Hokupa'a Observer's Guide

Notes from the QuickStart Experience with Hokupa'a and QUIRC

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[1]with input from many other Gemini and University of Hawaii astronomers

Contents

1 Introduction

This document is not intended as a complete operations manual for either Hokupa'a (the University of Hawaii curvature based adaptive optics system modified for use with the Gemini North telescope) or QUIRC (the University of Hawaii QUick InfRared Camera). This is mainly a collection of notes that accumulated during QuickStart queue operations in semester 2000B. Your primary source of information for Hokupa'a/QUIRC on Gemini North should be the Gemini web pages maintained by Mark Chun.

`http://www.gemini.edu/sciops/instruments/uhaos/uhaosIndex.html`

More detailed information about Hokupa'a (including design and control) can be found in Buzz Graves' SPIE article "First Light for Hokupa'a: the 36 element curvature AO system at UH" (Graves et al. 1998, Proc. SPIE 3353):

`http://www.ifa.hawaii.edu/ao/publi/UHAO_kona98.ps.gz`

as well as on the UH AO homepage:

`http://www.ifa.hawaii.edu/ao`

For more detailed information about QUIRC, please see the "Observer's Guide for QUIRC" 1997, Hodapp, Hora & Metzger (note that some of this information is not applicable to QUIRC on Gemini):

`http://www.ifa.hawaii.edu/88inch/manuals/quirc.ps`

and the QUIRC homepage:

`http://www.ifa.hawaii.edu/instrumentation/quirc/quirc.html`

Have a good run!

2 Hokupa'a Observation Notes

in original form 27 Sept 2000 – M. Chun

2.1 Telescope Parameters

Acquisition of a target into the Hokupa'a wavefront sensor field of view is still a quite complicated operation. We expect this to improve with the development of new software, and the classical observer does not have to be overly concerned with the details. However, we include those details here for reference and so that he/she can understand what the SSA is doing while setting up for Hokupa'a/QUIRC observations. Note that this does not include the extra steps that are required for off-axis guiding (which may be necessary to take out windshake in high wind situations).

There are several telescope parameters that are currently needed during target acquisition and setup. The Acquisition Camera optical axis is the position in pixels about which an image rotates on the Acquisition Camera when the CASS Rotator is moved. It's also known as the **Acquisition Camera Hot Spot**. This is the position on which the AO guide star should be initially placed in the acquisition camera when pointing to a new target IF the instrument origin is (0,0). The **Hokupaa Instrument Origin** is an (x,y) offset (measured in mm) which the SSA then enters in order to move the AO guide star from the Acquisition Camera Hot Spot onto the Hokupa'a AC Hot Spot. The **Hokupa'a Acquisition Camera Hot Spot** is the position in pixels on the Acquisition Camera where the AO guide star needs to be placed in order to be within the Hokupa'a wavefront sensor field of view when the wavefront sensor is at HOME (0,0). And finally the **Hokupa'a/QUIRC Hot Spot** is the position in pixels on the QUIRC detector where an object being guided on-axis will fall. It is near but not exactly on the center of the QUIRC array. The table below lists the most recently measured values for each of these parameters.

Instrument Parameter	(x,y)	Date of last update
Acquisition Camera Hot Spot	(544,547) pixels	01/29/01
Hokupa'a Instrument Origin	$(-0.4, -11.5)$ mm	02/22/01
Hokupa'a Acquisition Camera Hot Spot	(692,550) pixels	02/22/01
Hokupa'a/QUIRC Hot Spot	(441,529) pixels	02/22/01

2.2 FlatField Calibrations

Eventually observers will be able to use the GCAL unit to take flatfield calibration data. Currently GCAL cannot be used with the broad-band filters H, K, K' and H+K' because an infrared leak in the neutral density filters allows too much light to pass through and the QUIRC detector saturates or becomes non-linear in less than the recommended 5-sec exposure time. Note that if one is willing to work with 3-sec flats that have median count levels around 25,000 then H-band GCAL flats can be taken. The following GCAL notes are valid as of 02/17/2001.

- GCAL DM screens and VME Crate information can be found at `http://manta/intranet/Telescope/tcsGCal.html`
- The IR source should be turned on approximately 20 minutes prior to use as it takes a while to reach peak intensity. It can be left on during the night (with the shutter closed) or turned off if only needed again at the end of the night.
- Currently the strongest neutral density filter (4.0) is in the ND 2.6 slot of the GCAL DM screens. Note however that due to the IR leak the numbering does not correspond to actual attenuation of light.
- For the 02/2001 observing run we found the number in the A&G software for Hokupa'a-to-QUIRC science fold position did not give proper alignment. We found good alignment with the following position: (43.60, 0.15, 0.00)

Until better neutral density filters can be obtained for GCAL, observers will have to take dome flats. We recommend taking dome flats at both the beginning and the end of the night as we often see dust features moving around on the flatfield over the course of the night. The current arrangement has four shop lamps attached to scaffolding and pointed at the dome. These lamps are plugged into a power strip on the observing floor located to the right of the door as you enter the dome.

The telescope and dome must be in position AZ=120 for dome flats. For broad-band flats we have found that having the telescope at EL=45 gives adequate counts for 5 sec flats. Lowering the telescope elevation to 35° for example gives more counts and may be required for narrow-band flats. The disadvantage of this is that more liquid N_2 spills out of QUIRC at this low elevation. The important thing is to use the same telescope elevation for both your evening and morning dome flats so you can easily compare and identify which dust features have moved during the night.

The standard procedure employed during QuickStart operations was to take a series of five 5-sec exposures with the lamps on, followed by five 5-sec exposures with the lamps off for each filter used for observing. In J, H, K, and K' we find four lamps work well. For the H+K' filter we recommend unplugging one lamp. These flats, along with a series of ~10 1-sec dark exposures for identifying hot pixels can be used with the Gemini IRAF task `qflat` in the `quirc` subpackage to produce flatfield calibration images (see section 11).

2.3 Photometric Standards

To preserve photometric accuracy never integrate shorter than 1 sec, we recommend a lower limit of 5 sec. However, often photometric standards are too bright to observe for 5 sec while applying full AO correction without saturating. If necessary, one can lower the Hokupa'a loop gain if saturating QUIRC (or above ~25,000 cts).

Dither pattern: (0,0)
(-3,3)
(3,3)
(3,-3)
(-3,-3)

2.4 PSF Calibration Stars

At least a few minutes total integration time
Dither pattern: (0,0)
(-3,3)
(3,3)
(3,-3)
(-3,-3)

2.5 QUIRC Focus

The correct focus position of the QUIRC stage depends on the filter AND on the Hokupaa WFS Y Offset (in mm). Normally this is calculated automatically by the Hokupa'a software and the observer should not have to worry about it. However, you may want to check with the Hokupa'a operator occasionally to see that this is working correctly. Here is how to calculate the correct focus manually:

Focus = Focus_0 + BY $\times$ 2200

Filter	Focus_0
J	560000
H	560000
K	560000

(other filters are listed in the Hokupa'a "gold" book)

2.6 Sky offsets

Offsets for sky are done with the telescope not Hokupa'a. Note that offsets you tell the telescope operator (SSA) are opposite in sign to those you tell the Hokupa'a operator.

