

# Homework Assignment 1

**Due: Sunday September 13, 11:59 pm, UBlerns Digital Dropbox**

**PHY 410: choose any two problems.      PHY 505: work all three problems**

1. Modify the Hubble program to make a least-squares fit to the 9 open circles in Fig. [1] and compare the slope of the fitted straight line to Hubble's value of  $K$ . Estimate the age of the Universe that this value implies.

<http://www.physics.buffalo.edu/phy410-505/topic1/lec-1-1.pdf>

2. Convert the slope output from the supernova program to km/s/Mpc units and compare with Hubble's value. Divide the supernova data set into two subsets, low redshift and high redshift. Compute the slope separately for each of the two subsets. Can you conclude from your results that the expansion of the Universe is constant, accelerating, or decelerating?

<http://www.physics.buffalo.edu/phy410-505/topic1/lec-1-2.pdf>

3. Explore the use of various general linear fitting functions for the CMB power spectrum. Try to find one that looks reasonably like the theoretical curve in Fig. [3] and has a reasonable  $\chi^2/\text{d.o.f.}$ , without using too many parameters. Compare your fitted curve with CMBFAST using Gnuplot

[http://lambda.gsfc.nasa.gov/toolbox/tb\\_cmbfast\\_form.cfm](http://lambda.gsfc.nasa.gov/toolbox/tb_cmbfast_form.cfm)

<http://www.physics.buffalo.edu/phy410-505/topic1/lec-1-3.pdf>