Physics 162
Exercise: 1
Hubble's Law

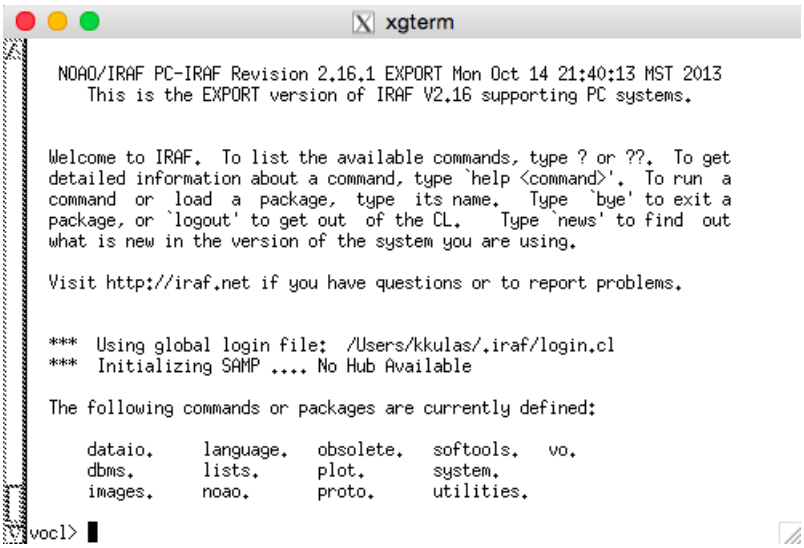
IRAF Instructions:
To complete this exercise you will need to use a program called IRAF (Image Reduction and Analysis Facility) which is a software system for the reduction and analysis of astronomical data. IRAF has been installed on the computers in the computer lab in Alumni Sciences 256. You will be given access to this computer with the strict understanding that you will not bring in any food, drink, or skateboards. Failure to meet these rules can result in an immediate and permanent ban from the computer lab.
You can also download and install IRAF on your personal computer if you have a computer that runs Mac OS X or Linux. Download the software here: http://iraf.noao.edu/. Follow the instructions provided on Camino. Please feel free to ask me any questions about the installation process.

Procedure:

1. To run IRAF open up an xgterm. On the command line change directories to where IRAF is installed.

> cd iraf/iraf/

2. Type "cl" on the command line to start IRAF. You should see something like what is shown below if it started correctly.



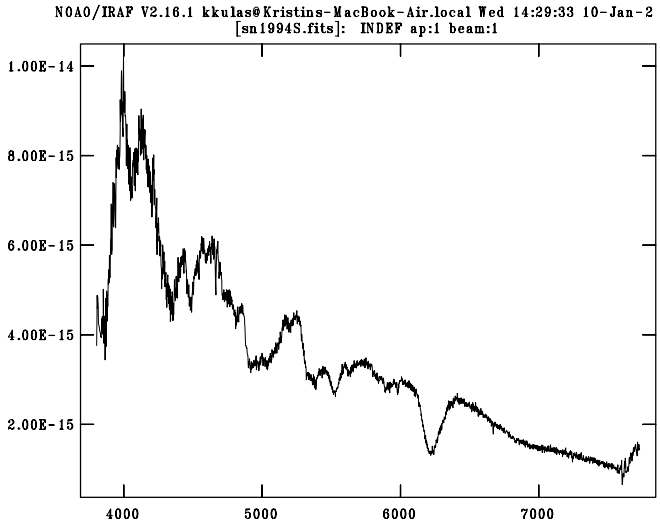
3. Change directories to where the spectra are. For example:

> cd ../../kkulas/spectra

4. To view the spectra you will use the **splot** command. Once you are in the folder that contains a spectrum (for example n1994S) you wish to examine type:

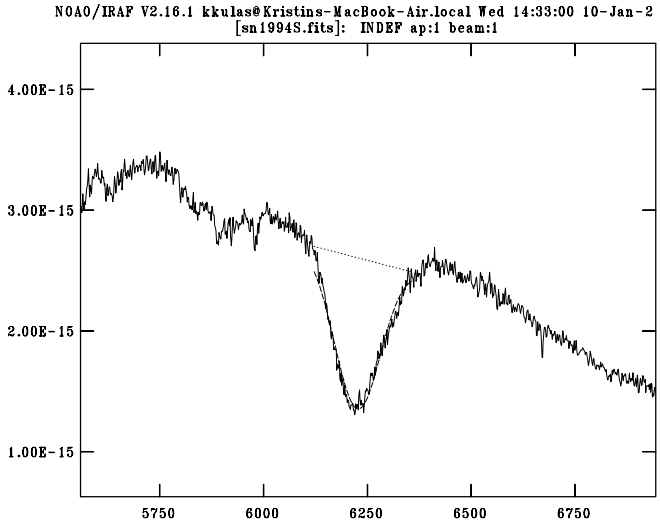
> splot sn1994S.fits

and then you should see the spectrum like shown below. The x axis is in wavelength in units of angstroms while the y axis is flux.



5. You will want to zoom in on the Si II feature. To do so put you cursor near the bottom left of the Si II feature and type ‘w’ ‘e’. Then move your cursor to the top right of the feature and type ‘e’. If you zoom into the wrong area type ‘w’ ‘m’ ‘w’ ‘n’.

6. To fit a gaussian to the Si II absorption line put your cursor at the top left of the absorption line and type ‘k’. Then put your cursor at the top right of the absorption line and type ‘k’ again. You should now see a red fit to the line and at the bottom of the screen you will see measured parameters from this fit. Record the “center” value in a table for each object. Below shows an image of what the fit should look like (in black and white).



7. From the measured “center” value and the real value for Si II calculate the redshift and velocity for each object and record the values.