

Mont 4K Checkout Instructions
5/07/18

NOTE: Highlighted green indicates updated material since last version

The Mont4K manual can be found at:

<http://james.as.arizona.edu/~psmith/61inch/CCD/CCDmanual.html>

Pre-Checkout Instructions:

- 1) Make sure the instrument has been properly installed according to the “Mont4K Installation” procedure. Proper filters installed, iris set to proper setting (Green typically uses 297/298 setting).
- 2) Make sure GPS unit “Brandywine” is plugged in and on in UPS room. Check for 4 green lights.
- 3) Turn ON (if not on already):
 - a) CCD power supply
 - b) guider box, filter wheel power
 - c) shutter power supply
 - d) guider chiller
 - e) guider controller

Autoguider Checkout:

- 1) Turn on bigguider computer located in rack below counter.
- 2) Check to see if you have an internet connection by looking at the networking icon in the lower right hand corner of the screen. If you have a network connection skip to step #3. If there is a triangle with a yellow (!) you do not have a connection. Follow steps below to connect:
 - a) Right click triangle with yellow (!) icon
 - b) Select “open network and sharing center”
 - c) Select “change adaptor settings”
 - d) Right click adaptor labeled “local area connection”
 - e) Click “disable”
 - f) Right click the other adaptor labeled “local area connection 2”
 - g) Click “enable” and wait a few seconds
 - h) Right click the same adaptor again and click “disable”
 - i) Right click adaptor labeled “local area connection”
 - j) Click enable
 - k) Close out of these screens and wait for a network connection
- 3) “Start BigGuider” (double click the BigGuider guider icon)
- 4) Select option number 1, bigguider.
- 5) Select “restart with saved parameters” option when prompted
- 6) When the autoguider program shows “ready” in bottom orange readout, check for updating camera temperatures. The system status should say “idle”.

- 7) Set the exposure to 1.0 second using the slider and take several images using “acquire single”.
- 8) Verify that the grayscale image comes up typical of a ccd readout. The image gets darker towards the top
- 9) Check for the proper camera operating temperature, -30’s (it reads colder with winter temps in the dome).

Gerard Set-Up:

- 1) If Gerard is already on, close out of everything that is up and running.
- 2) Otherwise, turn on Gerard and log in when prompted
- 3) Double click INDIserver
- 4) Double click the Xephem icon on the desktop
- 5) Hit RT in the window that comes up.
- 6) In this window go to View=>Skyview
- 7) In the Skyview window go to Telescope=>INDIpanel
- 8) Focus (NOTE: Telescope must be enabled)
 - a) In the INDI panel, find Focus INDI
 - b) Click on “zero”. This will home the focus to the zero value.
 - c) Click on “Mont4K” focus
 - d) The focus is now set to the default Mont4K value, observers will be able to refine from there.
- 9) Filter holders have magnets that are read in the filter wheel. If you have installed a nonfacility filter into an empty holder or swapped filters into different holders follow instructions in back of this document on Editing the “filters.txt” File
- 10) Double click the “dataserver” icon on desktop
- 11) Double click the “galilserver” icon on desktop
- 12) Double click the “fw-gui” icon on desktop
- 13) If a DS9 window did not come up, you can double click the “DS9” icon on the desktop
- 14) In filter wheel gui hit “read filter codes” button and wait several minutes for filter wheel to read the filters.
- 15) Once filters are read, filter names will populate GUI. Verify all six filters are shown in the correct order and spelled correctly. Click a filter other than one highlighted. Verify new filter loads. Watch the GUI as it changes (Filter X Loaded – filterwheel busy – Filter Y Loaded).
- 16) Click the “home x&y” button on the filter wheel gui to home the guider mirror stage.
- 17) Click the “center mirror in ccd field” button on filter wheel gui.
- 18) Verify that the stage is moving and colors/position values are changing.
- 19) Wait for the stage to quit moving.
- 20) Re-home the stage once it reaches center by selecting “home x&y”
- 21) Turn off autoguider monitor as there is not a screen saver.
- 22) On Gerard if you want to save your images, create a new directory from the /home/bigobs directory with the mkdir command (i.e. from the home/bigobs directory type; mkdir tirebiter). Change to the new directory you just created with the cd / command (i.e. from the /home/bigobs directory type cd /tirebiter). Verify you are in the current directory by typing “pwd” (print working directory).

On BigCCD:

- 1) Turn on the BigCCD computer in rack below counter.
- 2) Verify there is NOT a light next to the fiber cable connectors on the back of bigccd. If not, swap fibers on gray electrical channel along wall in corner of room behind computers on counter. Recheck to see if there is a green light.
- 3) Check to see if you have an internet connection by looking at the networking icon in the lower right hand corner of the screen. If you have a network connection skip to step #4. If there is a triangle with a yellow (!) in it you do not have a connection. Follow steps below to connect:
 - a) Right click icon
 - b) Select "open network and sharing center"
 - c) Select "change adaptor settings"
 - d) Right click adaptor labeled "local area connection"
 - e) Click "disable"
 - f) Right click the other adaptor labeled "local area connection 2"
 - g) Click "enable" and wait a few seconds
 - h) Right click the same adaptor again and click "disable"
 - i) Right click adaptor labeled "local area connection"
 - j) Click enable
 - k) Close out of these screens and wait for a network connection
- 4) Double click "StartMont4K" icon to start azcam, it is yellow.
- 5) Mont4k Tool opens two windows; AzCam Tool and AzCamSever (red)
- 6) Click "reset" button to get the camera and dewar temps to start updating.
- 7) On main Mont4k Tool screen (Exposure tab) verify the following:
 - a) "Time Sync" indicator circle is green. If it is red, AzCam is not syncing with local GPS. It should not turn red very often or stay red very long. If it does, there is a local time sync issue with the GPS. Check to make sure GPS is plugged in. Restart AzCam computer. Cycle power to GPS. Log on to GPS and make sure it is working.
 - b) Camera and dewar temperatures update in AzCam Tool. Note that the current camera operating temperature is -119C and dewar temp is around -186C to -196C.
- 8) Click "Filename" button.
 - a) Change yellow box under Directory to /home/bigobs/data. Hit enter. Verify blue box under Filename reads "/home/bigobs/data/test.fits".
 - b) Delete Rootname. Hit enter.
 - c) Delete Sequence Number. Hit enter.
 - d) Check that Auto increment sequence, Overwrite existing image, Include sequence number and Test Image are checked.
 - e) Image Format should read Extended FITS.
 - f) Click close to Close out of the window.
- 9) Click "Detector" button.
 - a) Set the binning 3X3
 - b) Hit full frame button and then apply button. Should now read:
 - i) first column 1
 - ii) last column 4096
 - iii) first row 1

- iv) last row 4096.
- c) Click "OK" when done. Then Close.
- 10) Click "Preferences" button. Select the following:
 - a) Clear Array Before Each Exposure
 - b) Show Users Warnings
 - c) Auto Title Image
 - d) Click file folder icon next to yellow box below Image Header File. A window called "Open" opens. Click "fits templates" folder.
 - e) Select "FitsTemplate_mont4k_master.txt" by clicking on it. Click ok. Verify yellow box below Image Header file reads
C:\AzCam/systems/mont4k/FitsTemplates/FitsTemplate_mont4k_master.txt. Click "Close".
- 11) Click Instrument tab at the top
 - a) Make sure Enable Instrument is checked
 - b) Click on the Instrument button and verify that the filter in the yellow box reads the same as on the filter wheel GUI on Gerard.
 - c) Click in yellow box. A drop down menu appears with available filters. Click on different filter
 - d) Verify that filter wheel gui loads selected filter
 - e) In filter wheel gui select different filter
 - f) Verify correct filter reads in yellow box on AzCam
 - g) Click close
- 12) Click the Telescope tab at the top
 - a) Make sure Enable Telescope is checked.
- 13) M4kTool window should now display:
 - a) Binning 3X3
 - b) Image Filename /home/bigobs/data/test.fits
 - c) "TestImage" should be checked.

Zero Image:

- 1) In dome turn off all lights, close mirror covers, etc.
- 2) On Gerard start IRAF.
 - a) In the new window with IRAF, type "pwd" to see what directory you are in
 - b) Change the directory to match what the Image Filename path reads in M4kTool.
Example: IRAF directory should read "/home/bigobs/data". To get into the data directory type "cd data" then hit enter.
- 3) If you are SAVING each image in your own directory, deselect TestImage on Mont4k Tool.
- 4) In IRAF type "mscred" to get into the mscred package. Hit Enter.
- 5) In Mont4k Tool, under Image Type, click up/down arrows until zero is displayed.
- 6) Press "Expose" to take the image.
- 7) In IRAF type "imheader test.fits[1] longheader=yes". Hit enter. This displays the image header information for the zero image you just took. Scroll up and verify that the correct exposure time, date, filter, RA and DEC are recorded. This verifies that you are looking at the correct image in the correct directory taken TODAY and not some old image labeled test.fits.

- 8) In IRAF type “mscdisplay test.fits”. Hit enter.
- 9) When prompted with “frame to be written into” hit “enter”
- 10) The image will display on Gerard in the SAOImage ds9 window. Verify that the image looks good. Click zoom button located in center of ds9 window about 1/3 of the way down. Then click “to fit”. Click + to make bigger. Adjust so you can see whole image. Hold down right mouse button and move mouse up/down right/left to adjust contrast of image.
- 11) See **EXAMPLE 1**
- 12) Take second zero and redisplay. Verify that it looks good

Telescope Balance and Configuration:

- 1) Let the system stabilize for 1 hour.
- 2) Balance the telescope (for notes on how to move the telescope, reference TCS-ng operating manual).
- 3) Set IRIS to 304/305 unless requested otherwise (Betsy or her observers typically want it at 297/298). Approach with numbers getting bigger.
- 4) Stow scope, close mirror covers and then move dome to flatfield screen.

Fill Out CCDLog:

- 1) It takes approximately an hour for the cam temp to stabilize after taking your first image if camera was pumped and cooled the day before. If time permits wait an hour before making measurements.
- 2) Before you take any images-turn off the IR camera in the dome. This will screw up any data you take! Make sure you turn it on every time you move the telescope so you can watch it move.
- 3) Take three zero images. Display each zero by typing “mscdisplay test.fits”.
- 4) Measure the third image.
- 5) Fill in a ccdlog form as you analyze the images. The M4K has 2 amplifiers which is why the screen is split. Note that amp[1] is on the left side of screen with bad column; amp [2] is on the right
- 6) All recorded measurements will be from amp[1].
- 7) Look at the image to verify it looks good by typing **mscdisplay test.fits**
- 8) When prompted with “**frame to be written into**” hit “**enter**”
- 9) The image will display on Gerard in a SAOImage ds9 window.
- 10) See **EXAMPLE 1**
- 11) Verify that the image looks good and does not have any noise patterns etc. You will see that there is a bad column on the left side of the chip.
- 12) From the “mscred>” prompt in the IRAF xgterm window type
imstat test.fits[1][300:350,300:350]
- 13) This command generates image statistics for the zero image that you just took. Record the following on the CCD Log : mean ~ 927 DN, min ~ 921 DN, max ~ 934 DN, stddev ~ 1.78
- 14) From the AzCam PC note the camtemp ~ -119 C and dewtemp ~ -196 C
- 15) Start a browser and go to Mike Lesser’s ITL web site: <http://cameras.itl.arizona.edu>. From there navigate to the M4K stats.
- 16) Note the gain for amp1 (currently 3.19 e⁻/DN for amp[1] on the left side and 3.08 for amp[2]

on the right side.

- 17) Use 3.1 as we do not need further significant digits per Mike Lesser.
- 18) Calculate the read noise for amp[1] on the left side (stddev x gain = read noise in electrons).
The read noise should be $\sim 5.27 e^-$ based on last checkout.
- 19) Record data on CCD Log
- 20) Type **implot test.fits[1]** (displays a horizontal, single line plot through the image, row 683 binned 3X3)
- 21) See **EXAMPLE 2**.
- 22) Redisplay the plot to bring the line into the center of view by bracketing the min and max pixel value. With the cursor in the plot type **:y 945 960** for example if the min value was 950, and the max value was 955
- 23) See **EXAMPLE 3**.
- 24) With the cursor in the implot window type **:l 300 350** (displays a line plot averaging lines 300-350) An averaged line plot will have less noise than a single line plot, should be fairly flat (1-2 DN) and have no abrupt changes in the profile of the plot.
- 25) To find out the pixel value at a given location hit "**Shift**" key and letter "**c**" at the same time when the cursor is in the interactive IRAF window. Two coordinates will be displayed:
 - a) First coordinate is the column number from the bottom of the graph
 - b) Second coordinate is the pixel value on the graph where that column intersects the graph
- 26) Measure the overscan, the difference between the image and the last 20 columns (right side of image). The overscan should be $\sim 1-2$ DN below the image. Increase the resolution of the y-axis if necessary by bracketing around the mean counts (see step 22).
- 27) See **EXAMPLE 4**.
- 28) Record the overscan on the CCD Log
- 29) With the cursor in the implot window type **:c 300 350** (displays a vertical column plot averaging columns 300 to 350). An averaged column plot may have a slight gradient (1-2 counts). A strong gradient across the chip may indicate a light leak.
- 30) See **EXAMPLE 5**.
- 31) Record the gradient of the column plot on the CCD Log
- 32) Type **q** to quit implot.
- 33) Type **imhist test.fits[1][300:350,300:350] z1=xxx z2=xxx** where z1 and z2 bracket the min and max values by ± 5 . The histogram should have a smooth profile (gaussian distribution) with no stair step appearance (missing or stuck bits).
- 34) See **EXAMPLE 6**.
- 35) Redisplay if necessary to adjust scale on bottom so it is close to beginning and ending value of histogram.
- 36) Record what the camera is binned at on CCD Log

Dark image:

- 1) Purpose - to check dark current, charge transfer and amplifier glow: Turn dome lights off, close mirror covers, make sure IR camera is off.
- 2) In AzCamTool click on the yellow field next to "Image Type" and select "Dark". Click the yellow field next to "Exposure" and set the exposure time to 300.0 seconds. Click "Expose" to take an image.

