

## Astronomy 350: Unix Lab III: Data Reduction with SCC data

- Note in what follows don't type the `<>` brackets.
- Login to the moxie lab and from there login to the machine 129.3.1.55 using `ssh -X -l <username> 129.3.1.55`.
- Now open up some "xterms" using the command `xterm&` from your command line.
- Now you can go on to take a look at the images we got at SCC.
- If you had already started this from last time, delete those files using the unix command `rm`. If you are in the SCC directory, type `rm -r *` to delete the files.
- They are in the directory `shashi/SCC`, sorted by date. Copy them over and take a look. Use a command like `cp -r ~/shashi/SCC .` The dot at the end in the above command is important. What does the `-r` do (use `man cp` or look it up on the web)?
- The files all have a `*.FIT` extension. the IRAF program likes to have files with a `.fits` extension. We are going to use the command `mv` to do this. Find out a bit about `mv`.
- Look up on google using a search term like "renaming multiple files in unix". Go to the link with the Debian administration url and read it.
  - Type `echo $SHELL`. What does it say?
  - Type `bash` and then type `echo $SHELL` again: what does it say?
  - Go into the 9-10-08 directory. Do an `ls`, you should see many files with the `*.FIT` extension.
  - Type: `for i in *.FIT; do echo $i; done`
  - Describe what happens and describe what this command does. What does the `$i` refer to it this?
  - This is an example of a shell script and is very common in more advanced Unix computing.
  - Now type, and be very careful about typing this correctly:  
`for i in *.FIT; do mv "$i" "${i/.FIT}" .fits; done`  
and describe what has happened and the shell script above.
  - Your `*.FIT` files should now be `*.fits` files.
  - Type `exit` to exit the bash shell.

- Now you are ready to do a very simple data reduction exercise. We are going to use the data from the first night, make a master bias and subtract this from all the images, then make a master dark and subtract this from all the science images.
  - cd into the directory that contains the data for the 9-10-08.
  - Type mkiraf and answer the following question with xterm.
  - Now start up a ds9 in the background with ds9&. Click ok if needed.
  - Type ls \*.BIAS.\* What happens?
  - Type ls \*.BIAS.\* > biasfiles and look at the file biasfiles. What has happened?
  - Take a look at some of these biasfiles using display in ds9. Use imstat to get some statistical details about the bias files. Note these down. Can you find a quick way to do imstat on all the Bias files?
  - Now start up IRAF using cl.
  - The command imcombine can be used to combine a bunch of fits files into a master. Typ epar imcombine.
  - For the input file, type biasfiles.
  - For the output file type mbias.fits.
  - The combine parameter should say average.
  - Now type "shift, colon, go". Display the fits file mbias.fits. What has happened? Use imstat to compare mbias.fits and the original bias files. Note down the stats details.
  - Now exit IRAF by typing logout.
  - Now create another file, called imagefiles, which contains the files \*NOAUTODARK\* and \*.DARK.fits: that is the science images with no autodark subtraction and the dark fits files. Make a copy of this file with cp called imagefilesa.
  - Use vi or another editor to edit the file imagefilesa such that instead of being \*.fits its \*.a.fits.
  - Now begin IRAF with cl again.
  - Use epar imarith to subtract the master bias files from all other files. For the input list in epar imarith put imagefiles, the operand is -, the second operand is mbias.fits, the outfile is imagefilesa. After you run it, what has happened? Use imstat to make sure some things have changed and note down some of the statistics.
  - So now you have subtracted the master bias from all the images. Logout of IRAF.

- Now create a master dark from the existing dark images, that is those images with \*.DARK.fits.
- Create a file of images from outside IRAF: use `ls *.DARK.fits > dark-files`.
- In IRAF use `imcombine` to create a master dark using similar methods to what you used above to make the master bias.
- Put the master dark in a file called `mdark.fits` and use `imstat` to compare its statistical properties with the original darks. Note these down.
- Now outside of IRAF, create a file containing a list of all the science images and use the above methods to subtract the master dark from all these science images - but use the method above to make sure that the originals are not overwritten.
- Compare the statistical properties of the final, reduced science images with the original raw images. Note these down. There should be some, though not a great deal of difference.
- Try to save some of the fits images as pdfs or jpgs from the `ds9` program and append these to your output.
- Repeat for the other 2 nights of observations.
- In `imcombine` you used the average as a means of combining the darks and biases. Investigate if there are any differences if you use a median combine.