

Procedure for off-axis guiding with MAESTRO:

1. Open the Maestro WFS package (Applications Menu -> MMTO -> WFS -> F/5 Wavefront Sensor for MAESTRO)

The main control of the WFS movement for MAESTRO will happen with the “Continuous WFS Catalog GUI” window.

Star Name	V Mag	RA (J2000)	Dec (J2000)	PA	Rot	Distance (arcmin)
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2. For maestro, guide stars are found in an annulus 20 arcminutes to 30 arcminutes from the target. These can be edited in the radii in/out boxes, but for off-axis guiding, they should remain 20 and 30. “Flip:” tells the software which direction you want the WFS stage to move when going to a guide star. Since the WFS moves radially in one direction, the flip basically allows it to search in an entire circle around the star rather than in only a semi-circle in one direction. To change flip, you can click the up or down arrow next to the flip box and then Click “Set Flip”. The values Flip can take are 0 and 180.

Section 1: On-Axis WFS:

1. Once you are at the target, you can choose “Find at Current Telescope Position” (or if slewing “Find at Current Catalog Position”) to look for suitable WFS stars near the target. If no good stars are found, you can click the arrow in the box next to “Flip:” and then click “Set Flip” Button to look on the other side of the target. If still no stars bright enough for WFS are found, you can change the radii in to 5 arcmin and check each again.

2. Once you have identified a star, highlight it and click “Go to Selected Star on Axis.” This should turn rotator tracking off, slew the telescope to the selected star, and move the WFS stage on axis. From here, the WFS procedure is the same as any other instrument.

3. When finished with WFSing, the button in the screenshot above labeled “Stow WFS” should be ungreyed out and say “Return to previous target”. Clicking this should return to the observers target. Please note that this feature is the least tested of the code and if there are issues please note in the night log and / or email Richard Cool and I’ll take a look at it. If this button fails to perform, you can simply slew back to the observer’s target with the catalog tool.

Section 2: Setting up off-axis guiding

First, you have to orient the guide camera with actual physical directions. As soon as you get on sky (and get see a star), open up maestroguider and slew to a star, making sure the comparison mirror is OUT in the Conductor GUI so you can see the star! Go to Telescope → xy RA/DEC transformation. Set offset mount to 10 in arcsec. Then hit “ok”. Click on the star, it will move the star. Click again on the star, and it will move it again. Do this once more (click on star). That should be it; from then on, open the “guider local” with saved parameters so that the guider knows which way is NSEW.

1. Ensure that the radii in/out are set at 20 and 30 respectively (you should only need to do this if you changed the inner radius for on-axis searching).

2. Slew to the target. It’s important that at the beginning of the night, you do a hexapod offset so that when slewing to a target it lands near the center of rotation for the system (the green dot between the WFS sweet spot and HECTO spot). This doesn’t have to be perfect, but having in somewhere near those three dots will make your life easier.

3. Click “Find at Current Telescope Position.” The list of suitable guide stars should be populated. We have guided successfully with a $V=10.8$ star under clear conditions, but the brighter is obviously the better here. If there are no suitable stars, be sure to check the second flip position. I have yet to find a situation where neither of these positions had a guide star.

