Astronomy 830, Autumn 2003, Problem Set 1

Due Wednesday, October 1 in class

Problem 1:

This problem is designed to acquaint you with how to look up basic information on stars. You can ask each other or me for hints on where to look, but otherwise you are on your own. For every quantity you find, please give a complete citation to the publication (catalog, journal article, etc.). If you find the information on a single Web-based source, (e.g., using SIMBAD), cross-check the result, either by consulting the primary reference or other online or print catalogs: do not always rely on a single source (especially if online). Not all answers will be found just using SIMBAD: try other search engines (e.g., Google, ADS, etc.) or, (gasp!) try one of the numerous *printed* catalogs in the Reading Room. Where given by your sources, also state the uncertainties associated.

a) What is the RA and DEC (equinox J2000.0), accurate to ~1", of Barnard's Star? On what date is this the correct position?

b) What is the proper motion and parallax of 61 Cygni (the first star whose parallax was measured by Bessel in 1835)?

c) What is the spectral type and luminosity class of HD209458?

d) What is the *measured* T_{eff} of Rasalgethi? Do not estimate T_{eff} from the cataloged colors or spectral type!

e) What type of variable star is CY Aqr? What are its properties (B magnitude, Period, amplitude of variability at B)?

f) Make a finding chart for Wolf 359, a popular battleground in TV science fiction. Make the finder appropriate to using a CCD with a 10-arcminute field-of-view (you should label the axes and provide a scale to make it useful). What type of star is it? What are its parallax and distance (with uncertainties)?

g) What is the angular separation and position angle on the sky between the two components of the visual binary star Albireo?

h) What are the IRAS flux densities at 12, 25, 60 and 100μm of AFGL 3089? What kind of object is AFGL 3089?

Problem 2:

Capella (α Aur) is a double-lined spectroscopic binary star consisting of a G8III primary and a G1III secondary.

Spectroscopic measurements of its radial velocities (Barlow, Fekel, & Scarfe 1993, PASP, 105, 476) give the radial velocity amplitudes for each component as:

$$K_1 = v_1 \sin i = 26.05 \pm 0.10 \text{ km s}^{-1}$$
$$K_2 = v_2 \sin i = 27.40 \pm 0.30 \text{ km s}^{-1}$$

The radial velocity curves are nearly perfect sinusoids, implying a circular orbit to within the uncertainties.

Interferometric observations with the MkIII interferometer (Hummel et al. 1994, AJ, 107, 1859) give the following orbital parameters:

$$a = 56.47 \pm 0.05 \text{ mas}$$
$$b = 41.42 \pm 0.05 \text{ mas}$$
$$P = 104.0233 \pm 0.0008 \text{ days}$$

Where *a* and *b* are the projected semi-major and semi-minor axes, respectively, and P is the orbital period.

a) Look up the Hipparcos parallax for Capella and its uncertainty. From this and the observed period and semi-major axis, estimate the total mass of the system as if it were just a visual binary (no velocity information) and its formal uncertainty.

b) Assuming a circular orbit based on the radial velocity curves, what is the orbital inclination of the Capella system (convention is i=90° for edge-on)?

c) Compute the masses of the components of Capella in $M_\odot$ and their uncertainties using the radial velocity and orbit measurements above.

d) How do the total masses and their uncertainties compare for the two different estimates?