Megacam Observers Manual

Contributors: J. Bechtold, N. Caldwell, M. Conroy, D. Curley, M. Lacasse, B. McLeod, G. Williams, D. Osip

Table of Contents

1. Introduction.
2. Megacam Description.
   2.1. Overview.
   2.2. Details.
3. Observing Instructions.
   3.1. Before your run.
   3.2. The Computers in the Control Room.
   3.3. Quick Start Up Procedure.
   3.4. Taking data with mice.
   3.5. Typical Observing.
   3.6. Focusing, Collimating & Guiding.
   3.7. Displaying an image.
4. ds9 Information.
5. Automatic Data Logging.
6. Data Storage.
   6.1. External USB Disk.
   6.2. CfA Archive.
7. Filters.
8. General Comments and Information.
   8.1. Computers.
   8.2. Typical Count Levels.
   8.3. Differential Refraction.
9. Problems.
10. Data Reduction for Megacam.
11. Appendices
   11.1. A: The Exposure Time Calculator, or ETC.
   11.2. B: How to plot the detector and guider footprint on the Sky Survey.
   11.3. C: How to list guide stars available for your target.
   11.4. D: How to set up catalog files.
   11.5. E: Gain Settings.

---

1. Introduction.

Megacam is a large mosaic CCD camera with a 24' x 24' field-of-view. The camera uses 36 CCDs that have a pixel format of 2048 x 4608 pixels. The pixel scale of 0.08"/pixel offers good sampling under the best seeing conditions at the Magellan and the MMT. Megacam has eight available filter slots that are normally populated with the Sloan u', g', r', i' and z' filters. Two in-dewar guide CCDs perform the guiding and focusing.

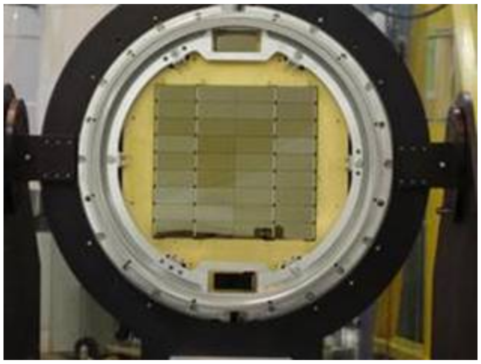


Figure 1 The Megacam focal plane array; 36 CCDs with 2048x4608 pixels.

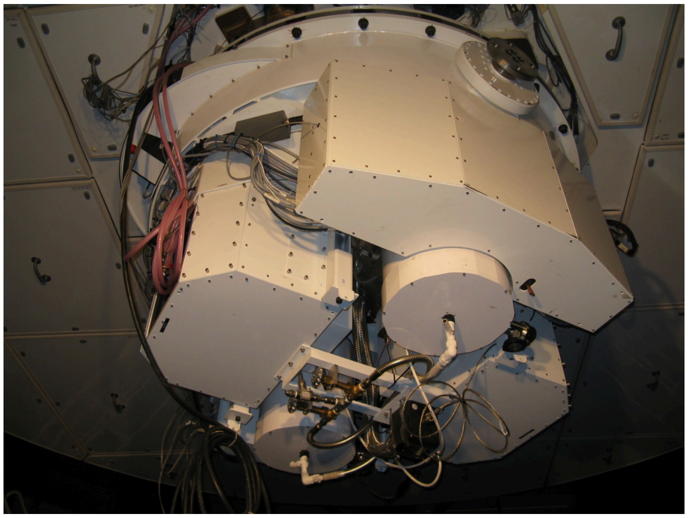


Figure 2 Megacam mounted on the Magellan Clay telescope.

Please cite the following paper with your Megacam results:

- Megacam: a wide-field imager for the MMT and Magellan, McLeod et al. 2015, PASP, 127, 366. **PASPMegacam-final.pdf**

Here are some older papers:

- The MMT Megacam (2005) **SDW2005_mcleod.pdf [1]**
- Megacam: A Wide-field imager for the MMT Observatory (1999) **icsoi.pdf[2]**
- Megacam: paving the focal plane of the MMT with silicon (1998) **megacam.pdf[3]**
- Coping with data deluge - a data system for the Megacam (1998) **datadeluge.pdf[4]**
- Wide-field CCD imager for the 6.5m MMT telescope (1996) **spie96.pdf[5]**

2. Megacam Description.

Overview and details of the Megacam instrument.

2.1. Overview.

```
Number of CCDs:                               36
CCD Type:                                     E2V CCD42-90 back illuminated
CCD Layout:                                   9 x 4 array
Pixels per CCD:                               2048 x 4608
Pixel Size:                                   13.5 microns
Field-of-View:
    Total:                                    25 arcmin x 25 arcmin
    Single CCD:                               160 arcsec x 360 arcsec
Plate Scale:                                  0.169 mm/arcsec
Pixel Scale:
    Unbinned:                                 0.08 arcsec/pixel
    Binned x2:                                0.16 arcsec/pixel
CCD Gap Size:
    Small:                                    6 arcsec
    Large:                                    31 arcsec
Exposure Overhead:
    Total:                                    45s
    Readout Time (single amp, binned 2x2):    23s
    Additional (write, shutter, etc):         15s
    Guide Star Lock (typical):                2-10s
Digitization:                                 16 bit (65,536 ADU)
Gain:                                         3.5 e-/ADU
Fits File Size (binned 2x2):                  184,345,920 bytes
Standard Filters:                             Sloan u', g', r', i', z'
Typical QE:                                   55% @ 350nm, 82% @ 500nm, 30% @ 900nm
```

2.2. Details.

Megacam is a CCD imager available at the Cassegrain f/5 focus of the Clay 6.5m telescope. It was designed and built by a team at the CfA. It employs 36 science CCDs and two guide CCDs. All of these are thinned, backside-illuminated E2V CCD42-90 CCDs, with a 2048 x 4608 pixel format. The field-of-view of each CCD is 160" x 360", for an effective science field of 24'x 24'. The science CCDs are mounted adjacent to one another, with a 6 arcsec gap between them. There is a larger gap of 31 arcsec between rows one and two and between rows three and four. (see also Figure 11 below)

Digitization is done with a 16 bit ADC, so data values up to 65,536 are recorded. Non-linearity sets in about 55000 ADU, so counts should be kept below 50000 to avoid non-linearity. Dark counts are normally insignificant, but are high after the controller has been powered up, and also after the chips have been exposed to very bright light (such as room light). QE curves for the chips are shown in Figure 3 below (also **CCD_QE_plot.pdf**).

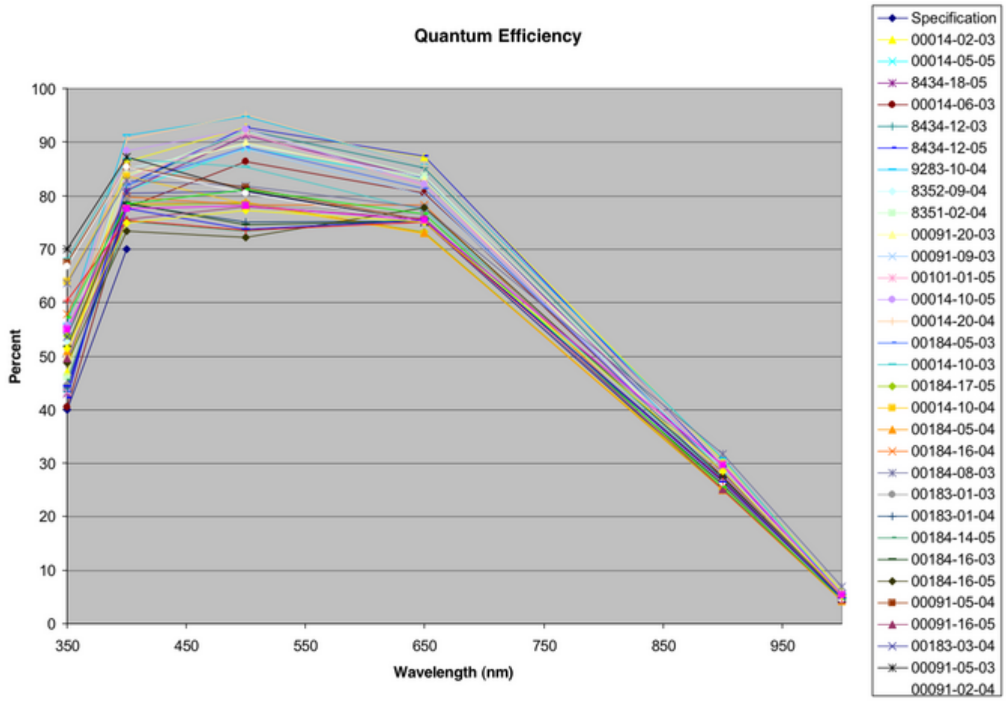


Figure 3 QE Curves for the Megacam CCDs.

