AY 5, Summer Session I, 2008:
Measuring the Universe

Due in class, Wednesday, July 23th

Draft: July 14, 2008

Name:
Name(s) of collaborator(s):

This problem set is about making connections between the astrophysics and the equations. There will be no calculations. Just clearly express your logic. Most answers should be brief.

Please feel free to ask for hints and/or clarification. Group work is strongly encouraged, but please identify who your collaborators are; each group member must submit the assignment copied in his/her own writing. Homework must be legible, neat, and stapled.

1. (**16 pt. total**) Blackbody radiation:

   (a) A blackbody is made of what? (**1 pt.**)

   (b) What physical property determines a blackbody's spectrum? (**1 pt.**)

   (c) What two properties can you calculate immediately once you know this physical property? How do you calculate these two properties? (**2 pt.**)

   (d) One of these two properties is fairly easy to observe (*i.e.*, measure). Which one, and how can you measure it? (**4 pt.**)

   (e) What other observation (*i.e.*, measurement) would you have to make in order to calculate the total *luminosity* of the blackbody? (**4 pt.**)

   (f) Name two different astronomical objects that are well-described by the blackbody model. (**4 pt.**)

2. (**22 pt. total**) Stars

   (a) What determines a star's color when it's on the main sequence? (The answer is not "mass." I want something more direct.) (**1 pt.**)

   (b) What is the equation that defines the outward pressure for a star in hydrostatic equilibrium? (**4 pt.**)

   (c) How would you calculate the *maximum lifetime* of a star on the main sequence? What assumptions do you have to make? (Hint: see previous problem sets.) (**6 pt.**)

   (d) What type of spectrum is a stellar spectrum? (**1 pt.**)

   (e) The surface of a star can pulsate in and out. How can you detect this pulsation? (**4 pt.**)

   (f) How can you measure the mass of a star? (**2 pt.**)

   (g) How can you measure the distance to a star in the Milky Way Galaxy? What information would you have to know beforehand? (**4 pt.**)

3. (**10 pt. total**) Miscellaneous astrophysics:

   (a) How would you make a scale model of the galaxies within 10 Mpc of our Milky Way Galaxy? There are two important steps. (**2 pt.**)

   (b) Given a blackbody's temperature, how do you determine in what electromagnetic wavelength band it emits most of its energy? (**3 pt.**)

   (c) If you double the distance between two masses and keep everything else the same, by how much does the force of gravity between the two masses change? (**2 pt.**)

   (d) In the previous scenario, by how much would you have to change one mass and/or both masses to keep the force of gravity the same as before (you doubled the distance)? (**2 pt.**)

   (e) How fast can spacetime move? (**1 pt.**)

4. **Extra Credit:** What can astronomers (and you) learn from electromagnetic radiation? (This has unlimited point possibilities. It just depends on how many correct ideas you enumerate.)