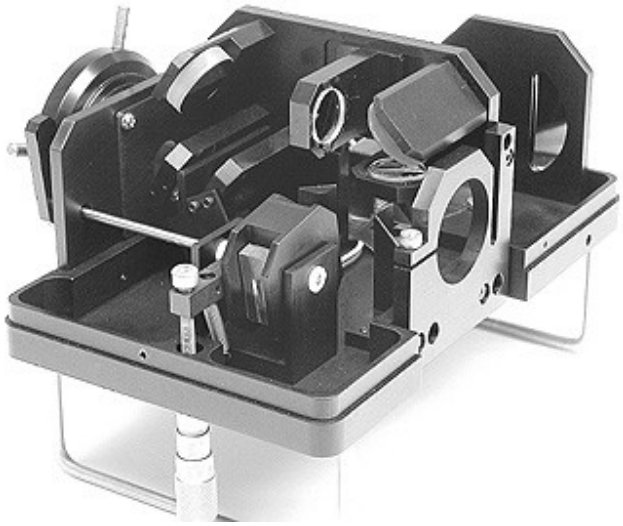
MODEL SGS
SELF-GUIDING SPECTROGRAPH



The Self-Guiding Spectrograph is designed to be used with an ST-7E camera. Although it can also be used with an ST-8E, there is no advantage in bandwidth when using the larger format camera. The spectrometer and ST-7/8 are coupled and mounted as a unit onto the telescope (See Figure 1). The system is quite handy for collecting spectra since both the object of interest and the spectrometer entrance slit are simultaneously imaged onto the tracking CCD, allowing the object to be viewed and accurately placed onto the slit. The slit is backlit by an LED during the setup so it clearly shows on the tracking CCD. Once the object is maneuvered onto the slit, self guiding will then hold the object on the slit.

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Overview of SBIG's Self-Guided Spectrograph Capabilities	
Measure Stellar Spectra: - Determine spectral class - Measure radial velocities	Figures 2, 3, 9, 10
Measure Emission Nebula:	Figures

- Determine spectral lines - Measure relative line strengths	4, 5
Measure Galactic Objects: - Measure radial velocity (red shift) of brighter galaxies - Distinguish quasars from other objects	Figures 6, 7, 8

Identify Stellar Spectral Class

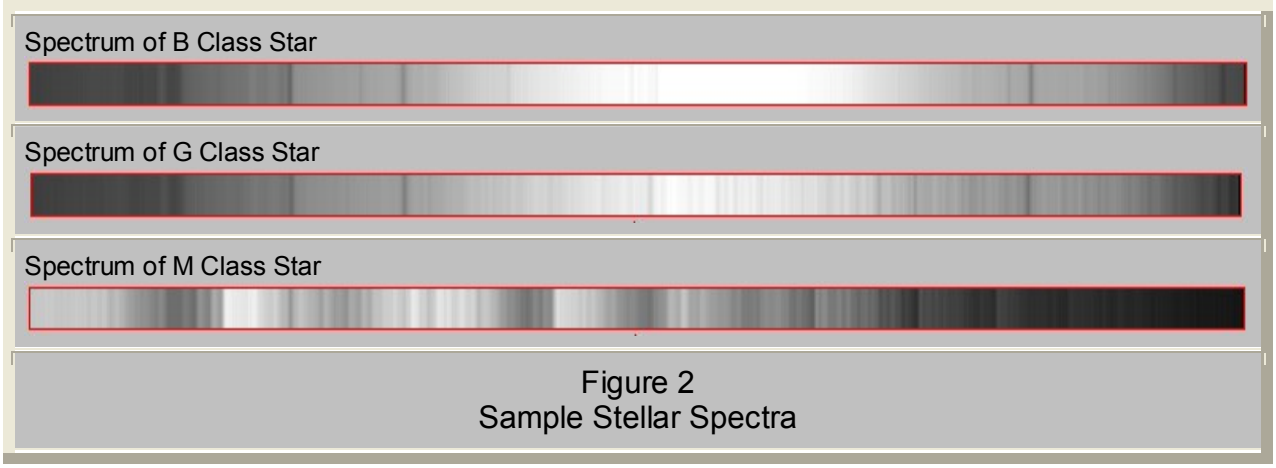

Figure 2
Sample Stellar Spectra

Measure Stellar Radial Velocities

Stellar Radial Velocity of Selected Stars Measured to +/- 6 km/sec with 8" SCT		
Star	km/sec*	If you face the celestial equator, straight south at sunset, you are looking BEHIND the earth in orbit (the wind is against your back)!
ATAU1	88	
ATAU2	88	
ATAU3	95	
AORI1	54	
AORI2	51	
AORI3	56	

