IRSF OBSERVING MANUAL

by

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Main Changes from the March 2002 version: dry air system, DVD backup (based on Chie Nagashima Manual on 2002.6.1), computer info, telescope setup first part → SIRIUS part cold shutter again, etc.

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Chapter 1

General

1.1 Introduction

To use the IRSF you will need to understand:

- Planning for observations
- How to use the telescope
- How to use the SIRIUS Camera
- How to reduce the data

1.2 Planning for observations

The absolute telescope setting is reliable to 15 arcsec when recently tuned; it can be trusted to about 1 arcmin otherwise. There is no need to guide exposures. The pointing while offsetting is good to a few arcsec. The field is 7.7×7.7 arcmin^2 and the scale is 0.45 arcsec per pixel.

A normal observation consists of a number n of exposures, starting at the nominal position and followed by n-1 exposures centred on positions which are equally spaced around a circle with radius equal to the "dither radius" in arcsec. This is to overcome effects due to individual bad pixels. During the pipeline processing, the n images are re-centered and combined to form a single image. The effective exposure time is thus increased by a factor equal to the number of dithers.

Table 1 shows typical limiting magnitudes for various exposure times. For deeper (30s) exposures in uncrowded fields more exact figures are as follows: 30 s exposure, 10 dithers, 3 sets J=19.2, H=18.6 and K=17.3 (10 sigma)

Note that the limiting magnitude goes according to the square root of the exposure time.

Table 1.1: Approximate exposure times and limiting magnitudes for 10 dithers:

Time	K_{min}	K_{max}
0.1s	K=6	K=11
5s	K=10	K=15
30s	K=13	K=16

Note: H_{max} is about 1 mag fainter; J_{max} about 2 mags fainter.

Time actually used:
Typically an exposure has 10 dithers; each dither motion takes about 20 sec; so time taken is 10 $\times$ (20 sec + max(exposure time, 5sec)).

1.2.1 Sky frames

These can be made in several different ways:

- Actual observation of blank or nearly blank sky: Sky frames should normally be taken between exposures and are necessary for crowded fields. They should be done with the same exposure times and number of dithers as the object frames.
- Self sky: In a single observation of a point-like object in a fairly empty field the individual dithered images can be used to make an empty sky. by median averaging.
- By combination of object frames: In a survey one can median average a number of survey frames if the object density is not very high.

1.2.2 Standards

Carter/Meadows standards, which are about 8 mag typically, can be used with 0.1s exposures, but Persson et al (AJ 116, 2475, 1998) are more suitable for longer exposures.

1.2.3 Typical Observing schedule

A typical observing schedule might be:

- Open telescope
- Take twilight sky frames for flat field
- Take dark frames
- Focus and do standard
- Typical object:

  - Do sky
  - Do object
  - Do sky

- Do standard - every hour or two
- Take dark frames
- twilight sky frames
- Close

Bring DVD-R disks (or DDS2 tapes) - see Miscellaneous notes at end.

1.3 Computers in the control room

- **mouko** (192.168.100.4; Linux) - operates the telescope; connected to the telescope rack.
- **SiriusB** work station (192.168.100.2; Sun OS) - operates camera.
- **bosanova** (192.168.100.3; Sun OS) - data reduction work station with disk stack 480 GB.
- **irsf** (192.168.100.1; Linux) - is the gateway computer - only this has an address on the SAAO net (192.168.2.230).
- **mayumi7** (192.168.100.5; Windows and Linux) - can be used for general purposes.
- **dassie** (192.168.100.7; Linux) - is for DVD-R backup. Has a 2GHz CPU, and can be used for data reduction with the bosanova disk stack.
- **bok** (192.168.100.8; Linux) - is for data reduction (2GHz CPU).

The EPSON laser printer (192.168.100.6) needs a special driver and can only be used from Linux machines and Windows machines having an appropriate printer driver.

The Canon ink jet color printer can be used with a USB cable.

1.4 IRSF Telescope Setup Manual

- **In the dome,**

  0a) make sure the elevation is locked

  0b) open the louvres

  0c) turn the mirror fans on with the white switch in the southwestern corner above the mirror cell.

0d) turn the dry air system on with the outlet switch on the north wall. The small iron ball in the cylinder is up 1.5 digit, and perhaps a red light comes on.

- **In the control room,**

1) switch ON the Telescope Motor Drive in the lower panel of the rack

2) go to the dome and unlock the elevation drive

3) switch ON the Dome Controller in the middle panel of the rack
(you can now use the hand-set, only for dome movements: ±X, Up, Dn)

4) switch ON the Telescope Controller in the upper panel of the rack
(you can now use the hand-set)

5) check the status of the Telescope Controller
Turn the monitor switch to B (you are now watching the internal telescope controller computer which runs DOS) and wait until the controller computer is up. The last line prints the error message, so it should be "NONE". (If you have an error, press MODE SELECT on the handset once to get manual mode and again to return to AUTO.)

6) run 2 programmes:
Turn the monitor switch to A (you are now watching the host computer (`mouko`) which runs Linux),
Log into `mouko` as user `obs` with the same password of user `observe` on `SiriusB`
`cd ~/telescope` (CR)
`startx` (CR)
Click the lowest of the three boxes in the upper right corner to open a kterm (Japanese kana xterm) window.
`startIRSF` (CR)
This will 1) override the default 10-minute screensaver timeout, 2) display the humidity and temperature graphs, and 3) open two kterm windows. **(usually done already)**

6a) in the landscape-shape window,
`telescope` (CR) [monitors telescope status] (you will see a stream of numbers)

6b) in the other (portrait) window,
`client` (CR) [telescope control software]

7) search for the zero of the encoders of Azimuth, Alt and Image Rotator, using the menu of the software client:
`3: Zero Search`
then check if the last 4 digit of the stream of the number on the `telescope`'s window turn from `8xx6` to `8xx3`
(when the telescope drive works, the last digit will be 7)

- **On SiriusB,** in the `gogo_sirius` window,

8) open the dome shutters
Click `Move` → `Dome` → `Open`

9) open the mirror cover
Click `Move` → `Mirror Cover` → `Open`
(if the telescope elevation is less than 80 deg, the cover will not open)
(In the very unlikely case the cover does not open or close properly, you will hear the noise the two chains make forever. You can just go up and lift the chain from the motor gear, and move the chain manually.)

