Physics 310/610 – Cosmology

Homework Set C

1. Telescopes on Earth have background light coming from the atmosphere that limits how dim of objects they can see. The James Webb space telescope, based in space, with an effective diameter of $d = 5.68$ m, does not have this problem
   (a) The dimmest objects detectable by the Webb have a bolometric magnitude of approximately $m = 34$. What is the corresponding brightness, in W/m^2? Convert this into watts by multiplying by the collecting area of the telescopes.
   (b) Assume this light is primarily in the infrared, with wavelength $\lambda = 20$ μm. Find the energy of a single photon with this wavelength.
   (c) Find the number of photons falling on the James Webb telescope per second, and the number collected in a one-hour exposure.

2. The nearest "star," α-Cen, is actually a double star. α-Cen A has apparent magnitude $m_A = 0.01$, and α-Cen B has apparent magnitude $m_B = 1.33$
   (a) What is the ratio of the brightness of these two stars, F_A/F_B ? Assuming these two stars are at the same distance from us, can you conclude anything about their relative luminosities, L_A/L_B ?
   (b) Suppose that you view the two stars together, so they look like a single star. What would be the corresponding magnitude for the two stars together?
   (c) These stars are each actually at a distance of $d = 1.325$ pc. What is each of their absolute magnitudes M_A and M_B?

Graduate Problems – No extra problems for PHY 610