Assignment 1 PHYSICS 8.284
Due 11:04am Wednesday 15 February 2006

- Reading: Mihalas and Binney (on reserve) Chapter 2
- Reading: `http://www.seds.org/~spider/spider/ScholarX/coords.html`

1. The worldwide web has become a major tool for astronomical and astrophysical research. There is a rudimentary homepage for 8.284 located at:

   Visit 3 of the sites listed below (and linked to the 8.284 homepage) and write 100 words about the content (as opposed to the form) of each of them. How much time did you spend doing this part of the assignment?

   Astronomy Picture of the Day
   Hubble Space Telescope Images
   Color Photographs from the Anglo-Australian Observatory
   STScI Digitized Sky Survey: The Whole Sky (gif or fits)
   – print out an image and include it with your problem set
   Falling into a Black Hole (GIF movies)
   The Milky Way Collides with the Andromeda Galaxy 3 Gyr from now (MPEG Movies)
   Webcasts of talks at "Final Years of Hubble" May 2004 (Real Player)
   Animation of real observations of stars orbiting the black hole at the center of the Milky Way.

2. The astronomical "literature" consists of journals, and to a lesser extent, monographs, which until recently were available only on paper. Abstracts for many of these (and in some cases pointers to electronic versions of the the paper) are now available the web. Use the the ADS Abstract Service (linked to the 8.284 home page) to look up one of the following astrophysicists: W. Freedman, M. Geller, R. Kirshner, S. Kulkarni, B. Paczynski, A. Readhead, C. Steidel, or C. Bennett. Try sorting by citation count. Read some of the abstracts you find and write 100 words giving your impression of the kinds astrophysical problems which interest this particular person.

3. Write a computer program to convert galactic longitude and latitude, ℓ and b into right ascension and declination, α and δ (equinox 1950). The necessary equations are:

$$\sin\delta = \cos b \sin(\ell - 33^\circ) \sin 62.^\circ 6 + \sin b \cos 62.^\circ 6$$

$$\cos\delta \ \sin(\alpha - 18^h 49^m) = \cos b \sin(\ell - 33^\circ) \cos 62.^\circ 6 - \sin b \sin 62.^\circ 6$$

$$\cos\delta \cos(\alpha - 18^h 49^m) = \cos b \cos(\ell - 33^\circ).$$

   Check your program on the North and South galactic poles and the galactic center.

4. Draw a graph in which the abscissa is right ascension (with 24 hours at the left and 0 hours at the right) and the ordinate is declination. Plot the galactic equator (a curve) and the galactic poles on this graph. Mark the galactic center.
Use the Digitized Sky Survey name resolver (linked through the 8.284 home page) to "get coordinates" for the following, and plot them all on your graph. Note that since some of them are outside the Milky Way, you may need to use the NED name button rather than the SIMBAD button. (You'll notice that the formulae in problem 3 are for for equinox 1950 but that the name resolver reports 2000. The difference, due to the Earth's precession, will be less than half a degree and can be ignored for this particular problem).

   Sirius (the brightest star)
   Alpha Cen (a nearby bright star)
   Achernar (a bright star you may never have seen)
   Polaris (bright star near the NCP)
   Alnitak, Anilam, Mintaka (stars; Zeta, Epsilon and Delta Ori)
   M 31 (the Andromeda galaxy)
   LMC (the Large Magellanic Cloud)
   SMC (the Small Magellanic Cloud)
   Cyg A (the brightest radio source in the sky)
   Sgr A* (another bright radio source)
   Cen A (a nearby radio galaxy)
   Sco X-1 (the brightest X-ray source)
   Cyg X-1 (a black hole candidate)
   NGC 4594 (a relatively nearby galaxy)
   Abell 1656 (a nearby rich cluster of galaxies)

5. MIThenge (more challenging): There are days on which the Sun sets exactly at the western end of the Infinite Corridor, and is visible from the eastern end.
   a) Use the "sine-sine-cosine-cosine-cosine" formula for the angular distance λ between points 1 and 2 on the sky,

$$\cos(\lambda) = \sin(\delta_1)\sin(\delta_2) + \cos(\delta_1)\cos(\delta_2)\cos(\alpha_1 - \alpha_2)$$

      to determine the i) declination of the Sun on such days and ii) the hour angle of the Sun when this happens. It will help to know that the latitude of MIT is approximately $+42°22'.8$. and that the Infinite Corridor points approximately in the direction $245^{\circ}.47$, slightly south of west. (*Hints*: What is the angular distance from the Sun to the zenith when it sets? What is the angular distance along the horizon from the setting Sun to the meridian on this particular day?)
   b) Assume that the declination of the Sun varies sinusoidally throughout the year. On what date(s) might you expect to see the Sun set at the end of the Infinite Corridor?