1.5 Start SIRIUS

see SIRIUS manual

1.6 Data Reduction

see Data Reduction manual (written by Nakajima)
See http://www.z.phys.nagoya-u.ac.jp/~nakajima/pipeline/pipeline2-e.html for current version of this manual.. The pipeline usually requires a lot of manual input. It can also be run on canopus.

1.6.1 Outline

In the reduction process the following steps are made:
Generation of the file *obslog*, which contains every individual exposure, its file number, object name, integration time, RA offset, Dec offset and airmass.
After correction of errors on *obslog*, dark and flat field corrections are applied.
Then sky fields are generated (as specified) and subtracted from each object frame. The file objectlist3 associates each object with the appropriate sky.
The dithered exposures are then combined into one image for each field. This is the final product. The final images are somewhat larger than 1024×1024 pixels because of the dithering. The data are in single-precision floating point.

Most of the original fits header information is no longer present, except for the standard star frames (which are left as individuals and are not undithered). Note: The sky fields can be individual or averaged ones, according to choice. The processes involved in reducing a night's data can take more than a day of work.

1.7 Ending observations

- **On SiriusB**, in the menu of `gogo_sirius`,

  1) move telescope to Zenith
  Click `Move` → `Zenith`

  2) close mirror cover
  Click `Move` → `Mirror Cover` → `Close`

  3) close dome shutter
  Click `Move` → `Dome` → `Close`

- **Before** the next procedure,

  4) end the `SiriusB` programme `telmon`.

- **On mouko,**

  5) end the software `client`
  In the menu of the software `client`
  `0: End (all)` (the `telescope` software also ends at the same time)

- **Rack switches etc**

  6) switch OFF the Telescope Controller in the upper panel of the rack (if it will not switch off, switch OFF the rear switch and then ON)

  7) switch OFF the Dome Controller in the middle panel of the rack

  8) go to the dome, lock the telescope

  9) switch OFF the Motor Drive in the lower panel of the rack

  10) go to the dome, close the louvres, and turn the primary mirror fans OFF

Chapter 2

SIRIUS Manual

2.1 Starting SIRIUS

- **0.** In the dome, switch on the two top and the two bottom switches on the 6-socket distribution board attached to SIRIUS (under the telescope) **(usually done already)**

- **1.** Log into SiriusB as user `observe` **(usually done already)**
  Click `Options` → `Command Line Login` (CR)
  `observe` (CR)
  `password` (CR)
  `xinit` (CR)
  You are now in the qvwm window system, and have three windows: ximtool, xterm (behind ximtool), and xgterm. You can opt for the CDE window system also.
  You should be in `/export/home2/observe`.

- **2.** MESSIA IV (Multi-purpose array controller) setup
  Go into the xterm window.
  `> cd ~/sirius/IRSF` (CR)
  `> ./messia` (CR)
  Minimize the resultant SIRIUS GUI CONTROL window because it does not do anything in the current version. In the xterm window, type (CR) once more and get prompt `SIRIUS>`.

  Proceed to the step 4-2 if you did not turn MACS off on the previous night. (Usual.)
  If you did turn MACS off on the previous night,
  `SIRIUS> Init` (CR)
  You may sometimes get an initialization error. Try again (and again).

- **3.** MACS (Multi-array control system) setup
  Currently two people are needed for this procedure, one in front of SiriusB and the other in the dome.

Type the commands below on SiriusB

`SIRIUS> PON` (CR) (capital letters)

The lower KENWOOD power supply attached to the SIRIUS instrument should read 2.1-2.4 on the upper indicator. If this is not the case, and it reads close to 3.0, the power should be switched off immediately by typing the following command:

`SIRIUS> POFF` (CR)

If this happens, repeat the procedure until the reading is in the range 2.1-2.4 ("3.0" is the electric current limit, and it indicates the limit has been reached, and with the protection mechanism the output is off. In the case of "2.1-2.4", the output indicator in the lower right corner should be lit red.)

- **4-1.** Apply necessary voltages to the detectors, and move Warm Shutter to zero.
  `SIRIUS> sirius_setup` (CR)
  `SIRIUS> ws z` (CR)
  Setup is done. Proceed to Step 5.

- **4-2.** Initialize Warm Shutter etc by

  ```
  SIRIUS> RESTART (CR)    Messia4 CIC.
  CPRAM 0x4155 double word loaded.
  Usage: load_parm ([file])
  Warm Shutter Init
  ```

- **5.** change the DATE, PATH, and COUNT number in the file `count.txt`.
  `SIRIUS> dirset 030831 1` (CR)
  This will create the directory `d020731` in `/export/home/data/raw/`.
  Make the final argument "2" when you create in `/export/home2/data/raw/`.
  This is equivalent to the operations below:

```
> pwd  (CR)
> /export/home/observe/sirius/IRSF/
> vi count.txt  (CR)
  1 DATE 020731
  2 PATH /export/home/data/raw/d020731
  3 COUNT 1
> mkdir /export/home/data/raw/d020731
```

`COUNT` is usually `1`, and it is the file number that should be written next.
`PATH` is usually like `/export/home/data/raw/d020731`, and the last numbers are the `DATE` in `yymmdd`.
The last line creates a new directory according to the `PATH` above.