1. Have the Hokupa'a operator HOME the WFS Steering mirrors and open loop
2. Tell the SSA either a new pointing position for the sky or an offset from the current pointing position.
3. Tell the SSA your dither pattern in ARCSEC

2.7 Reacquiring a lost guide star

1. Have the Hokupa'a operator HOME the WFS Steering mirrors and open loop
2. Have the SSA remove guiding offsets
3. If the AOGS is still not in the WFS then take an image in QUIRC making a note in the ObsLog.
4. Determine the offset to the hot spot (Hokupaa WFS HOMED?) Note normal orientation for Cass Orientation = "180" $\rightarrow$ N up, E right.
5. You can guesstimate the offsets (20" field of view). Tell the SSA to use POINTING OFFSETS.
6. If object is still not in the QUIRC field of view tell the SSA to go back to the acquisition and place the target back on the Hokupa'a hotspot.

2.8 qMon

More information on running qMon is available in Section 9.

If the vii (visitor instrument interface) is not already running:

1. rlogin -l gemvx vii.hi.gemini.edu *(password available from Gemini Staff)*
2. cd /gemini/vii/vii
3. .vis &

To start qMon:

1. xhost +quirc
2. rlogin -l quirc quirc
3. export DISPLAY=*workstationname*:0.0 (where *workstationname* should be either fama or callisto)
4. qMon & *(may be qMondev – check with Gemini Staff)*

2.9 Acquiring Stars Off-Axis

More information on dithering with Hokupa'a is available in Section 5 and a macro for calculating dither pattern (particularly useful when changing the default field orientation) is described in Section 6.

1. You need to calculate the base offset around which the dithers will be done. This is done by calculating the dRA (arcsec) and dDec (arcsec) from the target to the AOGS.

   HKXOFFSET (mm) = dRA / 1.6

   HKYOFFSET (mm)= dDec / 1.6

2. You can figure out the sign of the offset remembering that the Hokupaa offsets move in the opposite direction from the telescope.

3. Acquisition LIMITS are approximately as follows:

   Quadrant 1 +x,+y $\rightarrow$ +14,+12mm

   Quadrant 2 −x,+y $\rightarrow$ −14,+12mm

   Quadrant 3 −x,−y $\rightarrow$ −20,−18mm

   Quadrant 4 +x,−y $\rightarrow$ +16,−12mm

It may be easier to mark out the four quadrants (NESW) with Hokupaa X,Y offsets.

CassRot Orientation = "180":

1. QUIRC Orientation : N up E right

2. Hokupaa WFS steering mirror offsets: +x,+y acquires a target W,S of AOGS

```
+y,S
   ^
   |
   +--> +x,W
```

CassRot Orientation = "0":

1. QUIRC Orientation : N down E left

2. Hokupaa WFS steering mirror offsets: +x,+y acquires a target E,N of AOGS

```
+y,N
   ^
   |
   +--> +x,E
```

CassRot Orientation = "90":

1. QUIRC Orientation : N right E down

2. Hokupaa WFS steering mirror offsets: +x,+y acquires a target S,E of AOGS

```
+y,E
   ^
   |
   +--> +x,S
```

CassRot Orientation = "270":

1. QUIRC Orientation : N left E up
2. Hokupaa WFS steering mirror offsets: +x,+y acquires a target N,W of AOGS

```
+y,W
^
|
+--> +x,N
```

Calculate the offsets for the dither pattern based on these zero positions.

Arbitrary field PA

1. CassRot Orientation: a positive rotation rotates N into WEST!
2. Standard CR Orientation = 180 $\rightarrow$ N up E right

3 Hokupa'a Filters

July 31, 2000 – Mark Chun

The ND filters in Hokupaa for QUIRC decrease the photon flux by the following approximate *FACTORS*. Note that the filters are not 'neutral' since they attenuate the light by different amounts in the different filters. **CAUTION:** These filters have not been characterized and may, for example, contain unknown absorption features. If you are observing your target using these filters then you should consider observing standard stars also with these filters in place for better photometric calibration.

	K-band	H	J
ND1	Clear	Clear	Clear
ND2	$\frac{1}{2.5}$	$\frac{1}{3.0}$	$\frac{1}{3.2}$
ND3	$\frac{1}{6.1}$	$\frac{1}{8.8}$	$\frac{1}{17.6}$
ND4	$\frac{1}{5.3}$	$\frac{1}{7.1}$	$\frac{1}{12.0}$
ND5	$\frac{1}{7.3}$	$\frac{1}{11.1}$	$\frac{1}{24.6}$

For your information here are the ND filters in the WFS Path. These NDs decrease the star brightness by the following *MAGNITUDES*. There is NO NEED to specify the WFS ND filters for your program. This is set by the Hokupa'a operator. The approximate maximum numbers of counts in the Hokupa'a wavefront sensor is 50 million photons/second.

WFS_ND1	Opaque
WFS_ND2	9.8 magnitudes
WFS_ND3	6.5 magnitudes
WFS_ND4	2.7 magnitudes
WFS_ND5	Clear

4 Nightly Observer Checklist

in original form from QuickStart – Mark Chun

INITIAL NIGHTLY SETUP

1. Setup qcdcom: directory, fn, fp, object
2. Setup qMon: GemProgID, ObsID, Observer, SSA, Observing Conditions
3. Home the filter wheel in QUIRC

SETTING UP ON OBSERVATION FIELD

1. Check Finding Chart
2. Check Observing Conditions
3. Check ObsID in qMon
4. Check Object in qcdcom (see Section 7)

OBSERVING TARGET

1. Setup AO guide star into Acquisition Camera hotspot (if big slew), then use INSTRUMENT offsets to place it on the Hokupa'a Acquisition Camera hotspot
2. Science Fold to Hokupaa
3. Tune up AOS
4. Check qMon settings: Change OBSID every time you change pointing, filter, or exposure time:
5. Suggested dither patterns (5-pt squares):

Small: 0.6×0.6"	Medium: 3.2×3.2"	Large: 9.6×9.6"
(0,0)	(0,0)	(0,0)
(−0.2,0.2)	(−1,1)	(−3,3)
(0.2,0.2)	(1,1)	(3,3)
(0.2,−0.2)	(1,−1)	(3,−3)
(−0.2,−0.2)	(−1,−1)	(−3,−3)

OBSERVING SKY FRAMES

1. Set qcdcom OBJECT_SKY (see Section 7)
2. Point or offset to sky position

3. Suggested dither pattern: Unguided, dithering by SSA using target offsets.

(0, 0)
(1",−1")
(−1",−1")
(−1",1")
(1",1")

4. Set qcdcom OBJECT (see Section 7)

<u>OBSERVING PSF CALIBRATION FIELDS</u>

1. qMon: change ObsID
2. Set qcdcom OBJECT_PSF (see Section 7)
3. Close Hokupa'aWFS GS loops
4. Integrate for exposure time: want ∼20k counts
5. Follow dither pattern for total exposure time ∼2–3 minutes.

