

AY 127 HW 4
Due Wed May 20, 2011

1. **Transfer functions.** Suppose that Universe contained only baryons and radiation, and no dark matter or dark energy, i.e. $\Omega_b = 1$, $H_0 = 50$ km/s/Mpc, and $T_{\text{cmb}} = 2.73$ K. Qualitatively draw the transfer function $T(k)$. Give at order of magnitude level the comoving wavenumbers and corresponding values of T at important features.

2. **Cluster polarization.** A $6 \times 10^{14} M_\odot$ cluster is located at $z = 0.5$. Assuming it has virialized at ~ 200 times the mean density of the Universe:

(a) Compute its physical radius (under the idealized and unrealistic assumption of uniform density).

(b) What is the Thomson optical depth through the cluster?

(c) To an order of magnitude, what is the polarization signal (in μK) that should be seen by a CMB experiment looking at the cluster due to Thomson scattering within the cluster?

(This effect has not yet been observed, but if the standard cosmological scenario is correct it will be soon.)

3. **Practice with correlation functions.** Suppose the correlation function of galaxies is $\xi(r) = (r/r_0)^{-\gamma}$.

(a) Compute their power spectrum $P(k)$.

(b) Two samples of galaxies (Sample 1 and Sample 2) have bias b_1 and b_2 . Calculate the ratio of their correlation lengths $r_{0,2}/r_{0,1}$ (in terms of b_1 , b_2 , and γ).