Infra-red Survey Facility (IRSF) manual

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VERSION HISTORY

Document Number	Author	Version	Date	Change History
	M. Rust	1B	24 April 2015	Beta release
	M. Rust	1C	20 Nov 2015	Amended
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	M. Rust	1F	18 Dec 2015	Part 3 \ Instr. pump down procedure
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ACRONYMS AND ABBREVIATIONS

NRF	National Research Foundation
SAAO	South African Astronomical Observatory
SOP	Standard Operating Procedure

DEFINITIONS

TBD	

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Part 1: Sub systems description

Facility layout

This section tells you describes the layout of the building (see floor plan below), telling where things are located in IRSF. Interactions with the system are discussed under Operators guide.

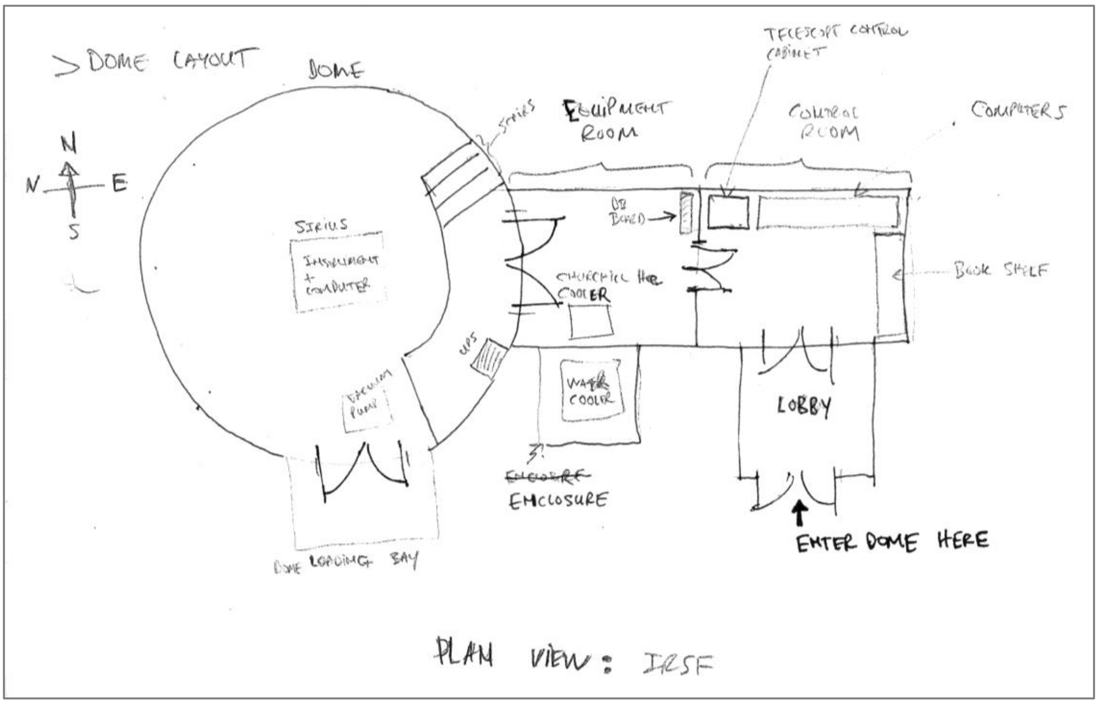


FIG 1: THE FLOOR PLAN SHOWS THE LAYOUT OF THE DOME, THE ARROW INDICATES THE FRONT DOOR

Arriving at the dome

The double door main entrance should be unlocked. The lobby has a **light switch on the wall on the right** which is useful when entering at night. Unlock the second double door by entering the code on keypad and enter the warm room.

The Control room

The light switches for the warm room can be found inside the second double door on the left.

Operator desk

FIGURE 2: WARM ROOM DESK

Facing the North wall, from left to right, identify the following:

- network cabinet
- TCS cabinet with display monitor and keyboard
- Time service remote display (wall mounted)
- Analogue clocks (set to South Africa and Japan time zone)
- Telescope operator desk with dual-monitor display
- power and network points

Telescope Control System rack

FIGURE 3: TELESCOPE CONTROL SYSTEM CABINET

Telescope Control MS-DOS computer

The Telescope Controller MS-DOS computer is located in the rack, on the top shelf. The keyboard is on top of the cabinet, in front of the flat-screen monochrome display monitor.

Video switch

A video switch device is used to select between two computers:

- Telescope Controller MS-DOS computer – Position B
- Mouko 2 computer – Position A

Figure X: Video switch

Mouko2 computer

Mouko2 is the desktop PC on the operators desk, on the right hand-side of the cabinet.

SIRIUS computer

Sirius computer (192.168.100.9) is the desktop PC with keyboard and dual-monitor display. This computer is used to monitor telescope and dome operations (left screen) and detector output (right screen).

Figure 4: Sirius computer with dual-monitor display for telescope and dome operations (left screen) and detector output (right screen).

Other things of interest

The following computers located at the operator workstation, either on the desk or floor.

- Mouko computer (198.168.100.4), a file server.
- Web server computer (198.168.100.??), used for temperature monitoring.
- General purpose laptop for browsing the internet.
- Archiving station. This is a desktop PC with 4-bay CD writer.
- On the floor under the desk is Uninterruptible Power Supply which provides backup power to the computers.
- SNOM phone.

On the East wall, the following.

- Book shelves with a collection of reference material (mostly in Japanese).
- Storage area under the desk where the Polarizer instrument change kit (SIRIUS-to-SIRPOL) is stored.

Other stuff.

- kitchenette with a small table and fridge
- some tools and telescope spares stored under the table
- Whiteboard with cryptic notes on the network.

Power and Network

Running horizontally along the walls are four channels for mains power and network. The dome uses two mains power standards, 220V AC (local) and 120V AC (Japanese).

The channels are configured, from top to bottom, as follows:

- 1 - 220V AC mains power
- 2 – network, ethernet cabling
- 3 – network, ethernet cabling
- 4 - 120V AC mains power

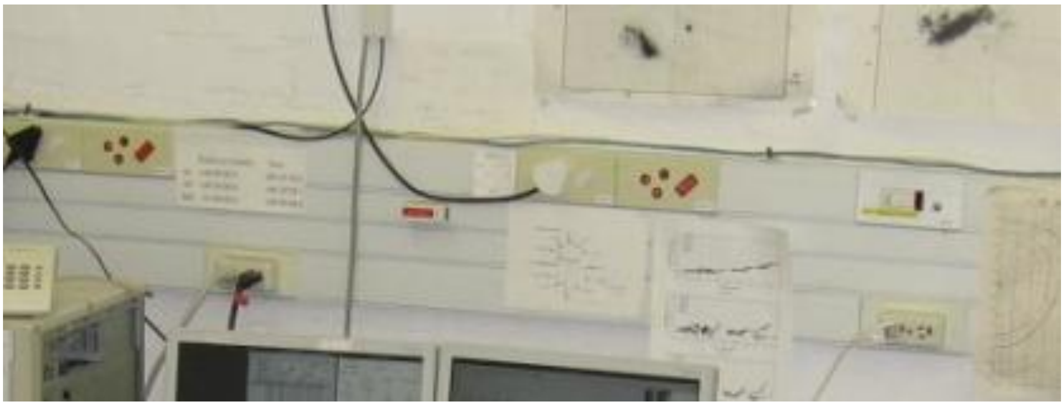


FIGURE 5: POWER AND NETWORK

Equipment Room

The light switch is inside the double doors of the warm room (adjacent), to the right. Things of interest include mains power distribution board, UPS (installed March 2015) and instrument cooling system.

To the left of the entrance () is an orange tool rack with an assortment of hand tools.

Power distribution

Main Distribution Board (DB)

The primary distribution board is in the white enclosure on the East wall.

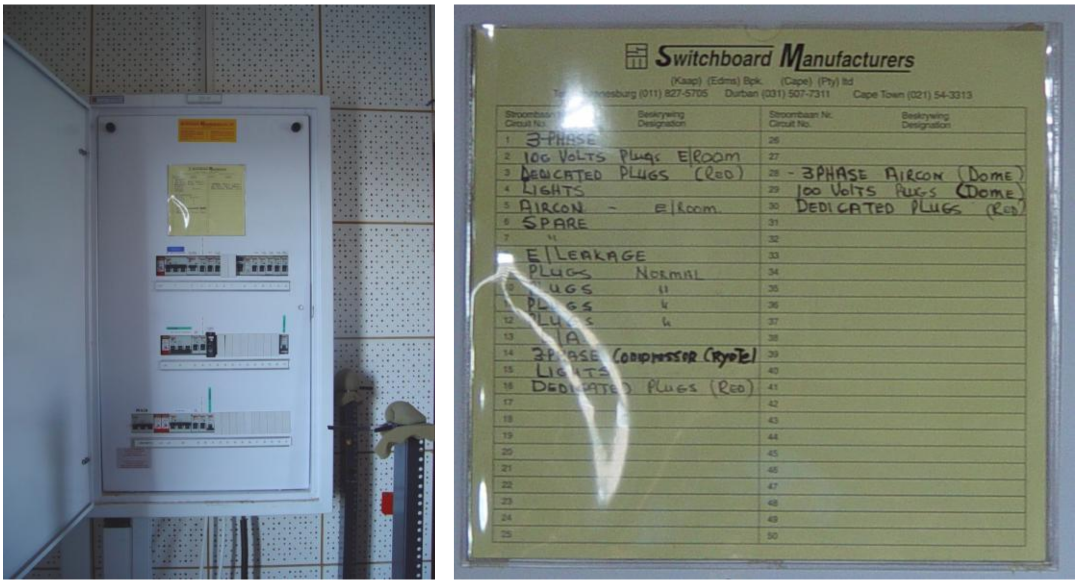


FIGURE 6: PRIMARY MAINS DISTRIBUTION BOARD FOR THE DOME (LEFT). CIRCUIT BREAKER INDEX CARD (RIGHT).

UPS sub DB

TBD: description of sub DB feeds and 20 KVA UPS for water chiller and helium compressor.

Transformers

On the floor, single phase and three-phase transformer, from left to right as follows:

1. 100V E–ROOM
2. 380V – 200V 3-phase
3. 380V – 200V 3-phase

Figure 7: Three transformers in the Equipment room.

Instrument cooling equipment

On the South side of the room is the Helium compressor (pictured below). This end has a built-on extension for housing the water chiller which is accessible from the outside.

- The water chiller cools helium compressor, the water pipes feed through the bottom louvers.
- The compressor cools the instrument. Braided metal pipes that run under the floor circulate liquid helium to the instrument at telescope.

FIGURE 8: HELIUM COMPRESSOR FRONT PANEL (LEFT) AND BACK PANEL (RIGHT).

Observing Floor

The light switch is inside the door on the right. Things of interest about the AltAz mount and telescope:

Telescope mount

Telescope safety pin

Up the stairs, looking at the altitude mount, identify the safety pin which is engaged when telescope is parked.

FIGURE 9: TELESCOPE SAFETY PIN ENAGAGED.

Hand paddle control

The paddle control, labeled MAN-BOX, is fixed to the rail of the stairs. Its cable runs under the floor from the Telescope Controller (MS-DOS) rack in the warm room.

Figure 10: Hand paddle control

Instrument platform

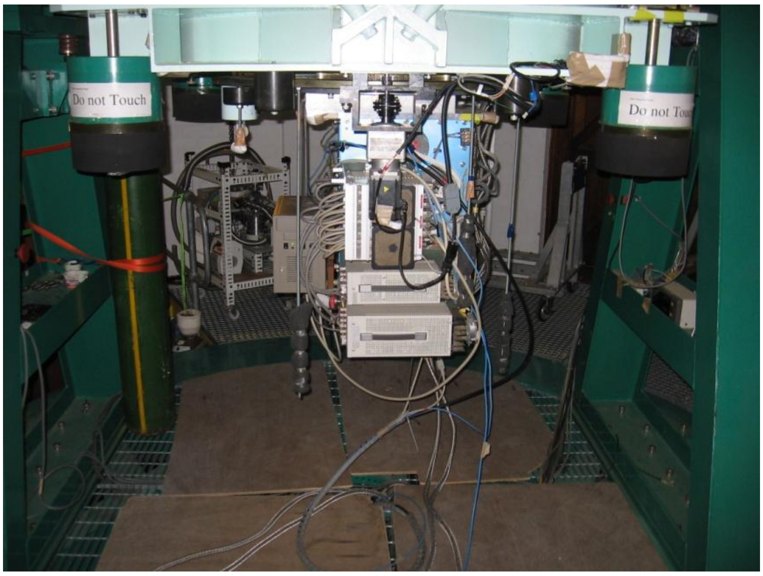


FIGURE 11: ESTABLISHING SHOT OF INSTRUMENT, LOOKING WEST-TO-EAST

Things of interest on the instrument

- Messiah 5 Instrument computer (192.168.100.10), also known as “M5”.
- Kenwood DC Power supply for the detector power.
- Instrument UPS device on the floor, left of the door.