(0, 0)
(−3, 3)
(3, 3)
(3,−3)
(−3,−3)

6. Set qcdcom OBJECT (see Section 7)

The most important consideration when choosing a PSF star is to match the number of counts in the Hokupa'a wavefront sensor for your AO guide star in both the object and the PSF fields. The second most important consideration (applicable for guiding off-axis only) is to match the separation between the AO guide star and the PSF star with that of the object field. For more information on selection of PSF stars please see the AO web pages:

`http://www.gemini.edu/sciops/instruments/uhaos/uhaosPSFStars.html`

<u>OBSERVING PHOTOMETRIC STANDARDS</u>

1. qMon: change ObsID
2. Set qcdcom OBJECT

3. Close Hokupa'a WFS GS loops. This is to increase SNR, as the openloop image is very big. Integrate for exposure time: want ~20k counts. Never go below 1 sec exposure time and recommend not going shorter than 5 sec. Decrease Hokupa'a loop gain if necessary.

$$\begin{array}{l}(\ 0,\ 0)\\(-3,\ 3)\\(\ 3,\ 3)\\(\ 3,-3)\\(-3,-3)\end{array}$$

Here are information, cataloges, and a search engine for near-IR photometric standards:

`http://www.gemini.edu/sciops/instruments/niri/NIRIPhotStandards.html`

CALIBRATION FILES

1. qMon: change ObsID
2. Set qcdcom OBJECT
3. Take 5–7 images with lamps on, followed by 5–7 images with lamps off.
4. Want ~20,000 counts in lamps on images.
5. Recommend minimum exposure time of 5 sec.

5 Dithering with Hokupa'a

an example

Suppose one had a hypothetical case in which the AO guide star was located 15" north and 15" east of the science object. The way we observe with Hokupa'a is the SSA centers up the guide star on the Acquisition Camera hot spot, then uses instrument offsets to place it on the Hokupa'a hot spot, and then puts in the science fold pickoff mirror to send the image to Hokupa'a. At this point the AO guide star should be in the Hokupa'a wavefront sensor and the Hokupa'a operator can close loop and tune the AO system. In order to place the science target onto the Hokupa'a hot spot, the Hokupa'a operator must input the correct offsets. These offsets are given in mm and should be calculated by the observer as part of his/her preparations. All offsets given to the Hokupa'a operator must be in mm and should be absolute, not relative positions. At this time there is no way to enter a series of offsets into a script – all dithering is done manually by the Hokupa'a operator.

Before calculating offsets one has to consider the CASS rotator field orientation – the standard configuration for Hokupa'a/QUIRC observations has a value of "180" which is the orientation assumed throughout this example. For our hypothetical situation you would need an offset that is positive in x and positive in y. Since the plate scale is approximately 1.61"/mm, the offset to put the object in the Hokupa'a hotspot is +9.32 mm in x, and +9.32 mm in y.

The QUIRC FOV is 20", so once the offset has been applied your object would be in the hotspot (near the middle of the QUIRC FOV) and the AO guide star would be off the detector, to the right and up. The QUIRC spatial orientation has E/W flipped with respect to what astronomers consider to be the normal standard, so for QUIRC you have...

```
N
|
|
|-----E
```

The Hokupa'a acquisition field is NOT symmetric about the Hokupa'a hot spot, so one may have to rotate the CASS Rotator field orientation in order to guide very far off-axis (see section 2.9). Section 6 describes a simple sm macro which you can use to help you calculate dither positions when guiding off-axis. It also lets you visualize whether or not you need to rotate the CASS field orientation, and can even handle random field orientations. Note that field rotations are NOT correctly recorded in the images headers at this time, so careful observing notes are crucial.

6 Calculating Dither Patterns for Off-Axis Guide Stars

an sm macro

Before starting sm, there must be a configuration file (`.sm`) in your home directory. This shouldn't be necessary, but at this time there are some problems with the Gemini installation of sm. The quirc account is already configured, but if you are running sm from your guest account you must first do the following:

```
cp /usr/astro/smongo/sm2_4_6p1/lib/sm/.sm  ~/.sm
```

1. Login under the quirc account, and cd to the `sm` directory. If logged in remotely be sure to set the DISPLAY using the command `export DISPLAY=workstationname:0.0`
2. To start sm enter the command `/usr/astro/sm`.
3. After starting sm, load the hokupaa macro:
   `macro read "/home/kroth/sm/Hokupaa/Hokupaa.mac"` (the " marks are required)
4. To run the macro you need four input arguments:
   (a) R.A. separation (in arcsec) between target and AOGS. If the AOGS is West of the target then this should be a negative number.
   (b) Dec separation (in arcsec) between target and AOGS. If the AOGS is South of the target then this should be a negative number.
   (c) Size (in arcsec) of dither pattern to be calculated. For the medium dither pattern (3") I use 3.2 for this argument (gives nicer dithers).
   (d) User Specified "special" angle. This angle is in units of degrees West of North that the QUIRC field should rotate FROM the normal CASS 180 position.

   So, if your AOGS is 10" east and 12" south of your target and you want a 3.2" dither pattern and you want to calculate the dither pattern for a CASS 220 position (+40 degrees from the normal CASS 180 position) the sm command would be:

   hokupaa 10 -12 3.2 40
5. to save a postscript file use the command sequence:

   ```
   device colorport qq.ps
   hokupaa 10 -12 3.2 40
   device x11
   ```

   and your output will be saved in the file qq.ps.
6. to exit sm simply type: `quit`

The hokupaa macro plots the QUIRC FOV (magenta), the Hokupa'a hotspot (red - currently based on measurements made in February 2001), the Hokupa'a acquisition field (black - somewhat of an approximation), indicates North and East on the QUIRC image, indicates the position of the AOGS (black star) (the target is assumed to be on the Hokupa'a hot spot), and puts a small green box around the AOGS representing the dither pattern. So if your AOGS or your green box are near (or over) the edge of the acquisition field of view then you know you have a problem!

This schematic is given for the four standard CASS rotation positions, 180 (the normal), 270, 0, and 90. A fifth schematic is shown for a random CASS angle, which you give as input to the sm macro. The dither pattern (5 point, origin plus surrounding square) is calculated for this final schematic and printed. All input to the program is in arcsec, all axes and plots are in arcsec, but for convenience of the observer the dither pattern is given in mm (1.6 arcsec = 1 mm).

