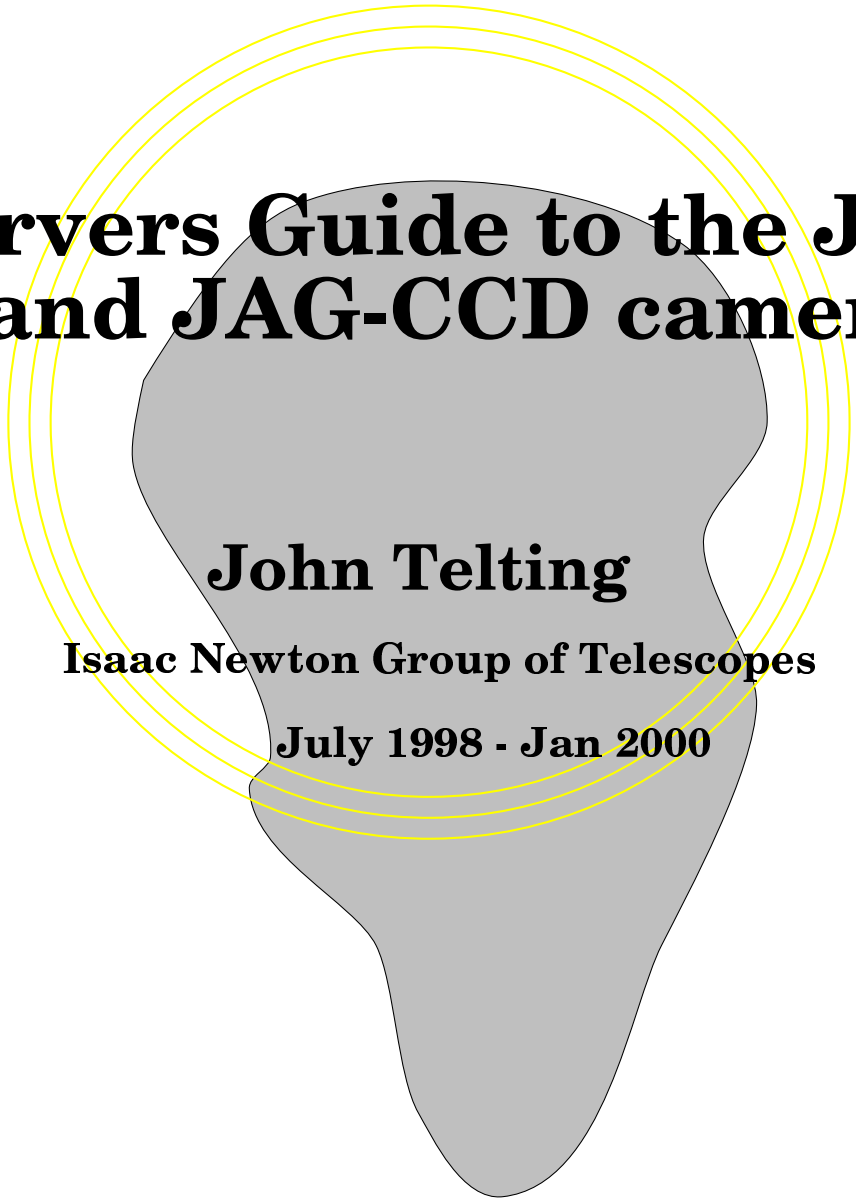
Observers Guide to the JKT and JAG-CCD camera



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Contents

1 Scope of this manual

This is a thorough rewrite of Phil Rudds "Observers Guide to the JKT CCD Camera".

This manual describes how to use the JKT and the JAG CCD camera with the Alpha-based Telescope Control System (TCS) and the Sparc-based Instrument Control (ICS) system and Data Acquisition System (DAS). The manual is aimed at visiting astronomers.

Sections 3–7 provide the reader with an extensive observing recipe, addressing all items necessary to operate the JKT and the JAG concisely.

This manual only lists the commonly used user commands of the DAS, ICS, and TCS systems. For an extensive command reference of each subsystem, please read the corresponding manuals (see below).

1.1 Document history

Additionally, this document tries to replace the previous JKT/JAG-CCD user manuals, as all of those were hopelessly out-of-date.

Some of the text in this document is taken from other documents.
Main sources:

- "Observers Guide to the JKT interim DAS CCD Camera", by P. Rudd.
- "Jacobus Kapteyn Telescope, a user guide to the JKT CCD camera", by R. Argyle, C. Mayer, C. Pike, and P. Jorden.
- "ING Observers' Guide", July 1994, by D. Carter, U. Sharan, and R. Clegg.
- "User Guide to the JKT", June 1989, by D. Jones, R. Argyle, and C. Pike.
- "User manual for the Sparc based Data-Acquisition system", May 1997, by D. Matthews and R. Edwards.
- "JKT Telescope Control System Manual", July 1998, by R. Laing and M. Fisher.
- "User Manual for the JAG Software", July 1998, by S. Crosby.

2 JKT, JAG, and CCD-imaging overview

As of 1998 the JKT is a single-instrument telescope, that can only be used for CCD-imaging. The night-time engineering support is minimal; there is no Telescope Operator, and the Duty Engineer is only available if the WHT or INT do not require his/her attention. You will be assisted by your Support Astronomer for the first part of the first night of your observing run.

The JKT is operated east of pier, with the f/15 secondary, and with the JKT Acquisition and Guiding unit (JAG) mounted at Cassegrain. The JAG holds the autoguider, the acquisition TV, the CCD shutter, and the filter wheel with 6 slots for 50x50mm filters. When the acquisition TV is in use, the light path to the CCD is blocked.

The CCD cryostat is mounted under the JAG. Currently, the default detector is SITe2, a device with 2048x2048 24μm pixels. For SITe2 the image scale is 0.33 arcsec/pixel, giving an unvignetted field of view of about 10x10 arcmin. A future CCD might be a 2048x4200 13.5μm pixel EEV device.

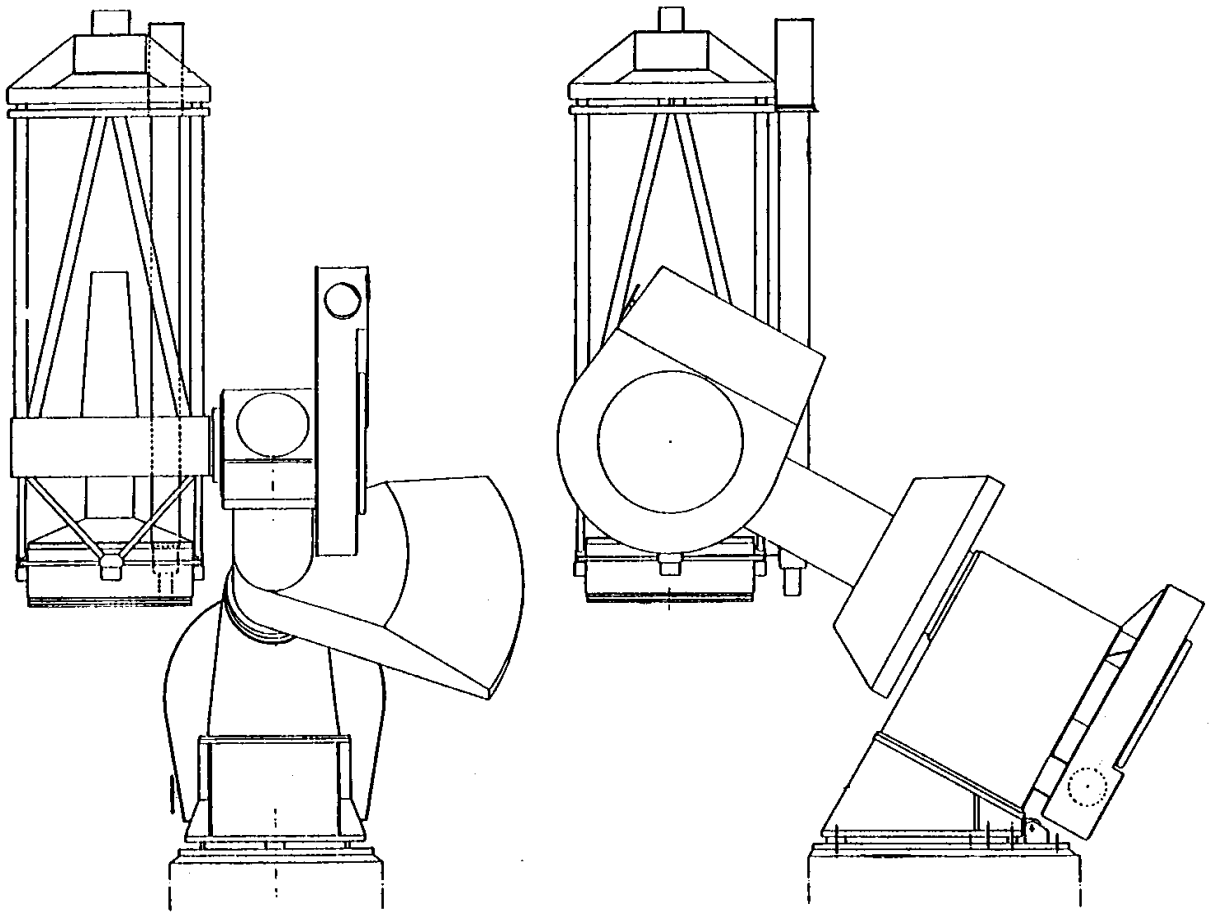

Figure 1: Schematic view of the JKT east of pier, as seen from the north (a) and west (b)

From July 1998 the JKT will be operated using new software systems: an Alpha-based Telescope Control System (TCS), a Sparc-based Instrument Control (ICS) system, and a Sparc-based Data Acquisition System (DAS). These systems are designed to be operated by just one visiting astronomer, although the JKT control room accommodates the presence of another astronomer.