- 3) Once the exposure is finished, examine the whole chip by typing **mscdisplay test.fits**. When prompted with “frame to be written to” hit “enter”.
- 4) See **EXAMPLE 7**.
- 5) An amplifier glow will cause a bright area in one or more corners of the image. If a corner of a five minute dark image shows a bright area where there was none during previous observing runs, check the instrument for a light leak. If you suspect an amplifier glow, call ITL.
- 6) Type **imstat test.fits[1][300:350,300:350]** and record the image statistics on the CCDLog for the 5 minute dark. mean ~ 931 DN, min ~ 925 DN, max ~ 937 DN, stddev ~ 2.6
- 7) Calculate the read noise (stddev x gain = read noise in electrons). The read noise should be ~ 5.8^{e-}.
- 8) Type **implot test.fits[1]** (displays a horizontal single line plot through the image, row 683 if binned 3x3).
- 9) See **EXAMPLE 8**.
- 10) Redisplay to bring up into view by typing **:y 845 870** bracketing a min of 850 and a max of 865.
- 11) Compare to the sample implot.
- 12) See **EXAMPLE 9**.
- 13) With the cursor in the implot window type **:l 300 350** (displays a line plot averaging lines 300-350).
- 14) See **EXAMPLE 10**.
- 15) An averaged line plot will have less noise than a single line plot, should be fairly flat (1-3 DN) and have no abrupt changes in the profile of the plot. Measure the overscan, it should be no more than 1-3 counts below the image. Increase the resolution of the y-axis if necessary by bracketing around the min and max counts
- 16) With the cursor in the implot window type **:c 300 350** (displays a vertical column plot averaging columns 300 to 350).
- 17) See **EXAMPLE 11**.
- 18) An averaged column plot may have a slight gradient (1-4 counts). A strong gradient across the chip may indicate a light leak.
- 19) Type **q** to quit implot.
- 20) See **EXAMPLE 12, 13, 14**.
- 21) Zoom in on the dark frame and look at the cosmic ray events. Increase the contrast and adjust the brightness to make the bright pixels stand out from the image. Using the panner window, drag green box to look at different sections of the chip in detail. Make sure that the cosmic ray events have no tails and/or that they do not all point in the same direction. This would indicate a charge transfer problem.

Flat Field Images:

- 1) Turn the dome to the flat field screen by clicking stow in the Dome module in TCS after hitting Connection=>On, do any fine tune adjusting upstairs using the paddle, click initialize in dome module. You can then choose the Dome Flat service position in TCS. Open the mirror covers, move the telescope to flat field screen using the preloaded service position in TCS. Note: both dome and telescope will only move if telescope is enabled.
- 2) Turn on the flat field lights and set them to 50%. Carefully climb up the steps and verify they

- are all on at the end of the scope
- 3) Using the filterwheel GUI, select the I filter and wait for it to load.
 - 4) In AzCam Tools set the image type to Flat and the Exposure to 1sec. Take a 1 second flat image in the I filter.
 - 5) In IRAF type **mscdisplay test.fits** to display the image in ds9. When prompted with “frame to be written to” hit “enter”.
 - 6) See **EXAMPLE 15**.
 - 7) Run cursor over image in ds9. Counts for I = 1 sec should be around 11,000 in the center of the screen.
 - 8) In IRAF type: **implot test.fits[1]**
 - 9) See **EXAMPLE 16**.
 - 10) The intensity in counts should be similar to previous test image if taken with the flat field lamps set at the same intensity and with the same M4K setup. Flat field images should verify that there are no obstructions in the light path above the CCD. Properly taken flats are high signal to noise ratio images and often reveal defects in the CCD chip; traps, hot columns, cluster defects etc. which should be repeatable from one observing run to the next observing run. Flats may also show patterns such as dust on the chip or dewar window which may or may not be repeatable from one observing run to the next observing run.
 - 11) Follow the graph to its highest point and hit the “Shift” key and the “C” together to get the column and pixel value at that point.
 - 12) Record counts on the CCD Log.
 - 13) Take a second I flat field image with a 2 second integration.
 - 14) In IRAF type **mscdisplay test.fits** to display the image in ds9. When prompted with “frame to be written to” hit “enter”.
 - 15) Graph the new 2 second flat by typing **implot test.fits[1]**
 - 16) Follow the graph to its highest point again and hit the “Shift” key and the “C” together to get the column and pixel value at that point. Try to get the same column as you did for the 1 second flat. Type “q” to quit plot
 - 17) Record counts on the CCD Log.
 - 18) The intensity in counts should be approximately double from the 1 and 2 second exposures. For example 1sec counts = 10,923 and 2sec counts = 20,330.
 - 19) Take a flat through each filter using the exposure times below. For each filter use the IRAF command **mscdisplay test.fits** to display the image and check that there is no dust on the filters. Then graph the flat by typing **implot test.fits[1]**. Follow the graph to its highest point and hit the “Shift” key and the “C” together to get the column and pixel value at that point. Do this for each exposure. Record counts on the CCD Log. See examples below:
 - a. R = 2 sec (12,500 counts) **EXAMPLE 17,18**
 - b. B = 60 sec (10,254) **EXAMPLE 19, 20**
 - c. V = 10 sec (14,540) **EXAMPLE 21, 22**
 - d. Schott = 5 sec (12,331) **EXAMPLE 23, 24**
 - 20) Go upstairs and turn flat field lights up to 100%

21) Take a 30sec U flat. Use the IRAF command **mscdisplay test.fits** check that there is no dust on the filter. Then graph the flat by typing **implot test.fits[1]**. Follow the graph to its highest point and hit the “Shift” key and the “C” together to get the column and pixel value at that point. See examples below:

a. U=30 sec (18,665) **EXAMPLE 25, 26**

22) Take a series of Zero images (10-20) to see if any noise patterns appear.

Wrap-Up:

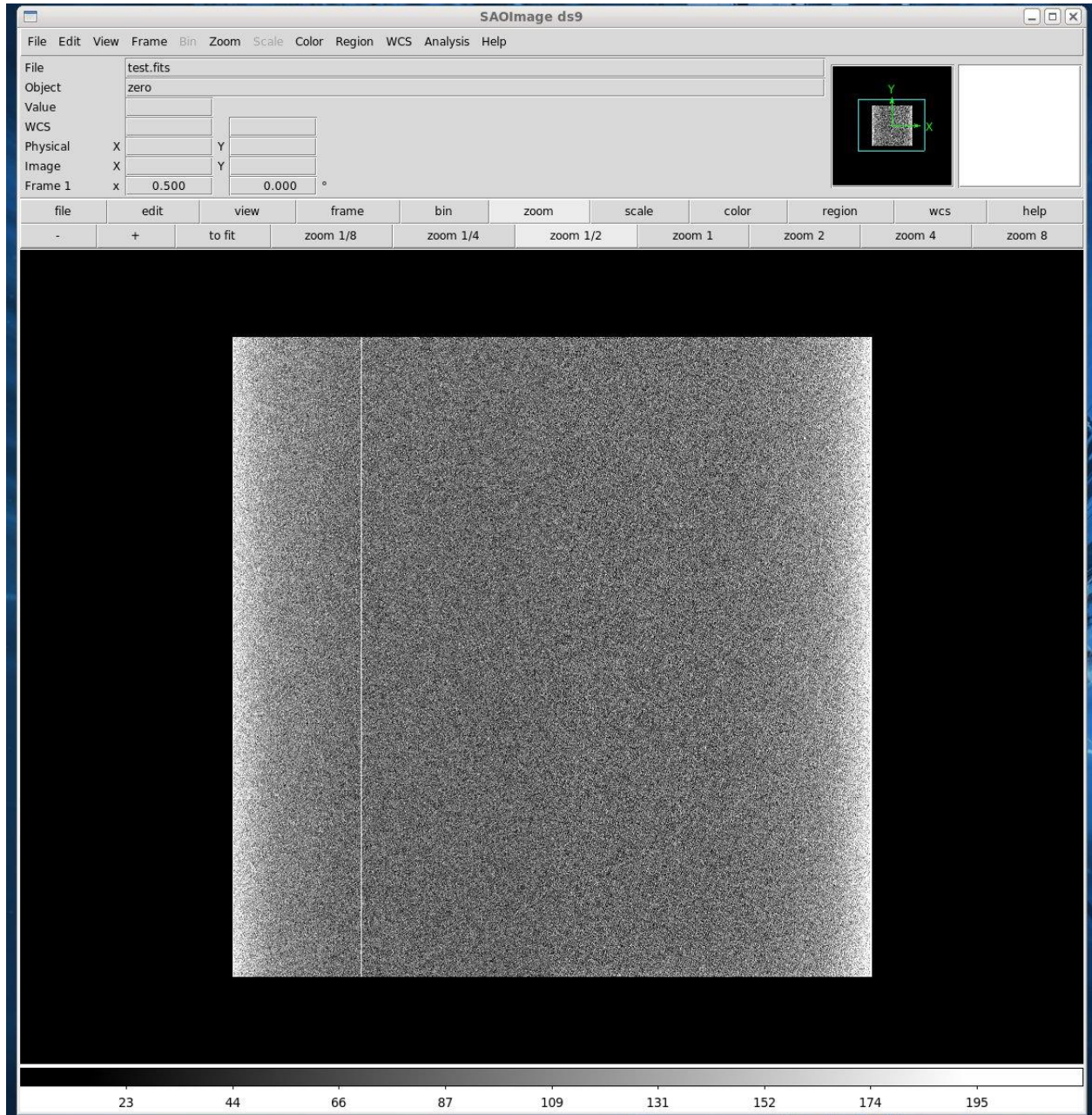
- 1) Send an email detailing the results of the tests performed on the images.
- 2) Use the ccdlog report as a template.
- 3) Send the email to garyr, jgrantham, jhoschei, mwaidanz, savage9, ealey, psmith, sbland, and mlessner; cc bgreen.
- 4) Delete any images you saved if you don't need them. To do so: Go to the directory where your images are stored. Type **cd** and then the file path to the images (for example `cd /home/bigobs/data/tirebiter`).
- 5) Once there, verify that you are in the correct directory by typing **pwd**.
- 6) Type **ls** to list your images in your directory (test.fits in tirebiter directory for example).
- 7) Type **del *** to delete any files in the directory.
- 8) Once images are deleted go up to the next highest directory by typing `cd ..` (from /tirebiter to /data).
- 9) Once you are in the data directory delete the directory you created by typing **rmdir tirebiter**. To make sure it is gone type `ls` in the data directory to list the current directories and files.

Editing the “filters.txt” File:

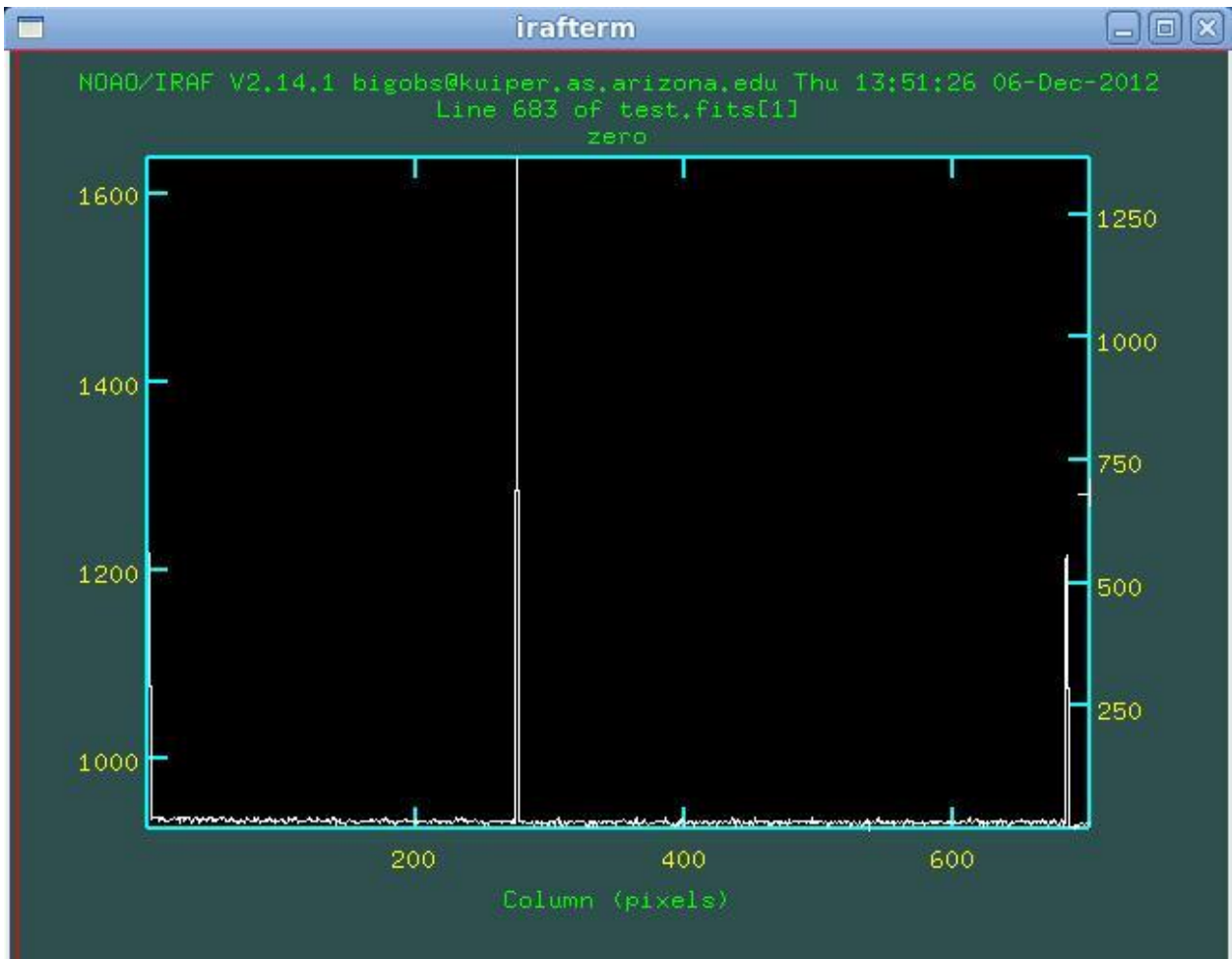
If you have changed the filter sequence, swapped out filters, or removed a filter follow steps below:

- 1) Click the blue heart tab at the upperleft of the desktop.
- 2) Goto “accessories” and select “GNU Emacs 24”. Emacs is a program to edit files.
- 3) Goto “file” tab at top of screen and click.
- 4) In drop down menu select “open file”.
- 5) Type “filters.txt” at bottom of screen where it reads “find file:”
- 6) Hit “enter”.
- 7) Note that filter names are associated with holder numbers based on magnet positions. If you use a new holder be sure to enter the holder number along with the filter name.
- 8) Rewrite the new filter sequence. There should be no spaces in the names.
- 9) Click “file” tab at top of screen and select “Save(current buffer)”
- 10) Click “file” tab and goto “exit emacs”