Dome

The light switch is inside the door of the observing floor on the right. The following things of interest:

- 100V AC Sub DB (North-East wall)
- Dome rotation and shutter override in the orange wall box.
- Dome motor protection
- Loading bay (South end)

FIGURE 12: 100V AC DB (LEFT), FAN CONTROL

Telescope Control System

Block diagram

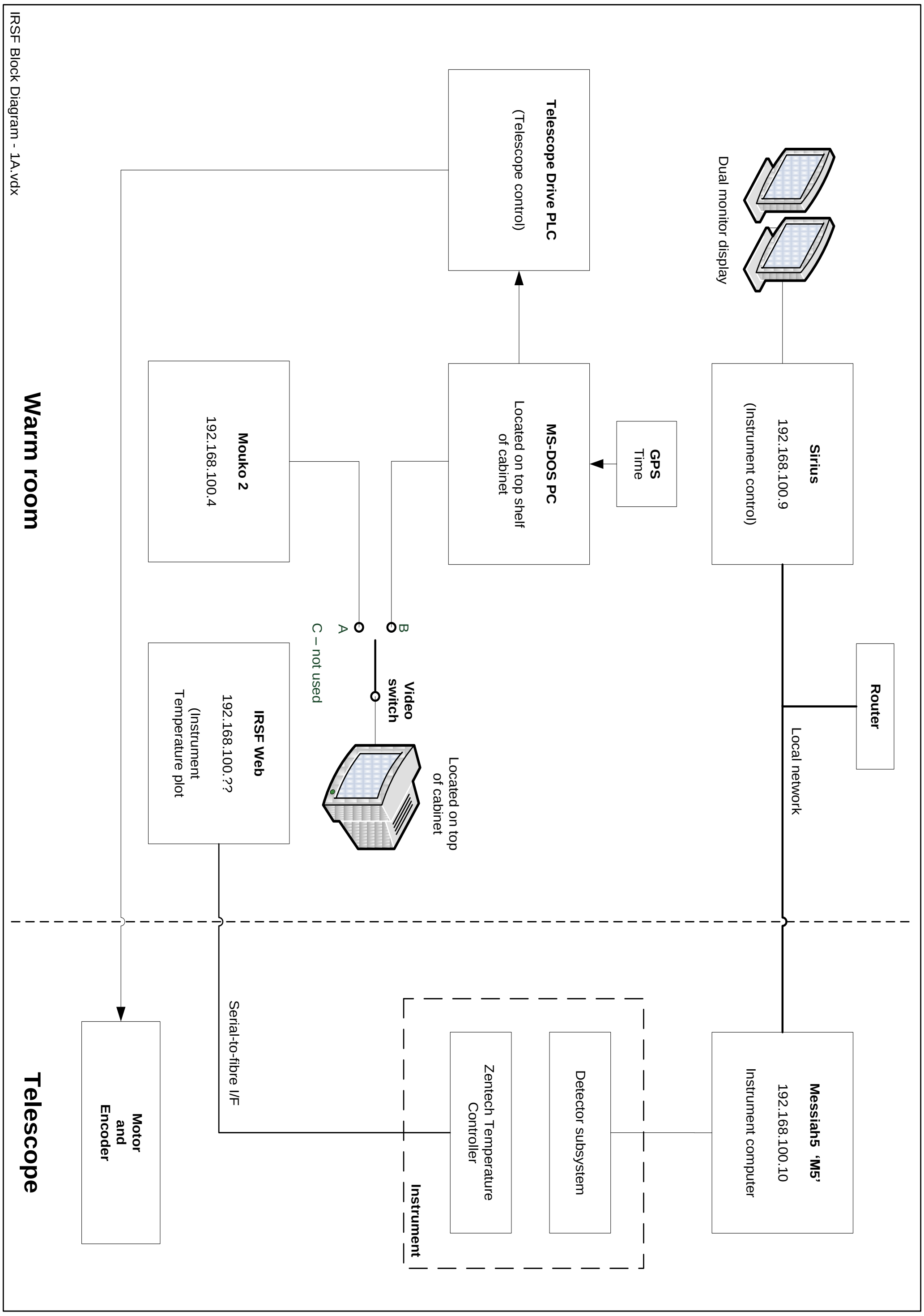


Figure 13: Telescope Control System block diagram

Telescope Control computers

Telescope control is done by two computers, MS-DOS PC and Mouko 2. Refer to the block diagram detailing IP address.

Video switch

The video switch connects the output one of the following computers to the flat-screen monitor.

- A - MS-DOS computer
- B - Mouko 2 computer
- C - Not used

MS-DOS computer

This is a PC with DOS Version 6 operating system. The video output is switched (B) to the flat-screen monitor. Peripheral inputs device include the GPS antennae (Time) and the hand paddle control (observing floor). The keyboard is stowed away, the start-up is automated so it is not usually required.

The computer is the interface to the telescope hardware. It sends control signals to telescope drive and monitors the status. It also monitors and reports environmental: humidity and temperature.

It runs a program for the telescope start-up sequence that uses a compact flash card in the PC.

Mouko2 computer

This is the host computer, it runs Linux operating system. The video output is switched (A) to the flat-screen monitor. The keyboard is provided for command input.

Together with the SIRIUS computer, is used to operate the telescope and dome.

It provides the command line user interface for TCS (portrait window) which is launched at start-up. It also reports the telescope status as a stream of numbers in the landscape-shaped window.

With the telescope programs running on this computer, the graphical user interface (GUI) can be launched on SIRIUS.

SIRIUS computer

This is Linux computer with has a dual-monitor colour display.

It provides the graphical user interface (GUI) for TCS and runs the software that operates the camera.

Telescope drive

The drive electronics is housed in the bottom draw of the TCS cabinet. The drive translates commands from the MS-DOS computer into power signals for the motors.

Removing the front plate will reveal four modules, numbered 1 through 4 in the picture below.

1	2	3	4
telescope (x)	telescope (y)	instrument rotator (theta)	focus adjust
1.2 arc-sec	0.6 arc-sec		2° mirror adjust

Figure 14: Drive electronics on the bottom shelf of rack.

Telescope position encoders

There are three position encoders are on the telescope, a brief description on their operation below.

Azimuth encoder

The azimuth encoder reference is in the direction of the East (to the door) on the azimuth base (green part) – marked with red arrow. The encoder origin is labelled with red tape “Encoder Origin” on the aluminium belt.

Altitude encoder

The altitude encoder origin is close to the zenith, towards the South. You can see the black zero sensor (origin) of the image rotator. The rest position and the rotator origin are marked with black lines, and the origin is labelled with red tape.

Encoder initialise

The telescope is initialized by doing a Zero Search. This is required for normal start-up and if control of the telescope is lost due to an abnormal shutdown.

Zero Search function

Zero Search is a TCS software function that finds the origins of the position encoder by moving azimuth by 40 degrees, and altitude and instrument rotator by 10 degrees from the parked position.

Dome controller

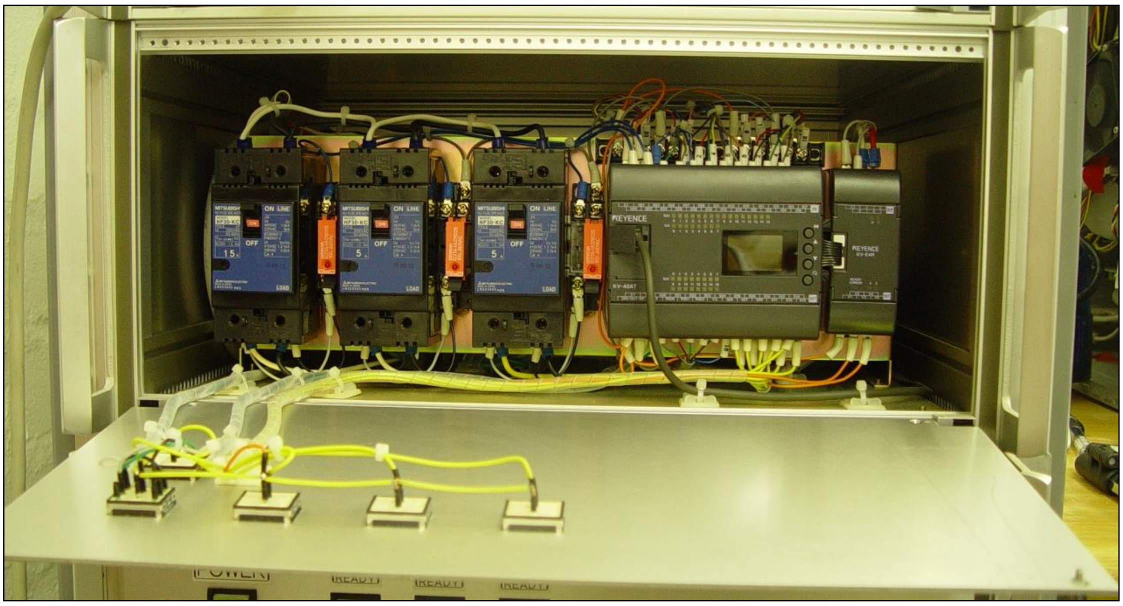


Figure 15: Dome controller cover lowered

Above, the Motor control compute r rack with the front cover removed. From left to right, three dome circuit breakers and a sequencer unit – function TBD.

Instrument

Block diagram

The block diagram shows the main components, starting from the top-left corner:

- Sirius control computer in the warm room
- Messiah5 computer at the instrument
- MACS instrument electronics
- cryostat and detector package
- Temperature controller unit

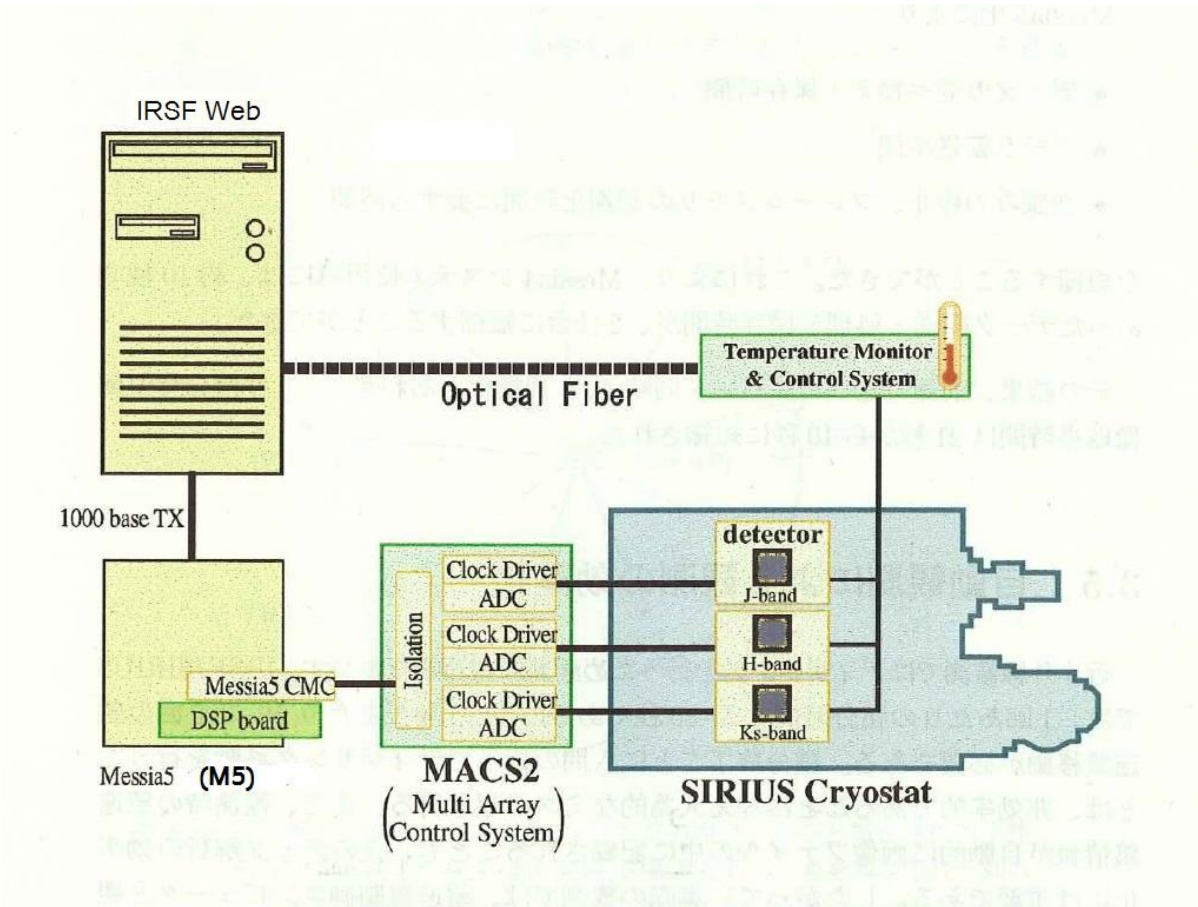


FIGURE 16: INSTRUMENT BLOCK DIAGRAM

Detector pack

The signal from the detector (three bands: J, K and H), located inside the cryostat, is processed by the Multi-array Control System (MACS). It consists of Clock driver and Analogue-to-Digital converter, which produce an output that can be read by the Messiah 5 computer.