The "messia" program increases `COUNT` by updating the `count.txt` file, every time DL or Lo is done. (If you really wants to overwrite the file, then all you have to do is to decrease this number.) (If you make `COUNT` 1 and do NOT change the directory `PATH`, then you will store the data in the previous night directory and lose the data taken during the previous day).
In this case,
`/export/home/data/raw/d020731/j020731_0001.fits`, `h020731_0001.fits`, and `k020731_0001.fits` will be written next.

For the time being, only vi and xedit are available.

- **6.** Image display preparation
  In the **xgterm** window,
  `cd /export/home2/observe` (CR)
  `cl` (CR) to start IRAF. Then,
  `cl>` `imexam` (CR)
  (usually done already)
  Imexam sometimes dies, then you can simply repeat `imexam` (CR).

- **7.** Taking a test image:
  `SIRIUS> TL 6 5` (CR) [Do twice]
  (If you do not wish communication with the telescope,
  `SIRIUS> TL 16 5` (CR) [Do twice])

  After about 30 secs you will see image after image in the ximtool window. Use box icon and click "tile frames", then "done". You will see images from all 3 bands in ximtool, N always at top, E at left.

  Check points: A 5-sec integration brings you
  1) 50 – 80 counts at J, -10 – 20 at H, -80 – 0 at Ks when the cold shutter is closed.
  2) 50 – 80 counts at J, about 100 at H, about 3000 at Ks (depending on the room temperature) when the cold shutter is open and the detector looks at the (warm mirror cover).
  3) about 200 counts at J, about 1200 at H (depending on OH airglow), about 1000 at Ks (depending on the sky temperature) when looking at the night sky.

- **8.** After setting up telescope, open another xterm window,

```
> cd ~/sirius/IRSF
> ./telmon & (CR)
```
(IRSF monitor window - displays coordinates, etc)
If "gogo_sirius" is not running yet,
```
> ./gogo_sirius & (CR)
```
(window for movement commands to telescope)

- **9.** Open cold shutter

  Manual cold shutter operation is necessary. The shutter should be kept open in usual observations, and should be closed for dark frames. A small handle on SIRIUS is on the right of the gray counter weight. When closed, an orange LED is lit. MESSIA circuits are in the left of the gray counterweight. From the bottom, 1) VMI board, 2) CIC board, and then 3) this shutter board with LEDs. First, Pull the handle and engage the gears. The handle should be rotated about nine turns (or about 18 half-turns) counterclockwise to open the manual cold shutter. When open, a green LED is lit. Push the handle and disengage the gears (to disconnect the thermal flow). Clockwise 18 half-turns will close the shutter, and an orange LED will be lit. (If turned more, a red LED will be lit, but do not try this.) In both operations, as soon as the LED comes, stop rotating the handle.

2.2 Exposure types

- There are currently 3 exposure types available in SIRIUS,
  `TLongEX`=`TL`: test exposure
  `LongEX`=`Lo`: long exposure without moving telescope (for dark, flat etc.)
  `DLongEX`=`DL`: long exposure with dithering

  `TL` (CR), `Lo` (CR), and `DL` (CR) are used as follows:
  ```
  TL mode exposure.time [object.name] [no.of.exposures]
  Lo mode exposure.time [object.name] [no.of.exposures]
  DL mode exposure.time  object.name [dithering.mode] [dithering.radius]
  [dithering.start.position]
  ```

  The argument with `[ ]` can be omitted, with the default values of
  obj.name=`TEST`,
  no.of.exp=`1`,
  dithering.mode=`9`,
  dithering.radius=`10`,
  dithering.start.positon=`1`.
  Note, however, dithering radius of 20 is recommended.
  `TL` creates temporary `j.fits, h.fits, k.fits` files in the current directory while `Lo` and `DL` create serial fits files in the directory assigned by `count.txt`

- **1.** Common arguments

mode
`6` : expose with 1 dummy reads first
`8` : expose with 1 dummy reads first and warm shutter movement
`16` : expose with 1 dummy reads first (for dark, without any communication to the telescope)
`18` : expose with 1 dummy reads first and warm shutter movement (for dark, without any communication to the telescope)
USE 6 and 16 FOR NORMAL OBSERVATIONS, and 8 and 18 FOR BRIGHT OBJECTS
exposure.time in unit of sec. (you must take the corresponding dark frame)
With 8 and 18, exptime is either 1sec or 0.1 sec.
object.name will be written in FITS header

- **2.** Specific arguments

  dithering mode
  `1` : 9 positions, centre + 8 positions E, NE, N, NW, W, SW, S, SE offset by 120 secs each in ra and dec from the centre
  `N` : N positions, centre + equi-spaced (N-1) points on the circle defined by the dithering radius (N= 5, 7, 9, 10) (mode 1 is for standard stars)
  dithering.radius is in units of arcsec
  dithering.start.position in case you want to start the next position after having interupted the previous exposure.

  Note: The dithering takes place in a circle and the **dithering.mode** can be 5, 7, 9 or 10 depending on the number of positions desired. The first exposure is at the centre of the circle. The **start.position** is only used when re-commencing an observation after an interruption.

2.3 Command examples

- **1.** Taking dark frame

  noindent First, close the cold shutter:

  Mode 16 might be more convenient than mode 6 because you can continue to take dark frames after shutting down the telescope.

  examples:

  `SIRIUS> source dark/dark5102030.tclsh` (CR) [This particular script takes 10 images of 5, 10, 20 and 30 secs each with mode 16.]