Figure 3 indicates that color terms may be significant for precision photometry -- and each CCD should have its own color term to account for its particular QE. At the current time, precise chip-to-chip color terms have not been measured for the CCDs, though data is available in the archive to do it.

There are two guide CCDs that are centered about 20 arcmin off axis. The guide CCDs are read out with a separate set of electronics and different computer. The guide chips can see light when the shutter is open OR when the shutter is closed through special openings in the shutter. There is no pickoff mirror, no TV guider and no acquisition camera. The guiding software can use automatic guide star selection, which greatly improves the observing efficiency. In this mode, the location of the guide boxes is determined from the positions of known stars. The default exposure time for the guider is 0.5 seconds but the exposure time, guiding gain and other guider variables can be adjusted by the telescope operator. The telescope operator runs the guider so the observer does not need detailed instruction on its operation. The guider is also used to maintain the focus of the telescope. However, it is sometimes difficult to find two appropriate guide stars when observing fields at high galactic latitude. Before coming to the mountain, the observer should verify that guide stars will be picked up in both guider CCDs, as described below. One-CCD guiding generally is to be avoided. Also, the observer should pay attention to the corrections being made by the guider to ensure guiding issues do not impact the image quality of the science frames.

The CCDs are in a LN2 dewar, which has a hold time of about 30 hours. Observatory staff are responsible for keeping the dewar filled. This dewar is mounted to the Megacam "topbox". The topbox, shown in Figure 4, houses two filter wheels and the shutter. Each filter wheel can accommodate 5 filters. The available filters include the Sloan u', g', r', i', and z' filters, and a set of guider blocking and polarizing filters (see Section VII. Filters for the transmission curves and instructions for using other filters.)

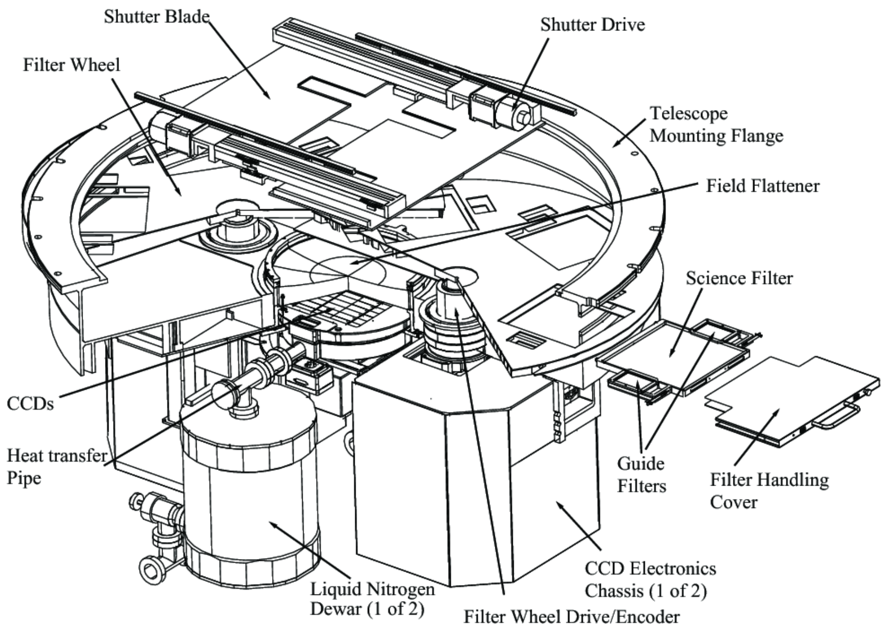


Figure 4 Cut-away engineering drawing of the Megacam topbox, cryostat, and electronics boxes.

The topbox shutter is a dual blade design, similar to the type used in SLR cameras. This allows accurate exposures over the large focal plane for times as short as 0.1 seconds.

Because we are using an Alt-Az telescope, the focal plane rotates, and therefore a derotator takes that rotation out for imaging purposes. The typical procedure for Megacam is to use a position angle of 0 deg when observing objects south of the observatory's latitude (dec<-29:00.2 at Magellan) and a position angle of -180 for objects north of that declination. This aligns one side of the CCD array with North. When using these position angles an object can be tracked from the eastern horizon to western horizon without hitting a rotator limit (+/- 145 deg). At Magellan for a position angle of 0deg North is to the left and East is down. For a position angle of +90, North is up, and East is left..

A further note on position angles at Magellan. In a Magellan catalog, you must specify both the rotator offset angle and a rotator offset mode. The rotator offset angle has the opposite sign of the position angle shown in the Megacam telescope status display. For example if you wanted a line 10deg east of north to be horizontal on the Megacam chips, you would specify a rotator offset angle of -10deg. With a rotator offset mode of "OFF" you must choose angles surrounding 0 for targets south of -29 and angles surrounding 180 for targets north of -29. With a rotator offset mode of "EQU" the telescope chooses the correct 180 deg orientation for you. In other words, if you don't care what the PA is, you can put in 0,EQU in your catalog for all targets.

3. Observing Instructions.

Instructions for observing with Megacam.

3.1. Before your run.

1. Read this manual.
2. Read the **Observing Protocol** page.
3. Read the **Megacam Current Status** page.
4. Run the Exposure Time Calculator (ETC) if you need to (Appendix A).
5. Prepare your target catalog in the correct format:
    - **http://www.lco.cl/technical-documentation/observing-catalogs-format/**
6. Figure out how you will take home your data (see below for your options).
7. Examine your targets on the Sky Survey and make sure you have guide stars. Megacam has two guiders and it is essential to have guide stars in each guider. By looking at the footprint of the science array and the guiders on the Sky Survey, you can see if you need to adjust your target center RA and Dec by, say, a few arcminutes to get a better guide star or to avoid a m=3 star from falling on one corner of the array. Instructions are given in the Appendix B and Appendix C for this step.
8. Set up dither files or other scripts. The observing sequence can be automated very easily, and you can set up scripts to dither the telescope, run through the filters at a standard star field, etc. automatically. See instructions on setting up dither files, Appendix D.

3.2. The Computers in the Control Room.

Magellan Computers Observations with Megacam are controlled via three linux workstations running Scientific Linux: **shack**, **wild** and **hurley**. These computers are physically located in the equipment room downstairs from the control room. The **hurley** computer is dedicated to data acquisition and is not directly accessed by observers. The observer in the control room will sit in front of the Magellan Observer Workstations (MacOSX computers) **guanaco** and **zorro** but can log into the Megacam computers **wild** or **shack** via a terminal by typing

```
megawild
megashack
```

3.3. Quick Start Up Procedure.

Starting up the instrument control software.

This procedure is normally performed by the observatory staff during instrument checkout.

. Magellan Quick Start

1. Log on to **guanaco** and **zorro** using the login and password listed on the posted Observer Setup Form.
2. On BOTH **guanaco** and **zorro** open a terminal or xterm and type

   ```
   f5host
   ```

3. On **guanaco** type

   ```
   megacam
   ```

4. The guis will appear on **guanaco** and **zorro**. You will now use the **Startup** tab on micemegacam.

   Press the **Start Power Control** button and wait for the Toppower light to turn green.

5. Start the topbox, home the shutters and filters and scan the filter ids

   - Press **Start Instrument (Topper)** and wait for the Instserv light at the top of mimce to turn green
   - Press **Home Topper** and wait for the 2 shutter and 2 filterwheels to be homed. If you get an error, press the buttons that remain red to home them individually.
   - Press **Start Science Camera System** and wait for "Detector Up" to be green.
   - Press **Scan Filters** and wait for the Scan lights to turn green.
   - Press **Start Wavefront Motor System** and wait for wfspower to turn green.
   - Press **Home WFS Stages** and wait for the 3 Homed lights to turn green.

   You can monitor the progress of these commands in the Topbox Monitor GUI on the **zorro** display.

6. The telescope operator will start the guider and WFS software, on the computer **vicuna**, located at the operator's console. The telescope operator will also start the telescope server once the telescope is brought up and running. Until this point, the Telescope field at the top of megacammice GUI will read "Telescope Down" in Red.

