Assignment 5: Radial Velocities

Due: Mar. 21
Value: 5%

On this assignment, we'll practice using the tasks in the NOAO.RV package.

1 Data

Several spectra of GJ 1108A and GJ1108B, a system of M dwarfs, were taken at the DDO over several months. If you have not already downloaded these data, you should obtain a copy from $ungrad00@ungrad :\sim /feb28$.

2 Tasks

2.1 Part 1

The task noao.rv.rvcorr can be used to compute values for heliocentric corrections by hand (rather than hidden inside another task). Compute the various components of the heliocentric corrections, for the StarA spectra, and put them in a table. Then, plot the components of the correction as a function of Heliocentric Julian Date: $v_{diurnal}$, v_{lunar}, and v_{annual}. Also, plot the total correction v_{Helio}.

Calculate roughly how much difference you might expect between a barycentric correction (correction to the centre of mass of the solar system) and the heliocentric correction. How does this compare to the accuracy of IRAF's heliocentric corrections? Would you need to do a full barycentric correction if you were doing a radial velocity search for extrasolar planets?

2.2 Part 2

Choose a high signal-to-noise spectrum of StarA as a template spectrum. Use noao.rv.fxcor to measure the radial velocities of all the StarA spectra relative to this template, but define the spectrum sample regions so that you correlate the Hα emission line only. Graphically compare these radial velocities you measure with the radial velocities that you measured for homework using the TFF01 spectrum as the template. How do the accuracy and estimated errorbars compare? Why? What task parameters did you use to get the best correlation peak? Did you have to modify the VHELIO header value at all for the template spectrum you chose? If so, how and why?

2.3 Part 3

The StarB directory contains spectra of the second component of this visual binary, but StarB happens to be a double-lined spectroscopic M-dwarf binary. So, if you apply fxcor to the StarB spectra, you should see two main cross-correlation peaks, each one corresponding to the radial velocity of one of the components. Use fxcor to derive the radial velocities of the two components of each of the StarB spectra. You will need to use the deblending option "d" to define the fitting region and background level upon which to fit the two cross-correlation peaks. Mark the cross-correlation peaks to be fit, choose an appopriate multi-peak fitting algorithm, and save the computed radial velocities, along with sample plots showing your best and worst final multi-peak fits. Please report the parameters you used and choices you made to do the deblending. If you noticed that particular choices gave you strange or bad results, say why you think that might be.

Tabulate and plot the radial velocities of the stars as a function of Heliocentric Julian Date. What is the period of this spectroscopic binary? Once you know the period of the binary, convert the times to phases and plot the radial velocities as a function of orbital phase.