PROBLEM 1: BRIGHTNESS VS. REDSHIFT WITH A POSSIBLE SOURCE AND THE ENERGY FLUX FROM IT

PROBLEM 2: AGE OF A UNIVERSE WITH MYSTERIOUS STUFF

**Cosmological Constant**

**Cosmological Events**

**PROBLEM 3: SHARED CAUSAL PAST**

**PROBLEM SET 8**

**UPCOMING QUIZ:**

**READING ASSIGNMENT:**

Massachusetts Institute of Technology
Luminosity distance. The luminosity distance in turn is really a measure of the

\[ d_L = \frac{1}{H_0} \sqrt{\frac{m}{M - m}} \]

where H_0 is the Hubble constant, M is the magnitude of the

Note for those plotting data from Press et al. 2004†

The luminosity distance, in turn, is really a measure of the
distance modulus, and

\[ m - M = 5 \log d_L + 5 \]

is the distance modulus, which is a direct measure of the luminosity distance. The

constant in this expression will not be needed. The word "corrected" refers both to
corrections related to the spectral sensitivity of the detectors and to the brightness

factor used in the sensing of the observed radiation by

\[ J/ \text{candles} \]

and the astronomers apply a correction based on the duration of the light

The original data on the Hubble diagram are observed with different redshifts, and hence one must apply corrections if the

For your convenience, the magnitudes and redshifts for the Supernova Cosmol-

ogy Project paper, from Tables 1 and 2, are summarized in a text file on the 8.286web page. The data from Table 5 of the Riess

2004 paper, mentioned above, should see the note at the end of this problem.

For the cosmological models to plot, you should include:

(i) A matter-dominated universe with \( \Omega_m = 0 \) and \( \Omega_vac = 0 \).

(ii) An anisotropic universe with \( \Omega_m = 0 \) and \( \Omega_vac = 0 \).

(iii) A universe with \( \Omega_m = 0 \) and \( \Omega_vac = 0 \).

Your graph should include on the graph the theoretical predictions for several cosmological models.

You may include any other models if they interest you. You can draw the plot

\[ z = 3, \zeta = 0 \]

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ogy Project paper, from Tables 1 and 2, are summarized in a text file on the 8.286web page. The data from Table 5 of the Riess

2004 paper, mentioned above, should see the note at the end of this problem.

If you choose to plot the data from the 3rd paper, Riess et al. 1998,* you

should get the results from the 2nd paper and in Ryden's book

8.286 PROBLEM SET 8, FALL 2013
The observed brightness of the object is defined as the distance that the object would have to be located to result in the observed brightness, if we were living in a static Euclidean universe. More explicitly, if we lived in a static Euclidean universe and an object radiated power \( P \) in a spherically symmetric pattern, then the energy flux \( J \) at a distance \( d \) would be

\[ J = \frac{P}{4\pi d^2}. \]

That is, the power would be distributed uniformly over the surface of a sphere at radius \( d \). The luminosity distance is therefore defined as

\[ d_L = \sqrt{\frac{P}{4\pi J}}. \]

Thus, a specified value of the distance modulus \( \mu \) implies a definite value of the ratio \( J/P \).

In plotting a theoretical curve, you will need to choose a value for \( H_0 \). Riess et al. do not specify what value they used, but I found that their curve is most closely reproduced if I choose \( H_0 = 66 \) km-sec\(^{-1}\)-Mpc\(^{-1} \). This seems a little on the low side, since the value is usually estimated as 70–72 km-sec\(^{-1}\)-Mpc\(^{-1} \), but I found that their curve is most closely reproduced if I choose \( H_0 = 66 \) km-sec\(^{-1}\)-Mpc\(^{-1} \). This seems a little on the low side, since the value is usually estimated as 70–72 km-sec\(^{-1}\)-Mpc\(^{-1} \), but I found that their curve is most closely reproduced if I choose \( H_0 = 66 \) km-sec\(^{-1}\)-Mpc\(^{-1} \). This seems a little on the low side, since the value is usually estimated as 70–72 km-sec\(^{-1}\)-Mpc\(^{-1} \), but I found that their curve is most closely reproduced if I choose \( H_0 = 66 \) km-sec\(^{-1}\)-Mpc\(^{-1} \). 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