

Introduction

VATTSpec is a medium resolution CCD range spectrograph with a “skinny chip” having excellent cosmetics. Its UA ITL chip, Serial Number 8228, has a gain = 1.3 e/DN with setting 10, noise = 3.4 electrons, and the full well is 65k DN (=85,000 electrons at gain 10).

More details are under *VATT CCD Spectrograph – VATTSpec* on the [VATT Instruments](#) page.

Wavelength range: 360 – 950 nm; with peak efficiency at 600 nm.

Gratings available:

Grating	Resolution R	Spectral Coverage	Blaze wavelength
300 g/mm	1500	400 nm	500 nm
600 g/mm	3000	200 nm	400 nm
600 g/mm	3000	200 nm	750 nm
1200 g/mm	6000	100 nm	500 nm
1200 g/mm	6000	100 nm	750 nm

The resolutions are for the 1 arcsec slit at 600nm.

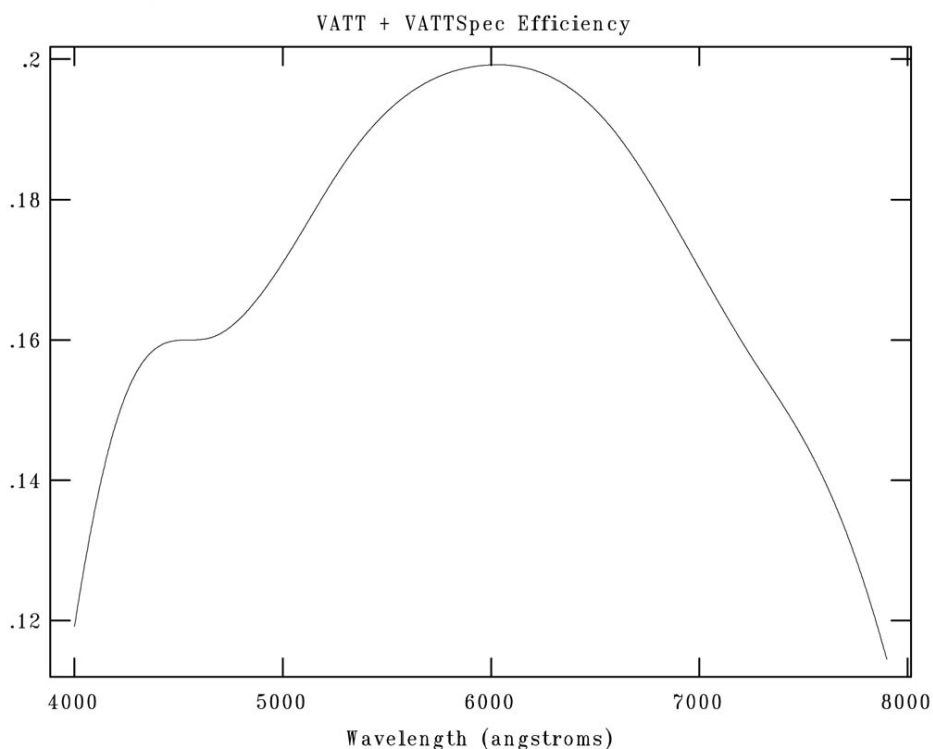
Slits of 1.5 and 2 arcsec are also available.

The slit length is 30 arcsec.

Bandpass filters: S8612 (red blocking) [slot bottom 5]; ZUL0350 [not usually inserted], GG-400 [bottom 2], GG-475 [bottom 3], OG-550 [bottom 4] (cut-offs to the blue in nm).

Neutral Density filters: ND1.0 [top 2], ND2.0 [top 3].

Sensitivity: curve is for efficiency of both telescope and spectrograph. Spectrograph efficiency alone is about 5 % higher throughout the range. This determination is courtesy of Mark Wagner and used the 300 g/mm grating.