Figure 1 shows the output for an example of off-axis guiding. In this case the AO guide star is so far from the target that none of the standard CASS rotator orientations will alow for guiding with Hokupa'a. As you can see, guiding with Hokupa'a is possible in this case for only a very specific field orientation. The command that was used to generate this example was:

```
: hokupaa -10.1 -32.5 3.2 -30
```

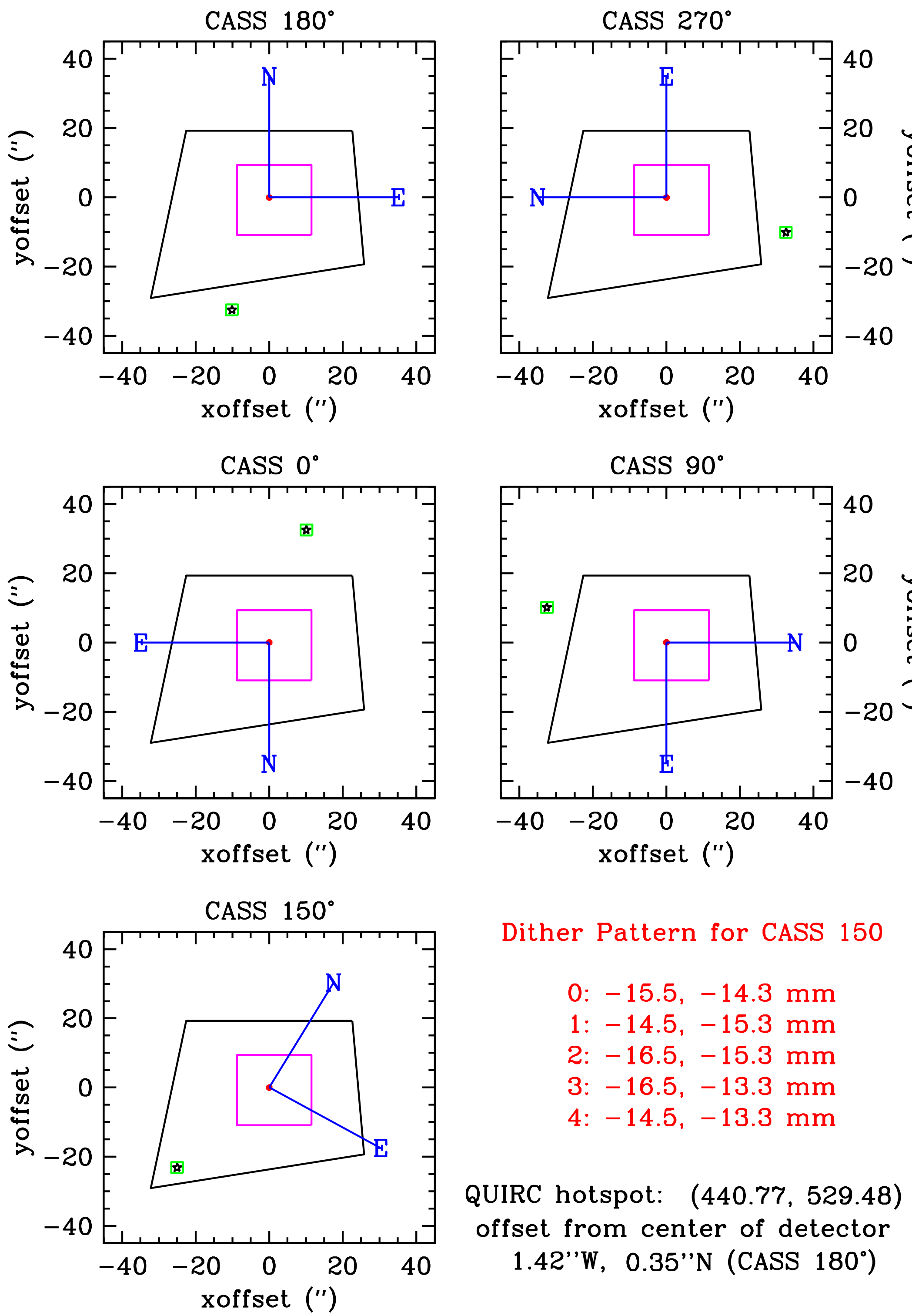

Figure 1: Example output from **hokupaa** sm macro for calculating dithers and offsets.

7 Summary of Common QUIRC/qcdcom Commands

a cheat sheet

qcdcom Command	Description
rlogin -l quirc quirc	Not technically a command within qcdcom, this command precedes the running of qcdcom. Note that all data taken with QUIRC/qcdcom should be taken while remotely logged into the quirc computer under the account name 'quirc'
qcdcom	starts up the qcdcom QUIRC data-taking software
df quirc	downloads the DSP code to the QUIRC camera
du util	loads the code performing filter wheel and pupil motions
cd /usr/quirc/2001feb20/A	set directory appropriately for the current UT date and A(or B) subdirectories if applicable
fp 01feb20_	set the file prefix appropriately for the current UT date
fn 1	set the running file number to 1 at the beginning of each night, do not reset when starting a second half-night
sync	check to see if communications with the QUIRC camera are in working order
status	list the current data-taking parameters
filter	list the possible (and current) filter positions
filter #	select filter position # to be the current filter
filter 14	select the LOWFLX crossed filter configuration for taking dark calibration frames
filter home	initialize (datum) the filter wheel, leaving the filter in position 1, the J filter
clear	clear the array
clear #	clear the array # times
dark 5 dark5	the preferred method for setting up to take dark frames. the 'dark' command specifically prevents the QUIRC shutter from opening. In this example the darks will have a 5-second integration time, and they will be called 'dark5'. Note that the LOWFLX filter should be selected and the instrument cover should be closed.
object 120 qso1234	setting up to take science data. In this example individual exposures will have a 120-second integration time, and they will be called 'qso1234'
go	take an exposure
go #	take a series of # exposures
et 25	change the exposure time, in this example to 25 seconds
name qso5678	change the object name, in this example to qso5678
quit	exit qcdcom
?	list of available qcdcom commands

8 Troubleshooting QUIRC Problems

8.1 Bringing QUIRC on-line

At the beginning of an observing run or following a power cycle of the QUIRC power supply it is not uncommon to encounter many difficulties establishing communications with the QUIRC camera. The following is a suggested protocol for establishing communications.

1. In the summit control room, login to the computer fama using the username `quirc`. If fama is not available or if one prefers you can alternatively use the computer callisto, but you must use the `quirc` account.

2. rlogin to the computer `quirc`. The quirc computer is physically located in the dome on a table next to the GIS rack.

   ******* This part may no longer be necessary ***** 01/30/01**
   - From the fama rlogin session to the computer quirc "rlogin manta" and then "rlogin quirc". This type of loop introduces slight delay from the network which seems to give more stable communications with the quirc computer. If manta is not available because communications with Hilo are down then you can use any summit computer for the rlogin loop. *****

3. Turn the power on to the QUIRC power supply (the big silver box usually mounted on the telescope near the QUIRC camera).