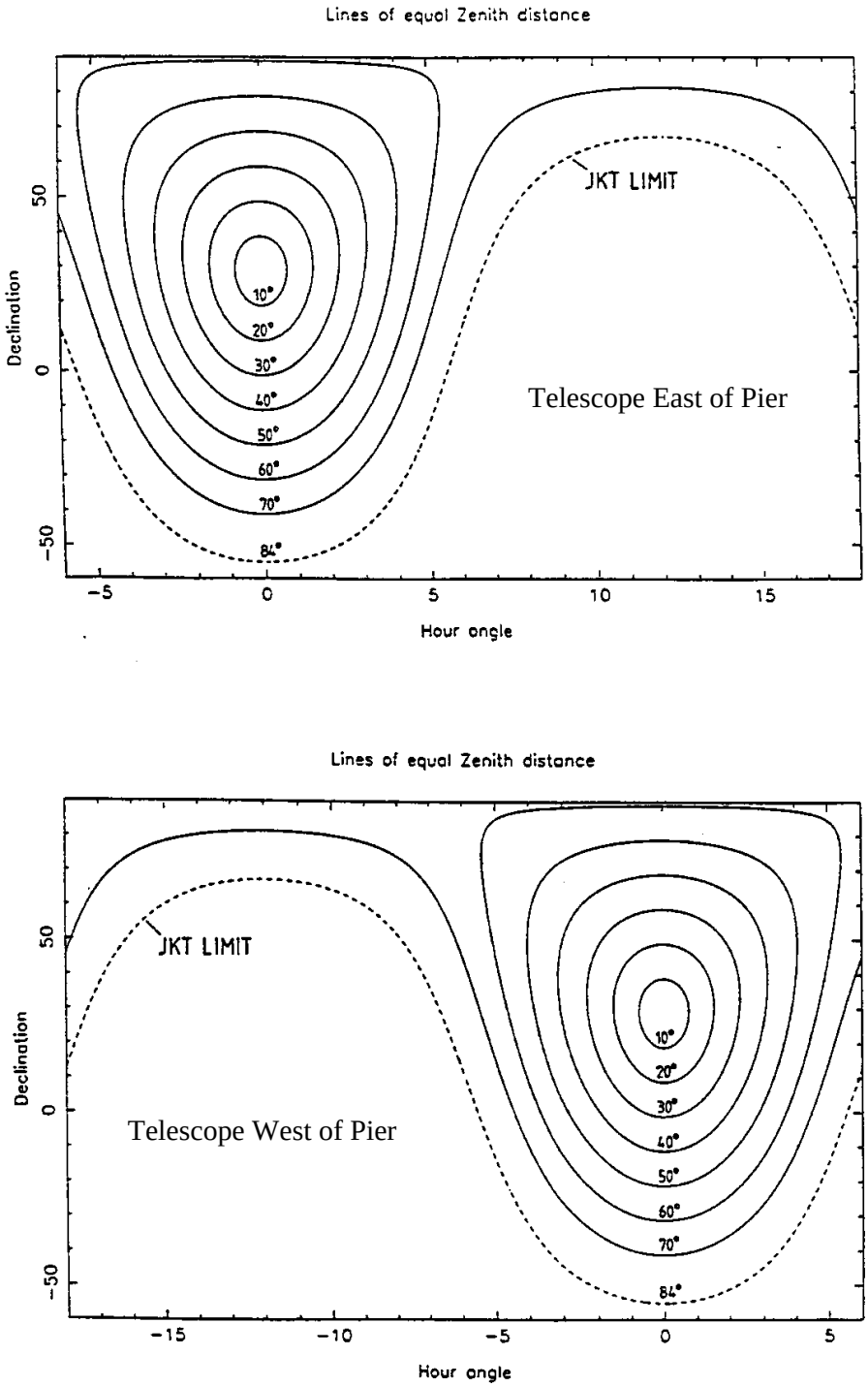

Figure 2: The area of sky accessible to the JKT. Lines of constant zenith distance are drawn on a plot of declination against hour angle. The horizon and hour-angle limits are shown for the two possible cases: (a) Telescope east of the pier (b) Telescope west of the pier

The TCS runs on a VMS-Alpha that can be accessed from an Xterminal in the control room. The ICS and DAS run on two Sparc stations that are also in the control room. Quick data inspection can be done using an IRAF session on one of these Sparc stations. Another terminal is available to access the data analysis Sparc station remotely, in case that a second astronomer needs access to the data.

2.1 The Jacobus Kapteyn Telescope

The Jacobus Kapteyn Telescope (JKT) has a parabolic primary mirror of diameter 1.0m. It is equatorially mounted, on a cross-axis mount, which allows operation east or west of the pier. Normally it is East of the pier, if operation West of the pier is required the user should contact the telescope manager in advance. The secondary is a hyperboloid, which gives a conventional f/15 Cassegrain focus.

2.1.1 Mechanical performance

Telescope limits:

- Zenith distance $<$ 84 degrees
- -6 h $<$ hour angle $<$ +18 h (telescope East of pier)
- -18 h $<$ hour angle $<$ +6 h (telescope West of pier)
- There are no explicit declination limits.
- The fully-lowered windshield which sits on the dome lintel sets a further limit. Because of the asymmetry of the telescope, the limits are different east and west of the pier (see La Palma Technical Note 28).

Speed limits:

- Hour angle and declination: 1.0 degrees/s
- Dome rotation: 1.5 degrees/s
- Pointing accuracy: RMS residual of a global fit $<$ 15 arcsec
- Tracking accuracy:

  (unguided) $<$ 1 arcsec in 3 minutes; $<$ 3 arcsec in 10 minutes

  (guided) $<$ 0.3 arcsec
- Rotator positioning: $<$ 0.2 arcsec over the whole field
- Offsetting accuracy: $<$ 0.3 arcsec over 10 arcmin

2.1.2 Optics

Details of the individual optical elements are collected in Table 1. Table 2 gives the most important parameters of the available optical configuration, illustrated in Figure 3. The parabolic primary has a clear diameter of 1.000m and a focal length of 4.596m.

The hyperbolic secondary constitutes with the primary a conventional f/15 Cassegrain system. The curved focal surface is located 760 mm behind the pole of the primary mirror, giving a 34.4 arcmin diameter field with a scale of 13.8 arcsec/mm.

The maximum movement of the secondary mirror is 20mm about the nominal focus position. For the f/15 system this produces a shift of 241mm about the optimum focal position; the on-axis image size is calculated to grow approximately linearly with focus shift up to a maximum diameter of 0.3 arcsec.

As of 1998 the Harmer-Wynne f/8.06 focus has been decommissioned.

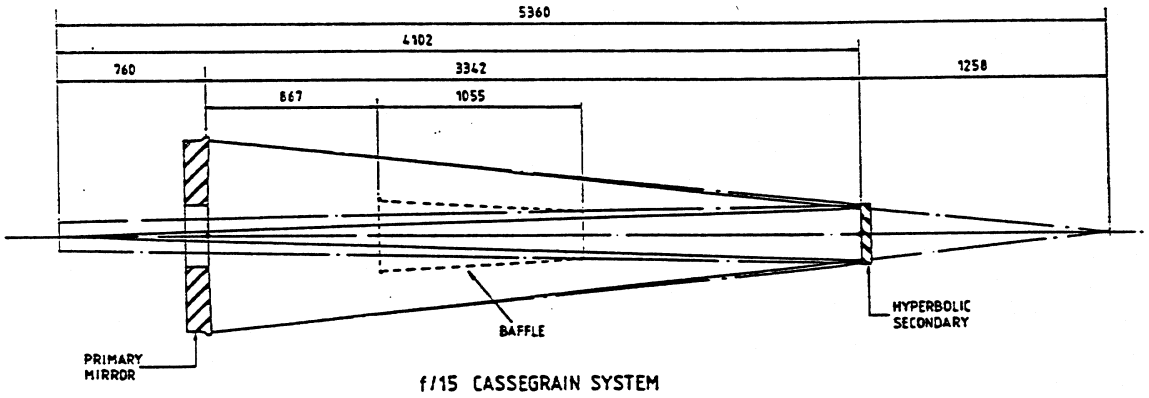

Figure 3: Optical layout of the JKT, showing the f/15 Cassegrain configuration

Table 1: Summary of mirror characteristics for the JKT

Element	Shape	Asphericity	Working Diameter	Focal length	Separation from primary	Material
Primary	Paraboloid	-1	1000 mm	4596 mm		Cervit
f/15 Secondary	Hyperboloid	-3.545	307 mm	1811 mm	3342 mm	Zerodur
Finder (doublet)	Sph. surfaces		200 mm	3250 mm		

2.1.3 Finder telescope

The JKT has a 20cm refracting visual finder telescope with a focal ratio of f/16.25. Depending on the eyepiece used, fields of 10, 30 and 90 arcmin may be viewed visually from the observing floor. The finder is only used to diagnose gross pointing problems and for fun.

2.2 The JKT Acquisition and Guiding box (JAG)

The Acquisition and Guiding Box for the JKT was first tested on the telescope in 1987 August. It is specifically designed to operate with the CCD camera and will accept all standard RGO cryostats. Figure 4 shows the essential features of the instrument.
The main features are as follows:

Table 2: Optical characteristics of JKT foci

Focal station	Cassegrain	Finder
Focal length (mm)	15000	3250
Focal ratio	f/15	f/16.25
Field diameter (arcmin)		
no vignetting	34	10,30,90(**2**)
50% vignetting	50	
Scale (arcsec/mm)	13.8	63.5
Diameter of central obstruction (mm)	406	
Focus/mirror shift(**1**)	11.7	

1) Movement of focal position for unit movement of secondary mirror
2) Depends on eyepiece used

- The filter wheel with 6 slots for 50x50mm filters. It has a raised index with a V-shaped indent located between positions 6 and 1, which is used to initialize the wheel.
  Check the ING filter database to see which filters we have currently available:
  http://ing.iac.es/ quality/filter/newfiltdoc.html .
- A fixed rectangular flat with a circular hole set at 45 degrees to the optical axis which directs light to a standard RGO autoguider. The field of view is annular with an outer radius of about 17 arcmin and an elliptical inner radius of 10–13 arcmin. The PA of the major axis is usually east-west. Stars as faint as V=13 can be used for guiding but brighter stars are preferred. The autoguider moves on x-y slides and can examine the offset field from the flat mirror. It has an acquisition field of 2x2 arcmin.

  The autoguider has two sets of filters: ND and colour. For the highest accuracy at large zenith distances, the colour filter should be similar to that of the CCD camera. This minimizes the effects of atmospheric differential refraction.
- An Westinghouse TV which gives a field of view of about 9.5x7.5 arcmin divided into 512x512 pixels, via an f/15 to f/7 converter lens and a moving small flat mirror which is placed in the on-axis beam to allow the TV camera to view the sky directly for field verification. Objects with V=15 can be seen in direct mode and V=20 at full integration in a dark sky.
- A six-blade iris CCD shutter.
- As of 1998 the JAG grisms and drift scan table have been decommissioned.

