

DBSP Observing Manual

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1 Before arrival

1.1 Submit observing setup

When submitting the online setup, use the following configuration.

Object	Setting
# of slits	Single
Dichroic	D-55
Polarimeter	None
Blue grating	600/4000
Blue angle	27°17'
Red grating	316/7500
Red angle	24°38.2'

Table 1: Usual ZTF setup.

1.2 Prepare observing schedule

- Find out what time sunrise and sunset is from your favorite ephemeris catalogs on the Internet. Then add or subtract 48 minutes to find the times of 12 degree twilight.
- Prepare your list of targets. The delimiter for DBSP is flexible: they accept comma, semicolon, tab, space, or anything else as long as you are consistent. Each row should have the **target name**, followed by **RA**, **Dec**, and any comments (recommend including the magnitude, for easy reference during the night). If your targets are coming from the ZTF marshal, you can automatically generate a target list in the right format.

2 Observing from Palomar

- Budget at least 3 hours to get to Palomar Observatory.
- The Dome is made dark by 4pm in the Summer and 3:30pm in the Winter. At this time, you can begin taking calibrations.
- Dinner is served at 4pm in the winter and 6pm in the summer. You can do dome flats and arcs before dinner.

3 Remote Computer Access

- If observing remotely, log in to the remote machine. Username and password can be found in the handbook in the observing room (or you can ask the telescope operator).

Double click the shortcut to the DBSP VNC sessions which will give you to the GUI operating DBSP on the **instrument 7** machine (see the diagram in Figure 1).

- On the left of the three screens should be a shortcut named **Instrument 7**. This opens the VNC session to the machine running the DBSP GUI. The password for access can be found in the handbook in the observing room, or you can ask the telescope operator.
- The left screen has three windows. On the left is the instrument control for the blue side. On the right side is the instrument control for the red side. In the middle is a general window (DBSP_AUX.vi) for controlling the turret (where the instrument is pointing), slit width, and turning off and on the arc lamps.
- The middle screen has DS9 and IRAF sessions running.
- The right screen shows a VNC session to the FacSum (facility summary) machine. This is where you will manage the target list and select targets to be observed.

4 Wavelength coverage check

- When you arrive, the observing staff will usually have taken a couple of test images in the afternoon. If not, it's important to do a couple of test exposures in order to clear both chips. If you need to do these test exposures yourself, see Section 4.1.
- Look at the test images and make sure that you can see the full wavelength range – that is, that the spectrum is well-centered and not falling off the edge of the CCD.
- Check if the spectral wavelength coverage is as expected and ensure overlap between the two cameras. On the blue side, this will be from around 290nm to 590nm and on the red, 435nm to 1065nm. The D-55 dichroic however will limit both sides to/from 550nm respectively.
- You can delete these test images using **del**. If you do that, you might want to reset the **image number** on the blue and red instrument panels so that your files start from 1.

4.1 Test exposures

- In the center (grey) window of the left monitor, change the **TURRET** setting to **lamps**.
- In the same window, set the **APERTURE** to 0.5". This is the value we usually use for arcs, although ideally one would do arcs for all three slit widths (0.5", 1.0", 1.5").
- Turn on the lamp He+Ne+Ar (this is for the red side) by clicking on the green circle under the name
- Set the exposure times as listed below for the given slit width. When you set the exposure time (or any value on the instrument controls) click, type the number, then hit **enter**.
- Start the exposure. Once you start, do **not** change anything on the instrument controls.
- Turn off the lamps by clicking the green circles again. **Don't** click **QUIT**.
- Now for the blue side. Turn on the Fe+Ar lamp. The Fe+Ar lamp takes a minute to warm up, and while it's warming up the light will be orange.

To check the resulting spectra:

	0.5	1	1.5
Red	0.4 sec	0.2 sec	0.1 sec
Blue	10 sec	5 sec	3 sec

Table 2: Recommended arc exposure times.

- Open the image you took, e.g. `ds9 blue0001.fits`
- The spectra can be cross-checked with the NOAO spectral atlas. The He+Ne+Ar and Fe+Ar arc lamp spectra have been downloaded from the NOAO website. You can find the spectral atlas plot in Figures 2 and 3 in the Appendix of this document. Alternatively, to open it on the observer1 machine, open a local IRAF session on the observer1 machine or by clicking the “IRAF Spectral Atlas” icon on the desktop (middle monitor).
- Enter `onedspec` at the prompt to run the necessary package.
- Enter `epar splot` to edit the splot parameters. Change the `xmin` and `xmax` values to match the blue side wavelength range.
- To adjust the plot dimensions, place the cursor over the desired bottom left corner and press “e”, then place the cursor over the desired top right corner and press “e again. You can also use this command to flip the plot: hover over the bottom right and press ‘e’, then hover over the top left and press ‘e’.
- Repeat the process for the red side using the `henear.fits` file. Find the wavelength solution and ensure the coverage is as expected and that there is an overlap of around 20nm.
- Note that the blue chip is vertical and the red chip is horizontal. To switch rows and columns, hover over the image and press ‘c’.