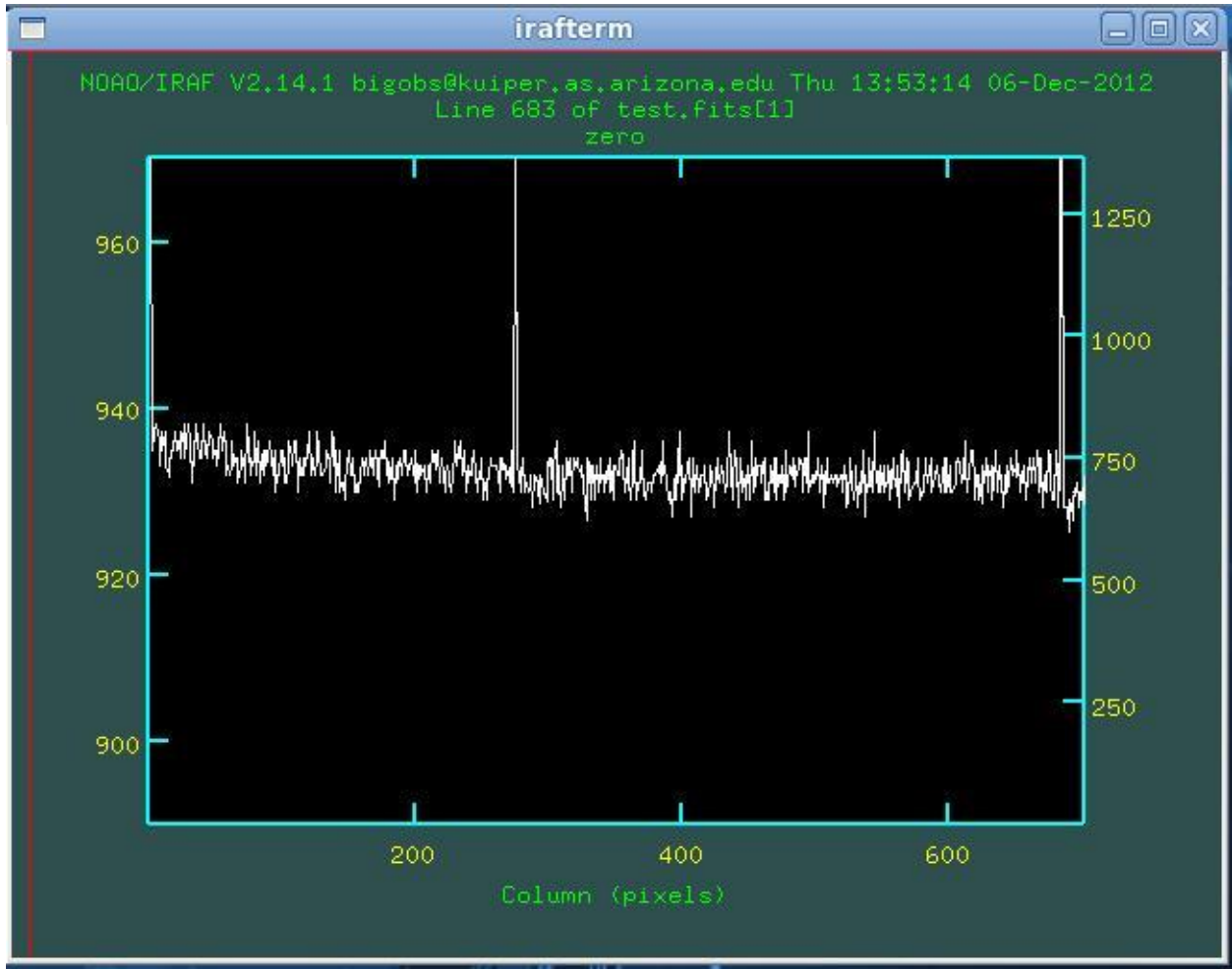
EXAMPLE 1
Zero



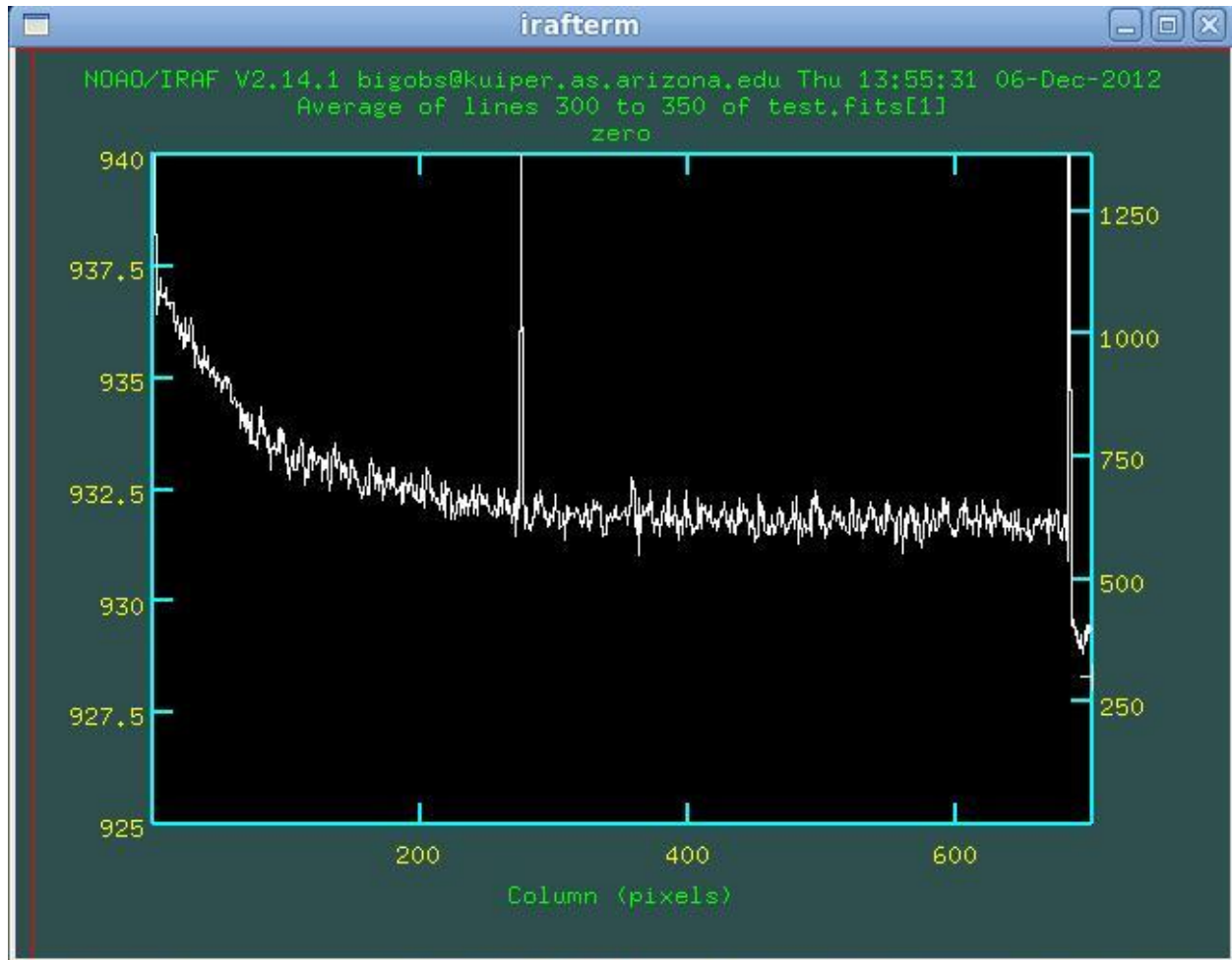
EXAMPLE 2
Implot



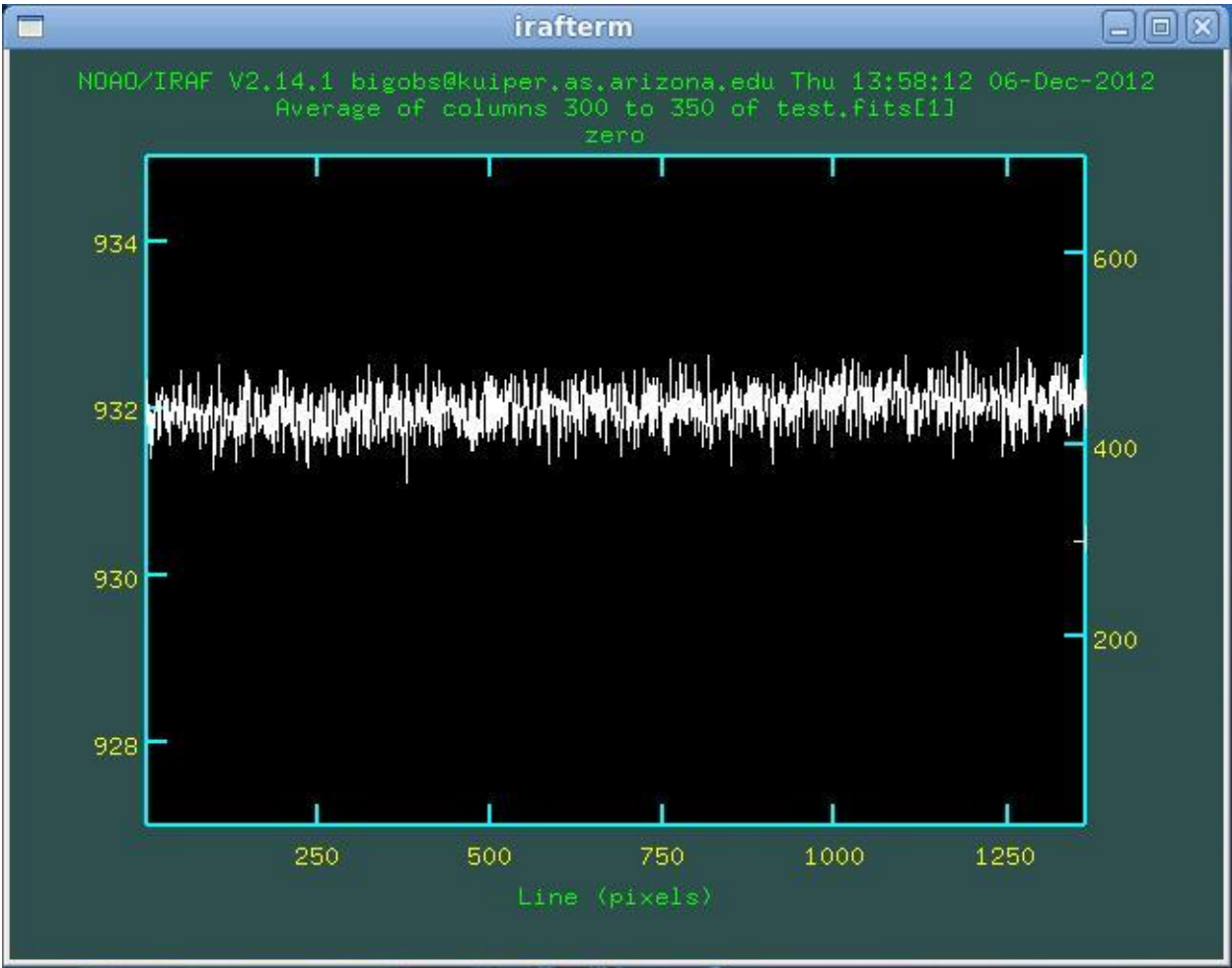
EXAMPLE 3
Implot Y
adjusted



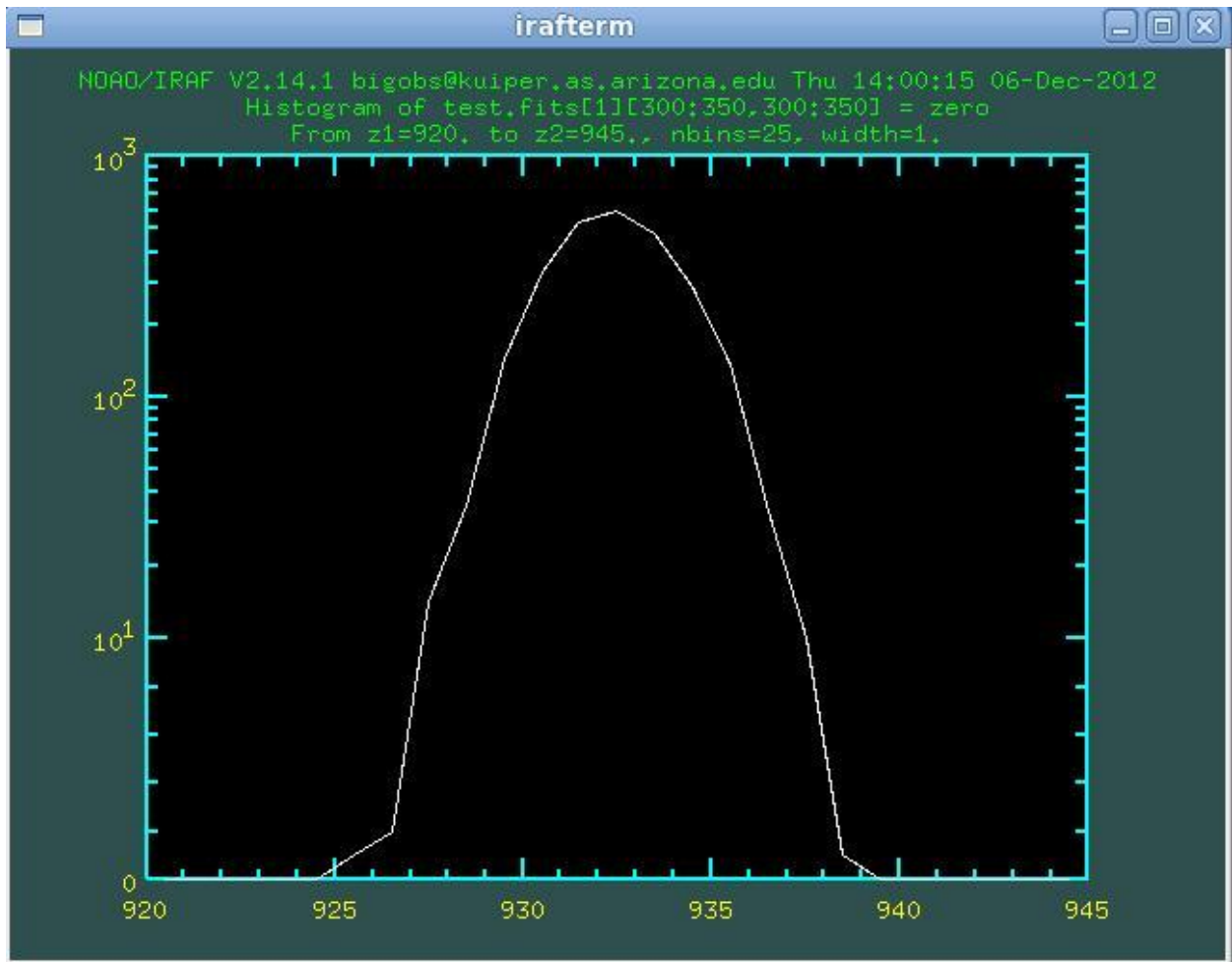
EXAMPLE 4
Line Plot