  `SIRIUS> Lo 16 5 DARK 10` (CR) [This command takes 10 images of 5 secs each with mode 16.]

  After taking dark frames,
  `SIRIUS> s_open` (CR)

- **2a.** Taking sky flat

On gogo_sirius, load a list containing appropriate objects.

Move telescope to appropriate position. (Morning twilight flat is probably better because in the evening the arrays are highly saturated first and then the light level gradually decreases.)

example:

Choose `twflat0230-3500` from `~observe/objlist/twflat.dat`

```
SIRIUS> Lo 6 5 twflat 30
```

In the evening, Start before when the K counts become 5000 (this probably happens in 15 minutes after the sunset - for the sunset and sunrise time, refer to "Almanac for Sutherland"). The H counts go down to 5000 in 19 min, J in 20 min. K goes down to 2000 in 21 min, H in 23 min, J in 24 min, and the exposures should be stopped in 25 min or so.

- **2b.** Taking dome flat

  Move telescope to point at screen. Connect dome flat lamps to Variac-type adjustable transformer. Do exposures with lamp on and with lamp off. The transformer setting should be close to the taped arrows. Some trials with test exposures are advised (TL etc). An ideal level with the lamp on is a count of ... as measured from the screen on SiriusB. It will be found that the J flats take longer than the K due to the low temperature of the bulbs.

  example:

  ```
  SIRIUS> Lo 6 5 on 30
  SIRIUS> Lo 6 5 off 30
  ```

- **3.** Observation of standards

  After reaching the required position, do a test exposure to get j.fits, h.fits and k.fits, in the current directory.

  ```
  SIRIUS> TL 6 5
  ```

  Check the images with IRAF task imexam and change focus on gogo_sirius if necessary. Also, determine the exposure time considering the ADU count of the star(s) especially in the K band. Saturation will occur if the count exceed ∼16000. then, example:

  `SIRIUS> DL 6 10 p9106std 1` [typical command for standard stars]

- **4.** Observation of objects

  After reaching the required position, do a test exposure to get j.fits, h.fits and k.fits, in the current directory.

  ```
  SIRIUS> TL 6 5
  ```

  Determine the exposure time considering the ADU count of the star(s) especially in the K band. Saturation will occur if the count exceed ∼16000. then, for example:

  `SIRIUS> DL 6 30 NGC2001 10 20` [typical command for deep survey]

2.4 Other messia commands (from SIRIUS¿ prompt)

- **0.** Cancelling observations (expsures)

  On the window which run SIRIUS program,

  `Ctrl-C`

  You will get normal unix prompt, then, type

  `> ./messia`
  (CR) (type return key once more and get prompt `SIRIUS>`)
  `SIRIUS> RESTART` (CR)
  `SIRIUS> TL 6 5` (CR)

  If you want to erase unnecessary fits files, edit `count.txt` to change the value of `COUNT` before the next exposure.

- **1.** Command List

  When you get `SIRIUS>`, ?(CR) will give you the command list.

  `dirset ---> dirset [date] [1 or 2]` creates the directory "dplus date" in `/export/home/data/raw/` when the last argument is 1, and in `/export/home2/data/raw/` when the last argument is 2. Also renew the file `count.txt`. (makes `COUNT` 1.) Shows the free disk space.
  `cdltest ---> cdltest`
  `reset_loop ---> reset_loop` starts the dummy read sequence.
  `rtc_dummy ---> rtc_dummy`
  `write_setup ---> write_setup`
  `pinit ---> pinit` initializes RS232C to communicate the KENWOOD power supply.
  `pon ---> pon` turns on KENWOOD
  `PON` does these two.
  `poff ---> poff` turns off KENWOOD
  `POFF` does `pinit, BCoff, poff`.
  `macs_setup ---> macs_setup [Addr]` supplies the voltage to the argument (detector), and prepares for clocking. Argument 10 is for Ks, 11 for H, and 10 for J, 3 for all. (same as `sirius_setup` ?)
  `BCoff ---> BCoff [Addr] --- MACS Bias & Clock off` stops the voltage and clocks for the detectors from MACS. No argument for all detectors, arg 10 for Ks, 11 for H, and 12 for J.
  `sirius_setup ---> Detector Bias ON` supplies the voltage to all the detectors, and prepares for clocking.
  `adc1024 ---> A/D Test for Debug` For debugging. Only for experts.
  `s_open ---> Cold Shutter open` For the cold shutter. Should follow ldsp. Currently not available.
  `s_close ---> Cold Shutter Close`

`s_stat ---> Cold Shutter Status`
`LongEX ---> LongEX`
`DLongEX ---> Exposure with Dithering`
`TLongEX ---> Test Exposure`
`SingleEX ---> SingleEX`
`zcom ---> Communication with Temperature Controller` (ZENTECH temperature controller) example: `zcom "setp? 1234"`
`print_temp ---> Report SIRIUS Temperature` Shows the temperature inside SIRIUS.
`offset ---> offset [ra_arcsec] [dec_arcsec]` Telescope offsets.
`point ---> point [epoch] [ra_h] [ra_m] [ra_s] [dec_d] [dec_m] [dec_s] [obj_name]` Telescope pointing. `epoch` should be integer, `ra_s` and `dec_s` should have one digit after the decimal point, and `dec_d` should have signs.
`focus ---> focus`
`WSinit ---> WSinit`
`wscom ---> wscom` communicates with the ZENTECH warm shutter controller. `wscom "z"` searches for zero, `wscom "m"` does one rotation. When the error of no zero point occurs and fails to start integration, try this and search for zero. If you get "z", you can start integration.
`WSopen ---> WSopen`
`WSclose ---> WSclose`
`ldsp` for dummy read sequence (not shown by "?").

