ASSIGNMENT 1, due date Jan 25th, in class

1. The red supergiant star Betelgeuse in the constellation Orion has $T_{eff} = 3500K$ and an angular diameter $0.045''$ (arcseconds). Assuming its distance $d = 140\ pc$, find its radius R and luminosity L.

2. Assuming that the Milky Way's luminosity is $L \approx 2 \times 10^{10} L_{\odot}$, and roughly estimating its radius as $8\ kpc$, show that if it radiated as a blackbody, it would have temperature $T_{eff} \approx 5K$. Starlight heats the interstellar dust to about this temperature.

3. In a galaxy at distance $d\ Mpc$ what would be the apparent magnitude in B band of the star like our Sun ? For the galaxy at this distance show that 1 arcsecond on the sky corresponds to 5d pc on the galaxy surface. If the surface brightness is $I_B = 27\ mag\ arcsec^{-2}$, how much light one square arcsecond of the surface emit, compared with a star like Sun at the same distance ? Show that this is equivalent to $1\ L_{\odot} pc^{-2}$. Does the answer depend on the distance d ?

4. A galaxy has absolute magnitude M and redshift z. Find how its apparent magnitude m is related to M and z. Look at Fig 1.17 in the textbook and measure the slope of the correlation between the apparent magnitudes of the brightest galaxies in rich clusters and their redshifts. Is the observed correlation consistent with an assumption that all the brightest galaxies in rich clusters have approximately same absolute luminosity ?