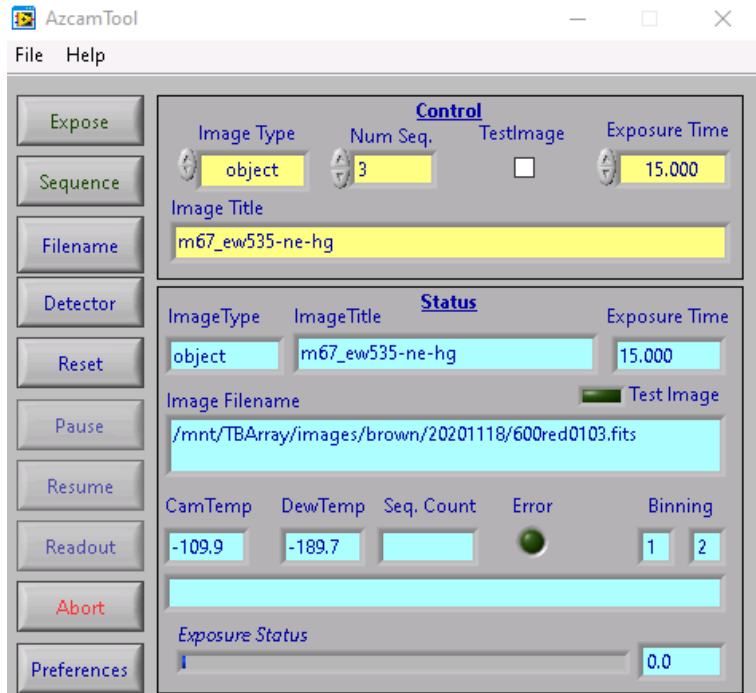


Setup for AzCam and VATT Spectrograph GUI

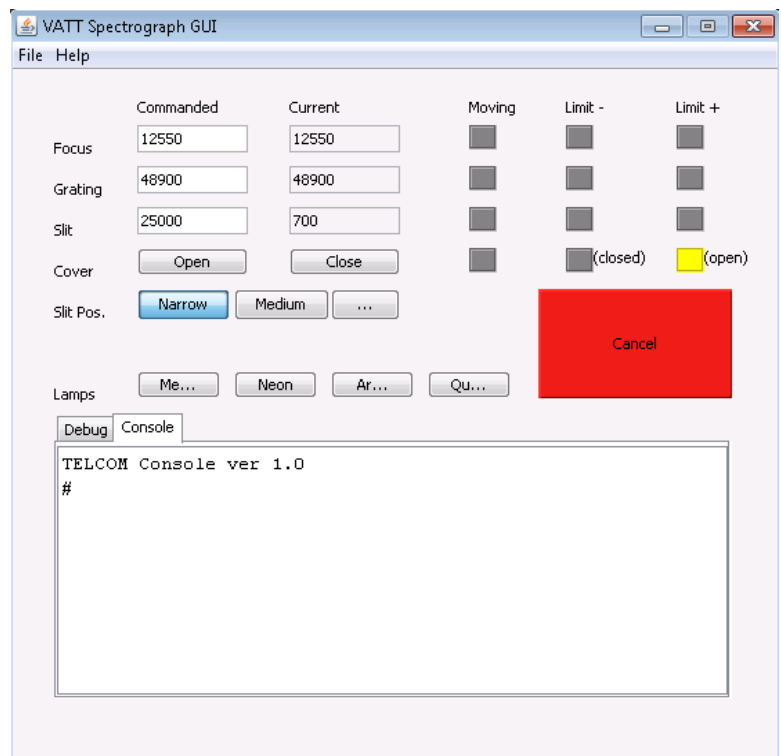
- On VattControl terminal, click on vattocda icon.
 - Open “vattspec server”, which brings up AzCam Tool also, and open “vattspecgui”.

With TestImage checked, it writes spectrum to **test.fits**, overwriting previous image.