4. Turn the power on to the fiber box (the smaller silver box usually located on the same table as the quirc computer).

5. Back in the control room, in the quirc session type `qcdcom`, then `df quirc` and `du util`. More information on these commands can be found in the "Observer's Guide for QUIRC". Note that once the df quirc and du util commands have executed successfully (error free) they should NOT have to be re-issued after exiting and re-entering qcdcom unless either the QUIRC power supply or fiber control box have been power cycled.

6. If all of the above commands work with no errors you are ready to observe.

8.2 Establishing Communications with the QUIRC Camera

`*** Couldn't communicate with camera`

This is the usual error message when setting up for observing with QUIRC. There are (at least) three possible causes for this problem:

1. Electronic communications with QUIRC camera flaky. To solve this problem Andrew Pickles recommends pressing the red "reset" button located near the QUIRC camera on the telescope. After pressing the reset button type `sync` within qcdcom to see

if that has helped re-establish communications. This is often the problem and is by far the easiest to correct so try this several times before moving to another possible solution.

2. Corrupt code within the QUIRC computer loaded from the silver box with `du util`. One solution to this we have had success with in the past is to log completely out of the quirc computer, turn off the QUIRC power supply and fiber box, and reboot the quirc computer. This cleans out the corrupted code and allows for a clean `du util` upon startup, although I have found that the above procedure #1 may still need to be repeated a few times before communications are reliably established.

3. Fiber Optics need replacing. The optical fibers are very fragile and sometimes they need replacing. There are electronics for checking the fiber transmission (black boxes from SIECOR) and spare cables in the electronics lab on floor 2. When attaching or testing the fibers note that the fiber going into the silver fiber box marked "C" attaches to the "Receive" connection on QUIRC and the "D" attaches to "Transmit". "C" stands for communications (so the fiber box is transmitting) and "D" stands for data (so the fiber box is receiving).

Stamping about and swearing have not been convincingly proven to be effective yet are also commonly employed mechanisms to restore QUIRC communications. Other tactics which are often tried but have not been shown to be effective and do not have the Andrew Pickles seal of approval include:

- power cycling the QUIRC power supply and fiber control box
- repeatedly exiting and re-entering qcdcom
- playing the Hamster Dance (although this has a strangely soothing effect on Gemini astronomers)

Passwords for the quirc account and the quirc computer root account can be obtained from Gemini astronomers. To reboot the quirc computer login as root, and type `sync; sync; reboot`

8.3 QUIRC filter wheel positioning and reliability

QUIRC does not have absolute encoders on its filter wheels. The only position which is known reliably is "HOME". Other filter positions are not exactly repeatible and it sometimes happens that the filter position can be lost. One can usually tell which filter is in place from the number of counts in the background. However, to ensure accurate filter operation it is recommended that one HOME the filter wheel at least once per night. The HOME operation can sometimes take up to ~ 10 minutes to complete. For approximate sky counts in each filter see:

`http://www.gemini.edu/sciops/instruments/uhaos/uhaosQuirc.html`

9 Operation of qMon

Version 1.2 02/06/01 - Colin Aspin

9.1 Running Up qMon

qMon now requires an environment variable (QMON_HOME) to be set before it will run at all. The environment variable defines where the qMon software resides on disk. The environment variable is now set in the quirc and oscir .cshrc/.bashrc files so manual intervention should not be necessary. If you see the error:

```
QMON_HOME: Undefined variable
```

when trying to run qMon then the environment variable QMON_HOME is not set and you should do:

`% export QMON_HOME=/home/quirc/haku` from bash (quirc)

or

`% setenv QMON_HOME /home/quirc/haku` from csh/tcsh (oscir)

9.2 qMon and QUIRC/OSCIR

The qMon process defines both instrument (for Hokupa'a/QUIRC only) and telescope (TCS for both Hokupa'a/QUIRC and OSCIR) parameters in the FITS data image headers. These values are read through the Visitor Instrument Interface (the vii).

1. Set your DISPLAY to the machine you are sitting at before running qMon! (export DISPLAY=name:0.0 in bash, the default shell for quirc, setenv DISPLAY name:0.0 in csh/tcsh, the default shell for oscir).

2. To run qMon for QUIRC, login on quirc as username quirc and type

   ```
   qMon &
   ```

   To run qMon for OSCIR, login on manta as username oscir and type

   ```
   qMon &
   ```

3. From the small green window (sometimes behind the larger one!) connect to the vii server vii.hi.gemini.edu. Make sure the server is vii.hi.gemini.edu and NOT vii-sim.hi.gemini.edu!

4. Select Instrument from drop-down menu to be QUIRC for QUIRC or OSCIR for OSCIR. This selects the appropriate data directory in /net/archie/staging/quirc or /net/archie/staging/oscir for the current UT date.
   (e.g. /net/archie/staging/quirc/2001feb01/ for QUIRC).
5. Goto the 'File' drop-down menu and 'Start Copy to betty'. This makes an automatic copy of the updated data file on a computer at the HBF. The field on the qMon screen labeled 'Copying to Betty' will go from NO to YES. To stop copying to betty goto File and 'End Copy to Betty'.
6. Select whether the night is a full night for one observer or a split night for two observers. This is defined in the drop-down menu to the lower-right side of the qMon screen. Select "Not Split" for a full night of one observer, "Use A/" for the first half of a split night and "Use B/" for the second half of a split night. Data goes into sub-directories A/ and B/ for split nights.
7. Enter 'Observer's Names', 'SSA Name', 'Gemini Program ID' (format is GN-2001A-C-24 for Gemini program 24 in classical (C) mode in semester 2001A).
8. As you perform observations of targets within this program, enter the 'Observation ID' corresponding to the target being observed. The 'Data Label' is updated automatically from the running number defining each data FITS image. The Gemini Program ID, Observation ID and Data Label are used to fully identify each Gemini image. An example of an identification is: GN-2001A-C-24-12-037 where the Gemini Program ID is GN-2001A-C-24, the Observation ID is 12 and the Data label is 037. Note, Observation IDs should be changed by the observer every time the target or instrument setup (filter, exposure time) change.
9. Define the current 'Image Quality', 'Cloud Cover', 'Water Vapour' and Background values from the drop-down list of percentile values. The item "PI Requirements Met?" is not applicable for Classical runs. For Classical runs, leave the "Data Usable?" item at "USABLE".
10. Highlight the 'Monitor Data Directory' button at top-right, this enables the auto-update of the QUIRC/OSCIR images using the above user-defined parameters.
11. Goto item #8 above and update Observation ID and observing condition info as required.
12. Throughout the observing night and at the end of that (split?) night, occasionally goto the File menu and run the 'Copy Obslog to betty' option. This will copy all .txt files from the current data directory to the equivalent directory on betty. Note, observation logs should be written in the data directory (e.g. /net/archie/staging/quirc/2001feb06 or /net/archie/staging/oscir/2001feb06) and be called e.g. 2001feb06_obslog.txt.