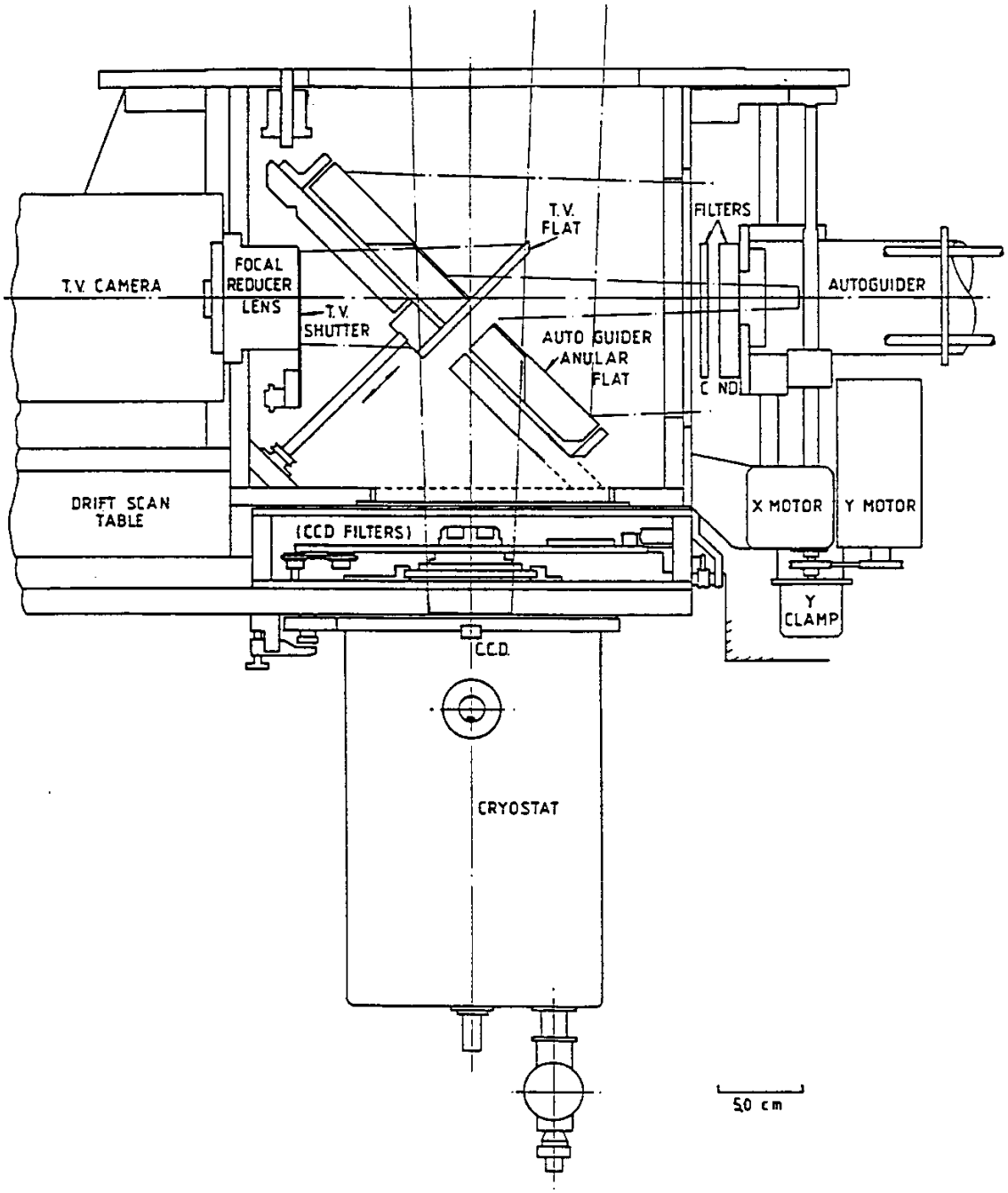

Figure 4: Schematic view of the JAG. The grisms and the drift table have been decommissioned; the CCD shutter is in between the main filter wheel and the CCD mounting plate

3 Things you need to know

3.1 Lone worker alarms

A potentially serious problem has always existed where people are working alone (as is quite often the case at the JKT),in the event of sudden illness, accident etc. Hence the introduction of the lone worker alarm is very welcome, and requires minimal effort from the lone worker. Whilst lone JKT workers are strongly encouraged to use the system, those who choose not to should simply leave the sender unit in it's charger.

JKT lone workers are referred to the OPERATION section below. The rest is included partly for information, and partly to remind lone workers of the consequences of leaving the sender unit somewhere. If you intend to use the system please use the belt provided, or your own.

- **PURPOSE**. To inform duty staff that a person working alone requires urgent assistance or is hurt or immobile.
- **LOCATION**. The signal receiver unit is located within the WHT control room, with sender units located with the meridian circle observer, DIMM operator, and JKT visiting observer (or Support Astronomer during an S/D night).
- **OPERATION**. The JKT observer will be instructed how to use the system by their Support Astronomer (SA), and must then decide whether they wish to use the system. If yes then please use the belt provided (to prevent leaving the sender unit somewhere, and issuing a false alarm), and ensure that you return the sender unit to its charger at the end of each night. If no, then please leave the sender unit on its charger, alongside the 2-way radios in the ICS room adjoining the control room. The sender unit motion sensitive, and must be worn on the person at all times during the night. Normal movement, even sitting, will **NOT** activate the sender unit. However, if the lone worker should not move for a period of one minute the unit will issue a local beep. If after a further 12 seconds the unit has still not sensed movement it will send a radio signal to the alarm receiver unit in the WHT control room, and the alarm plus the automatic telephone dialing and messages will be activated. Alternatively if the lone worker is in difficulty they can push the red button on the sender unit and it will also send the radio signal to activate the alarm receiver unit.
- **RESPONSIBILITIES**. Workers in the WHT control room will normally be the first person to hear the alarm. This will be indicated by an intermittent beeper. A red light will indicate the particular lone worker who requires assistance. The Incident Officer will be informed immediately with the information on which lone worker has activated the alarm. The IO will record the event and when satisfied can reset the alarm. If the WHT control room is unoccupied and the alarm call is not answered, after one minute the system auto-dials the following numbers: 559 (WHT control room and kitchen), 640 (the INT control room and kitchen) and 522 (the Incident Officers bedroom in the Residencia). A recorded message will repeat "Lone worker alarm activated, inform the Incident Officer immediately"
- The receiver unit in the WHT control room will need to be reset by the Incident Officer after every alarm. If the IO is called at 03:00 because the observer put their sender unit down and forgot about it, then the IO is not going to be too happy. Please ensure that you use the belt provided (or your own), or attach it to your person by some other means. Once it is in place, do not remove it, unless it is to replace in the charger at the end of the night.

3.2 Filling the cryostat

The cryostat has a hold time of at least 12 hours with the telescope stationary at zenith. If the telescope is tipped to the least favourable inclination then nitrogen loss will occur and the hold time can be reduced to less than 12 hours. Standard practice is that the cryostat gets a refill of liquid nitrogen at the start of the night, at the end of the night and at midday. The refill at midday (approximately 14:00) is the

responsibility of ING staff. The refill at the start and end of observing is the responsibility of the visiting astronomer. Your Support Astronomer will give you instructions on how to fill the cryostat.

You can check the CCD temperature on the CCD-STATUS window on lpss12.

In order to minimize nitrogen boil-off and give some temperature control the detector assembly (and temperature sensor) have an intrinsic time constant. This explains the 2-3 hour cool-down period. A further effect is that if the liquid nitrogen runs out completely then it may take an hour or so before any temperature rise is detected; the temperature rise may then be rapid.

If you forget to refill the cryostat and the dewar warms up, it will take about 10 hours to let the nitrogen evaporate, to pump it to vacuum, and to cool it down again. In other words: you will lose observing time!

If you leave the JKT early in the night to go to bed, for instance when the weather is bad, then you cannot fill the cryostat in the morning. Please request the day-time staff to fill the cryostat for you, by submitting a FAULT report. This is the only way to communicate with day time staff, and to make sure that they are aware of the situation first thing in the morning.

If you find that the hold time of the cryostat is not sufficient to get you through the night without an extra refill, leave a fault report. This usually means that the cryostat is losing its vacuum and that you will have the same problems for the following nights as well. In the fault report you can request the cryostat to be checked or pumped.

You are advised to use the protective gloves and mask when filling the cryostat.

3.3 Humidity, dust, and wind limits

Always monitor the current weather on the MET station in the control room.

- If >90% humidity outside, close dome and wait until <80% or conditions seem stable. If in doubt contact the INT Telescope Operator (telephone 640).
- Wind speed limit for JKT is 50km/hr (steady, not gusts). Close the dome if this limit is exceeded. If concerned, check with the INT Telescope Operator (telephone 640).
- If the air is very dusty outside, the telescopes will not be opened. Keep in touch with the Telescope operators on the INT (telephone 640) and WHT (telephone 559) about this.
- If >50% humidity in dome, turn on dry N2 to first 'notch'. The flow is controlled by the flow valve hanging around the mirror cell, and should be adjusted to deliver 100 l/hr. This to make sure that the CCD-window will stay free of condensation.
- If the humidity is high or if it is very dusty outside, please turn off the dome fans with the four switches in the control room.
- If it is wet and stormy, position the the dome with the shutter into the wind.
- If it is wet and very cold, position the dome such that the shutter is facing south. In case the dome freezes up, the Sun will get a chance to heat up the shutter.
- Please read the instructions accompanying the new met station, to the right of the control desk, particularly with respect to the alarms. The alarms sound if the above environmental thresholds are transgressed, or the dew-point falls to less than two degrees.

3.4 Telescope panic button

There is a big red button on the telescope console. Press it to stop the telescope, when the telescope is not behaving properly, or whenever there is a need for pressing it!! After pressing the panic button, the telescope cannot be moved until RESET has been pressed.

If the telescope moves by itself while in engineering mode, probably one of the console buttons is sticking. Turn the speed knobs to minimum and fiddle with the push buttons.

If the telescope moves to the wrong part of the sky while in computer mode, you might have to redo the ZEROSET.

3.5 Observing floor

The observing floor should be lowered before moving the telescope. Push the yellow handset buttons on the observing floor to bring it down. If the floor doesn't move, check that all the safety switches are released (check ladder and metal door). Clear the floor such that the telescope cannot run into things like steps and dewars.

The telescope is affected by movement on the rising floor. It amounts to a movement of the image of a few arcsec if the observer jumps up and down. Keep off the rising floor when exposing unless absolutely necessary.

3.6 JKT image quality

3.6.1 Optical abberations

The JKT mirrors have abberations (mainly astigmatism) such that the best seeing you can measure on the detector is about 0.7 arcsec. Contrary to what many astronomers think, this 0.7 arcsec seeing is achieved regularly. Due to flexure the quality and focus may degrade a little when observing at large zenith distance.

Usually, best seeing occurs when the difference between mirror and outside temperature is less than 2 degrees centigrade. The JKT is equipped with 4 dome fans to enhance temperature exchange. However, many observers open the doors to the dome and the catwalk to improve the airflow in the dome.

3.6.2 Dust on the CCD window or filters

La Palma is a dusty observatory. Due to the slow f/15 beam at the JKT, dust that lies on the CCD window is easily seen on your flatfield images, as rings of about 7 arcsec diameter. Dust particles on the filters give rise to rings that are about 5 times as big.

A thick dust grain on the CCD window can easily cause 1% absorption of the background light. In principle these effects will flatfield out, but as the JKT is rather sensitive to flexure, the image on the detector of the dust grains might shift a little as a function of telescope position.

Standard practice is that ING staff cleans the filters and the CCD window at the start of each observing run. If, during your run, you find that dust has accumulated to unacceptable levels, please submit a fault report asking for the appropriate optical surface to be cleaned.