2.5 Image quicklooks (useful IRAF imexam features)

- **1.** Star contours
  Move the cursor onto a star and type "e".
- **2.** Star radial profile
  Move the cursor onto a star and type "r". Numbers including FWHM are printed at the bottom.

2.6 Rasters (offset-kun features)

(Since we can now use the "cq" commands, this became obsolete.)
When making raster exposures, fields can be offset from a central field by using the window "offset-kun", in which the x and y offsets can be set. It is suggested that around 408 arcsec is used to give a $1'$ overlap. This is an efficient way for making rasters. Up to 5×5 fields can be set up.
If not running, in `/export/home2/observe/sirius/IRSF`, type
`> ./offset-kun &` (CR)
Click `Set` → `Center` sets the central field to the current position of the telescope. Use this while `telmon` says `Ready`.

Click `Set` → `Set Offset Unit` sets the x and y offsets.
Click `Set` → `Set Sky Position` sets the sky position in case you need sky observations.
The mouse right clicks change the colors of the tile. You can color the tiles as you like, e.g., the survey areas white.

2.7 Object lists and Telescope moves (gogo_sirius features)

- **1.** Object list
  Click `File` → `Add List` or `New List` will search for the object file from (any) directory. The default directory is `/export/home2/observe/objlist` . Copy the `.dat` file there and create your own list file. Currently, **the epoch should be in integer, and RA sec and Dec arcsec should contain decimal points.**
  (correct)
  ```
  NGC1068_1 2000    01 23 45.6  +78 90 12.3 Any comment here
  ```
  (wrong)
  ```
  NGC1068 1 2000.5  01 23 45  +78 90 12
  ```
  Click an object and then click `INPUT`. It will set the object as the next target.
  When you go to the next target, click `GO`.

- **2.** Other clickable telescope movements
  Click `Move` → `Dome Flat`
  Click `Move` → `Zenith`
  Click `Move` → `Zero Search`
  Click `Move` → `Dome` → `Stop Rotation`
  Click `Move` → `Dome` → `Open`
  Click `Move` → `Dome` → `Close`
  This cannot raise only the lower shutter when the wind is strong, but you can do this from the mouko xterm (see Miscellaneous notes at end.)
  Click `Move` → `Mirror Cover` → `Open`
  Click `Move` → `Mirror Cover` → `Close`

2.8 Command queue ("cq" features; New and Convenient!)

The exposure commands as well as the pointing commands usually issued from `gogo_sirius` can be written in the file `next.txt` in `~observe/sirius/IRSF` in advance. Then

```
SIRIUS> cq (CR)
```

will execute the commands in `next.txt` one by one. Such commands are:
`TL (TLongEX)`

`DL (DLongEX)`
`Lo (LongEX)`
`point` - example: `point 2000 13 44 45.0 -32 33 45.0 objname`
`point2` - example: `point2 ~observe/objlist/gc.dat GC17` finds the object `GC17` in the file and points the telescope to it.
`offset` - example: `offset 200 200`
`focus` - example: `focus 12.28`
`source` - example: `source dark/dark5102030.tclsh`

This feature is very convenient, and perhaps makes offset-kun unnecessary; a survey can be done with this without occasional possible human mistakes. Another good point: the commands already executed are recorded in the file `done.txt`, so they can be checked afterwards. Keep in mind, however, that cq can sometimes die, so the command execution should always be watched carefully.

Example of `next.txt`:

```
point2 ~observe/objlist/persson98tab2.dat p9172
DLongEX 6 10 p9172n1std 1
point2 ~observe/objlist/gc.dat GCsky
DLongEX 6 5 GC001sky 10 60
point2 ~observe/objlist/gc.dat GC1745-2840
offset +400 +400
DLongEX 6 5 GC1745-2840A 10 20
point2 ~observe/objlist/gc.dat GC1745-2840
offset    0 +400
DLongEX 6 5 GC1745-2840B 10 20
point2 ~observe/objlist/gc.dat GCsky
DLongEX 6 5 GC002sky 10 60
point2 ~observe/objlist/gc.dat GC1745-2840
offset -400 +400
DLongEX 6 5 GC1745-2840C 10 20
```

This will make the observations of the standard star, sky, object (regions A and B), sky, and object (region C).

```
____________
| A | B | C |
|___|___|___|
|   | * |   |   *: GC1745-2840 center
|___|___|___|
```

Once you type
`SIRIUS> cq` (CR),
it will not accept any more commands other than `Ctrl-C`. To finish the cq execution, in another terminal window (not in `SIRIUS>`), type `cq exit`.

Other cq arguments are
`add` - adds a command to the last of the queue.
`list` - lists the current queue.
`del` -example: `cq del 2` deletes the second line command.
`stop` - stops cq after the current command completion.
`restart` - restarts after "`cq stop`".
`insert` -example: `cq insert TL 6 5` inserts test exposure after the current command completion.

You could edit the `next.txt` file while execution, but `cq` reads the file and deletes the first line as it is executed, so the editing and saving could screw up the sequence. Either 1) use `cq insert`, or 2) use `cq stop`, re-write the `next.txt` file, and `cq restart`.

2.9 Shutting down SIRIUS

Usual procedure:
`SIRIUS> exit` (CR)
Also end `telmon` after the telescope moves to the rest position. Leave the other programmes on.