Useful Tip: Every time a data file is updated with the qMon parameters, the currently defined setup (all parameters on the qMon screen) are saved to disk in a qMon.save file. If you have to exit qMon and re-enter it then goto the 'File' drop-down menu and select 'Load', this re-loads the last set of saved parameters!

9.3 If there are Problems...

9.3.1 qMon Errors

If you have an error from qMon, usually in the form of a pop-up error box, the best solution is to run down qMon (using the Quit/Exit entry in the File menu) and re-start it. You can re-load your latest parameters using the Load feature of the File menu.

9.3.2 Re-starting the vii

qMon requires both the TCS and VII software to be operational to run. If, when you run up qMon, the Local Time at the bottom right of the qMon screen is not updating then one of these is not running. If you get messages in the qMon window log area telling you that TCS parameters are Unknown or Unavailable, again, either the TCS or vii (or both) are not running.

If you need to start-re-start the vii:

1. telnet vii.hi.gemini.edu and login as gemvx
2. cd /gemini/vii/vii
3. use the command 'ps -adalf — grep -i ocs' to see if the vii server is already running. If it is you will see an ocswish.exe as one of the processes, e.g.

   ```
   lepus% ps -adalf | grep -i ocs
    8 S gemvx 29575 29567 0 40 20 ?  2088 ?  Jan 30 pts/22 4:37
   /gemini/ocs/ocs/bin/solaris/ocswish
   ```

4. If the server is running and you wish to kill it do so now with the command 'kill -9 pid' where pid is the process id number of the ocswish.exe process (pid = 29575 in the above example).
5. Start the vii server by typing `./vis &`
6. Log out of vii.hi.gemini.edu

10 qMon - Program IDs, Observation IDs, and Data Labels

adapted from the QuickStart Data Management Document v1.0, Inger Jorgensen

Each Gemini Science Program has a unique program ID. For classical observing the program IDs have the format, e.g. GN-2001A-C-24 for Gemini program 24 in classical (C) mode in semester 2001A. Each observation within a program should have an observation ID, e.g. GN-2001A-C-24-1 for the first observation for program 24. Each dataset (each FITS file) has a unique data label, e.g. GN-2001A-C-24-1-321 for FITS file number 321 obtained during the night, which in this case happens to be part of the first observation for program 24.

The definition of an observation is consistent with that employed during queue observations. A new observation begins whenever the telescope is pointed to a new target, or whenever the Filter is changed, or when the exposure time of a dataset (FITS file) is changed. The observation ID within qMon should be incremented every time a new observation begins. It is not considered a new observation every time the telescope is dithered or offset for sky observations. For flatfield observations, the lamps on and lamps off exposures for a single filter are considered part of the same observation.

Each classical observer should set the Gemini program ID for his or her program in the qMon window at the beginning of the run. In some cases this will be in the middle of the night. For those cases where the run extends over more than one night there should be no need to reset the program ID at the beginning of the next night unless the qMon program has to be restarted (see Section 9 for more information).

The data label is automatically generated using the file number recorded by the qcdcom data taking program on the quirc computer. This file number should be set = 1 using the `fn` command at the beginning of the night, and never changed until the beginning of the next night, when if should be set back to = 1. This means that for half nights the observer taking over in the middle of the night should change the Gemini Program ID within qMon, should change the Observation ID within qMon, but should *not* change the running file number within qcdcom.

11 The Gemini IRAF packages for QUIRC data

Gemini is in the process of developing data reduction software for use with observational data obtained with the Gemini Telescopes. The released version of the software is available to users and other interested parties as the Gemini IRAF package, an external package layered upon IRAF. More details concerning the Gemini IRAF packages, including retrieval and installation directions, can be found on the Gemini web pages at:

`http://www.gemini.edu/sciops/data/dataSoftware.html`

The Gemini IRAF packages are installed on all the Hilo Base Facility, Hale Pohaku and Mauna Kea Summit computers. Visiting observers are invited to use these packages to aid in their data reduction and data quality assessment during their stay on the Big Island. In the table below are listed tasks from the gemini package which are specifically designed or particularly useful for reduction and analysis of imaging data obtained with Hokupa'a/QUIRC. More information about the locally installed version of IRAF can be found by looking at the URL (NOT accessible from outside the gemini firewall):

`http://manta/inSci/data/irafHBF.html`

To reduce your data using IRAF please logon to a machine (or rlogin to a remote machine) using your visitor account. It is very important that all data reduction and analysis be done using this guest account and its associated data directories. **Do not write reduced data to the directory where the raw data are stored and do not use the "quirc" account for reducing data**. This is to preserve the integrity of your data and the data of your fellow observers!

To start IRAF and load packages:

1. Logon (or rlogin) using your visitor account
2. Change to your iraf directory:
   `> cd ~/iraf`
3. Start IRAF:
   `> cl`
4. Load the packages you will need:
   `cl> gemini`
   `cl> quirc`

To start an image display (e.g. `ximtool`):

1. If using a remote machine, allow "remote_machine" to display on your display machine by issuing on "display_machine" the command
   `> xhost +remote_machine`

2. On "remote_machine", set the DISPLAY environment variable:
   `> setenv DISPLAY display_machine:0.0`

3. Start the image display, on the remote machine if running IRAF on a remote machine:
   `> ximtool &`

Subpackage	Task Name	One Line Description
gemini.gemtools	gemhedit	Add header keyword, value and comment
	gemqa	Gemini data quality assessment
	gemseeing	Determine the image quality for imaging data
	imcoadd	Co-add direct images with removal of cosmic-ray-hits
	rgbcomb	Make color composite of direct images
gemini.quirc	qflat	Derive flat field for QUIRC images based on GCAL lamp exposures
	qfastsky	Derive sky image for QUIRC, median or min/max filtering
	qreduce	Reduce images from QUIRC (sky, flat)
	qsky	Derive sky image for QUIRC, includes flagging of objects
	quircinfo	Help for the quirc package

12 Preparing Object Lists

revised 09/11/01

We have found that ease of observing and efficiency are greatly improved if a formatted object list with J2000 coordinates is provided prior to the observing run. This object list is then transformed into telescope control code (TCC) that the SSA can access from the summit. We strongly urge all visiting observers to submit their formatted target/coordinate lists to the program Gemini Contact Scientist before they arrive in Hilo, do not try to do this after arriving at the telescope because we cannot insure the appropriate personnel will be available should there be problems!

Below is described a simple procedure for turning your target and AO guide star coordinates into TCC. This is based on a "quick 'n dirty" process initially thrown together for QuickStart operations and for now is serving as a surrogate Phase II for the visiting instrument Hokupa'a+QUIRC. While not specifically designed for use with OSCIR (there is not an AO guide star (OIWFS) when observing with OSCIR) the same scripts could be used for OSCIR or other visiting instrument observations.

