PHYS 321: PROBLEM SET 6

Due April 2, 2018 Mon @ 11:30 am

*Solve the problems listed below, and **write up your answers clearly and completely**. Do not turn in rough work – instead, make a clean copy after checking your calculations. Use English sentences and phrases to explain your solution and describe your answers step by step. Even if you did not get the correct answer, you may get partial credits for these steps!*

1. (2 credits) Use Figure 12.9 in the textbook, calculate the radius of an 1 solar mass protostar for its evolution since the gravitational collapse began at 1 kyr, 10 kyr, 60 kyr, and 0.5 Myr. Express your answer in units of solar radius.

2. (2 credits) Using the technique of main-sequence fitting, estimate the distance to M3; refer to Figs. 13.17 and 13.19 in the textbook.

3. (3 credits) Comparing the evolution of low-mass stars and high-mass stars.
   (a) Using data available in the Tables 12.1 and 13.1 in the textbook, compare the pre-main sequence evolutionary time of a 0.8 $M_\odot$ star with the lifetime on the main sequence for a 15 $M_\odot$ star. How does this information help to explain the appearance of a color?magnitude diagram such as Fig. 13.18 in the textbook?
   (b) Estimate the mass of a star that would have a main-sequence lifetime comparable to the pre-main-sequence evolutionary time of a 0.8 $M_\odot$ star.

4. (3 credits) The Helix nebula is a planetary nebula with an angular diameter of 16 arcminutes that is located approximately 213 pc from Earth.
   (a) Calculate the diameter of the nebula in pc.
   (b) Assuming that the nebula is expanding away from the central star at a constant velocity of 20 km s^{-1}, estimate its age in years.