Monitor temperature here (~-110 for camera, -190 for dewer).
Dewer LN2 hold lasts between 9 to 12 hours (longer time in winter).
Keep an eye on temperatures!

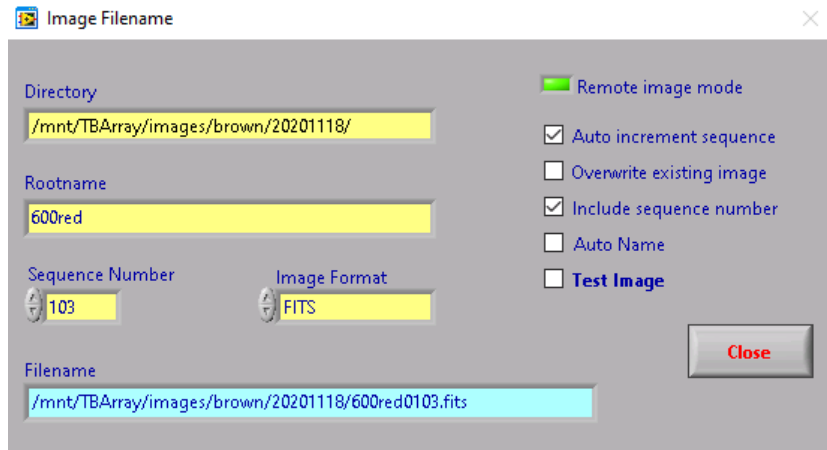


Focus value
Grating value. To select central wavelength of spectra, see Appendix A
Open/close cover (close at end of night)
Slit Position (narrow=1 arcsec, medium=1.5 arcsec, wide=2 arcsec)
Calibration lamps, and flat field lamp (Qu...artz).
(Argon lamp burns out quickly, so have it on for as short as possible.)



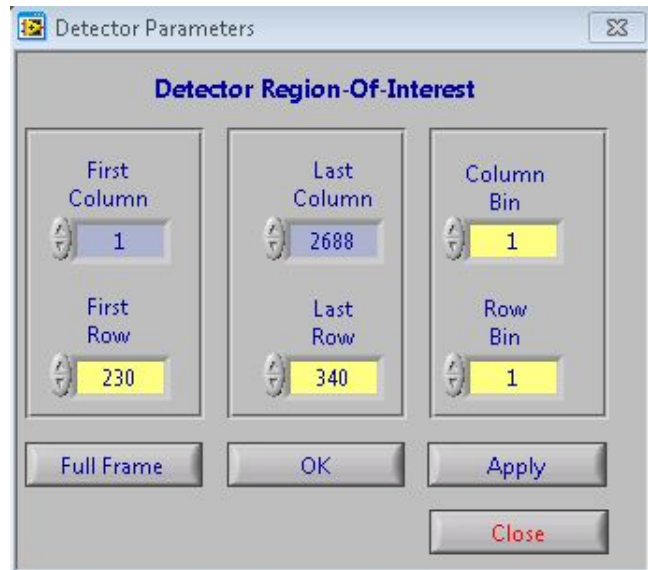
- Create a directory for your images, using the IRAF window, within (/mnt/TBArray/images).

- Click on 'Filename' (see left column in AzCam), enter the new directory name, the root name, and the sequence start number.



