Care and Feeding of the Blue Channel Spectrograph

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December 8, 2004

1 Controlling the Spectrograph

There are three separate control interfaces for using the blue channel spectrograph (BCS). There is the PC, which controls aperture, grating, shutter, etc (As of Fall 2003, there is a GUI on ALEWIFE that replaces the PC). The observer's paddle for the top box controls the comparison and flatfield lamps (not replaced by the GUI—yet). Finally, there is ALEWIFE, a Linux box that runs the data taker. (For other documents, look at `http://cfa-www.harvard.edu/cfa/oir/MMT/mmt/foltz/instruments.html`.)

1.1 The PC (now a GUI on ALEWIFE)

The PC changes some of the hardware in the BCS. The control software is called BCCS: The Blue Channel Control System. If the PC is down (which I have never seen), you type `bccs` at the `C:>` prompt (hey, DOS lives!). Usually you want to do a warm start (it asks this). Eventually you get a status screen that reports on the current grating, tilt, aperture, filter, etc. You can change any of these things by typing a (probably) obvious command at the `Command:` prompt. Typing any command followed by a `?` will list the acceptable options. Some commands we actually use:

Command:	Result:
`grating 300`	sets 300-line grating
`wave 5800`	sets central wavelength to 5900 Å
`apert 2″x180″`	chooses the 2″ by 180″ slit
`focus 2.2`	sets spectrograph focus
`lfw lp-495`	puts long-pass 4950 Å filter in lower filter wheel
`open (shut)`	opens (closes) spectrograph shutter

Our default mode is the 300-line grating with a 5800 Å central wavelength. We also use the same grating with a 7500 Å central wavelength, but then we include the lp-495 filter to block second-order light. See `http://cfa-www.harvard.edu/cfa/oir/MMT/mmt/foltz/sccs.html` for a complete list of commands. In the Fall of 2003, the PC was replaced with a GUI on ALEWIFE. The PC still exists in case of problems, so the above information is still included. There is a button labeled "BCCS" on the toolbar at the bottom of the screen on ALEWIFE that starts the GUI. The GUI has pull-down menus to set the focus, aperture, upper & lower filter wheel, grating, and wavelength. Changing these just sets up a queue. You then need to click the 'Configure Spectrograph' button at the bottom of the window. The top of the window has a button to toggle the shutter open and closed.

When you start up, make sure that you have the 300-line grating in, that the filter wheels are clear, and the wavelength is set properly. You can choose your aperture and then move on to setting up the instrument. Remember to `open` the shutter!

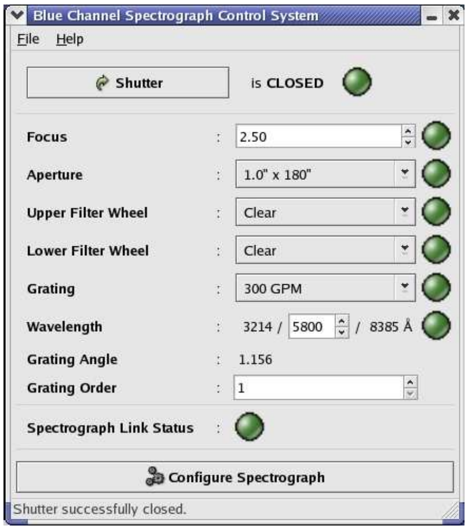

Figure 1: The Blue Channel Spectrograph Control System GUI

1.2 The Observer's Paddle

The observer's paddle for running the top box lives below the PC. At the lower right is a toggle switch for using the box by hand (PADDLE MODE) or from the PC (SCCS CONTROL). The paddle mode is probably the way to go. Directly above this is the toggle switch for the pick-off mirror (labeled COMP MIRROR). This needs to be IN for comparison and flat field lamps and OUT for observations. Warn the TO when you change this so they can stop guiding on the object. Above the pick-off mirror is the green COMPARISON button that toggles the various lamps on or off. To its left are the toggle switches for the individual lamps. The individual switches do **not** turn the lamps on, they merely enable the lamps, and the green COMPARISON button actually turns them on. We use BRIGHT for flat fields and HE-AR and NE (these two together) for comparison lamps. It is a good idea to turn things off with the green COMPARISON button before toggling individual lamps on and off.