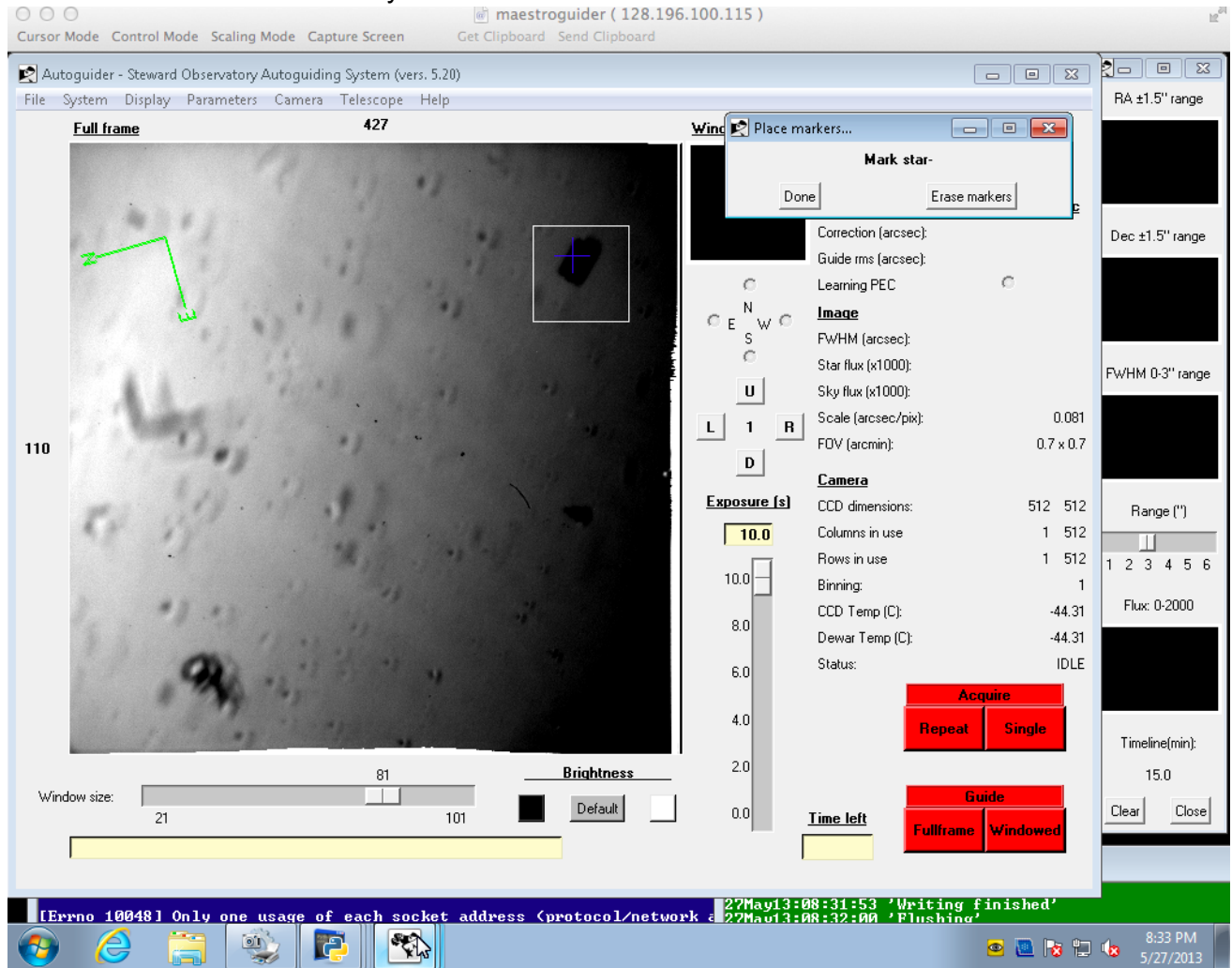
4. Highlight the star and click “Go to selected star *OFF* axis” This will move the WFS stage off axis in preparation for guiding, turn on rotator tracking, and move the rotator the angle needed to reach the guide star. **Once this move is completed if you see no guide star in the frame don’t panic. The move is designed such that a guide star will be available once the observer has placed the target on the maestro slit. The slit is offset considerably from the center of rotation so it’s likely that a star will not be visible until this offset is completed. It’s also vital the observer not offset until the the guide probe is finished moving.**

5. Once the guide stage is finished moving and the rotator has finished ask the observer to offset their target to the slit.

a. Using the maestroguider software in their VNC window, take a “Single” image. **It’s vital this is done after the probe has moved and the rotator finished or the offset will be in the wrong direction.**

