, which arises from the expansion of the Universe.
Before recombination, the baryons are tightly coupled to photons. On large scales ($k<<k_J$ corresponding to the Jean's length set by the distance travelled by a sound wave within a gravitational free-fall time), the baryonic perturbations closely follow the dark matter perturbations. Before the time of recombination, this length scale corresponds to supercluster sizes. After recombination, this length scale drops to the size of a globular cluster. On small scales ($k>> k_J$), we have baryon oscillations that slowly damp due to the expansion of the Universe.

2) Linear transfer function:

The linear transfer function corrects the matter power spectrum arising from the following physical effects:

- Possible presence of hot dark matter, which leads to small scale density perturbations from not forming through free streaming
- The change in expansion law $a(t)$ for $z>z_{eq}$ (radiation dominated) and $z<z_{eq}$ (matter dominated)
- The existence of a cosmic horizon. For fluctuations on scales larger than the cosmic horizon, Newtonian perturbation theory ceases to be valid and one needs to apply linear perturbation theory in the framework of GR

3) Amplitude of power spectrum:

σ_8 is the variance of the mass density field that scales with the amplitude of the power spectrum $P(k)$ at $R= 8 h^{-1}$ Mpc. It is evaluated from the initial power spectrum evolved to the present time based on temperature fluctuations in the CMB obtained on large scales and from the abundance of rich galaxy clusters.