7. There is also a **Start/Stop** Tab in *mice* that gives more detailed information on each of the individual servers (some of them behind the scenes functions) and a means to restart any that are not running and/or to look at the log files. It is also possible from this page to individually kill or restart any of the GUIs (including *mice* itself). This page cannot determine if a GUI is already running, but restarting GUI's does no harm with a single exception:

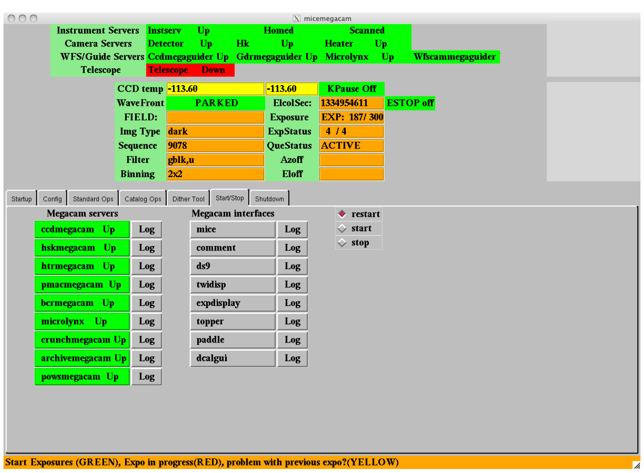


Figure 6 Mice Start/Stop tab. Full size image: MegaStartStopScr.png

If *mice* is restarted during an exposure, the exposure will be lost.

MEGACAM versus MEGACAM SPLIT MODE. Each science chip can be read out with either 1 or 2 amplifiers; For a 2 amplifier readout (split mode) the binned 2 x 2 readout time is approximately 12 seconds. In single amplifier mode, the readout time is doubled to 24 sec. At the present time there is one amplifier (number 21) that intermittently has high readout noise. For that reason, **we currently recommend using the single amplifier readout mode (MEGACAM mode.)** For programs with typical exposure times of 5 minutes or longer the additional 12sec overhead is insignificant. For programs with large numbers of very short exposures consult with B. McLeod before your run for advice.

3.4. Taking data with mice.

Data taking is done through the Config, StandardOps, and CatalogOps tabs of *mice*. The StandardOps tab allows for traditional observing (one image at a time). The CatalogOps tab performs sequences of exposures allowing for efficient observing. The sequences are defined by an ascii catalog file which can be generated with a text editor or by using the DitherTool tab of *mice*. Details on how to make catalog files, with examples, are given in Appendix C.

1. **Check that all the subsystems are happy.**

   In the previous section you should have gotten all the subsystems initialized. The status of each subsystem is indicated with color using the color convention of all the f/5 instruments; green means OK or RUNNING, yellow means HUNG (perhaps only temporarily), and red means NOT RUNNING. If any items are not green, go back to the Startup Procedures. Note, Telescope Server is only started from the operators workstation and is usually not running during the day.

   The middle section is mostly informational. The first two lines display CCD temperature measurements, wavefront sensor location status (should be PARKED) and an ESTOP indicator. The CCD temperatures should read -115 C. During normal operation the ESTOP (emergency stop) indicator should read "off" indicating that none of the ESTOP buttons are depressed. Lines 3 and 4 of the middle section displays exposure status information including image type, exposure time, and exposure status.

   Next you'll go to the Config tab in mice:

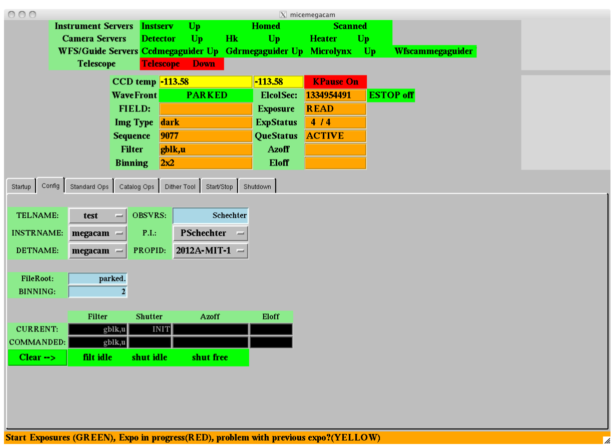


   Figure 7 Mice Config tab. Full size image: MegaConfigScr.png

2. **Check that TELNAME, INSTRNAME AND DETNAME are set correctly**

   TELNAME= clay_f5 INSTRNAME = megacam DETNAME = megacam

   IMPORTANT: For normal operations, make sure none of these indicates *Test*. During daytime calibrations when the Telescope Server is likely not active, it will be necessary to change the TELNAME to *Test* in order to take images.

3. **Enter the BINNING you want**, "2" for 2x2

4. **Select the correct the PI and Observing Program.**

   The program number information is important to enter correctly in order to be able straight-forwardly retrieve data from SAO later on. If your observing program is not in the list please contact Igor Chilingaryan at CfA. **If you switch programs during the night, don't forget to update the Observing Program and PI.**

5. **Type your name(s) into the OBSRVRS box.**

6. **Chose a GUIDING mode.**

   The drop down **GUIDING** box allows the user to choose one of three guiding modes. You will use "auto" virtually all the time.

Here is a description of these modes:

- *none* In this mode, the data acquisition process will continue independently of what the guider is doing. The data acquisition will not attempt to wait until the guider reports that it is locked on the stars. This is useful if you are not guiding or if you are not dithering.
- *manual* In this mode, *mice* will prompt the observer before starting each exposure with a **Guide Tracking Lost** message. Once you are happy with the guiding click to proceed.
- *auto* In this mode, *mice* will query the guider as to whether it has locked onto the guide stars. Data acquisition will begin only after the guider is locked on the stars. This is the recommended mode but if it gives you trouble you can drop back to manual mode.

The status of guiding will be displayed in the Exposure Status GUI on the lower right corner of the **zorro** display.

7. **The STANDARD OPS tab: taking images one at a time.**

The **Standard Ops** tab is the part of the GUI that is used for manual observations. You'll typically use this page for taking setup exposures or if you only need a single exposure of a given target.

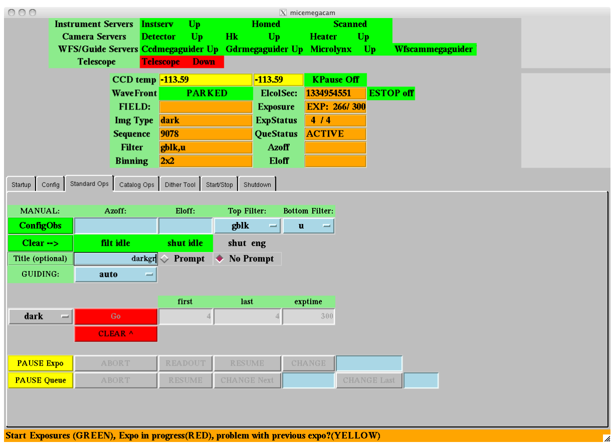


Figure 8 Mice Standard Ops tab. Full size image: MegaStandardScr.png

The first line lets you specify the telescope offset in instrument coordinates (see more below) and the filter. The offset will typically be left blank, and the telescope will not move from it's current position.

The top lines in the **Standard Ops** tab are used to setup and perform manual observing. There are two boxes which allow the user to select the filters for both the upper and lower filter wheels. If you only want one filter make sure one of the boxes is empty. The upper filter wheel currently contains a science blocking filter holder and a guider blocking filter holder. The lower filter wheel contains the Sloan u', g', r', i' and z' filters. To block the guider detectors or the science detectors for calibration purposes choose gblk or sblk, respectively. The gblk filter should be used when obtaining twilight flats to minimize the scattered light when the sky is bright. During science observations the top wheel should be either "open" or blank. Note that *mice* comes up with Filter 1 = {} which will give an error. Change this to blank.

If you press the **ConfigObs** button then the offset will be applied and the filter will be selected. This is purely optional, as it will be done when you start the exposure.

8. **The CATALOG OPS tab is the part of the GUI that is used when running automated observing sequence catalogs.**

A full description of creating catalogs is described in Appendix D.

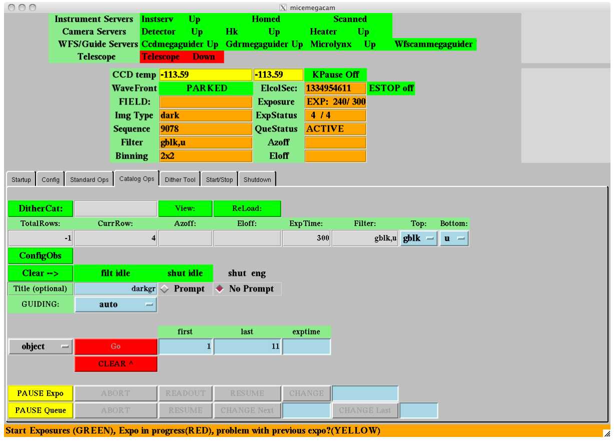


Figure 9 Mice Catalog Ops tab. Full size image: MegaCatalogScr.png

To load a dither catalog, you must press the **DitherCat:** button and then select the appropriate file. The values for the current line (initially the first line) will be displayed on the second line.