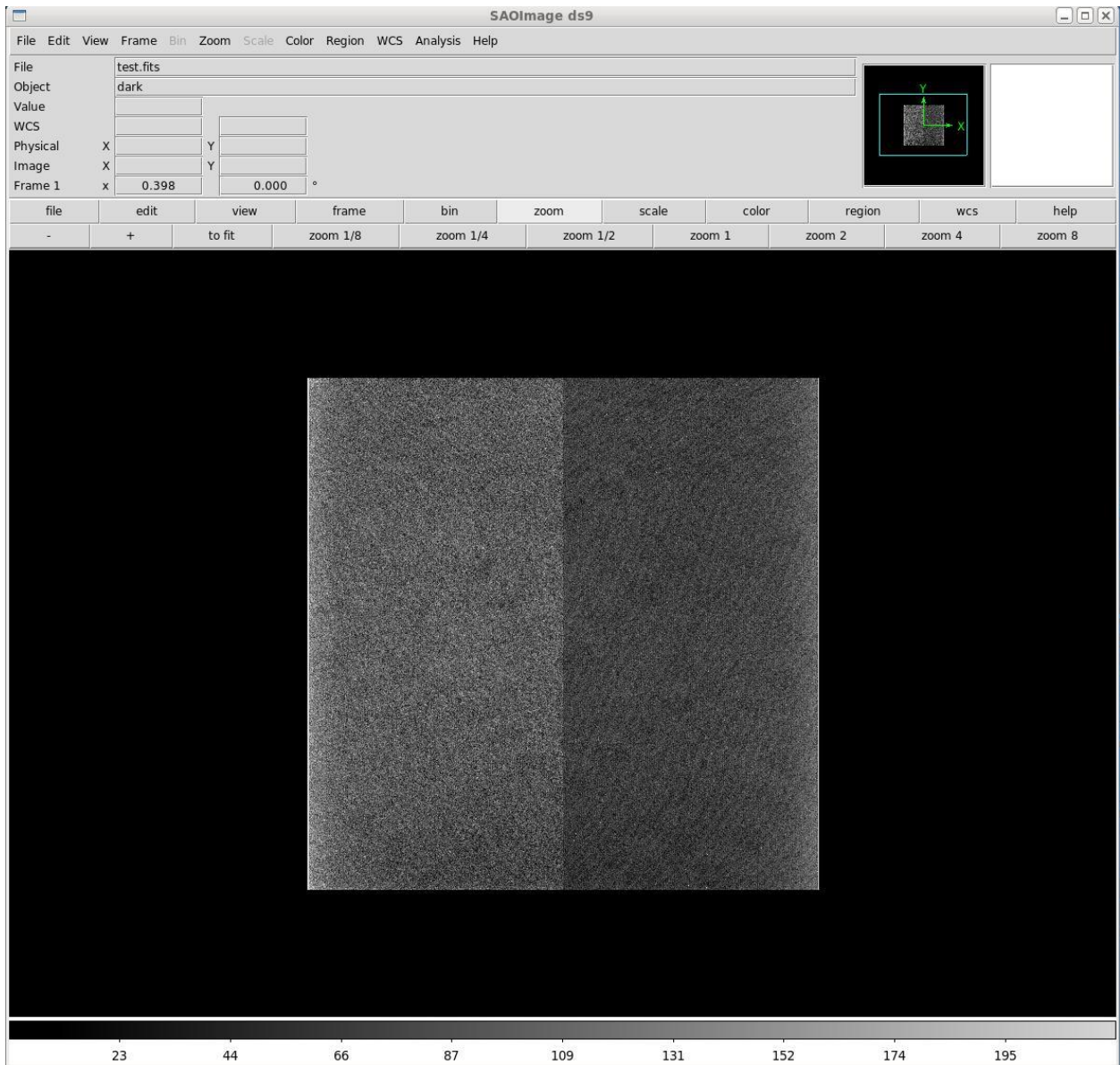
EXAMPLE 5
Column Plot



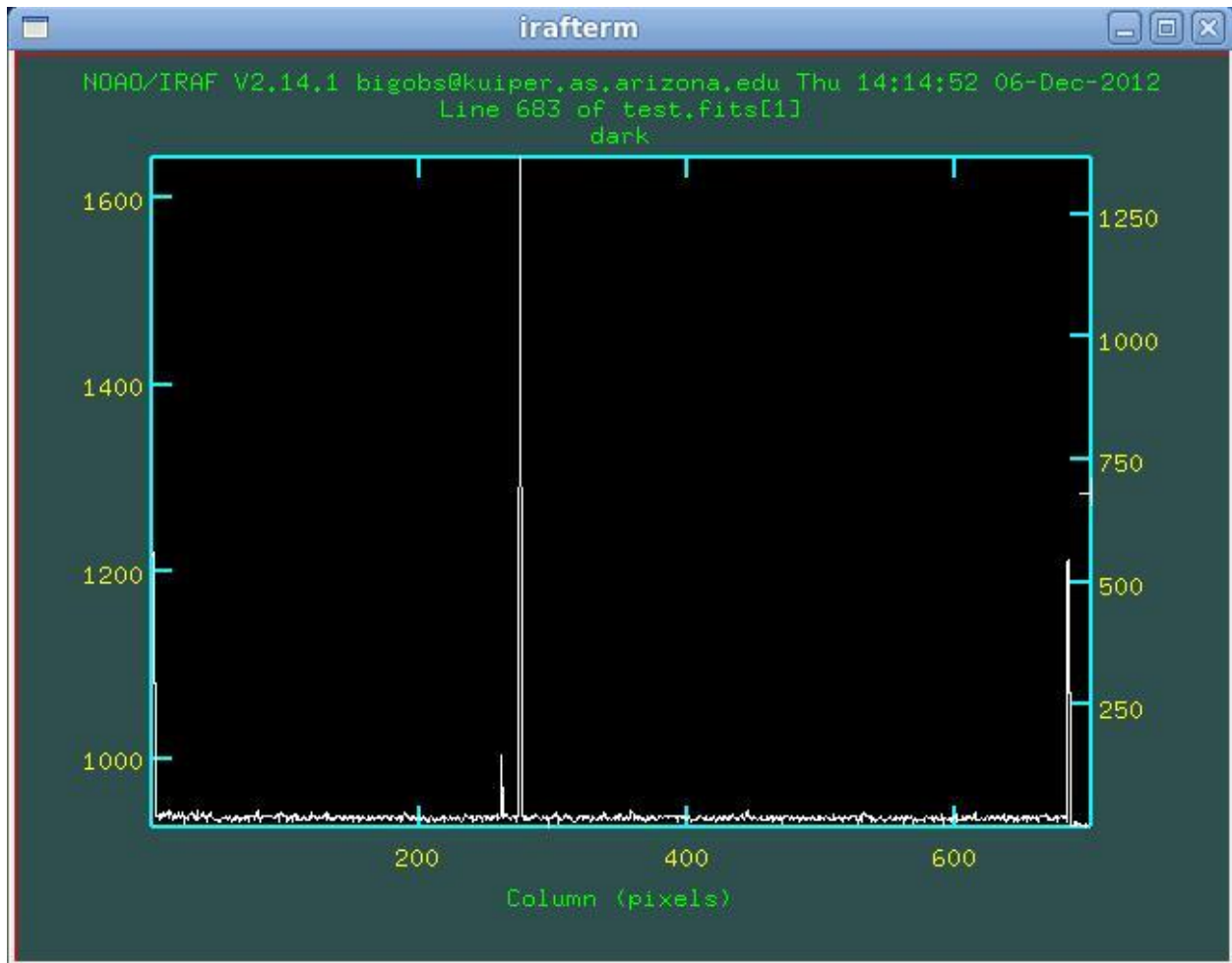
EXAMPLE 6
Imhist



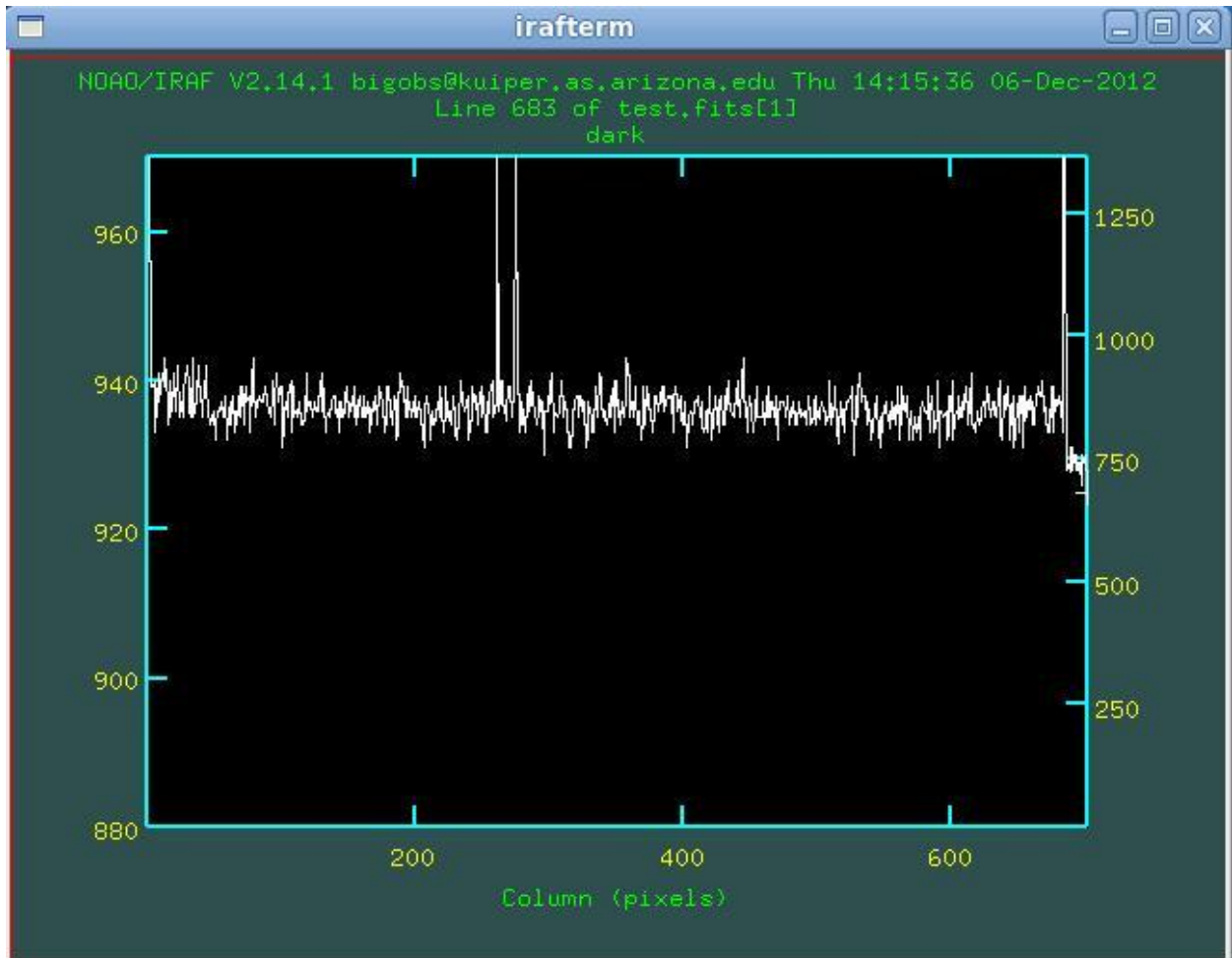
EXAMPLE 7
Dark



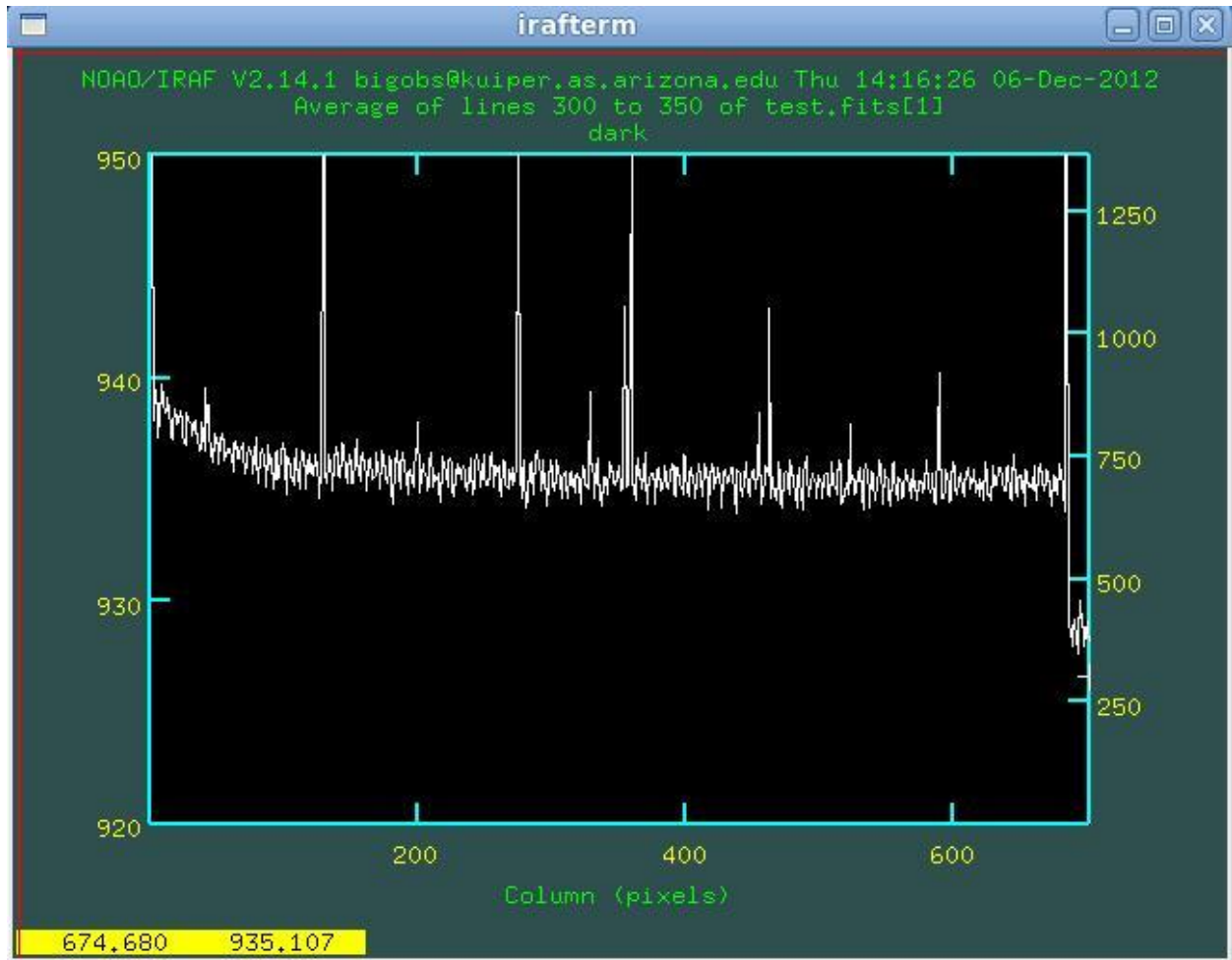
EXAMPLE 8
Dark Implot



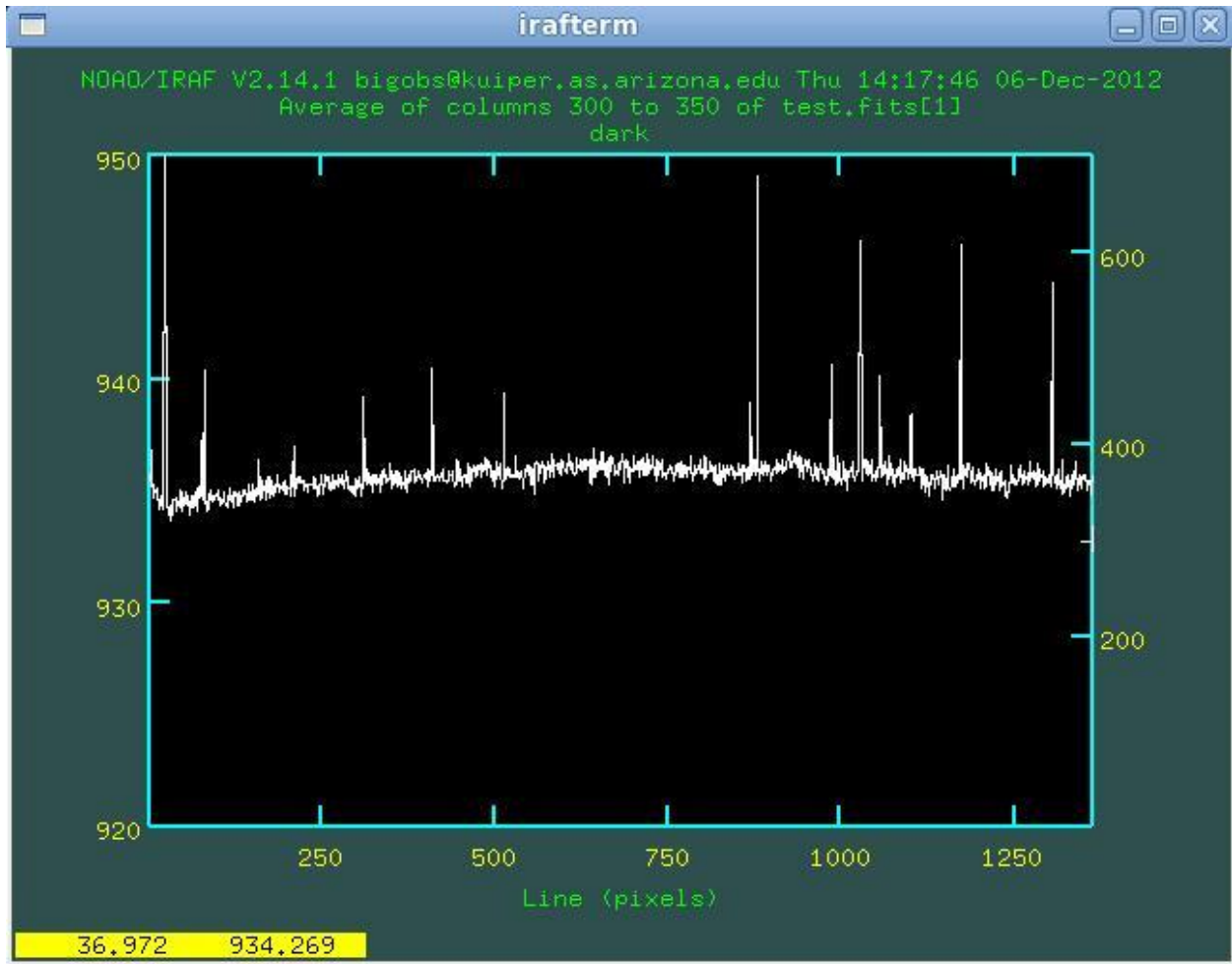