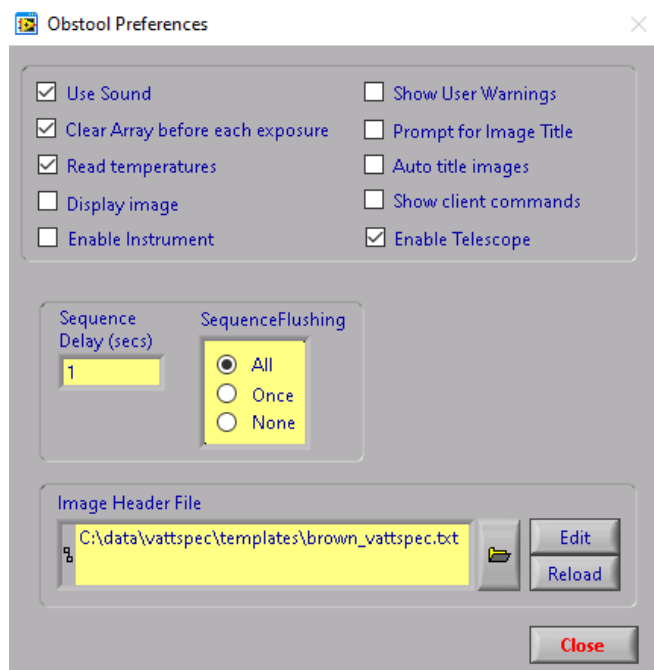
- Click on 'Detector' (left column in AzCam), from here the binning and the specific region of the detector read out can be changed, and the level of binning in each direction.

The slit length, with row binning equal to 1, corresponds to only 90 rows. To allow for the current small shift in the grating perpendicular to dispersion as elevation changes, 10 rows either side of the image of the slit on the detector should be added to make a total of 110 rows. The actual "First Row" and "Last Row" will depend on the grating used.



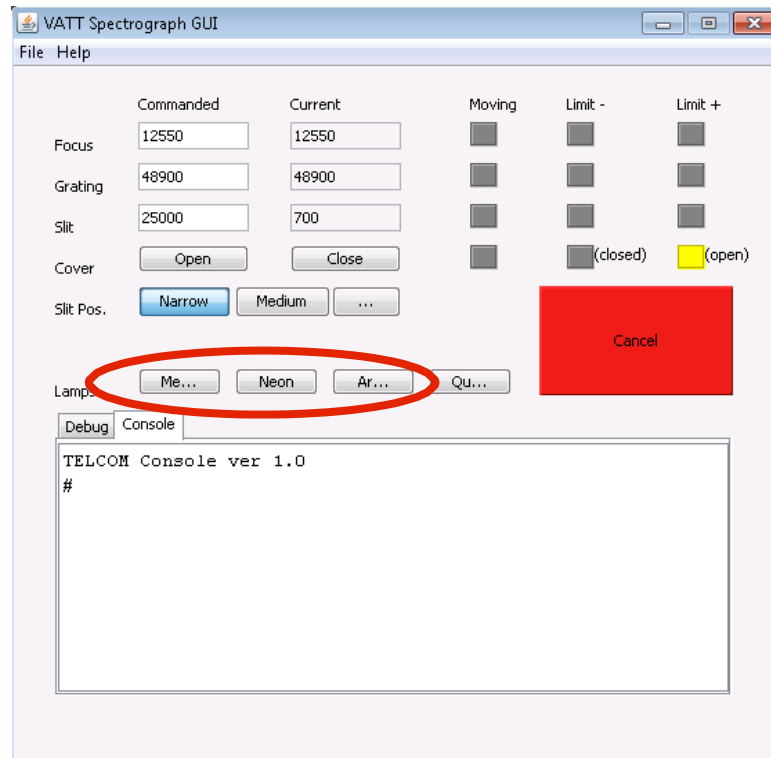
- Click on 'Preferences' in AzCam. Uncheck "Display image" (by AzCam, since done on IRAF), and uncheck 'Enable Instrument' (for now).

Check "Read temperatures", "Enable Telescope" (puts telescope info in FITS header), and check others as desired. Edit your own Image Header File.



Focusing VATTSpec camera

- Replace the U-mirror with the Center mirror on the guider GUI.
 - Turn on the Mercury (blue region) or Neon (red region) lamp, and allow it a minute to warm up.
- NB: Mercury and Neon warm up twice as fast as Argon, and you may want to delay their turn-on when taking wavelength calibration exposures with all three lamps.