In case you **really** need to turn SIRIUS off, follow Steps 1 and 2.
1. End the programmes.
`SIRIUS> ldsp` (CR)
`SIRIUS> POFF` (CR) (capital letters)
`SIRIUS> exit` (CR)
Also end `telmon` after the telescope moves to the rest position.
2. In the dome, switch off the two top and the two bottom switches on the 6-socket distribution board attached to SIRIUS.

2.10 Backup

It is essential to transfer each night's data from SiriusB to bosanova as Sirius B cannot does not have spece for more than one or two night's files. Remove the transferred files from SiriusB. Otherwise,

```
FITSIO status=106:|\verb| error writing to FITS file|
```

appears and "`SIRIUS>`"dies when there is no more disk space. Expect around 6GB of data from one night, depending on number of exposures. Instructions for backing up (since 2003.6 copying to DVD-R) are given on the wall.

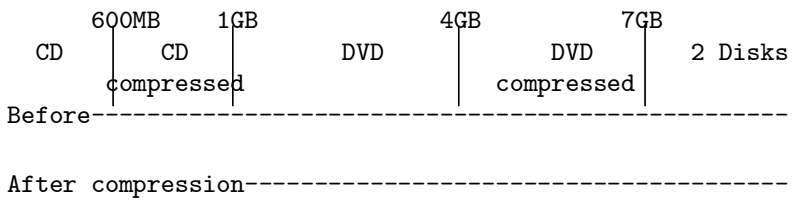
- dassie (192.168.100.7): exclusive for DVD-R/CD-R writing
  - Right to the SiriusB display, under the laserbeam printer LP-1900.
  - Does not have a display or keyboard. (ssh log-in)

  - Account: `observe`, password as usual.
  -
  - SiriusB `/extern/home/data`, `/extern/home2/data` and bosanova `/data`(RAID) are NFS mounted as `/data1`, `/data2`, `/data`, respectively.
  - First copy data into `/home/observe/backup`, then burn DVD-R/CD-R. Burning over NFS is not recommended.
  - IRAF, sirius pipelines installed. Can be used in data analysis, but watch out! If enough disk space ($\sim 3\times$ writing data) is not available, writing might fails.

- Rules
  - Make (at least) two copies.
  - Make `obslog` by sirius pipeline, and copy it into `/home/observe/obslog`.
  - Directories should be

    ```
    Date(YYMMDD)/rawdata/*.fits
    Date(YYMMDD)/obslog/obslog
    ```

    When a DVD/CD is mounted, `/cdrom/rawdata` and `/cdrom/rawdata`obslog—.
  - One disk should contain one night data. More than one night should not be put together.
  - If one night data is small enough to be put in a CD, use a CD (much cheaper).
  - If compressed with `imcopy`, data becomes 2/3. When not necessary, do not use `imcopy` compress. A rough guideline is

  - Write the date e.g., "`IRSF/SIRIUS 2003.5.31.`" with a felt-tip pen on the disk.

- Method 1 (using scripts)
  Do 1) - 3) in `/home/observe/backup (~/backup)`. This automatically follows the rules above.

  1) datacopy.sh
     Usage: `datacopy.sh [Date(YYMMDD)]`
     copies observation data on the SiriusB HD into an appropriate directories on the local disk of dassie. You do not have to specify which of SiriusB `/home` and `/home2` has the data.

2) mkobslog.sh

   Usage: `mkobslog.sh [Date(YYMMDD)]`

   makes `obslog` in an appropriate directory, and copies obslog to `/home/observe/obslog`.

3) backup.sh

   Usage: `backup.sh [Date(YYMMDD)] ([number of copies])`

   Judges which of CD or DVD should be used, on the basis of the data amount. Imcopy compress if necessary. Burn the specified copies (default: 2). When two DVDs are necessary, files 1200 and over are written on the second disks. Prompts to insert a disk. If there is not enough disk space ($\sim 3\times$ writing data), finishes with the error message. Does not work when more than two DVDs are necessary ($\sim$2,400 observations) as of 2003.8.

   Example: 2003.5.31 data

```
>cd ~/backup
>datacopy.sh 030531
>mkobslog.sh 030531
>backup.sh 030531
```

   This creates `~/backup/030531/rawdata/`, copies data files into this directory, creates the file `030531/obslog/obslog`, and these directories and files are copied into `/cdrom/`.

- Method 2 (step by step)
  If you cannot use the above scripts for some reason, then use individual scripts and follow the above rules.

  – mkimcopy (imcopy compress)

    Usage:

```
>mkimcopy
(edit imcopy.sh if necessary)
>sh imcopy.sh
```

    Shell script to compress the files `*.fits` in the current directory. This makes `imcopy.sh`, so edit `imcopy.sh` if necessary, and execute it. `sh imcopy.sh` creates compressed files `*.fits.ic` in the current directory. N.B. `imcopy`works with only INT format FITS, so we cannot use this for the reduced data. (However, we can if we change [compress] in mkimcopy into [compress GZIP 100,100:4] etc.)

  – mkunimcopy (imcopy extract)

    Usage:

```
>mkunimcopy
(edit imcopy.sh if necessary)
>sh imcopy.sh
```

Makes the shell script `imcopy.sh` to uncompress `*.fits.ic` in the current directory. Edit `imcopy.sh` if necessary, and execute it. `sh imcopy.sh` creates uncompressed files `*.fits` in the current directory.

- cdrecord.sh (burning CDs)

  Usage: `cdrecord.sh [Directory] ([volume name])`

  Writes the directory on a CD.

  If volume name unspecified, uses the directory name.

- dvdrecord.sh (burning DVDs)

  Usage: `dvdrecord.sh [Directory] ([volume name])`

  Writes the directory on a DVD.