5 Instrument focus

The staff do the instrument focus during the day. You should not need to do this.

6 Calibrations

6.1 Bias frames

- If you were just doing the test exposures, then the arc lamps might be on. If they are, turn them off by pressing the green circles underneath them.
- Switch the turret setting to “Closed.”
- Set the exposure time to 0 (click on the box, type 0, then click enter to make sure it registers).
- On both the red and blue side, set the object name to `bias`
- On both the red and blue side, select `bias` from the dropdown menu.

- On both the red and blue side, set the textttnumber of images to 10.
- Click expose on both sides. You can take bias images on both sides simultaneously.
- Open the bias images and mouse over them to make sure the counts are OK. You expect counts of around 3000 on the blue side.

6.2 Arc lamps

- Switch the turret setting to “Lamps”
- Set the exposure time to 0.4 seconds on the red side and 60 seconds on the blue side
- Change the object type to `Cal`
- Set the object name to “arcs”
- Turn on the He+Ne+Ar lamp (red) and take three sets of exposures.
- Turn off the He+Ne+Ar lamp, turn on the Fe+Ar lamp (blue), and take three sets of exposures.
- Open the images, and use the `region` → `projection` tool in `ds9` to draw a cross-section through the spectrum and make sure the lines look good. Blue saturates around 60,000 and red around 3000. It doesn’t matter if you’re well below these values, as long as you can clearly see the lines and the S/N looks good.

6.3 Flat frames

- Check with the TO that it is okay to remove the mirror cover
- Switch the turret setting to “Aperture”
- Turn on the high lamps
- Set the aperture size to 1.0”
- Set the object name to “flat”
- Set the object type to “flat”
- Set the exposure time to 90 seconds on the blue side and 60 seconds on the red side
- Take one image (you can do this simultaneously on both sides) and take a look. If you aren’t saturated (red is OK up to 40,000 and blue is OK up to 62,000) then do 9 more on each side. Ideally you want to have a lot of counts without being saturated.
- Repeat this process for the 1.5” slit.

Note:

Red camera – 4k × 2k CCD linear to 40000 DN, saturation at 45000 DN.

Blue camera – 2k × 4k CCD linear to 62000 DN, saturation at 65000 DN.

7 Getting started on science objects

- **Star-list:** The star-list can be retrieved from the relevant page on the Marshall where targets are assigned for a particular run. Use SCP to copy the star-list text file to the local computer [user1@observer1.palomar.caltech.edu:/observer/observer/targets/username/]. Ask the support astronomer for the password. Load it into the star-list program on the right screen. Sort the targets by RA to aid in the scheduling process. The starlist is in the following sample format to be parsed by the FacSum machine program:

```
14 gjt                00 18 39.64   +02 11 03.5   2000.0   !   c o m m e n t
```

- **Sky focus:** Once the dome is open, the TO will do a sky focus. Ask for the seeing and choose the appropriate slit width for observations. Keep an eye on the seeing during the night and change the slit width accordingly. This can be monitored at the Palomar maintenance page: www.palomar.caltech.edu/maintenance/index.tcl.
- **Standard star measurements:** Change the turret setting to “Aperture”. At the onset of 12 degree twilight, take two one-minute exposures of one of the standard stars from Table 7.

Star	RA	Dec	Epoch
G191B2B (blue)	05 05 30.6	+52 49 56.0	2000.0
Feige34 (red)	10 39 36.71	+43 06 10.1	2000.0
BD+28d4211 (blue)	21 51 11.07	+28 51 51.8	2000.0

Column 211 on the blue chip is a bad column so make sure that the trace is far enough away from there. If switching slits during the night ensure that standard star measurements are made with all slits used.

- Open the viewer to the slit viewing camera. On the computer to the right there will be a shortcut that opens a VNC session to the computer that is running the slit viewing camera.