EXAMPLE 9
Dark Implot Y
adjusted



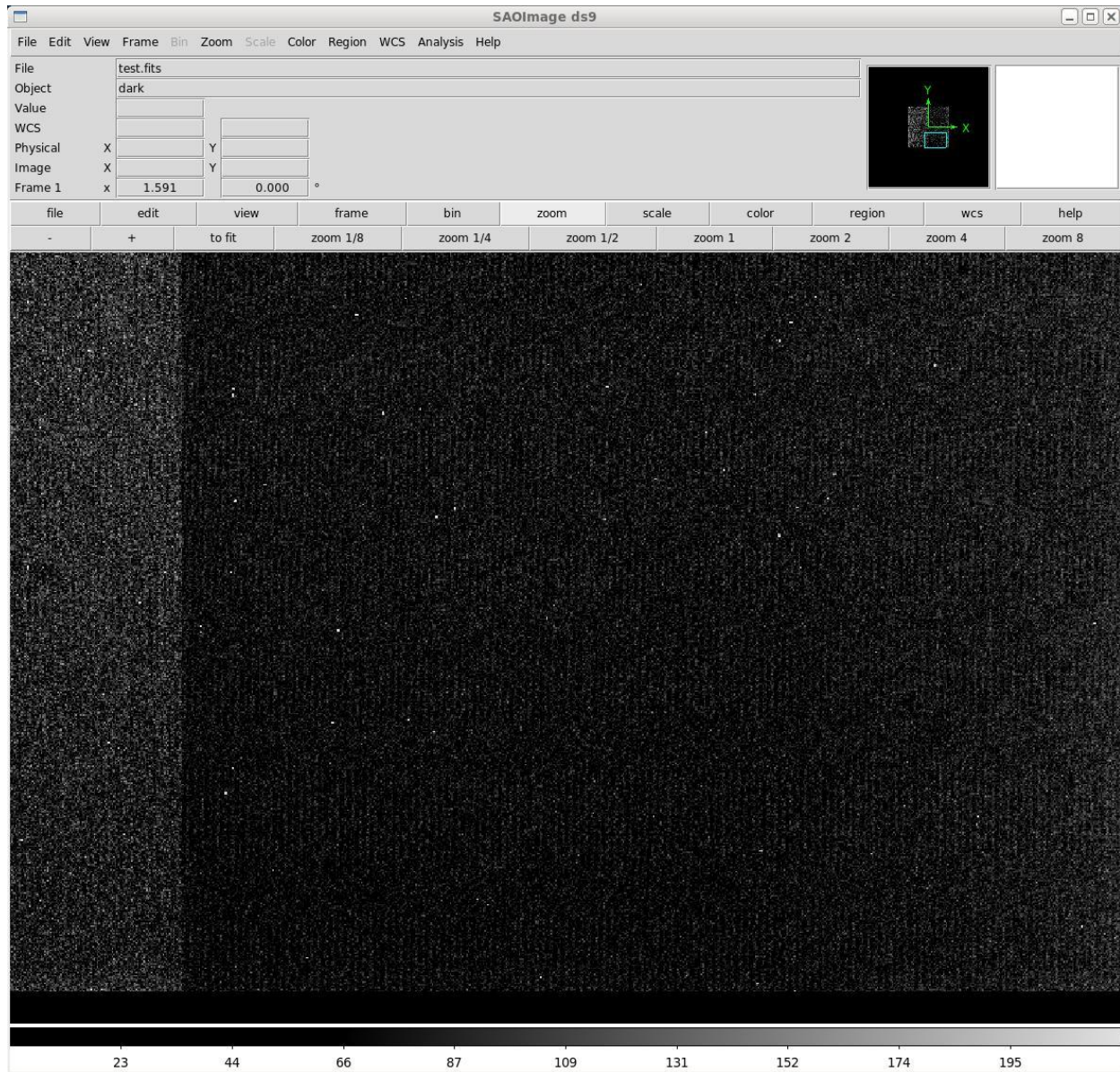
EXAMPLE 10
Dark Line Plot



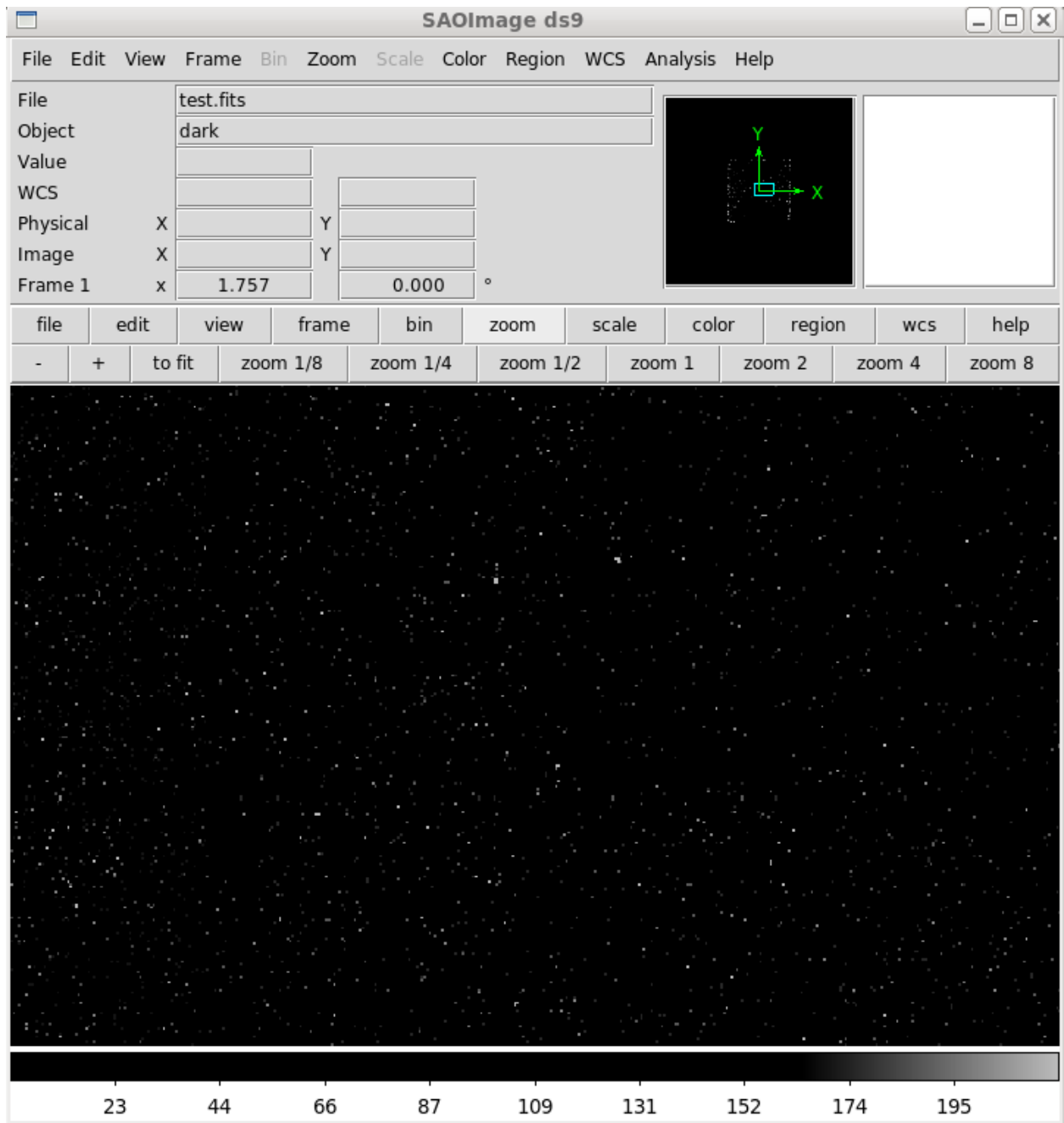
EXAMPLE 11
Dark Column
Plot



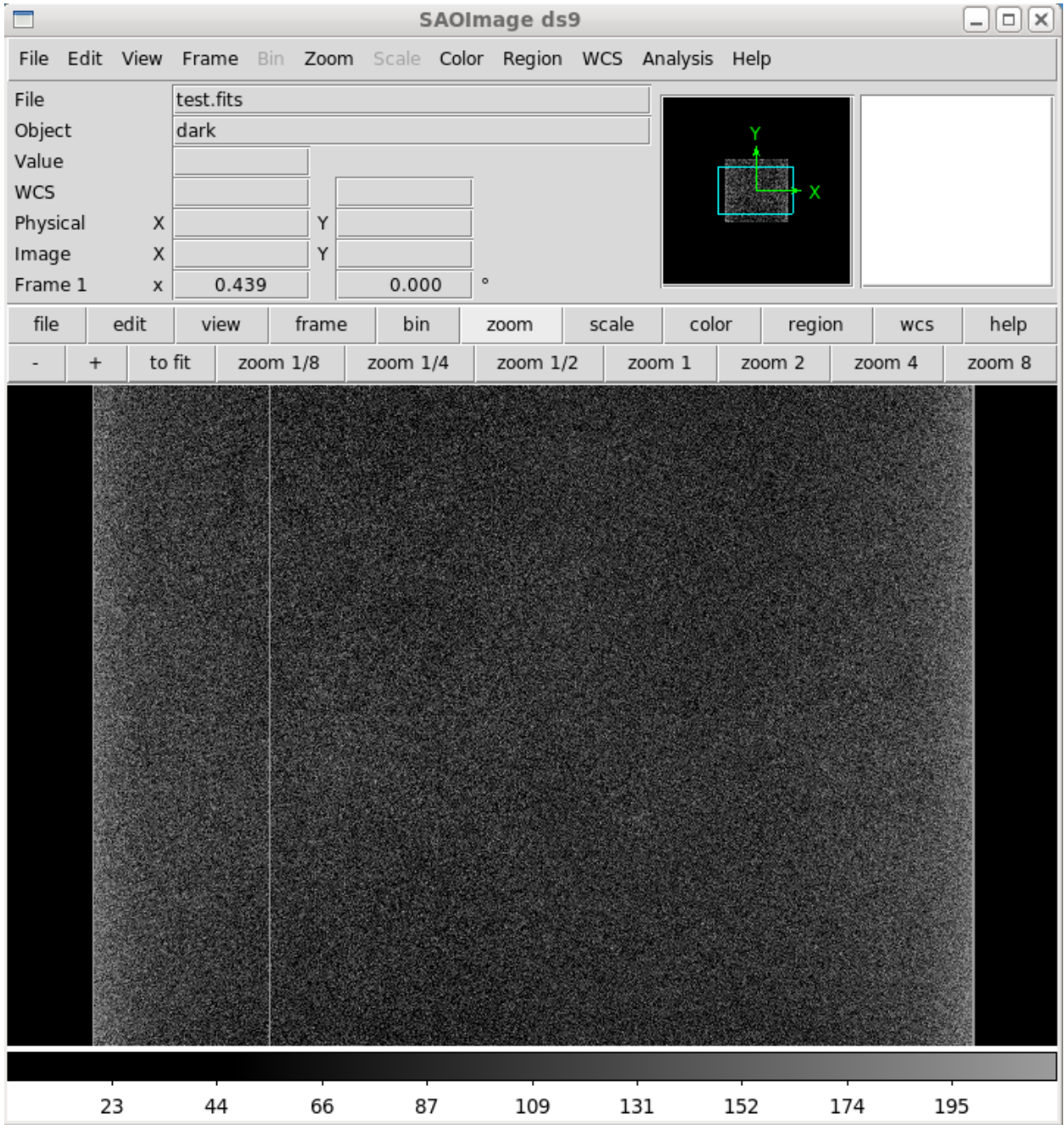
EXAMPLE 12
Cosmic Rays
Dark