The end of the second line allows the user to manually select the filter(s) if they were not specified in the dither catalog. It also provides a "ConfigObs" button which allows the instrument and telescope to be setup according to the current dither catalog information. This can be helpful to configure the instrument and then possibly take a singe manual exposure using the "Standard Ops" page to verify the settings.

9. **For either Catalog Ops or Standard Ops:**

The remaining buttons and entries are common to both the "Standard Ops" and "Catalog Ops" pages.

Table 1 Megacam image types.

Object	A normal image containing an observing target.
skyobject	An image with an offset for observing sky in the target locations. Normally used only for spectroscopy, not with Megacam.
Skyflat	A twilight sky flat field image.
Finder	A finder image. Not used with Megacam
Focus	A focus frame. Additional entry boxes allow you to specify the starting focus value and step size. This feature does not currently work.
domeflat	A dome flat field image. Not used with Megacam
Dark	A dark image.
Bias	A zero or bias image.

The first, last, and exptime allow the user to enter the first and last image in an exposure sequence and the exposure time in manual mode.

10. **Take an image by pressing Go.**

The *mice* GUI automatically queries the user for the title when the observer presses **Go**. The **Clear** button is used to clear the camera in the event of an error. If the **Go** button remains red because of an error during observing the user must press **Clear** to reset the system.

If you are in manual guiding mode, at the beginning of each exposure the software pops up a window saying "Error Can't Lock Guide Stars". Choose"OK Start Exposure" once the telescope operator confirms that the guiding has started. The auto guide star selection will choose new stars after each dither (if the original star is dithered off the chip).

11. **Pause. Abort, Resume.**

The bottom 2 lines of the "Standard Ops" tab or the "Catalog Ops" tab allow the user to PAUSE an exposure or to pause the sequence of exposures. "Pause Expo" pauses the exposure and closes the shutter and then after pausing allows the options: ABORT, STOP, RESUME, or CHANGE the exposure time. ABORT will discard the current exposure, whereas STOP will readout the camera for the current truncated exposure time. Pause Queue has no effect on the current exposure, but it allows you to alter to automated exposure sequence, usually by changing the "last" requested exposure.

12. **The "Dither Tool" tab**

Allows you to set up a dither or other observing sequence. See Appendix D. for further information.

13. **Where's my data and what are the files called?**

The raw images are stored on a large data disk on **hurley**, in multi-extension FITS format. A copy of each file is automatically made available for immediate analysis on **red**. The analysis directories are called /data/crunch/MEGACAM/yyyy.mmdd (e.g., /data/crunch/MEGACAM/2005.1014). The files themselves will have names like target.0001.fits, where target is the catalog name supplied to the telescope. In addition, an archive copy of all data and ancillary files is created each morning at 9:00am in /data/archive/MEGACAM/yyyy.mmdd directory. The archive is again updated at noon to be sure that all ancillary files are included. The anlayis (CRUNCH) and archive (ARCHIVE) data disks are cross-mounted on the Observer Worstations **zorro** and **guanaco** as /Volumes/CRUNCH_MEGACAM and /Volumes/ARCHIVE_MEGACAM. Utilizing these cross-mounts, it is easy to inspect data with IRAF or IDL running on **zorro** while acquisition is ongoing in the Megacam GUIs on **guanaco**. The cross-mounted archive on **zorro** is also the best choice for copying data to your own external disk.

3.5. Typical Observing.

See Observing Protocol for a summary of this information.

- **AS SOON AS YOU ARRIVE EACH DAY**

  Take a test exposure to verify that the instrument is functioning properly (although the instrument specialist will likely have already confirmed this).

  - Go to the Standard Ops tab
  - Select exposure type Bias
  - Select filters u and gblk
  - Enter 1 for **first** and 1 for **last**
  - Press **Go**

  On **zorro**, in an IRAF window (you can bring up both ds9 and iraf with the 'goiraf' command in any terminal)

```
   mscred
cd /Volumes/CRUNCH_MEGACAM/YYYY.MMDD/
mscstat zero.NNNN.fits[1080:1099,*] fields=image,mean,stddev
```

  The mean of each amplifier should be 1200, the stddev should be 1.5. For splitmode data use image section 550:580,*? for measuring the noise.

- **ONCE IT IS DARK IN THE CHAMBER**

  - Take 15 bias frames each day.
    - Go to the Standard Ops tab
    - Select exposure type Bias
    - Select filters u and gblk
    - Enter 1 for **first** and 15 for **last**
    - Press **Go**

  - Take 4 dark frames
    - Select exposure type Dark
    - Select filters u and gblk
    - Enter 1 for **first**, 4 for **last**, and 600 for **exptime**

  The dark counts are normally insignificant, so taking long dark exposures is not strictly necessary. However, it is a good insurance policy to have them in case anything goes wrong. The detector dark current will be high for a couple of hours after the controller has been powered up, and also for a couple of hours after the chips have been exposed to very bright light such as room light. Therefore, it may be better to wait a few hours after the instrument has been turned on and the chamber is dark to take bias frames.

  Note that it is not possible to take dome flats. The telescope is so close to the chamber wall that it is not possible to illuminate it evenly. You will need to take twilight flats.

- **START OF THE NIGHT**

  1. **Twilight Flats:**

     Twilight flats can be started approximately 10 minutes after sunset. If it's clear take twilight flats in all the filters. When it's cloudy, twilight flats are not useful, so other observers may want to use flats you obtained on your clear night. If you don't get twilight flats during your run, consult Maureen Conroy to get flats that other observers took. Flats taken months before your run will not flatten your data very well however.

The exposure times are computed automatically to attain well exposed flats.

To prepare for twilight flats, start the auxiliary program twidisp from the Start/Stop page.

Binning	2
TwiEl	80
Counts	20000
Sunangle	-8.6782209383
TwiAz	291.578730908
TwiRA	12.3940452313
TwiDec	34.8665801628
Time: u	41.1854351619
Time: g	9.36795707862
Time: r	42.3692749658
Time: i	40.2961543423
Time: z	112.537759374

Figure 10 Twilight flat exposure time GUI

This program tells you the estimated required exposure time at the current time, as well as the location in the sky that will be used. You should start evening flats when the predicted exposure times reaches a few tenths of a second. Morning twilight flats can be started when the exposure time reaches 60 seconds.

First, have the operator point the telescope close to RA/Dec where twidisp tells you or at a blank field of your choice. Twidisp recommends pointing at an elevation of 80 degrees, pointing directly away from the sun. This location is chosen to be close to the point where the gradient in the sky brightness is at a minimum. At some times of the year the automatically selected location is in the galactic plane. In this case you should point the telescope to a location of your choosing. Twilight flats taken under conditions anything other than clear skies are probably of little use. Remember, if you can see structure in the sky on a scale of less than a degree, your flat will not be flat.

To take the actual exposures of twilight flats, go to the "Catalog Ops" page and select an exposure type of "skyflat". The standard twilight flat dither files are located in the "twiflat" subdirectory and have the name twiX.cat where X represents the filter u, g, r, i, or z. Each of these files can be used to take up to 25 flats (they each have 25 lines). Evening flats should be taken in the order u, z, i, r, and g and the reverse order in the morning. If you want, you could use the text editor to make a custom combination of the twilight dither files.

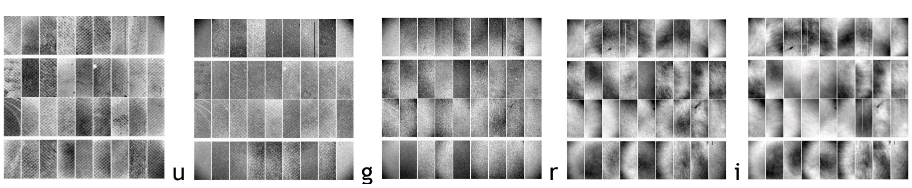
To avoid a very large unexpected telescope slew, do **not** press ConfigObs or Go on your twilight flat sequence while the telescope is still pointing at the zenith.

If you bring your own filter, you will need to copy and modify one of the existing dither files.

A sky brightness model is used to calculate the exposure time for the first image in a sequence. Subsequent images also use the model but the exposure time is also scaled based on the average counts in the previous exposure. The guide CCDs are blocked with an opaque filter during twilight flats to eliminate scattered light in the flats.

Take at least 5 exposures per filter, and it's better try to get 9 or 10. The software adjusts exposure times so that each exposure has 20,000 ADU per pixel.

Here are examples of what the twiflat images should look like. Fits files can be found at the MMT in lewis:/home/bmcleod/Reference.



u g r i z

twiflat_u.jpg twiflat_g.jpg twiflat_r.jpg twiflat_i.jpg twiflat_z.jpg

After taking twilight flats, take a 1 second exposure with the r filter in manual mode, to remove the gblk filter from the beam. Otherwise you will not be able to see any stars on the guide cameras.