8 Science objects

- Ask the TO to use the parallactic angle for all measurements unless otherwise required. It is best to cover targets in order of RA. Depending on the viewing conditions, the maximum acceptable air-mass should be between 1.5 and 2.
- A target is communicated to the TO by highlighting it in the target list on the FacSum machine and clicking Load to Telescope. Help the TO identify the target in the slit viewing camera (which will most likely be FLI) so that it can be positioned on the slit.
- If the target is too faint to be detected on the slit viewing camera, it may be necessary to use blind offsets. The two ways to do this are, 1) Go directly to an offset star by having it in the target list and loading it to the telescope. Once positioned, read out the offset coordinates of the target to the TO. 2) From the position of where the target is expected to be, read out the offset coordinates of the offset-star from the target. Once the offset star is positioned in the slit, ask the TO to reverse the offset coordinates to return to the target.

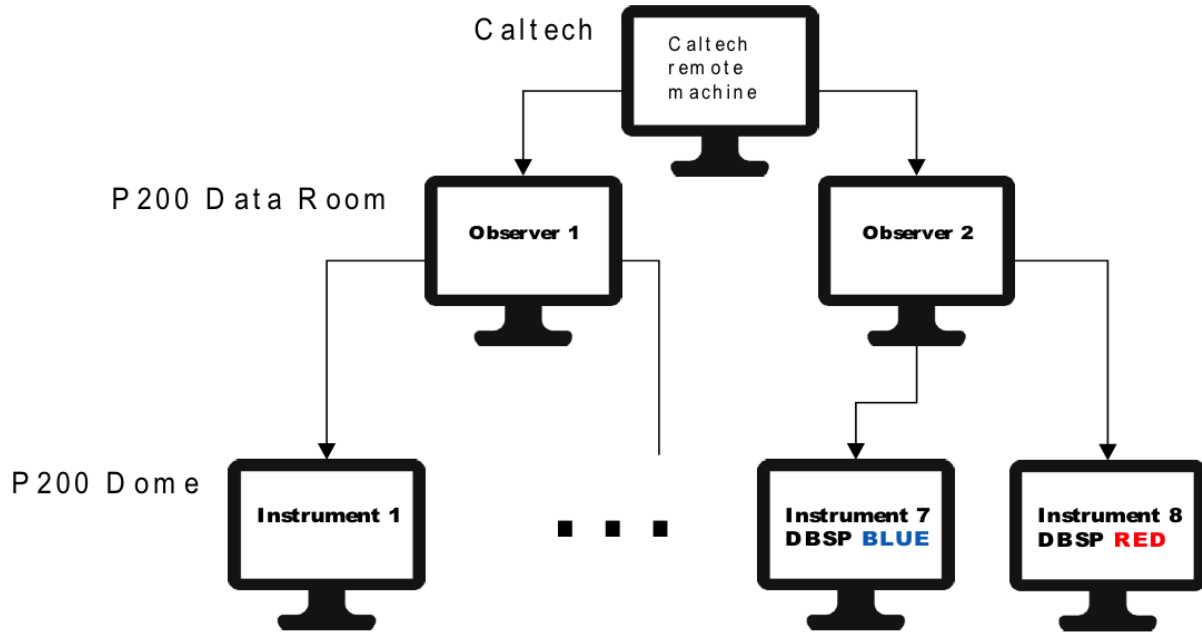


Figure 1: P200 instrument computer network

- Finding charts and offset coordinates can be found at any targets homepage at the ZTF transient or galactic marshal websites <http://skipper.caltech.edu:8080/cgi-bin/growth/marshal.cgi>. Alternatively, you can use Nadia's script¹ which uses the Pan-STARRS catalogue to find the offset stars and plot the finder.

- Check the quality of the trace after each exposure. The minimum acceptable S/N for a given target is usually 5. A good rule of thumb for deciding exposure time is the 20-20 rule. That is to say that a 20th magnitude object requires a 20 minute exposure to achieve a decent S/N.

Note: There is software on the observer1 machine to get a quick look at reduced spectroscopic data on the fly. This software does background subtraction and source extraction. Open a terminal on observer1 and type in `dbsp_drp`. This should open Jennifer Milburns quick look software for which the manual is at www.astro.caltech.edu/palomar/observer/software/drp.html.

9 Data transfer

The various instrument computer directories are mounted on the observer1 machine also. Access the DBSP data folder at: `[/remote/instrument7/DBSP/date/]`. Alternatively you may use rsync to periodically transfer data throughout the night to your location of choice for on-the-fly data reduction.

The remote machine at Caltech connects to either observer 1 or 2 at the P200 data room through a VNC session. Both the observer 1 and 2 machines have three physical desktops at the ports shown in Table 9:

The GUI for DBSP is loaded on the `instrument 7` machine (the one for the blue camera). Each instrument computer has three desktops of which the GUI is typically loaded onto that desktop

¹Download from here: https://github.com/nblago/utls/blob/master/finder_chart_ps1.py.