1.3 ALEWIFE

ALEWIFE lives in the middle of the control room (in January 2004, it had two black Dell monitors and a fancy wireless keyboard–in case you want to observe from the other side of the room). You log in as `mmtobs`. The password will be on a white board to your far right (or some out there will tell you). This automatically brings up an Acquisition window where you will run ICE commands (see below) to take data. There is also a Reduction window where you can—you guessed it—reduce data. **DO NOT** reduce data in the same directory where you write the raw files. Make a different directory, and copy the files you want to work on over there. In one of the windows, type `set stdimage=imt38` so that your image looks good in the ds9 window. It will create fits files by default.

Another thing to check is available disk space. The disk is big, just make sure that old data is stored away in other directories. The acquisition window is in /home/mmtobs at startup, so that is where your files will be written unless you change directories in that window.

The next thing to do in the acquisition window is to check the various *pars* files that ICE uses to assist in data taking. In *obspars*, you can put in your name and comments on the conditions. In addition, *obspars* controls the rootname for the fits files (files are named with ROOT####.fits) and the post-processing command (currently set to display the image). Both *instrpars* and *telpars* are pretty much to be left alone, although *telpars* should have *telname* set to "mmt" so that the headers will have all the useful information from the telescope like the UT or the RA. (At the beginning of the night, the operator's computers may not be active, so you will see error messages about some telescope parameters–ignore them. They are only important for the actual objects.)

The parameters in *detpars* control the readout of the CCD. We usually bin by 2 spatially, so set the row binning factor to 2. We only need to read out the part of the chip that is illuminated, so you can set the first and last row. A test exposure with the flat lamp may help (see Taking Data section below); the row values should be in device coordinates (i.e., before binning by 2). Good trial-and-error starting points are 180 for *firstrow* and 500 for *lastrow*.

2 Taking Data

Taking data is done through the Acquisition window using ICE. ICE has its own long and detailed manual (`http://www.noao.edu/kpno/manuals/ice/ice.html`, for information specific to the MMT, see `http://cfa-www.harvard.edu/cfa/oir/MMT/mmt/foltz/uaoice.html`). All you really need to know is `observe`. Type that, and it will ask you what you want: object, flat, comparison, etc. It will ask all the appropriate questions about name and exposure time. Some of the commands have shortcuts. You could just type `zero`, `comp`, or `flat` to jump start the process.

2.1 Calibrations

Taking a zero right off the bat isn't a bad idea. It will show you if you can talk to the detector and how the chip is doing. If it looks crazy, take another one. If it is still crazy, ask for help.

The next thing is to take a test flat. With the bright lamp, 7 seconds is a good length. Use this to check the read-out region and how the illumination looks. Look at a flat reading out the whole chip to choose the row limits in *detpars*, but remember that you are binning by 2, and *detpars* wants the *original* coordinates (that's why 180 and 500 give you a 180 width chip). Note that blue is on the **left**.

Once you have the read-out region set, you can focus the spectrograph. (In fact, you can create a very small read-out region for the focus check such as just rows 300 to 500 to speed things up.) This means going back and forth with the observer's paddle and ALEWIFE to change focus and take exposures, but it isn't too bad. Set the focus to some low value like 1.6 or 2.0. Take a comparison lamp (you usually need 30 seconds for a good lamp, but you can get away with shorter exposures for the focus run, like 15 seconds). Bump the focus up by 0.2 and take another lamp. Do this until you get up to 3.0-3.2. Take all the focus files and put a list of their names in a text file. You can then (in the reduction window) run the *specfocus* task. This used to live in the *nmisc* package, but is now in *noao.obsutil* (on ALEWIFE as of Dec 2004–you may get different results, so be careful). You should epar *specfocus* so that images=@filelist and focus="2.0-3.2x0.2" (or whatever your starting focus, ending focus, and increment were—note the lower-case "x"—this task is very finicky about syntax). For some reason, it also only wants eight (8) files and no more. The wonders of IRAF. This will fit the lines and find the best focus. If you miss the minimum, do more lamps and edit the filelist appropriately.