  If volume name unspecified, uses the directory name.

- sh_mklog.cl (makes obslog)

  Usage: `sh_mklog.cl`

  Executes `mklog` in the sirius pipeline, without entering cl.

- Other memo about CD/DVD writing
  - When writing CD/DVD, do not use dassie for other jobs. — Higher risk of failure.
  - Success if the last messages say `fifo empty 0` and that `min fill` is more than 30%. (Even when `fifo empty` if more than 0, success is possible.)
  - To verify the data on CD/DVD: `cdtest.sh`

    Compressed files are examined if uncompressing is possible (resultant uncompressed files are then erased). For non-compressed files, tries `imstat` (However, this takes time — is there a better method?). A log file is written.
  - `mount /cdrom` (Caution: If mounted, the eject button will not work.)
  - `umount /cdrom`
  - As of 2003.8.1, 100 DVD-R and 50 CD-R are in stok. Contact Nagoya in well advance of using them up.
  - Raw DVD-Rs are in bags. Put CD-Rs in new bags after writing.

Chapter 3

Miscellaneous notes:

3.1 Format of output

There are 3 raw data fits files (JHK) for every exposure. So a typical dithered object or standard generates 30 fits files. Each file is 1024 x 1024 pixels of 2 bytes each, so the file size is just over 2Mbyte.

The output of the pipeline processing is 3 fits files (JHK) for each object with, depending on dither, a size of about 1100 $\times$ 1100 $\times$ 4 bytes (floating point), so each file is over 4 Mbytes.

Thus, one night's work can generate 6 or so Gbytes of data. These are stored during the night on the 480Gbyte disc system of the 'bosanova' computer and backed up afterwards. The output can be CDROM (too small, only 650 Mbytes each), DAT tape DDS2 (about 4 Gbytes), DDS3 (about 12 Gbytes), DDS4 (20 Gbytes). The SAAO computers can read only DDS2. Thus, bring enough DDS2 tapes for 2 backups of 7 nights, or about 22.

[Possibly DVDs, which are cheaper and more reliable, may be available in the near future]

3.2 High humidity

When the relative humidity (on computer) exceeds about 80% condensation on the cryostat window is a possibility. A symptom of condensation is ring-like structures on the images.

On 2002.7.17, a pump was installed on the northern wall. You can leave it on when you observe. The metal box contains two cylinders which produce dry air in turns. 1.6 litre/min flow. Be careful, though. You should not continue the observation because the window does not get condensation, when the humidity is very high; the primary and secondary mirrors, or electronics might get condensation. When the display shows 100% humidity, close the dome. When >90%, check frequently if the telescope does not get condensation.

A heater around the cryostat window can be turned on with the top switch but one (marked with red tape and "Heater") of the table tap on SIRIUS. Turn

Table 3.1: Zero search details:

	"Rest" position →	"Zero" position	(velocity)
Az	+40:00:00.0	+00:18:20.0	(2 deg/sec)
Alt	+89:50:00.0	+88:30:58.9	(0.3 deg/sec)
InR	−01:00:00.0	+00:00:00.0	(0.3 deg/sec)

it off when condensation disappears because the heater probably deteriorates the seeing.

3.3 Encoder Zeros

(This section only needed in case of problems)
About Zero Search

Zero Search is to find the origins of the encoder of azimuth, altitude and instrument rotator. Their origins are respectively close to the rest position of the telescope. The software client's Zero Search searches for them by moving azimuth by 40 degrees, and altitude and instrument rotator by just 10 degrees from the rest position. Thus, their origins must be within 40 degrees (azimuth) and 10 degrees (altitude and instrument rotator) from the rest position when carrying out Zero Search.

When you fail to move telescope to the rest position or the computer has been down in some reason, you must do Zero Search again. (In that case, you cannot move telescope to the rest position by the menu because the computer does not know the origin.) In order to do so, you have to move the each origin close to the rest position MANUALLY. First, set manual from AUTO using the hand-set. (If you find the hand-set does not work, switch ON the Telescope Controller again. see 1-4 (5))

1) The zero sensor mark of the azimuth encoder is in the direction of the East (to the door) on the azimuth base and labeled with a red tape (vertical line). The origin of the azimuth encoder is also labeled with red tapes (vertical line on thin aluminium). You must move the azimuth mount red line to the right of the base red line. The azimuth mount will rotate clockwise from viewing the zenith when Zero Search is excuted.

2) The zero position of the altitude encoder is close to the zenith but a little bit towards the South. Move the telescope to the zenith until you reach the position in which you could lock the telescope, although the telescope should not be locked before the zero Search. The lock position and the encoder origin are marked with black lines just below the lock. The encoder origin is also labeled with a red tape.

3) You can see the black zero sensor of the image rotator. Also the rest position and the rotator origin are marked with black lines, and the origin is labeled with a red tape. The rotator will rotate counter-clockwise, viewing from the bottom, so rotate it so that the red tape is to the right of the sensor.

4) Then, execute Zero Search (see 1.4 (7)).

Possible problem:
Alt limit switches1: +89:59:00.0, +18:48:00.0
(If you go beyond, only the slow movement (10″/sec) is possible.)
Alt limit switches2: +91:30:00.0, +13:50:00.0
(If you go beyond, the motor stops.)
Thus, if you accidentally increase Alt over +89:59, returning to the encoder origin will take very very long.