GLEO1	-15
GLEO2	-30
GLEO3	-14
* Uncorrected for earth's orbital velocity	

Measure Emission Nebula

The spectra of M57 below was obtained using the low resolution grating and the narrow slit:

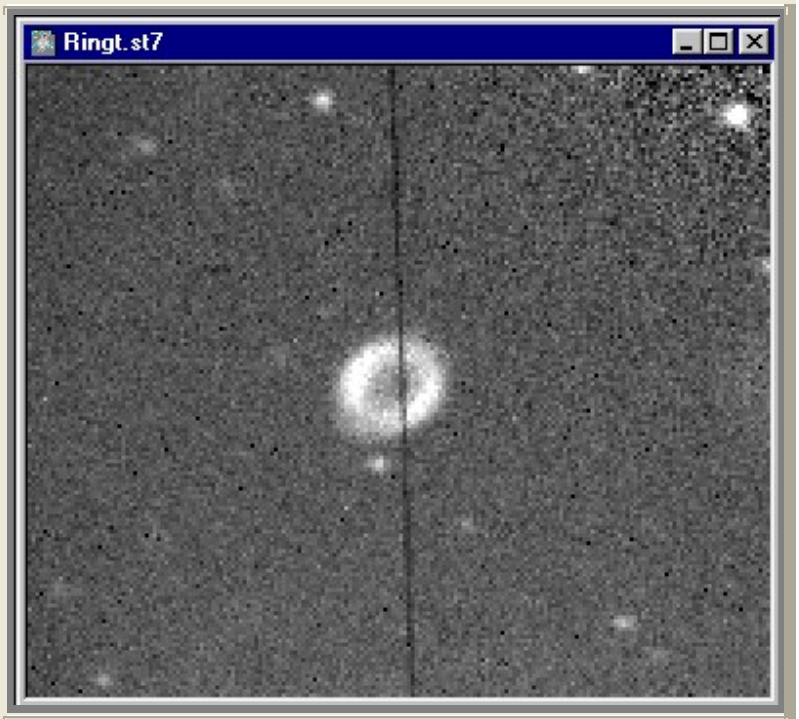

Figure 4

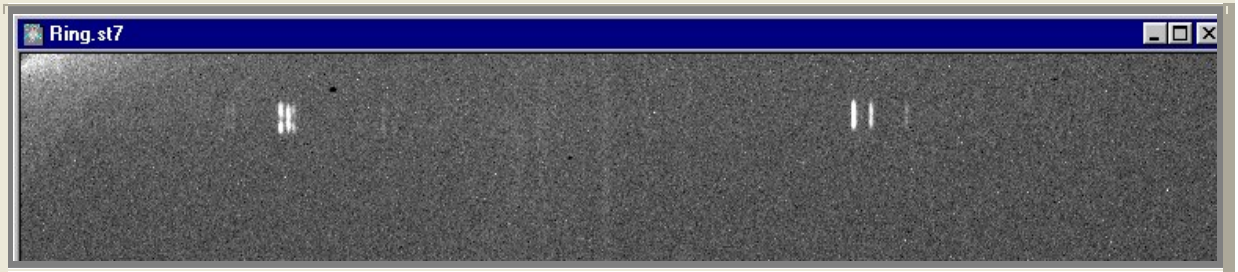

Figure 5

The top image (Figure 4) is a screen shot showing the view of the tracking CCD displaying the
slit and the object (M57) simultaneously. The lower image (Figure 5) is a screen shot showing the
view of the imaging CCD with emission lines from M57.

Measure Galactic Objects and Distinguish Quasars

The self-guiding feature of the ST-7/8 camera makes taking long exposures relatively painless and helps to keep the object centered on the slit for extended periods of time. This technique is necessary if one attempts to measure the red shifts of galaxies of emission lines of quasars. The samples below of M104 show the red shift of the galaxy relative to the star Mu UMA:

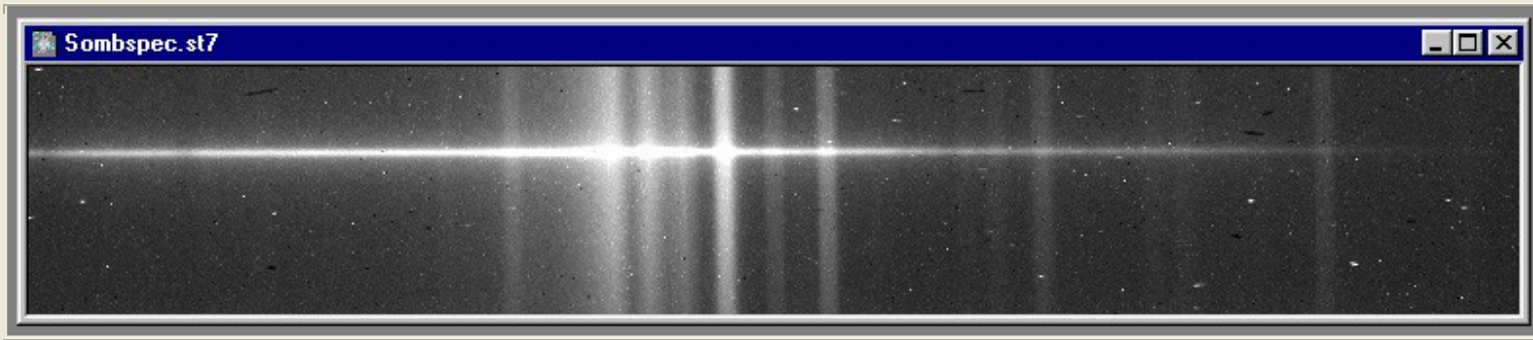

Figure 6
Screen shot of spectrum obtained of M104, The Sombrero Galaxy
(The many small white spots are cosmic ray hits)

