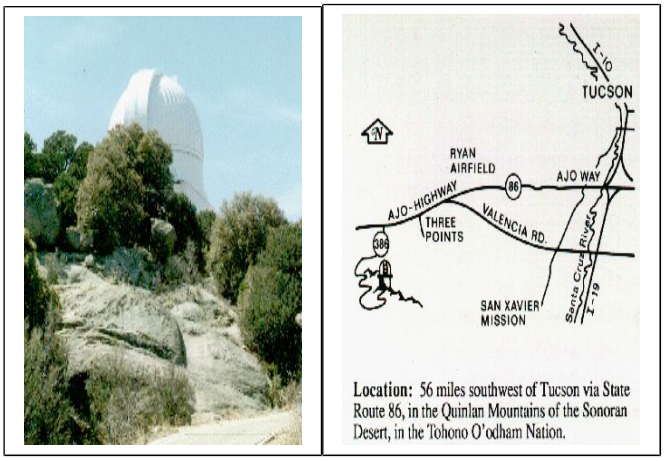
WIYN 0.9M TELESCOPE OPERATIONS MANUAL

February 16, 2011

By Heidi Schweiker

Edited By Hillary Mathis

LOCATION OF THE 0.9M TELESCOPE



The 0.9-m telescope is located on the southern ridge of Kitt Peak in the Quinlan Mountains, about 50 miles southwest of Tucson.

SAFETY WALKTHROUGH

Prior to starting up the systems or moving the telescope the safety walk-through needs to be done to ensure that systems are at nominal operating conditions and that one can safely move the telescope.

On the observing level:
Make sure the crane is fully stowed.
Check to make sure the ladder is stowed to the north of the telescope, along the railing.
The platform should be at its lower limit.
Check the area around the telescope for obstructions.
Check cabling on/around the telescope for snagged, strained, or pulled out cables.

STARTUP CHECKLIST

DOWNSTAIRS

Turn off the white light at the entrance.
Make sure the bathroom door is closed.
Make sure the door to the loading dock is open.
Check the liquid Nitrogen level: It should be > 1/4 full.
Check the dry air in the back of the computer room to make sure the machine is on.
Turn on the fan above the dry Nitrogen bottles.
Turn off the light in the loading dock area.
Make sure the door to the control room is closed.

UPSTAIRS

Check cables around telescope - make sure none are strained, pulled out.
Check the area around the telescope for obstructions.
Make sure the crane is stowed.
Make sure the hand-paddle is properly stowed.
Fill the dewar (if using S2KB) and sign the log sheet.

CONTROL ROOM

Bring up the control system on Olive if not already up (Select "ACE" from the desktop) - Login and password are on the whiteboard (ACE TCS Olive).
Slew the telescope to the mirror cover park position.

UPSTAIRS

Use the ladder to remove the mirror cover. Be careful not to bump the flat field lamps.
Stow the mirror cover in the blue holder on the south side of the platform.

IF DOING DOME FLATS:
Move the telescope to the Dome Flat Park position (via the ACE TCS computer). The dome will also move to the correct position.

IF OPENING FOR OBSERVING:
Open the dome shutter via the control panel on the platform.
Turn on the dome fans.
Open the dome vents - Be sure to turn off the circuit breaker when done.
Plug in the exhaust fan (if humidity is below 70%)
Turn off the dome lights.

CONTROL ROOM

Slew the telescope to zenith (Remember to Reset the slew interlock)
Move the telescope to a bright star near zenith and check the pointing or simply turn on the telescope tracking if taking sky flats.
Turn AutoDome on.
Go to your first object and check focus.

SHUTDOWN CHECKLIST

CONTROL ROOM

Stop your exposure and guiding. Quit the guider software on Moss. If using S2KB be sure to *Disconnect* the guide camera before quitting the software.
If using Mosaic, turn off the guide cameras and put shutter in "dark" position.
Turn off AutoDome and send the dome to the home position. Under Dome => Home.
Move the telescope to the mirror cover park position.

UPSTAIRS

Use the ladder to replace the mirror cover.
Close the dome shutter via the control panel on the platform.
Turn off dome fans.
Unplug the exhaust fan.
Close the dome vents - remember to switch off the circuit breaker.

From the control room, bring the telescope to zenith. Fill the dewar (S2KB only) and sign the log sheet.

CONTROL ROOM

Log out of the TCS control system on Olive (Select User => Logoff from the top tool bar).
Turn off the hand held radio and stow it in the charger.
Turn off the heater or A/C and the coffee pot.
Fill out the nitelog form at http://www.noao.edu/cgi-bin/09m/nlog.cgi.
Fill out the Observing Run Evaluation if it's your last night.
If there were problems during the night send an email to the Site Manager hmathis at noao.edu.

DOWNSTAIRS

Turn off the fan in the loading dock.

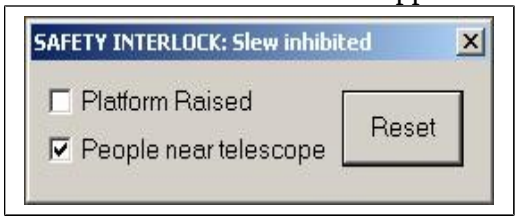
When leaving the building please make sure the outside door closes fully behind you. If this is the last night of your run see the End of Run Checklist for additional shutdown items.

INTERLOCKS

For safety reasons, there are a couple of interlocks in the dome that will disallow slewing of the telescope when people are in the dome or the platform is raised. The telescope will also stop slewing if an interlock is tripped during a slew. **This only affects a slew - all other functions (telescope tracking, guiding, dome tracking, etc.) will still function normally when an interlock has been tripped**.

1. **Motion sensor**
   A motion sensor is located below the upper stairwell in the dome. Someone walking on the platform will trip this sensor.
2. **Platform interlock**
   When the platform is raised it will trip the interlock. The platform must be stowed at its lower limit in order to slew the telescope.

When an interlock has been tripped a small window will appear on the TCS.



The platform interlock is automatically reset when it has been fully lowered. To reset the interlock caused by the motion sensor, click the Reset button in the small window. Keep in mind that you will need to reset this each time you walk onto the platform.

FILLING THE DEWAR

In order to keep the CCD cold the dewar needs to be filled on a regular basis with liquid Nitrogen. The observer is responsible for filling the dewar when S2KB is in use, but the WIYN OA will fill the dewar when Mosaic is on the telescope. The telescope does need to be at the zenith park position in order for the liquid nitrogen fill line to reach the instrument so be sure to park it there at the end of each night. The Site Manager will review proper liquid nitrogen handling procedures with you if appropriate.

S2KB holds approximately 8 hours, meaning it will be necessary to fill the dewar every 8 hours. If the dewar is allowed to warm up it may take quite a while for it to cool down again and could cause the vacuum to go soft, resulting in even shorter hold times. So please be diligent about filling it. However, Mosaic will hold for 12+ hours so you shouldn't need to interrupt observations to have it filled.

To check the temperature of the S2KB dewar and camera type "ccdinfo" in the Data Acquisition window. The last two lines displayed indicate the dewar and camera temperatures. Nominal temperatures are: CCD= -98 Dewar= -191. If the dewar begins to warm up you should stop your observations and fill it with liquid nitrogen, even if it has been less than 8 hours since the last fill.

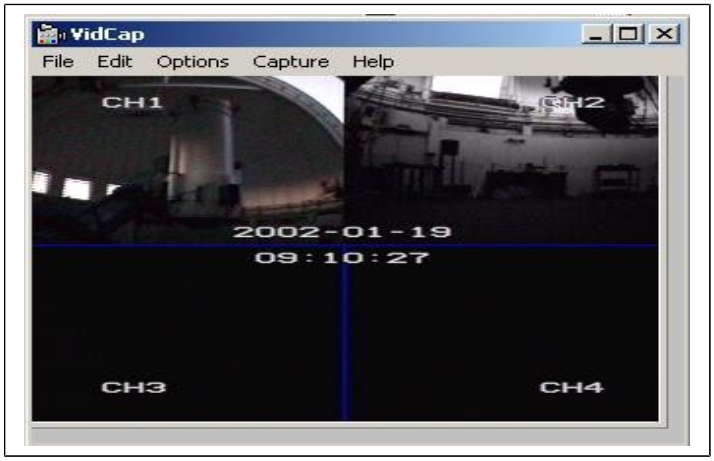
If the dewar has warmed up, check the troubleshooting section Dewar Warmups for recovery procedures.

Mosaic's temperatures are constantly displayed on the Mosaic GUI. If the dewar begins to warm up mountain personnel will be notified by email and will come to fill the dewar shortly.

The dewar is usually filled at the beginning and end of each night with liquid nitrogen (you may have to interrupt observations during the night to make sure S2KB is filled every 8 hours). There is a fill line and valve mounted on the side of the telescope pier that runs down to the 230L dewar in the loading area where the liquid nitrogen is stored. The fill line should be precooled before attaching it to the instrument - simply open the valve on the observing floor and point the fill line away from you. Close the valve when liquid starts to spew out of the line and attach the line to the instrument. Liquid will spill out (of the overflow holes between the dewar and the nut attaching the line to the instrument) when the dewar is full. Close the valve when it is full and replace the cap on the dewar.

For more help on filling a dewar, see the Dewar Filling Tips and Tricks section in the Appendix.

DOME CAMERAS



There are two small video cameras fixed in the dome - one located on the south wall and the other just below the stairs above the motion sensor. The cameras allow you to view the telescope and platform area when there is light in the dome. (*Nothing will be visible on the cameras during the night or when the lights are off.*)

You can view the video on Olive. From the Desktop select: Vidcap32
A small window with 4 quadrants will pop up. The quadrants are labeled CH1, CH2, CH3, CH4. We have the capability to view up to four cameras, but only channels 1 and 2 have input.

EXHAUST FAN OPERATION

To help improve the seeing at the 0.9m an exhaust fan has been installed along the polar axle. This will draw air across the primary mirror, alleviating pooling of hot air on the mirror.

If the outside humidity is greater than 70% this exhaust fan should not be used. For more on how to check your humidity see the weather section.

Currently, operation of the fan is done manually. (Weather permitting) the fan should be turned on when opening the dome for the evening, and turned off when closing in the morning. The fan is located on the observing level behind the telescope pier. You will need to plug in the electrical into the socket on the wall to turn it on and unplug it to turn it off.

In order to determine the effects this fan is having on seeing we request that observers closely monitor seeing throughout the night, noting the seeing in the nightly observing report. In addition, we request that observers check the seeing near the end of the night on a very short, unguided exposure (e.g. on a standard star field) on a field that is at less than

2 airmasses. This seeing measurement should be noted in the comments section of the nightly observing report

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WIND SCREEN

In cases where the wind has not reached the closing limit of 45mph, but the telescope shake is affecting science, a wind screen is available for use. The controls are located to the left of the dome slit. In order to reach the controls the dome must be rotated to face the slit west. Make sure to turn the power on for the controls before use and turn it off after moving the screen into place.

TELESCOPE DOME VENTILATION

 The 0.9-m at sunset with 7 of the 11 ventilation louvers visible.

In August 1994, dome vents were added to the 0.9-m dome to provide much improved flow-through ventilation as part of an image quality improvement project. The 11 individually controllable vents are located opposite the dome slit to allow the dome air to flush several times per minute under typical wind conditions. Rapid flushing helps eliminate warm air pockets from forming in the dome, which in turn, reduces convection that would otherwise compromise image quality (that is, "seeing").

Normally, some complement of vents will be opened at the beginning of the night, around sunset, and closed when the telescope is closed. If the dome is iced up, the vents may need to be broken free.

Based on limited testing, the dome flushes adequately with about half the vents open during mild wind conditions. You may wish to open every other vent.

Under the following conditions the observer should restrict the air flow by closing some or all of the vents.

- High gusting winds that cause the telescope to bounce.
- The dome shutter is opened during the day and the outside temperature is higher than inside.

Selective operation of the vents is done by setting the switches on the control panel located near vent #7, opposite the dome shutter, as described in the "detailed operation" section below.

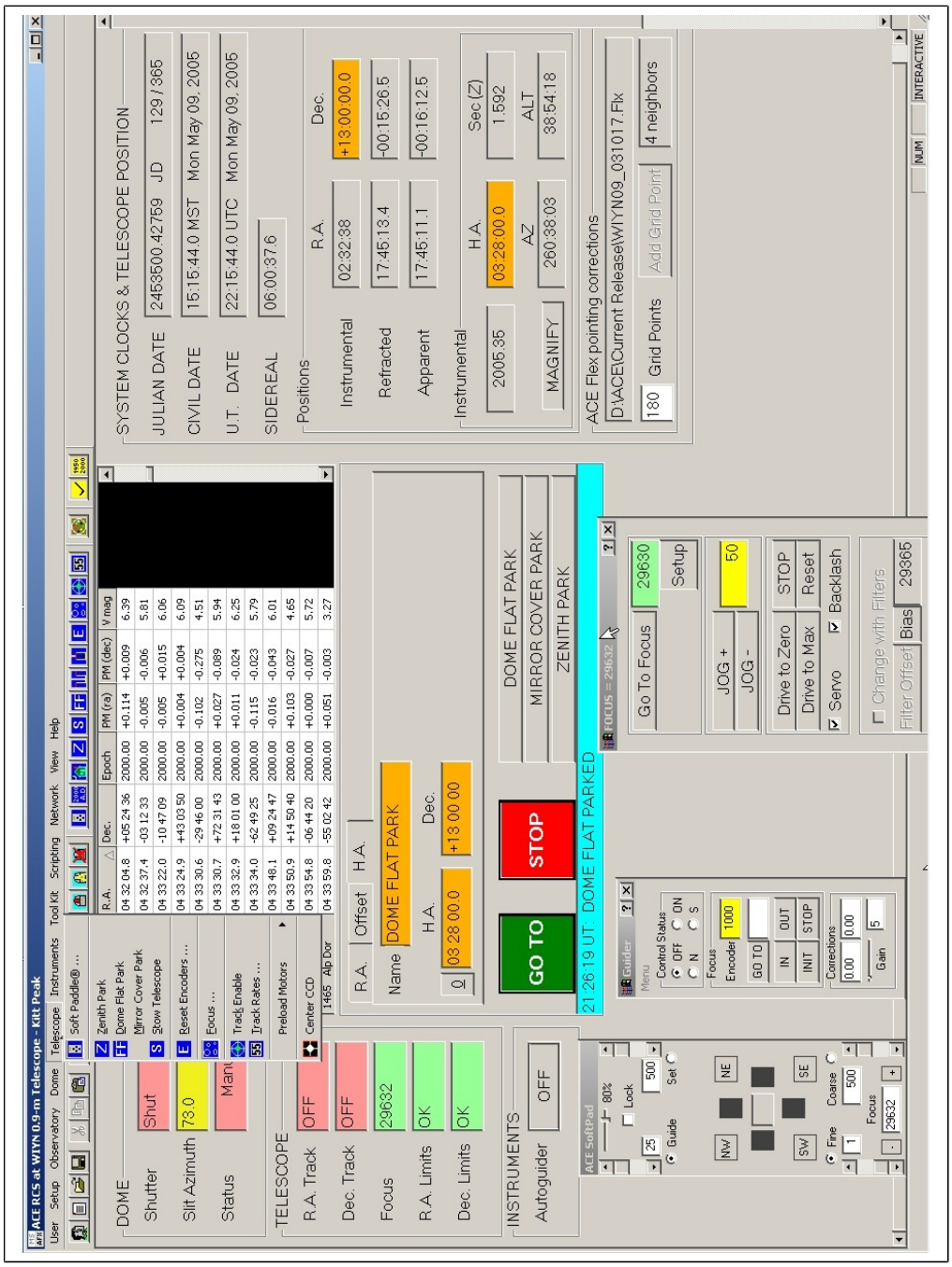
If the air is very calm, less than about 5 mph, you may wish to open additional vents.

Detailed Manual Operation of the Vents

In this mode, one can open or close any or all of the 11 vents individually. The vent control panel consists of four types of switches as described below. The term "ensemble of vents" refers to those vents whose "Together-Off-Separate" switches are set to "Together".

- **Auto-Off-Manual** - this is the main control switch at the top of the control box.
    - Auto - Enables automatic open/close of the ensemble of vents when the dome shutter is opened/closed. This disables manual open/close operations from the "Open-Close" main switch (see next major bullet).
    - Off - Disables both automatic and manual open/close operation of the ensemble of vents.
    - Manual - Disables automatic open/close of the ensemble of vents when the dome shutter is opened/closed. Enables manual open/close of the ensemble of vents with the "Open-Close" main switch.
- **Open-Close** - This switch operates on the ensemble of vents. It is a "momentary" switch which must be held while the vents continue to open or close.
- **Together-Off-Separate** - This is a row of 11 switches, each having 3 positions, to control the detailed operation of an individual vent.
    - Together - Include this vent as part of the ensemble.
    - Off - Remove this vent from the ensemble and disable it from manual open/close operations.
    - Separate - Remove this vent from the ensemble and enable it to be opened/closed manually by its individual open/close manual switch (see next major bullet).
- **Open-Close (row of 11)** - If the individual vents "Together-Off-Separate" switch is set to Separate, then it can be opened/closed by its individual open/close switch from this row (towards the bottom of the control panel).

THE ACE TCS


ACE RCS at WIYN 0.9-m Telescope - Kitt Peak
User Setup Observatory Dome Telescope Instruments Tool Kit Scripting Network View Help
DOME
Shutter
Shut
Slit Azimuth
73.0
Status
Manu
TELESCOPE
R.A. Track
OFF
Dec. Track
OFF
Focus
29632
R.A. Limits
OK
Dec. Limits
OK
INSTRUMENTS
Autoguider
OFF
Zenith Park
Dome Flat Park
Mirror Cover Park
Stow Telescope
Reset Encoders ...
Focus ...
Track Enable
Track Rates ...
Preload Motors
Center CCD
1465 Alp Dor
R.A.
Dec.
Epoch
PM (ra)
PM (dec)
V mag
04 32 04.8 +05 24 36 2000.00 +0.114 +0.009 6.39
04 32 37.4 -03 12 33 2000.00 -0.005 -0.006 5.81
04 33 22.0 -10 47 09 2000.00 -0.005 +0.015 6.06
04 33 24.9 +43 03 50 2000.00 +0.004 +0.004 6.09
04 33 30.6 -29 46 00 2000.00 -0.102 -0.275 4.51
04 33 30.7 +72 31 43 2000.00 +0.027 -0.089 5.94
04 33 32.9 +18 01 00 2000.00 +0.011 -0.024 6.25
04 33 34.0 -62 49 25 2000.00 -0.115 -0.023 5.79
04 33 48.1 +09 24 47 2000.00 -0.016 -0.043 6.01
04 33 50.9 +14 50 40 2000.00 +0.103 -0.027 4.65
04 33 54.8 -06 44 20 2000.00 +0.000 -0.007 5.72
04 33 59.8 -55 02 42 2000.00 +0.051 -0.003 3.27
R.A.
Offset
H.A.
Name
DOME FLAT PARK
H.A.
Dec.
03 28 00.0
+13 00 00
GO TO
STOP
DOME FLAT PARK
MIRROR COVER PARK
ZENITH PARK
21:26:19 UT: DOME FLAT PARKED
SYSTEM CLOCKS & TELESCOPE POSITION
JULIAN DATE 2453500.42759 JD 129 / 365
CIVIL DATE 15:15:44.0 MST Mon May 09, 2005
U.T. DATE 22:15:44.0 UTC Mon May 09, 2005
SIDEREAL 06:00:37.6
Positions
R.A.
Dec.
Instrumental 02:32:38 +13:00:00.0
Refracted 17:45:13.4 -00:15:26.5
Apparent 17:45:11.1 -00:16:12.5
Instrumental
H.A.
Sec (Z)
2005.35
03:28:00.0
1.592
MAGNIFY
AZ
ALT
260:38:03
38:54:18
ACE Flex pointing corrections
D:\ACE\Current Release\WYN09_031017.Flx
180 Grid Points
Add Grid Point
4 neighbors
ACE SoftPad
Lock
Guide
Set
Fine
Coarse
Focus
Guider
Menu
Control Status
OFF
ON
N
S
Focus
Encoder
1000
GO TO
IN
OUT
INIT
STOP
Corrections
Gain
Focus = 29632
Go To Focus
29630
Setup
JOG +
JOG -
50
Drive to Zero
Drive to Max
Servo
Backlash
STOP
Reset
Change with Filters
Filter Offset
Bias
29365
NUM
INTERACTIVE

OVERVIEW

The ACE TCS program runs via the computer named Olive, a WindowsXP machine. The autoguider runs on a dual boot Windows/Linux computer named Moss where Linux is the OS used when Mosaic is in use and Windows is the OS when S2KB is in use.