Detector DC power supply

These are two Kenwood bench power supplies mounted on the side of the instrument.

FIGURE 17: KENWOOD DC POWER SUPPLIES MOUNTED ON THE INSTRUMENT

Normal operating voltage

Under normal operating conditions the detector voltages are as follows.

Output	Volts	Amps
+18V O/P	+15.8	0.56
-18V O/P	-15.8	-0.48
+6V O/P	+5.77	2.2

TABLE 1: LARGE KENWOOD PSU NORMAL VOLTAGE

Output	Volts	Amps
+18V O/P	+15.8	1.13
-18V O/P	-15.8	-0.96*

TABLE 2: SMALL KENWOOD PSU NORMAL VOLTAGE
* RANGE: -0.55A TO -0.96A

Kenwood PSU operating instructions

To switch off/on, do NOT use the mains "POWER" switch. Instead use the "OUTPUT" button at the top RH corner (Figure 18, labelled 'B'). When the red LED above the output button is ON, the DC output is live.

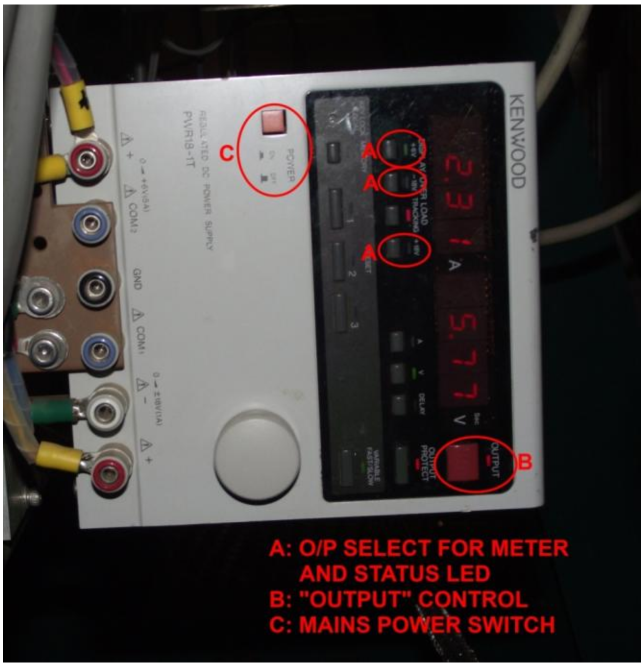


FIGURE 18: POWER SUPPLY CONTROLS

Both PSUs should be activated/deactivated pseudo-simultaneously at all times. A caveat on this is that experience has shown that activating the small (upper) Kenwood unit slightly earlier than the large (lower) one sometimes has a better chance of success

The PSUs are occasionally unstable when switched on. Instability is indicated by the associated output green led flashing (Figure 18, label 'A'). This situation sometimes self-corrects within a few seconds, but often requires that the switch off – switch on sequence be repeated.

Each output voltage/current can be checked by selecting the output so the front panel meters display the measurement (Figure 18, label 'A'). Note that when the "Output" is OFF, the meters display the voltage and current limit set points. This can be very confusing!!!!

NB!!! Achieving a trouble-free, works-first-time switch on of the detector power is unlikely. You may have to repeat this step MANY times before the power eventually starts up properly. Tech report of a procedure that worked - below.

Occasionally it may be necessary to switch off the PSUs completely using the Mains power switch (Figure 18, label 'C').

A software setup is required when taking dark frame. ("sirius_setup")

See the Tech report on the next page.

This is also described in Part 2, under Take dark image.

TECH REPORT - 20 APRIL 2013

After some fiddling, traced fault to KENWOOD PSU's which gone into current limit (best seen by the 6V output of the big KENWOOD drawing >3A, instead of 2.4A). Was fooled at first by the fact that the KENWOODS display their setpoint voltages and currents when switched on and only show actual current drawn when switching on "output".

Managed to get KENWOODS to deliver correct currents, but had to find out the hard way that "sirius_setup" needs to be run for instrument to recover after being powered down. Once I realised that however, I could not get KENWOODS to deliver correct power again, even after 1000's of tries, even when switching on small KENWOOD before big one, etc - you name a sequence, I tried it!! It did not help much when told by Jaci that it took her two days to get them to switch on properly last time we had this problem.

In the meantime, the observer forwarded a mail from Taka via a colleague who had the same trouble on his last run where Taka suggested another strategy which finally worked. After four hours, finally got it going as follows:

1) Switch on both Kenwoods and allow them a few seconds to settle.
2) Switch the large KENWOOD to display the its 6V output current (normally 3.6A) to monitor.
3) Turn on the outputs of both KENWOODS simultaneously (by punching their "output" buttons - indicated by a red LED at each button.
4) Check that the current of the big KENWOOD 6V does not exceed 2.4A or that any current limit (yellow) LEDs flash - if it does, it has gone into current limit and proceed to the next step. If OK, stop right here en skip the next step.
5) On both KENWOODS simultaneously, switch off their outputs and immediately switch both outputs back on. Check the currents of step 4 - if OK, go to the next step - if not, keep repeating this step until the currents are OK.
6) VERY IMPORTANT ... run "sirius_setup" on the Sirius control computer.

Messsiah 5 computer

The computer is a PC running DOS?? operating system. Interaction with the computer is through the Mouko2 computer in the warm room, from the Messiah command prompt.

The computer monitor and controls functions relating to the instrument. This includes detector readout and temperature.

Temperature system

The temperature system consists of the following components.

- Water chiller
- Helium compressor
- Zentech temperature controller

The water chiller and Helium compressor cool the detector. The Zentech controller is used to define the set point for the heater. The principle of operation is to cool the detector to an absolute value then use the heater, temperature regulated by the controller, to achieve set point. The sensor, located in the cryostat, is a PT-1000 device.

Water chiller

The water chiller unit is housed outside in a built-on extension of the South side of the equipment room. The unit can only be accessed from outside the dome.

It is powered off the UPS (installed March 2015) in the equipment room.

Two water hoses, fed through the louvers, connect to the inlet/outlet at the back of the Helium compressor. The set temperature displayed on the control panel, as well as inline flow meter give an indication of the health.

Helium compressor

The Helium compressor unit is located in the equipment room. It is powered off the UPS (installed March 2015) in the equipment room.

Note that sometimes the compressor does not start due to an oil pressure trip state. To reset the trip, use a small screwdriver to depress the trip switch – indicated on figure 19.

Figure 19: The Helium cooler compressor Unit

Zentech Temperature Controller

READING INSTRUMENT TEMPERATURES

There are three ways to monitor the instrument temperatures:

1. Read the small LCD meter on the instrument itself (See Figure 20)
2. Watch the SIRIUS temperature web page at http://irsfweb.suth Note this is updated every 5 minutes.
3. Log on to the "m5" computer in the control room and use it to communicate directly with the Zentech temperature controller unit:
   a. At the computer, ensure that "m5" appears in the command prompt of the xterminal. If not, type 'm5', press enter.
   b. The command `zcom "sdat? abcdefgh"` - including quotation marks – will return `cdat? Abcdefgh -> N1 N2 N3 N4 N5 N6 N7 N8` where N1 – N8 are temperature readings in Kelvin. The first three readings are the important ones – the three detector temperatures

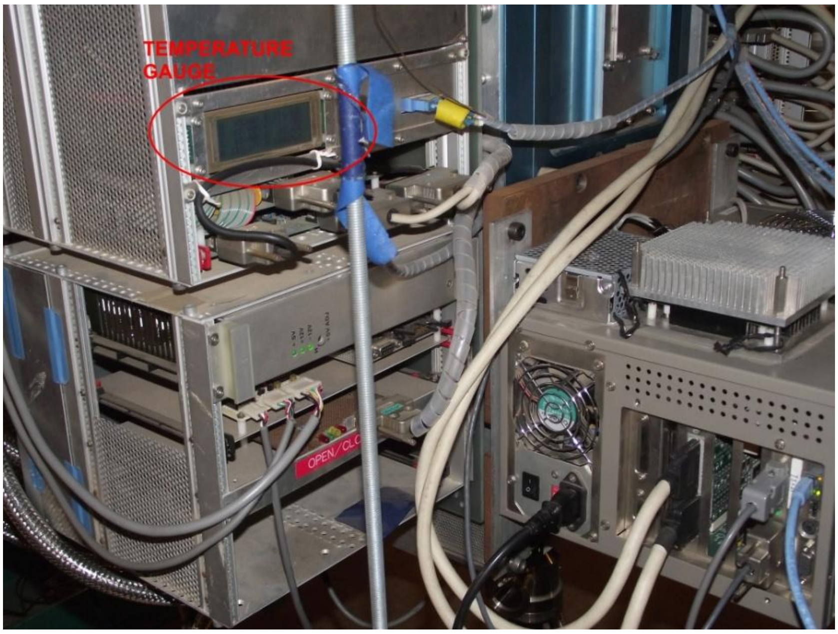


Figure 20: Instrument layout showing Temperature Gauge Display

ZENTECH COMMANDS

The controller commands are issued from the Messiah5 computer.

- To check the setpoint: `zcom "setp? 1234"`

  will return four setpoint temperatures

- To change the setpoint: `zcom "setp 1234:N"`

  will change the servo setpoint to N, where N is a temperature value in Kelvin.

  Normal operation: 85K, Prepare for warm-up: 110K, Warm up: 320K

  To this command the controller replies with:

  `setp 1234:N No reply from TC`

  This is normal.

- To check the temperatures: `zcom "cdat? Abcdefg"`

  will display all 8 channels temperatures in Kelvin.

- To check the control mode: `zcom "cmod 1234?"`

- To set the control mode: `zcom "cmod 1234:N"`

  where N = 0 switches servo control OFF (monitoring)
  N = 1 switches servo control ON (to the setpoint immediately)
  N = 2 switches servo control ON with ramp

- To set the Heater ramp rate: `zcom "rampr 1234:N"`

  Normally, N = 0.3 (Kelvin/min)

- To check the ramp rate: `zcom "rampr? 1234"`

- To display the servo heater output: `zcom "heat? 1234"`

The IRSF Vacuum Pump

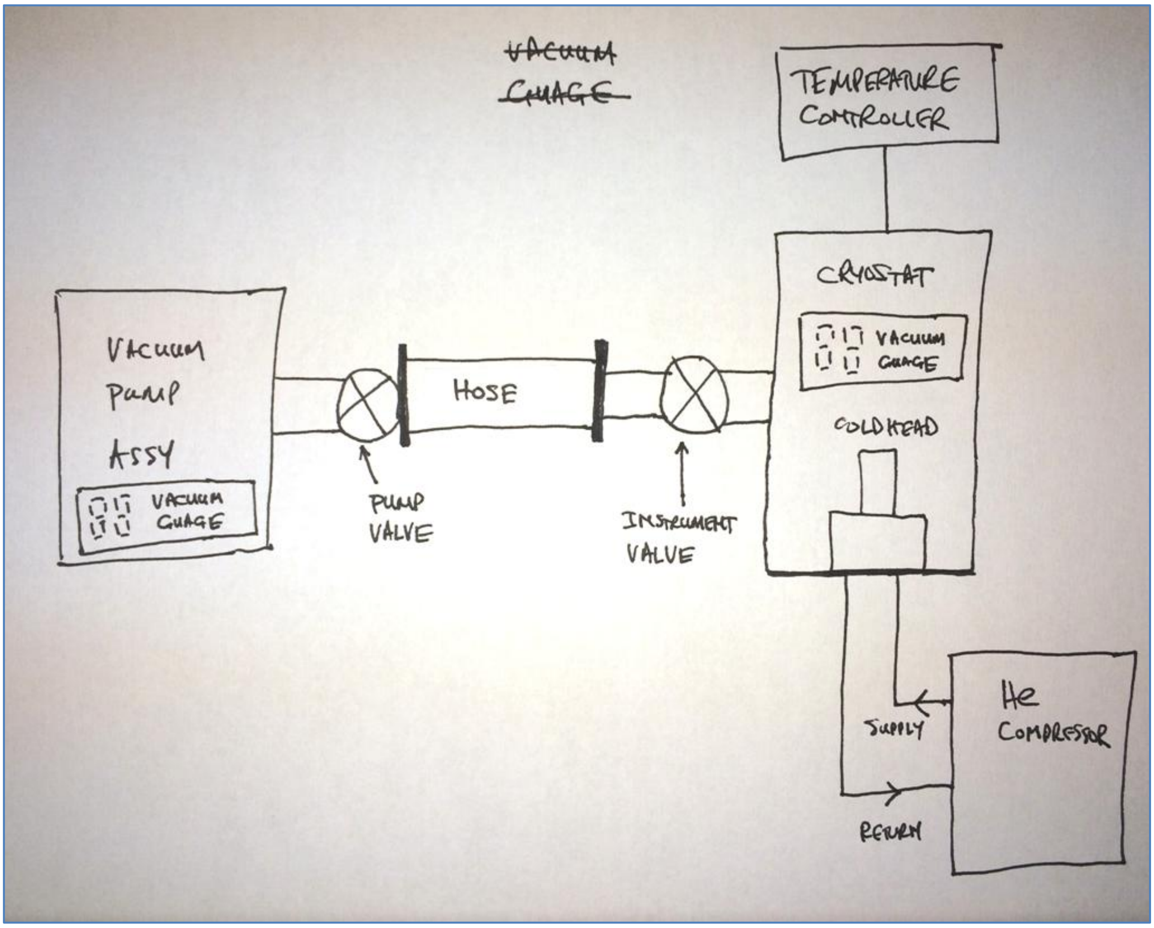
The purpose of this section is to describe the pump setup and principle of operation. The procedure can be found in Part 3.

