

Manual for Goodman Spectrograph Multi-Object Spectroscopy

v3

September 23, 2019

1. Pre-Observing Planning

Before observing with Goodman MOS, please see the Mask Design Manual for instructions on making masks for Goodman. It is helpful to have the mask design software accessible as a reference for alignment as you proceed below.

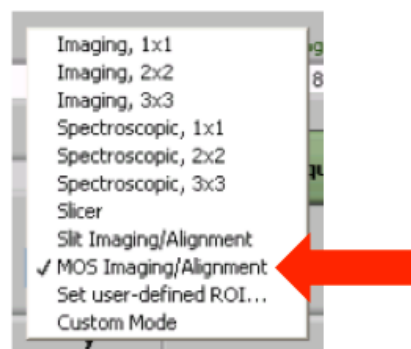
2. Setting up the Instrument

Before setting up on the field, you should give the operator the coordinates of the mask you made. You also need to tell the operator the Position Angle at which you made the mask. In the Mask Drop-Down Menu, the name of the MOS mask should include the Position Angle. You will most likely need to adjust the Position Angle. Thus, it is quickest if you tell the operator to not find a guide star before you have the correct Position Angle. Once you have adjusted the Position Angle, ask the operator to find a guide star.

Select the mask that you want to use from the Mask drop down menu.

3. Image the field

Withdraw the mask. Under the CCD ROI Mode, choose MOS Imaging/Alignment. This will only readout the mask area:



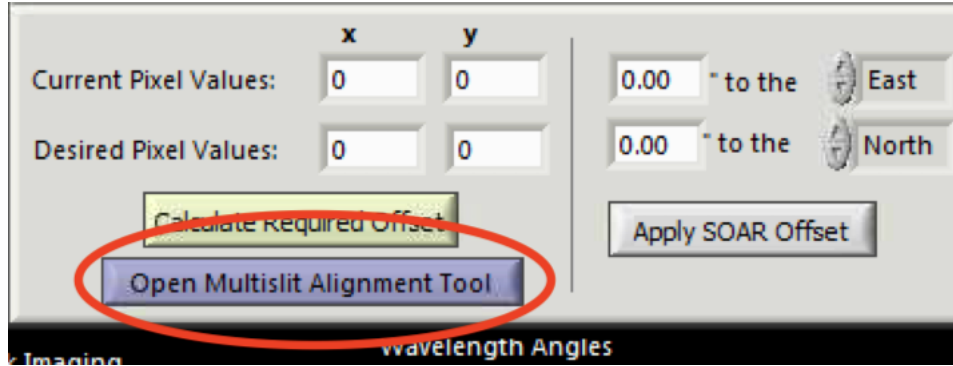
It is suggested that you use “400 kHz, ATTN 0” for the CCD Readout Speed, as this will help things go a bit faster. Take an image of the field. Check this image to make sure you can see the stars you will align to. If you cannot, you should adjust the field until you can.

4. Image the Mask

Replace the MOS mask. Take another image once the mask is replaced.