The TCS (Telescope Control System) is a Windows based system. Dome and Telescope status are on the left. Time and date stamps such as UT date, Sidereal time and current RA and Dec are all displayed on the right side. The center of the screen is where the coordinate catalogs will load. Below the coordinate catalog area is a field with RA, Offset, and HA tabs at the top. This is where you enter coordinates and offsets. The Go To button is self-explanatory - it will send the telescope to the coordinates in the boxes above. This Go To button will change to a Cancel Slew button when the telescope is slewing, and back to the Go To button when the slew is completed. The Stop button is an emergency stop button. It will stop all axes (ra, dec, focus, dome, etc).

The main toolbar is at the top of the window. It contains pulldown menus such as User, Setup, Dome, etc. The menus you will use most frequently are Dome, Telescope, and User. Shortcut buttons are available for frequently used tasks such as moving the telescope to the Zenith park position. These buttons are blue and located on the main toolbar just below the pulldown menus. You can find out what each button does by holding the mouse over a button. A short description of the button also appears at the bottom of the window.

STARTING UP

At the end of every night the observer should log off of the ACE TCS program. This will disallow anyone from operating the telescope from the TCS, but will not close the program. A login box should be in the center of the screen. If the program does not appear to be running you will need to start it before you can do anything. Check on the bottom of the screen to make sure the program or the socket server is not currently running (you would see an icon entitled ACE RCS and/or Socket Server if it was). If it isn't you can bring up a new one. To open it double-click on the "Ace" Icon on the desktop on Olive. You can also bring up the program via the Start menu:
Start => Programs => Ace => Ace

The login and password are on the white board under "ACE TCS". The telescope drives energize when you open up the ACE TCS program. No initialization of the telescope is needed at the beginning of the night.

TELESCOPE PARK POSITIONS

There are four programmed telescope park positions that will move the telescope to common positions and turn the telescope tracking off: Zenith park, Dome flat park, Mirror cover park, and the Stow position. Before moving the telescope to any of these

positions the safety walk-through must be performed to ensure it is safe to move the telescope.

To move the telescope to one of these positions select *Telescope* from the main toolbar. Send the telescope to the desired park position by selecting one of the options.

Zenith Park The Zenith park position will send the telescope to zenith and turn the telescope tracking off. The telescope should be left at zenith at the end of each night.

Dome Flat Park The Dome Flat park position will send the telescope to a Dec of +13 and an HA of 3:28. It will also send the dome to the appropriate azimuth for taking flats.

Mirror Cover Park The Mirror Cover park position will send the telescope to an HA of -4:00 and a Dec of +85 and turn the telescope tracking off. Mirror cover operation is manual at the 0.9m. You will need to move the telescope to this position in order to be able to remove or replace the mirror cover.

Stow Telescope The Stow position is identical to the Zenith park position. It will send the telescope to zenith and turn the telescope tracking off.

COORDINATE CATALOGS

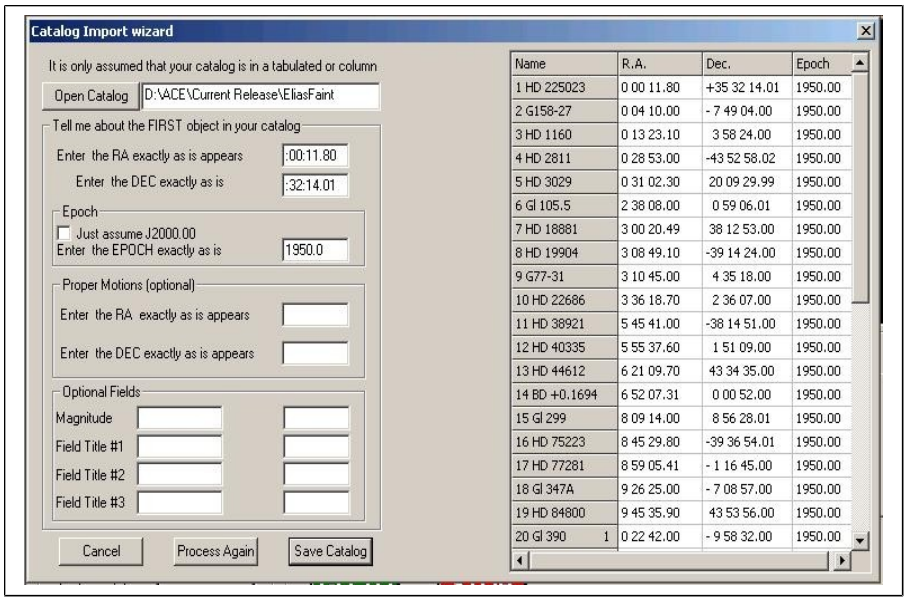
Format

Any text file that is column delimited can be imported into the ACE TCS, regardless of format.

Note: All coordinates must have the same epoch.

Importing a catalog

First you must transfer your cache, in text format, to Olive. To import a catalog select the *Tool Kit* pulldown menu and select *Import Catalog*. This opens the Import Catalog program where you can manipulate the spacing in your file to the appropriate TCS format.



Click on *Open Catalog* and select your file. Enter the RA and Dec of the first object in your catalog exactly as it appears. You will also need to note an Epoch - you can select the J2000.00 default or enter a different one. If you've included magnitudes and proper motions in your catalog you'll need to also enter those exactly as they appear for your first object. Once you've entered the above information click on Process and you should see your processed catalog appear on the right. Edit the original file or modify your entries in this Catalog Import Wizard until you are satisfied with the result. Click on Save Catalog and then open your catalog within the TCS to see that it has indeed been processed correctly.

Add/Replace and Delete buttons

The Add/Replace and Delete buttons (located on the RA coordinate entry tab) allow you to modify the currently loaded catalog. Delete will remove the currently selected object from the catalog. The Add button allows you to add the current target to the currently loaded catalog. The Replace button will allow you to modify the currently selected object.

ACQUIRING AN OBJECT

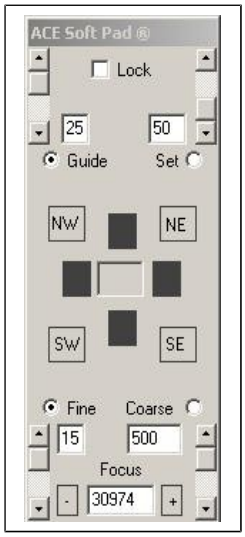
Accessing a cache:
From anywhere on the TCS click the right mouse button. Select "Open Database". The caches are stored in the following path:
ACE Control System (D:) => ACE => CurrentRelease
The caches all have .cat extensions. Double click on the appropriate cache. They should load into the center area of the TCS. You can sort the cache by field by clicking on the top of the column. To send coordinates to the TCS double-click on the object.

Once you have loaded the star into the fields click the green "GoTo" button. A confirmation box will pop up with your coordinates listed. Check the coordinates carefully to be sure they are valid coordinates - check the HA, secz, Dec, etc. If these look correct select "Move Telescope". When the telescope starts to move the "GoTo" button will turn into a "Cancel Slew" button. Two status bars will also appear above this button - one for the RA and one for the Dec. You have reached the target when the green "GoTo" button comes back and the status bars read "Locked on Target".

Don't forget to turn on your dome tracking.

SMALL TELESCOPE MOTIONS

If you need to jog the telescope to center up on your object you can either type in offsets into the offset window just below the coordinate catalog area or you can use the black jog buttons on the ACE Soft Pad, the software hand-paddle To enter offsets click on the "Offset" tab and enter your offsets in the appropriate boxes. You can enter either arcseconds or seconds and arcseconds by selecting the appropriate units in the pulldown box to the right. Click on "GoTo" to move the telescope. The underlined zero to the left of the entry boxes is a button that allows you to clear any entries.



The ACE Soft Pad is a software hand-paddle This comes up automatically when you log in. You can also bring it up by clicking on the dark blue "SoftPAD" button on the toolbar, or by selecting Telescope => Soft Paddle on the main toolbar.

THE DOME

Moving the dome under computer control

Although the dome can be controlled either via computer control or manually from the control panel on the platform, throughout the night you will want to use the dome tracking program (AutoDome) to keep the dome slit aligned with the telescope. To turn dome tracking on, on the TCS select Dome=> AutoDome. A box will pop up asking you to confirm turning dome tracking on.

You can also send the dome to a specific azimuth. On the ACE TCS select Dome => Azimuth. A box will pop up noting the current dome azimuth. Below the current azimuth is a box where you can enter a desired azimuth. Enter the az and click on Move Dome.

To turn the dome tracking off at the end of the night, select Dome => AutoDome and confirm that you do want to turn the tracking off.

Moving the dome via the control panel

When setting up to do dome flats, it's a good idea to check the alignment of the white spot and telescope. You may need to bump the dome in one direction to more precisely align them. Manual dome control is possible via the control panel in the dome. The "Left" button will move the dome counter-clockwise, and the "Right" button will move the dome clockwise.

You can also move the dome via the hand paddle. The hand paddle is located on the chain railing near the LN2 hose. The dome rotation buttons are on the left top-side of the hand paddle. The left button turns the dome counter-clockwise and the right button turns in clockwise.

Note: There is an interlock on the dome that will not allow you to quickly switch directions. If you move the dome Left you will need to wait 20 seconds before trying to move the dome Right and vice versa.

The system that rotates the dome, to align the dome slit with the telescope does not performed optimally. As a result, occasionally, part of the telescope beam may be occulted by the dome. There appears to be both a systematic and random component to these errors. Anyone doing all-sky photometry should check the dome/telescope alignment after every slew by going to the telescope floor, stand behind the telescope, and sight along the tube. Move your eye around the entire "circle" of the back of the telescope and find the two places where the dome is closest to the cylindrical beam of the telescope. If it is occulting, move it using either the control panel or the hand-paddle (See the above paragraph for further instructions on using the hand-paddle)

Opening/Closing the dome shutter

Before opening or closing the dome shutter make sure that either the mirror cover is on or the telescope is titled over (e.g. at the white spot) to prevent junk from falling onto the mirror.

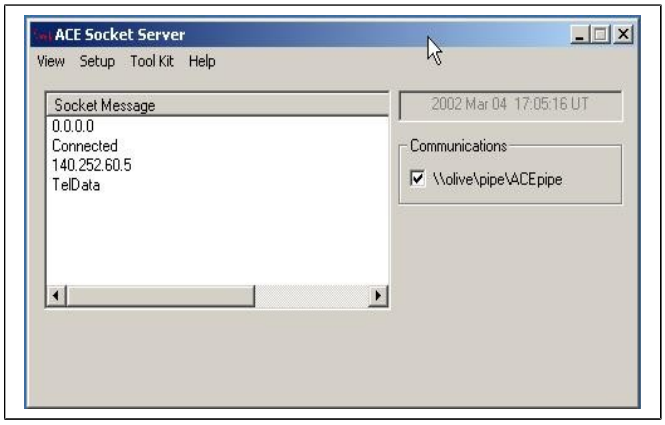
You should only operate the dome shutter from the control panel upstairs. To operate it from the control panel push and hold the appropriate button (open or close) until the limit switches are hit and the motors turn off.

See the Troubleshooting Tips section if you are having trouble moving the dome.

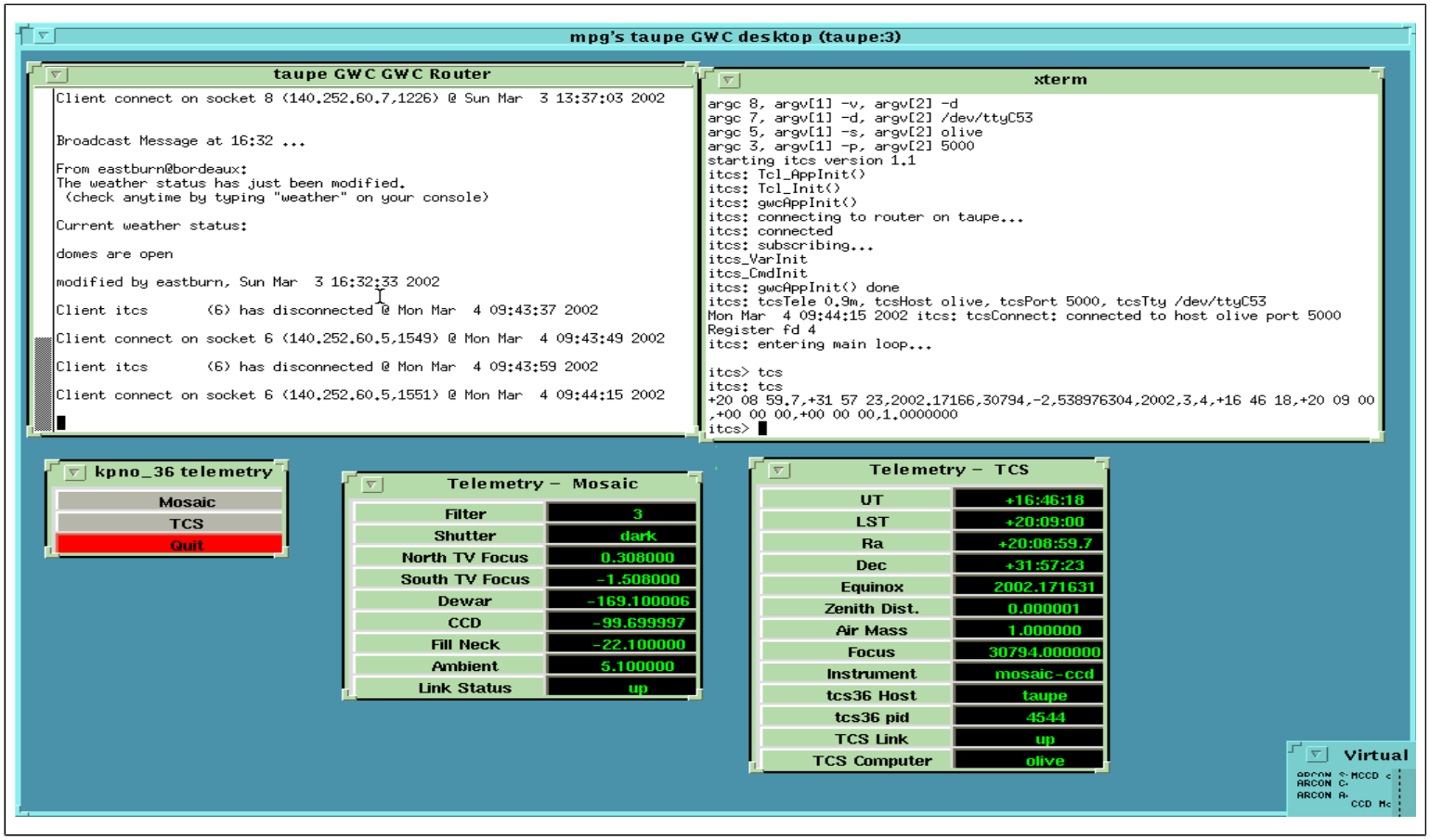
TCS/INSTRUMENT COMMUNICATION

We currently need to manually setup the communication between the instrument control computer and the TCS. This will allow pertinent telescope telemetry to be placed into the image headers.

On Olive:



- The ACE Socket Server starts whenever the ACE RCS is brought up. Make sure another Socket Server is not running before starting the program. (It may be minimized on the bottom toolbar).
- From the main toolbar on the ACE RCS select Network => Start Socket Server.
- A smaller window will pop up and should read 0.0.0.0


mpg's taupe GWC desktop (taupe:3)
taupe GWC GWC Router
Client connect on socket 8 (140.252.60.7,1226) @ Sun Mar 3 13:37:03 2002
Broadcast Message at 16:32 ...
From eastburn@bordeaux:
The weather status has just been modified.
(check anytime by typing "weather" on your console)
Current weather status:
domes are open
modified by eastburn, Sun Mar 3 16:32:33 2002
Client itcs (6) has disconnected @ Mon Mar 4 09:43:37 2002
Client connect on socket 6 (140.252.60.5,1549) @ Mon Mar 4 09:43:49 2002
Client itcs (6) has disconnected @ Mon Mar 4 09:43:59 2002
Client connect on socket 6 (140.252.60.5,1551) @ Mon Mar 4 09:44:15 2002
xterm
argc 8, argv[1] -v, argv[2] -d
argc 7, argv[1] -d, argv[2] /dev/ttyC53
argc 5, argv[1] -s, argv[2] olive
argc 3, argv[1] -p, argv[2] 5000
starting itcs version 1.1
itcs: Tcl_AppInit()
itcs: Tcl_Init()
itcs: gwcAppInit()
itcs: connecting to router on taupe...
itcs: connected
itcs: subscribing...
itcs_VarInit
itcs_CmdInit
itcs: gwcAppInit() done
itcs: tcsTele 0.9m, tcsHost olive, tcsPort 5000, tcsTty /dev/ttyC53
Mon Mar 4 09:44:15 2002 itcs: tcsConnect: connected to host olive port 5000
Register fd 4
itcs: entering main loop...
itcs> tcs
itcs: tcs
+20 08 59.7,+31 57 23,2002.17166,30794,-2,538976304,2002,3,4,+16 46 18,+20 09 00
,+00 00 00,+00 00 00,1.0000000
itcs>
kpno_36 telemetry
Mosaic
TCS
Quit
Telemetry – Mosaic
Filter 3
Shutter dark
North TV Focus 0.308000
South TV Focus -1.508000
Dewar -169.100006
CCD -99.699997
Fill Neck -22.100000
Ambient 5.100000
Link Status up
Telemetry – TCS
UT +16:46:18
LST +20:09:00
Ra +20:08:59.7
Dec +31:57:23
Equinox 2002.171631
Zenith Dist. 0.000001
Air Mass 1.000000
Focus 30794.000000
Instrument mosaic-ccd
tcs36 Host taupe
tcs36 pid 4544
TCS Link up
TCS Computer olive
Virtual

On Emerald:

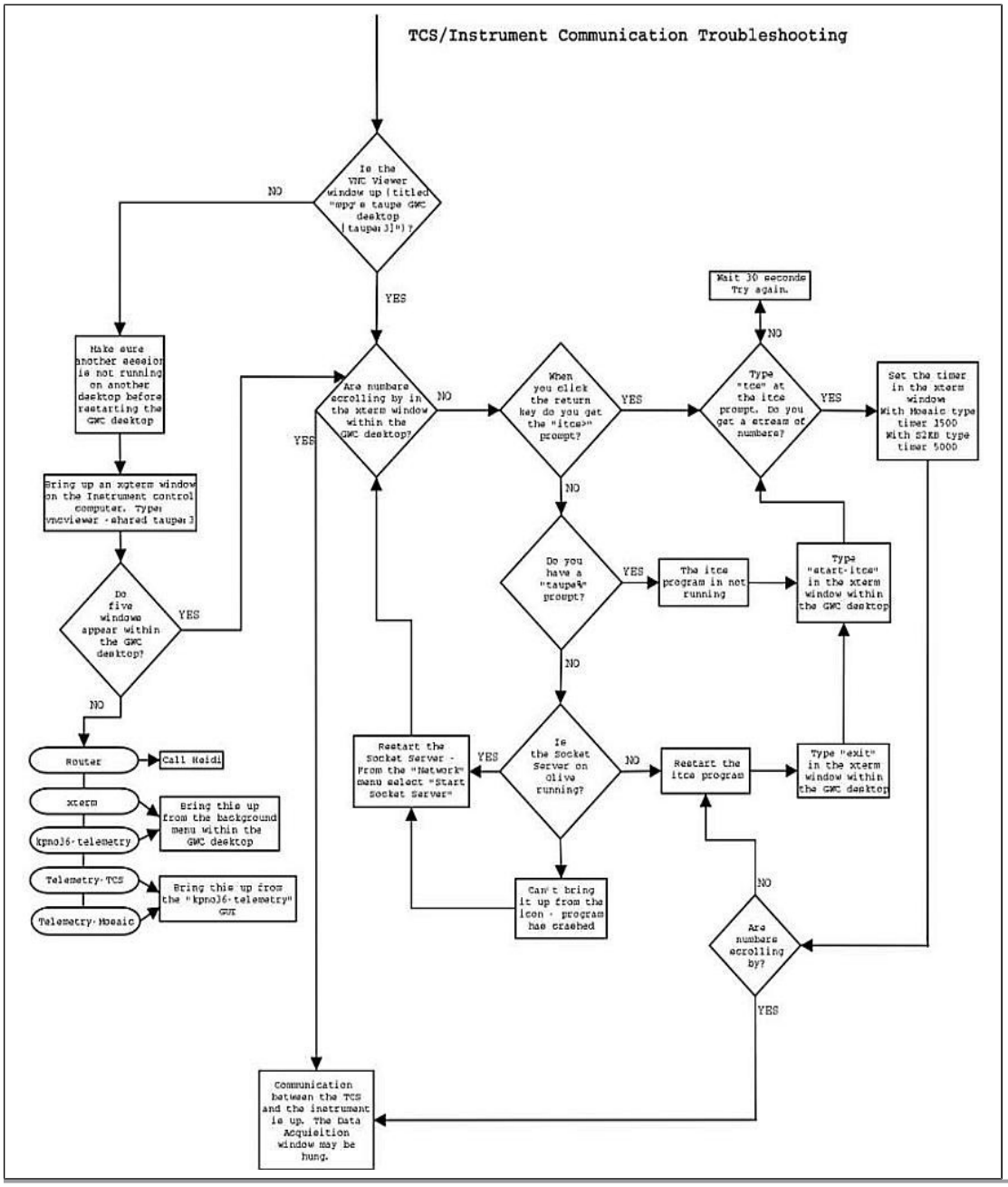
- Select *VNC GWC Taupe* from the background menu.
- The GWC desktop window above should pop up with 2 windows in it: Taupe GWC GWC Router, an xterm. If there are no windows up, first check to see they are not open on another desktop. If there are no windows open on any of the desktops, they can be opened by right-clicking on the background and selecting the appropriate item.
- In the xterm window you should see streams of numbers (no words) streaming by. If so, the TCS/Instrument connection is up.
- If nothing is streaming by, check to see if the ITCS program is running (if it is running you should get an *itcs>* prompt).
- If you see a *taupe%* prompt instead of the *itcs>* prompt type the following at the *taupe%* prompt: *start-itcs*
- This will start the ITCS program. You should see a lot of information streaming by. Near the bottom you should see "connect: Connected to host olive port..."
- In your Socket Server window on Olive you should now see "Connected"
- At the *itcs>* prompt type *timer 5000*, when using S2KB, or *timer 1500*, when using Mosaic
- Again at the *itcs>* prompt type *tcs*
    - A stream of numbers should be returned.
    - On Olive you should see "TelData". If so the Instrument/TCS connection is up.
    - The stream of numbers should keep scrolling by every 1.5 or 5 seconds depending on which instrument is in use.

