

Lab 9 -Stellar Spectra using SGS Spectrograph

Purpose

In this experiment we become familiar with the SBIG SGS Spectrograph and ST-7XME-S CCD camera combination, to gather spectra of stars for later analysis.

http://www.sbig.com/site/assets/files/18237/sgs_manual3.pdf

This includes taking calibration spectra, to identify known wavelengths of a particular light source such as neon. Once calibration measurements are established, we can identify and study Balmer lines in our spectra, and measure radial velocities in Lab 10.

http://en.wikipedia.org/wiki/Balmer_series

The SGS is normally set up (bench tested) to center the strong H-alpha (hydrogen) line <http://en.wikipedia.org/wiki/H-alpha> located at 6562 angstroms, (10^{-10} meters).

Imaging techniques learned in **Section I** are employed, including telescope control, guiding, and image acquisition.

Procedure

Using TheSky6, prepare a list of 3-5 bright stars of varying spectral types currently in the sky. They should be 1st to 4th magnitude and at least 30 degrees above the horizon during class time.

Power on the telescope mount and CCD camera, sync to the sky, focus the image (see below), and calibrate the autoguider. The SGS light path places objects on the imaging chip and guide chip, simultaneously. Starlight passes through the telescope optics then through a slit in the spectrograph. A reflective diffraction grating then splits the incoming light into a spectrum, which is focused onto the CCD, and recorded.

For focusing the spectrograph use the guide chip, binned 1x1. Draw a square (subframe) with left-click mouse, around the star. Under **Focus Tools**, set exposure to 1 second, continuous, and start imaging.

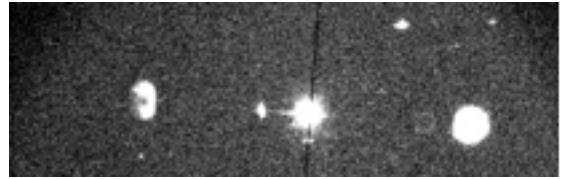
Note the star's ADU count in the CCDSoft Autoguider window at bottom, and the shape of the star. To establish SGS focus: with a vertical egg-shaped star, turn the telescope focus knob counter clockwise to focus. Watch for the maximum ADU count, (strongest signal) in the autoguider window and a round star. Focusing involves using the telescope and computer simultaneously, and is best done with a partner.

The SGS is now ready to take data.

Slew to, and position your target star on the guide chip.

The target star will appear centered between 2 reflections (from inside the spectrograph) in the field of view. The guide chip will be used for positioning the target, and for autoguiding. The imaging chip will be used to take the spectra.

Position the target star, centered on the slit, using the **NSEW** buttons in the Motion Control window in TheSky6. The slit appears in the image as a thin dark line running top to bottom. Autoguiding is performed on the target star.



Target star centered on the slit. CCDSoft.

Initiate autoguiding and confirm X and Y errors below 1.0. In CCDSoft **Autosave**, create a desktop folder for your data called Star Name (or catalog number), Date, Your Name. (i.e. Mirfak 031614 Ali) Turn **Autosave** on. In the take image tab, under **Prefix**, list only the spectral type of your target. (i.e. "A3") CCDSoft automatically adds the star name or catalog number to the .fits image header for later identification

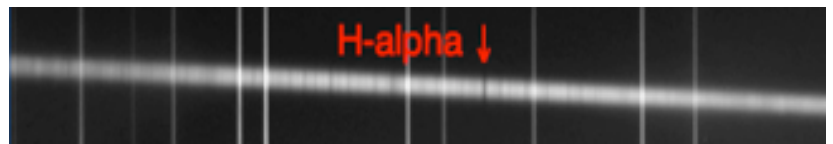
Take a 5 minute exposure on the imaging chip. The raw image appears as a long thin spectrum, and is saved in your folder.

Next, we'll take another 5 minute exposure that will include calibration spectra (to be used in Lab 10) in the image. Under **Autosave_Prefix**, type "cal" after the spectral type, to identify this as the calibration spectra. (i.e. A3cal)

The SGS has an opal diffuser on the bottom, for taking calibration spectra. We will use a neon gas lamp to take the calibration spectra. The neon lamp shows emission lines http://en.wikipedia.org/wiki/Emission_spectrum at known wavelengths, allowing us to then identify features in the target star's spectrum.

With a partner running the imager, begin the 5-minute exposure, then hold the neon lamp to the glass diffuser for about 60 seconds, approximately half way through the 300 second exposure.

The resulting image shows neon's vertical emission lines, along with the horizontal star spectra. These neon calibration lines will be identified in Experiment 2.



SGS image with vertical neon calibration lines. H-alpha shown. (CCDSOFT)

Your folder now contains 2 images, one stellar spectra, and one calibration spectra. Repeat this procedure for other stars on your list. These images are now ready for processing and analysis with Vspec, in Lab 10.