PUMP SYSTEM OVERVIEW

The block diagram of the vacuum pump setup below.

The main components are:

- Vacuum pump
    a. scroll pump
    b. turbo molecular pump
    c. shut-off valve
    d. vacuum gauge
- Pump extension hose
- Instrument cryostat
    a. shut-off valve
    b. vacuum gauge
    c. temperature controller



Block diagram of vacuum pump setup

IMPORTANT INFORMATION

- Disconnected from the instrument.
- Stored on the raised platform, in the south-east section of the dome.
- A 110V unit – it CANNOT be used anywhere else on site! Powered from the 110V AC wall socket.

PRESSURE DIFFERENTIAL BETWEEN PUMP HOSE AND CRYOSTAT

NB! The pumping procedure depends on the level of vacuum at the cryostat ie. cryostat pressure. The vacuum of the pump and the cryostat must be equal, before pumping on the instrument. This is covered in the procedure. There are two scenarios:

1) cryostat pressure is tending to atmospheric, greater than 1torr.
2) cryostat is partially evacuated, between 1 x 10^{-3} and 1torr.

TO SETUP THE PUMP

1. Move the pump close to the instrument.
2. Connect the pump and vacuum gauge mains cables (100VAC).
3. Connect the hose to the instrument.
4. The state of the valves before pumping should be
   - Pump valve - closed
   - Instrument valve - closed

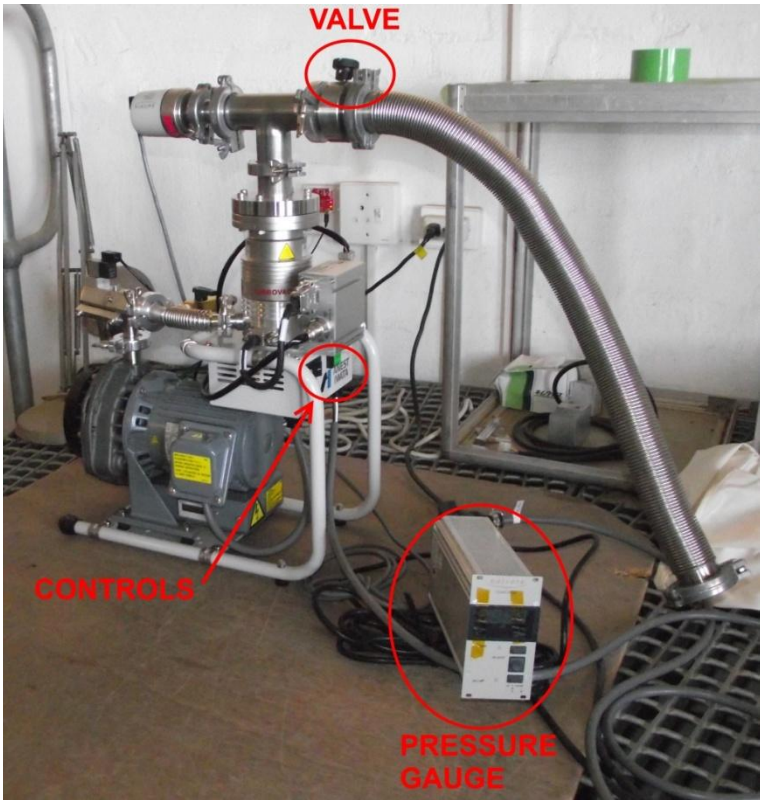


Figure 1: The IRSF Vacuum pump

TO START PUMPING

1. Open the valve on the pump (see figure 1).
2. Switch Button A ON to start the scroll pump (see figure 2).
3. Wait until the pressure in the hose reaches 1 x 10^{-2}torr or less, the base vacuum for the Turbo molecular pump.
4. Switch Button B ON to start the turbo molecular pump (see figure 2).
5. Wait until the **vacuum level in the hose reaches a similar or lower pressure than in the instrument**. See figure 3 for the location of the on-instrument vacuum gauge.
6. Open the valve on the instrument (See figure 3)
7. Continue pumping to target pressure, then do the following procedure to finish.

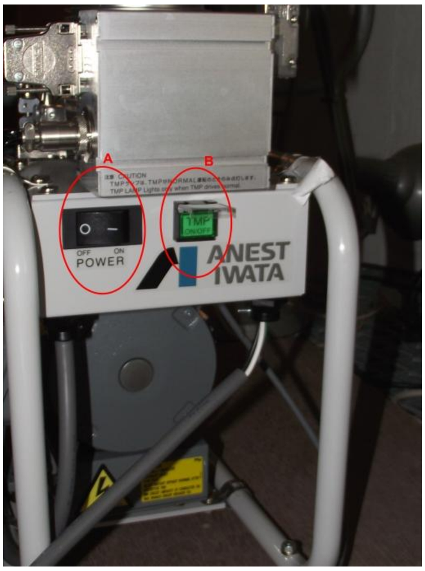


Figure 2: Pump controls:
A: Scroll Pump, B: Turbo pump

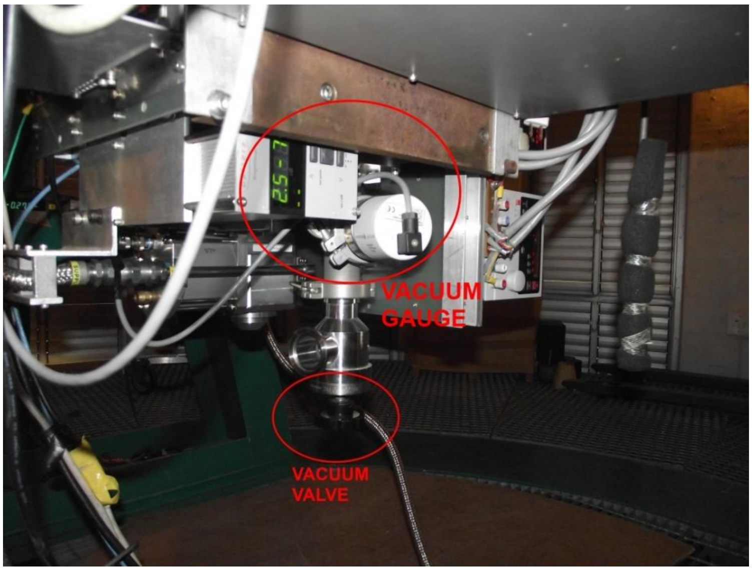


Figure 3: Instrument Vacuum Valve and Vacuum gauge

TO END THE PUMPDOWN

1. Close the valve on the instrument (Figure 3)
2. Close the valve on the pump (Figure 1)
3. Disconnect the hose from the instrument flange – and **blank off the hose** and put a plastic dust cover on the instrument flange.
4. Switch Button B OFF to stop the turbo molecular pump (Figure 2)
5. Switch Button A OFF to stop the scroll pump (Figure 2)
6. Wait for the turbo to slow down - ~ 5minutes or so – then open the valve on the pump (Figure 1) for about a minute, then close it again.
7. **NB!** To avoid possible damage to the turbo pump bearings, **do NOT move the pump until the turbo has stopped spinning**.
8. Cover the pump with the makeshift dust cover.   It is exposed to the elements when the telescope building is open.

Part 2: Operators section

Startup

The procedure to start-up the telescope.

Pre conditions

The Telescope is parked. If not, see **Procedure to park the telescope .**

Startup procedure

1. Switch the Telescope drive ON

On the telescope rack **Push button A, Power ON** in Figure 1 on the bottom panel. The three orange LEDs, labelled X, Y, theta, should turn ON and remain steady to indicate the health of the telescope drive.

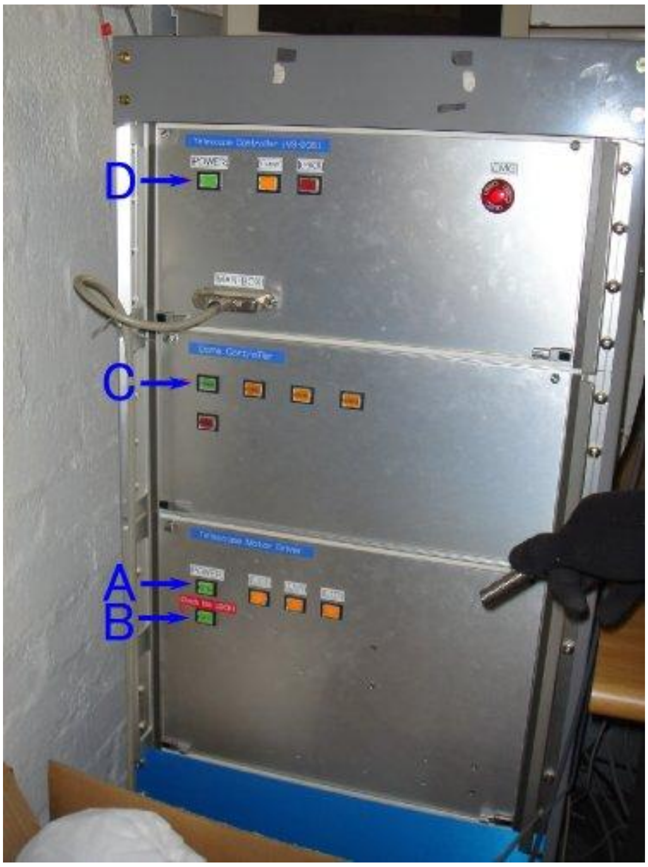


Figure 1: Telescope rack

2. Disengage the altitude lock

Climb up the telescope mount, and move the altitude safety pin, from the Lock position, to the Unlock position.

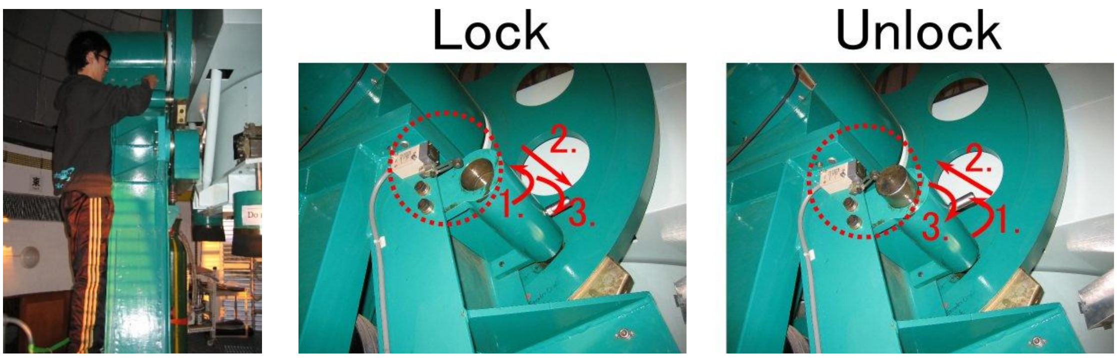


Figure 2: Technician at telescope mount (left), altitude lock / unlock sequence

3. Switch Dome Controller ON

- Push button C in Figure 1 to turn the dome controller ON.