  When using Mosaic, a good check to see if the TCS/Instrument connection is indeed alive is to check the TCS status on the MCCD Configuration GUI. If there is a green check mark beside the words TCS then the link is alive. If instead there is a red X, then the connection needs to be restarted.

See the TCS/Instrument Communication Troubleshooting Flow Chart if you are having problems.

If you continue to have problems with the communications you can set a parameter in *telpars* on your Data Acquisition computer that ignores this connection. **If you set this parameter you will not have the pertinent information in your headers.** Type *telpars* in your Data Acquisition window on Taupe or Emerald. Enter *test* in the *telescope* field. To return to automatically getting this information into your headers, enter *kp09m* in the *telescope* field.

TCS/Instrument Communications Troubleshooting Flowchart



OBSERVING

WEATHER

Conditions for observing

At the start of every night the Observing Assistant at the 4 meter telescope should send out a weather status report. This will show up in any xterm window on Rust or Taupe as "Domes are open" or "Domes are closed due to...", etc. **This statement is only a guideline - you are ultimately responsible for the decision to open or close due to weather**. You can check the weather status at any time by typing "weather" in any xterm window on Taupe, Rust, or Emerald or can be found on the web at http://www-kpno.kpno.noao.edu/weather.shtml. Note that this is not always updated.

There are several criteria that have to be met before the dome may be opened. These criteria have been set with the safety of the equipment and the telescope in mind and are not flexible.

- The humidity may not exceed 90%.
- Wind speeds may not exceed 45 mph (20.25 m/s).
- Dome surfaces must be dry and free of ice.
- Skies must be free of threatening clouds and rain.
- Air must be free of blowing dust, snow, fog or dripping water.
- The outside temperature must be above -10C.

As an added protection measure, whenever the sky is too overcast to observe through, the mirror covers, and preferably the dome, shall be closed.

There are a couple ways to check the humidity and wind speed:

- From the background menu on Taupe GWC select "WIYN Weather Info". Then click on Weather data. This GUI displays Outside Temperature, Relative Humidity, Wind Speed (in meters/sec), and Wind Direction. These readings are taken from the WIYN 3.5m Telescope control system. That means that if the WIYN TCS is down you will not receive current readings.
- The wind speed from the 2 meter and 4 meter telescopes is logged and broadcast on the intranet at http://www-kpno.kpno.noao.edu/cgi-bin/kpno-misc/Weather/data.cgi

- The humidity from the 2 meter, 4 meter, and WIYN are logged and broadcast on the intranet at http://www-kpno.kpno.noao.edu/cgi-bin/kpno-misc/Weather/dew.cgi
- There is a hygrometer mounted on the wall in the dome. It is located on the wall at the top of the stairway.

- Kitt Peak site information at http://www-kpno.kpno.noao.edu/Info/Mtn_Weather/

- The Kitt Peak all sky camera (internal access only) http://kpasca-db.tuc.noao.edu/

- Kitt Peak all sky camera (external access) http://www-kpno.kpno.noao.edu/Info/Mtn_Weather/allsky/kpasca.html

Weather Links

- Kitt Peak Lightning Strike data (http://bordeaux.kpno.noao.edu/lds/lds.html)
- Intellicast Jetstream (http://www.intellicast.com/Local/USNationalStd.asp?loc=usa&seg=LocalWeather&prodgrp=SurfaceMaps&product=JetStream&prodnav=none)
- Intellicast Surface Analysis (http://www.intellicast.com/Local/USNationalWide.asp?loc=usa&seg=LocalWeather&prodgrp=SurfaceMaps&product=SurfaceAnalysis&prodnav=none)
- Real Time Satellite images (http://www.rap.ucar.edu/weather/satellite/)
- National Weather Service (http://www.wrh.noaa.gov/twc/)
- Arizona forecast discussions (http://iwin.nws.noaa.gov/iwin/az/discussion.html)
- Weather Underground - Tucson (http://www.wunderground.com/cgi-bin/findweather/getForecast?query=tucson)

DATA ACQUISITION COMPUTERS

Data acquisition is done on the computer Emerald via the program VNC Viewer for S2KB and via ssh for Mosaic. VNC stands for Virtual Network Computing, a software program that allows one to view and manipulate windows on another computer. We use VNC to remotely view ICE acquisition computer, Taupe (used with S2KB). For more information on VNC see http://www.realvnc.com.

Emerald has 2 monitors. The computer Emerald is a fast Linux box with a 3.4 GHz (Pentium 4) CPU and 2 Gbytes of memory.

S2KB setup

To begin your observing session with S2KB you should follow these steps.

1. Log on to **Emerald** as user *36inch*.

2. Select *VNC Viewer Taupe* icon from the desktop. This will open the VNC client in emerald in which the window from **Taupe** will be displayed. Within this Taupe VNC ICE window you will need (i) a Data Acquisition window, (ii) a Data Reduction window, and (iii) an Ximtool. If they are not already up and running, you can bring up these windows from the background menu (right-click) within the Taupe VNC ICE window. Commands for acquiring data will be executed in this Data Acquisition window within the Taupe VNC ICE window.
3. Select *VNC GWC Taupe* icon from the desktop. This will open the VNC client in emerald in which the router (socket server information) is displayed. There should be an xterm window within this Taupe VNC GWC window in which numbers are continuously scrolling by. If not, see the TCS/Instrument Communications section for how to restart this.

Mosaic setup

To begin your observing session with Mosaic you should follow these steps.

1. Log on to **Emerald** as user *36inch*.
2. Select *Mosaic1 Menu* icon from the desktop. This will open a menu where you can start the Mosaic software, stop the Mosaic software, open an autolog, start the guider and the guider gui.
3. Click on *Start Mosaic.* Please refer to the Mosaic Manual for a description of the windows that appear when starting Mosaic, as well as instructions on how to run Mosaic.
4. Select *VNC GWC Taupe* icon from the Emerald desktop. This will open the VNC client in which the router (socket server information) is displayed. There should be an xterm window within this Taupe VNC GWC window in which numbers are continuously scrolling by. If not, see the TCS/Instrument Communications section for how to restart this.

The system is now ready for you to start observing.

HOW TO CHECK AND ZERO TELESCOPE POINTING

How to Check Telescope Pointing

It's best to check your pointing with a bright star at zenith. The first thing to do is load the Bright Star Catalog into the TCS. To do this right click anywhere within the TCS and select the first option "Open Existing Database". This should take you to the file containing all of the coordinate catalogs. The path is
ACE Control System (D:) => ACE => CurrentRelease
The bright star catalog is labeled ACE_BSC5.cat. Select this and click "Open". The catalog will open up into the center of the TCS.

Now find a star near zenith. You can sort the catalog by clicking on the title of any column. Clicking that same column title a second time will sort the catalog in descending order. Scroll down until you find the stars around the current Sidereal Time (this can be found on the right side of the TCS screen, labeled S.T.). Select one that is close to the sidereal time and near a Declination of +32. A 5th magnitude star works best. Once you've selected a star double-click anywhere on that line in the catalog to send the coordinates to the appropriate RA boxes. Confirm the coordinates in the boxes are reasonable and click the "Go To" button.

If Using S2KB:

The best way to discern your pointing with S2KB or Mosaic is to take a very short image (~2 second exposure). Once the image has read out you can fine-tune the pointing if the star doesn't land exactly where you would like it. You can find how far you need to move the telescope from the image. (The pixel scale is 0.6 arcsec/pixel for S2KB and .43 arcsec/pixel for Mosaic). Be aware that if the pointing is centered exactly the star may fall in the gap between the chips on Mosaic. If this happens, you can offset the telescope by 60 arcsec in two directions (ie N and W or S and E) and if the star was centered it will now fall on one of the chips.

How to Zero the Telescope Pointing

If telescope pointing needs to be rezeroed please contact the Site Manager.

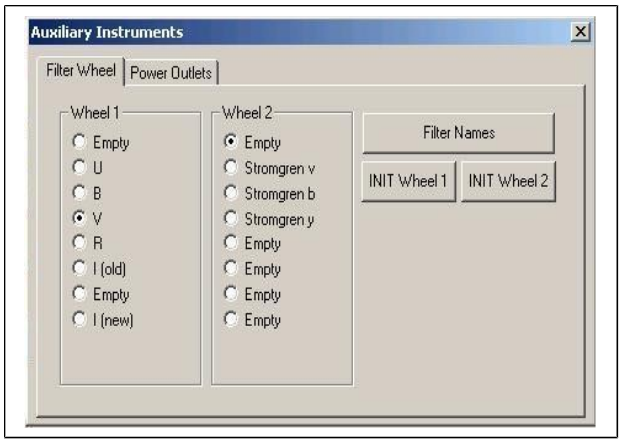
CHANGING FILTERS WITH S2KB

There are two filter wheels in the Filter Shutter Assembly associated with S2KB. Each wheel contains 8 slots, giving the capability to house up to 14 filters at any one time. The filter wheels are stacked, meaning both filter wheels are in the light path at all times. For this reason it's important to make sure that at least one of the filter wheels is in an "empty" position when taking data.

To change filters you need to bring up the Filter Wheel GUI (displayed below):

- From the Instruments menu, select Filter Wheel.

Move the desired filter into the light path by selecting the radio button to the left of it's name. Do this for both wheels. After selecting a filter in one wheel you should see all the names in that wheel turn gray while the filter wheel moves. Once it has reached the desired position the names will reappear as usual. If the filter names do not reappear black you may need to reinitialize that wheel. To do this, click on the appropriate INIT Wheel # button within the Filter Wheel GUI.



Currently, filters are listed in the headers with numbers as opposed to names. To convert these numbers to their corresponding names you can edit and run the kpfilt script on a specific image (or list of images). The script and instructions for it's use can be found here.

Beware of changing filters while slewing the telescope. This may result in a filter wheel lockup.

DOME FLATS

Send the telescope and dome to the flat field position by selecting from the pulldown menu *Telescope => Dome Flat Park* on the TCS. A box will appear with HA, Dec and Dome azimuth. The correct positions should be HA 03:28, Dec 13:00, Dome az 74. Press "Park" to move the telescope and the dome to the correct positions. It's a good idea to go upstairs and sight along the telescope tube to check the telescope/dome alignment. You may need to bump the dome via the control panel.

The Flat Field lamp control is in the computer room. It is located in the middle of the first electronics rack as you enter the computer room. Control for the High lamps is on the left, and control for the Low lamps is on the right. Each has a toggle switch to turn power on/off and a rheostat to change the voltage to the lamps. To turn on a bank of lights turn the voltage to 0 by turning the rheostat counter-clockwise. Turn the power on with the toggle switch and then turn the voltage to the desired setting. When turning off the lamps be sure to turn the voltage all the way down before turning the power off. Ramping of the lights like this will help preserve the lifetime of the lamps. Suggested lamp settings and exposure times for each instrument are listed below:

S2KB			
Filter	**ExpTime**	**LampSetting**	**Counts**
U	15s	High 100%	~30,000

B	13s	Low 100%	~30,000
V	5s	Low 100%	~30,000
R	3s	Low 100%	~25,000
I	3s	Low 100%	~25,000
Ha 6580	6s	High 50%	~18000
Ha 6620	6s	High 50%	~18000
Ha 6660	6s	High 50%	~18000
Ha 6700	6s	High 50%	~18000
Ha 6740	6s	High 50%	~18000

MOSAIC		
Filter	**ExpTime**	**LampSetting**
U	65s	High 100%
B	60s	Low 100%
V	27s	Low 100%
R	13s	Low 100%
I	11s	Low 100%
[OIII] #2	17s	High 100%
[OIII] +29 #2	?	Low 100%
Halpha	2.5s	High 100%
Halpha +4	2.5s	High 100%
Halpha +8	2.5s	High 100%
Halpha +16/[SII]	2.5s	High 100%
SDSS g'	25s	Low 100%
SDSS r'	15s	Low 100%
SDSS i'	12s	Low 100%
SDSS z'	18s	Low 100%
Wash M	?	Low 100%
DDO 51	?	Low 100%
White	?	Low 50%
Us	42s	High 100%

FOCUSING

Due to the mechanics of the secondary system there is some inherent focus drift (~50 units). To try to eliminate this drift there is a routine that keeps the telescope at the last commanded focus position. If you would like to use this routine, simply check the box beside "Servo" in the Focus GUI. Each time you change the focus the system will automatically keep the focus at this new position. It is highly recommended to keep this box checked.

WARNING: Only click buttons in Focus GUI once and wait until action has taken place!

WARNING: Do not perform other tasks in TCS while changing focus!

WITH MOSAIC:

The best way to focus the telescope is to run a focus sequence "manually". You will be running a focus sequence from a Mosaic script, but setting the focus on the TCS manually at each step.

See the Mosaic Manual for instrutions on how to set up a focus script. Start a focus sequence and you will be prompted to set the focus each time. If you are trying to find focus at the beginning of the night it's best to set the number of exposures taken in the focus sequence to 7 (set as the default for the focus script). If temperature from night to night has remained constant you can use the previous night's ending focus as your middle focus value. A typical step size to use is 100 units (set at the default for the focus script). The smallest focus increment detectable is ~25 units. Once you have entered in all of the information for the focus sequence you will then be prompted to manually set the focus for each exposure in the sequence. To do this you need to bring up the Focus Inspector Gui on the TCS. You can bring this us from the Telescope menu on the main toolbar: Select Telescope => Focus...

You can enter a desired focus into the box beside "Go To Focus" and then hit the "Go To Focus" button. Or you can use the JOG+ or JOG- buttons to jog the focus a specified

amount. The current focus is displayed on the toolbar of the Focus GUI, on the main TCS screen near the middle left and at the bottom of the ACE SoftPad.

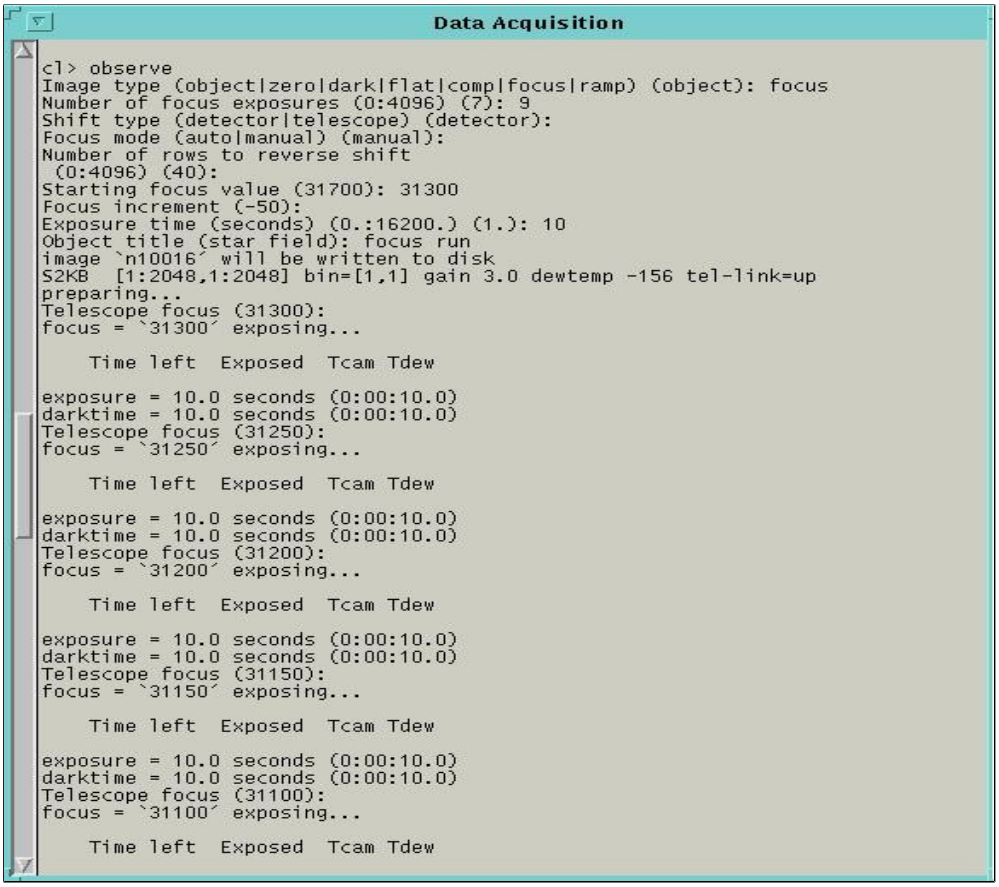
The range of focus is from 0 to 60000. One step is approximately 0.5 microns. You always want to increment the focus to larger numbers to remove backlash. Nominal focus for both Mosaic and S2KB is around 32000.

Once your focus exposure has read out you can use the *mscfocus* routine to determine the best focus.

WITH S2KB

When using S2KB it's best to run a focus sequence manually where ICE prompts you to enter the desired focus in the TCS. In the Data Acquisition window type *observe* and then *focus*. You will then be prompted for exposure time, starting focus number, etc. If you have a good idea of where focus should be, a good step size to use is 50 units. Otherwise use a step size of 100 units. The smallest step size you will be able to detect is 25 units. You should always move the focus in the positive direction, (ie your focus sequence steps should be +50 units).

Below is a typical focus sequence as seen in the Data Acquisition window.



When the image has read out you can use the *kpnofocus* routine to determine the best focus. See the IRAF help page on kpnofocus for more information. In your Data Reduction window type *kpnofocus*. Once you have determined the best focus type it into the Focus Inspector GUI (see above).

When changing the focus make sure to watch the focus values so (a) it reaches the desired focus value and (b) you will notice if the focus value starts to run away. A runaway can result in hitting the focus limit and restoring the system may result in the focus being significantly off from the previous value.