2. **Wavefront sensing.**

Before you start observing your first object, the operator will go to a bright star near your first target and move the Shack-Hartman wave front sensor to the middle of the focal plane. The operator runs a routine to focus and collimate the telescope. Note for Magellan observers: unlike all other Magellan instruments, Megacam does not offer continuous wavefront sensing.

You should repeat this process any time you slew to a new object, particularly at the start of the night.

Monitor the collimation and focus. During long exposure sequences on the same target, you may have to interrupt your observing to go off and do a wave-front sensing sequence. You can tell when the collimation and focus could be improved by looking at the postscript file which is displayed on **zorro** every time you read out an image. The postprocessing routine runs sextractor and plots the FWHM of stars as a function of position on the field. The FWHM should not be a function of position. Here's an example of a good plot. **goodfwhmplot.png** If you see a plot like this **badfwhmplot.png**, it's time to adjust the focus. Sometimes, if one of your guidestars turns out to be a galaxy, the focus may run away. It is important for the telescope operator to keep an eye on the focus corrections, and for you to monitor the plots. If the plots do not appear on **zorro**, you should restart **crunchmegacam** on the mice Start/Stop page. Sometimes the automatic focus correction, even when stable, will not put the image perfectly in focus. This may be an effect due to the colors of the guide stars. You can compensate for this by asking the telescope operator to change the focus offset in the guider control panel.

At Magellan:

- If it is bowed upwards (higher in the middle than the edges) you need to decrease the focus offset (which will increase the focus value)
- If it is bowed downwards (lower in the middle than the edges) you need to increase the focus offset.
- Typical changes are 5 units of focus offset.

If the images are not round or the image quality is uniformly degrading it is time to perform a WFS. Sometimes you will have to stop and re-collimate every 1/2 hour, other times you may run several hours without re-WFSing.

3. **Pointing:**

It is possible that at the start of the night the telescope pointing will be far enough off that the telescope operator cannot locate a star in the small field of the wavefront sensor.

You will need to first take a single short (1sec) exposure with the r' filter.

Make sure that all the offsets in the paddlemegacam GUI are zero. (This will be true immediately after a slew). Click on "Draw Regions" in the **paddlemegacam** GUI. Drag the "Star" marker to the star you are pointing at. Click on "Fix Pointing". Ask the operator to do a "cset" before you do **anything** else.

From this point on, the coordinates you are tracking should be very close to the center of the Megacam focal plane. This happens to fall on the gap between 2 CCDs so if you are observing a particular point source you may want to offset slightly. This can be done interactively with ds9 or you can just enter an offset. If a target appears in the gap between CCDs at the center of the field an offset of:

```
   instaz=30"
instel=30"
```

will put it at a better location. Or see the figure below.

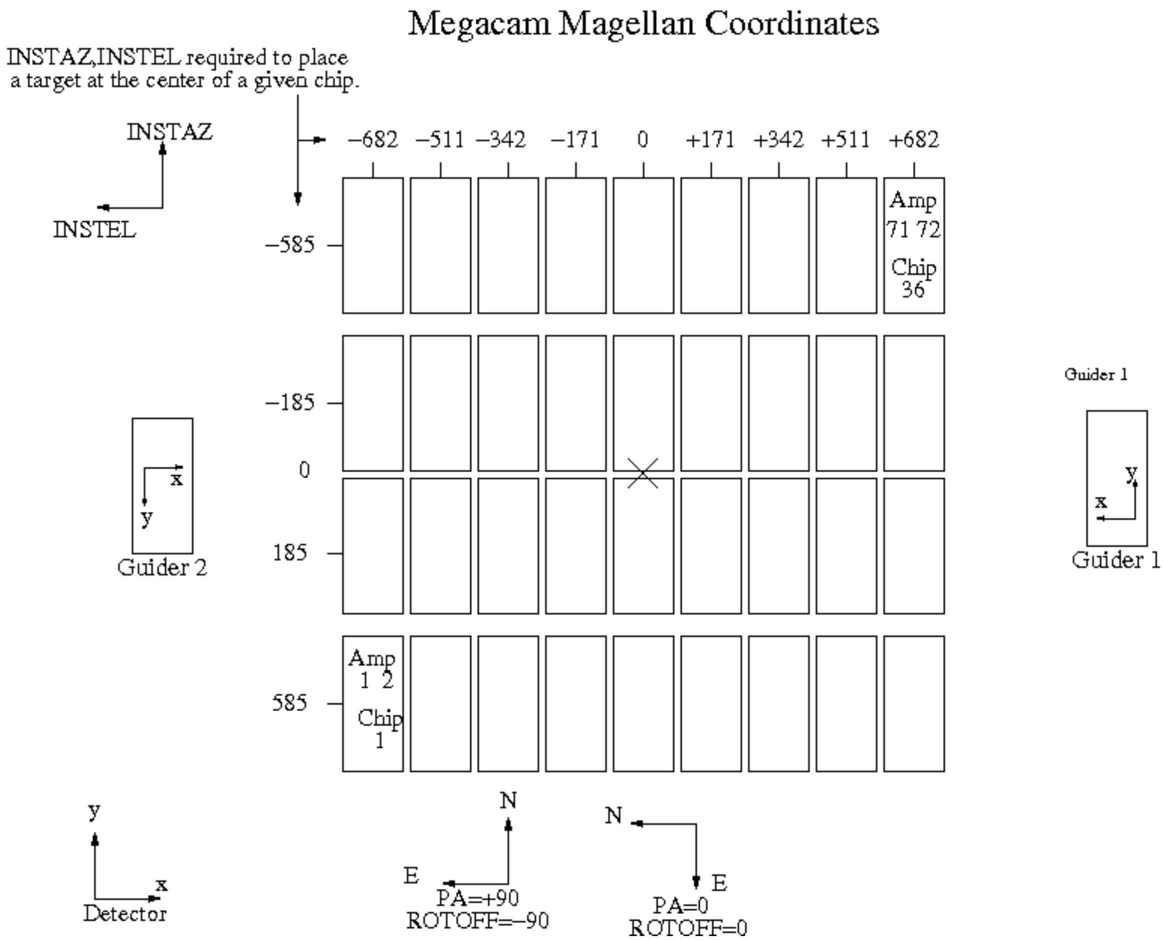


Figure 11 Location of the target for a given instrument offset. Additional formats...megacam_magellan_layout.pdf, megacam_magellan_layout.fig (which is the original xfig format).

4. **Standard Stars.**

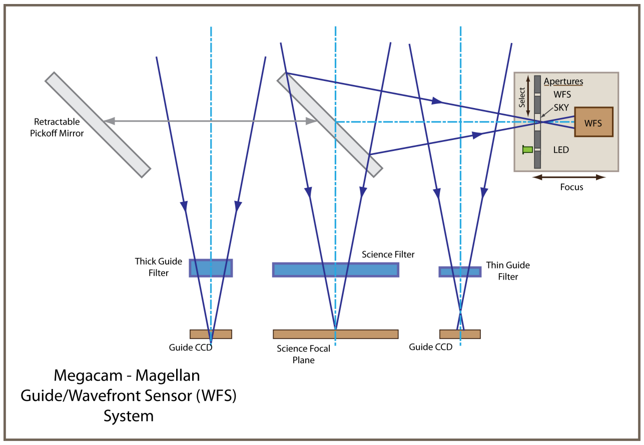
If your field happens to have been observed by the Sloan Digital Sky survey, you may be able to use their photometry and astrometry to calibrate your data without having to take standards. However, it doesn't take long to observe standards if you use a script, and observations may be done during twilight.

The Canadians have compiled a web page with standard star fields that Stetson has worked on, and which have photoelectric photometry by Landolt. Note that the photometry listed is UBVR, so it's best to observe a field that Sloan has also observed, so you have ugriz fluxes to use.

The subset of the Canadian list which has Landolt photometry over a wide (>10') field AND have been observed with Sloan, is available here Stetson Photometric Standard Fields.html. Note that Stripe 82 is a part of the SDSS which was observed repeatedly and is particularly well calibrated, see Ivecik et al. (2007) AJ 134, 973.

3.6. Focusing, Collimating & Guiding.

Focusing, Collimating, and Guiding are done by the telescope operator. A few salient points are mentioned here. The guider CCD is of the same type as the science CCD and is mounted on the same focal plane inside the Megacam dewar. The guider CCD views the sky through it's own dedicated filters. Wavefront sensing is performed on axis periodically be moving a mirror into the beam to feed the wavefront sensor. The guider and wavefront sensor geometry is shown conceptually here.



Full size image: Focal_Plane_Diag.jpg

The secondary does need periodic adjustments as the elevation changes. The telescope software normally takes care of this "elcoll" correction automatically. At Magellan this is completely automatic.