3.4 Lower Shutter

When you observe an object whose altitude is more than 50° (sec z = 1.31) and you are facing into a strong wind, raising the lower shutter is highly recommended.
From `SiriusB gogo_sirius`, to close the lower shutter only,
click `Move` → `Dome` → `Under Shutter Close`

From `mouko`, in the menu of the software `client`, type
`o: Dome Control`
then
`5: UPPER Shutter OPEN`
`7: lower Shutter OPEN`
(to go back to the main, type `0: End`)
The background color of the IRSF monitor window changes to yellow to warn you, if you are observing objects of sec z > 1.31 with the lower shutter closed.

3.5 Maximum wind speed

Ashdome give 30 mph as a maximum wind speed but say this is conservative. We suggest about 60 km/hr or about 17 m/sec is appropriate. It will be found that if the telescope is pointing into the wind when it is this high, it will shake. The lower shutter can be used as a wind screen, but take care that it does not vignette the telescope (see above). The dome louvres in the direction facing the wind can be shut to reduce the wind effect.

3.6 Telescope "Moving" on "telmon" (IRSF monitor Window)

Strong wind can cause this sign to appear and prevent the integration from starting. Another possibility of a long standing "Moving" sign is when the azimuth or instrument rotator axis has reached the limit and it rotates nearly 360 degrees. In this case, just be patient because the azimuth axis rotates at 2 deg/sec, and the instrument rotator 2.5 deg/sec.

3.7 Parameters for camera

The gain is 5 electrons per ADU.
The readout noise is 30 electrons.
(Information good for all channels.)

3.8 Specialities

Nagata Tetsuya (Overall) nagata@z.phys.nagoya-u.ac.jp
Nakajima Yasushi (pipeline reduction) nakajima@z.phys.nagoya-u.ac.jp
Nagayama Takahiro (camera software) nagayama@z.phys.nagoya-u.ac.jp
Nagashima Chie (camera hardware) chie@z.phys.nagoya-u.ac.jp
Kato Daisuke (telescope software) kato@z.phys.nagoya-u.ac.jp
Tanabe Toshihiko (post-pipeline reduction) ttanabe@mtk.ioa.s.u-tokyo.ac.jp

3.9 Web report page, temperature monitor, etc

`http://irsf.saao.suth/report/` is the web log page. Write observer names, weather (including the photometric period ratio from 0/3 to 3/3 and J-band seeing in pixels), and objects etc. Do not use the double quotation marks (`"`). The password is the same as the one for "observe".

From this page, can go to the pages of temperature & humidity, and the temperatures inside SIRIUS.

Log sheets are copied with the copying machine near the window in the hostel computer room.

Fault book full of flowers on the cover is useful at IRSF also.

Korean star number monitor is useful: `http://ystar1.saao.suth/nstar.php` , Concam also: `http://concam.net/sa` .

Altitude runaway and Azimuth wandering

It seems to me (T.N.) that stack overflow or something of the Telescope Controller MS-DOS computer is the cause.
Several cases are possible:
1) The altitude limit switch is on (Alt>89d59m) and only extremely slow movement by motor is possible.
2) The altitude value held by Telescope Controller is wrong, and/or the backup data file SCOPE.DAT is also wrong.
3) mouko thinks the altitude is over 90deg and continuously send the halt command.

How to handle each problem— 1) and 2) are important.
First of all, stop the telescope azimuth wandering. Similarly to "ending observation", on mouko, end the software `client`
In the menu of `client`

`> 0: End (all)` (the `telescope` software also ends.)

1) Turn altitude limit switch OFF

When the altitude is over 89d59m, only slow movement (1arcsec/sec) is possible. Switch OFF the Motor Drive in the lowest panel of the rack, and manually lower the altitude. Here we first assume we can leave Telescope Controller ON.

Two people are needed for this:

1. A supports the tube of the telescope. B turns on the monitor TV.
2. B turns OFF the Motor Drive.
3. A manages to move the telescope altitude by pulling or pushing an appropriate point, and when the telescope points lower enough (¡89d59m), tell B.
4. B turns the Motor Drive ON quickly and stops the telescope's move by inertia. If the telescope oscillates, turn the Motor Drive OFF quickly; in this case, turn Telescope Controller OFF and repeat. See below.

If Telescope Controller is left ON, Zero search etc is not necessary and immediate observation after resetting error is possible.

2) Reset Telescope Controller value

Turn OFF Telescope Controller in the upper panel of the rack by **turning the rear switch OFF, not the front one.** Then turn the rear switch ON. Using the rear switch, we do not allow Telescope Controller to write wrong value to the file SCOPE.DAT, (probably). Thus all we have to do is to turn it ON again. Check the status (monitor switch to B). If the Azimuth and Altitude look reasonable, just move the telescope by the handset to the zenith, and do Zero search.

If, however, the Azimuth and Altitude do not look reasonable (like 999deg), the file SCOPE.DAT is probably corrupt. Delete it.

Turn Telescope Controller OFF, then ON. MS-DOS starts, so hit Ctrl-C several times and stop the batch job (of starting the telescope controller program). Answer to "**バッチ処理を中止しますか？**(Y/N)"(Japanese) by "Y", and get the `C:SCOPE>` prompt.

`C:SCOPE> del scope.dat` deletes the bad file. Again, turn Telescope Controller OFF, then ON. Check the status (monitor switch to B). You get the "No backup Data" error, which is correct because of no SCOPE.DAT file. Hit the mode switch of the hanndset, and the red error lamp will goes off.

If the Azimuth and Altitude do not look reasonable again, turn OFF everything and try again (repeat the deletion of SCOPE.DAT).

3) Stop mouko's continuous HALT commands

When mouko thinks the altitude is over 90deg, mouko program `telescope` and `client` issue continuous HALT commands. To stop this, In the menu of `client`,

`> 4: STOP`

Then, one HALT and continuous "No commands" will be issued, and you can move the telescope by the handset.

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