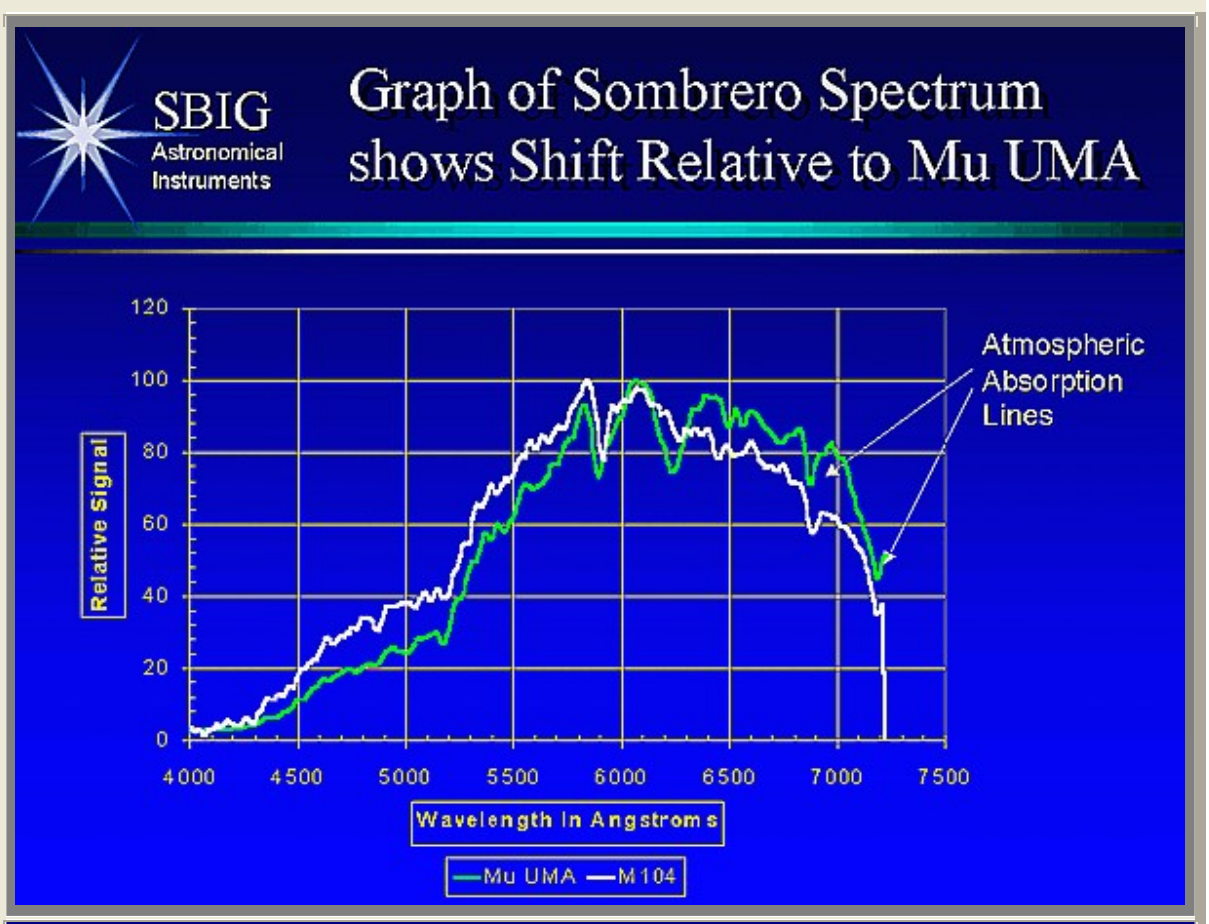

Figure 7
Graph showing the measured red shift of M104 relative to Mu UMA

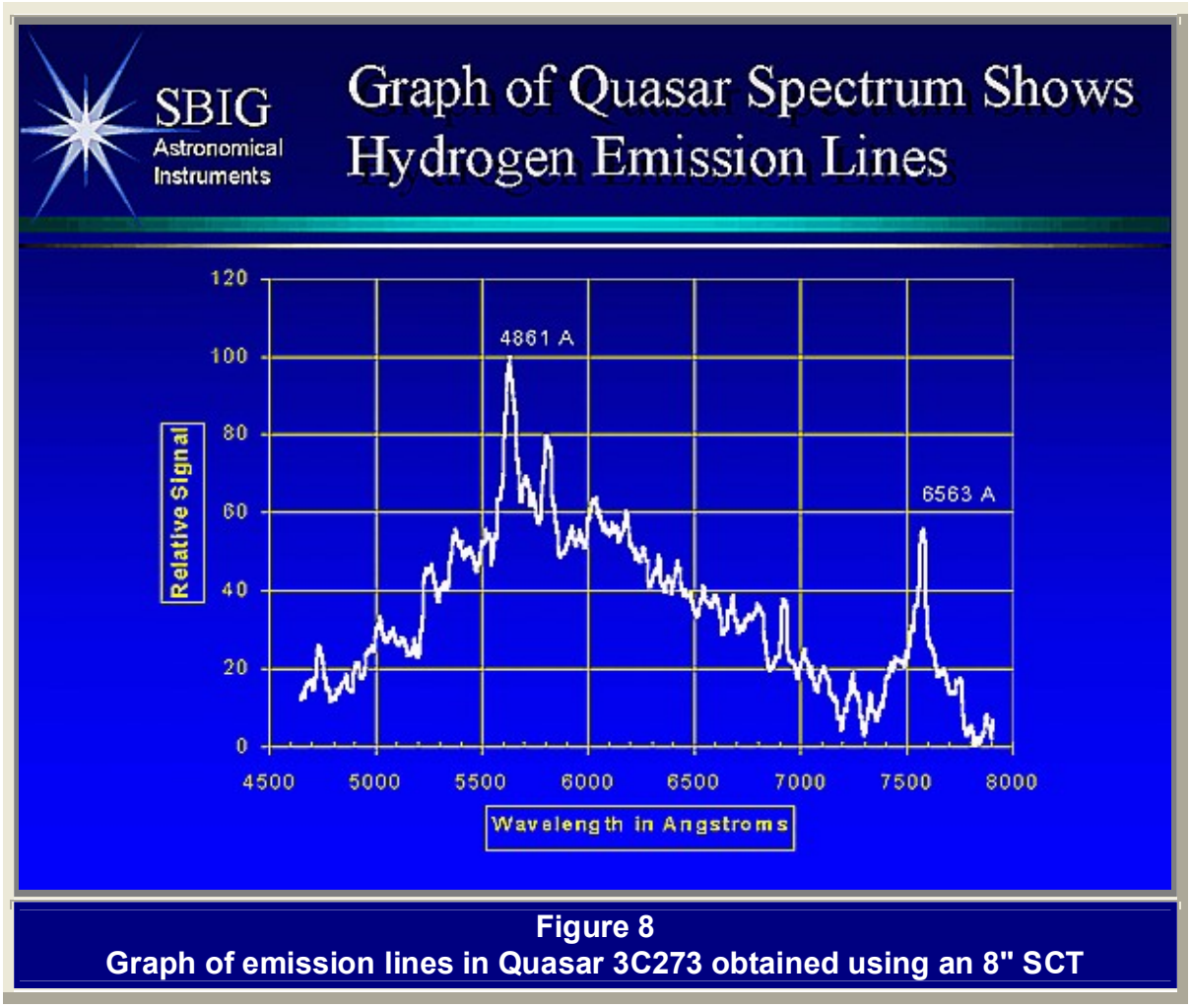

Figure 8
Graph of emission lines in Quasar 3C273 obtained using an 8" SCT

Obtain High Resolution Spectra

Using the high resolution grating and the narrow slit the spectrograph is capable of resolving narrowly separated lines. The sodium doublet lines in Figure 9 below are easily separated although they are only 6 angstroms apart. The magnesium lines in the three stars shown in Figure 10 are separated by only 5.4 angstroms.