For the r', i' and z' science filters, the guider uses clear glass. For the u'and g' science filters the guider uses a B-like filter to control scattered light. This dramatically cuts down on the amount of scattered light on the science camera and modestly cuts down on the amount of star light reaching the guide camera.

The thickness of the guide camera filter glass is different for the two guide chips. This allows one to use the guider to control focus as well as AZ/EL and rotator. Note that the guide star catalog is contaminated with galaxies. The focus control will drive the telescope out of focus if a galaxy is selected instead of a star. If one guide star has a larger "Seeing" value (shown in the Exposure Status GUI on **zorro**) you should be suspicious that it might be a galaxy, and have the operator either turn off the focus control or select another guide star. We are in the process of improving the guide star catalog to eliminate this contamination.

3.7. Displaying an image.

After an exposure is finished, the postproc server will receive the incoming image and display it in ds9megacam on the observing console. If it is not already present, you can start an xgterm window from **wild** to display on **guanaco** by first typing megawild in any terminal to establish an sh connection to **wild** and then typing 'xgterm -sb -rv &'. In the new xgterm, you can start iraf with 'cl'. The usual iraf programs such as imexamine will now work for interaction with the ds9megacam window.

The **ds9megacam** window is intended to be dedicated to the near-realtime display. To look at previous images, we highly recommend working on **zorro** with a separate IRAF session. To view images, load them into ds9 using the File menu --> Open Other --> Open Mosaic IRAF. This may require typing the file name as the IRAF selection tool does not seem to work consistently.

4. ds9 Information.

For general information about ds9 see http://hea-www.harvard.edu/RD/ds9/

ds9 should be used to display images directly from its own pull-down menu, and not by using "display" in iraf. Iraf programs such as imexamine will still work, even with the multi-extension files that megacam produces.

- to load an image: pull down the file menufile and go to open. If your image is a multi-extension fits file (the case for raw data), choose "Open Other" and then "Open Mosaic IRAF", otherwise choose "Open".
- to change contrast, hold the right mouse button down and move it (this is always operational). Futher features are found under the scale menu.
- Zooming can be accomplished via the zoom panel button, the zoom pull down menu, or using the middle mouse button in the pan window or in the main window. Panning can be done with the left mouse button in the pan window, or in the zoom menus.
- Displaying a multi-extension file typically uses different min & max values for each extension when loading. This helps take care of the different gains in the different extensions. After flatfielding images, you may want to display the extensions with the same contrast. For this, select Scale --> Scope --> Global (instead of local).
- Don't use mscexamine after loading an image directly into ds9, rather use imexamine. Likewise. mscdisplay does not function properly.

5. Automatic Data Logging.

Please keep observing notes using the **comment** GUI which is started with **megacam**. This will bring up a panel showing the fits files in the current data directory. You can highlight any one of the files and add comments to that log entry. To produce a nice postscript output click on "View Log". The comments are archived along with the data and provide a valuable future reference.

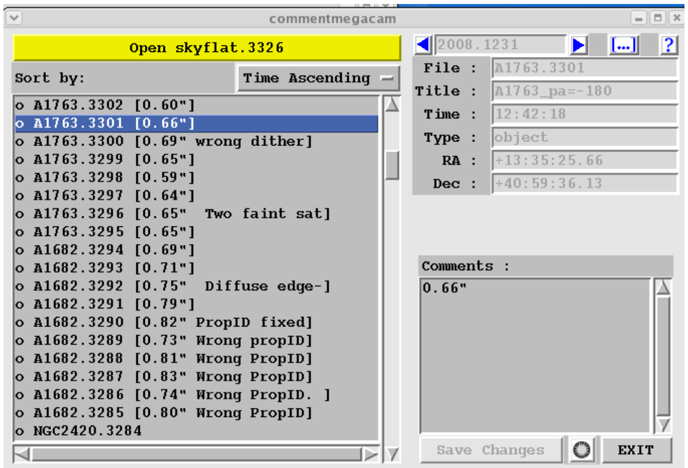


Figure 12 Comment GUI. Full size image: MegaCommentScr.png

6. Data Storage.

There are two options for getting you data home: on an external disk that you bring with you, or over the network from the CfA Telescope Data Center archive in Cambridge.

6.1. **External USB Disk.** At Magellan the data is cross-mounted onto **zorro** for easy access. A USB or Firewire disk can be plugged into **zorro** and mounted directly in the Finder (and under /Volumes/diskname). The data can be copied directly using the Finder or from a unix shell. At the end of your run, deactivate your disk, Eject it using the Finder, and unplug it. During the night, data will be cross-mounted onto **zorro** in $HOME/Shares/MEGA_CRUNCH/yyyy.mmdd and the following morning the archive version will be copied with ancillary files and available from $HOME/Shares/MEGA_ARCHIVE/yyyy.mmdd. Note: the copy of a full night of data to external disk can generally take in excess of 1 hour with a data transfer rate of about 50GB/hr over USB. It is recommended to avoid large data transfers during the night to avoid interfering with time-critical I/O.

6.2. **CfA Archive.** Each night's raw data is transferred to the CfA Telescope Data Center archive, normally during the morning following each night's observations. To request your data from the archive, send an email to tdchelp@cfa.harvard.edu after your run is complete.

7. Filters.

Megacam has two filter wheels, top and bottom, which have five slots each.

The bottom wheel contains the science filter. Transmission data for u', g', r', i' and z' are available in pdf and text format at http://www.cfa.harvard.edu/~bmcleod/Megacam/Filters/. Additionally a wide-band g+r filter is available.

The top wheel contains the following options

Name	Description
open	Normal observing configuration -- light reaches science and guider CCDs
gblk	Guider CCDs blocked -- used during twilight flats to minimize scattered light
dark	All CCDs blocked
sblk	Science CCDs blocked, guiders open -- not normally used

It is possible to bring your own filters for use with Megacam with **advance preparation**.

Only authorized observatory staff are allowed to change filters.

See Requirements for Megacam Filters.

8. General Comments and Information.

8.1. Typical Count Levels.

The bias level is typically 1200 ADU.

The dark sky background levels and the counts expected for a 20th mag (AB) object are given here:

MMT

Filter	Mag20	Background
u	83 ADU/sec	0.2 ADU/pix/sec
g	500 ADU/sec	2 ADU/pix/sec
r	390 ADU/sec	4 ADU/pix/sec
i	243 ADU/sec	8 ADU/pix/sec
z	86 ADU/sec	7 ADU/pix/sec

Magellan (10/2009)

Filter	Mag20	Background
u	106 ADU/sec	0.2 ADU/pix/sec
g	580 ADU/sec	1.6 ADU/pix/sec
r	550 ADU/sec	4.6 ADU/pix/sec
i	310 ADU/sec	6.0 ADU/pix/sec
z	110 ADU/sec	4.8 ADU/pix/sec

The numbers refer to a 2x2 binned pixel.

8.2. Differential Refraction.

Differential refraction across the filter bandpass is expected when observing a low elevation angles. Figure 13 shows the expected differential refraction as a function of elevation and filter.

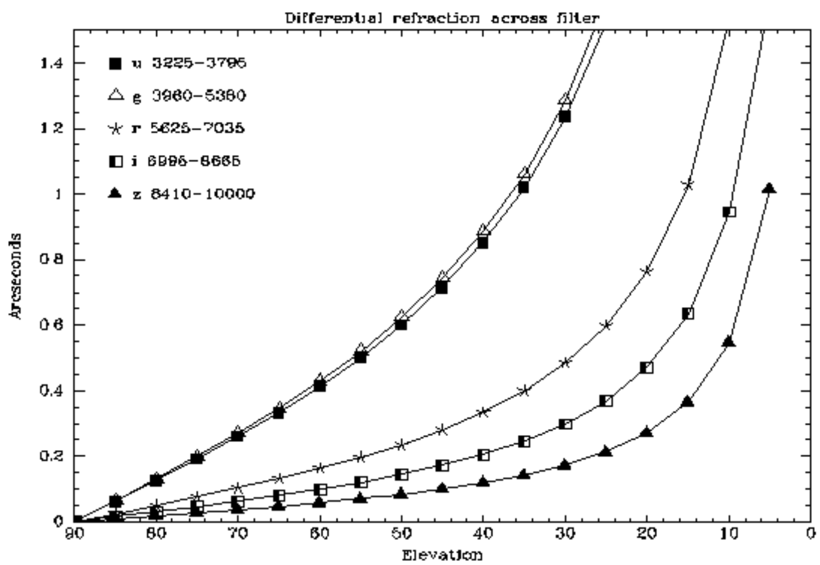


Figure 13 Differential refraction as a function of elevation and filter.