3.6.3 Dust and full moon

With full moon, stray moonlight can cause a serious shadowing effect on the dust grains on the CCD window. This will not flatfield out with twilight flats. Either dither the telescope to obtain flats while observing, or try to observe a different object, at a different part of the sky, for a while.

3.6.4 The black bag around the JAG

To make sure no stray light enters the camera from the side, the telescope is fitted with a black bag that hangs around the JAG and CCD. The bag is quite heavy; if it is taken off, the telescope has to be rebalanced by observatory staff.

You have to open the bag in order to refill the cryostat; close it afterwards.

3.7 Computer guest accounts

The JKT system computers do not have guests accounts set up. Nevertheless, you can get a guest account on our user cluster (lpss1@ing,iac.es, lpss2@ing,iac.es) if you want to be reachable by email or if you need (limited) disk space for data analysis. To obtain a guest account, TELNET to lpss1 or lpss2:

```
login:     reqacct    (lower case)
Password:  qgoxms
```

and follow the instructions. You will be asked for your name and for an expiry date for the account.

Note that you do not need these accounts for regular observing.

3.8 Deleting files from disk

3.8.1 The data partitions

At the start of your run, check whether there is enough disk space available on the /obsdata partitions on the system Sparcs lpss12 or lpss10:

```
SYS> df -k /obsdata/jkta
SYS> df -k /obsdata/jktb
```

If you anticipate that there is not enough free space, then inform your Support Astronomer. It is the responsibility of your Support Astronomer to make sure that there is enough space for all the nights of your observing run.

Note: **Only ING staff may remove FITS files from the data partitions** !!

3.8.2 The scratch partitions

At the start of your run, check whether there is enough disk space available on the /scratch partition of the data analysis Sparc lpss10:

```
SYS> df -k /scratch/jkta
SYS> df -k /scratch/jktb
```

If the scratch directory on lpss10 is full, you may delete the contents of any of the subdirectories that contain IRAF image files. You can do this from within IRAF

```
cl> imdelete 19980522/r*.imh
```

or from a UNIX shell

```
SYS> rm /scratch/jktb/19980522/r*.pix
SYS> rm /scratch/jktb/19980522/r*.imh
SYS> rm /scratch/jktb/19980522/..r*.imh
```

3.9 Logs and Log books

3.9.1 Computer log

Automatic logging occurs at the JKT, for every FITS file produced. The most essential FITS headers are copied into the log file. This file is displayed on-line on one of the system Sparcs.

At the end of the night you can FTP or MAIL the log file to your personal account at your home institute. You can also print a copy. Use the PRINT menu button on the logger window, to print a log or to write it to a file.

After writing the log to a file, you can email yourself the log file with

```
SYS> Mail -s 'subject-text' you@yoursite.place < 'logfile-name'
```

3.9.2 Operations log book

The OPERATIONS LOG BOOK is a log book that is kept up to date by both ING staff and visiting astronomers. Enter in the OPERATIONS LOG BOOK the times of opening/closing dome, filling cryostat, operational problems, etc. As explained below, please enter all faults into the FAULT database.

3.10 FAULT Database

The FAULT or DEFECT database must be used to log **any** faults of any nature, resulting in down time or not. The interface to the database consists of a WWW form which must be edited and then submitted - such entries are printed by the duty staff first thing in the morning, and distributed to section leaders for prompt action. If you don't log it, now'ts gonna happen!

Note that the FAULT database is the only way to communicate with ING day-time staff in the morning (the OPERATIONS LOG BOOK will only be read if staff happens to be in the JKT control room). So if you require the CCD to be filled in the morning, because you left early due to bad weather for example, than submit a fault report saying so.

- Pull up a NETSCAPE session on lpss10.
- Click on the link 'Fault Database' on the ING home page (http://orion.roque.ing.iac.es/faultdb/).
- Click 'New Report'
- Fill in all the required fields, and optional fields when applicable. Although it is difficult to write proper language at five in the morning, please try to be clear in your phrasing.
- Click 'Submit Report'

You can see your fault report and the response from ING staff to the report in the following way:

- Click on the link 'Fault Database' on the ING home page (http://orion.roque.ing.iac.es/faultdb/).
- Click 'Search'
- In the 'Date Reported' field type

```
> 19980613
```

  Include the > sign as well !! This will return all faults issued after 13 June 1998.
- At the bottom of the form, make sure enough faults will be returned.
- Click 'Search DB' at the top of the form. This will return a number of faults. If you did not enable the 'Use full-screen output' flag, you have to click 'M' to see all information regarding the fault.

3.11 Intercom and telephone

You can call the Duty Engineer over the intercom. Use the key-sequence F-7-9 and hold the SIMPLEX button while you speak in the microphone. Press the blue button after your message to enable people to call you back.

You can call from the JKT to the rest of the world. You can reach the other telescopes by dialing 640 (INT) or 559 (WHT), or you can reach the residencia by dialing 9. The telephone number of the JKT control room is +34 922 405585.

3.12 Feedback report

At the end of your observing run, please fill out the WWW-based Feedback Report
http://www.ing.iac.es/INGweb/feedbackform.html.
You can find a link to this page on the ING home page.

Your feedback will be greatly appreciated, as we can use the information you provide to make things better. Please enter all your comments about items you think need attention, and/or about facilities that you especially liked.

4 Data tapes

The observatory stores a copy of your data on tape: the archive tape or D-tape. You can make a copy for yourself as well: the copy tape or C-tape. It is your responsibility to write the D-tape.

4.1 Writing the D-tape at the end of night

Note that you **must** write your D and C tapes from the data analysis Sparc (lpss10). Don't use lpss12, because this will interfere with doing observations. Please use one D-tape per night, and carefully write your name, the date, and the run numbers that are written to tape on the wrapper that is provided. The DAT tapes can store about 2 Gbyte of data, so with the SITe2 chip you will have to use only one D-tape per night.

To write the data to tape we provide two programs: FITSINIT to initialize the tape, and FITSOUT to copy and append FITS files to the tape. Once a tape has been initialized, you should not run FITSINIT again because this may destroy the data that is already on the tape. Program FITSOUT can be used as often as you like.

On lpss10 open an XTERM window and CD to the directory that holds the data

```
> cd /obsdata/jktb/19980611
```

Type FITSINIT to initialize a **new** tape only, then FITSOUT to write the files to tape:

```
> fitsinit
              Initialize a NEW tape only!
              Reply to the prompts,
              e.g. D tape number> JKTDxxxx

> fitsout
              Append FITS files to tape.
              Reply to the prompts,
              e.g. run numbers> 1-n
```

Make sure that you enter the UNIX device names correctly. If you are not sure, then the use the default option as prompted by FITSINIT and FITSOUT.

Writing data from the Sparc is very rapid! If you start dumping data before you fill the cryostat, then it will probably finish by the time you've filled it.

Leave the D-tape in the carton box near the tape drive, such that daytime staff can pick it up and archive it.

4.2 Producing C tapes

You may produce your C-tape by dumping from the Sparc, in much the same way as with the D-tape:

```
> fitsinit
              Only difference here is that the software
              expects a D and not a C tape, so when asked
              for the tape number, call it JKTDxxxx and
              not JKTCxxxx.

> fitsout
              As before.
```

4.3 Verifying the tapes

You can verify the tapes by using the VERTAPE program on lpss10:

```
> vertape nnnn
```

with *nnnn* the tape number. This program checks the run numbers of the files that are on the tape. When the program is finished you can check the result with the FITSMAIL program:

```
> fitsmail nnnn
```

5 Afternoon activities

- Fill cryostat with LN2 (usually every 12 hours).
- Startup the TCS (on Xterminal).
- Startup the ICS/DAS (first on lpss12 and then lpss10).
- Check filters required, and check the ING WWW filter page for where the filters are.
- Remove filter wheel from the JAG, change and clean the filters, and put the wheel back in the JAG. *This should only be done by your Support Astronomer.*
- Update the ING filter database (Support Astronomer).
- Update the filter information of the ICS.
- Zeroset the filter wheel.
- Set the CCD readout speed.
- Startup an IRAF session on lpss10.

5.1 TCS startup

You have to startup the Telescope Control System (TCS) before starting up the DAS/ICS system. The TCS runs on an DEC-Alpha station, which can be accessed from an Xterminal in the control room. At this Xterminal, startup a TELNET session to lpas1.

```
Username: JKT_LOGIN
Password:
                    (the current password is posted in the control room)
```

This will bring up a menu. You can start the TCS by typing

```
START
```

This will fire up two new windows: the Telescope Info Display which displays the telescope position etc., and the TCS User Interface window.

5.1.1 Adding sources to the TCS catalogue

At the TCS User Interface you can type in your sources, for example

```
USER> source landolt110234 18 1 09.5 -0 5 23 j2000
USER> add
```

The ADD command adds the object to the catalogue.

5.1.2 Adding your own source catalogues to the TCS catalogue

To add the catalogue with blank fields (see Table 4) type

```
USER> inc blank
USER> out term
```

To add a home-grown catalogue, copy or ftp a file with coordinate entries (same format as the SOURCE command, one target per line) to the directory /jkt/cat/ on lpss10, and give it a suitable name e.g. 'funnyname.cat'. Then type the following in the TCS interface

```
USER> inc JKT:[CAT]funnyname.cat
USER> out term
```

5.1.3 Closing and restarting the TCS

To stop the TCS type

```
USER> park zen
```

and switch to engineering mode. Cancel the TCS alarm

```
USER> acknowledge
```

and

```
USER> tcsexit
```

to stop the TCS.

If the TCS User Interface hangs:

- switch to engineering mode,
- start another TELNET session to lpas1,
- login as user JKT_LOGIN,
- and choose the STOP option.

If the telescope was not at zenith when stopping the TCS, move it back to (near) zenith with the console buttons. Then restart as above, if you wish. Don't forget to ZEROSET and CALIBRATE.

5.2 ICS/DAS startup

The Instrument Control System (ICS) and Data Acquisition System (DAS) are integrated systems, and are accessed through one single XTERM window running an ordinary UNIX shell. This user interface runs on lpss10, whereas the actual data acquisition is controlled by lpss12. *You are advised not to use lpss12 for anything else than running the system, as this could seriously interfere with the data flow.*

If you haven't started up the TCS then do that first! To startup the system login to lpss12

```
login: jktobs
Password:
                    (the current password is posted in the control room)
```

and type

```
jktobs@lpss12> obssys
```

in the pink window that popped up. The obssys command lets you choose which system version to run; the white board or your Support Astronomer will tell you what is the appropriate system to select. Then type

```
jktobs@lpss12> startobssys
```

to startup the system. From this point, you should not have to issue any commands in the XTERM window on lpss12.
Then login to lpss10 (same user, same password) and again type

```
jktobs@lpss10> obssys
```

and enter the same system version number as on lpss12, and type

```
jktobs@lpss10> startobssys
```

in the pink window that popped up. This will bring up 5 extra windows:
- the TALKER window, which lists system messages that can be useful if something goes wrong,
- the LOG window, which lists the entries in the automated log file,
- the CCD-MONITOR window, which displays the status of the CCD,
- the TELESCOPE INFODISP window, which displays the status of the telescope,
- the JKT-MIMIC window, which displays a simplified mimic of the light path in the JAG.