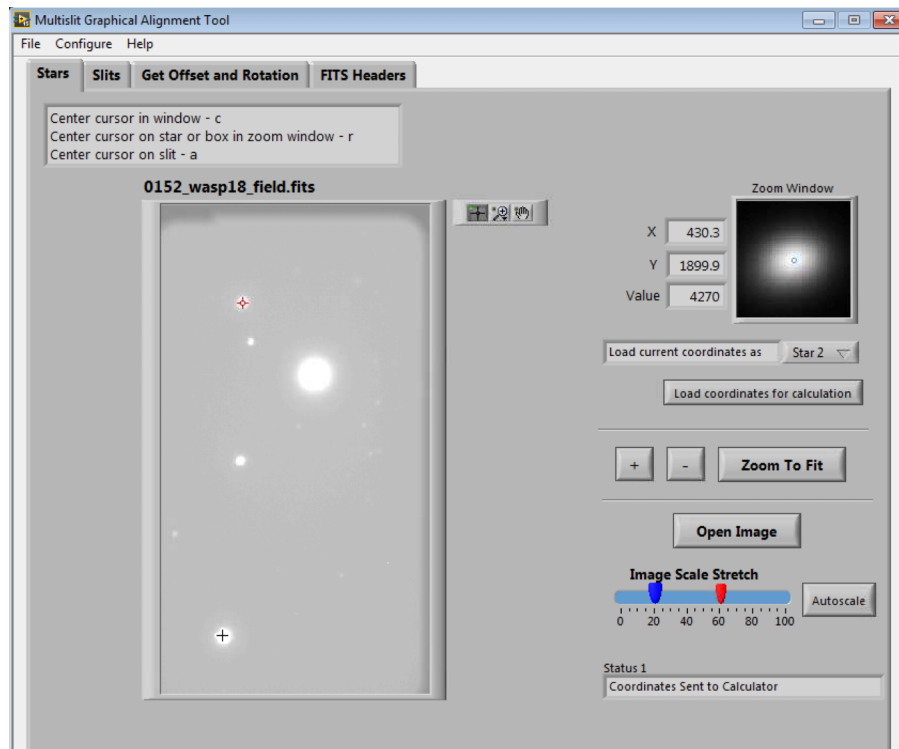
5. Open the Multislit Alignment Tool

Once you have both these images you are ready to run the Multislit Alignment Tool. Click “Open Multislit Alignment Tool”:



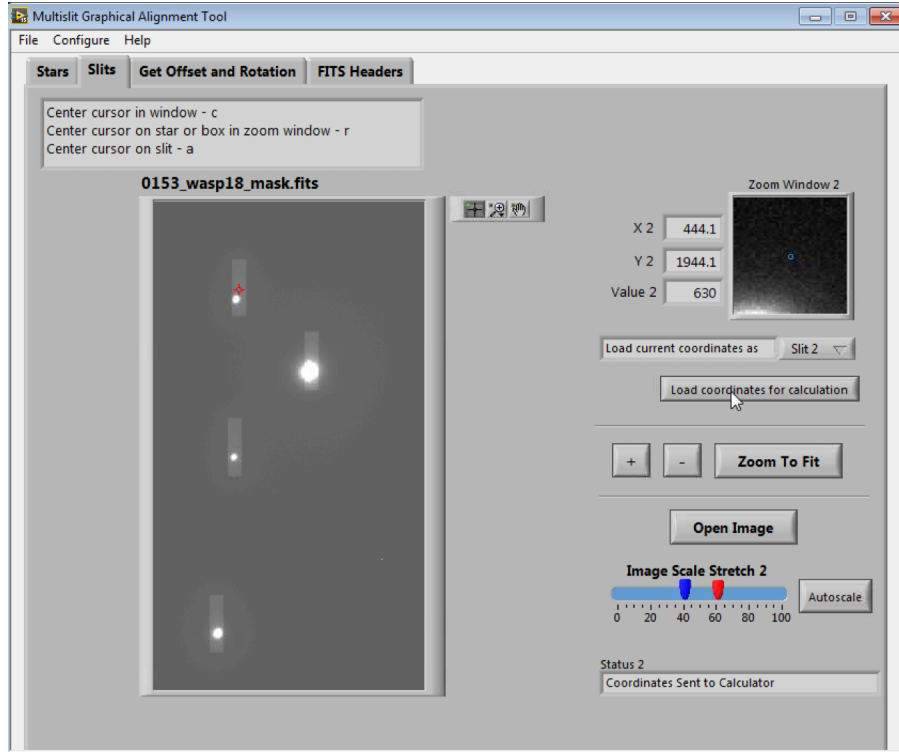
6. Open the Image of the Field

You should be in the “Stars” tab of the MOS Alignment Tool, shown below. Click the Open Image button. The images you just took should be in the current directory. Open the image of the field you just took. Once the image loads, it might appear off-centered, but this will be corrected momentarily.



7. Open the Image of the Slit Mask

Once you have the image of the field open, switch the tab at the top to “Slits,” shown below.



Now, use the “Open Image” button to open the image of the MOS mask. Again, the image is located in the current directory. Click “Zoom to Fit” and “Autoscale” after you open the image. If the scaling is not useful, you can use the red and blue sliders to adjust the scaling of the images.

8. Find the Coordinates of your alignment stars

Go back to the Stars tab. Click “Zoom to Fit” and “Autoscale.” If the scaling is not useful, you can use the red and blue sliders to adjust the scaling of the images.