9. Problems.

1. Problems with mice.

   Many problems can be diagnosed using the *mice* Status display. The top section shows the status of all the servers in the Megacam client/server system. Green indicates that the server is up. Red indicates that the server is not running. Yellow indicates that the server is up but not responding. Sometimes servers will go yellow briefly if they are very busy. Servers can be restarted in the Start/Stop Tab and the Logs can also be reviewed.

2. All problems.

   All problems (weather not withstanding), comments and suggestions should be sent directly to Brian McLeod, as well as being put in your daily report and observer's report. Remember, if you don't report it, it can't be fixed!

10. Data Reduction for Megacam.

For more information on Megacam data reduction see: http://hopper.si.edu/wiki/piper/Megacam+Data+Reduction

A few preliminary notes about data reduction of Megacam images.

- Use mscred in iraf. Most of the parameters needed are in the data headers.
- epar setinstrument, and change the "directo" to mscdb$sao/
- run setinstrument. enter mmto, mmt, and megacam to the queries (or magellan).
- exit the epar session of mscred (you may want to change the backup option first).
- you are now editing the ccdproc parameter file. Enter no for fixpix, darkcor, flatcor and merge. You must at least turnoff fixpix and merge, else the program will crash. Overscan, trim, zerocor should be set to yes.
- run zerocombine on your bias exposures, this will create the file Zero.
- run flatcombine on your sky flats. I typically run it like this: flatcombine sky*.fits ccdtype=skyflat statsec=300:500,300:500?. You may want to change the statsec but you must use the ccdtype=skyflat command.
- now run ccdproc on your objects: ccdproc **.fits flatc+ flat=Flat**.fits. You may want to turn flatcor on in the parameter file. Flat*.fits should include the names of the flat files you just created.
- now run ccdproc again with merge turned on. ccdproc *.fits merge+

  NOTE: ccdproc merge+ not reliable!
- The result should be an image with only two extensions now.

11. APPENCICES

11.1. APPENDIX A: The Exposure Time Calculator, or ETC.

Exposure Time Calculator

This calculator uses the information contained in the previous section.

http://www.cfa.harvard.edu/mmti/megacam/obs_manual/exptime.html

11.2. APPENDIX B: How to plot the detector and guider footprint on the Sky Survey.

With ds9 version 5.4 or later you can overlay a Megacam science and guider chip template over an image. In the Region menu, select Instrument FOV -> MMT -> MEGACAM-CHIP-GUIDE. Then click with the left button on your image.

11.3. APPENDIX C: How to list guide stars available for your target.

To get a listing of the guide stars available at a given RA, Dec, position angle, and instrument offsets, follow this link

http://hopper.si.edu/megacam/gstars and fill in the form.

Or if you wish to call it from the unix shell you can do, for example:

```
wget -O - 'http://hopper.si.edu/megacam/gstars?RA=01:12:12.12&Dec=-11:12:13&AzOff=10&ElOff=5&PA=0&Epoch=2000'
```

or on a Mac:

```
curl  'http://hopper.si.edu/megacam/gstars?RA=01:12:12.12&Dec=-11:12:13&AzOff=10&ElOff=5&PA=0&Epoch=2000'
```

if that does not work, you may try /usr/bin/curl in place of the curl command above.

Recall that the PA has the opposite sign as the rotator offset that is specified in the Magellan format observing catalog. Note also that it is not required to select a particular guide star in advance of your run, just to verify that one is available.

11.4. APPENDIX D: How to set up catalog files.

Rather than entering separate, time-consuming commands to do things such as change the filter, enter an exposure time, and type in an object name, the Catalog Ops refers to an established catalog to perform all those functions, and more. A series of exposures for a given target can be planned in advance and executed without astronomer intervention, in principle. Dither catalogs can be generated manually or with the DitherTool tab of mice.

The catalog can be very versatile as it allows you to offset the telescope, specify filters for each image, and specify exposure times for each image.

The catalogs are TAB delimited tables. Columns in the table are delimited by the TAB character. The first line contains the column names. The second contains dashes separated by tabs. See [6] for information on manipulating tables of this format. The available column names are

```
exptime    The exposure time
filts      The filter name
azoff      The azimuth instrument offset
eloff      The elevation instrument offset
```

11.4.1. Examples.

Example dither files are located on the Magellan computers (shack or wild) at:

```
/home/megacam/*.cat
```

The following are commonly used dither files:

line3.cat 3 position diagonal dither that gets rid of the gaps

line5.cat 5 position diagonal dither that gets rid of the gaps

xyphotom.cat used for making photometric illumination correction

3x3.cat 3x3 pattern with 10 arcsec spacing

standards.cat run through filters and get standards in each; 1sec, 10sec and 100sec exposures

To list the offsets for a catalog use the following command:

```
column < line5.cat azoff eloff
```

11.4.2. DITHERTOOL.

You can of course create your own cat files in a text editor. However, the Dither Tool allows you to create cat files easily.

To use the dither tool, bring up the dithertool tab:

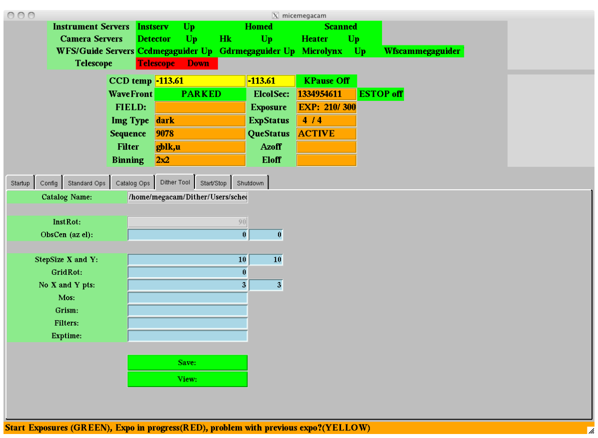
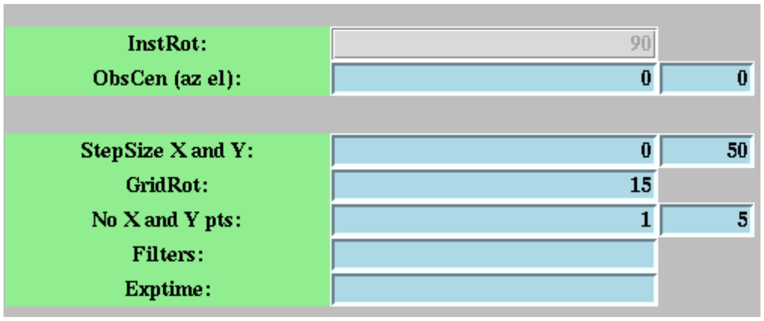


Figure 14 mice DitherTool tab. Full size image: **MegaDitherScr.png**

The output of the dither tool is saved to a tab delimited text file which can be viewed or modified with any editor. Some examples of the output of the dither tool are shown below.

- Dither Example

  The first example shows the input and output of a request for five exposures along a line which is inclined 15 degrees to the camera coordinate system.




```
   azoff   eloff
-----   -----
0       0
48.2963 12.9409
-48.2963        -12.9409
96.5926 25.8818
-96.5926        -25.8818
```

The azoff, eloff columns give the offsets which need to be sent to the mount, i.e. the unrotated coordinate system. Note that the "eloff" values (elevation offsets), are offsets across the narrow dimension of the guide chips. So the default ordering is to sort by increasing absolute value of eloff as the best way to minimize the number of times that new guide stars have to be chosen.

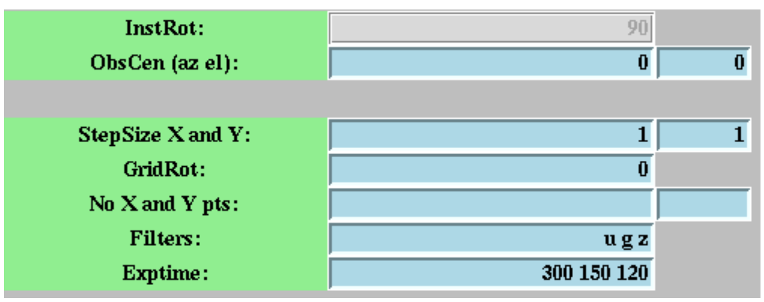
- Compound Filter Example

Filter names may NOT have spaces. A compound filter is delimited with a comma (,) as in the following case which specifies the u filter with a polarizer.

```
    filts exptime
----- -------
u,pol_45    300
```

- Pairing filters and exposure times

A sequence of filters is delimited with spaces and will expand into a sequence of exposures. If a single exposure time is specified all the filters will use the same exposure time. Alternatively, a space-delimited list of exposure times can be specified as well and then the sequence of filters will be matched with the corresponding exposure time. To specify a filter sequence without dithering, the NoXpts or NoYpts entries must be blank.




```
    filts exptime
----- -------
u     300
g     150
z     120
```

300s u, 150s g and a 120s z exposure would be taken. (As a reminder, there are tabs separating columns in the output table, but only spaces are allowed between entries in the GUI window. For instance, in the GUI entry boxes there is only a space between u g and z and also between 300 150 and 120.