12.1 Instructions for Observers

in original form 02/2001 - Simon Chan

Below is an example target list. The first line demonstrates the case where peripheral wavefront sensor guide stars have already been selected. If peripheral wavefront sensor guide stars have not been selected please use the format given in the second or third lines.

Each target list consists of 12 columns. **Gemini_Program_ID** for classical observers is, eg., GN-2001B-C-50. If you don't remember your Gemini program ID you can find it by looking at the online classical observing schedule, eg.

`http://www.gemini.edu/sciops/schedules/schedClassicalNorth2001B.html`

Target_Name refers to your science target. **Target_RA** and **Target_DEC must** be in J2000. **AO_GS_Name** is the name of your AO guide star (on-instrument wavefront sensor star OIWFS) which may or may not be the same as your science target. **AO_GS_RA** and **AO_GS_DEC** (also J2000 coordinates) are the coordinates of your AO guide star (which is also the science target in the case where one is guiding on-axis). **AO_GS_Mag** is the magnitude of your OIWFS. **PWFS_GS_Name** is the name of the peripheral wavefront sensor star, and **PWFS_RA**, **PWFS_DEC**, and **PWFS_MAG** are for this guide star. If you haven't selected peripheral guide stars then just replace the PWFS fields with the string ##### as shown in the examples below. Please avoid spaces in your target list - **there can be no blanks in the target or guide star names and the coordinates must be delimited with ":"s as in the examples below. Each entry must be separated by the following entry by exactly one Tab character.** Please terminate each line with a carriage return. Do not include the line beginning with a #. Template files are generated from your Phase I proposal and will be provided to you prior to your observing run by your Gemini contact scientist. Please verify all coordinates in the template file, add any additional targets and return the template file to your contact scientist prior to your observing run. Note that the first line of the example illustrates the case where you are guiding off-axis (target and AO Guide Star have different coordinates), and the second illustrates guiding on-axis with Hokupa'a. This is unrelated to the selection (or lack thereof) of peripheral wavefront stars.

```
#Gemini_Program_ID   Target_Name   Target_RA     Target_Dec    AO_GS_Name     AO_GS_RA     AO_GS_DEC
AO_GS_Mag            PWFS_Name     PWFS_RA       PWFS_DEC      PWFS_MAG

GN-2001B-C-50        SCIENCE1      10:00:00.0    +20:00:00.0   AOGS1/OIWFS1   10:00:00.0   +20:00:15.0
R=13.0               PWFS_STAR1    10:00:00.0    20:05:00.0    10_mag

GN-2001B-C-50        SCIENCE2      15:00:00.0    +10:00:00.0   AOGS2/OIWFS2   15:00:00.0   +10:00:00.0
R=14.0               #####         #####         #####         #####

GN-2001B-C-50        SCIENCE3      20:00:00.0    +00:00:00.0   AOGS3/OIWFS3   20:00:00.0   +00:00:00.0
R=15.0               #####
```

12.2 Instructions for Contact Scientists

in original form 02/2001 - Brian Walls & Simon Chan

The directory structure for the Gemini North 2001B classical proposals is as follows:

`/usr/astro/2001BclassNorth/GN-2001B-C-*/`

where * is 1 – 24.

Within these subdirectories live the original `.xml` file, the `.html` summary generated from the `.xml` file and various attachments associated with the proposal. In addition to these files are various files generated from Simon's Perl script, eg.

```
GN-2001B-C-10.tcc
GN-2001B-C-10.txt
GN-2001B-C-10.tmp
```

The `.tcc` file has been generated from the initial proposal. If an updated list of targets is provided by the PI then a new `.tcc` file can be generated. (see 12.2.1).

The `.tmp` file is the simplest target list with only 6 columns: Gemini Program ID, object name, object RA, object Dec, AO guide star RA and AO guide star Dec. Note that in some cases the target and AO guide star coordinates are the same. This file is in the format originally used in QuickStart operations, and still file can still be used to find Peripheral Wavefront Sensor stars (see 12.2.2).

The `.txt` file is a more complex target list which is what can be used to actually create the `.tcc` file. The `.txt` file has 12 columns: Gemini Program ID, object name, object RA, object Dec, AO guide star name, AO guide star RA, AO guide star Dec, AO guide star magnitude, PWFS guide star name, PWFS guide star RA, PWFS guide star Dec, and PWFS guide star magnitude.

Please have your PIs verify the coordinates in the `.txt` file (at least for the object and AO guide star). Also if they have any additions to make to their list of targets they will need to add these lines to their `.txt` file. Please stress that your PI follow strictly the file format, specifically:

- There should be no spaces in any of the entries.
- There is exactly one tab separating each entry (even if that means the columns do not line up as nicely as they do in the previous example).
- The colons (:) delimiting coordinate fields are necessary.

Your observer should fill in and send back to you one of the two template files, preferably the `.txt` file. Please ensure the observer provides J2000 coordinates.

12.2.1 To create the new TCC file (hktxt2tcc.pl)

Let's say the original txt file is GN-2001B-C-20.txt, then the original TCC file is called GN-2001B-C-20.tcc, they both live in the directory `/usr/astro/2001BclassNorth/GN-2001B-C-20`.

After the PI has updated the `.txt` file (eg. updated.txt) and emailed it to you then do the following:

1. Copy the new file across to the proposal directory
`cp updated.txt /usr/astro/2001BclassNorth/GN-2001B-C-20/GN-2001B-C-20a.txt`
2. Change directory to the proposal directory
`cd /usr/astro/2001BclassNorth/GN-2001B-C-20`
3. Generate the new TCC file
`/usr/astro/utils/hktxt2tcc.pl GN-2001B-C-20a.txt`

This will create a new tcc file called GN-2001B-C-20a.tcc

12.2.2 Original procedure useful for finding PWFS guide stars

If your PI has not found PWFS guide stars for his objects yet it becomes necessary to guide with P2 (eg. too much wind shake) you can use the original procedures developed by Brian and Simon to automatically find PWFS guide stars and put those into a `.tcc` file. Note that this procedure may not be supported in the future.

1. In the appropriate directory for your program make a copy of the `.txt` file generated by Simon's scripts (or of the updated version provided to you by your PI) and name it `targets.txt`.

2. In the directory `/usr/astro/2000QSprops` there is a file called `GuideStarSearch-ONE.csh`. Edit this file to set the directory pathname appropriately, eg.

   ```
   set files = /usr/astro/2001BclassNorth/GN-2001B-C-20
   ```

3. type "`GuideStarSearch-ONE.csh`" which writes two files in the specified directory called `Guidestars.all` and `Guidestars.best`. The first contains all the peripheral wavefront sensor stars found for each target, and second file contains only the best (brightest, yet appropriately far away) guidestar from the total list for each target. We do not use the `Guidestars.all` file in normal operations, it merely serves to contain backup information in case the selected guidestar turns out to be bad.