Find the first alignment star (one of the stars in the boxes). For this part it is helpful to have open the mask design software showing the mask you created. The stars you align to must be the same as the stars you placed in the boxes when you made the mask. Mouse over the star and it should appear on the zoomed in view in the upper right. The following keys allow you to quickly centroid on the star:

Center Cursor in Zoom Window	c
Center Cursor on Star or Box in Zoom Window	r
Center Cursor on Slit	a
Move Cursor Left	j
Move Cursor Down	k
Move Cursor Right	l
Move Cursor Up	i

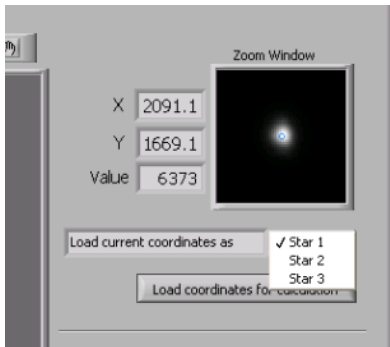


At the top right of the image field lie the above three tools:

Left	Select
Middle	Zoom – A variety of zoom options will first be presented
Right	Pan

These options can be useful if you need to zoom into various parts of the image. You must use the “Select” tool to get the coordinates of the stars and slits as described below.

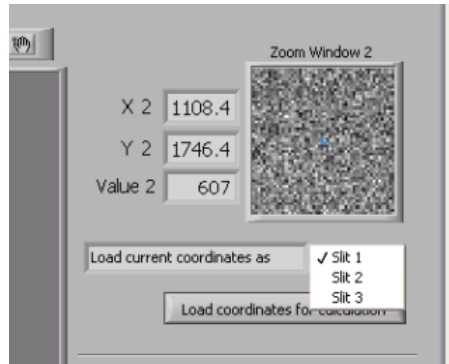
Most of the time, it is sufficient to centroid on the star. Make sure the “Star 1” option is selected below, then click “Load Coordinates for Calculation.” After you load the coordinates, use the drop down menu to switch from Star 1 to Star 2.



Repeat the same procedure for Star 2. Then send the coordinates to the calculator. Again, use the drop down menu to switch from Star 2 to Star 3, then find and load the coordinates for the third star and send them to the calculator.

9. Find the Coordinates of the alignment boxes

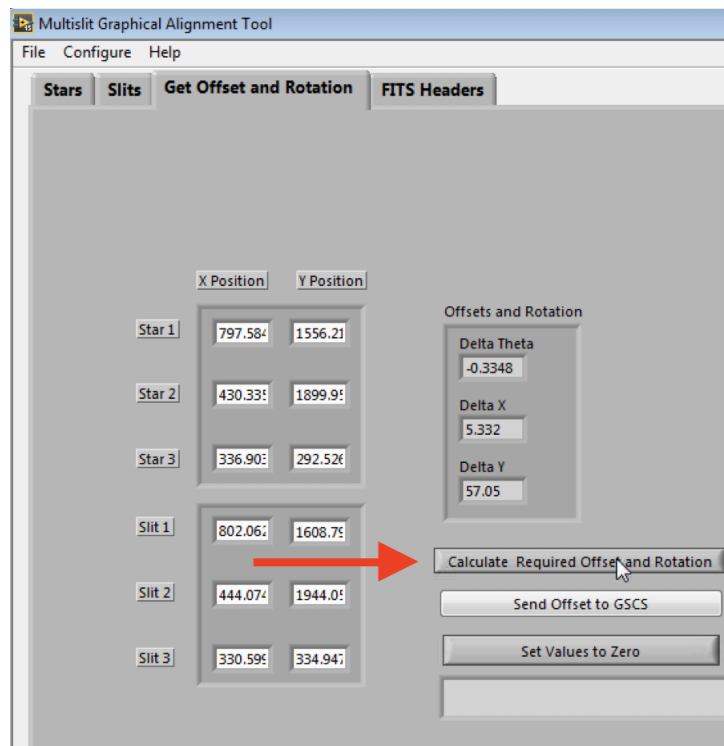
Go to the “Slits” tab. Report the above procedure to get the coordinates of each alignment box. Make sure you use the same numbering you used for the stars.



Do not forget to switch the number of the slit before you load the coordinates for calculation. Often times, for the alignment boxes, it is easier to find the centroid by eye instead of using the centroiding algorithm.