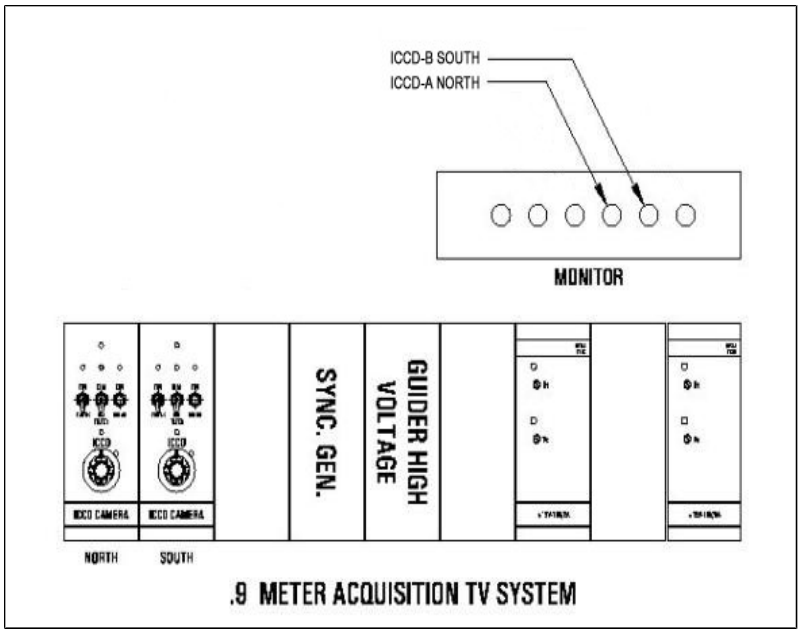
GUIDING WITH MOSAIC - THE LINUX GUIDER

Overview

Guide cameras

Mosaic has two fixed guide cameras - one North of the science field and one South of the science field. Guiding is accomplished by selecting a star from one of these fields. Both guide cameras are at fixed positions relative to the science field (~2400 arcseconds North/South). Suitable guide stars are almost always available without moving the telescope from the desired position. The field of view of each camera is approximately 5 arcminutes on a side. It is possible to guide on stars as faint as V~17 near new moon.

Mosaic's guide cameras are intensified fiber-optically coupled CCD cameras (ICCD's), and can be damaged if exposed to bright light, so it is important to protect these cameras from bright stars. The camera controls (shown below) reside on the shelf above the TCS computer, Olive, and are labeled "North" and "South". The video switcher above the controls allows you to switch between cameras. The buttons needed to select the North and South cameras are labeled.



.9 METER ACQUISITION TV SYSTEM

Video signal is routed from the cameras, through the controls and to the video monitor to the guider computer, Moss. Select the desired camera from the video switcher and adjust the camera from the ICCD Control Panel:

1. Turn the high-voltage potentiometer completely counterclockwise (10 turn pot)
2. Toggle the power switch on (on TV screen, pixel defects will appear).
3. Neutral density switch should be up (on)
4. Push the momentary button to enable high voltage (red button).
5. Slowly turn the high voltage potentiometer clockwise to see if there are any bright stars in the field. If you don't see any stars, turn the potentiometer counter-clockwise, toggle the neutral density switch off (down) and slowly turn the high voltage potentiometer clockwise again, monitoring the video monitor until guider stars appear.

When switching between the two TVs, be sure to turn the high voltage potentiometer counterclockwise and turn off high voltage on the TV no longer in use.

Guider software

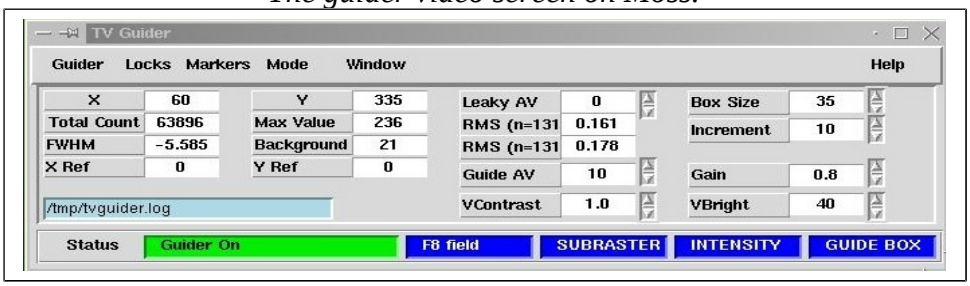
The computer Moss is the guider control computer. Moss is a dual-boot machine with Windows2000 and Linux RedHat. When the 2K camera is in use Moss is booted into Windows and the MaximDL software is used to control the guider. When Mosaic is in use Moss is booted into Linux.

By default Moss should boot into Linux. However, if it stops booting and you see lilo: in the upper left hand corner of the screen, type linux. This will boot Moss into Linux and you will eventually get the login prompt. The login and password are on the white board, but you do not need to login to Moss in order for the software to work.

At this point you'll need to restart the guider software from Emerald. Select *Restart Guider* from the Mosaic Menu. This should bring up an xterm window. Eventually this should bring up the video screen on Moss and then the Guider GUI on Emerald. You may see the message "waiting...." repeated many times in this xterm window on Emerald. If so, be patient as it may take a minute or so for the video screen to appear. The Guider Gui on Emerald should appear immediately after the video screen on Moss appears. If not select *Restart Guider GUI* from the Mosaic Menu. This should bring up the Guider GUI.

When the guider is running, Moss will show a video picture with two white boxes. The smaller box is the cursor, and the larger box is the guide box. There will also be one or more status lines at the top of the screen containing useful information.

The guider video screen on Moss.



The Guider GUI on Emerald.

For more on the Guider Control GUI, see the section "More on the Linux Guider" in the appendix.

Guiding

You will need to make sure the video screen is running on Moss and the Guider Gui is running on Emerald. If not, follow the instructions above under "Guider Software" to start them.

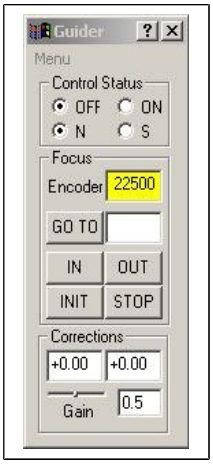
Video signal is routed through the ICCD controller (the gray box above Olive). Make sure the gain on the controller is turned all the way down. Turn on the controller power (left-most toggle switch). Push the red INTEN button on. Make sure the ND filter is on (middle toggle switch). Slowly turn up the gain to ensure there are no bright stars in the field. If you see no stars, turn the gain back down (counter- clockwise), remove the ND filter (toggle switch down) and slowly turn the gain up again, watching for guide stars on the video screen.

There are 2 fixed cameras to choose from - North and South. You can switch between them with the Monitor Input Selector that's just above the ICCD controller.

There are 2 ways to select guide stars.

1. On the Guider GUI on Emerald, under Guider select "Warp to Star". This should move both boxes to the brightest star in the field.
2. You can also move the cursor on Moss over a star and then left-click to move the guide box over the star.

Now select Guider => Guider On from the Guider GUI on Emerald. You're not guiding yet. You must also turn on the guider on the TCS. On Olive, under the Instrument drop-down, there is an option for Autoguider. This brings up the guider GUI seen to the right. In the Control Status box on this GUI you'll see OFF, ON, N, S. Disregard the N, S buttons as these are only used with S2KB and not with Mosaic. Click the On button. Near the bottom of the TCS autoguider GUI you should see numbers changing in the boxes below "Corrections". If you do not see these numbers changing, you are not guiding. See the troubleshooting section for help.



You will need to turn guiding off in both places (on Olive and Emerald) before moving the telescope. On Olive, click the radio button beside "Off". On Emerald, select Guider => Guider Off from the Guider GUI. Order counts, be sure to turn the guider off via Olive first.

The orientation on the guider video window: North is down and East is to the left.

Hints and Troubleshooting

- If the star drifts from the box, change the leak average to 3.
- If the background is high and/or the guide star is faint, consider removing the background.
- If the box doesn't move on "Warp to Star", a) try it again, b) check it's not too near the edge. If the brightest star is too close to the edge, you need to select a different star by (left button) double-clicking on another star.
- The "Leaky AV" option averages incoming video frames before analysis. New frames 'leak' in at the same rate as old frames 'leak' out. Use this option to reduce the noise and guide on fainter stars. Note that this does not enable you to see below the camera's abilities and may be of no use with bright backgrounds, such as on moonlit nights.
- If the Guider GUI never appears on Emerald, select "Restart Guider GUI" from the background menu on Emerald. You may need to wait a minute or so as the "waiting..." message appears. If the Guider GUI does not appear immediately following the close of this window, bring up an xterm window on Emerald and type "xhost moss" (no quotes) and try again.
- If the video screen on Moss freezes:
    1. Turn off the guider on the TCS (on Olive) and on the Guider GUI on Emerald.
    2. From the background menu on Emerald select "Restart Guider". Eventually this should refresh the video screen on Moss and restart the Guider GUI. Note you may need to wait a minute or so as the "waiting..." message appears repeatedly.
    3. If the Guider GUI refreshes but the video screen on Moss never refreshes and is still frozen you will need to do a hard reboot of Moss. Go into the computer room and locate the CPU for Moss (at the bottom of the second rack as you enter the computer room - it has a blue plate on the front). Pull down the blue face plate for Moss. Hit the red Reset button and wait for the computer to reboot. Moss is a dual-boot machine and should automatically boot into Linux (you may need to type 'linux' at the 'lilo:' prompt). Login and password are on the white board. After logging in you will need to restart the guider software to get the video screen to appear. On Emerald, select "Restart Guider" from the background menu. This should initiate the guider video screen and refresh the Guider GUI.

GUIDING WITH S2KB - the MaximDL software

Guiding with S2KB

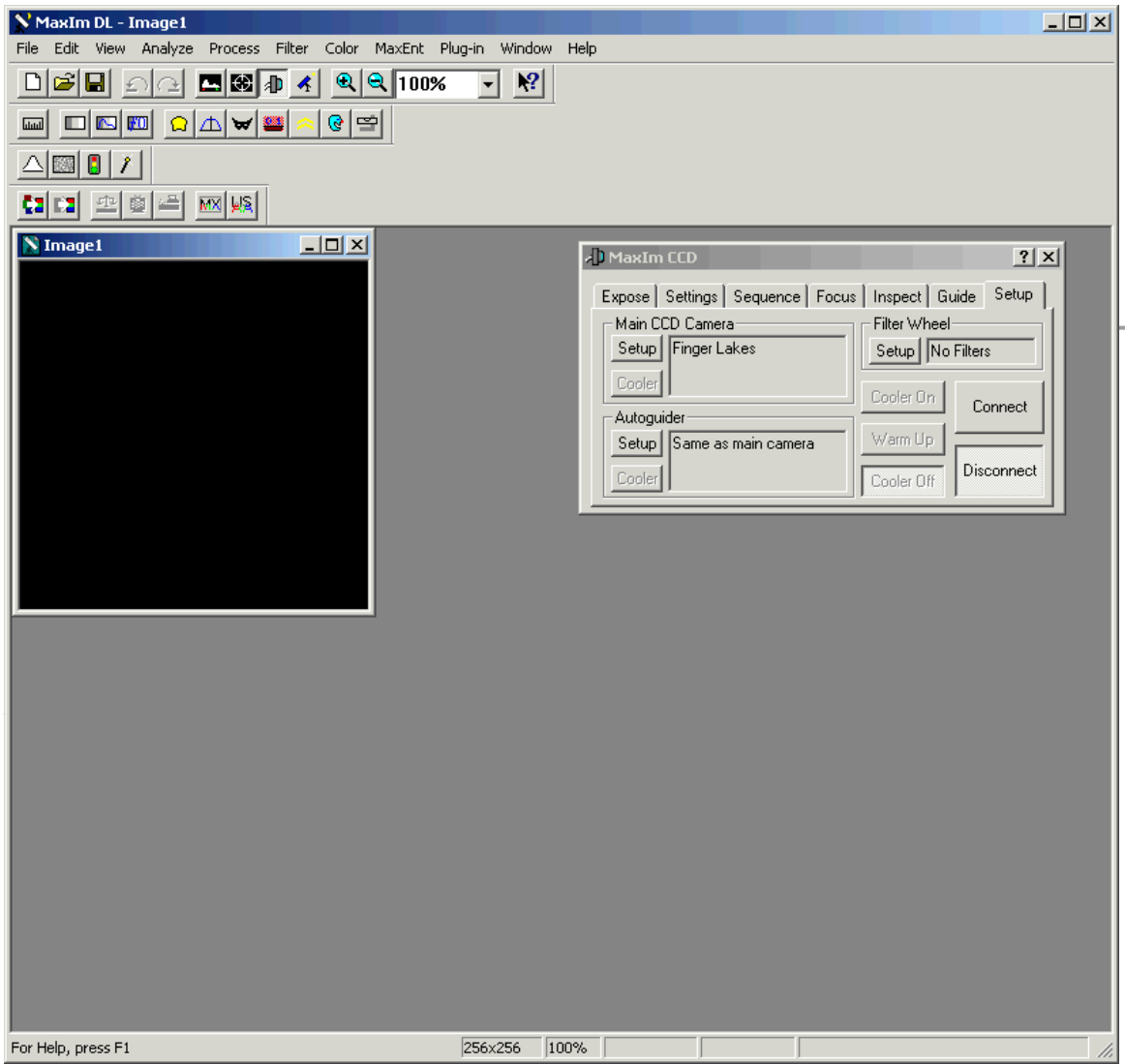
- Guidestar Search
- Switching guide cameras

Overview

In October 2006 new SBIG guide cameras were installed while the original guide cameras were sent out for repair. The SBIG cameras are now the permanent guide cameras. These SBIG cameras are also controlled through MaximDL and operate the same as the original cameras. The only differences are in connecting to the cameras and switching between the North and South cameras.

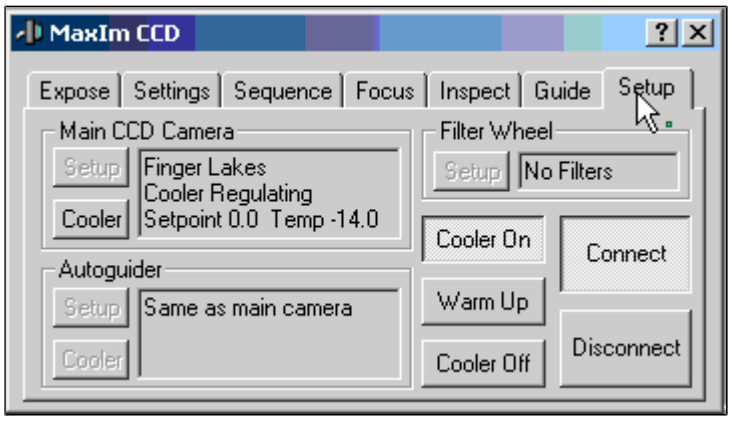
The computer Moss is the guider control computer. Moss is a dual-boot machine with Windows2000 and Linux RedHat. When the 2K camera is in use Moss is booted into Windows and the MaximDL software is used to control the guider. Linux is used with Mosaic. Linux is the default boot. After a hard reboot of Moss, in order to use the MaximDL software for guiding with S2KB, you must type windows2000 at the lilo prompt.

As of January 2003 both North and South guide cameras are fully functional, increasing the likelihood of finding suitable guide stars. See the section below on switching between cameras.



After launching the program select View => CCD Control Window.

Click on the Setup tab in the CCD control window.

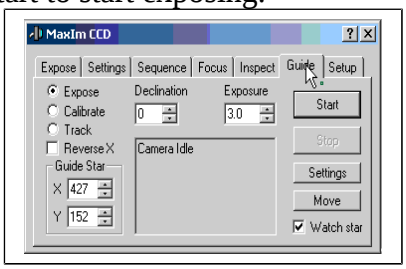


Make sure the box below Main Camera reads "SBIG Universal" and the box below Autoguider reads "Same as main camera". You can change what's displayed in these areas by clicking the Setup buttons beside each area.

On the same Setup menu now select Connect and wait for the mouse to return to an arrow. Then select Cooler On.

Guiding

Select the Guide tab again. Choose an integration time, 2-3 sec is suitable, and select the Expose radio button. Click Start to start exposing.

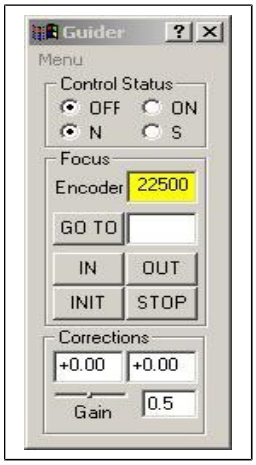


A star field should soon appear. The program will pick a suitable guide star and place its coordinates into the Guide Star X and Y boxes. You can select a star manually by entering different coordinates into these boxes, or by double-clicking on the star of your choice.

If you get a message that there are no guide stars available, you will need to try taking a longer exposure or shifting the field slightly. You can change the length of the exposure by using the up and down arrows below Exposure on the Guide Menu. Recommended exposure times are between 3 and 5 seconds. To shift the field you will need to jog the

telescope slightly via the ACE SoftPad on the TCS.
If you are having trouble finding suitable guide stars you can use the Guide Star Search program on Sage to search for stars nearby. (see section below for guide star searching)

After the guide star has been chosen, you must set the exposure time to at least 3. Click on Track and then click Start. **You're not guiding yet**. You need to then turn guiding on via the TCS Autoguider GUI.



Bring up the Autoguider GUI from the main toolbar: Select Instruments => Autoguider. Select the N or S for the guide camera you are using. Click On. When the guider is on you should see numbers changing in the boxes below Corrections. Make sure these numbers are changing and that your star is not wandering before starting your exposure.

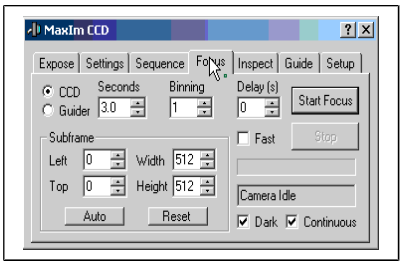
Focusing

The guide camera focus is controlled via the TCS Autoguider GUI displayed above. The focus range is between 0 and 28000, with typical focus values around 0 for the North camera and 20000 for the South camera. The current focus is indicated in the yellow box beside Encoder. To change the focus, enter a desired focus value into the box beneath the current focus setting and click on GO TO.

The easiest way to focus the guider is to turn guiding on with the MaximDL software (but not the TCS) and change the focus values in the Autoguider GUI until you reach a desired focus.

You can also setup the MaximDL software to take continuous exposures of a single star while you change the guider focus on the TCS.

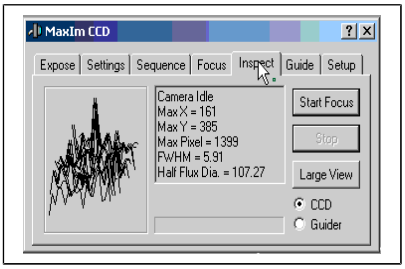
- Stop guiding.
- Click on the Focus tab



- Make sure there is no check mark to the left of Continuous. If there is, click on that box to deselect it.
- Click the Reset button.
- Click Start Focus. This will take a single exposure of the entire field.
- When the image has fully downloaded you will need to select on of the stars to focus. Drag a box around a star. You should see the numbers in the boxes within the Subframe area changing to the coordinates of the box.
- Now click on the box beside Continuous to select it. This lets you take continuous exposures of the guide field.
- You may want to change the exposure time or the time delay between exposures. To adjust these use the arrow keys beneath Seconds and Delay (s).

Click Start Focus and change the focus when the status bar reads "Downloading image" until you get a reasonable looking focus.

You can do a rough analysis of your guide star a few different ways:



- Click on the Inspect tab of the CCD control window to give a surface plot of the star as well as FWHM and Half Flux diameter.
- From the main toolbar in MaximDL select View => Information Window.

Once you've found a good focus value, click Stop on the Focus Menu and start guiding.

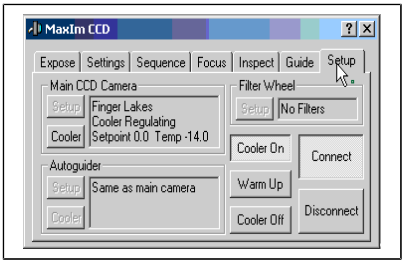
Note: You will need to change the guider focus when changing filters. Some typical guider focus values are given below.

Filter	Guider Focus
U	26,000
B	18,000
V	18,000
R	18,000
I	15,000

Switching guide cameras

When changing between guide cameras you need to disconnect the communications to the camera currently in use and reconnect to the other.