When creating catalogs with both dithering and filter changes it is most efficient to sequence all the filters at each dither position since there is essentially zero overhead in a filter change (the filter change is completed during the detector readout) and potentially a large overhead in a dither, if the new dither position requires acquiring new guide stars.

11.4.3. Check your cat files.

If you create your own dither file it is important to verify that the formatting, especially the white space, is correct before using it. To verify the formatting type:

```
justify < filename.cat
```

which should produce the output neatly aligned in columns. Remember columns in the table must be separated by tabs.

11.4.4. Random Dither patterns.

The best deep images are obtained if the dither pattern is random, rather than a square or line. You can read all about dither patterns on the Spitzer Science Center web site, here **[7]**. For megacam, Bechtold created an offset file with a random dither pattern given here **megacamdither.out**; an example catalog file using this dither pattern for 25 exposures is **bechtoldu.cat**.

11.5. Appendix E: Gain Settings.

The standard gain settings provide a gain of 3.5e-/ADU. Other gain settings are possible and are described here for completeness. If you think your project could benefit from an alternate gain setting, contact B. McLeod in advance of your run.

There are two independent controls of the gain, one on the CCD itself, one in the controller.

The CCD output node gain is changed by adjusting the output gate voltage on the CCD.

The normal ccdgain=HIGAIN setting allows a full well of 180000 e- on the output node which corresponds to slightly more than the full well of a single unbinned pixel.

With ccdgain set to LOGAIN, the full well of the output node is increased by a factor of 3, with a corresponding decrease in the gain. Unfortunately, with the range of voltages allowed by our controller electronics, we have not been able to optimize the voltages properly and ended up with significant non-linearity. As a result this mode is not currently recommended.

The ccd controller offers two gain settings as well. The 4 possible combinations are summarized here.

CAMGAIN	CCDGAIN	Gain	FullWell	Bias level	Read noise	Comments
LO	HI	3.5e-/ADU	55000 ADU=190000 e-	1200	5e-	RECOMMENDED MODE
HI	HI	1.75e-/ADU	65535 ADU=115000 e-	2400	4e-	Lowest noise, but for imaging, not necessary
LO	LO	10e-/ADU	55000 ADU=550000 e-	1200	13e-	Non-linear
HI	LO	5e-/ADU	65535 ADU=300000 e-	2400	10e-	Non-linear

Attachment	Author	Date		Size	Actions
../3x3.cat.files/v0.1-3x3.cat	Unknown	06-11-2024	3x3.cat, ->	29	Delete
../CCD_QE_plot.png.files/v0.1-CCD_QE_plot.png	Unknown	06-11-2024	CCD_QE_plot.png, ->	45	Delete
../Focal_Plane_Diag.jpg.files/v0.1-Focal_Plane_Diag.jpg	Unknown	06-11-2024	Focal_Plane_Diag.jpg, ->	55	Delete
../MegaCatalogScr.png.files/v0.2-MegaCatalogScr.png	Unknown	06-11-2024	MegaCatalogScr.png, ->	51	Delete
../MegaCommentScr.png.files/v0.1-MegaCommentScr.png	Unknown	06-11-2024	MegaCommentScr.png, ->	51	Delete
../MegaConfigScr.png.files/v0.2-MegaConfigScr.png	Unknown	06-11-2024	MegaConfigScr.png, ->	49	Delete
../MegaDitherScr.png.files/v0.2-MegaDitherScr.png	Unknown	06-11-2024	MegaDitherScr.png, ->	49	Delete
../MegaShutdownScr.png.files/v0.2-MegaShutdownScr.png	Unknown	06-11-2024	MegaShutdownScr.png, ->	53	Delete
../MegaStandardScr.png.files/v0.2-MegaStandardScr.png	Unknown	06-11-2024	MegaStandardScr.png, ->	53	Delete
../MegaStartStopScr.png.files/v0.2-MegaStartStopScr.png	Unknown	06-11-2024	MegaStartStopScr.png, ->	55	Delete
../MegaStartupScr.png.files/v0.2-MegaStartupScr.png	Unknown	06-11-2024	MegaStartupScr.png, ->	51	Delete
../MegacamOnClay_smallcolor.jpg.files/v0.1-MegacamOnClay_smallcolor.jpg	Unknown	06-11-2024	MegacamOnClay_smallcolor.jpg, ->	71	Delete
../SDW2005_mcleod.pdf.files/v0.1-SDW2005_mcleod.pdf	Unknown	06-11-2024	SDW2005_mcleod.pdf, ->	51	Delete
../Stetson Photometric Standard Fields.html.files/v0.1-Stetson Photometric Standard Fields.html	Unknown	06-11-2024	Stetson+Photometric+Standard+Fields.html, ->	95	Delete
../badfwhmplot.png.files/v0.1-badfwhmplot.png	Unknown	06-11-2024	badfwhmplot.png, ->	45	Delete

../bechtoldu.cat.files/v0.1-bechtoldu.cat	Unknown 06-11-2024 bechtoldu.cat, ->	41	Delete
../cutaway_final_edited.png.files/v0.1-cutaway_final_edited.png	Unknown 06-11-2024 cutaway_final_edited.png, ->	63	Delete
../datadeluge.pdf.files/v0.1-datadeluge.pdf	Unknown 06-11-2024 datadeluge.pdf, ->	43	Delete
../goodfwhmplot.png.files/v0.1-goodfwhmplot.png	Unknown 06-11-2024 goodfwhmplot.png, ->	47	Delete
../icsoi.pdf.files/v0.1-icsoi.pdf	Unknown 06-11-2024 icsoi.pdf, ->	33	Delete
../image002.jpg.files/v0.1-image002.jpg	Unknown 06-11-2024 image002.jpg, ->	39	Delete
../image006.jpg.files/v0.1-image006.jpg	Unknown 06-11-2024 image006.jpg, ->	39	Delete
../image018.gif.files/v0.1-image018.gif	Unknown 06-11-2024 image018.gif, ->	39	Delete
../line3.cat.files/v0.1-line3.cat	Unknown 06-11-2024 line3.cat, ->	33	Delete
../line5.cat.files/v0.1-line5.cat	Unknown 06-11-2024 line5.cat, ->	33	Delete
../line5.png.files/v0.1-line5.png	Unknown 06-11-2024 line5.png, ->	33	Delete
../megacam.pdf.files/v0.1-megacam.pdf	Unknown 06-11-2024 megacam.pdf, ->	37	Delete
../megacam_magellan_layout.fig.files/v0.2-megacam_magellan_layout.fig	Unknown 06-11-2024 megacam_magellan_layout.fig, ->	69	Delete
../megacam_magellan_layout.pdf.files/v0.2-megacam_magellan_layout.pdf	Unknown 06-11-2024 megacam_magellan_layout.pdf, ->	69	Delete
../megacam_magellan_layout.png.files/v0.2-megacam_magellan_layout.png	Unknown 06-11-2024 megacam_magellan_layout.png, ->	69	Delete
../megacamdither.out.files/v0.1-megacamdither.out	Unknown 06-11-2024 megacamdither.out, ->	49	Delete
../spie96.pdf.files/v0.1-spie96.pdf	Unknown 06-11-2024 spie96.pdf, ->	35	Delete
../standards.cat.files/v0.1-standards.cat	Unknown 06-11-2024 standards.cat, ->	41	Delete
../twidisp.png.files/v0.1-twidisp.png	Unknown 06-11-2024 twidisp.png, ->	37	Delete
../twiflat_g.jpg.files/v0.2-twiflat_g.jpg	Unknown 06-11-2024 twiflat_g.jpg, ->	41	Delete
../twiflat_i.jpg.files/v0.2-twiflat_i.jpg	Unknown 06-11-2024 twiflat_i.jpg, ->	41	Delete
../twiflat_r.jpg.files/v0.2-twiflat_r.jpg	Unknown 06-11-2024 twiflat_r.jpg, ->	41	Delete
../twiflat_u.jpg.files/v0.2-twiflat_u.jpg	Unknown 06-11-2024 twiflat_u.jpg, ->	41	Delete
../twiflat_z.jpg.files/v0.2-twiflat_z.jpg	Unknown 06-11-2024 twiflat_z.jpg, ->	41	Delete
../ugz.png.files/v0.1-ugz.png	Unknown 06-11-2024 ugz.png, ->	29	Delete
../xyphotom.cat.files/v0.1-xyphotom.cat	Unknown 06-11-2024 xyphotom.cat, ->	39	Delete