- The hand paddle control, labelled Man-Box (observing floor), is enabled for the following functions:
  - ±X - dome rotation
  - Shutter Up/Down - dome shutter open or close

Figure 3: hand paddle control labelled Man-box

4. Start Telescope Control System (TCS) computer

- Push button D in Figure 1 to start Telescope Control computer, labelled Telescope Controller MS-DOS.
- Turn the monitor switch to "B" for the Telescope Controller MS-DOS computer and check the display monitor on top of the rack.

Figure 4: Video switch on the desk in the warm room

- The last line of the program that is running prints the error message - it should say:

  “Errors NONE".

➢ If you have an error, then solve it by doing the following. On the handset, press MODE SELECT once to get manual mode, and again to return to AUTO. This should clear the error.

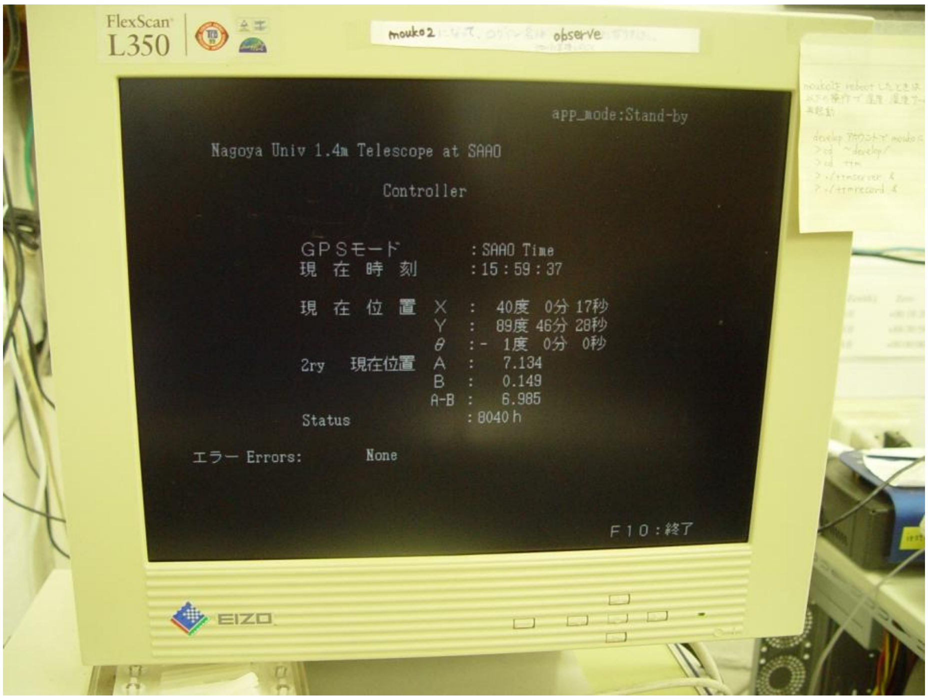


Figure 5: TCS program on MS-DOS computer

5. Start Telescope programs - Mouko2 computer

- Turn the monitor switch to "A" for the Mouko2 computer.
- Check that the following windows are displayed on the screen, initially two:
  - Landscape-shape window - top, left corner of the screen.
  - Portrait-shape window - left side of the screen.

  If you do not get this result, at the console prompt log in as follows.

  User: obs

  Password: Ten-6-Sei

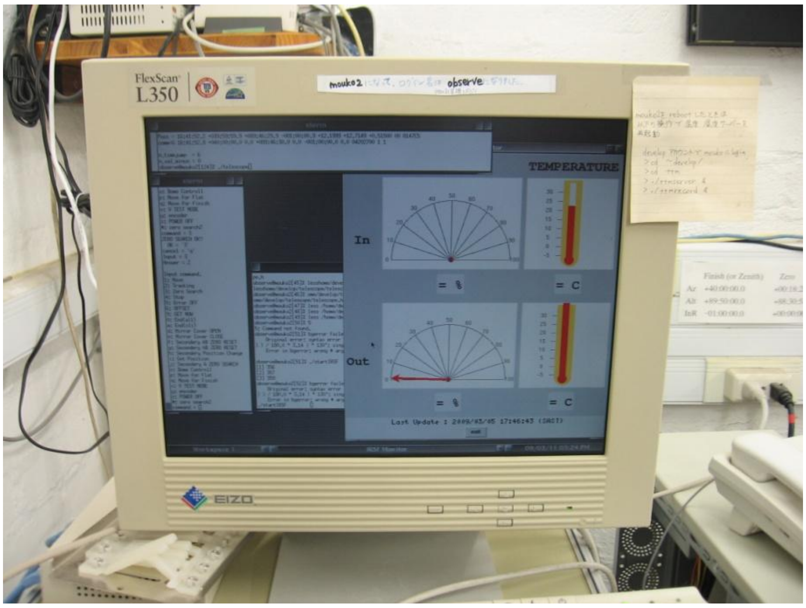


Figure 6: The display monitor with Mouko 2 selected

- On Mouko 2 start the Telescope program, enter the following at the prompt.

  ./telescope

  This will do the following on Mouko2.
  - Override the default 10-minute screensaver timeout.
  - Display the humidity and temperature graph.
  - Open two kterm windows, the portrait and landscape (as above).
- On the landscape window is the telescope status as streaming numbers. The portrait-shaped window displays the Command line interface for the Telescope control program.

6. Start Telescope program – Sirius computer

Telescope control can be done either from the command line interface on Mouko 2, or Go Go Sirius graphical user interface (GUI) on Sirius. The GUI is the preferred method, it is described below and used in the steps that follow.

USING GO GO SIRIUS FOR TELESCOPE CONTROL

The GUI runs on Sirius, on the left screen of the dual-monitor display. If the program is not running, you may need to do one or more of the following steps to restart.

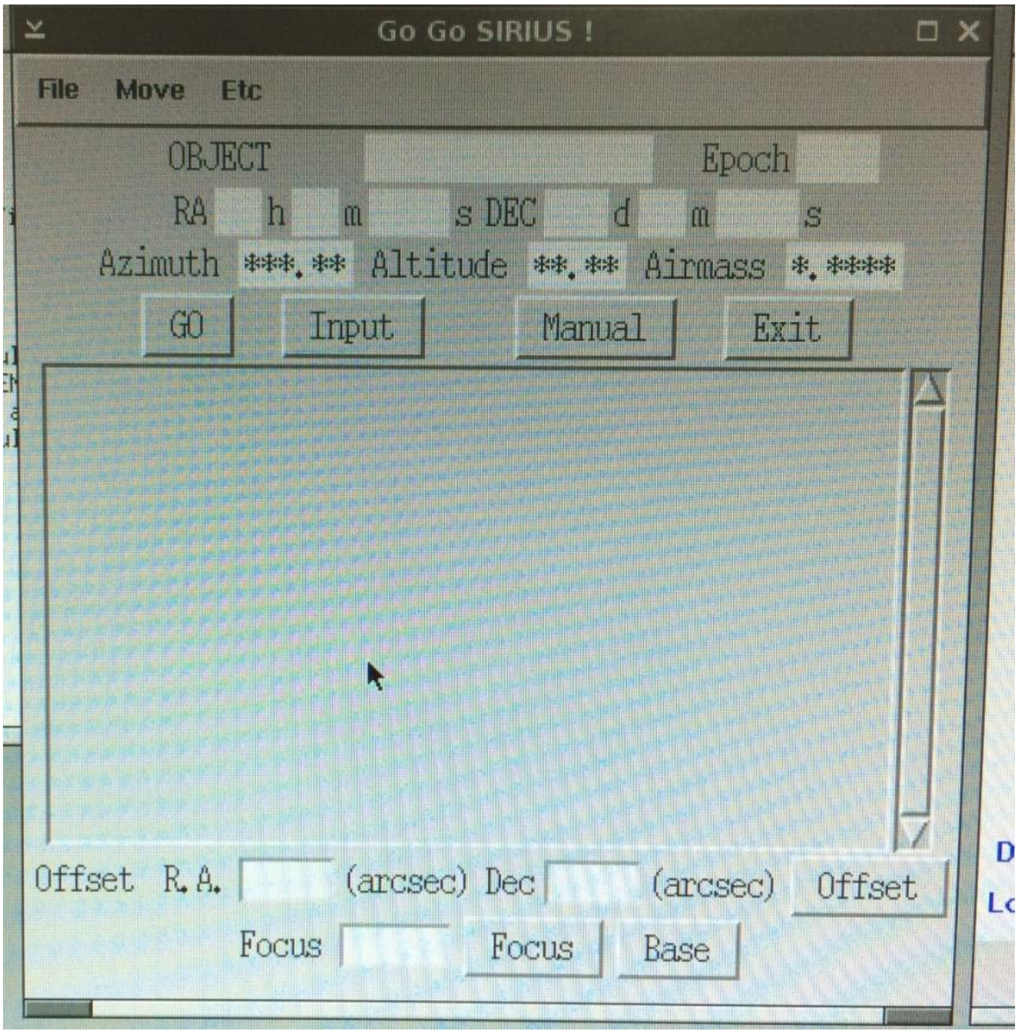


Figure 7: Go Go Sirius on Sirius computer

RESTARTING GO GO SIRIUS

- On Sirius, in any terminal of computer Messia5 (M5), do the following.
  - Login to Sirius. From the Sirius login prompt, as follows.

    User name: observe

    Password: ten-6-sei

  - Login to Messiah5. In the Xterm terminal window, at the *observe@sirius[1]%* prompt, enter:

    m5

    The prompt changes to *observe@m5[1]%*

  - Change to the Observe directory, enter:

    pwd

    /home/observe is displayed on the screen and the prompt changes to *observe@sirius[2]%*

  - Start the Observing program, enter:

    start_obs

    A text string is returned, starting with "xgterm:.."

The steps above are shown in the picture below.

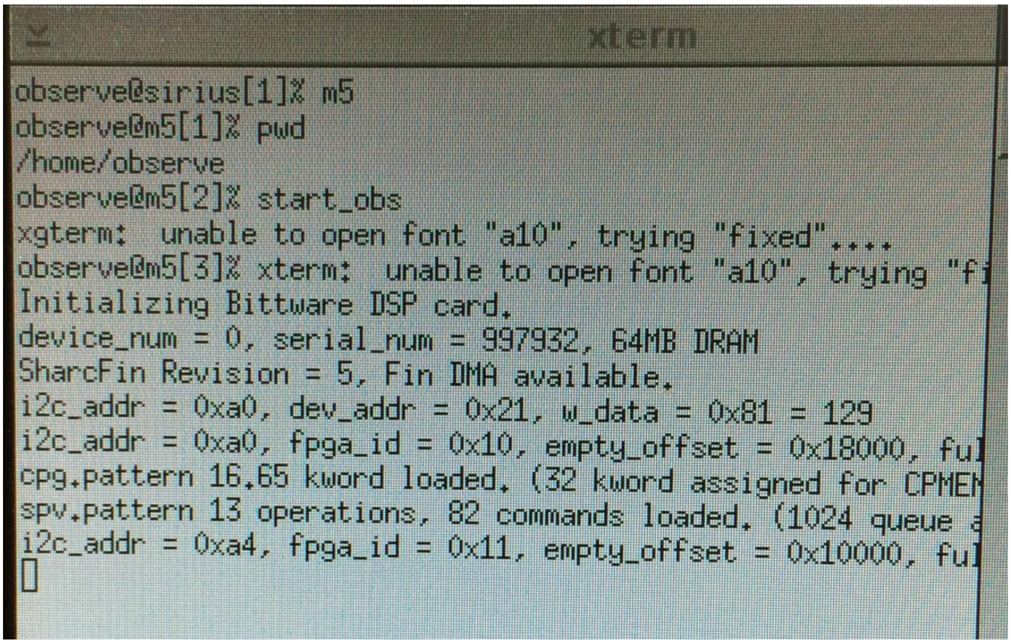


Figure 8: Xterm window on Sirius

- At this stage, the following windows are displayed on the left-hand screen of the dual-monitor display:

  - Xterm (top, left)
  - Go Go Sirius (top, middle)
  - Telescope monitor (top, right)
  - Shell 1 (bottom, left)
  - Shell 2 (bottom, right)

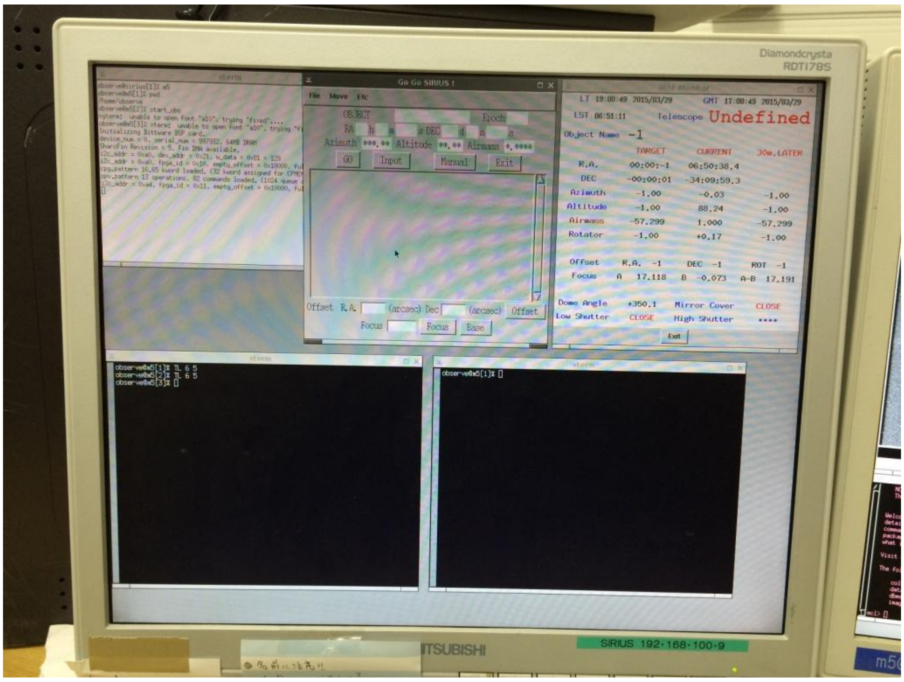


Figure 9: Left screen on Sirius dual-monitor display

7. Initialise telescope encoder – Zero search

- Select from the Go Go Sirius menu:

  Move ➔ Zero Search, then Yes" to confirm.