- Click on the Setup tab in the CCD Control Window.



- Click on Cooler Off.
- Click on Disconnect.
- In the same window (Setup tab) click the Setup button just below "Main CCD Camera". This brings up the "Setup SBIG Universal" window below.
- You have several choices of cameras. The two that are used for guiding are the two on the bottom of the list, ST-402 and ST-402 (yes they both have the same name). Which camera is which is listed on the whiteboard. Choose the appropriate camera.
- Under the Settings tab there is a choice on the right for Options. Click on the arrow.
- In the menu you should see, among other options, one for FLIP HORIZONTAL and one for FLIP VERTICAL. The correct direction for each camera is on the whiteboard. MAKE SURE YOU ONLY HAVE ONE OPTION SELECTED AT A TIME. THEY DO NOT UNCHECK THEMSELVES. YOU MUST DO IT YOURSELF.
- Back in the Setup tab window, click on Connect.
- Click on Cooler On.
- You will also need to change cameras on the TCS Guider GUI (select N or S).

GUIDESTAR SEARCH WITH S2KB

If you are having trouble locating guide stars (when using S2KB) you can run a search for guide stars near your field.

To search for guide stars:

- Open a terminal on Sage.
- Type ./setup_s2kb.sh
- An interactive GUI will appear. Enter your RA and Dec in the appropriate boxes. If you need assistance use the help menu under the help tab.

Note: The guide cameras are sensitive to V magnitude of 14.5.

THE AUTOMATED CCD LOG

There are two different autologging systems available at the 0.9m. The first is a GUI interface log sheet and is recommended for use with S2KB. The second is an IRAF based log sheet and is recommended for use with Mosaic. Both autologs run on Emerald, and pull information from your image headers to create the log. In order for autolog to run, you must have the TCS/Instrument communications up and running.

To start the S2KB autolog program, on Emerald:

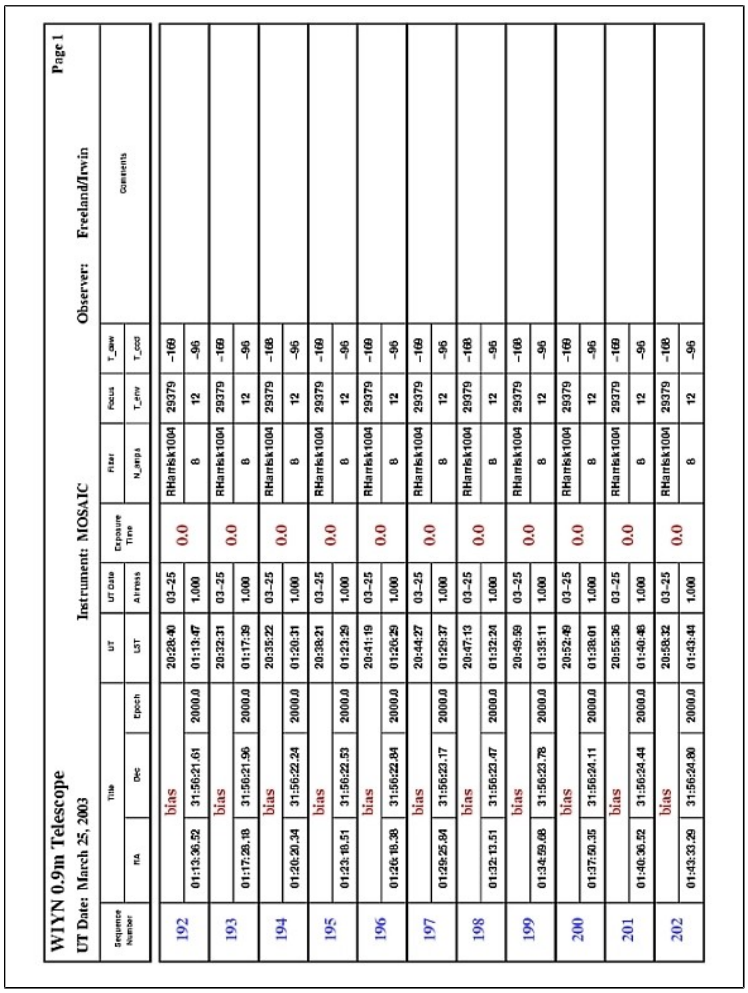
- Select S2KB Autolog on the desktop.
- In the "image directory" box, you will need to type in the full path to your working directory of your Data Acquisition window (e.g. /taupe/data1/36inch/night1 or /md1/36inch/night1).
- Select which instrument you are using.

- Click on Start Logging. Images will

only be written to the
log after selecting
Start Logging.

The images (.fits images only) are written to the log after the exposure has readout. An example log is show below. Every time an image is logged, the log page is written to a postscript file and saved. These files are stored in the same directory as your images and are called autolog_page1.ps, etc. Each page is then printed when it is full. One nice feature of this log is that you can type virtually anywhere within the log - you can edit any field or add comments wherever you like.

Note: Image root names that contain a period will not show up correctly in the log (e.g. n001.0002.fits). To avoid this, make sure your image root names do not contain periods.



WIYN 0.9m Telescope — Page 1

UT Date: March 25, 2003 — Instrument: MOSAIC — Observer: Freeland/Irwin

Sequence Number	Title	RA	Dec	Epoch	UT	LST	UT Date	Airmass	Exposure Time	Filter	N_amps	Focus	T_env	T_dew	T_ccd	Comments
192	bias				20:28:40		03-25		0.0	RHarris1004	8	29379	12	-169	-96	
		01:13:36.52	31:56:21.61	2000.0		01:13:47		1.000								
193	bias				20:32:31		03-25		0.0	RHarris1004	8	29379	12	-169	-96	
		01:17:26.18	31:56:21.96	2000.0		01:17:39		1.000								
194	bias				20:35:22		03-25		0.0	RHarris1004	8	29379	12	-168	-96	
		01:20:20.34	31:56:22.24	2000.0		01:20:31		1.000								
195	bias				20:38:21		03-25		0.0	RHarris1004	8	29379	12	-169	-96	
		01:23:19.51	31:56:22.53	2000.0		01:23:29		1.000								
196	bias				20:41:19		03-25		0.0	RHarris1004	8	29379	12	-169	-96	
		01:26:18.38	31:56:22.84	2000.0		01:26:29		1.000								
197	bias				20:44:27		03-25		0.0	RHarris1004	8	29379	12	-169	-96	
		01:29:25.84	31:56:22.17	2000.0		01:29:37		1.000								
198	bias				20:47:13		03-25		0.0	RHarris1004	8	29379	12	-168	-96	
		01:32:13.51	31:56:23.47	2000.0		01:32:24		1.000								
199	bias				20:49:59		03-25		0.0	RHarris1004	8	29379	12	-168	-96	
		01:34:59.08	31:56:23.78	2000.0		01:35:11		1.000								
200	bias				20:52:49		03-25		0.0	RHarris1004	8	29379	12	-169	-96	
		01:37:50.35	31:56:24.11	2000.0		01:38:01		1.000								
201	bias				20:55:36		03-25		0.0	RHarris1001	8	29379	12	-169	-96	
		01:40:36.22	31:56:24.44	2000.0		01:40:48		1.000								
202	bias				20:58:32		03-25		0.0	RHarris1004	8	29379	12	-168	-96	
		01:43:33.29	31:56:24.80	2000.0		01:43:44		1.000								

To start the Mosaic autolog program, on Emerald:

- Select Autolog on the Mosaic Menu GUI

S2KB CCD INFORMATION

- Technical Specifications 4/10/97

  CCD NAME : S2KB

  CCD SN : 1383BR03-01

  PIXEL SIZE : 21x21 microns

  PIXEL SCALE : 0.60 arcsec/pixel

  CHIP SIZE : 2048 x 2048

  DIGITAL LIMITATION : 65,534

  BIAS LEVEL : ~750 (gain=#3)

  MICROCODE : "Harcon1009"

  PREFLASH, e- : none

  NOISE, e-/RMS : ? ? 20 14-15 9-10

  GAIN, e-/ADU : 9.8 6.5 3.9 2.5 1.3

  GAIN, DETPARS#: 1 2 3 4 5

  LINEARITY,0.1%,e-: ~210,000

  LINEARITY,1.0%,e-: ~230,000

  COLUMN SPILLOVER, e- : ~240,000

  INTERNAL RADIATION EVENT RATE, EVENTS/HR : ~2700

  CONTROL TEMP. deg C (thermocouple) : ~-107

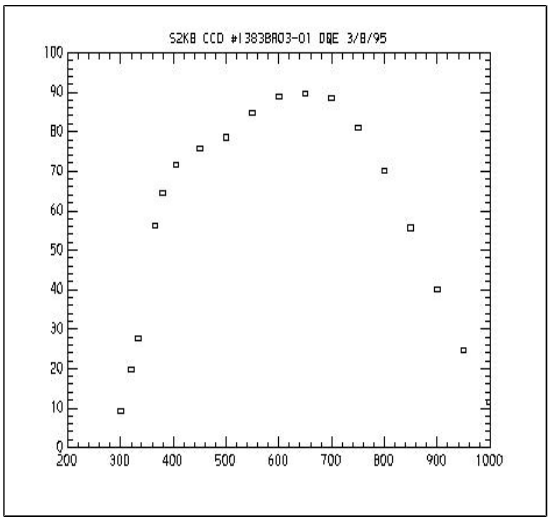
  COMPUTER TEMP. deg C (ccdinfo) : ~-109

  DARK CURRENT, e-/hr/pix : ~5-10

  DEAD COLUMNS : HOT COLUMNS : [1571:1571,1134:2048] bias

  LOW COLUMNS : [1103:1103,744:2048] flat field

- The quantum efficiency of S2KB is given in this figure. The abscissa is wavelength in nanometers and the ordinate is dQE (%).



- Here are examples of the original calibration frames for S2KB. Click on the link to display the (BIG) image.
    - Bias Frame
    - B dome flat
    - V dome flat
    - R dome flat
    - I dome flat
    - H-alpha dome flat
- More recently, S2KB has developed an enhanced bias level in one corner amounting to a peak of ~1500 ADU above an overall level of ~965 ADU. Here is a bias exposure which shows this effect. The enhancement is limited to the region X < ~240 pix and Y> ~1800 pix.
- You can estimate exposure times for S2KB using the CCDTIME package in IRAF v2.11.3 which should still have the necessary information in its ccdtime$kpno.dat database file. If it does not, here is the kpno.dat file.

WIYN 0.9m / S2KB Frequently Asked Questions

- **Q. What do I need to know about taking bias frames?**

  A. While the overscan (or DC offset) region records the absolute value of the bias level as each observation is taken, zero exposure images (i.e. bias frames) are used to correct for two-dimensional structure in the bias level. These are typically taken in the afternoon before the dome flats. Be sure the inside of the dome is dark. You will probably want to obtain 9 bias frames, which will later be combined with the zerocombine task in IRAF. It is advisable to intersperse a few bias frames throughout the night as you obtain your program observations in order to track any temporal variations in the bias structure.

- **Q. What do I need to know about taking dome flats?**

  A. Dome flats are used to correct for pixel-to-pixel sensitivity variations in the CCD. They are usually taken in the late afternoon 1 to 2 hours before you open the dome slit to begin your evening of observing. If it is not possible to obtain the dome flats in the late afternoon, they can also be procured in the morning after your night of observing is done. Making sure the lights in the dome are off, position the dome at an azimuth of 73 +/- 1 degrees and point the telescope at HA = +3:28 and Dec = +13d (this is usually done using the 'flat-field park position' selection in the TCS GUI). Go to the computer room and turn on the flat-field illumination lamps (high intensity for the U filter or narrow band filters, low intensity for BVRI and other broad band filters); then, ramp up the rheostats to achieve the proper level of intensity (usually 100%). You will need to expose the CCD to achieve a mean level equal to about half the saturation of the A-D converter - ~30,000 ADU - making sure that the CCD itself has not become nonlinear, which occurs at ~210,000 electrons (the limit of the A-D converter for a gain of 3e/ADU). Recommended exposure times for the UBVRI filters are given in the manual. You will probably want to obtain ~5 dome flats in each filter, which will later be combined with the flatcombine task in IRAF.

- **Q. How many dark current exposures should I take?**

  A. The dark current on the S2KB CCD is low (5-10 e/hour/pixel), which means that there is no need to obtain dark current exposures.

- **Q. What's that bright corner on the CCD?**

A. It is unfortunate but true that the upper left corner of the CCD is plagued by higher than average background counts - even in a bias frame. This results from a faulty LED that is illuminating one corner of the chip. The good news is that the standard technique of bias (image) subtraction does an excellent job of removing this gradient - to better than 1%.

- **Q. What are the most useful IRAF commands to know for observing?**

  A.

  - ccdinfo - outputs basic information about the CCD including the available gain settings.
  - detpars - set the gain value, region of the chip to readout, etc.
  - display - displays an image in the ximtool window
  - flpr - stands for 'flush process.' It is recommended that flpr be issued anytime cntr-c is used to interrupt a process.
  - imexamine - allows the user to use certain keystrokes to operate on the currently displayed image in the ximtool window. Useful keystrokes include r (plots a radial profile and outputs profile diagnostics), a (only gives the profile diagnostics), a (plots a contour plot), and s (plots a surface plot).
  - imhistogram - plots a histogram of the pixel intensity values. Note that the ordinate is a logarithmic scale. This is useful for checking the distribution of pixel values looking for a stuck bit, which would manifest itself as a sequence of intensities with no pixels.
  - implot - plots pixel intensities along rows and columns.
  - observe - the primary observing command, which initiates and otherwise controls CCD exposures.
  - obspars - set the run information, nightly file prefix, update the current image index number, etc.
  - rfits - read a fits file or convert a FITS image to an imh/pixel image.
  - test - takes one exposure and saves it to test.imh without incrementing the image index.
  - unlearn - resets IRAF parameter sets to their default values. Use this with caution because it may restore parameters to undesirable values.
  - wfits - write a FITS file or convert an imh/pixel image to a FITS image.

- **Q. Do I need twilight sky flats?**

  A. Twilight sky flats are taken just after sunset before the sky is completely dark. The idea in taking these is to correct for any illumination differences between the dome flat white spot and the actual sky. Since time is limited, one usually tries to acquire at least 3 twilight sky flats in each filter to be used for the program. You should aim to expose each flat to a mean level equal to about half the saturation of the A-D converter - ~30,000 ADU - making sure that the CCD itself has not

become nonlinear. If enough twilight sky flats are obtained in each filter (i.e. > 4) on each night with the appropriate mean intensity levels and no stars, then they can be used to flatten the program images in place of the dome flats. However, if less than ~3 twilight sky flats have been obtained on a given night, it is better to use them as an illumination correction (if one is needed) after the dome flats have been applied to correct for pixel-to-pixel sensitivity variations.

- **Q. Do I need dark sky flats?**

  A. Generally speaking, the answer to this question is 'no.' However, if you feel particularly uncertain about the quality of the dome and twilight flats you have obtained, you are encouraged to also take dark sky flats. The direct imaging manual lists the locations of 'blank' sky fields on page 16 to be used for this purpose.

- **Q. Is there a significant shutter correction?**

  A. The S2KB shutter moves linearly across the field of view. As a result, any shutter correction will be an additive offset that is applied to the requested exposure time. On two separate occasions, this correction was measured to be +0.016 +/- 0.002 sec. Thus, a requested exposure time of 1 second will actually be 1.016 seconds. This means that requested exposure times of 2 seconds and longer will incur errors of less than 1%.

- **Q. What gain setting should I use?**

  A. The CCD has a full well capacity of ~210,000 electrons which means that at a gain of 2.5 e/ADU (index = 4), the A to D converter uses the full dynamic range of the CCD up to 65,536 DN. Gain values as high as 9.8 e/ADU are available. The read-out noise of S2KB varies with gain. Please see S2KB info above for read noise values with each gain setting.

- **Q. What trim section should I use?**

  A. The recommended trim ([1:2048,1:2048]) and overscan sections ([2049:2080,1:2048]) are given in the image headers. Feel free to check these by plotting intensity vs column number to be sure that the trim and overscan regions are appropriate.

- **Q. What's the deal with images in FITS and imh/pixel formats?**

  A. The native image file format for IRAF is the imh/pixel format. However, all of the tasks will also run on FITS files. When you run a task, be sure to have only one version of each image in the working directory (i.e. either FITS or imh/pixel) and do not provide the image file extension to the task. To convert between these formats, use the rfits and wfits tasks. Converting images from imh/pixel to FITS

makes them more portable allowing you to put them on tape with TAR and/or FTP them to your home institution.

- **Q. When should I call Hillary?**

  A. The problem you have encountered is not covered in the manual, the troubleshooting guide, or this FAQ. Telephone numbers are on the whiteboard.

WHAT TO DO WHEN PROBLEMS OCCUR

If you should run into problems during the night, first look through the on-line manual and the Troubleshooting section below for possible solutions. If you still can not solve the problem, and it's before 22:00, call the Site Manager for assistance - phone numbers are on the white board. If it is after 22:00, you have exhausted all other possibilities and you are still unable to observe, feel free to call the Site Manager. **Do Not Call Kitt Peak Electronic Maintenance**, or the WIYN operator unless told to do so.

[MOSAIC] GUIDER PROBLEMS

- The numbers in the "corrections" boxes aren't changing, ie the connection between Moss and Olive is down.
  - Have you turned the guider on in both places? Be sure to turn it on on Moss and Olive?
- The video on Moss is hung.
  - Try restarting the guider software by selecting "Restart Guider" from the background menu on Emerald. If it is still hung you will need to reboot Moss. Locate Moss's CPU in the computer room. Pull down the front

cover and push the red reset button. Wait for Moss to reboot into Linux. You'll need to login again - name and password are on the whiteboard.

- The Guider GUI never opens on Emerald.
    - In an xterm window on Emerald, type "xhost moss". Select "Restart Guider GUI" from the background menu on Emerald.
- Can't see anything on either Mosaic guider cameras
    - Is the shutter set to "guide" on the Mosaic GUI?
    - Are the cameras on (the intensity and power)?
    - Is the ND filter in?
    - Is the shutter open and the mirror cover removed?
    - Is the dome in the way?
    - Is is cloudy?
- The box on the Mosaic guider will not move when selecting "Warp to Star".
    - The "Warp to Star" command sends the boxes to the brightest star in the field. If the brightest star is on the edge of the field the box will not move there and you will need to select another star manually:
        - Move the cursor to another star and left-click the mouse.
        - Or jog the telescope, via the TCS softpad, enough to bring the star into the field
- The telescope "jumps" when turning the Mosaic guider on
    - Exit and restart the ACE TCS program on Olive. You will need to turn your telescope and dome tracking back on.

TELESCOPE PROBLEMS

- There are star trails in images
    - There are several possible causes for star trails in your images. Try the following in this order.
        - The telescope takes several seconds to settle down after any move - offsets or slews. Be sure to wait 10-15 seconds after moving the telescope before beginning an exposure.
        - Check to see if your preload motors are on. Located in the computer room the power supply for the preload motors is housed in the first set of racks as you walk in the door (same one that contains your flat field lamps). The second rack from the bottom is your preloads power supply. First check the front panel to see if there is current. If not, you will need to turn this on. On the back of this rack there is a small toggle switch. Put the switch in the On position. Be careful not to disturb any of the other wires at the back of this rack.
        - There is a spot in the sky where the telescope is known not to track well. This spot is in the northwest. If you suspect this is the problem you can try turning off the preloads to see if it helps. On the ACE TCS select Telescope -> Preload Motors -> HA preload to turn the HA preload off. Then select Telescope -> Preload

Motors -> DEC preload to turn the DEC preload off. Remember to turn the preload motors back on when moving away from this area.
        - If the stars trail North/South and you are using S2KB there may be a problem with the CCD shutter. Check the section titled "S2KB problems" below.
- The telescope is in a soft limit (one of the limits boxes is red on the TCS).
    - Note which limit you have run into. On the TCS the box that is red should read either E, W, N or S.
    - Visually inspect the telescope to make sure no damage has occurred by running into the limit.
    - Move the telescope in the opposite direction with the hand paddle.
        - Go upstairs and remove the hand paddle from it's stowed position near the liquid nitrogen fill line (stowed on the chain railing).
        - The toggle switch on the top of the hand paddle controls the speed at which you move the telescope - "slew" speed (fastest) is engaged when pushing the toggle switch to the left, "guide" speed (slowest) when the toggle switch is in the center position, and "set" speed (medium) when the toggle switch is pushed to the right. Push the toggle switch to the left to use "slew" speed. Note that while near the limit slew speed is reduced to set speed, but when clear of the limit the speed increases to nominal slew speed.
        - Push the button related to the opposite direction from your limit (e.g. if you have hit a West limit push the East button).
        - Move the telescope well out of the limit area.
    - Stow the hand paddle back on the railing and resume operations from the TCS.

