Assignment 4: Spectroscopic Preprocessing and Wavelength Calibration

Due: Feb. 14

Value: 5%

This assignment will give you some practice calibrating spectra taken with the 16" telescope.

1 Data

On the night of Jan. 22, I collected several one-minute long test exposures using the current setup of the spectrograph plus 16" telescope. You should download a copy of these data, along with the night log, from $ungrad00@ungrad :\sim /SBIGspectra2006S/22jan2006$.

2 Procedure

2.1 Preprocessing

When you read the night log file, README_nightlog.txt, you will see that I collected several biases, darks, domeflats, and skyflats. Please use these calibration images to preprocess your data using IRAF. There is no overscan region, and there are no milky flats. Remember that this is spectroscopy, and you will have to use the special spectroscopic flatfielding procedures.

Please set your parameters to combine the images by taking the median. Since combining by median will eliminate cosmic rays for you, you can set crreject=none.

You will notice in the domeflats that our spectrograph has a bright band around columns 210-290. You will need to make sure you fit the response function with a sufficiently high order polynomial to divide out this feature. Don't choose a higher order than you need, though, since a very high order fit will begin to pick up on noise features.

You should be able to use quite a low order fit to derive the illumination (slit) function. However, you will need to be selective in defining the fitting region, since there is a sharp dropoff near the edge of the chip (read up on how to use the "t" and "s" keys in the interactive curve fitting mode).

In your assignment, please exhibit your master bias, master dark, master domeflat, master skyflat, domeflat with response function divided out, illumination function, and final superflat. Use appropriate scaling to show the important features of these calibration images. Use cut plots across the images if appropriate. Also, include the results of running imstatistics on these images. Show an object image raw and after processing.

Also, you may wish to investigate the difference between using the cloudy dayflats and the twilight skyflats. Comment on the features you see when you take a skyflat.

2.2 Wavelength Calibration

Do a wavelength calibration and extraction of the spectra of Capella. These are images 104-109. The relevant comparison lamp spectra you may wish to use are 101-103 and 110-112.

Perform the reduction in two ways. Do it using the ONEDSPEC package (extraction first, then calibration). Then do it using the TWODSPEC package (calibration first, then extraction). Describe how you did your reduction (in particular, comment on any parameter settings you had to tweak to get a good reduction). You will want to use imcombine to create a master arc spectrum for the TWODSPEC analysis. You will probably want to use the 16" line atlas off the web when you identify the lines, paired with one of the henear line libraries that IRAF provides to do automatic identification of your Ne lamp lines.

In each final spectrum, measure the centroid and FWHM of the Hα 6563Å line. You may use splot to make your measurements. Print out examples of your final spectra and indicate which lines you measured. Make a plot of the centroids and FWHMs as a function of time. Can you quantify how stable/precise/accurate the spectrograph was over this short run? Are there any effects in these plots which are not due to instrumental or reduction uncertainties (if so, estimate their contributions)? Are there differences between your final results as performed using ONEDSPEC versus TWODSPEC? Which way is better for use on our spectrograph data? Why?

I took some of the Capella spectra with arc lines superposed. Measure the centroids and FWHMs of a couple of strong arc lines, and again, plot them as a function of time and comment on the stability, precision, and accuracy of the spectrograph. Try self-calibrating the spectra with superposed arcs (i.e., use the object spectrum itself as the master arc spectrum). How stable is this simultaneous calibration? Can you think of a way to do a simultaneous wavelength calibration without having to turn on our comparison lamp?