  On the Mouko2, check the landscape window that gives telescope status. The encoder values will change as follows:

  - Azimuth - decrease
  - Altitude - decrease
  - Instrument rotator - increase

  The telescope will start moving, and will stop, aligned North-South.

- Check the last 4 digit of the stream of the numbers in the portrait window of Mouko2. It should change from 8xx6 to 8xx3.
- When Zero search is successfully done, it will be 8xx7. At base of the telescope, the label "Encoder origin" on the aluminium plate of the rotating structure should be aligned with the red tape (marked with arrow) on the non-rotating structure (green).

  If not, Zero search has failed and must be repeated.

Figure 10: Encoder origin aligned

8. Open the dome shutter

- From Go Go Sirius, open the dome shutters:

  Move ➔ Dome ➔ Open

9. Open the mirror cover

- From Go Go Sirius , open the mirror cover:

  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 from the two chains. To remedy go up and lift the chain from the motor gear, and move the chain manually.

10. Start the graphical Telescope status monitor

- Start the program in any terminal of computer "m5" (dual monitor display), enter:

  telmon (CR)

11. Take dark image

CHECK COLD SHUTTER

- Check that the shutter is closed, the yellow LED indicates the correct position.

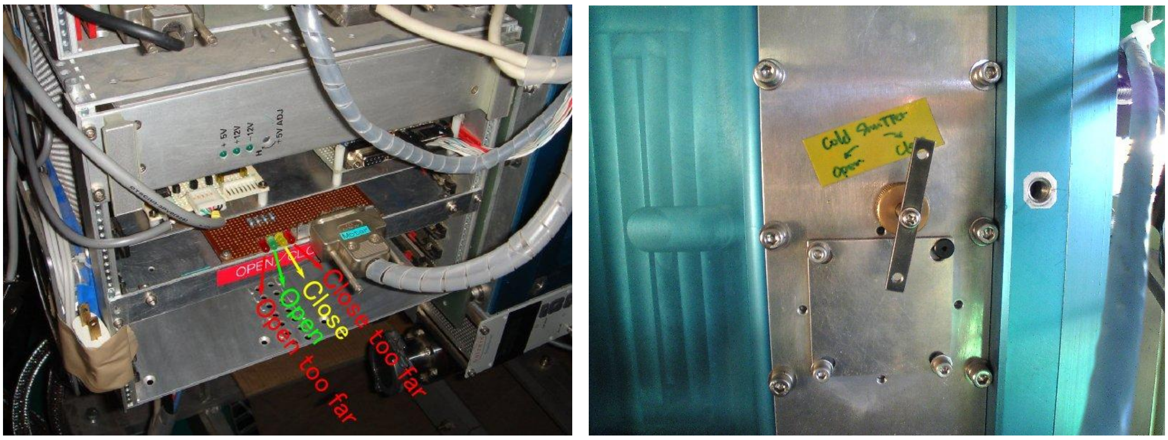


Figure 11: Cold shutter position indicators (left), cold shutter lever (right)

COMPLETE THE OBSERVING SETUP ON SIRIUS

- Go to the Sirius computer in the warm room (pictured below) for the last step in the procedure, to issue the command to take a dark image.

Figure 12: Sirius computer in the warm room

PREPARE SCIENCE DATA STORAGE AND FRAME NUMBER

- In any terminal of m5, enter:

  dirset [yymmdd (ex. 090805)]

- create the directory, enter:

  dirset

- reset frame number counter, enter:

  /home/data/raw/<dyymmdd>

TAKE DARK FRAME

1. In any terminal of "m5", enter:

   *sirius_setup

   messia

   ds9 &

   * Includes power supply setup described in Part 1, under Kenwood power supply operating instructions.

2. Take a dark frame by typing:
   TL 6 2

   Ignore the first image. Repeat the command and inspect the image in the ds9 panel (right-hand side screen of the dual-monitor display), compare it to figure 13 (below).

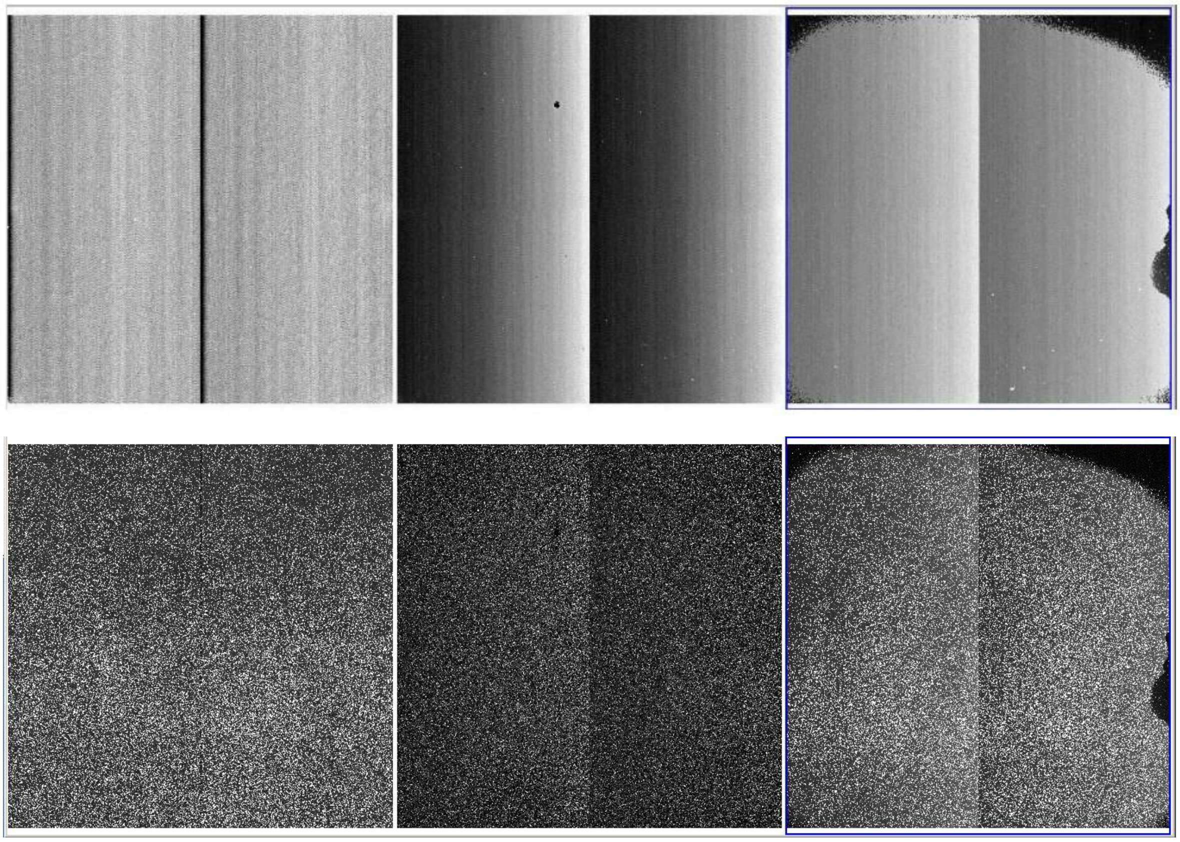


Figure 13: Normal dark image (top), Hot pixels image (bottom)

Postcondition

With the telescope and instrument initialized, it is ready to operate. Commands to move the telescope can be issued from either TCS computer, or the hand paddle.

Shutdown procedure

The procedure for shutting down under normal operating conditions, once observing has finished.

Pre conditions

- Instrument and telescope control systems are running.
- The operator is familiar with the controls which have been described in more detail in the **Startup procedure**.

Procedure

1. Move the telescope to the "Zenith" position

- On Go Go SIRIUS:

  Move ➔ Zenith

  Then wait until the telescope becomes READY on Telmon.
- End telmon once the telescope is at the rest position.

2. Close the Mirror Cover

- On Go Go SIRIUS:

  Move ➔ Mirror Cover ➔ Close

  Then wait for the mirror cover status on Telmon to change to CLOSE.

3. Close the Dome Shutter

- On Go Go SIRIUS:

  Move ➔ Dome Shutter ➔ Both Shutter Close

  Then wait until the shutters closed completely.

4. Close the Cold Shutter of SIRIUS

- Go to the East side of the SIRIUS instrument. Turn the lever clockwise about 20 times (1 turn is 180 deg) to close the shutter.
- A yellow LED will turn ON to confirm that the shutter is close. If the red LED (right-hand side) turns ON, then the shutter is closed too far.

5. Exit "telescope" program

- On Go Go SIRIUS:

  Etc ➔ Exit telescope

  The stream of numbers by the telescope program (Mouko2) will stop and a prompt is available.

6. Shutdown "MS-DOS" computer

- Push **button D** in the Figure 1, and then "MS-DOS" computer will stop.

  If this button does not work, power-cycle the rack using the **main power switch at the back**. If you are facing the rack, it is on top, on the right-hand side.

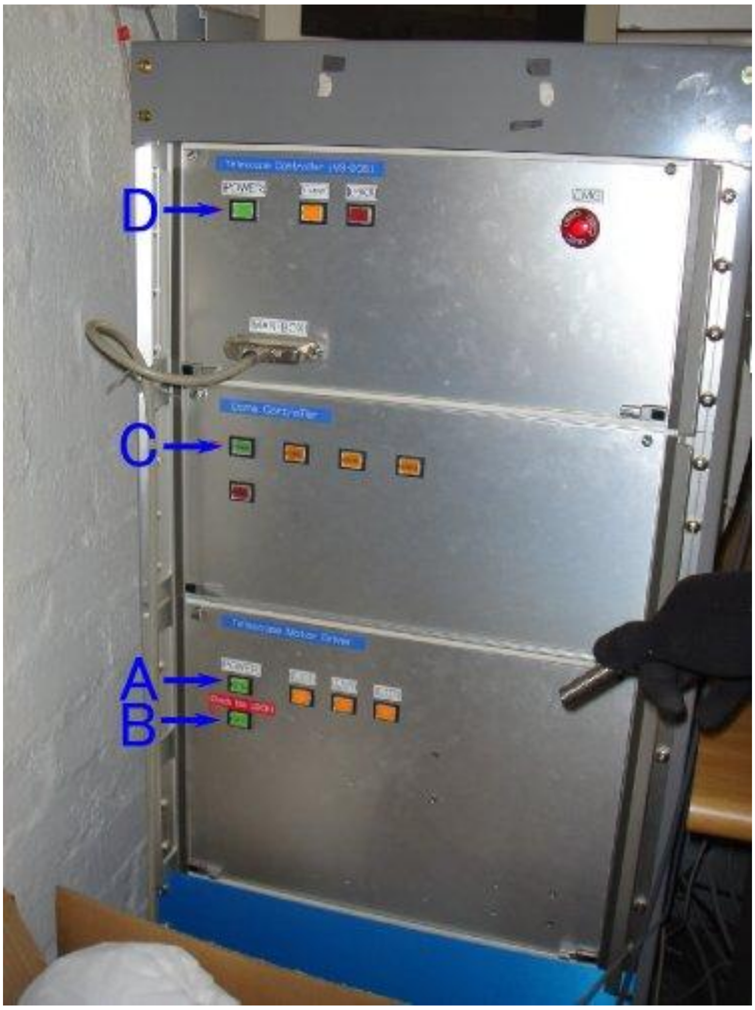


Figure 1: Telescope rack

7. Switch the Dome drive OFF

- Push **button C** in Figure 1.