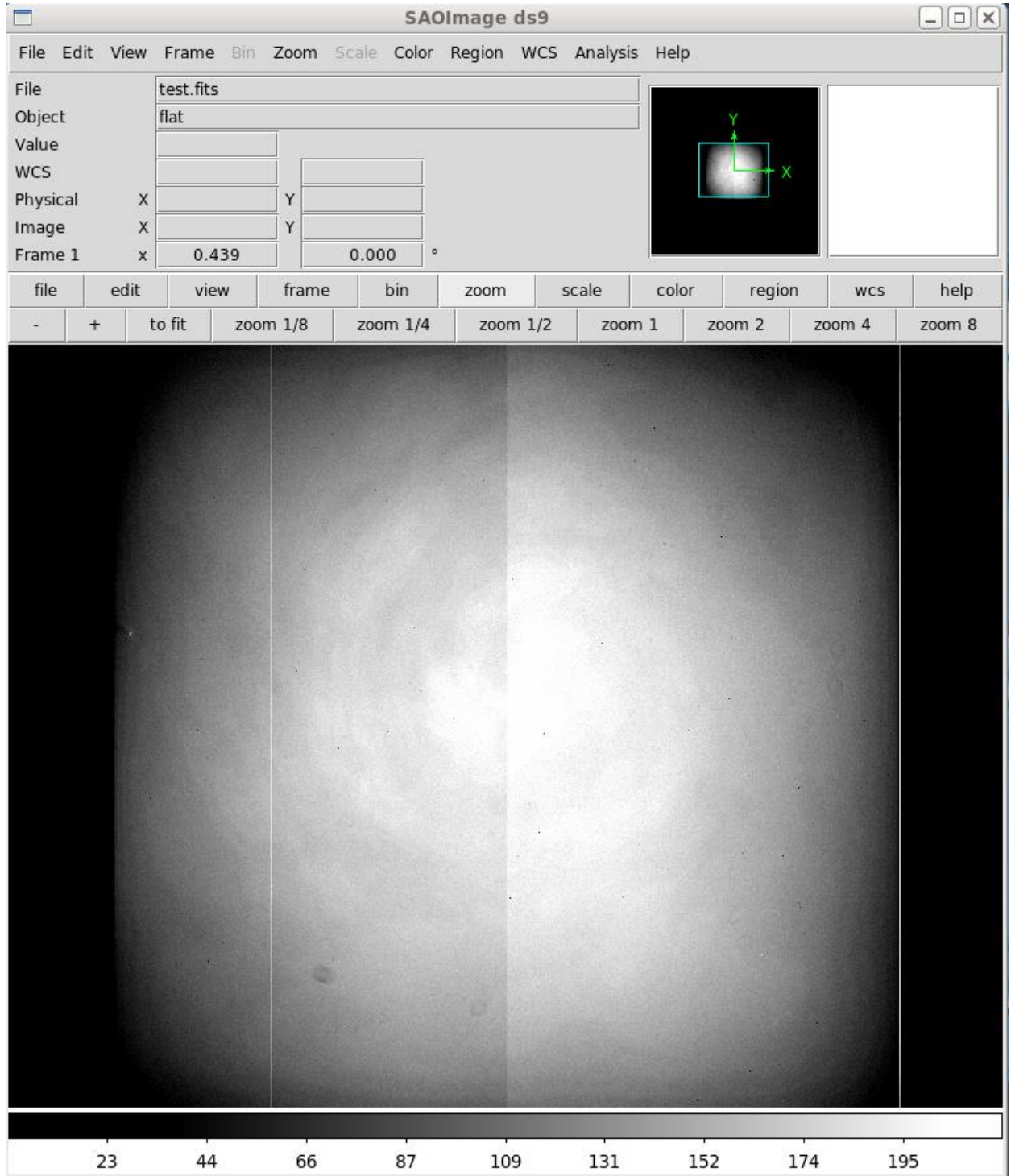
EXAMPLE 13
Cosmic Rays
Dark



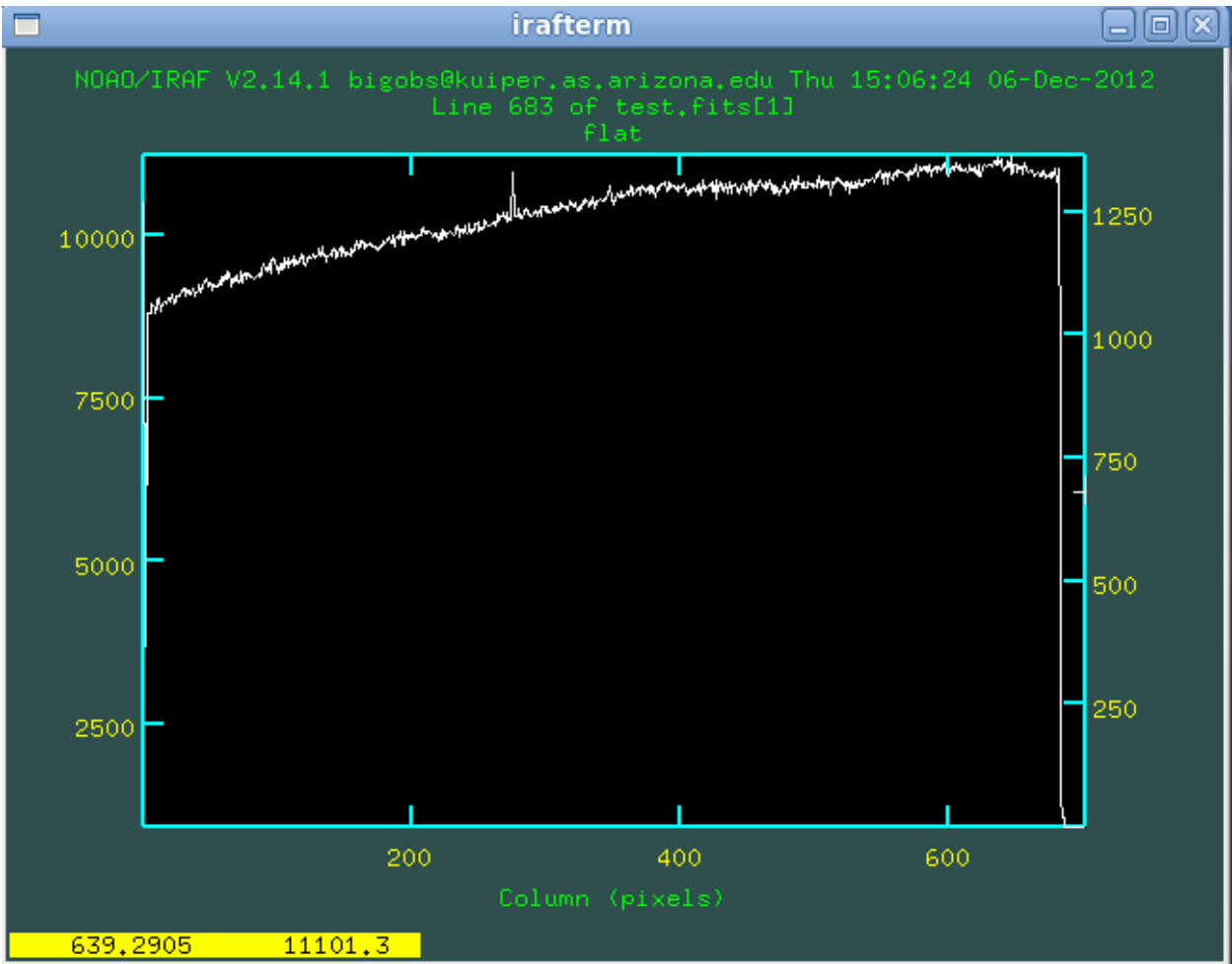
EXAMPLE 14
Second Dark
Stabilized



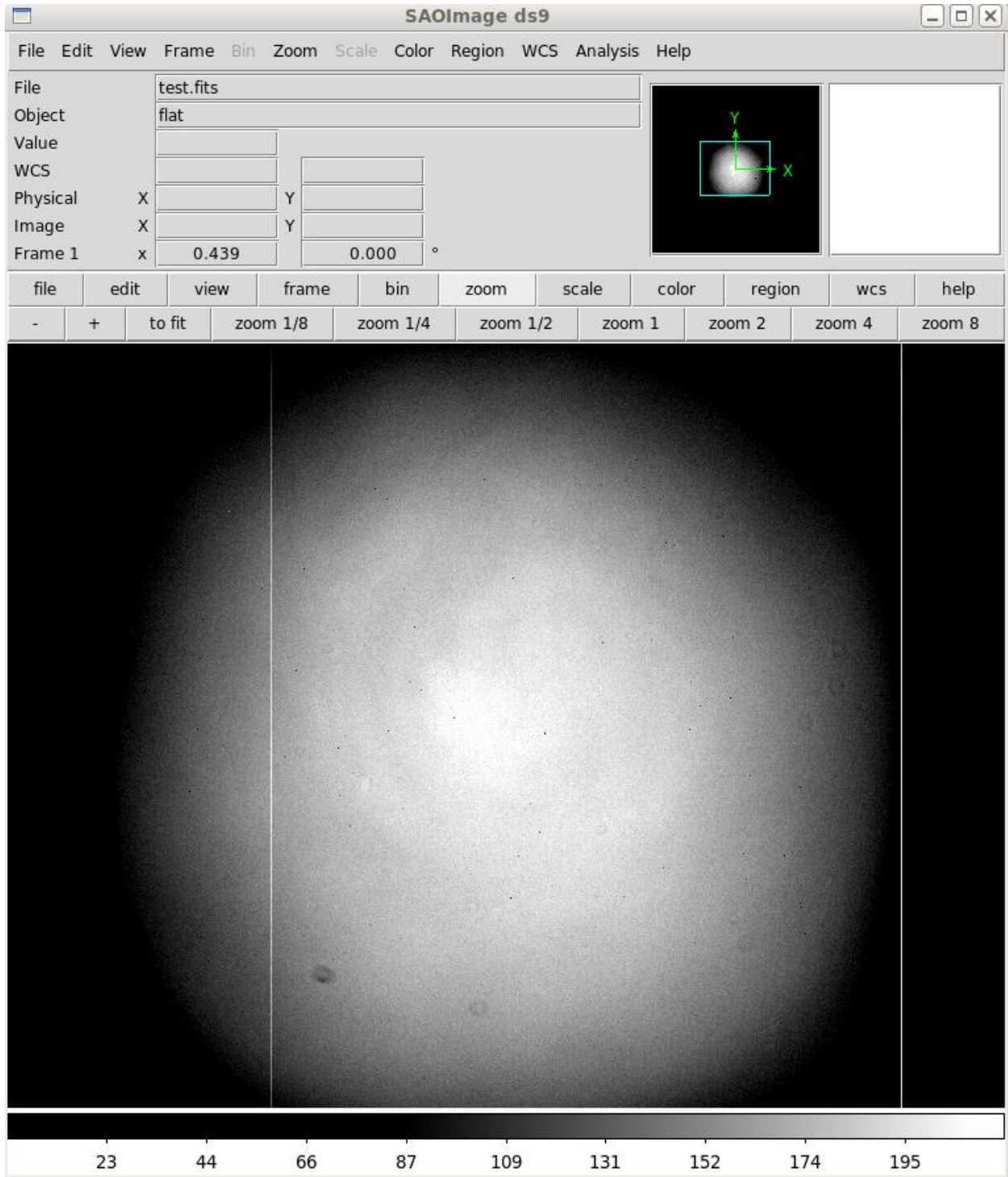
EXAMPLE 15
I Flat



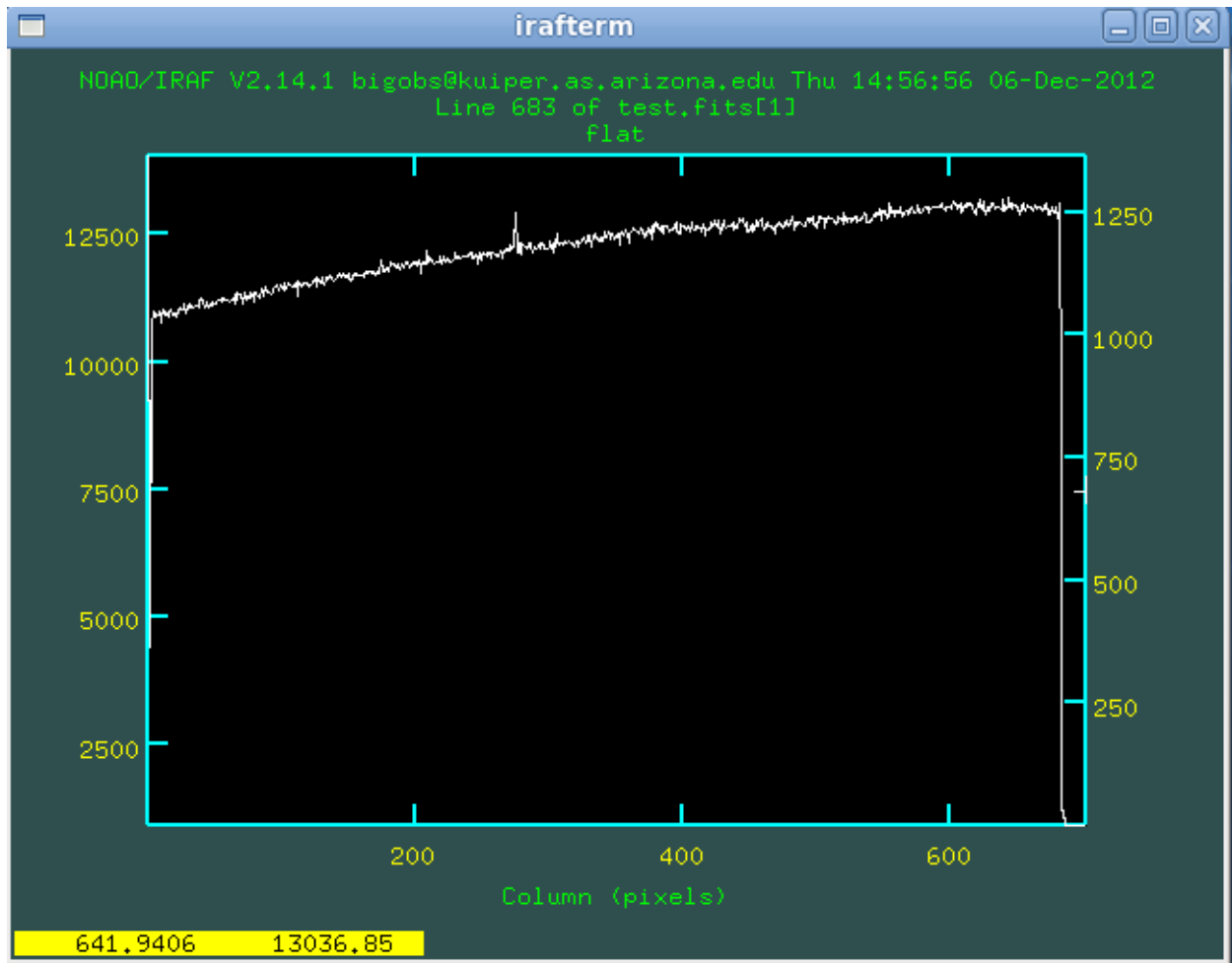
EXAMPLE 16
I Flat Impot