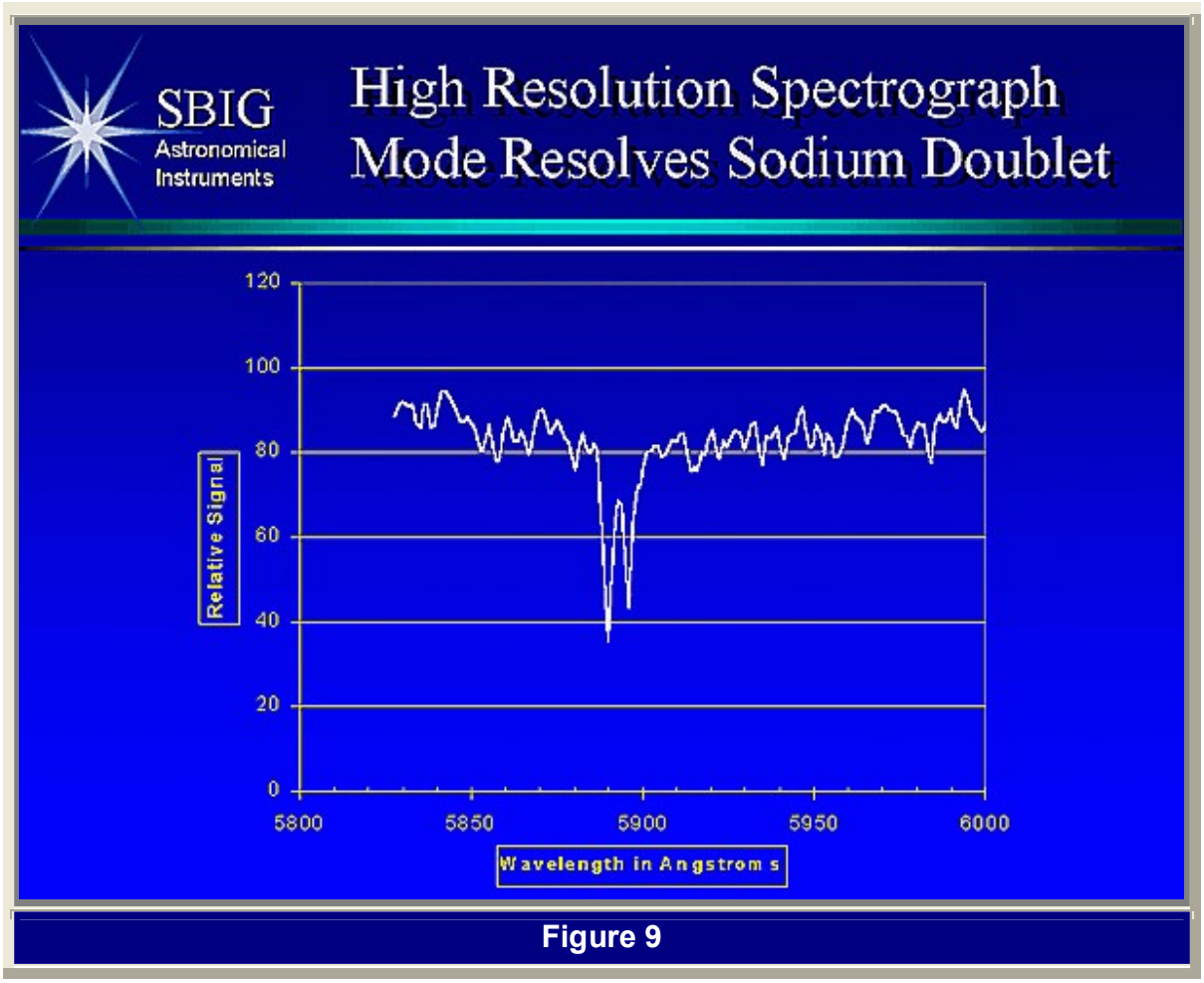
SBIG
Astronomical
Instruments
High Resolution Spectrograph
Mode Resolves Sodium Doublet
120
100
80
60
40
20
0
Relative Signal
5800
5850
5900
5950
6000
Wavelength in Angstroms

