Astronomy 205:
Assignment 3: Due February 15 2019
Analyzing Data on a Binary Star

In the files for this assignment you are given photometric data in the V-band (ass3_unknown_pht.txt) and radial velocity data (ass3_unknown_vel.txt) for a real eclipsing binary star system. The two stars are not individually visible so they appear as a single star on the sky. The distance to the system is about 1.82 kpc.

The photometry file lists the date the observations were taken (in Julian Days), the V magnitude of the system (column 2), and the photometric error (column 3).

(1) The first thing you need to do is to try and derive the period of the system. To do this, use the unknown_pht.txt file, as there are many observations available. The trick here is to find the period that phases the data correctly. To do this, examine the primary and secondary eclipses near JD53108. The time between the two minima here is exactly half the full period. If you have phased the full data set correctly, it will look like the image in the lower left on slide 5 in the slide set on stellar radii. You will need to be precise as possible in determining the half-period – to at least the 4th decimal place - in order to have the data phased accurately enough. When you plot just the data near JD53108, plotting enough to show both the primary and secondary eclipses, measure the half period in days as accurately as possible. Then iterate about this solution in units of ten-thousandths, hundred-thousandths, and eventually millionths of a day, plotting the full phased data set each time until you get the best plot. This will exhibit just the primary and secondary eclipses, some time when the stars are separated so the flux is constant, and no blurry sections.

Here is a short bit of python code to help you fold the data.

```
T = ???       # period (start with your estimation at JD53108)
phase = t / T  # divide time (JD) by period to convert to phase
phase = phase % 1  # take fractional part of phase only (i.e.
discard whole number part)
```

If you are having difficulties here contact Ronan. Plot the full photometry data set properly phased.

(2) The velocity file lists the day of the observation (JD=Julian Day – probably you won't need this), the radial velocity of the primary and secondary stars (in km per second) and the phase of the observation. The phase in this file runs from -0.5 to +0.5. Since you will use the two files (radial velocity and photometry) independently, it does not matter that the phases do not align. Plot velocity versus phase of the observation. Note that there are a few flagged velocity values for the secondary component (999.99 km/s). These are not real but the result of poor photometry, and should be excluded from your figures

(3) Beyond this, I am not going to tell you what to do in detail with these data other than that you should derive as complete parameters for the system as you can, but AT LEAST the velocities of the two stars in their orbit, their masses, their radii, the shape of the orbit, the centre of mass velocity of the system and the semi-major axes of the orbits of the two components. Be sure to make lots of plots and include your code so that we can clearly judge what you are doing.

(4) After the assignment is handed-in I will reveal the name of the binary system and provide a reference so that you can see how your results compare with that of the experts.