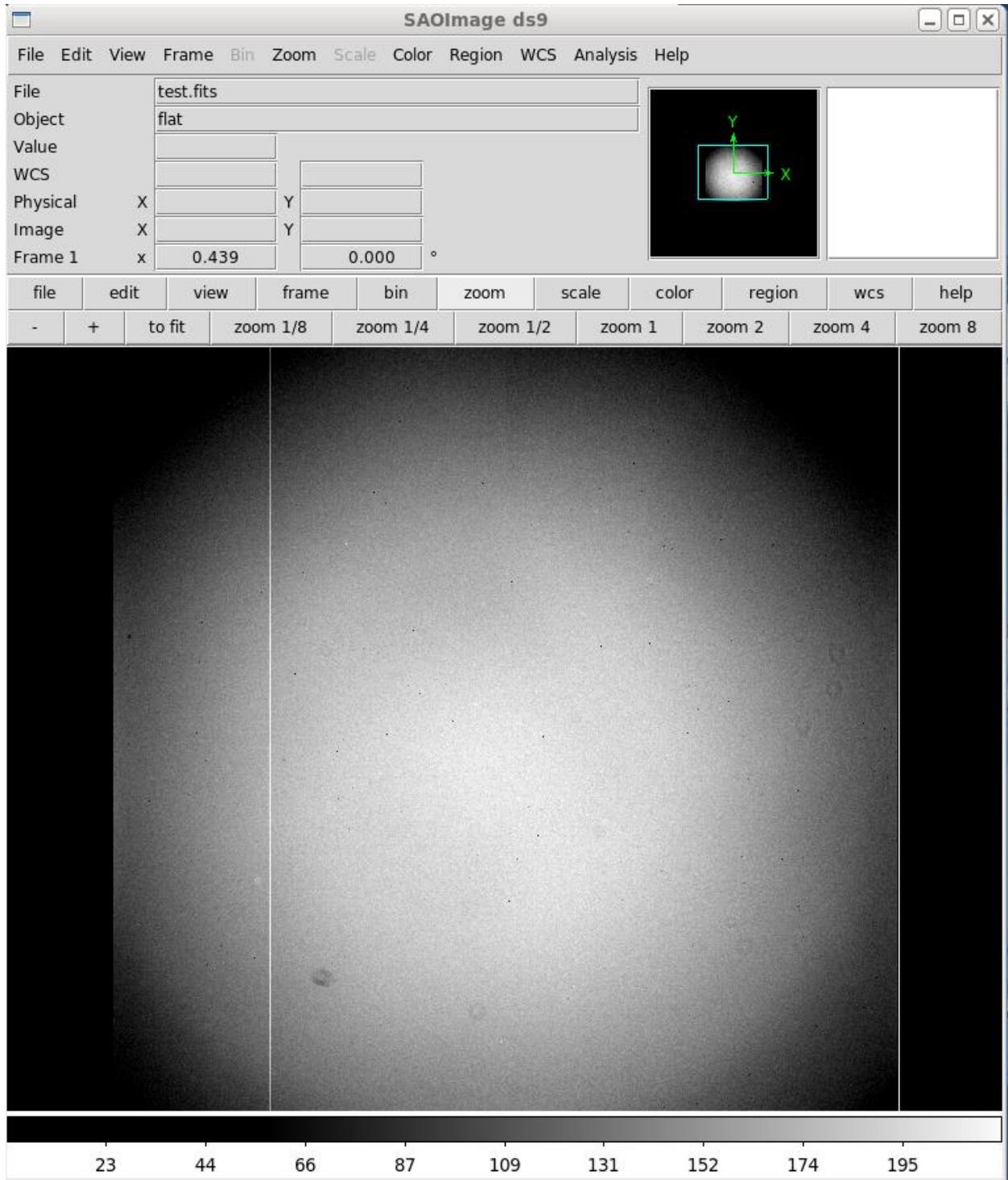
EXAMPLE 17
R Flat



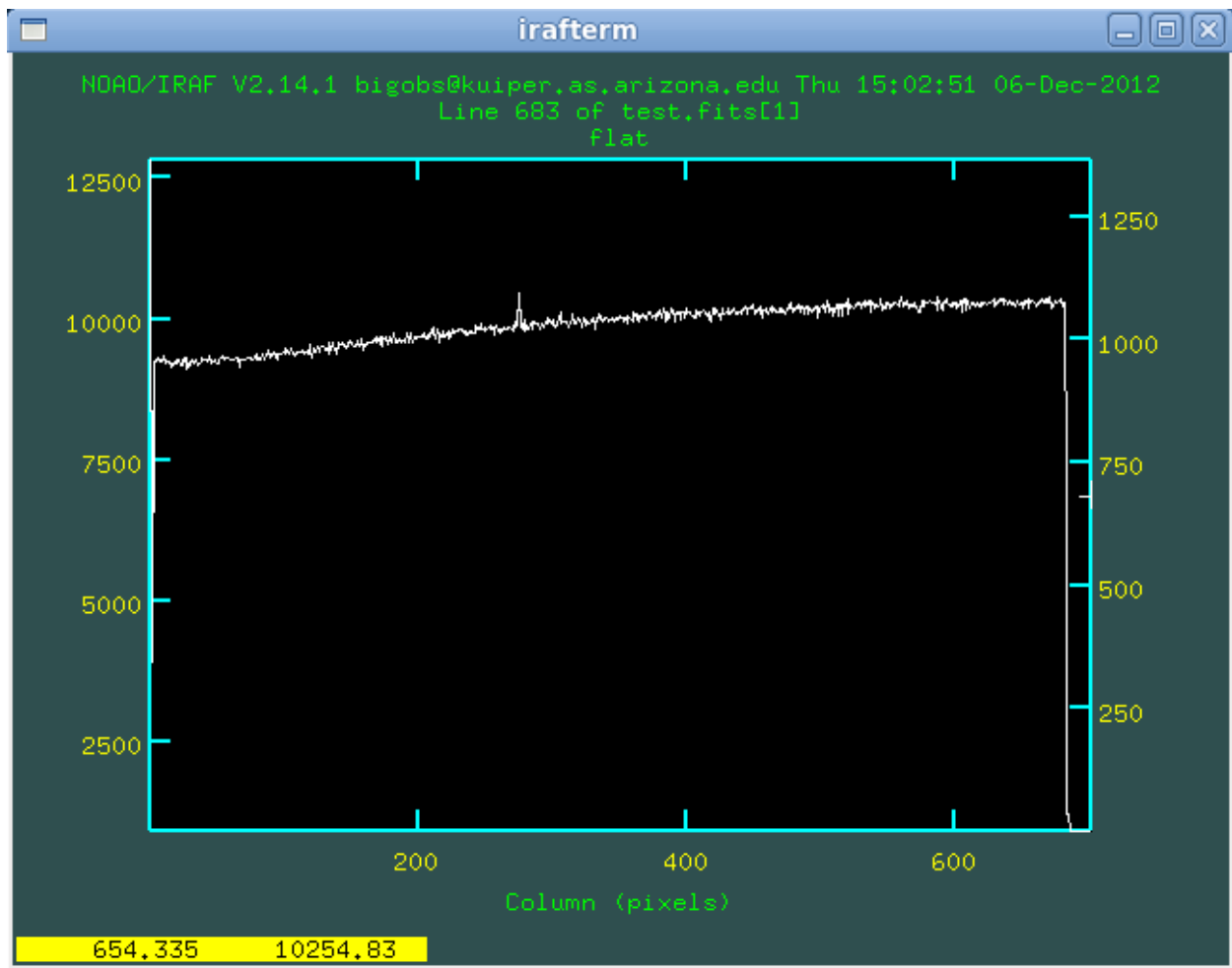
EXAMPLE 18
R Flat Implot



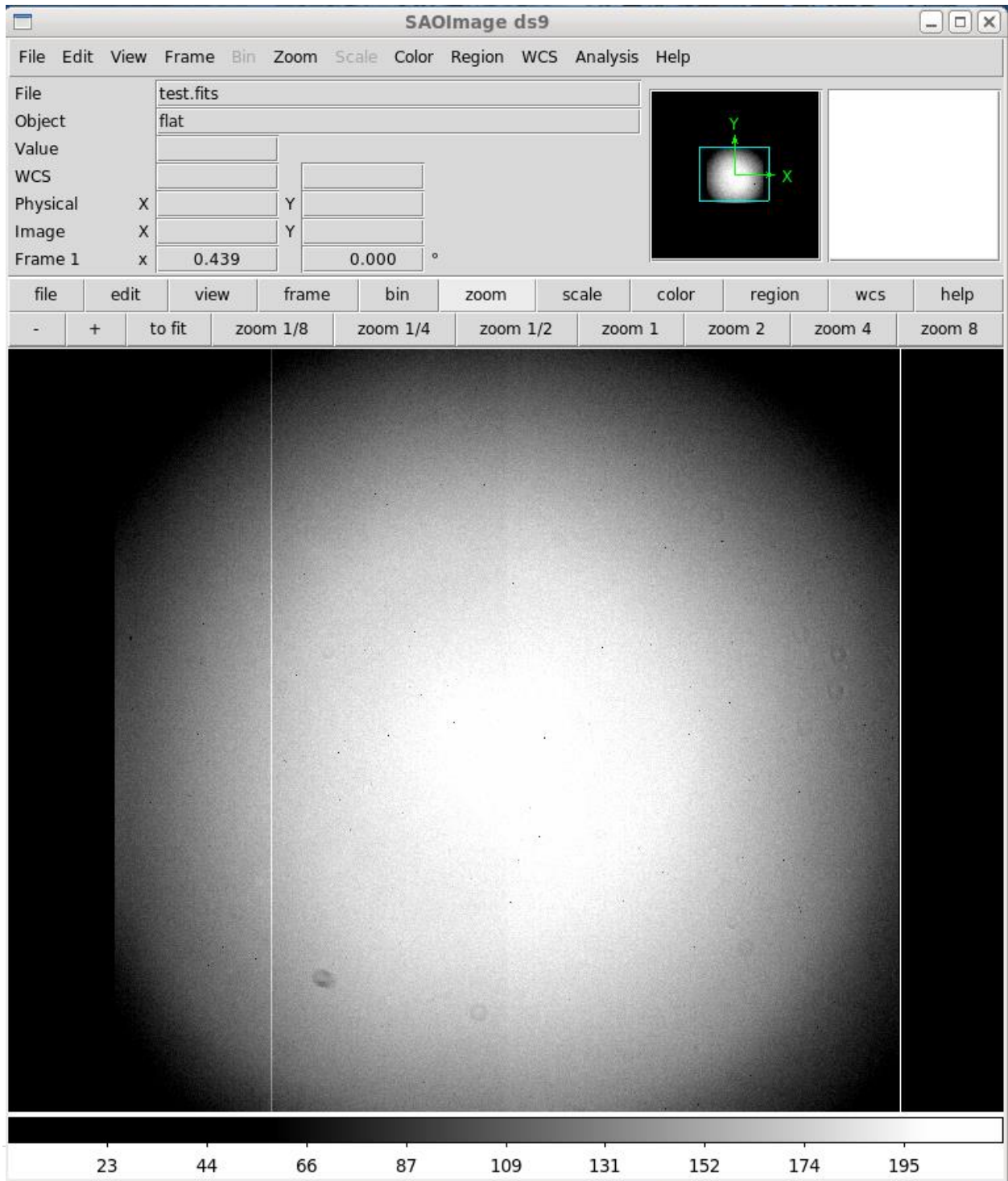
EXAMPLE 19
B Flat



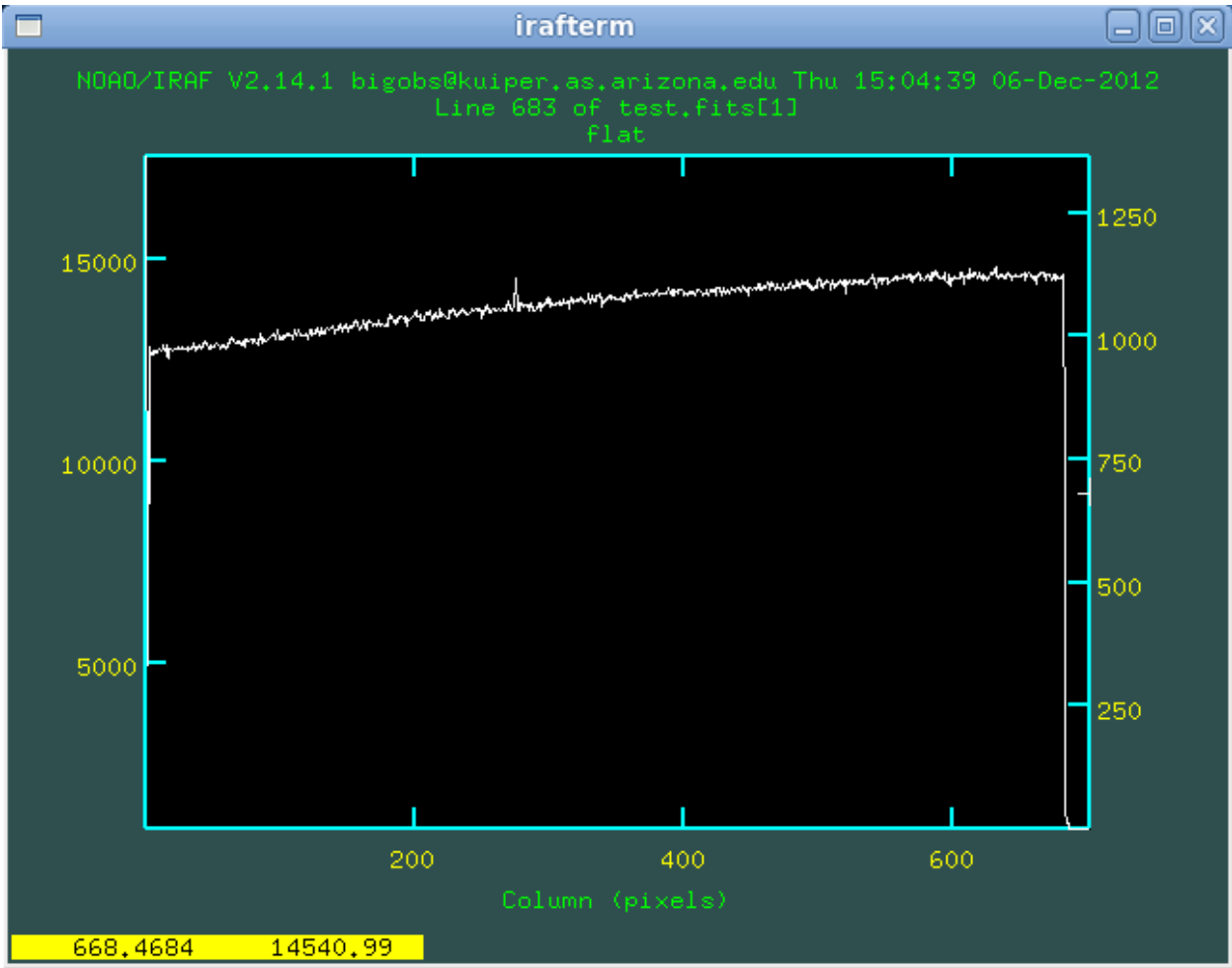
EXAMPLE 20
B Flat Implot