Figure 9

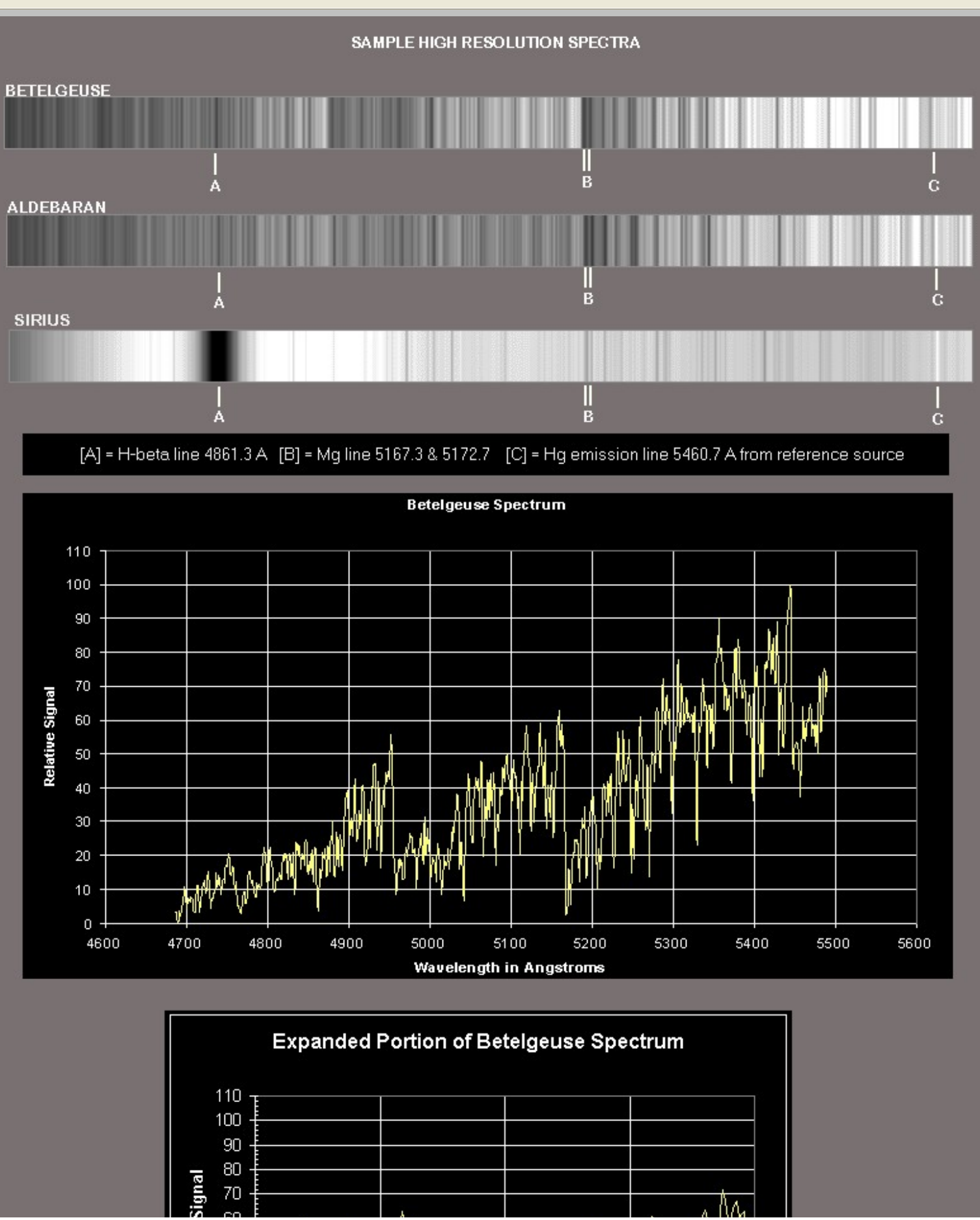
SAMPLE HIGH RESOLUTION SPECTRA
BETELGEUSE
A
B
C
ALDEBARAN
A
B
C
SIRIUS
A
B
C
[A] = H-beta line 4861.3 A [B] = Mg line 5167.3 & 5172.7 [C] = Hg emission line 5460.7 A from reference source
Betelgeuse Spectrum
Relative Signal
110
100
90
80
70
60
50
40
30
20
10
0
4600
4700
4800
4900
5000
5100
5200
5300
5400
5500
5600
Wavelength in Angstroms
Expanded Portion of Betelgeuse Spectrum
Signal
110
100
90
80
70

Figure 10
Spectra of Several Bright Stars Captured with a Prototype SBIG Spectrometer on 2/3/98
Parameters: Telescope: 10 inch LX200 F/6.3, Exposure: 120 seconds

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Acquisition and Analysis Software Included

The spectrograph is provided with a special version of CCDOPS for data acquisition and SBIG's Spectral Calibration Program for analysis. These programs make the spectrograph immediately useable as an analytical instrument without the need for the user to write or obtain third party software.