You can set the CCD readout speed (standard/quick/turbo) by typing

```
SYS> quick
```

which you have to do every time the SHUTDOWNOBSSYS command has been used. To set the full readout window use

```
SYS> window 1 0 0 0 0
```

or, to set the window to a central 1k x 1k window extending to the overscan region on the SITe2 chip use

```
SYS> window 1 1604 1000 544 524
```

where the last two arguments are the X and Y offsets. Type

```
SYS> zeroset mainfilt
```

to initialize the JAG filter wheel.

5.2.1 Closing and restarting the ICS/DAS

You can issue the command STARTOBSSYS at any time: it will check if all tasks are running, and if one is missing it will start it up.

To shutdown the system issue

```
SYS> shutdownobssys
SYS> cleanup
```

on lpss10 first, and then on lpss12. Log off from both computers (use EXIT under the background pull-down menu), and restart as above if you wish.

5.3 Filter changes

Look on the white board and in the WWW filter page (http://ing.iac.es/~quality/filter/newfiltdoc.html) to see if the filters you need are already loaded in the JAG, or if they are currently somewhere else. If your science requires a filter change then your Support Astronomer will load up the wheel for you. If necessary, up to three wheels can be loaded, each with 6 filters.

If the JAG filter wheel contents have been changed, you will have to update the corresponding information in the ICS. The ICS stores for each filter its name, type (Harris/interference/etc.), unique ID (serial number), thickness, focus offset, and its position in the wheel. The WWW filter page lists all the necessary information. The focus offset introduced by the main filters goes as 0.03mm focus change per 1mm filter thickness.

Additionally, the ICS stores for each JAG filter the names of the filters that need to be put into the autoguider light path, in order for it to remain in focus when switching from one science filter to another. The two autoguider filters that are in the beam should have roughly the same combined thickness as that of the main filter, such that the autoguider is in focus while the detector is in focus.

To update the filter information in the ICS you type

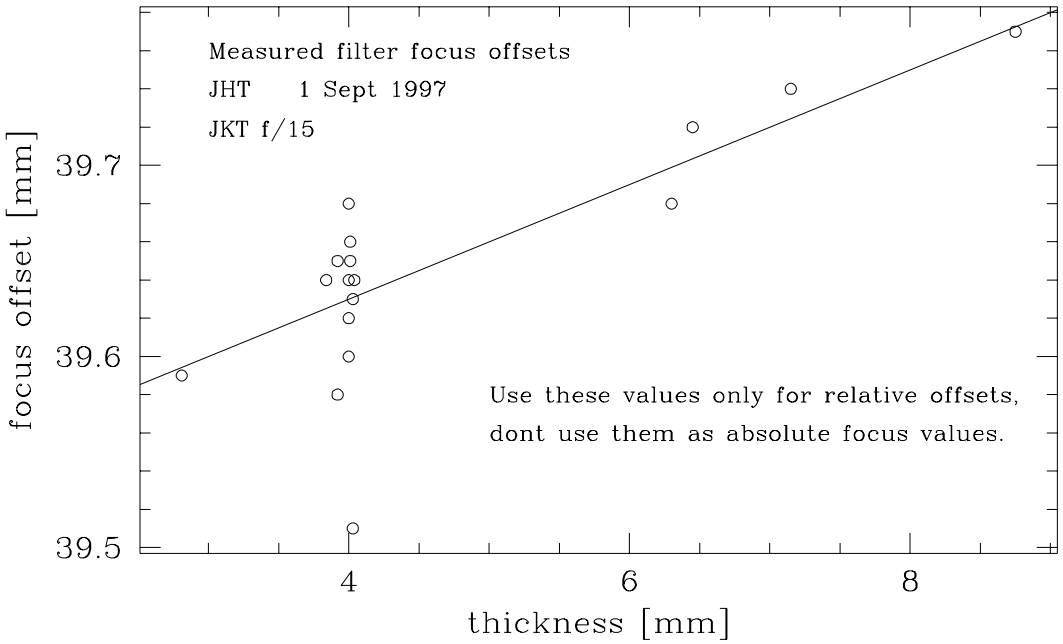

Figure 5: Focus offset versus thickness of the science filters. These offsets are taken into account when pressing the CALCULATE button in the CHANGEJAG command

```
SYS> changejag
```

which will pop up a small window that allows you to edit the contents of up to five filter wheels, and to choose which wheel definition is active. To make a new wheel definition a separate window will pop up. For each filter you will have to supply its name, type, unique ID (serial number), thickness, and its position in the wheel. The focus offset and the corresponding autoguider filters will be calculated when you click the 'CALCULATE' button. Don't forget to click 'SAVE CHANGES' before you exit this editing routine. Then choose which wheel is active, click 'SAVE CHANGES' on the small pop-up window and click 'EXIT'.

Note: *All filter movements across the site should be logged into the ING filter database by your Support Astronomer*, using the FILTER program on lpss1.

Always issue the command

```
SYS> zeroset mainfilt
```

after the JAG door to the filter wheel has been opened and closed (even when the filter wheel has not been touched).

5.3.1 Mounting CCD filters

ING staff will mount the filters in the wheel(s) for you. The filter cut-out in the wheel is designed to take 2.0inch square filters (in a 51mm square hole); a 47mm clear aperture is provided.

The maximum thickness of filter allowed is 12mm ; filters of thickness less than 3mm will require packing material to stop them moving about within the 3mm deep cut-out hole; filters of thickness 3–12 mm can be held in place with the standard filter masks and adjustable clamps.

It is important that the wheel is in balance, otherwise it might get stuck when observing and moving the filter wheel at large zenith distance. In the standard UBVRIZ or UBVRIHα setups, make sure that the thick filters U, Z, and/or Hα are mounted opposite to each other.

Table 3: Available autoguider filters

Autoguider ND filters				Autoguider Colour filters			
no.	filter	thickness (mm)	glass type	no.	filter	thickness (mm)	glass type
1	clear	1.0	UBK7	1	clear	1.0	UBK7
2	ND1	1.0	NG4	2	UV	1.0	UG1
3	C5	5.0	UBK7	3	Blue	1.0	BG38
4	ND5	5.0	NG4	4	Red	1.0	RG610
5	C8	8.0	UBK7	5	clear	2.0	UBK7
6	ND8	8.0	NG4	6	UV	2.0	UG1
7	C11	11.0	UBK7	7	Blue	2.0	BG38
8	ND11	11.0	IG4	8	Red	2.0	RG610

5.4 Biases and dome flats

You can take bias frames (dome lights off!!) with the commands

```
SYS> bias
SYS> multbias 5
```

where the first command does only one bias exposure, and the second executes a series of 5 bias exposures.

If you want to make dome flats, turn on the tungsten lamps on the telescope top ring with the buttons on the telescope console in the control room. Turn on the oil pumps and telescope (see Section 6, Twilight activities), and leave it in Engineering mode. You don't have to zeroset the encoders. Then manually point the telescope to a part of the dome that gives good reflected illumination of the telescope aperture, using the push buttons on the console. Open the mirror covers with the button on the console.

Make sure that the JAG light path is towards the CCD and not to the TV

```
SYS> tv off
```

You can take dome flats of 10 seconds with the commands

```
SYS> flat 10 "Dome flat"
SYS> multflat 5 10 "Dome flat"
```

To change the filter position use

```
SYS> filter V
SYS> filter R
```

with arguments according to what you defined in the ICS filter database.

5.5 IRAF startup

On lpss10 pull up an XGTERM (not XTERM) window. Start up the image display

```
> ximtool &
```

IRAF needs to be started from the home directory, so type

```
> cd
> cl
```

and activate the ING package of routines

```
cl> ing
```

Move to a scratch directory

```
cl> cd /scratch/jktb
```

and make a directory for today and step into it

```
cl> mkdir 19980612
cl> cd 19980612
```

Use the EPAR (edit parameters) task to make the DAS_GET task aware of the current FITS data directory (e.g. /obsdata/jkta/19980612)

```
ing> epar das_get
```

and use Cntr-D to exit the EPAR session. Now the command

```
ing> das_get last
```

will copy the latest FITS file that was created by the system over to an IRAF file on the scratch directory, and it will display it automatically on the XIMTOOL image display. Type

```
ing> help das_get
```

to get information on what other command line parameters the task DAS_GET accepts. The IRAF task IMEXAMINE is a powerful tool to do a quick check of your data with

```
ing> imexamine r234567
```

will display run r234567 and allows you some useful keystrokes with the cursor on the XIMTOOL image display:

- m gives pixel statistics of a small region around the cursor
- s draws a surface plot
- l plots a line
- c plots a column
- j fits a vertical Gaussian
- k fits a horizontal Gaussian
- r fits and plots a 2D Gaussian (useful for seeing measurements)
- a fits a 2D Gaussian
- v vector plot (press v twice)
- e contour plot
- q quit

5.5.1 Closing down IRAF

If you want to quit IRAF type

```
ing> log
```

If you experience difficulties displaying images, then close the image display and close down the IRAF session and exit the shell in the XGTERM window. Then restart everything: XGTERM, XIMTOOL, and IRAF.

6 Twilight/evening activities

6.1 Start telescope and zeroset encoders

- Check that all corridor and basement lights are off.
- Fill cryostat.
- Check observing floor, and lower rising floor so instrument will not foul floor during observing.
- Telescope power ON (Engineering mode) with key switch.
- RUN oil pump and cancel alarm(s) if necessary by pressing CANCEL ALARMS and RESET (may need to be done twice if alarm sounds again).
- In ENG mode with dome lights on, set speed knobs to green marks.
- With the push buttons, drive the telescope >3 degrees from Zenith in -HA and -DEC, manually. On the TCS User Interface type

```
USER> zeroset dec tar
USER> zeroset ha tar
```

  and move the telescope back to Zenith in reverse order, +DEC and +HA, until the TCS acknowledges for both directions.
- Turn off dome lights and lower blind.
- Switch to COMP mode using key switch.
- Open dome shutters (hold button in).
- Open primary mirror covers and check that they don't stick.

6.2 Powering up the JKT: normal procedure in detail

The telescope can only be powered up from the control console (CC) in the control room.

1. Turn on the key labelled TELESCOPE POWER. It is on the upper right of the CC. A green light indicates ON.

2. Switch on the oil pump which lubricates the telescope drive by depressing the button marked OIL PUMP RUN on the upper left of the CC. The oil may take up to a minute to reach pressure depending on when it was last used. When ready the green switch will light and will usually be accompanied by an ear-piercing shrill from the alarm section (lower right of CC). Stop this by depressing the CANCEL button (left most red button of the ALARMS - lower right of CC).

3. Press the green RESET button which is alongside the big red EMERGENCY STOP button (upper right on CC). The green light should go out.

