

PH673 - High Energy Astrophysics

Assignment 18 - Nov. 7, 2007

1. (a) Solve the Kompaneets equation in the case of an input photon distribution (at $t = y = 0$)

$$n(x, 0) = x^{-1} \quad (1)$$

by neglecting the n and n^2 terms ($\partial n / \partial x \gg n, n^2$), to show that

$$n(x, y) = x^{-1} e^{-2y} \quad (2)$$

(b) Show that the situation of case (a) can be interpreted as a Rayleigh-Jeans spectrum which has its temperature reduced by a factor of e^{-2y} upon inverse Compton scattering.

(c) Estimate the temperature decrement of the CMB radiation upon scattering with electrons in clusters ($R=1$ Mpc, $n = 10^{-3} \text{ cm}^{-3}$, $T = 10^8 \text{ K}$).