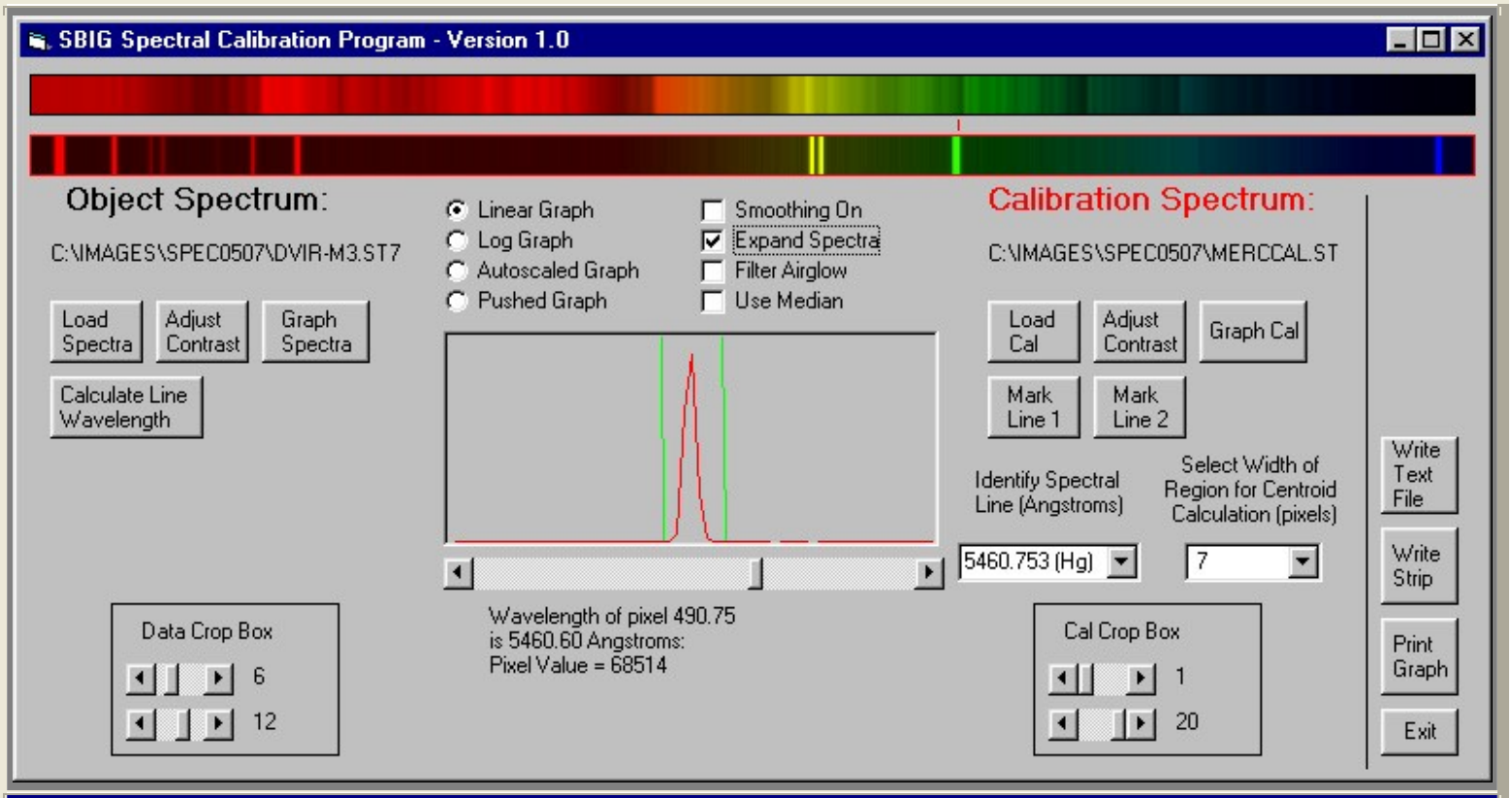

Figure 11
Screen shot of the Spectral Calibration Program supplied with the spectrograph