4. There is a Perl script in /gemini/files/2001A called `guidestarsbest.pl` that you will use to convert the Guidestars.best file into TCC. This directory is not visible from all machines, but it is visible from `draco` (or any other summit or HBF control room computer). Therefore, once you have generated the Guidestars.best file for your program, say for example GN-2001B-C-20, you would do the following:

   ```
   rlogin draco
   cd /usr/astro/2001BclassNorth/GN-2001B-C-20
   ls -l /usr/astro/2001BclassNorth/GN-2001B-C-20/Guidestars.best | /gemini/files/2001A/guidestarsbest.pl
   ```

   and now there will be a TCC file called

   ```
   /usr/astro/2001BclassNorth/GN-2001B-C-20/GN-2001B-C-20
   ```

   which the SSA will be able to access at the summit.

13 Observing Logs

Gemini is committed to providing access to all scientific data to the entire astronomical community through the Gemini archive. All data will become public after an initial proprietary period of 18 months. It is essential that classical observers maintain an observing log which will assist in the proper use of data retrieved from this archive as well as assisting the observer in their own data reduction and analysis.

We request that all observers keep an electronic (ASCII) observing log. An example template form can be found in `/home/quirc/hokupaalog_example.txt` and a blank form in `/home/quirc/hokupaalog_temp.txt`. At the beginning of each night (or half-night for split observing nights) this temp file should be copied to the appropriate data directory and renamed eg. `2001feb28_obslog.txt`. This log not only serves as a backup source of information in case the image header updates are incorrect (if for example you forgot to update the name field in QUIRC), but more importantly it should contain several items which are not input into the data headers, for example the current weather conditions.

The template columns and comment items which are especially important to note include:

- Weather information: Please note down the weather conditions at the beginning, middle and end of the night. If you notice the weather changes, eg. goes from photometric to non-photometric because you notice the counts in the Hokupa'a wavefront sensor are varying, please make a note in the Comments column.
- ProgramID and ObsID correspond to your Gemini program ID (eg. GN-2001A-C-30) and the ObsID is the running number you are changing in qMon each time you switch object, filter or exposure time.
- UT slew refers to the time at which you first start moving to a new target. This field is useful to us for calculating observing efficency.
- Data labels are the incremental numbers assigned to each file by QUIRC. These are also reflected in the qMon window.
- Target is your object name.
- Filter is the current QUIRC filter.
- Exptime/Frame is the exposure time per frame. Feel free to put multiple exposures that all have the same characteristics on one line.
- Dither HKxoff HKyoff are the dither positions in mm that you request from the Hokupa'a operator. Remember, these are opposite in sign from dithers that you request for the Gemini SSA when doing unguided sky offsets for example, and are also opposite in sign from the XOFFSET and YOFFSET fits header keywords that will appear in the image.

- Comments are probably the most useful for everyone, since they provide information that will not be included in the header. Two items that we especially request that observers include in the Comments column are:
  - Non-standard CASS rotator field orientations or states. The standard is to have the CASS rotator "following" (which means your field does not rotate as you are tracking across the sky) with a field orientation of $+180°$. If you either adjust the field orientation or turn off the CASS rotator (or both) you MUST make a note of it because this information is NOT included in the fits image header.
  - We request each observer take a minute to note in the comments the number of counts in the Hokupa'a wavefront sensor for each object. This should be the open-loop counts after the guide star has been centered up in the wavefront sensor. This information will be invaluable to us for compiling a database of PSF stars, and the observer can monitor this number as a good check for clouds.

Please be sure to save your file occasionally, and also to click on the "Copy Obslog to betty" button in the qMon window to save an extra copy of your observing log several times during the night and especially at the end after you have finished taking data. A copy of this observing log will be included on your data CDs as well as in the data archive.

14 Retrieving Your Data

Because of the firewall and potential load on the internet, it is not possible to allow observers to ftp into Gemini computers once they have returned to their home institutions and retrieve their data. Eventually we will have DAT and Exabyte tape drives available for the observers' use at both the summit of Mauna Kea and the Hale Pohaku 9000ft station. These devices may not be available in the early days of classical observing.

Gemini will provide to all classical observers one or more CDs containing all the data from their run. These will be available for pickup at the front desk of the Gemini Hilo Base Facility at 2pm the day following the end of their observing run. Should this day happen to fall on a weekend or holiday, check with your contact scientist to see if this service will be available and to make arrangements to pick up your CD if it will be ready. If the data CD is not ready by the time you leave the Big Island (either because of early departure, unavailability of data packers on weekends/holidays or other unforeseen problems), your CD will be mailed to you. For Gemini Program Office mini-queue observing, all the data will be recorded onto CDs, and it is the responsibility of the Program Office to distribute the data from the CDs among the individual program PIs.

To preserve the confidentiality of your data, all data obtained during classical observing will be deleted from the /net/archie/staging/quirc disks the day after the run has been completed. Copies of all data exist on other disks at the Hilo Base Facility and backups of all data will be performed on a daily basis. All Gemini data obtained during classical observing programs (including all calibrations – dark frames, flat fields, and standard stars) are considered proprietary. Each observer is responsible of obtaining his or her own calibrations and standard star observations and these must be done within the time allotted for those instances of shared nights. It is up to the Gemini Program Offices to decide how to handle calibration data obtained during the mini-queue observing. The normal Gemini policy states that all data will become publically available to the astronomical community through the Gemini archive after a period of 18 months.

15 Publications Acknowledgement

Taken from the UH/Ifa/Gemini Memorandum of Understanding – 02/05/2001

Papers containing data from the Gemini telescopes should include the following general acknowledgment (`http://www.gemini.edu/sciops/ObsProcess/defAcknowledgement.html`):

> 'Based on observations obtained at the Gemini Observatory, which is operated by the Association of Universities for Research in Astronomy, Inc., under a cooperative agreement with the NSF on behalf of the Gemini partnership: the National Science Foundation (United States), the Particle Physics and Astronomy Research Council (United Kingdom), the National Research Council (Canada), CONICYT (Chile), the Australian Research Council (Australia), CNPq (Brazil) and CONICET (Argentina).'

All classical users of Gemini with Hokupa'a/Quirc should be aware that in addition to the standard Gemini acknowledgement above, "all publications resulting from data obtained with Hokupa'a should include the following acknowledgement:

> 'This paper is based on observations obtained with the Adaptive Optics System Hokupa'a/Quirc, developed and operated by the University of Hawaii Adaptive Optics Group, with support from the National Science Foundation.'

In addition, the first mention of Hokupa'a in the paper should reference the paper 'Graves, J.E., Northcott, M.J., Roddier, F.J., Roddier, C.A., & Close, L.M. 1998, Proc. S.P.I.E., 3353, 34.' Press releases and images from Hokupa'a placed on the Web should have versions of the above acknowledgement, appropriately modified, but retaining the same substance."