4. Check no further alarms are showing on the array of red alarms (lower right on CC). If there are any, seek the advice of the duty technician.

   The telescope is now capable of being moved so make sure all obstacles are removed from the rising floor and that all instrument cables, hand sets, etc. are firmly stowed. Note that a handset MUST ALWAYS be plugged into the OBSERVER socket at the telescope. If not you will experience a slow telescope runaway with a constant in the drive error display.

5. The telescope may now be moved using the control buttons labelled HA+, HA-, DEC+, DEC- on the left centre of the CC. The rotary potentiometers next to the push buttons allow the speed of slew to be varied but only when under engineering control.

Table 4: Blank fields from Christian et al., 1985, PASP 97, 363. These fields are all in the system catalogue.

name	RA (B1950)	DEC (B1950)
BLANK1	04 25 46.0	+54 09 03
BLANK2	13 04 33.0	+29 50 49
BLANK3	16 49 42.0	−15 21 00
BLANK4	19 19 09.0	+12 22 05
BLANK5	21 26 54.4	−08 51 41
BLANK6	23 54 08.9	+59 28 18

6.3 Sky flats

You can take sky flats at zenith or at a 'blank' field. Source names for blank fields can be found in Table 4. Once you found the name of the correct blank field, issue on the TCS User Interface

```
USER> gocat blank2
```

When both telescope and dome have reached their destination, move the filter wheel and take the flats with

```
SYS> filter Ha
SYS> sky 2 "sky Halpha"
```

and check the count rates in IRAF (use DAS_GET and IMEXAMINE). Narrow band sky flats can be taken just before sunset, for broad band sky flats you have to wait a bit longer.

BEWARE that the CCD iris shutter takes about 0.1 seconds to fully deploy, so short flats aren't flat! Depending on the accuracy that you need, flats should have exposure times of >2 seconds.

6.4 Handset

With the handset you can move the telescope around by little steps. The handset used to be a separate box/console with buttons, but is now integrated in the TCS User Interface. After pointing the telescope, you can bring up the computerized handset by pressing the DO button of the Xterminal keyboard. You will see a graphical handset panel pop up on the TCS User Interface window.

You can move the telescope in RA-DEC or X-Y coordinates; toggle between these with the F7 and F8 keys. You can select the step size with the FIND and INSERT keys. These keys are all clearly marked on the keyboard.

To exit the handset, press the DO key again.

6.5 Calibrate

Each time the TCS has been switched off, it is necessary to calibrate the collimation and index errors, and to modify the pointing model accordingly. Since the guide star zero point refers to the rotator centre, the 7-star CALIBRATE should also be done at the rotator centre. The rotator centre should be marked on the DIRECT TV monitor by a translucent ring **DO NOT REMOVE**.

- After doing the telescope ZEROSET and sky flats, switch on the TV and the TV and Grinnell monitors.
  IMPORTANT: Check gain control is turned off before pressing the ON button. Wait about 15 seconds until the red and yellow lights go out, then turn the gain up SLOWLY in DIRECT mode (check the GRINNELL buttons), until an image appears. Always remember to back off the gain when slewing the telescope to a new object - the TV is

very sensitive and can permanently damaged by over illumination. The TV has a field of approximately 9x7 arcmin.

- Move the JAG TV flat in the beam, and the TV shutter out of the beam; on lpss10 type

```
SYS> tv on
```

  and watch Mimic display.

- Start up the CALIBRATE routine

```
USER> calibrate
```

  The routine will move the telescope to 7 bright stars; you have to centre the stars on the rotator centre with the handset. Press DO each time you have centred a star. *Make sure the TV scan-direction switches are pointing the right way!* At the end, the routine calculates new values for the pointing offsets, and prints the RMS of the stellar positions with respect to the new model. The sky-RMS should be around 20 arcsec, which is not excellent but normal for the JKT. Note the results down in the OPERATIONS LOG BOOK, and file the calibrate plot in the corresponding folder.

  You can skip a calibrate star in the sequence (for instance S19+07 which is a double star) by pressing the 'i' key.

Alternatively, you can use the command

```
USER> calibrate last
```

to activate the previously used pointing model.

6.6 Focus

The telescope needs to be focused. The focus differences due to temperature changes will be tracked automatically. Typical change in focus with temperature is -0.05mm per degree C. The focus offsets (derived from the filter thickness) that you entered into the ICS database will make sure that the telescope remains in focus when you change between filters. Typical change in focus with filter thickness is 0.03mm per mm filter thickness.

Take 7 exposures of a star, each with the telescope focus offset by 0.1mm, centred around the expected focus value. For the expected focus value you can use the focus value that was used the night before, which should be a value close to 40.1mm.

Pick a focus star (e.g. 10-11 mag photometric standard) near zenith, point the telescope to it, select the appropriate filter to do the focusing with (usually V), and do a test exposure.

```
USER> source focusstar hh mm ss.s dd mm ss j2000
USER> next

SYS> filter V
SYS> tv off                    (get the TV flat out of the beam)
SYS> run 15 focustest
```

and check the result in IRAF

```
ing> das_get last
ing> imexamine                 (keystrokes a, r and q)
```

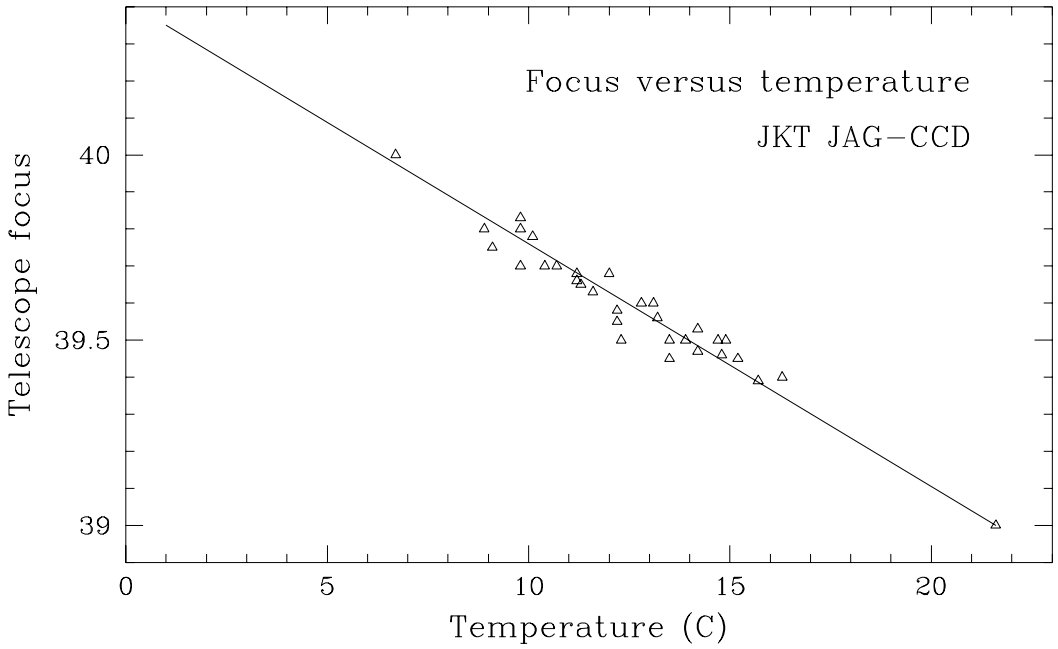

Figure 6: Focus versus temperature. A zeropoint offset may appear after mirror maintenance (e.g. aluminizing). This curve is accounted for automatically by the TCS. The TCS reference focus value is usually between 40.0 and 40.2

the count rate of the 15 second exposure should be sufficient to do a proper Gaussian fit. If your star is too bright, pick a fainter one; do not expose less than 15 seconds otherwise the seeing will not be sampled evenly. If your star is too faint, pick a brighter one.

When you have found a good star, make a 200x200 pixel window around it

```
SYS> window 1 200 200 xxx yyy
```

where the values of offsets xxx and yyy should be computed from the result of the centroid fit in IRAF (in this case $xxx = x_{\mathrm{centroid}} - 100$ and similar for yyy).

Set the telescope focus to 0.3mm less than the expected best focus, and do a RUN

```
SYS> focus 39.8
SYS> run 15 "focus 39.8"
```

Then increase the focus by steps of 0.1mm and take a total of 7 runs. While doing these exposures, you can compute the FWHM of the stellar images in IRAF (the image scale for SITe2 is 0.33arcsec/pixel)

```
ing> das_get last
ing> imexamine                (keystrokes a, r and q)
```

The image with the smallest FWHM will give you the best focus value. Set the focus and undo the windowing

```
SYS> focus 40.13
SYS> window 1 0 0 0 0
```

In cases of very good seeing repeat the focusing sequence with a focus increment of 0.05mm.

6.7 Observing

6.7.1 Target acquisition

```
USER> source mygalaxy hh mm ss.s dd mm ss b1950
USER> add
USER> gocat mygalaxy
```

The ADD command adds the source name to the catalogue, and the GOCAT command slews the telescope and moves the dome. Then press DO to activate the handset and centre the object on the rotator-centre mark on the TV. *Make sure the TV scan-direction switches are pointing the right way.*

There is often an offset between the rotator centre and the chip centre (usually smaller than 1 arcmin). You can calibrate this offset, and then account for this when centering the object with the handset.

6.7.2 Autoguiding

- Power on the autoguider. The SHUTDOWN button still works; use it whenever the autoguider needs a reset.
- Find guide-star coordinates in the Guide Star Server (GSS); or use the ones you have used before for the same object.
- Move the guide probe (command AUTOXY).
- Do the FIELD, ACQUIRE, GUIDE sequence.
- Close the guide loop with AUTOGUIDE ON (or key F18).

6.7.3 The Guide Star Server (GSS)

To access the Guide Star Server, pull up an XTERM on lpss10 and TELNET to lpvs1

```
Username: GSS
Password:                      (check the white board)

$ which telescope (WHT/INT/JKT)? JKT
$ GSS
GSS> CONFIG JKT CCDE

GSS> SEARCH  hh mm ss.s  dd mm ss  B1950 (or J2000)
GSS> EXIT
$ TYPE OUTPUT.GS
```

This is the simplest format. For more info refer to the document by Robert Laing (http://ing.iac.es/ manuals/man_var.html).

The search coordinates should be the current telescope coordinates !! These may differ from the coordinates you entered into the TCS catalogue.

Alternatively run the GSS with an input file, rather than interactively. The file must only contain search records as above and it is essential that positive declinations are unsigned (i.e. Do **not** use + explicitly, the software will fail). The file must have a .com extension (e.g. PHIL.COM). Then:

```
$ GSS
GSS> CONFIG JKT CCDE

GSS> DO PHIL
GSS> EXIT
$ TYPE OUTPUT.GS
```

Guide star output in OUTPUT.GS is tagged with an asterisk if the object is classified as stellar on all GSC fields and a question mark represents an ambiguous classification. No symbol is given for objects classified as non-stellar on all plates. These should only be used as guide stars in cases of dire need.