8. Engage the altitude lock of telescope

- Climb up the telescope mount, and insert the lock pin to the lock position.

9. Switch the Telescope drive OFF

- Push **button B** in Figure 1.

10. Close the louvres

- Close the louvres in the dome. The louvres in the equipment room may be left open.
- Switch the de-humidifier fan OFF.
- Switch the mirror fan OFF.

Post condition

The telescope is parked. Telescope and instrument systems are shutdown, certain systems may be left running. For example, the Observing programs on Sirius.

Part 3: Troubleshooting

Recovery from abnormal shutdown

Introduction

The procedure describes the instrument and telescope checkout done after a power fail event.

The procedure references others section in the manual.

Pre conditions

None.

SIRIUS instrument checkout

1. Cooling system

- The water chiller is ON. Restart as required.
- The Helium compressor is ON. Restart as required

2. Detector temperature

- On the instrument at the telescope, check the detector temperature (K, H, J) is 85K. The cold head (1st Head) should be less than 65K. This is illustrated in the extract from the web page, link below:

  http://irsfweb.suth/~develop/graph/sirius_temp.html

  It shows the typical temperature values under normal operating conditions.

Current Temperature

Ks-Detector	+085.00K	Offner 2nd	+112.55K	1st Head	+063.73K
H-Detector	+084.98K	ColdBox Center	+109.94K	Shutter	+150.95K
J-Detector	+084.98K	ColdBox Corner	+113.27K		

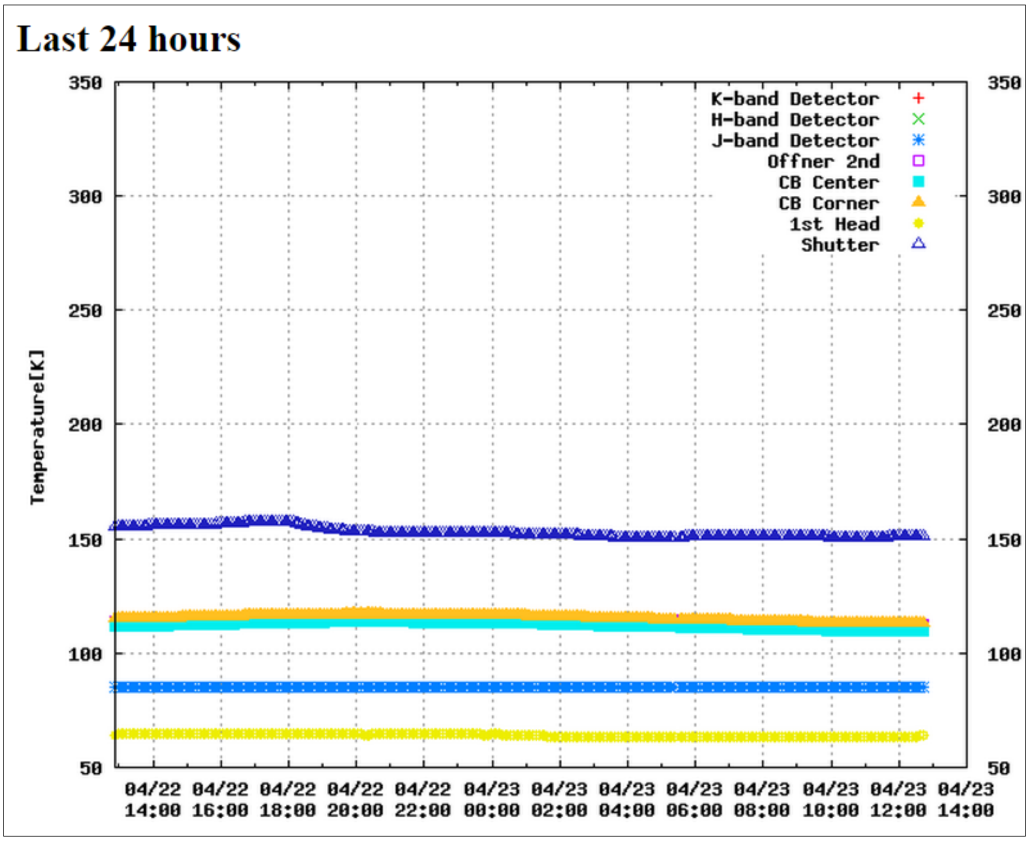


Figure 1: SIRIUS temperature. Normal values (top). Last 24 hours plot (bottom).

3. Cryostat vacuum

- The vacuum is better than 1 x 10^{-5} Torr (normal operating). If it is not, complete the following assessment to determine what remedial action to take.

ASSESSMENT OF VACUUM

The purpose of the assessment is to determine whether the Vacuum Pumping procedure is required. At this stage the Cold head temperature is greater than 85K, continue monitoring the plot on the temperature web page. The following scenarios:

1. **Scenario 1**
   - The water chiller and helium cooler is restarted within 30 minutes of the mains power failure.
   - The vacuum is improving, correcting to 1 x 10^{-5}.
   - The Cold head temperature is falling, correcting to 85K.

   Conditions are promising, monitor the vacuum and temperature for further improvement. Repeat the assessment every half hour for two hours, by which time it should be fully recovered.

2. **Scenario 2**
   - The vacuum is NOT improving, tending to 1 x 10^{-3} Torr or worse.
   - The Cold head temperature has increased more 10K from normal operating and continues to rise.

   You may need the **Vacuum Pumping procedure** to recover the instrument**.**

4. Detector power

CHECK KENWOOD DC POWER SUPPLY VOLTAGES

- Check the voltage outputs of the two PSUs:

Output	Volts	Amps
+18V O/P	+15.8	0.56
-18V O/P	-15.8	-0.48
+6V O/P	+5.77	2.2

Table 1: Large Kenwood PSU normal voltage

Output	Volts	Amps
+18V O/P	+15.8	1.13
-18V O/P	-15.8	-0.96*

Table 2: Small Kenwood PSU normal voltage
* Range: -0.55A to -0.96A

- The Kenwood power supply setup is described in the Sub systems description, under Instrument – Detector DC power supply.

5. Instrument computer

- At the instrument, check that Messiah 5 is powered ON.

- In the warm room, check that DS9 observing application is running on SIRIUS. Do a dark frame to verify. This is described in the Operators Startup procedure.

Telescope re-initialise

- A power failure event can cause telescope control to be lost. The telescope position encoders and Telescope Control computer, among other TCS systems, need to be re-initialized.

To remedy, do the following:

1. Telescope shutdown procedure

   Skip the following steps:

   - Close louvers
   - Engage altitude lock
2. Telescope start-up procedure

Post condition

Telescope and instrument are re-initialised ready to operate.

Telescope encoder limit fault

Introduction

This document describes how to reset the telescope encoder limits by doing a "Zero Search" on the IRSF telescope. This procedure initialises the telescope in azimuth and altitude and also initialises the instrument rotator prior to starting observations.

Procedure

1 Azimuth - Align the silver tape on the telescope with the red mark on the base.

2 Altitude – Make sure the telescope is pointing at the zenith and not in the limit.

3 Instrument Rotator – set the sensor to the left of the tape on the telescope.

4 If the X co-ordinates are out of range, then do the following:

4.1 Select the DOS PC – switch position B

4.2 Switch off the MS DOS PC (top of drive rack)

4.3 Switch on the PC pressing Ctrl C repeatedly. You should get a prompt in Japanese. Answer Y to it to get into DOS. **Type "del scope.dat"** to delete the file scope.dat holding the erroneous number.

4.4 Switch the DOS PC off then on at the back, then switch on using switch on the front panel.

4.5 The screen should flag a backup error because of deleting the file. Push the "Mode Select" switch twice on the handset to correct the error.

5 Assuming X coordinate is correct, do the following.

6 Switch KVM selector to position A.

7 In the ./telescope window type" ./telescope" .

8 On the Sirius PC (LHS observers screen) log in at Sirius prompt by typing "m5".

9 At the m5 prompt type "start_obs". Numerous windows are opened.

10 In the gogo Sirius window select "move" then "zero search".

11 The azimuth moves to align the two red markers, the altitude finds the zenith position and the rotator initialises.

12 Check that the number in the. /telescope window is 80x3 indicating all OK.

Instrument pumping down procedure

Introduction

The procedure describes the instrument cryostat pump down procedure. The general flow is: warm-up, vacuum assessment and pump-down, finish pump-down and cool instrument.

To familiarize yourself with the process refer to The IRSF Vacuum Pump, in Part 2.

Pre conditions

The cryostat pressure is greater than 1 x 10^{-3} torr (partially evacuated), as high as 1 torr (tending to atmosphere).

Procedure

ASSESS VACUUM AND SELECT PUMP-DOWN PROCEDURE

Take the reading on the instrument vacuum gauge to determine which of the following conditions apply, then take the recommended action.

1) **Partially evacuated cryostat**

The cryostat pressure is greater than 1×10^{-3} torr and less than 1 torr.

Action: pump-down.

2) **Cryostat at atmosphere**

The cryostat pressure is greater than or equal to 1 torr - **cryostat is tending to atmospheric pressure**.

Action: warm-up, pump-release, pump-down, finish pump-down and cool.

PUMP-DOWN PROCEDURE: PARTIALLY EVACUATED CRYOSTAT

Study the pictures of the vacuum pump setup below before doing the procedure that follows.

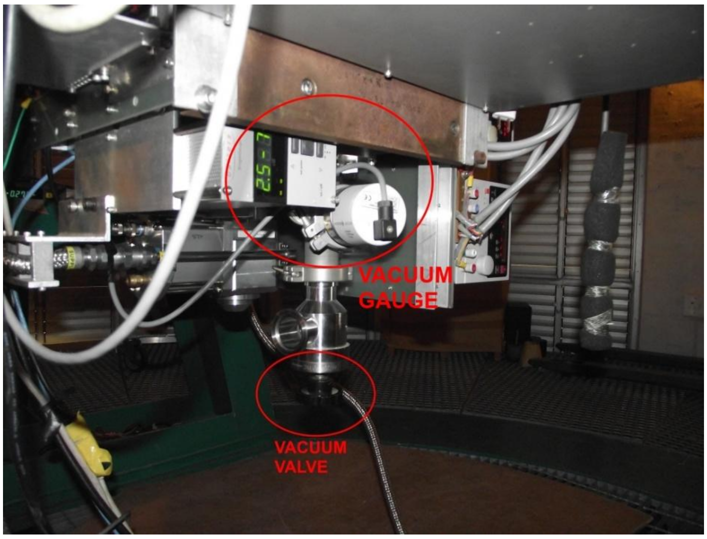
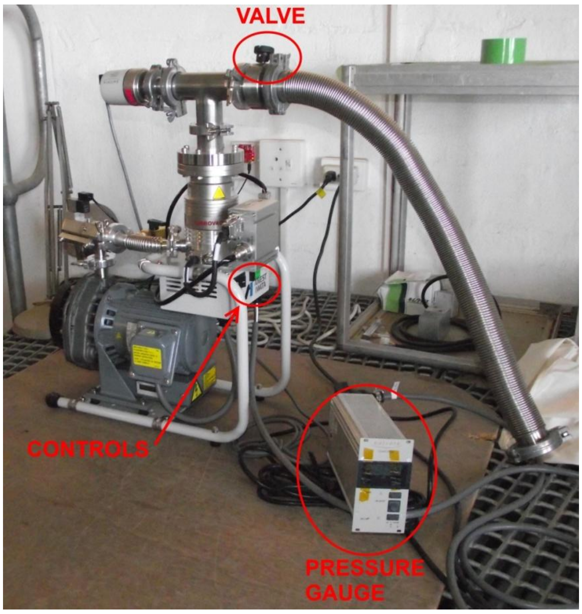


Figure 1: Instrument Vacuum Valve and Vacuum gauge



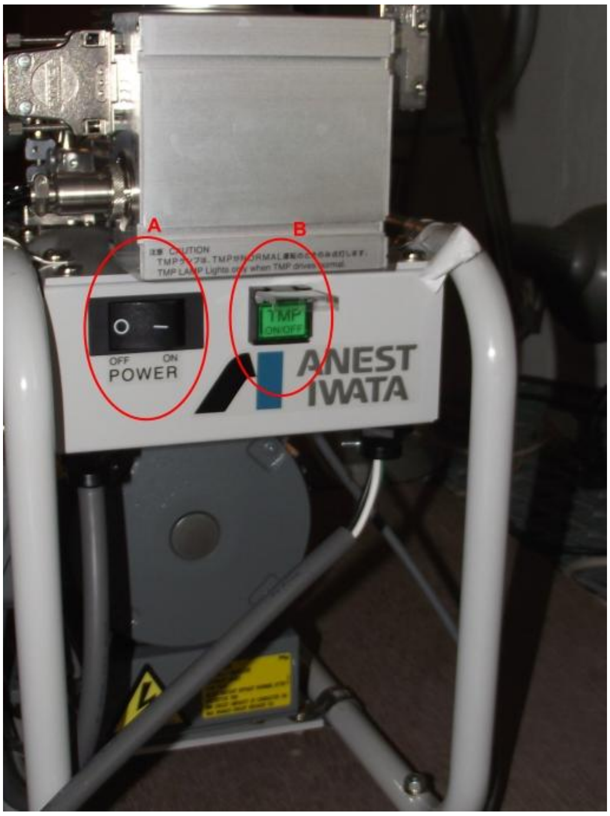


Figure 2: The IRSF Vacuum pump (left),
Pump controls: A: Scroll Pump, B: Turbo pump (right)

Start pump down on a cryostat that is partially evacuated

1. Move the pump close to the instrument.
2. Connect the pump & vacuum gauge mains cables (AC100V).
3. Connect the hose to the instrument .
4. Open the valve on the pump (see figure 2). The valve on the instrument remains closed.
5. Switch Button A ON to start the scroll pump (see figure 2). Pump to 1×10^{-2}torr, the base pressure for the turbo molecular pump.
6. Switch Button B ON to start the turbo molecular pump (see figure 2).
7. Wait until the hose pressure is less than or equal to the cryostat. See Figure 1 for the location of the instrument vacuum gauge.

