AST 250 Spring 2010
HOMEWORK #8

Due Monday May 03

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(1) On April 20th, the brightest ever observed type Ia supernova explosion was reported in a host galaxy with a redshift z = 0.0736. If the maximum apparent magnitude was m_v = 17.1, then what was the maximum absolute magnitude, M_V ? If the typical type Ia supernova has M_V = -19.3, then how many times brighter was this "over-luminous" supernova ?

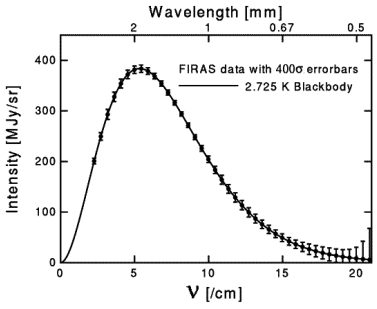
(2) The rate of change in the expansion of the universe is traditionally parametrized by q, the "deceleration constant" (it is named "deceleration" because historically, an accelerating universe was considered unlikely!). The deceleration parameter is related to the Hubble constant by the first order differential equation

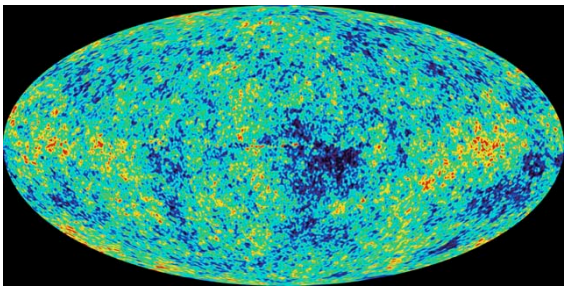
$$1 + q = - (1/H^2) \; dH/dt$$

Prove how q depends on the scale factor, a, from the FRW metric. Hint: since it is a "deceleration" parameter, it probably has to depend on d^2a/dt^2.

(3) If q = 0, the universe is expanding at a constant rate. Then the age of the Universe is simply given by $t = 1/H_0$. What is this age in billions of years?

(4) Prove that the temperature of the Cosmic Microwave Background is warmer by a factor of (1+z) at a redshift z. Hint: Assume that the CMB is a blackbody for all z and use Wien's Law. What was T_{cmb} at z = 6 ?





(5) Submillimeter Galaxies (SMGs), are extremely dusty starburst galaxies that were discovered at high redshifts (z ~ 1 to 3). Assume the dust emission from SMGs are well characterized by blackbodies at a single dust temperature. If the observed spectrum of a SMG peaks at 180 μm, what would be its dust temperature if it is at a redshift of z = 2 ?