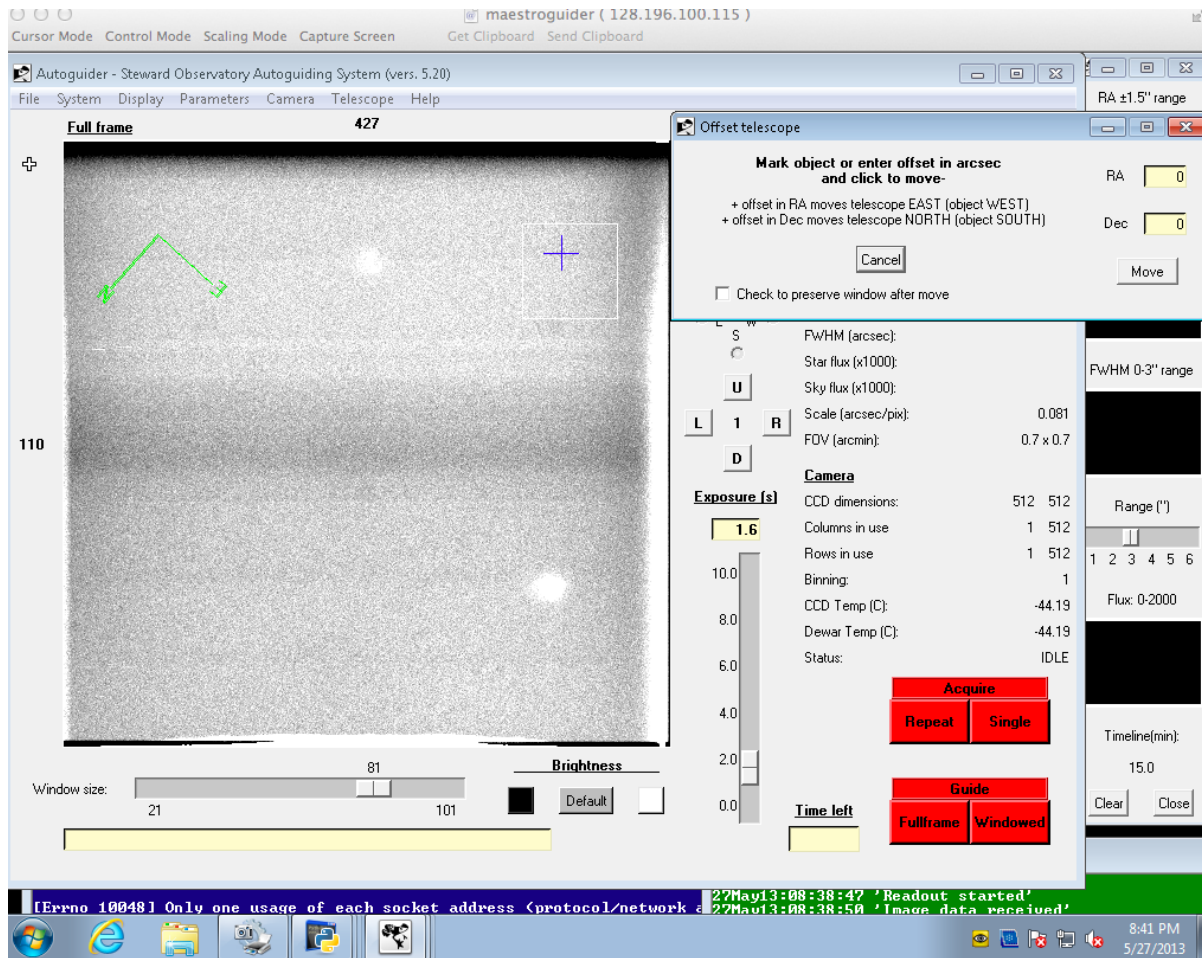
b. If they have swapped slits or it’s their first observation of the night, have them turn on their ThAr lamps (externally), move the calibration mirror in (using the Conductor GUI) and take a ~7s exposure with the guide camera. This will show the location of the slit. They can mark this by right clicking the image, choosing Set Markers, and then clicking the location of the center of the

slit. This will be the location they want to offset the star to.