Use as: `python finder_chart_ps1.py [RA] [Dec] [Name] [[rad]] [[telescope]]`

Port number	Observer 1	Observer 2
5900	FacSum display	DBSP control screen
6900	LFC control desktop	FacSum display
7900	LFC IRAF+DS9 sessions	DBSP IRAF+DS9 sessions

with an access port at 5916. Thus, the DBSP GUI is accessed from the observer computer by initiating a VNC connection to, [instrument7.palomar.caltech.edu:16]. There is a shortcut for this on the DBSP control screen on the observer machine.

A Appendix - Spectral atlas plots

NOAO/IRAF V2.16.1 @tucana.tuc.noao.edu Tue 11:12:37 23-Jun-2015
identify /tmp/104.175.198.46/output30682 - Ap 1

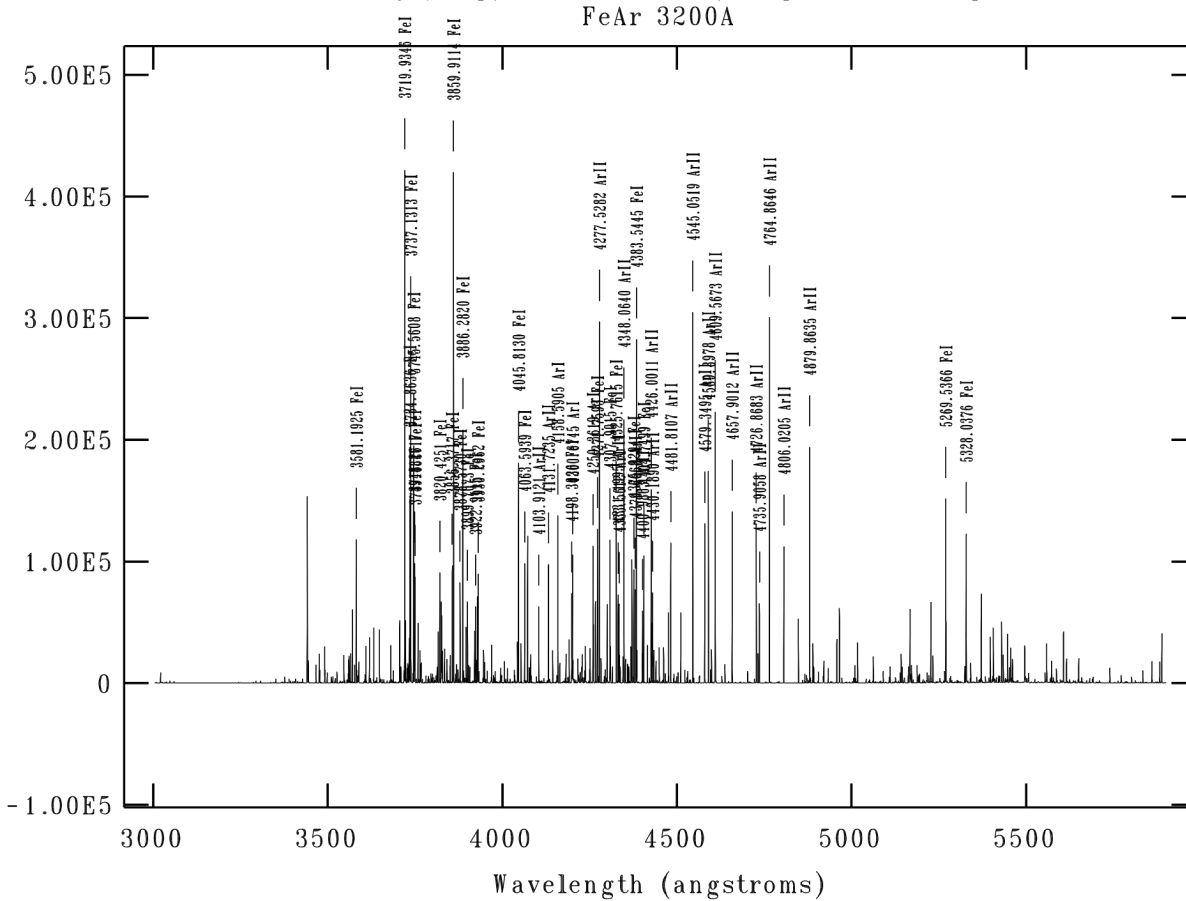


Figure 2: Fe+Ar spectral atlas

near $\underline{3500\text{\AA}}$

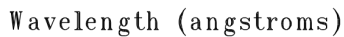


Figure 3: He+Ne+Ar spectral atlas