6.7.4 Acquisition and guiding

Select the brightest guide star from the GSS list, and move the guide probe to the correct position

```
SYS> autoxy xxx yyy
```

Issue the FIELD command on the TCS User Interface

```
USER> field
```

and wait for the star to appear during raster scans. If the star is very faint allow several scans to ensure that the autoguider is seeing a real star and not just scan noise (cursor jumping randomly after each scan). The autoguider raster scan is 2 arcmin square with 5 arcsec pixels.
Issue the ACQUIRE command

```
USER> acq
```

The star is scanned in a maltese cross and attempts are made to acquire the star. The probes are moved to centre the star in the scan and a "NEW FIELD" message appears. If attempts to pull in the star for guiding are successful, the profiles of the star will be displayed, and the message "OK TO GUIDE" will appear. *Note* that one can use

```
USER> acquire tel
```

to move the telescope rather than the probes to centre the guide star.
Give the GUIDE command

```
USER> guide
```

and *wait a few seconds* for the tracking cursor to appear within the seeing disk below the field raster display, then finally....
press the F18 key or type

```
USER> autoguide on
```

THE GUIDING LOOP IS NOW CLOSED
During autoguiding, if the star is lost for any reason (e.g. cloud) as signified by a "CLOUDY" message and the tracking cursor leaves the seeing circle and takes wild random jumps, then immediately press F17 (or AUTOGUIDE OFF), and re-acquire as above.

When going to a different source use

```
USER> autoguide off
USER> agstop
```

to disable the guide loop and to stop the guider. If you want to resume guiding after issuing the AGSTOP command, you will have to do the FIELD-ACQUIRE-GUIDE sequence again.

If autoguider freezes, then power off-on, then re-acquire.

6.7.5 Exposing

Set the CCD readout speed, window and binning as required;

```
SYS> quick
SYS> window 1 0 0 0 0
SYS> bin 1 1
```

will set the standard configuration. Then select the filter and make sure the lightpath is to the CCD

```
SYS> filter I
SYS> tv off
```

and check the mimic display to see if everything is OK.

Use one of the following

```
SYS> run t name
SYS> multrun n t name
```

to do a t seconds integration, which will be called "name", or alternatively, to do n multiple exposures of t secs each. While a RUN is in progress you can monitor its status on the CCD-STATUS display.

You can change a run that is exposing with the NEWTIME, FINISH, and ABORT commands. You first have to put the RUN process in the background with

```
^Z        (type Cntr-Z)
SYS> bg
```

to gain control over the process. Then you can issue one of the following commands

```
SYS> newtime 1200
SYS> finish
SYS> abort
```

The first command changes the exposure time to 1200 seconds, the second command stops the exposure and reads out the frame into a normal file, the last command aborts the exposure and no file is saved.

Use the command

```
SYS> killmultrun
```

to abort an ongoing MULTRUN.

7 Morning activities

- Switch the JAG lightpath to CCD to protect sensitive TV system.
- Turn TV and Autoguider OFF.
- Zenith park telescope.
- Switch to engineering mode and type ACKNOWLEDGE in the TCS window.
- Close mirror covers - check they're not sticking.
- Close dome shutters.
- Rotate the dome to avoid any expected bad weather.
  Storm: point shutter into the wind. Ice: point shutter south.
- Turn off oil pump and cancel alarm(s).
- Turn OFF telescope power.
- Start dumping your D tape.
- Refill cryostat.
- If D tape finished, start C tape dumping, and leave a note on the Sparc terminal.
- Turn off dome lights.
- Put the cat out.
- Go to bed.

8 Appendix A: TCS commands

General TCS commands
All allowed in engineering mode.

- `ACKNOWLEDGE` Turn off a limit or engineering mode alarm.
- `HANDSET` Select handset mode.
- `HELP` Get help on a command.
- `RECALL` Recall a previous command.
- `TCSEXIT` Close down the control system.

Source data entry
All allowed in engineering mode.

- `DEC` Enter declination of edit source.
- `DIFF_RATES` Enter non-sidereal tracking rates for the edit source.
- `EPOCH` Enter epoch of position for edit source.
- `EQUINOX` Enter equinox for edit source.
- `PARALLAX` Enter parallax of edit source.
- `PM` Synonym for `PROPER_MOTION` (*q.v.*).
- `PROPER_MOTION` Enter proper motions of edit source.
- `RA` Enter right ascension of edit source.
- `RADIAL_VEL` Enter radial velocity of edit source.
- `RV` Synonym for `RADIAL_VEL` (*q.v.*).
- `SOURCE` Enter name, right ascension, declination and equinox for edit source.

Catalogue handling
All allowed in engineering mode.

- `ADD` Add the contents of the edit source data block to the catalogue as a named entry.
- `ERASE` Clear the user catalogue.
- `FIND` Get a named catalogue entry and put it in the edit source block.
- `INCLUDE` Append a text catalogue to the current user catalogue.
- `MARK` Store the current telescope position as a named catalogue entry.
- `OUTPUT` Output the current catalogue to an ASCII file, terminal or line printer.
- `REMOVE` Delete a catalogue entry.

Source change
None allowed in engineering mode.

- `BLIND_OFFSET` New source (from catalogue) with local corrections to the pointing model.
- `GOCAT` New source (from catalogue; specified by name only).
- `GOTO` New source (direct input of name, right ascension, declination and equinox).
- `NEXT` New source (using data in edit source block).

Positional and Aperture offsets
`ENTER` is allowed in engineering mode; the remainder are not.

- `APERTURE` Execute a preset (numbered) aperture offset.
- `BEAMSWITCH` Execute an aperture offset with direct input of x and y.
- `ENTER` Input data for numbered aperture or positional offsets.
- `OFFSET` Execute a positional offset with direct input of $\Delta\alpha$, $\Delta\delta$ or ξ, η.
- `POSITION` Execute a preset (numbered) positional (ξ, η) or ($\Delta\alpha$, $\Delta\delta$) offset.
- `STORE` Store aperture or positional offsets set up using the handset.

Autoguiding
`AGSELECT` is allowed in engineering mode; `AUTOGUIDE` is not.

- `ACQUIRE` Centre a guide star on the autoguider.
- `AGSELECT` Identify the autoguider currently in use.
- `AGSTOP` Send a `SHUTDOWN` shutdown command to the autoguider.
- `AGWAIT` Send a `WAIT` command to the autoguider.
- `AUTOGUIDE` Lock or unlock the autoguider loop.
- `FIELD` Locate the brightest guide star in the autoguider field.
- `GUIDE` The autoguider sends guiding errors to the TCS.

Calibration procedures
The keywords for this command which require the telescope to be moved are not allowed in engineering mode.

- `CALIBRATE` Determine encoder zero-points and collimation errors.

Mechanism control
None allowed in engineering mode.

- `DOME` Move the dome to a given azimuth and stop it.
- `DFOCUS` Change the focus by a specified amount.
- `FOCUS` Move the focus to a specified position.
- `PARK` Move the telescope to a defined position.
- `STOP` Stop a mechanism or combination of mechanisms.

Mechanism configuration
`ZEROSET` is allowed in engineering mode; `TRACK` is not.

- `TRACK` Turn focus, dome, rotator or telescope tracking on or off.
- `ZEROSET` Determine incremental encoder zero-points.

Change of focal station and instrument
Note that "Select" in this context means "set up software and drive the correct rotator". Both allowed in engineering mode.

- `STATION` Select focal station.
- `INSTRUMENT` Tell the TCS which instrument is in use.

Display functions
All allowed in engineering mode.

- `DISPLAY` Change the coordinate system of the displayed telescope position.
- `MOON` Give the current right ascension and declination of the Moon.
- `PAGE` Switch to another information display page.
- `SHOW` Display information about the system state.

Logging of test data
All allowed in engineering mode.

- `LOG` Log tracking errors and associated data.
- `POINT` Write encoder coordinates to a data file.
- `RMS` Calculate and display mean and rms servo errors.
- `SNAPSHOT` Record the current information display page.

Meteorological and Earth-rotation data
All allowed in engineering mode.

- `HUMIDITY` Input relative humidity used in refraction calculation.
- `POLE` Input values of polar motion.
- `PRESSURE` Input barometric pressure used in refraction calculation.
- `TEMPERATURE` Input temperature used in refraction calculation.
- `UT1UTC` Input UT1 − UTC.
- `WAVELENGTH` Input wavelength used in refraction calculation.

8.1 TCS commands that can be issued through the ICS

```
acquire                 the same as the AQUIRE PROBE command of the TCS
add
agoff                   does TCS command AUTOGUIDE OFF, then AGSTOP
agon                    does TCS command GUIDE, waits a bit, then AUTOGUIDE ON
autostop                does TCS command AGSTOP
autowait                does TCS command AGWAIT
aperture
autoguide               the same as the AUTOGUIDE ON command of the TCS
field
focus
gocat
guide
next
object                  the same as the SOURCE command of the TCS
offset
park
point
```

Never issue the FOCUS command two consecutive times with the same value, as the ICS will time out for 3 minutes. At the TCS User Interface you can issue the command as many times as you like.

Here are some ICS short cuts

```
tcs <command>                 is a synonym for:    cmd TCS USER <command>
tcs "<lots of parameters>"    is a synonym for:    cmd TCS USER "<lots of parameters>"
```

9 Appendix B: ICS commands

Filter commands:

```
jagfilter <pos>          Moves the CCD filter [1-6].
                         Also adjusts the telescope focus if the TCS is running and
                         selects autoguider filters to keep the autoguider in focus.
mainfilt <pos>           Synonym for jagfilter.
filter <pos>             Synonym for jagfilter.
autocol <pos>            Moves the autoguider colour filter [1-8].
autond <pos>             Moves the autoguider ND filter [1-8].
changejag                Starts the GUI to view/change filter wheels.
```

Autoguider probe commands:

```
autoxy <x-posn> <y-posn>  Move the autoguider probe in X and Y
autox <x-posn>            Move the autoguider probe in X (0 to 29,200)
autoy <y-posn>            Move the autoguider probe in Y (0 to 28,900)
autopark                  Moves the autoguider probe to position 5 5.
autocentre                Moves the autoguider probe to the centre 15000 15000.
```

NB: You cannot have both probes above 20,000, as the motor is in that corner.