- The telescope is in a hard limit (3 degrees above horizon)

    - You must contact Site Manager to recover from this

- Telescope wont move in either RA, Dec or both

    - First check to see if the safety interlock is visible in the TCS.
        - Clear the interlock by clicking the reset button
        - If the interlock will not clear see instructions below, under TCS problems, for what to do when the interlock wont clear
    - Are you in a limit? See instructions above.
    - There is a way to reset the drives via the software on Olive
        - On the desktop there is a Dynaserver icon that says Dynaserver RA=3 Dec=4
        - When the GUI is opened there is a pull down menu on the top left for picking what you want on-line. RA is 3, Dec is 4. Choose the appropriate drive.
        - Click the connect button on the upper right of the GUI and wait for the connection to complete. There will be two green buttons on the

upper right of the GUI. You may have to try connecting a couple times for it to work.
    - Under menu, under operation, click the drive button. A message box may pop up that says: Operation authority is switched to the serial I/F side. Is this ok? Click yes.
    - When the new GUI opens up click on error reset. When error reset button goes gray the drive has been reset.
    - There is a button on the right hand side that says either controller side, or I/F side. It MUST say I/F side when you exit or the telescope will still not move.
    - Close the error reset GUI
    - Click disconnect and wait for the disconnection
    - Repeat for other drive if necessary
    - Close Dynaserver and resume telescope operations
    - Occasionally the motor breaker may have to be reset, but this is rare

TCS PROBLEMS

- When sending the focus to a specified number the focus takes off.
    - Hit the Stop button on the focus inspector GUI and try again.
    - If it continues to take off select the "Go to Zero" button the focus GUI. This will reinitialize the focus motor by taking to a limit.
    - Gradually back it out of the limit by moving in small steps (+30 units) until the focus readout is no longer red.
    - *Be Warned:* the focus may be drastically off from what you expect after this. Recheck focus before resuming observing.
- Focus is stuck at a limit
    - Click the STOP button on the Focus Inspector GUI
    - Click the Drive to Zero or Drive to In button to drive the focus to a limit.
    - If the focus still does not move you will need to reset the Telescope Control Crate in the Computer room by unplugging the crate and plugging it back in again. **Only do this if you have been shown how!**
    - *Be Warned:* the focus may be drastically off from what you expect after this. Recheck focus before resuming observing.
- The focus runs away when changing filters (S2KB only).
    - Make sure the "Change with filters" box is not selected on the focus GUI.
    - To recover from a focus runaway see above.
    - *Be Warned:* the focus may be drastically off from what you expect after this. Recheck focus before resuming observing.
- Can't enter a specified Declination
    - There is a known bug that will not allow you to enter in only the degrees for Declination - when hitting the GoTo button the units you have entered will have been overwritten.

    - You must also type in the minutes and seconds (instead of 75, enter 75 00 00).
- Problems with the TCS/Instrument Communication.
    - See the Troubleshooting Flow Chart.
- The Filter Wheel is not responding.

  If the filter wheel is grayed out and will not move to the desired position, try the following steps in order.
    - In the filter wheel GUI check which filter wheel is grayed out (wheel 1 or wheel 2). On the right hand side of the filter wheel GUI click INIT Wheel 1 or INIT Wheel 2, depending on which wheel is not responding.
    - Go upstairs and move the faulty wheel by hand to check for any mechanical obstructions (if you don't know how to do this call the Site Manager). If it does not move, stop and call the Site Manager immediately.
    - If the wheel moves freely Exit the ACE TCS (under User select Exit). Then restart the ACE TCS via the icon on the desktop - you will also need to restart the ACE socket server (under Network select Start Socket Server).

DOME PROBLEMS

- The dome runs away
    - Select Dome => Stop from the pulldown menu or click the dome stop button on the toolbar.
- The dome position is lost
    - Select Dome => Home from the pulldown menu. This will rotate the dome until it finds its home position. This may take a few minutes so be patient while the dome moves.
    - If the dome never seems to find home you may need to reset the dome home position manually. To do this you need to go upstairs and align two sets of duct tape - turn off Dome tracking first. The dome home position is at 90 degrees, which is close to the dome Flat Field position of 73. From the control panel on the platform, move the dome either Left or Right to the approximate dome flat field position. There are two strips of duct tape low on the wall, left of the dome vent control. There are two matching strips of duct tape on the dome wall that you will need to align with them. If the dome is approximately in the flat field position you will need to move the dome ~20 degrees to the right. If you have aligned the pieces of tape well the dome will have reset this position as 89 degrees. Go downstairs and look at the dome azimuth readout. It should now read 89.0 HOME. If not you will can tell the TCS that the dome is at 90 degrees. On the pulldown menus select Dome => Reset Encoders. Enter 90 in the box and click RESET.

    - If the above procedures do not fix the positioning problem you may need to reset the dome encoder a different way. To do so:
        - Take hand paddle and move the dome due south.
        - Stand at the far north point of the dome so you are under the polar axle.
        - Check that the dome slit is bisected by the polar axle. If not move dome until that condition prevails. The amount you moved was the error in the system.
        - Then in the TCS pulldown menu select Dome => Reset Encoders. Enter 180 in to the box and click RESET.

- I've turned Dome tracking on and the dome moved, but not to the correct position.
    - Toggle the dome tracking off and then on again.
        - Select Dome => Smart Dome. Acknowledge turning the tracking off.
        - Select Dome => Smart Dome. Acknowledge turning the tracking on.
    - If the dome is still lost see the above procedure for resetting the dome position.
- The dome is making a lot of noise but is not moving. Sometimes the dome gets stuck in one position. If this happens:
    - Turn dome tracking off.
    - From the control panel upstairs move the dome in the opposite direction close to the desired position.
    - Turn dome tracking back on from the ACE TCS.

- The dome status says sleeping and the dome will not track

    - Most likely you have adjusted the dome pointing while AutoDome is on.

    - Toggle the dome tracking off and then on again.

        - Select Dome => Smart Dome. Acknowledge turning the tracking off.
        - Select Dome => Smart Dome. Acknowledge turning the tracking on.

S2KB PROBLEMS

- "Error on line 47" or "Floating Operand Error" in Data Acquisition window and you can't take any exposures
    - Is the socket connection up? This needs to be up to be able to take any exposures.
- The Data Acquisition window hangs or times out when trying to start an exposure
    - Is the socket connection up?

    - Are the CCD power and controller boxes turned on in the computer room?
- Stars trail North/South and the tracking is on:
    - The shutter may be stuck open.
    - On Olive select Instruments => ACE Linear Shutter => Reboot.
- Data Acquisition window says "Preparing..." and the exposure never starts.
    - This is a new "feature" that has been introduced into the system in September 2004, and is usually seen when typing anything except "observe" in the Data Acquisition window. The exact cause of the problem is unknown, but seems to be easy to recover from.
    - Check whether the socket connection is up and that only numbers (no words) are scrolling through the xterm window with the VNC viewer window.
    - Type *Ctrl-C*, then *flpr*. This should clear the hang and you should again be able to start an exposure.
- An exposure looks like a bias image.
    - Is the mirror cover removed and the dome shutter open?
    - Is the dome in the way?
    - Is it cloudy?
    - The shutter may be stuck closed. See the instructions above for resetting the shutter.
- When displaying an image only the central 1k x 1k is displayed.
    - In the Data Reduction window type: *set stdimage=imt2048*

DEWAR WARMUPS

- If your CCD and/or dewar has been allowed to warm up above nominal temperatures you will need to fill the dewar immediately. *Note: there are 2 distinct temperatures - one for the CCDs and one for the dewar. Your Dewar temperature will start to increase before your CCD temperature. If either of these has started to warm, stop and refill your dewar.*
    - Stop observing and move the telescope to the Zenith Park position.
    - If using Mosaic, alert the WIYN OA that the dewar has warmed up and ask them to please refill the dewar.
    - If using S2KB, follow the normal procedure for filling the dewar and note on the logsheet that a warmup has occurred.
    - In both instances, the WIYN 0.9m Site Manager should be notified (via email is sufficient – hillary at noao.edu).
    - If the CCD temperature is also above nominal operating temperature, you will need to wait until it is back to nominal temperature before taking science data.
    - Because the dewar is significantly warm, it will burn off the liquid nitrogen rather quickly. Due to this you will need to refill the dewar in another 2 hours.
    - Keep a close eye on the dewar temperature for the next 8 hours. If it begins to warm up, again stop and refill your dewar. If you're sure the

dewar has been getting a complete fill and it looks like the hold time has decreased, notify the 0.9m Site Manager (hillary at noao.edu).
    - To check your CCD and Dewar temperatures when using S2KB, in your Data Acquisition window type *ccdinfo*. The temperatures will be displayed at the bottom. When using Mosaic, the CCD and Dewar temperatures are continuously displayed in the Mosaic GUI.
- For hints on properly filling a dewar see the section in the Appendix Dewar Filling Tips and Tricks.

S2KB GUIDER PROBLEMS

- Stars trail or bleed when "expose" is selected, but not when "track" is selected.
    - Our guide cameras are small CCDs. We do not operate the shutter on these CCDs under normal guiding conditions and so you may see star trails in you images due to the shutter being open upon readout.
- No stars are seen on either guide camera and there should be lots of guide stars in this field.
    - Is the mirror cover off and the dome shutter open?
    - Is it cloudy?
    - Are you pointed at the side of the dome?
    - Sometimes this is due to the temperature of the guide camera being too warm. On the Setup tab in the CCD control window within MaximDL check what your setpoint temperature and your current temperature are for the currently connected camera. If the temperature is well above the setpoint temperature the stars will be "drowned out" by noise on the camera. Wait until the camera comes down to nominal temperature (takes only a couple minutes) and try again.
    - Also, the guider software automatically subtracts a dark from the guide camera image. Another way you can solve this issue is to tell the software to not subtract a dark frame from the image. To do this select the Settings button on the Guide tab and uncheck the box at the top next to Autodark.

IRAF PROBLEMS

- When displaying an image only the central 1k x 1k is displayed.
    - In the Data Reduction window type: *set stdimage=imt2048*
- A graphical IRAF window has poor color mapping.
    - In the Data Reduction window type *cl> reset stdgraph = xgtermb*. This will reset the window into black/white.
- Get the error message "Can not open device _" when trying to allocate a tape device.
    - This will require a hard-boot of the data taking machine. Call the Site Manager for help on this.
- How to change between .imh and .fits for your data files:

    - In your Data Acquisition window on Taupe type *set imtype=fits* or *set imtype=imh*.
    - Alternatively you can edit your login.cl file. In the middle of the file there is a section with several *#set PARAMETER = VALUE*. Edit the last line in this section, which reads *#set imtype = "imh" [or "fits"]*, to remove the # at the beginning of the line. Also input the desired file type (either imh or fits) at the end of the line.
    - You will need to restart your Data Acquisition window before the change takes affect.
- Can not write to tape using IRAF.
    - You may need to specifically set the blocksize to zero.
      To check the blocksize type *mt -f /dev/nst* status*
      To set the blocksize type *mt -f /dev/nst* setblk 0*
- Other IRAF specific questions can be directed to the IRAF group at iraf@noao.edu.

COMPUTER PROBLEMS

- For problems with Olive please see the TCS problems section
- For problems with Moss please see either the S2KB or Mosaic guider problems section
- For problems with Taupe please see the S2KB problems section
- For problems with Mosaic please see the Mosaic Manual

FACILITY ISSUES

- Running out of drinking water in the control room.
    - Note that even though you don't see water in the clear bottle, the bottom, blue container is a reservoir and most likely contains water. The water level is checked several times per week and refilled as needed. If the bottle and reservoir are indeed dry send an email notification to the site manager at hmathis at noao.edu.
- Running out of liquid Nitrogen.
    - The dewar scale reads 348lbs when the dewar is empty. The liquid nitrogen tank level is checked and filled on Mondays, Wednesdays and Fridays as needed. If the level is below 1/4 tank when you arrive at the telescope in the afternoon, notify the site manager by email hmathis@noao.edu or by phone (phone numbers are on the whiteboard in the control room).
- Unusually low pressure from the liquid nitrogen line.
    - Sometimes you may see very low pressure on the liquid nitrogen line when filling the dewar. This is a rare occurrence, but will most often occur

shortly after the liquid nitrogen storage tank has been refilled. If there is a lot of pressure in the tank the pressure will bleed off through the overpressure valve, eventually freezing the valve open. The valve will eventually warm up, close and the tank will build pressure again, but this may take a couple hours to get the pressure up to the normal 22psi.

- It is safe to fill the dewar even if the pressure is lower than normal. However, it may take significantly longer to fill the dewar.
- *Note:* it is normal to hear bleed off from the storage tank, especially after filling the dewar or when the tank has been refilled. This is ok.

APPENDICES

APPENDIX A - LIGHTNING SHUTDOWN AND RECOVERY PROCEDURES

If you need assistance or have questions, call Hillary - numbers are on the whiteboard.

Shutdown Procedure

Control Room:

- Shutdown the TCS
  - Logout of the TCS on Olive - From the *User* menu in the upper left-hand corner select *Exit*
  - From the Start menu at the bottom left select *Shutdown*
- Shutdown the rest of the computers:
  - On Moss, close all windows and shutdown via the *Start* menu (for the Windows boot)
  - On Emerald, close all widows:
    - For S2KB
      - Close the Taupe VNC GWC window
      - Close all windows within the Taupe VNC ICE window
      - Close the Taupe VNC ICE window
    - For Mosaic
      - Select Shutdown Mosaic from the Mosaic Menu
      - Close the Taupe VNC GWC window
    - On Emerald, in a xterm window type **shutdown-all.** This should shutdown Emerald, Taupe, Sage, Moss (when in Linux mode) and Mosaic1.

Computer Room:

- Disable the room monitor :
  - Press "What is"
  - Press "Code". The unit will respond 'enter security code'
  - Enter the security code which is listed on the left side of the unit.
  - Unit will respond 'OK' or 'error 2'. If you get an error, start over at 1.
- Press the "Run/Standby" key to disable the monitor
- On the East wall, flip the breaker for the telescope motors to the off position

- Turn off all racks (all appropriate switches are marked with orange dots)
    - Turn off the 2 racks closest to the door at the bottom back – 1 switch each rack
    - For S2KB
        - Turn off the CCD controller via the 2 switches at the front with red guards. Then turn off the power to the controller at the back of the racks
    - For Mosaic
        - Make sure the power is off at the back of the S2KB rack
    - Turn off computer rack at top/back
    - Turn off dry air system
    - Close the in-line valve on the outlet side of the dry air system

Upstairs:

- For Mosaic
    - Turn off the power supply
    - Unplug the power cord that goes from the instrument to the extension cord on the telescope mount.
    - Disconnect the air hose from the instrument and plug in the dummy plug

UPS room:

- Turn the compressor off with the red switch on the power box.
- Unplug the auto drain.
- Switch the compressor disconnect breaker to the off position.
- Turn the keyswitch to the off position on the UPS.
- Switch the main disconnect breaker to the off position.

Recovery Procedure

UPS room:

- Switch the main disconnect breaker to the on position.
- Turn the UPS keyswitch to the on position.
- Switch the compressor disconnect breaker to the on position.
- Plug in the auto drain.
- Turn the compressor on with the red switch on the power box.

Upstairs:

- For Mosaic
    - Plug the Mosaic power cord back into the extension cord

- Turn on the power supply
- Disconnect the air hose dummy plug and plug the air hose back into the instrument

Computer Room:

- Push the big green reset button on the south wall.
- Enable the room monitor
  - Press "Run/Standby"
  - Press "Set"
  - Press "Code".
  - Enter the security code which is listed on the left-hand side of the unit.
  - Unit will respond "Ok".
- Turn on the breaker for the telescope motors
- Turn on the 2 racks closest to the door at the bottom back
- Turn on Moss and Olive (Second rack from the door. The power switches are on the front, inside the doors)
- For S2KB:
  - Turn on the racks for the S2KB controller at the back- 2 switches. Then turn on the controller via the two switches at the front with RED guards.
- Turn on the computer racks - switch at top rear.
- Wait 30 seconds then:
  - Turn on Taupe and Emerald. The switch for Taupe is on the back and the one for Emerald is on the front
- For Mosaic
  - Turn on the computer rack
- Turn on the dry air system
- Open the in-line valve on the outlet side of the dry air system

Control Room:

- Make sure Olive, Emerald, Taupe and Moss boot up. *Note: to boot Moss into Windows for S2KB, at the lilo: prompt, type Windows2000 – the default is to boot into Linux*
- Turn on Sage. The computer is located under the desk
- Start the appropriate programs:
  - For S2KB:
    - On Emerald select the **VNC GWC Taupe** from the desktop as well as the **VNC Taupe** window.
    - Within the Taupe VNC ICE window start up the data acquisition window, a data reduction window and Ximtool-alt (all from the background menu.
  - For Mosaic (if in use):
    - On Emerald, select **Mosaic Menu** from the desktop

- From within the menu select **Start Mosaic**
- From the Mosaic Menu select **Restart Guider**

You will also need to check the following systems:

- Take several bias (zero) exposures prior to taking any science data.
- Wait until the CCD is at nominal temperatures before taking any science data. If using S2KB, type *ccdinfo* in the Data Acquisition window. Nominal CCD temps are on the whiteboard.
- Reset the dome position from the TCS by selecting Dome => Home
- If using S2KB, initialize the guider focus.
  - From the guider control window on the ACE TCS make sure the North camera is selected and then click INIT.
  - Set the guider focus to 6000 - near nominal focus.
  - Repeat for the South guide camera
- Reset the socket server.
  - In the Taupe GWC window on Emerald, in the xterm window type start-itcs.
  - At the *itcs*> prompt type tcs.
  - With S2KB type timer 5000
  - With Mosaic type timer 1500

APPENDIX B - ADDITIONAL S2KB INFORMATION

KPNO Telescope, Filter, and Detector Database

KPNO Telescope, Filter, and Detector Database
Revised on the basis of drawings (true aperture size) and
improved count rates. Agrees with KPNO Direct Imaging Manual
1 May 1997 --- plm
22 Jul 1998 --- dj
12 Aug 1998 --- gj

Telescope data:
aperture diameter in meters, scale in arcsec/mm, and transmission.

- telescope = "0.9m"
  - aperture = 0.81
  - scale = 28.3
  - transmission = 1.0
- telescope = "0.9mf13"
  - aperture = 0.81
  - scale = 15.9
  - transmission = 1.0
- telescope = "4m"

    - aperture = 3.42
    - scale = 17.5
    - transmission = 1.0
- telescope = "4mf8"
    - aperture = 3.42
    - scale = 6.67
    - transmission = 1.0
- telescope = "4mf15"
    - aperture = 3.42
    - scale = 3.75
    - transmission = 1.0
- telescope = "2.1m"
    - aperture = 1.94
    - scale = 12.7
    - transmission = 1.0
- telescope = "2.1mf15"
    - aperture = 1.94
    - scale = 6.5
    - transmission = 1.0
- telescope = "Schmidt"
    - aperture = 0.61
    - scale = 96.4
    - transmission = 0.7
- telescope = "WIYN"
    - aperture = 3.185
    - scale = 9.4
    - transmission = 1.0
- end

Filter data:
Magnitude corresponding to photon count rate.
Photons/second/stellar-image for a 1-m telescope at 1 airmass.
Sky magnitudes per sq arc sec:
sky = sky0 + sky1 * phase + sky2 * phase**2 (phase=0-14)

- filter = "U"
    - extinction = 0.55
    - mag = 20
    - star = 8.0
    - sky0 = 22.0
    - sky1 = -0.2666
    - sky2 = -.00760
- filter = "B"
    - extinction = 0.25
    - mag = 20

    - star = 34.5
    - sky0 = 22.7
    - sky1 = -0.0998
    - sky2 = -0.00953
- filter = "V"
    - extinction = 0.14
    - mag = 20
    - star = 36.2
    - sky0 = 21.8
    - sky1 = -0.0153
    - sky2 = -0.00838
- filter = "R"
    - extinction = 0.10
    - mag = 20
    - star = 36.8
    - sky0 = 20.9
    - sky1 = -0.0211
    - sky2 = -0.00364
- filter = "I"
    - extinction = 0.05
    - mag = 20
    - star = 26.7
    - sky0 = 19.9
    - sky1 = -0.0086
    - sky2 = -0.00311
- filter = "J"
    - extinction = 0.08
    - mag = 20
    - star = 36.5
    - sky0 = 16.2
    - sky1 = 0.
    - sky2 = 0.
- filter = "H"
    - extinction = 0.04
    - mag = 20
    - star = 21.8
    - sky0 = 14.2
    - sky1 = 0.
    - sky2 = 0.
- filter = "K"
    - extinction = 0.07
    - mag = 20
    - star = 14.6
    - sky0 = 13.3
    - sky1 = 0.

