PHYS 354 — Problem Set 6 January 20

Due Jan. 24

1. Consider a newly formed globular cluster with a total mass of 106 solar masses. Assume a Salpeter initial mass function of the form dN/dm = am-2.35, m is a star’s mass divided by the mass of the sun. Assume only stars in the 0.1 to 20 solar mass range were formed. a) Determine the value of a. b) Use a main sequence scaling relationship to find the total luminosity of the cluster. c) Determine the fraction of the cluster’s mass coming from stars with masses greater than five solar masses and the fraction of the cluster’s luminosity coming from those stars. Take the ratio of these two numbers and comment. d) Determine the mean mass of a star in the cluster. e) Taking the sun’s main sequence lifetime to be 10 Gyr, calculate the mass of the most massive main sequence star after the cluster has aged 1 Gyr. f) What is the total luminosity of the cluster after 1Gyr, ignoring the contribution from stars no longer on the main sequence?

2. Charles Messier constructed a list of objects for observers of comets to beware of, lest they confuse these “less interesting” objects for comets. These objects include star clusters, nebulae and galaxies that are among the best observational targets for small telescopes. A list of these object can be found in Appendix H of Carroll and Ostlie. You can do a web search to learn more about when and where Messier observed. a) You wish to design an experiment to look for gravitational microlensing that arises when trans-Neptunian objects in the outer solar pass in front of background stars. To maximize your likelihood of success your field of view should include both the plane of the Galaxy and the plane of the solar system. Use the appropriate data from Appendix H and from an Astronomical Almanac to create graphs with empirical fits to data that will help you identify the best two directions to center your data acquisition efforts. Which of these directions is appropriate for an observer in the northern hemisphere? In/near what constellation(s) will your northern hemisphere data acquisition take place? b) Use the appropriate data from Appendix H to determine an estimate of the location on the sky of the center of the Galaxy based on Messier’s data. Use graphs and empirical curve fits as appropriate. Compare your calculated galactic center coordinates to the accepted values for these. Discuss.

3. Carroll & Ostlie 12.13

4. Carroll & Ostlie 12.18

5. Carroll & Ostlie 13.6

6. Carroll & Ostlie 13.7

7. Carroll & Ostlie 13.10