- On the VattControl terminal, open an IRAF window (a “c/” not needed if IRAF already loaded). Then *cd* into the directory which contains your images (/mnt/TBArray/images/your-name).
- Take a ~10 second *Test* exposure, and measure the FWHM of a particular line (see below).
- Change the spectrograph focus on the VATTSpec GUI in steps of +200, and take another exposure. Measure the FWHM of the same line as before. Search for the focus value which minimizes the width. For the narrow slit, this value is near 2.0 (pixels).

Measuring FWHM of a line

- On the Control terminal, within the DS9 window, you may want to invert the X axis (in top line Zoom menu). This will place the blue end of the spectrum on the left.
- To measure the FWHM of a line:
In IRAF window, issue *imexam filename 1* to gain access to the various analysis procedures of DS9 (e.g., “j” to measure the FWHM of a calibration lamp line, or “k” for the FWHM across an object’s spectrum).
Or use *implot* on a particular file (e.g., *implot filename*), to plot particular rows or columns. The equivalent of the “j” in *imexam* is “:l 68 72” to average these lines, “e” and “e” at bottom left and top right of line to expand it, and then “p” and “p” on either side of the base of the profile to find its FWHM.
Implot command “:x 2680 10” inverts X axis, when plotting line(s), and so puts blue to the left of plot.
NB. (1) resizing the whole *Implot* window is only possible after doing a “q”.
(2) reload *imexam filename 1* (after “q” from previous) for each new image.

- Turn off the lamps by clicking the ‘Me’ and/or ‘Ne’ buttons. “Cancel” will clear residual color.

[The above steps are best done in the afternoon before observing, with due allowance in the best focus for the expected drop in temperature during the night. Focus setting number increases as temperature drops.]

For Acquiring an Object and Initializing Coordinates

To see an object in the guide camera, remember to open the slit cover! And put in the U-Mirror!

The guide camera and guiding are controlled by PHD2.

https://lavinia.as.arizona.edu/~tscopewiki/doku.php?id=phd2:phd2_guiding

For VATTSpec's guide camera, NB:

- Use ip:port 10.0.3.12:2571
- Set binning to 3 x 3

Focusing VATTSpec and the telescope

- Check on the guider GUI that the Center mirror is replaced with the U-mirror.
- The dome floodlights can be turned on, and the guider exposure time increased for the slit to be visible on the guider camera. In PHD2, check the "Spectrograph Slit" option, and size it.
- Place the bright star slightly above the slit using the paddles.
- Using an exposure time of 100 sec or so, start "Expose". Then track the star down across the slit at a rate of 1 arcsec/sec until it appears below the slit. Then push "Pause" and "Readout". (This saves any need to keep the star perfectly centered to get exact repeat exposures.)
- Use *implot* to measure a consistent column of the spectrum, for example column 1300 (command *:"c 1300"*, and use *"p"* on either side of the base of the profile to find its *FWHM*.) The goal of telescope focusing is to make the spectrum as narrow as possible in the direction perpendicular to the dispersion.
- Adjust the telescope focus at the Secondary GUI and take another exposure. Plot the same column again, and adjust the focus until the spectrum is as narrow as possible, or equivalently, the peak is as high as possible.
- Since telescope now in best focus on slit, in PHD2 refocus guide camera onto slit mirror...which is easiest done on fainter stars.

Guiding, and taking science data

- Slew to the first target using the XEphem GUI (with Dome Floodlights on!).
- Once the target is acquired and it has been maneuvered into the slit using the paddle, the autoguider can be started in either on-slit or field star mode.
- See the PHD2 Guiding Manual, with VattSpec specific Notes.

Chris Corbally (initiated by Rob DeRosa)

Appendix A: Setting Grating Value for a Central Wavelength (approximate guide only)

Note: the 1354 pixel position is for when the data is not binned; it would be 1354/2 for 2x column binned data.

