ASTR469: Homework #2.

Due Jan. 27 at beginning of class.

1. Let's make (and use) a color-magnitude diagram of the Pleides star cluster!
   The goal of this question is to get you to use real astronomical data, and to teach you a little more about the actual application of CMDs. You may use Excel or any other plotting program you have that can make a scatter plot. Let me know if you have trouble finding software to do this.

   First download the data from the website ("pleides_phot.csv"). **It is always a good idea to first look at any data by eye (in this case, use a text editor) to understand what you are working with!**

   Side note: in addition to their spectral type, stars can be classified by their "luminosity class" which ranges I–VI (I are brightest and include supergiants, VI faintest and include sub-dwarfs). The Sun is a G2 V star, which means it's a G-star of a particular mass and luminosity class V. We only want class V here.

   As noted in class, as stars age they leave the main sequence. A young star cluster will therefore have O- and B-type stars, whereas an older star cluster will not. One use of CMD and H-R diagrams is to determine a cluster "turnoff point," which is the magnitude at which stars are leaving the main sequence to become giants. The lifetime of a star at the location of the turnoff point is the age of the cluster. Let's create a plot of the Pleides star cluster to determine the turnoff point and therefore the cluster age!

   (a) (4 pt) Make a CMD plot of the Pleides members, with labelled axes, using the apparent V-band magnitude and the $B-V$ color (note: make sure to plot it so the hotter stars are on the left and brighter stars are on the top).

   (b) (1 pt) What is the apparent V-band magnitidue of the turnoff?

   (c) (2 pt) The Pleides is 120 pc away. Derive the absolute V-band magnitude of the turnoff.

   (d) (3 pt) The lifetime of stars t is proportional to stellar luminosity as approximately $t \propto L^{-2.5}$. Given the absolute magnitude of the turnoff, $M_V = 4.8$ for the Sun, and the Solar lifetime of 10^{10} years, how old is the Pleides star cluster?

2. Airmass!

   (a) (2 pt) What airmass does your sight line traverse for observations at an angle 30° above your horizon?

   (b) (3 pt) Now imagine that you have two stars, one observed at 30° elevation, and one observed $10'$ more toward the zenith. What is the difference in extinction (in magnitudes) due to our atmosphere for these two stars, assuming an extinction coefficient of $k = 0.14$ magnitudes per air mass?

(c) (2 pt) For the same two stars, what is the percentage decrease in flux using the two values of extinction?

3. A few (hopefully easy!) questions on positions...

(a) (2 pt) From Morgantown, what declinations are visible?

(b) (3 pt) From Morgantown, for how many hours in any given 24-hour period is a source of $\delta = -10°$ visible?

(c) (1 pt each) The HEASARC online coordinate converter is an excellent tool that you should become familiar with. Using this tool (available on https://heasarc.gsfc.nasa.gov/cgi-bin/Tools/convcoord/convcoord.pl , answer the following:

i. What is the RA and Dec of the Galactic center in J2000 coordinates?

ii. What is the Galactic latitude and longitude (l, b) of the J2000 north pole?

iii. With a big dark X, mark the J2000 north pole position on this map of the sky (which shows the rough span of the Galactic plane at optical wavelengths in grey). Remember that latitudes range from –90 to +90 (either use the printed assignment or roughly reproduce this figure):