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Optical Specifications

Dispersion:	
Two gratings are available, on a carousel for rapid selection - 150 lines per mm (4.3 Angstroms per pixel) - 600 lines per mm (1.0 Angstroms per pixel)	
Slit Width Interchangeable slits are included 18 microns wide (2 arcseconds at 80 inch focal length) Best for stellar work 72 microns wide (8 arcseconds at 80 inch focal length) Best for galaxies	
Acceptance cone angle: F/6.3 by F/10	
Resolution:	
Narrow slit & 600 lines/mm	2.4 Angstroms
Narrow slit & 150 lines/mm	10 Angstroms
Wide slit & 600 lines/mm	10 Angstroms
Wide slit & 150 lines/mm	38 Angstroms
Relative Sensitivity to Diffuse Sources:	
Narrow slit & 600 lines/mm	1.0
Narrow slit & 150 lines/mm	4.0
Wide slit & 600 lines/mm	4.0
Wide slit & 150 lines/mm	16.0

General Specifications

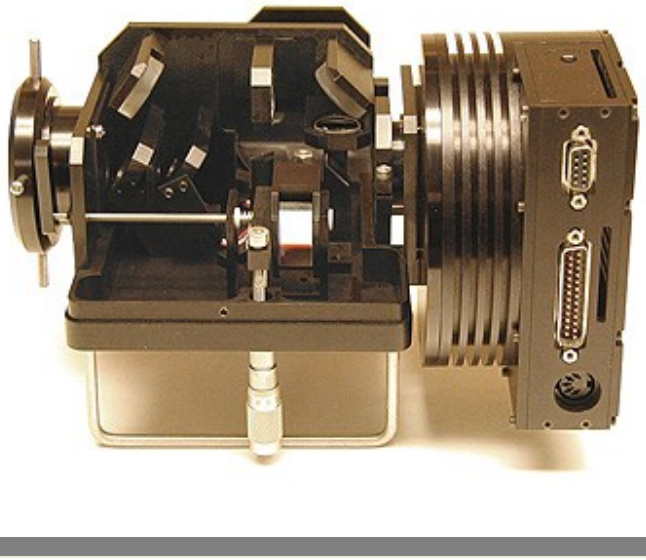

Figure 12
SBIG Spectrograph shown attached to an ST-7E

Description: The spectrometer is designed to operate with the ST-7/8. The object that is to be analyzed is viewed on the tracking CCD, simultaneously with the slit. The slit is backlit by an LED during setup to render it clearly visible on the tracking CCD. The object is manually maneuvered onto the slit using the telescope controls, and is held there using SELF GUIDING during a long exposure. The spectra is recorded by the imaging CCD, oriented long-ways so the spectra falls across 763 pixels, with a height of about 16 pixels for stellar sources. Two gratings and two slits are available for maximum versatility. The standard grating, 150 rulings per mm, gives a dispersion of 4.3 angstroms per pixel, and allows the user to capture the entire interesting range from the calcium H and K lines to H-Alpha with a single exposure. Depending on the slit size, the resolution will be 10 or 38 angstroms per pixel. An interchangeable high resolution grating can also be used that gives 1.07 angstrom per pixel dispersion, with a resolution of about 2.4 angstroms when used with the narrow slit. The spectral range is smaller, being only about 75 angstroms. This resolution is adequate to detect the Doppler shift due to the earth's motion around the sun when carefully calibrated, and detect spectroscopic binaries.

Dispersion: 1.07 or 4.3 Angstroms per pixel

Resolution: emission line is recorded with 2.4, 10 or 38 Angstroms Full Width at Half Maximum

Spectral coverage per frame: about 750 Angstroms with the high resolution grating, or 3200 with the low resolution grating

Center Wavelength Selection: Calibrated Micrometer Adjustment

Wavelength Range: 3800 to 7500 Angstroms

Sensitivity: Signal to noise ratio of 10:1 for a 9^{th} Mag star, 20 minute exposure using a non-ABG ST-7 and a 10 inch (25 cm) aperture in high resolution mode. An ABG ST-7 will reach magnitude 8. The low resolution mode will be 1.5 magnitudes more sensitive.

Entrance Slit: 18 micron (2.3 arcseconds wide with 63 inch focal length telescope) or 72 microns.

Dimensions: 3 x 4 x 7 inches (7.5 x 10 x 18 cm)

Weight: 3 pounds (with ST-7 head attached)

Uses: Stellar Classification
Analysis of Nebular Lines
Identification of spectroscopic binaries
Measurement of Stellar proper motion to +/- 6 km/sec accuracy
Measurement of Emission Nebula Proper Motions
Spectra of Laboratory and field sources

Galactic Red Shifts: When used with the new Kodak "E" detectors red shifts of bright galaxies are possible with amateur sized telescopes.