    - sky2 = 0.
- end

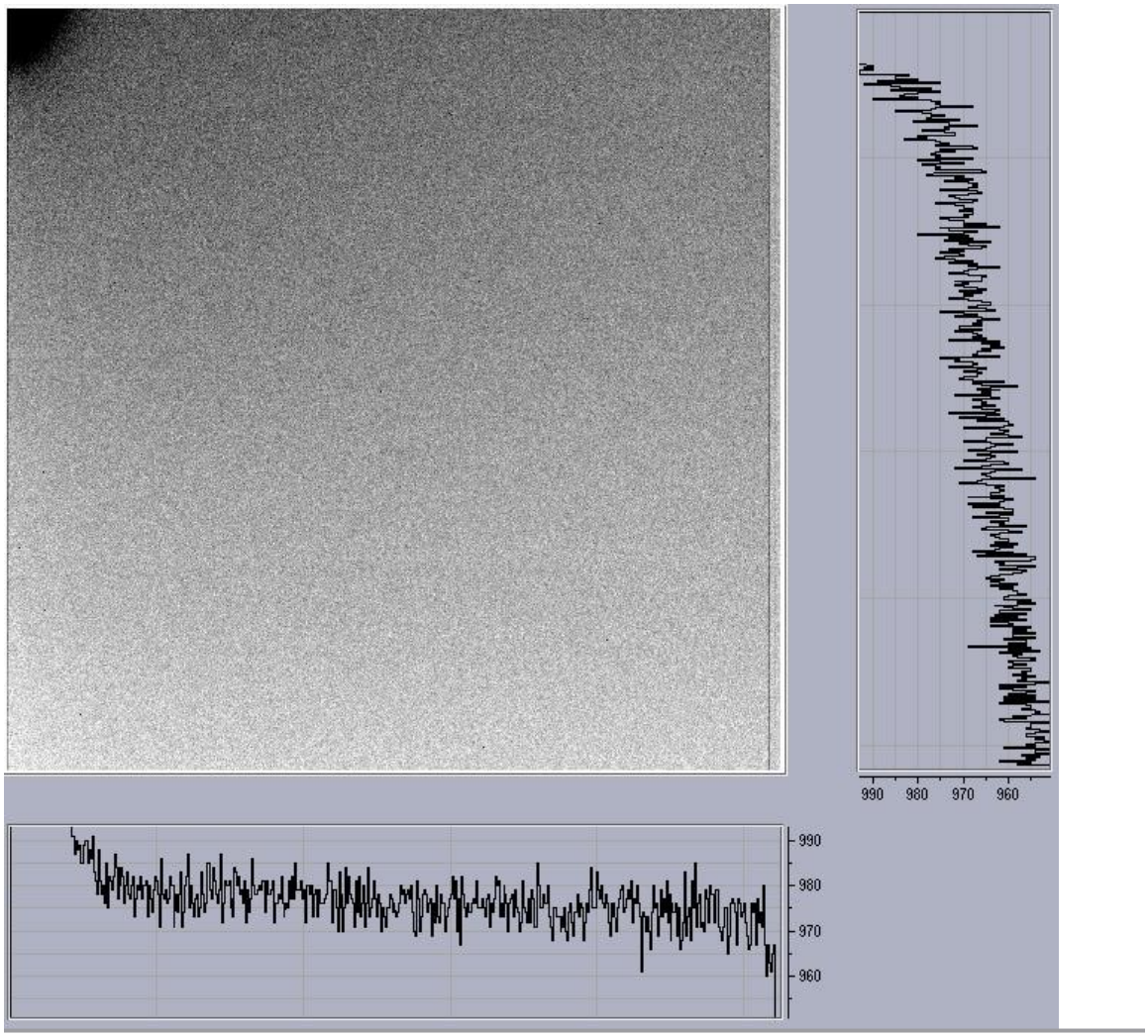
Detector information:
rdnoise in photons, dark rate in photons per second, pixel size in microns,
and the effective DQE for each filter.

- detector = "MOSAIC1"
    - rdnoise = 5.0
    - dark = 0.0015
    - pixsize = 15
    - U = 0.48
    - B = 0.68
    - V = 0.81
    - R = 0.86
    - I = 0.63
- detector = "T1KA"
    - rdnoise = 3.5
    - dark = 0.001
    - pixsize = 24
    - U = 0.24
    - B = 0.44
    - V = 0.70
    - R = 0.79
    - I = 0.59
- detector = "T2KA"
    - rdnoise = 4.0
    - dark = 0.001
    - pixsize = 24
    - U = 0.31
    - B = 0.53
    - V = 0.63
    - R = 0.67
    - I = 0.51
- detector = "T2KB"
    - rdnoise = 4.0
    - dark = 0.001
    - pixsize = 24
    - U = 0.42
    - B = 0.67
    - V = 0.78
    - R = 0.79
    - I = 0.56
- detector = "TI5"
    - rdnoise = 8.6

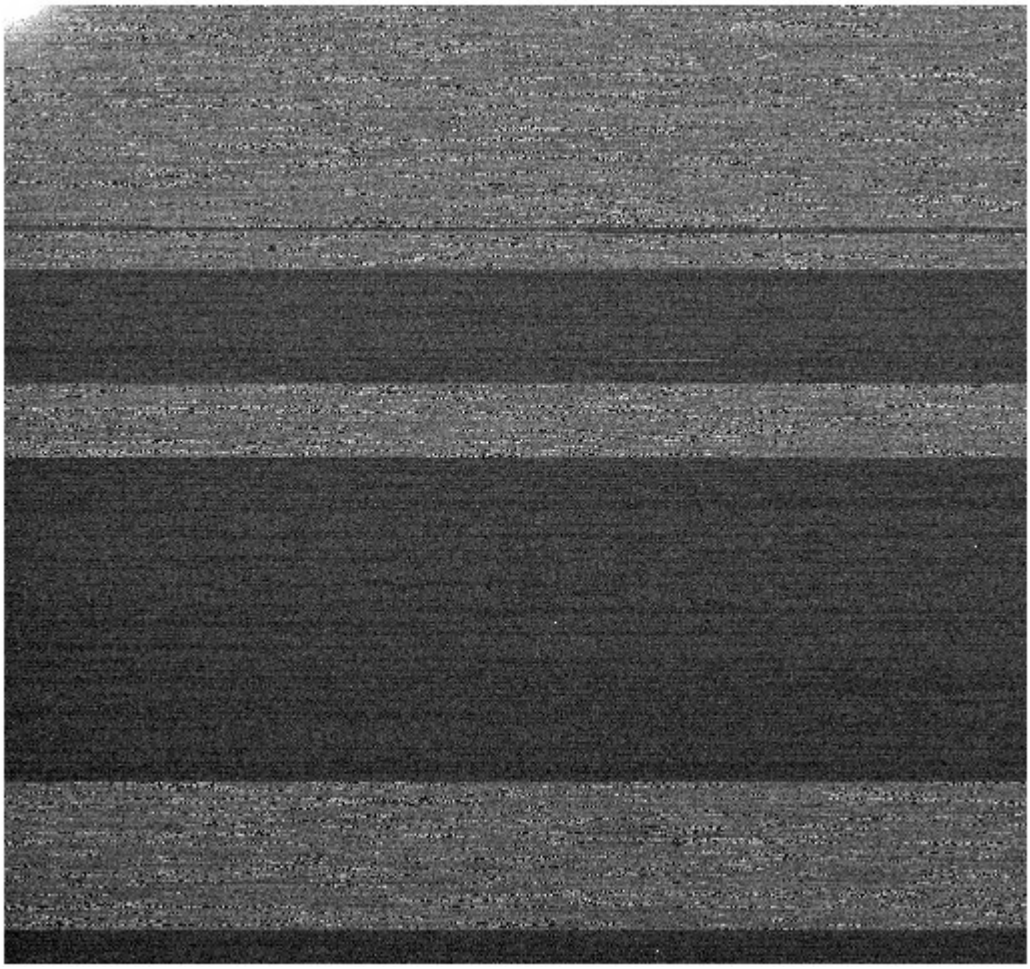
    - dark = 0.001
    - pixsize = 15
    - U = 0.51
    - B = 0.59
    - V = 0.69
    - R = 0.61
    - I = 0.39
- detector = "T5HA"
    - rdnoise = 13.5
    - dark = 0.001
    - pixsize = 27
    - U = 0.30
    - B = 0.51
    - V = 0.64
    - R = 0.69
    - I = 0.50
- detector = "S2KA"
    - rdnoise = 3.0
    - dark = 0.001
    - pixsize = 21
    - U = 0.30
    - B = 0.18
    - V = 0.34
    - R = 0.40
    - I = 0.60
- detector = "S2KB"
    - rdnoise = 7.0
    - dark = 0.001
    - pixsize = 21
    - U = 0.40
    - B = 0.70
    - V = 0.80
    - R = 0.82
    - I = 0.60
- detector = "IRIM"
    - rdnoise = 35
    - dark = 1
    - pixsize = 167
    - J = 0.23
    - H = 0.33
    - K = 0.31
    - K' = 0.38
- detector = "ONIS"
    - rdnoise = 35
    - dark = 0.75

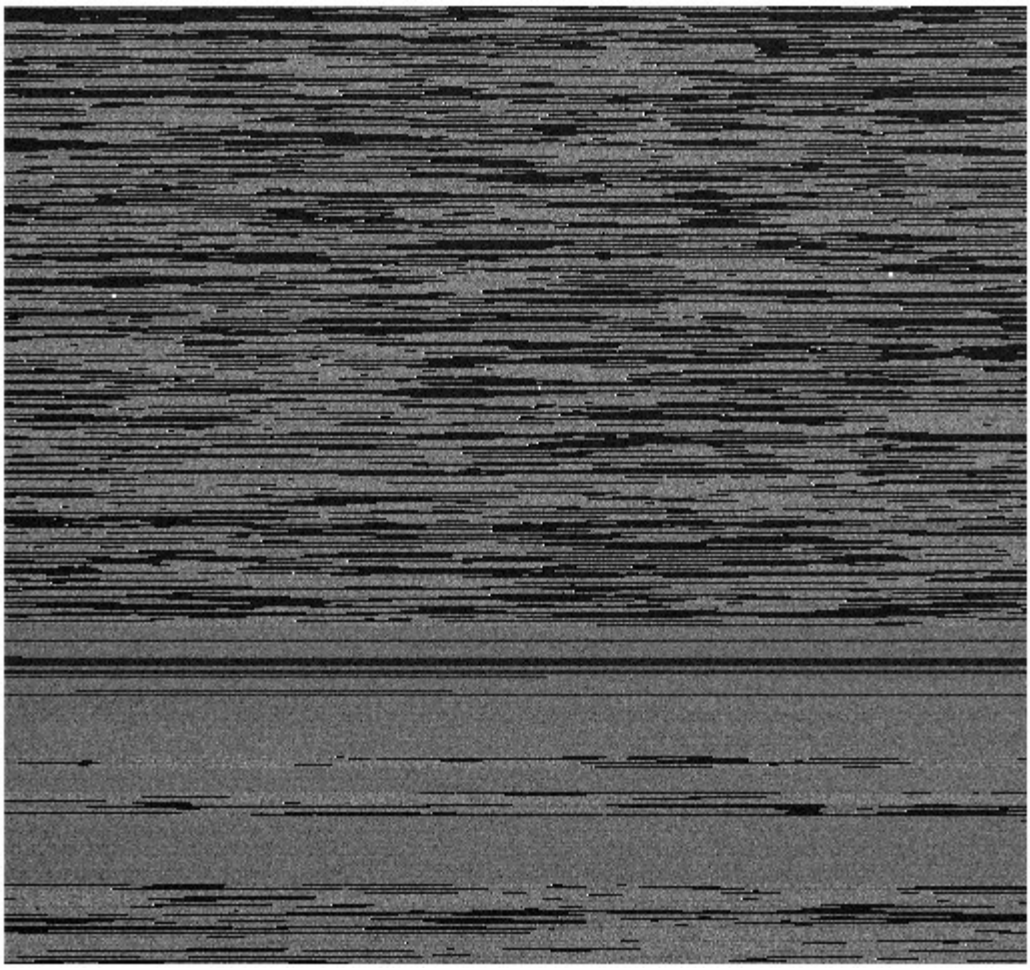
- pixsize = 27
- J = 0.18
- H = 0.28
- K = 0.22
- K' = 0.34

Normal Bias Image



Bad Bias Images





APPENDIX C - GETTING THE CORRECT FILTER NAMES IN YOUR HEADERS (S2KB only)

Instructions

Observers can insert the filter names into their image headers by running the included kpfilt.cl script after they have taken their images. The steps to run it are as follows:

- Determine which filters are in each wheel. For example:
- `Filter Wheel 1:`
- `0 Empty`
- `1 U`
- `2 B`
- `3 V`
- `4 R`
- `5 I`

- `Filter Wheel 2:`
- `0 Empty`
- `1 SII`
- `2 H alpha`
- `3 O III`
- `4+ Empty`
- The locations of the two filters bolts are stored in the header as two numbers separated by a zero. The keyword FILTERS is used to indicate this. So that FILTERS = 100 means that filter 1 is in position 1 and filter 2 is in position 0.
- The kpfilt script uses the FILTERS keyword to determine which filter name should be placed in the header. The statements look like this....
- `  if (filt==" 100"){`
- `# hedit imgname FILTER U ver- show+ add+`
- `     hedit (imgname, fields="FILTER", value="U", add=yes, delete=no,`
- `                    verify=no, update=yes)`
- `  }`

  The user needs to change the value of 'filt' that corresponds to the U filter or alternatively exchange the name of the filter that sits in the '100' slot.

- Tell IRAF where the script lives using
- `task = /path/kpfilt.cl`
- Then, just type kpfilt *image* or kpfilt *@list_of_images*.

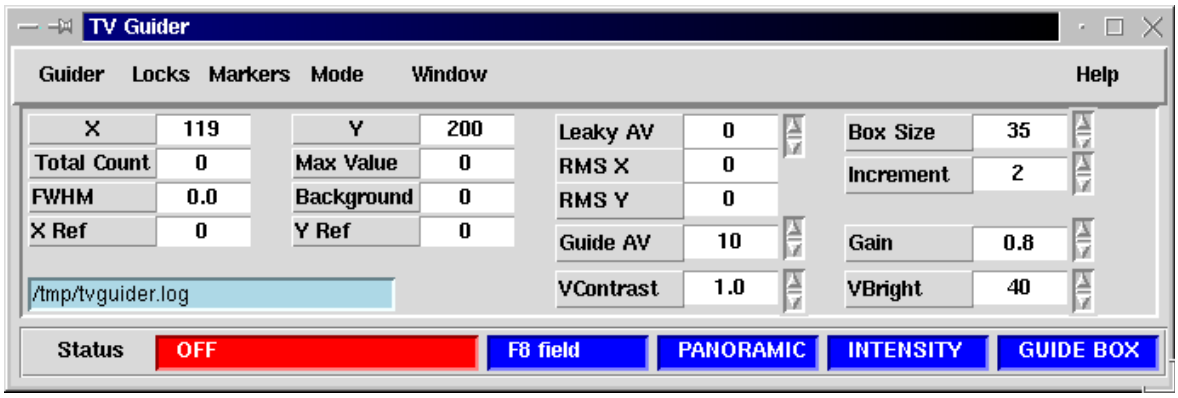
The kpfilt Script

```
# This will name the filters to things that make sense
# Brian Marsteller, Michigan State University

procedure kpfilt (input)

string input {"",prompt="Input images"}

struct *inlist

begin
string filt

string intmpfile

string imgname


# This will set things up in case your input is a list

intmpfile = mktemp ("intem")
files (input, sort=no, >> intmpfile)
inlist = intmpfile

while (fscan (inlist, imgname) !=EOF){

  imgets (imgname, param="FILTERS")
  filt = imgets.value

  if (filt==" 100"){
# hedit imgname FILTER U ver- show+ add+
     hedit (imgname, fields="FILTER", value="U", add=yes, delete=no,
verify=no, update=yes)
  }

  if (filt==" 200"){
# hedit imgname FILTER B ver- show+ add+
     hedit (imgname, fields="FILTER", value="B", add=yes, delete=no,
verify=no, update=yes)
  }

  if (filt==" 300"){
# hedit imgname FILTER V ver- show+ add+
     hedit (imgname, fields="FILTER", value="V", add=yes, delete=no,
verify=no, update=yes)
  }

  if (filt==" 400"){
# hedit imgname FILTER R ver- show+ add+
     hedit (imgname, fields="FILTER", value="R", add=yes, delete=no,
verify=no, update=yes)
  }

  if (filt==" 500"){
```

```
# hedit imgname FILTER I ver- show+ add+
     hedit (imgname, fields="FILTER", value="I", add=yes, delete=no,
verify=no, update=yes)
  }

  if (filt==" 001"){
# hedit imgname FILTER SII ver- show+ add+
     hedit (imgname, fields="FILTER", value="SII", add=yes, delete=no,
verify=no, update=yes)
  }

  if (filt==" 002"){
# hedit imgname FILTER Ha ver- show+ add+
     hedit (imgname, fields="FILTER", value="Ha", add=yes, delete=no,
verify=no, update=yes)
  }

  if (filt==" 003"){
# hedit imgname FILTER OIII ver- show+ add+
     hedit (imgname, fields="FILTER", value="OIII", add=yes, delete=no,
verify=no, update=yes)
  }

}

inlist=""

delete(intmpfile)


end
```

APPENDIX D - MORE ON THE LINUX GUIDER

Guider Control GUI



The Guider control graphical user interface is started from the 'Guider GUI' icon on the desktop.

Information fields

The information fields X, Total Count, FWHM, X Ref, Y, Max Value, Background, Y Ref, RMS X, and RMS Y contain status information which updates either when the guider is ON, or when it is calculate only mode.

X and Y

These values are the current guider box center positions in integer pixel coordinates.

Total Count

The total count is the number of counts summed over all pixels in the guider box. It provides a relative indicator of signal strength.

FWHM

The FWHM is the full-width-half-max of the guider star image and can be used as a rough indication of guide signal quality. The value is in arcseconds.

Max Value

This is the maximum pixel value inside the guide box. As the digitization is 8-bit, the maximum possible value is 255, which represents signal saturation. If the signal is constantly above 240, then turn down the controller gain. Expect to see this number fluctuate; if it seems to be pegged you may be saturating even if the value is not 255.

Background

The background is an estimate of the sky background. It is calculated using the pixels around the perimeter of the guide box. If the background is high (>50), then increasing the guide box size is recommended.

X Ref and Y Ref

The X and Y Ref values are the measured centroid deviations. These are in units of arcseconds and provide an indication of the amount of correction the guider is making. The actual corrections applied are somewhat smoothed (see Guide AV and Gain).

RMS X and RMS Y

The RMS values show the root-mean-square values of the last "n" centroid measurements. The value of n is shown. To reset n to zero, select a guiding mode using the "Mode" menu. The default mode is "Intensity Centroid".

Interactive Fields

The interactive fields Leaky AV, Guide AV, Box Size, Increment, Gain, VContrast and VBright, are fields which can be changed by the arrow buttons to their right.

Leaky AV

This value is the amount of "Leak". The units are "number of frames". For example, selecting a value of 3 will use a running average of 3 frames. This helps to reduce background noise and bring out fainter objects. Values above about 5 are unlikely to be used except during acquisition of very faint targets.

Guide AV

The Guide AV value controls the number of guide star centroid measurements to average, BEFORE sending a guide correction to the TCS. This does not change the appearance of the video picture but it does change the frequency of pointing correction. The default value is 10; larger numbers may be useful to avoid over-correction if there is a lot of image motion. Values of less than 10 are NOT recommended as the TCS may have problems accepting corrections at this rate.