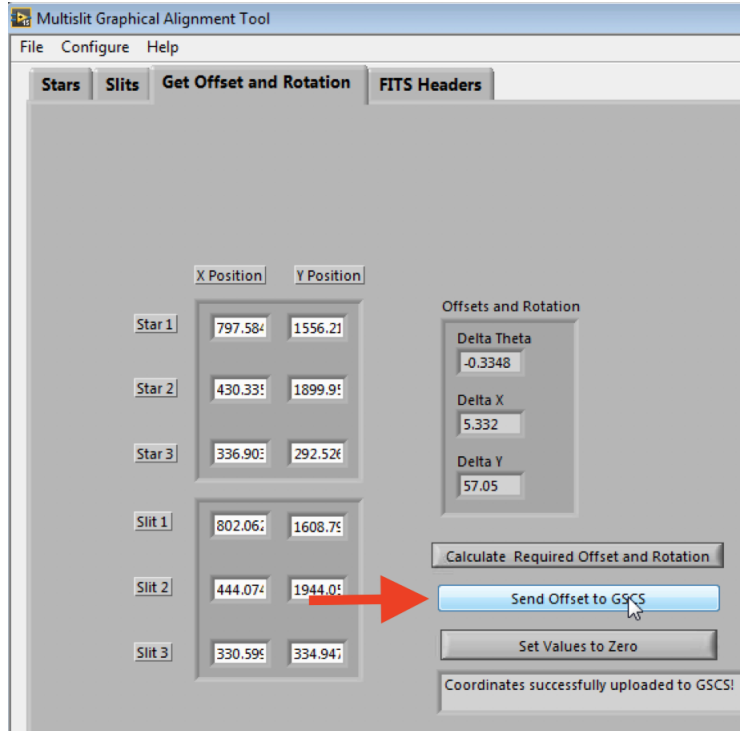
10. Determine the Offset and Rotation

After you have captured the coordinates of all three alignment stars and boxes, go to the “Get Offset and Rotation” tab. You should see the coordinates in the boxes for the stars and alignment boxes. Click “Calculate Required Offset and Rotation.” Your rotation and translation offset will be computed and displayed.

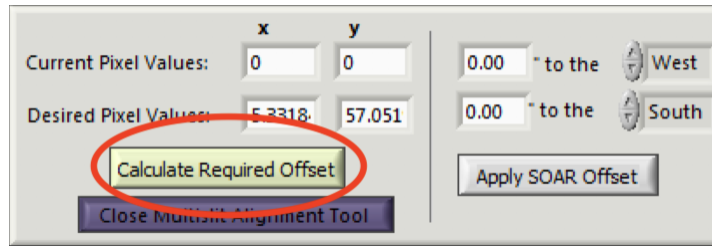


11. Adjust the Position Angle and apply the offset

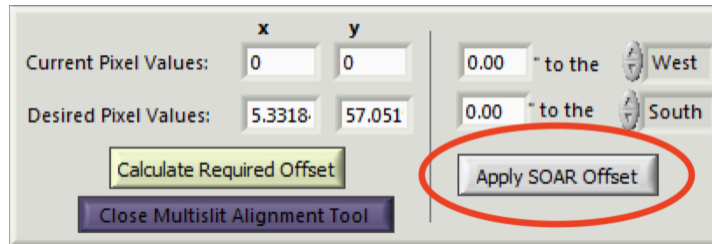
You must first adjust the Position Angle of the telescope before making the translation offset. Add or subtract the given delta theta from the current Position Angle and tell the Telescope Operator the new Position Angle. After the rotation is applied, click “Send Offset Coordinates to GSCS.”



This sends the offset coordinates to the main GUI panel. On the main GSCS Panel, click “Calculate the required offset”.



Then “Apply SOAR Offset.”



Finally, use the “Close Multislit Alignment Tool”.

12. Check Alignment

Now, take an image of the slit mask and see if you are lined up. If you are not, repeat the above procedure.

Once you are aligned, ask the operator to mark the current position as the one to come back to. This will make it possible to return to alignment if anything happens with the telescope. You should also ask them to find a guide star and begin guiding once you will no longer be making rotations or offsets.

13. **Take Spectra**

Once you are aligned, you are ready to take spectra. Do not withdraw the mask again. Put in the grating and move to the correct grating and camera angles. If you need more information, please reference the “Taking a Spectrum” Manual.

Notes and Tips

- If you prefer to not use the MOS Alignment GUI to find the coordinates for the alignment stars and alignment boxes, you can enter coordinates directly into the “Get Offset and Rotation” Tab.
- Use the standard spectroscopic ROI modes.