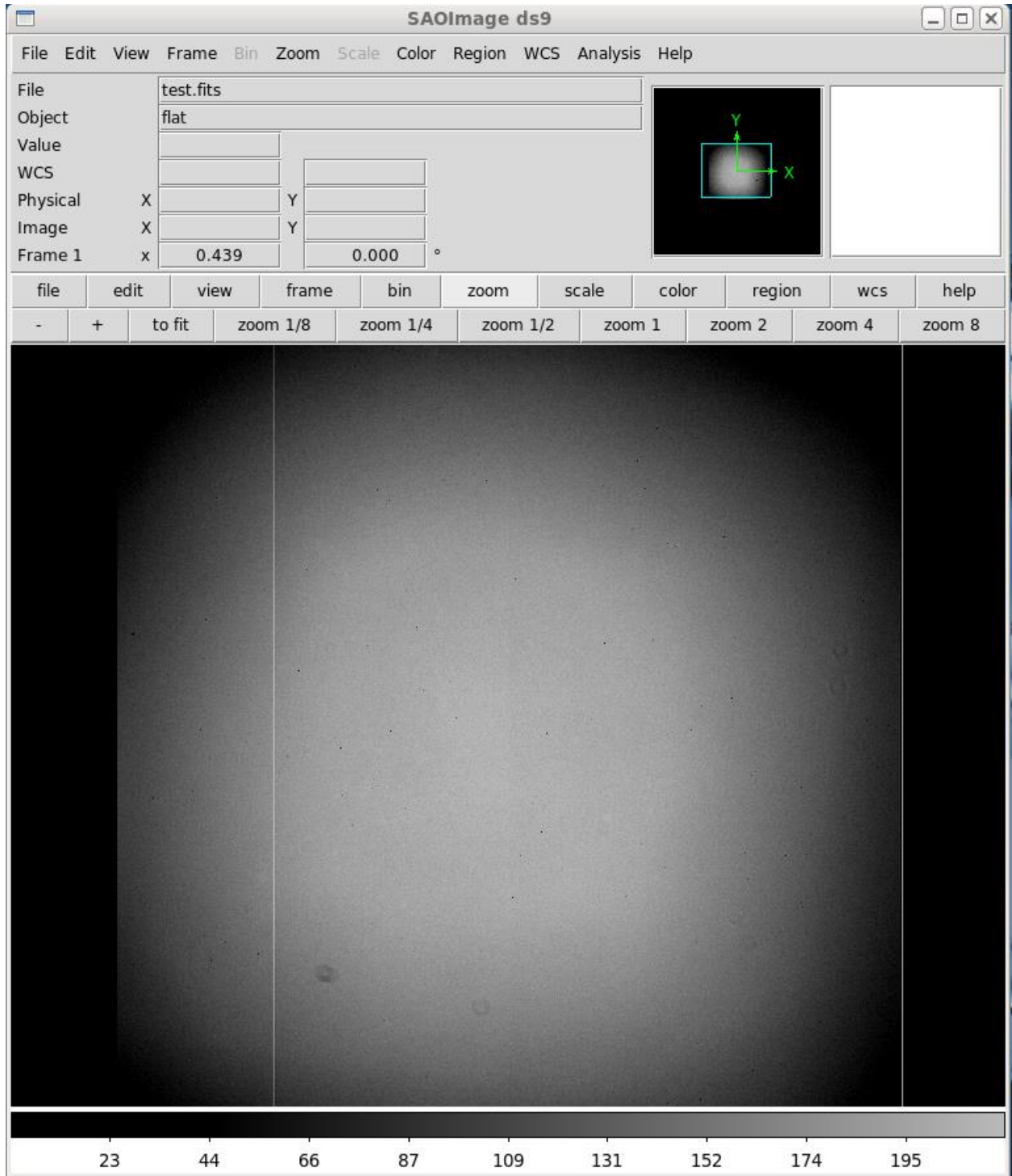
EXAMPLE 21
V Flat



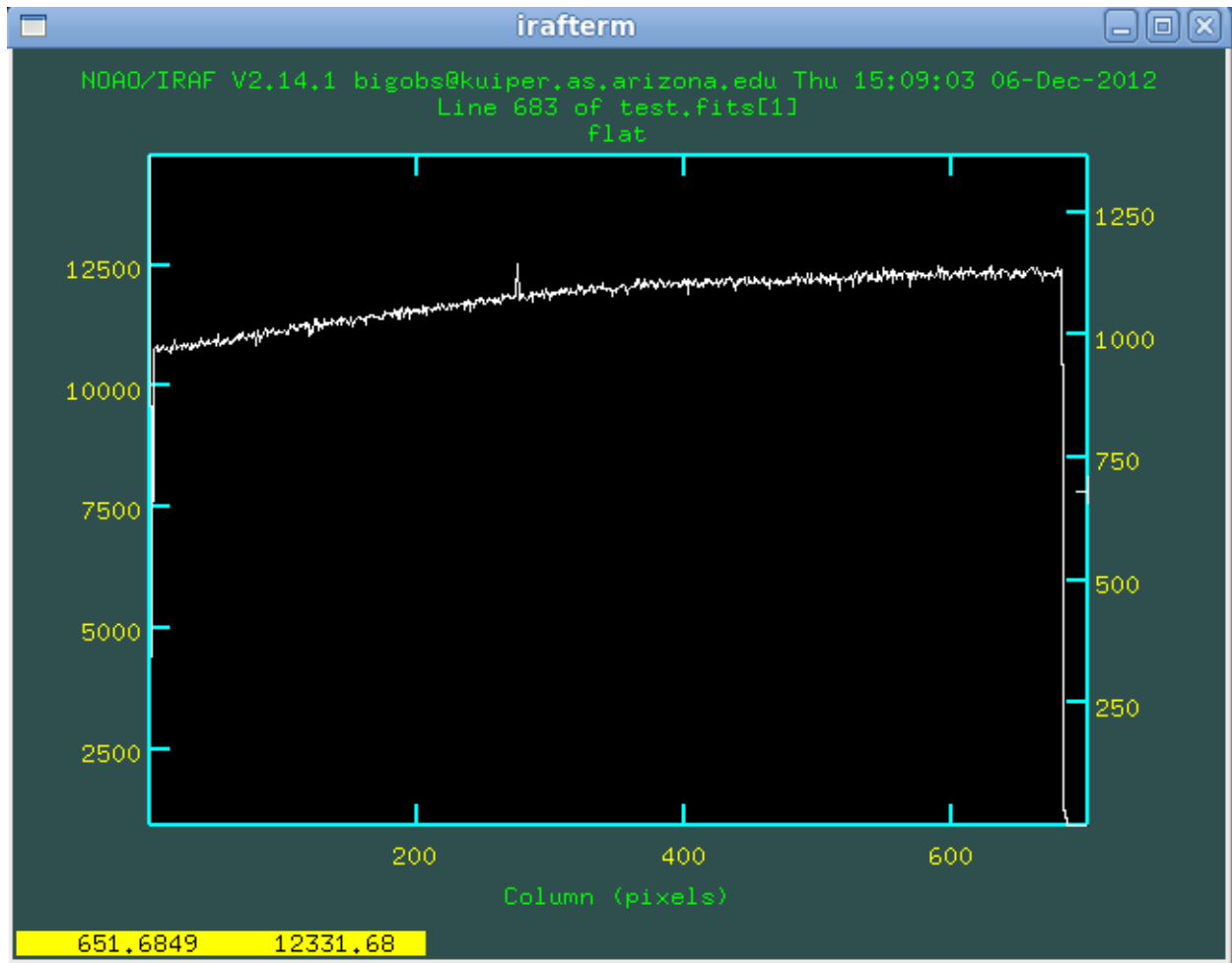
EXAMPLE 22
V Flat Implot



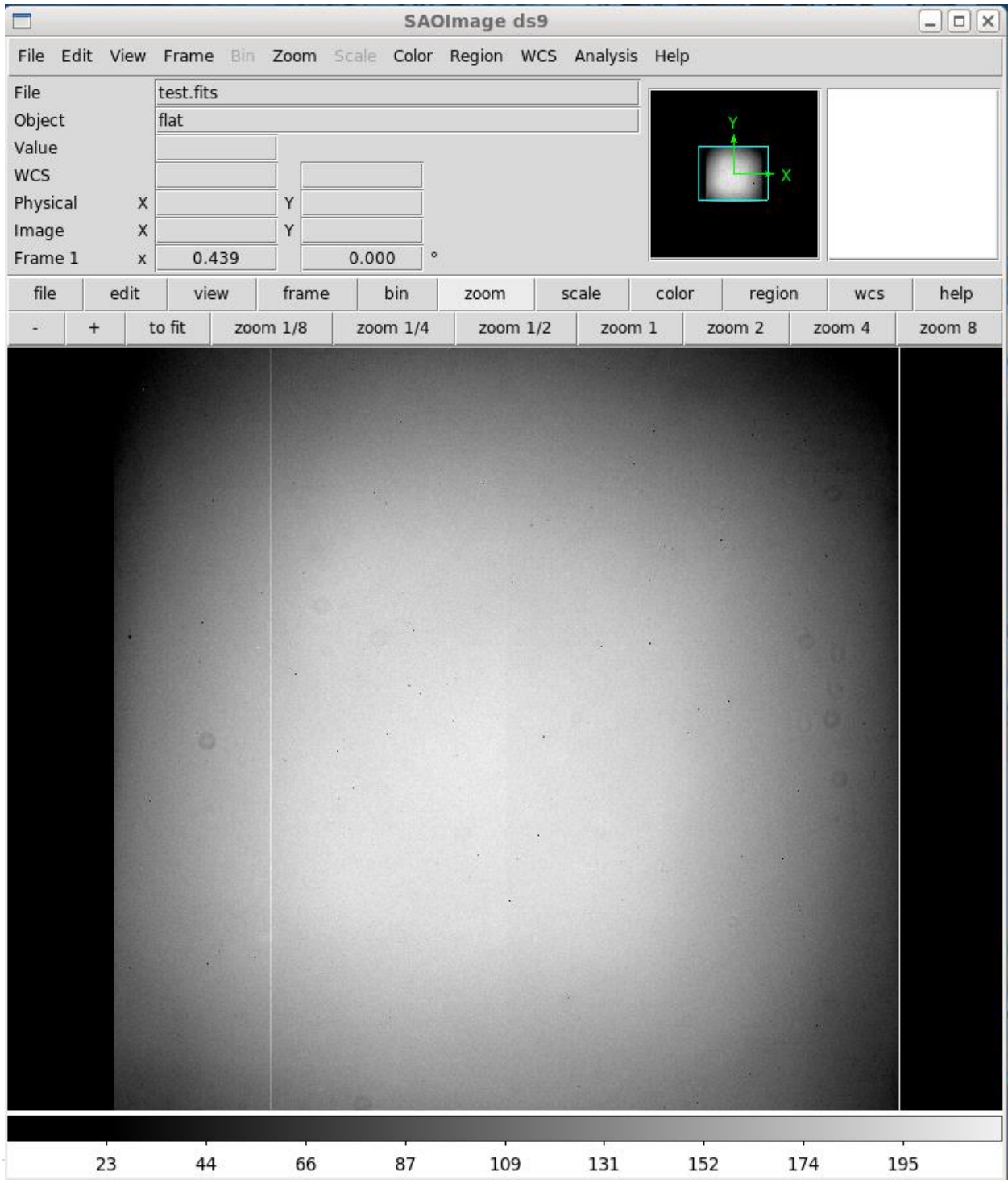
EXAMPLE 23
Schott 8612 Flat



EXAMPLE 24
Schott 8612
Implot



EXAMPLE 25
U Flat



EXAMPLE 26
U Flat Implot