Box Size

This value controls the size of the guide box (in pixels). It needs to be an odd number of pixels, so it will only change by 2 pixels at a time up or down. The ideal size for the guide box will provide a few pixels of "sky" between the guide star and each box edge.

Increment

This value controls the step size (2, 10, or 100 pixels) by which the guide box can be moved around the screen. When the guider GUI window is selected, the "arrow" cursor keys have the effect of moving the guide box inside the subraster box. To move both boxes together, hold down the "shift" key while pressing the arrow keys. Be sure not to hold down the arrow key - this is known to crash the program. Manual control of the guide box will not usually be needed because the box will "warp" to the guide star automatically in most circumstances.

Gain

The Gain parameter is an interactive value which controls how much of the guiding correction actually gets sent to the TCS (default 0.8). For example, a gain of 0.5 means that if the measured error is 1.0 arcseconds, then the guider would send a correction of only 0.5 arcseconds. Setting the Gain low and the Guide AV low can give excellent results in good seeing. The Gain will normally be set between 0.4 and 1.0 in normal operation. The "Guider" menu has an autotune option which attempts to determine the best settings for the "Gain" and "Guide AV" parameters for you. NOTE: autotune is only going to work when the seeing is good.

Log file name field

This entry field issued to alter the log file. Enter a new log file name (including the directory path) and press RETURN to activate it.

Status line

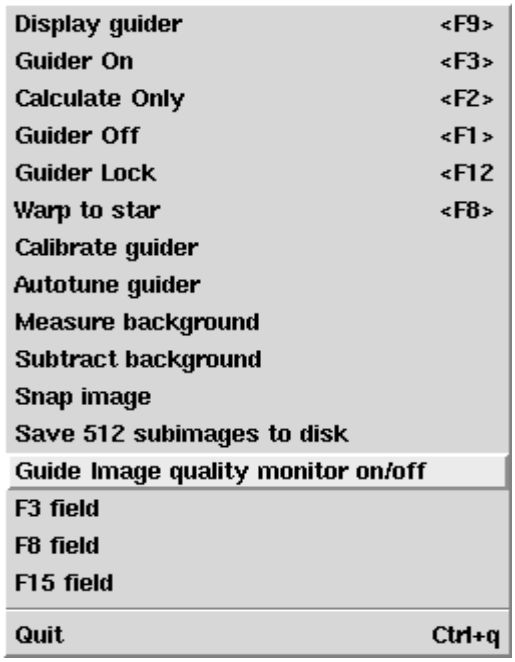
The bottom of the window contains the status fields, which are:

- Guider status - on (green), off (flashing red), calculate only (flashing yellow)
- Focus - f8
- Sampling - panoramic (whole screen) or subraster (maximum speed)
- Mode - type of centroid used (intensity, moment, shectman, quadrant, gaussian)
- Box

Guide control (menu) options

The major operations are controlled via menu selections. The menus available are:

Guider



Display guider

Guider On

Switch guiding on.

Calculate Only

This mode of operation does all the calculations identically to normal guiding mode, but never sends any corrections to the TCS.

Guider Off

Switch guider off.

Guider Lock

Defines the precise position at which to guide. Normally, guiding occurs at the center of the guide box: selecting guider lock will make the guider attempt to keep the guide star at its CURRENT location (at the moment you select this option) within the guide box. The guider-lock status is independent of guider on/off, and may be used while guiding is on or off. If you select guider lock, then move the telescope and switch guiding on, it will guide back to the precise position when guider-lock was selected. The guider-lock position is zeroed by a "Warp to star" operation. See also Locks menu below.

Warp to star

Locates the brightest guide star in the field, and centers the guide box on it. This option may be used while guiding is on or off. Note that the guider cannot use stars too close to the edge, defined to be such that the subraster would overlap the full video field. The guide box will not move if the brightest star in the field is unavailable: you will need to move the guide box manually to another star in the field.

Calibrate guider

The guider has information about the instrument and telescope focus, and will automatically adopt the appropriate pixel scale. This option is not used at the 0.9m.

Autotune guider

This option automatically adjusts the guider parameters (Guide AV and Gain) through a set of possible values. At each setting the RMS behavior of the guiding offsets is calculated. The best combination of parameters is then presented to the operator for confirmation. This option will only be worthwhile in good to excellent seeing.

Measure background/Subtract background

These options are used together to improve the guider performance when the sky background is high or the guide star is faint (ie. in low contrast situations). It can also remove detector gradients or other camera pattern noise. First, move the guide star, and any other visible stars, out of the field and click "Measure background". After approximately 20 seconds the average background will have been measured. Click on the "Subtract background" option and the screen should go almost black. Now move back to your guide star.

The guider algorithm defines loss of signal depending on how much brighter the guide star is than the background. Background subtraction forces the background to almost zero, and thus lets you guide in extreme conditions.

Snap image

Save a FITS format copy of the full 640x480 video field to disk. Images are saved in files called frame_XXXXX.dat, where the running number is simply incremented on each save operation.

Save 512 subimages to disk

Save a sequence of 512 FITS format snaps of the 65x65 subraster of the video field to disk. Images are saved in files called sampleXXX_yyy.dat, where the running number XXX is incremented on each save operation, and the number yyy runs from 000 to 511.

Guide image quality monitor on/off

This option is used to gain a quick look at the instantaneous image quality of the guide star. It may be useful for fine focusing and determining if the seeing has suddenly changed (better or worse), or is stable or variable. This puts up a continuous sequence of subraster field across the video image (NOTE: this does not interfere with guiding and only changes the display). This option can be used when guiding is on or off.

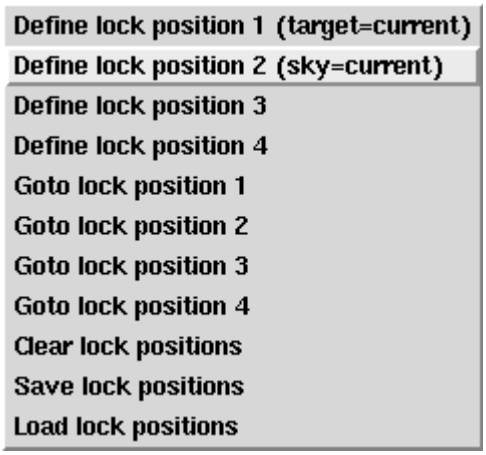
Field scale options

These options allow you to select the appropriate telescope focal ration. There is only one focal ratio used at the 0.9m (f/8), which is automatically selected on startup so this should never need to be changed.

Quit

Quit the guider GUI. NOTE: this does not turn off guiding, it only shuts down the guider program. Guiding will continue until manually turned off.

LOCKS



Define lock position X

Set up any of four available lock positions at the current centroided star location.

Goto lock position X

Move the guider box to the lock position

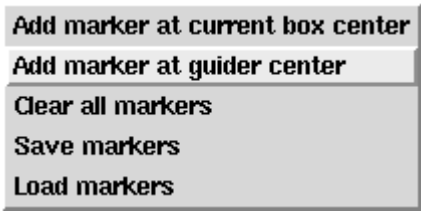
Clear lock positions

Undefine all lock positions. Note that the guider still knows where they are and you can still move to them, but you will not be able to save them. This option was more important in earlier versions of the guider software.

Save/Load lock positions

Save or load the current lock positions to or from a disk file. A dialog box will prompt you for a filename.

MARKERS



A set of up to 4095 markers may be created and optionally saved and restored to and from disk files. The current marker is always indicated by extended vertical features. Once a new marker is created it automatically becomes the current marker.

To cycle through a set of markers use the ALT-+ key combination. The cursor must be in the GUI window for this and the following key combinations to work.

CAUTION: Please switch guiding OFF before cycling between markers.

To move the current marker (one pixel at a time) hold down the ALT key and press an arrow key.

To delete the current marker, hold down the ALT key and press the Del key.

Add marker at current box center

Adds a new marker at the center of the guide box.

Add marker at guider center

Adds a new marker at the center of the screen (i.e. x=320,y=240).

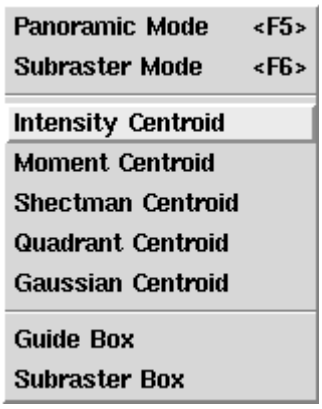
Clear markers

Delete all markers

Save/Load markers

Save or load the marker positions to or from a file. A dialog box will prompt you for a filename. These files are on the guider computer and are not generally accessible except from these menu options.

MODE



Panoramic Mode

This option selects full screen mode digitization. Depending upon available CPU this mode will run at approximately 8 frames per second.

Subraster Mode

This option selects Subraster mode digitization. A full video frame rate of 30Hz is possible with this mode. CAUTION: only the area inside the larger box on the screen in updated when in subraster mode. This is the default mode when guiding.

Intensity centroid

Selects a simple intensity centroid calculation. In practice this method seems to work as well as any, and is the most robust with noisy signals.

Moment centroid

Uses a very simple "moment" calculation. May be of some use in very poor signal conditions.

Shectman centroid

The classic Shectman centroiding algorithm.

Quadrant centroid

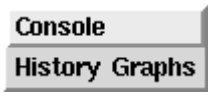
A simple quadrant centroid calculation. May be useful for very low signal conditions.

Gaussian centroid

A full gaussian parameter fit with centroid calculation. The extra processing is only worthwhile when a very good guide signal is available.

Guide/Subraster Box

Window



Console

Diagnostics and engineering window which allows low level access to the guider functions. DO NOT USE THIS unless you are the responsible programmer!

History graphs

The history graphs window contains the following six historical data plots, which can be used to evaluate the efficacy of the guiding.

X correction: the guide correction in arcseconds in the X axis

Y correction: the guide correction in arcseconds in the Y axis

Total Count: the summed signal inside the guide box

FWHM: the full-width-half-max in arcseconds

X data: the guide star signal summed by column (ie an X slice)

Y data: the guide star signal summed by row (ie a Y slice)

HELP

The help menu contains only one item, "About TV Guider", and no useful help information.

APPENDIX E - UNIX CHEAT SHEET

Common UNIX commands

- **cp** - CoPy an existing file to a new file.
  Format: cp <existing file> <new file>
- **df** - Stands for Disk Free and shows the amount of disk space available on the currently mounted disks.
  Format: df -k
- **ftp** - Stands for File Transfer Protocol. Allows you to transfer files back and forth between the 0.9m and your home institution.
  Format: ftp <host computer IP address>. Once you are connected you can use the *get* and *put* commands to manipulate files.
- **kill** - KILL a currently running process.
  Format: kill -9 <PID>, where PID is the process identification obtained from the ps command.
- **lpr** - PRint a file on the Laserprinter.
  Format: lpr <file name>
- **ls** - LiSt the files in the current directory.
  Format: ls
- **mail** - Allows you to check your email. You can also use Pine, which is a keystroke driven mail program. *Pine* is recommended over *mail*
- **man** - Invokes the UNIX MANual pages allowing you to get help on any UNIX command.
  Format: man <Unix command>
- **mkdir** - MaKe a new DIRectory.
  Format: mkdir <directory name>
- **mv** - MoVe an existing file to a new file, which is the same as renaming the original file.
  Format: mv <existing file> <new file>
- **ps** - Displays the currently running ProceSses.
  Format: ps -x
- **rm** - Delete (ReMove) a file.
  Format: rm <file name>
- **sftp** - Secure FTP.
- **ssh2** - Stands for Secure SHell. Allows you to log into another computer using a secure connection which protects the privacy of information passed between the two computers.
  Format: ssh2 <host computer IP address>.
- **tar** - Stands for Tape ARchive. Allows you to make a backup of your data onto a magnetic tape.
  Format: tar cvf <tape device name> <files to be backed up>

Useful web page: http://www.nmt.edu/tcc/help/unix/unix_cmd.html

APPENDIX F - IRAF CHEAT SHEET

Common IRAF commands

- **ccdinfo** - Outputs basic information about the CCD including the available gain settings.
- **detpars** - Set the gain value, region of the chip to readout, etc.
- **display** - Displays an image in the ximtool window.
- **flpr** - Stands for 'flush process'. It is recommended that flpr be issued anytime ctrl-c is used to interrupt a process.
- **imexamine** - allows the user to use certain keystrokes to operate on the currently displayed image in the ximtool window. Useful keystrokes include *r* (plots a radial profile and outputs profile diagnostics), *a* (only gives the profile diagnostics), *c* (plots a contour plot), and *s* (plots a surface plot).
- **imhistogram** - Plots a histogram of the pixel intensity values. Note that the ordinate is a logarithmic scale. This is useful for checking the distribution of pixel values looking for a stuck bit, which would manifest itself as a sequence of intensities with no pixels.
- **implot** - Plots pixel intensities along row and columns.
- **observe** - The primary observing command, which initiates and otherwise controls CCD exposures.
- **obspars** - Set the run information, nightly file prefix, up date the current image index number, etc.
- **rfits** - Read a fits file or convert a FITS image to an imh/pixel image.
- **test** - Takes one exposure and saves it to test.imh without incrementing the image index.
- **unlearn** - Resets IRAF parameter sets to their default values.
- **wfits** - Write a FITS file or convert an imh/pixel image to a FITS image.

Useful web page: http://www.noao.edu/kpno/manuals/ice/node20.html

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APPENDIX G - USING SFTP

Why use sftp instead of ftp?

- sftp is a more secure way to transfer files, as compared to ftp. Many sites that hide behind firewalls and no longer support ftp will support sftp.

How does one use sftp? Using sftp is similar to, but not identical to using ftp. Here is a sample session:

- > sftp 36inch@taupe.kpno.noao.edu
- Connecting to taupe.kpno.noao.edu...
- 36inch@taupe.kpno.noao.edu's password:
- sftp> put test*

- Uploading test.1 to /data1/36inch/test.1
- Uploading test.2 to /data1/36inch/test.2
- Uploading test.3 to /data1/36inch/test.3
- Uploading test.4 to /data1/36inch/test.4
- sftp> quit

Comments: "36inch" is the userid, and "taupe.kpno.noao.edu" is the address. After the password is typed in correctly, you get the "sftp>" prompt. A simple "put" (not "mput") will transfer all the files indicated by the wildcard character; in this case, the four test files shown. Additional info can be found from "man sftp", e.g. on taupe.

APPENDIX H - EMACS CHEAT SHEET

Common Emacs keystrokes

- **Ctrl-x Ctrl-s** - Save changes to the current file.
- **Ctrl-x Ctrl-c** - Quit emacs.
- **Ctrl-b** - Back one space.
- **Ctrl-f** - Forward one space.
- **Ctrl-k** - Delete entire line.
- **Ctrl-x u** - Undo last change.
- **Alt-v** - Previous page.
- **Ctrl-v** - Next page.

Useful web page: http://www.stanford.edu/group/dcg/leland-docs/emacs.html

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APPENDIX I - VI CHEATSHEET

- **x** - Delete a single character. 2x deletes two characters.
- **j** - Move the cursor down one row.
- **h** - Move the cursor left one space.
- **k** - Move the cursor up one row.
- **l** - Move the cursor right one space.
- **:w** - Save changes to the current file.
- **:wq** - (Write and Quit) Save changes to the file and quit vi.
- **:q!** - Quit vi without saving changes.
- **i** - Insert.
- **u** - Undo last change.
- **D** - Delete from character to end of line.
- **dw** - Delete word.
- **Ctrl-b** - Previous page.
- **Ctrl-f** - Next page.

Useful web page: http:/ /www.uic.edu/depts/accc/software/unixgeneral/vi101.html#startvi

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APPENDIX J - A REFERENCE GUIDE FOR TAKING SKY FLATS

The following describes a method that provides useful twilight sky flats at the 0.9m telescope using either the MOSAIC or S2KB setups.

Philosophy: If you want to use twilight sky flats (instead of dome flats) to correct for pixel-to-pixel sensitivity variations, then you need at least 5 well-exposed sky flats in each filter each night. If you want to use twilight sky flats in conjunction with dome flats to do an illumination correction (twilight flats will be smoothed), then you need at least 3 flats per filter approximately every other night.

The following describes how to obtain 5 twilight sky flats in each filter. The aim is to expose the CCD to between 1/3 and 2/3 of the full well. If the level is not optimum, adjust the exposure times appropriately.

- Begin a few minutes after sunset.
- Point the telescope at Dec ~ +30 and HA ~ -4h (east) and make sure tracking is ON.
- Take a very short exposure (< 0.5 sec) using the filter where the system throughput is lowest (e.g. U). This image is likely to be saturated.
- Keep taking short exposures with the same exposure time until the CCD is exposed to about 2/3 of its full well.
- Move the telescope a few degrees west (following the setting sun).
- Take an exposure with twice the exposure time as the previous one.
- Repeat steps 5 and 6 for the next 4 exposures adjusting the exposure time appropriately.
- Move the telescope about 10 to 20 degrees west.
- Change filters to the one with the next highest throughput (e.g. B).
- Take an image with the same exposure time as the last image in the previous filter.
- Move the telescope a few degrees west.
- Take an exposure with twice the exposure time as the previous one.
- Repeat steps 8 through 12 for the next 4 exposures.
- Continue until the sky gets too faint to provide enough illumination to give you a mean level of about 1/3 of the full well in a 5 minute exposure.
- About 15 to 20 minutes (exact time varies considerably based on your specific circumstances) into astronomical twilight, begin the process of taking morning twilight flats.
- Point the telescope at Dec ~ +30 and HA ~ -4h (east).

- Perform the above steps in reverse order making sure to begin with the longest exposure time and progress to the shortest times and moving the telescope west again to move away from the rising sun.

APPENDIX K - DEWAR FILLING TIPS AND TRICKS

Filling a dewar can be tricky, but once you've figured out the right technique it will become second nature. Below are a few pointers to help you make sure the dewar has gotten a good fill.

- You must have the telescope parked at the Zenith Park position in order to fill the dewar.
- When precooling the liquid nitrogen line, lay the line on the ground pointed away from all persons nearby.
- Before attaching the (precooled) liquid nitrogen line to the dewar, wipe the threads on the dewar with a glove to make sure it is dry (you may need to melt any ice on the threads with the heat gun first). This will allow the line to be secured on tightly and prevent a lot of liquid nitrogen from leaking around the line/dewar connection.
- Many people have trouble determining when the dewar is actually full. This is especially tricky to determine when the liquid nitrogen line is not properly seated on the dewar, causing nitrogen to leak around the connection. **The dewar is full when you see a stream of liquid spraying out of the 3 small holes above this connection (looks like a sprinkler)**.
- To remove the liquid nitrogen line from the dewar elbow use the wrench. The hose should easily loosen and should only need to be used for about half a turn, it should be finger tight by then. If the hose will not easily loosen you will need to use the heat gun to thaw out the area. When using the heat gun, you do not want the heat gun touching any of the surrounding metal - this could send vibrations up into the dewar. Keep the heat gun approximately 2 inches away from the dewar/line. Also keep the heat gun pointed away from the yellow plastic connector just beside the connection.
- Do not touch the aluminum end of the heat gun after use - THIS IS VERY HOT! After use, be sure to rest the heat gun on the counter with the nozzle pointed up to make sure it doesn't come in contact with anything.
- When removing the liquid nitrogen line from the dewar, after using the heat gun, unscrew the line as quickly as possible to avoid refreezing of the line onto the dewar threads. This is especially true in high humidity conditions. If the line does refreeze onto the threads, DO NOT USE FORCE TO REMOVE THE LINE. Reheat the area with the heat gun.
- If your dewar has warmed up, see the Troubleshooting section Dewar Warmups.

APPENDIX L - TAKING A SEEING MEASUREMENT

We are seeking to track the seeing quality of the 0.9m telescope. As such, we would like each observer to measure the seeing toward the end of the night using the following procedure.

- We need an uncrowded star field with airmass less than 2, preferably less than 1.5. A standard star field or one that you are currently observing are fine as long they fulfill these criteria.
- At the end of the night before morning twilight begins, take a short (2 to 5 seconds) unguided exposure of the star field with the V filter.
- Use IMEXAMINE in IRAF to measure the FWHM for 3 well-exposed (peak counts between 5,000 and 20,000 ADU) stars in the image and report the average value in the nightlog.

  *Note that having the dome vents open and the telescope exhaust fan on (weather permitting) helps to improve the seeing.

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