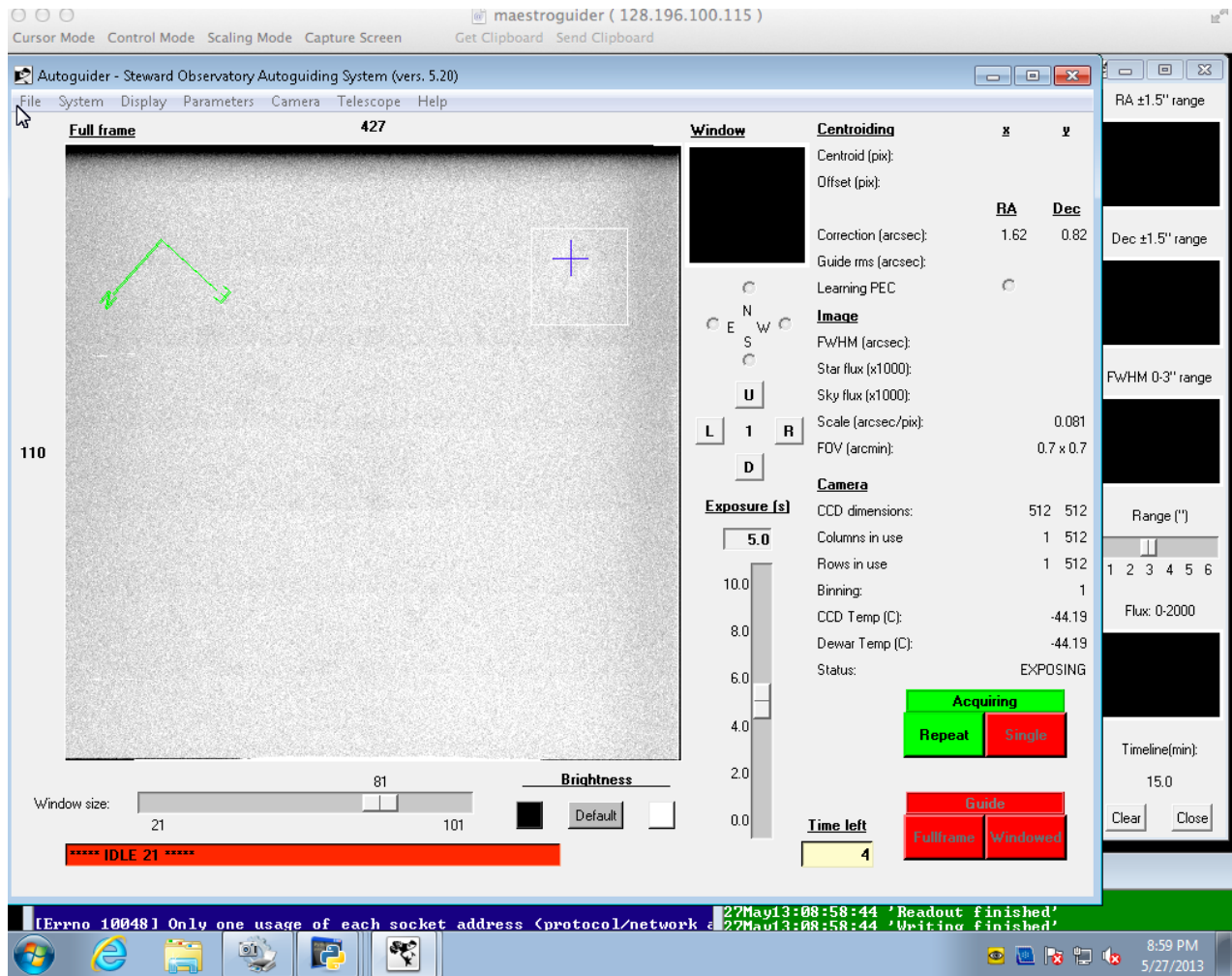
This image is with the 1.1" slit (you can see it has a shadow). The blue cross is where I right-clicked to mark the slit position.

- Turn off the ThAr lamps and move the comparison mirror out (with Conductor GUI), take a single exposure with maestroguider to show the location of the target.
- Choose Telescope -> Offset Telescope from drop down menu
- Click the star center and then click the location of the slit marker. This will offset the star to the slit. They may have to do this 2-3 times to get the positioning satisfactory for them.



You can see two stars here; the top one is “our guy”. It’s V=16.5, and easily visible with a short exposure on the guider acquisition camera. The blue cross in this image is the slit marker that I made in the previous image (with the ThArs on and the comparison mirror in).

6. Once the star is in the slit, the guide star should show up in the Stellacam. Guiding is performed using the F5 WFS Stellacam software under guiders (it’s the SAOguider software and the procedure for guiding at this point is the same as any other usage of the SAOguider).



This photo was taken with a very faint star, $V=16.5$, so it's hard to tell, but it's in the slit!