Once the focus is set, you can take real calibrations. (You can delete all the setup data—but remember to reset the sequence parameter in *obspars* to 1.) Take a 30 second comparison lamp. Do 15 flats (at 7 seconds or so). Note that your mileage may vary for all these exposure times, so run tests at the telescope. Do 11 zeros, although there isn't really any pattern. That's pretty much all the calibration you need. If you are doing a second setup (like the 7500 Å central-wavelength described above), do a comparison lamp and flats for it. For the red setup, though, we really need flats at the position of the object to deal with fringing properly. This means that when you do a comp before or after an object in the red setup, you should also do three flats.

2.2 Real Data

Have the TO move to a real object. Once there, have them fix the slit at a specific position angle that is close to the average parallactic angle for the course of the exposure. We don't want to have rotation of the sky going on, as that makes the background subtraction difficult (but, this does mean that you want the rotator on, to compensate for the motion of the instrument as the alt-az telescope tracks). Use `observe` or `object` to take an exposure of the object. Once you are done with the object, take a comparison lamp (warn the TO before moving the COMP MIRROR on the observer's paddle).

In the 5800 Å central-wavelength setup, we are getting second-order contamination. This isn't too bad for the objects, but it is a killer for standard stars. To calibrate the blue end, we need a good sdO star, but these are so blue that they don't work at the red end. Thus, we need a red standard as well. This is *critical*. Here is a list of the good secondary standards:

Star	type	Coords. (J2000.0)
Feige 34	blue	10:39:36.740 +43:06:09.25
BD+28 4211	blue	21:51:11.022 +28:51:50.36
HD 19445	red	03:08:25.589 +26:19:51.39
HD 84937	red	09:48:56.100 +13:44:39.32
BD+26 2606	red	14:49:02.357 +25:42:09.16
BD+17 4708	red	22:11:31.374 +18:05:34.17

3 Generic MMT Information

Try to move the telescope sparingly. It seems to want to rotate the wrong way every time. It is an Alt-Az scope, so avoid the zenith (elevations over 80°) and transits. When the wind is from the north-east, the seeing is bad. Make sure that the times in the header make sense.

4 Saving the Data

There are many options for saving the data. The internet connection from Mt Hopkins is quite good, so you should ship the data back to the CfA via FTP. There is a DAT drive on *alewife*, as well as a CD writer. The CD writer does not seem to be working now (November 2002), but it may be functional later.

5 Reducing the Data

The document *Tom's Reduction Notes* contains a wealth of useful information on this subject. Here we address specific issues of MMT blue channel data.

Normally, you want to run a *fixhead* routine at first, to make sure that the headers will have all the right information. The first thing to do is trim and overscan-correct the files. This is all done in *ccdproc*. For our 5800 Å setup, recent numbers are biassec = [2698:2708,*] and trimsec = [6:2687,1:157]. For the trimsec, the y-values will depend on your choice of window at the telescope (180:500 in this case). Finally, the overscan needs to be fit with a 2nd order polynomial (linear fit), not just a constant.

The next step is to make the flats with *flatcombine* and then *response*. An order 23 spline3 seems to work well. Flatten the data and then extract the 1-d files. Right now, I'm using *lower* = -3.5 and *upper* = 3.5 with a background region of -25:-10,10:25. Don't forget to turn on optimal (*background* = `fit`)—current read noise and gain are 2.7 e^- and 1.1 e^-/DN, respectively.

Then you can *identify* and *dispcor* all the data and pass those along to the IDL routines for fluxing, etc.