   For example, if the cryostat pressure was 1×10^{-3}, the hose pressure can be equal to or less than 1×10^{-4}. This is to ensure the flow is out of the cryostat.

8. Open the valve on the instrument (See figure 1).
9. Operate the pump for at least 8 hours. The cryostat pressure should decrease to normal operating, that is less than or equal to 1×10^{-6}torr.
10. Next, finish pump down and cool instrument.

PUMP-DOWN PROCEDURE: CRYOSTAT AT ATMOSPHERIC PRESSURE

Warm-up detector

1. Change the detector temperature control set point to 110K – and keep the He cooler running.
2. Wait for the detectors to reach the set point (~2 hours).
3. Change the set point to 300K and switch off the He cooler. Wait between 5 and 18 hours for the detectors to reach 300K.
4. Check that the detector temperature has settled at 300K. This is to ensure that ALL the cold parts inside the cryostat have warmed up to ambient temperature, to avoid condensation when the vacuum is released.
5. Switch off DC power to the detector electronics at the two Kenwood PSUs attached to the side of the instrument. Use the "OUTPUT" buttons at Top RH corner.
6. **Open the instrument vacuum valve** (See Figure 1) slowly to allow air to flow into the cryostat – as slow as you can make it, especially at first.

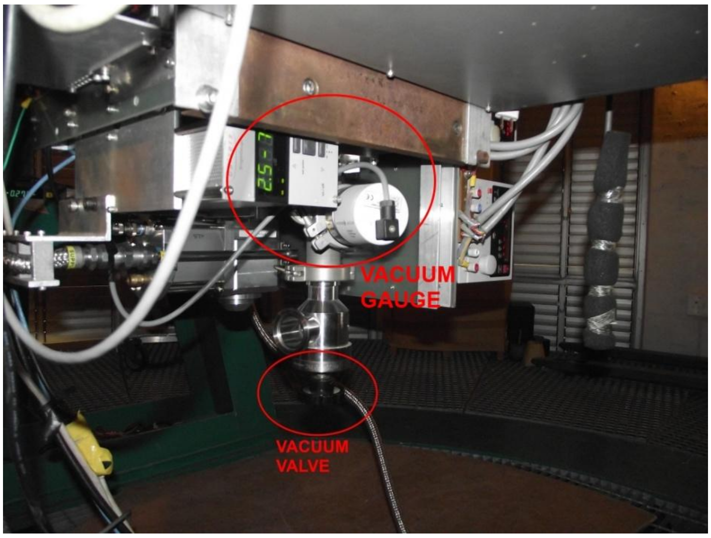
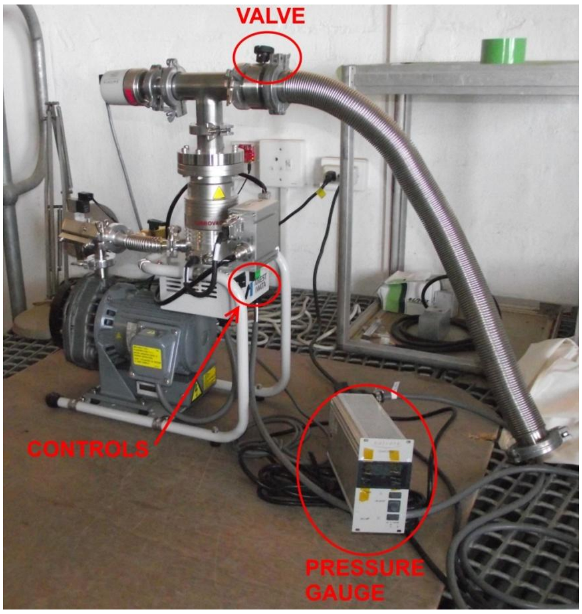


Figure 1: Instrument Vacuum Valve and Vacuum gauge

7. Leave the vacuum valve open for about 10 minutes with clean paper covering the valve opening.



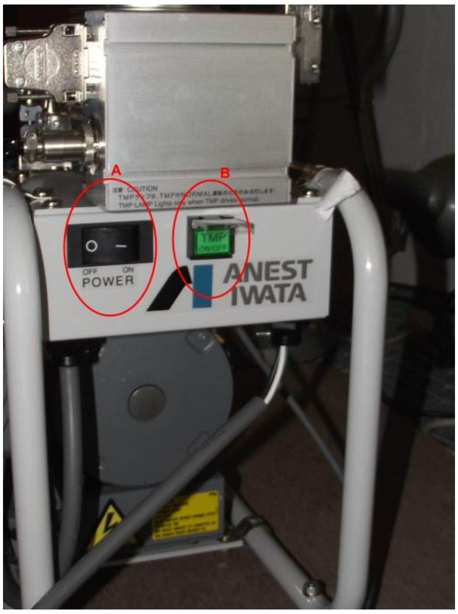


Figure 2: The IRSF Vacuum pump (left),
Pump controls: A: Scroll Pump, B: Turbo pump (right)

Setup the pump

1. Move the pump close to the instrument.
2. Connect the pump and vacuum gauge mains cables (AC100V).
3. Connect the hose to the instrument.

Pump-release

4. Open the pump valve (see figure 2).
5. Open the instrument valve (See figure 1). It should be open already.
6. Switch Button A ON to start the scroll pump (see figure 2). Wait until the pressure in the hose reaches 1 x 10^{-2}torr or less.
7. Switch Button B ON to start the turbo molecular pump (see figure 2). Pump for 5 minutes.

8. Close the cryostat valve, switch off the pump and wait for the turbo to spin down, then disconnect the hose at the cryostat.
9. Close the pump valve.
10. **Open the cryostat valve - slowly -** to allow air to flow into the cryostat. Wait 5 minutes.

11. Repeat steps 4 – 10 for the second time.

Final pump down

12. Reconnect the pump (Steps 3 - 7 above) and pump for at least 8 hours.
13. Next, finish pump down and cool instrument, as described below.

FINISH PUMP DOWN AND COOL INSTRUMENT

Having pumped for at least 8 hours (from cryostat pressure 1 x 10^{-3}torr), check that the pressure is decreasing (vacuum improving). It should settle at the target pressure of 1 x 10^{-6}torr.

If the cryostat pump-down was done from atmospheric pressure, then:

1. Set the detector temperature set point to 85K.
2. Start the He cooler compressor.
3. Continue pumping until the detectors reach the 85K set point (~18 hours).

Routinely do the following, regardless of initial cryostat pressure

4. Close the valve on the instrument, stop the vacuum pump.
5. Close the valve on the pump (Figure 1).
6. Disconnect the hose from the instrument flange – and blank off the hose and put a plastic dust cover on the instrument flange.

Shutdown the pump

9. Switch Button B OFF to stop the turbo molecular pump (Figure 2)
10. Switch Button A OFF to stop the scroll pump (Figure 2)
11. Wait for the turbo to slow down **-** ~ 5minutes or so – then open the valve on the pump (Figure 1) for about a minute, then close it again.
12. **NB!** To avoid possible damage to the turbo pump bearings, **do NOT move the pump until the turbo has stopped spinning**.
13. Cover the pump with the makeshift dust cover. It is exposed to the elements when the telescope building is open.

Check the detector system

14. Ensure that the detector DC power supply is turned ON.

15. Check the detector performance by following the step listed below. This is detailed under **Take Dark Image** under **Startup procedure** in Part 2**.**

    The science programs on Sirius computer (dual monitor display) may be running. A known issue is that the **image frames may not refresh**. As a result, hot pixel image from the initial instrument failure event may persist.

    If hot pixels persist, close all the programs and repeat the DS9 setup as follows.

Take dark frame

1. In any terminal of "m5", enter:

   *sirius_setup

   messia

   ds9 &

   * Includes power supply setup described in Part 1, under Kenwood power supply operating instructions.

2. Take a dark frame by typing:

   TL 6 2

   Ignore the first image. Repeat the command and inspect the image in the ds9 panel (right-hand side screen of the dual-monitor display), compare it to figure 13 (below).

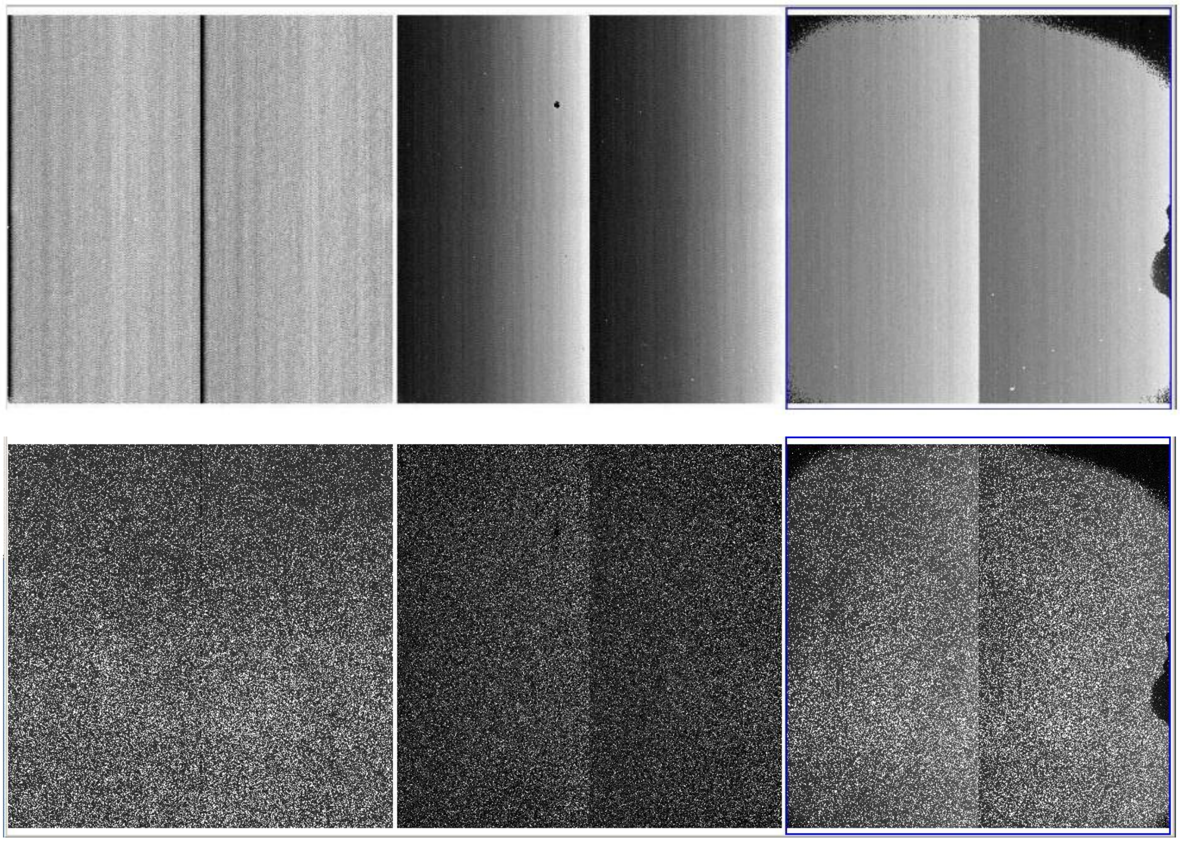


Figure 13: Normal dark image (top), Hot pixels image (bottom)

Post condition

Cryostat pressure is less than or equal to 1 x 10^{-6}torr and detector temperature has settled at 85K.