TV commands:

```
tvmirror <in|out>        Puts the TV flat in or out of the light path
tvshutter <open|close>   Opens or closes the TV shutter
tv on                    Puts the flat in and opens the shutter,
                         but does NOT switch on the TV.
tv off                   Takes the flat out and closes the shutter,
                         but does NOT switch off the TV.
ccd                      Same as TV OFF.
```

Miscellaeous commands:

```
showstatus               Prints out the status of every mechanism in the JAG.
zeroset <mechanism>      Reset and zeroset the mechanism. Possible mechanisms are:
                           tvmirror, tvshutter, autocol, autond,
                           mainfilt, autox, autoy.
                         This may take 2 or 3 minutes, depending on the mechanism.
jagreset                 Resets the JAG micro -- equivalent to power cycling it.
                         Use only when zeroset has failed and when the mechanism
                         is NOT at its limit.
```

10 Appendix C: DAS commands

```
Here "t" stands for a time in seconds, and "n" stands for the number of exposures.

Bias and multiple bias frames
bias                    take a bias frame and save it, with OBSTYPE defined as BIAS
multbias "n"            make multiple exposures, all with OBSTYPE defined as BIAS

Normal exposures (all commands use similar arguments)
arc "t" "name"          take and save an exposure, with the OBSTYPE defined as ARC
dark                    take and save a dark frame, with OBSTYPE defined as DARK
flash                   take and save an exposure, with the OBSTYPE defined as FLASH
flat                    take and save an exposure, with the OBSTYPE defined as FLAT
run                     take and save an exposure, with the OBSTYPE defined as RUN
sky                     take and save an exposure, with the OBSTYPE defined as SKY

Multiple exposure sequences (all commands use similar arguments)
multarc "n" "t" "name"  make multiple exposures, all with OBSTYPE defined as ARC
multdark                make multiple exposures, all with OBSTYPE defined as DARK
multflash               make multiple exposures, all with OBSTYPE defined as FLASH
multflat                make multiple exposures, all with OBSTYPE defined as FLAT
multrun                 make multiple exposures, all with OBSTYPE defined as RUN
multsky                 make multiple exposures, all with OBSTYPE defined as SKY

Test exposures
glance "t"              take one exposure and leave in the glance file
promote                 promote the glance file to a normal run
scratch "m" "t"         take one exposure and save it to a scratch file numbered "m"
promote "m"             promote a scratch file to a normal run

Changing image size
bin "x" "y"             select binned readout of the detector
disable_win             suspend the effect of windowing on a CCD
enable_win              resume windowing after disable_win (q.v.)
window "window number" "xw" "yw" "xoff" "yoff"
                        define a read-out window on a CCD

Changing CCD speed
clear_speed "type"      set the clear speed, to STANDARD to QUICK
nonastro                change the readout speed to NONASTRO
quick                   set the readout speed to QUICK
readout_speed "type"    change the read-put speed of the CCD
rspeed "type"           synonym of readout_speed
slow                    change the readout speed to SLOW
standard                change the readout speed to STANDARD
turbo                   change the readout speed to TURBO
```

```
Interrupting an exposure (these have to be preceeded by Cntr-Z)
abort                          abort an observation, discarding and associated data
finish                         terminate an exposure immediately; saving the data
newtime "t"                    change the length of an exposure
pause                          suspend an exposure
resume                         restart an exposure suspended by pause (q.v.)

Housekeeping
cleanup                        get rid of system remains after SHUTDOWNOBSSYS
dasreset                       use this on lpss12 when having FOX problems;
                               see trouble shooting section. Follow with STARTOBSSYS
                               on lpss10.
obsdata "directory" "size"     define the FITS data directory,
                               and define approximate FITS file size in Mb
preflash "t"                   set the length of a CCD preflash
rtc_sync                       synchronize the real time clock on the CCD controller
setup_ccd "name"               prepare CCD channel; part of STARTOBSSYS
shutdownobssys                 kill the system
shutter ""                     move or unjam the shutter (arguments: open/close/unjam)
startobssys                    use to start up or when when a subtask has died
```

11 Appendix D: Example DAS/ICS observing scripts

As the user interface of the DAS/ICS runs through a normal UNIX TCSH environment, you can use scripts to execute groups of commands successively. You can edit these script using VI, EMACS, or XEMACS. We advise you to script the commands sequentially, i.e. not using the & character to put the processes in the background.

Below follow two examples of scripts, one using a command line parameter that is used to pass the object name through, and one script that does not use a command line parameter.

If the following script were in a file called myscript.csh, than one would invoke it by typing

```
> chmod 755 myscript.csh
> myscript.csh NGC43210
```

on the command line. The CHMOD routine has to be run only once. The script makes BVRI exposures and can be used when target acquisition and guiding have been accomplished.

```
#!/bin/csh
# When passing parameters, the line above is essential,
# is NOT a comment, and should be the first line in the file !!!
#
filter B              # move the filter wheel
run 40 "$1 b-band"    # expose 40 sec
filter V              # move the filter wheel
run 30 "$1 v-band"    # expose 30 sec
filter R              # move the filter wheel
run 20 "$1 r-band"    # expose 20 sec
filter I              # move the filter wheel
run 20 "$1 i-band"    # expose 20 sec
echo "READY"
beep                  # ring the bell to warn you
#
```

If the following script were in a file called myscript.csh, than one would invoke it by typing

```
> chmod 755 myscript.csh
> myscript.csh
```

on the command line.

```
#
filter B                    # move the filter wheel
run 40 "NGC43210 b-band"    # expose 40 sec
filter V                    # move the filter wheel
run 30 "NGC43210 v-band"    # expose 30 sec
filter R                    # move the filter wheel
run 20 "NGC43210 r-band"    # expose 20 sec
filter I                    # move the filter wheel
run 20 "NGC43210 i-band"    # expose 20 sec
echo "READY"
beep                        # ring the bell to warn you
#
```

12 Appendix E: Relevants parts of the 1989 version of JKT user manual

12.1 About the telescope

12.1.1 Engineering mode

It is possible when in engineering mode to move the telescope hardware without needing the computer. It is used by technical staff to move the telescope for such jobs as top end changes or by the astronomer for the initial setting up at the start of the night. The telescope is protected from being driven too far by the use of limit switches. See Section 13.2 for the procedure to use in the event that these limit switches are activated. The relays that protect the telescope are set so that it is only possible to drive away from trouble. Note however that hitting limits is regarded as an unusual case. In these circumstances, the computer loses control over the hardware and so when a limit has been reached it is impossible for the computer to drive out. It is then necessary to use Engineering Mode and no guarantee of the accuracy of the telescope position is made until the encoders have been freshly zeroset. Engineering Mode is the default mode on powering up the system.

12.1.2 Computer mode

The second mode of operation is computer mode. In this mode, the computer is allowed access to the servo amplifiers at full power and to the focus drive.

12.1.3 The drive system; position encoding

Each axis of the telescope has a main power amplifier which is connected to the drive motor. Each axis also has a second amplifier and motor which counteracts the effects of backlash.

The position of each axis is measured by an optical disc encoder which is attached to a shaft carrying the worm gear, drive motor and flywheel. The flywheels stop lockup in the gears. The encoder gives out a train of pulses which are counted (up or down) by a Hytec CAMAC module. There is one module for each axis.

Every tenth of a second, a strobe pulse comes from the time service and goes into the Hytec modules. This strobe causes a fresh copy of where the telescope is positioned to be copied into a register which in turn is readable by the computer.

This same strobe pulse goes into the computer which is interrupted from what it is doing and goes to look at the encoder position. The encoder position is compared with where the computer calculates that the telescope ought to be and it then applies a correction, as necessary, to the demanded drive voltages on the servo amplifiers. This procedure involves a CAMAC module which does a digital to analogue conversion. (DAC module). The voltage from the DAC is applied to the preamplifiers which in turn drive the main "Inland" power amplifiers.

There are circles on the telescope to help you get within a fraction of a degree if necessary while in engineering mode.

12.1.4 Alarms and status lights

There is a set of lamps at the right hand end of the console which indicate major changes of status or alarms. Alarms are of various types but upon no account should any be ignored. You will be unable to ignore an alarm anyway since when an alarm occurs and puts on the warning light the system trips a relay which sounds a high pitched, loud and very irritating whistle. You may cancel this by pressing the button marked "CANCEL". The alarm will remain lit but the noise will cease.

12.1.5 Instrument rotator

1. The rotator position angle is conventionally zero. It is usually difficult to rotate an instrument because of the cable ties. Guiding proves to be extremely difficult at position angles other than zero.

2. First zenith park the telescope. None of our instruments is exactly balanced in rotation and may swing out of control when the telescope isn't in the zenith.

3. Go to the observing floor and undo the rotation clamp.

4. Rotate to the desired angle using the push buttons. Watch the cables carefully throughout because even if they are long enough they may still get tangled.

5. Reclamp. The control computer can read the rotator position angle so no further action is needed.

12.1.6 How to reverse the telescope

How to reverse the telescope from East to West of the Axis. The reverse operation is carried out by interchanging West for East.

1. Go to Zenith Park.

2. Switch to engineering Control.

3. Exit the TCS.

4. Turn the speed knobs on the engineering panel to their maximum allowed values. This will be marked against the knobs and may be substantially slower than the maximum physically possible.

5. Watching through the window use the engineering controls to move the telescope to the pole and over the axis. When the telescope reaches the pole carry on turning in Hour Angle until the telescope is well to the West of the polar axis. Continue turning in HA and restart the declination motion in the same direction so that the telescope comes near to the Zenith West of the axis.

6. Start the TCS for west of pier.

7. When the user-interface appears carry out the zeroset and then switch to computer control.

8. Do a CALIBRATE.

9. Note: both the TV and CCD displays will appear to have rotated through 180 degrees.

12.2 The dome and rising floor

12.2.1 Control of the dome, shutters and wind screen

Access to the roof and the outside of the dome is via the aluminium door at the top of the stairs near the control room. At present there is no easy way of closing this door from outside (the only way is to take the key with you and lock it).

In winter inspect the outside of the dome during daylight for icing on the shutters before attempting to open them. It is a good plan to rotate the dome during the day so that the Sun melts as much ice as possible. Wear a hard hat (provided near roof exit door) and a safety harness when climbing the dome. It is strictly forbidden for any ice to be cleared from the dome unless supervised by a person without astronomical interests.

If there is no power to the building call the Duty Engineer, otherwise you can rotate the dome and raise/lower the wind screen from either the grey control panel mounted on the inside wall of observing floor or (if the local/remote switch thereon is set to remote) via buttons on the upper left of the telescope control

console in the control room. At both stations the buttons must be kept depressed for the mechanism to work.

Even though it may not appear so, the shutters do open to a full 2 metres.

The dome rotation is normally set to maximum speed (one 360° rotation takes 3.5 minutes). Please leave the speed control (lower right of control panel in dome) set at maximum.

Remember, during hours of darkness, to switch the dome lights off before opening for fear of feeding unwanted light into the INT and WHT.

12.2.2 Control of the rising floor

To facilitate access to the telescope, the dome is provided with a rising floor. Control of this is achieved through a control panel (yellow) which although on a 4 metre extension lead is normally left hanging on a post below the dome rotation control panel. Four buttons give fast raise and lower (the upper - i.e. near cable input - two buttons) and slow raise and lower (bottom 2 buttons). The floor control has 2 circuit breakers, 1 power switch and for safety reasons, 3 micro switches and 3 emergency stop buttons (apart from the upper and lower level limit switches) which can disable the floor operation. The procedure for investigating rising-floor malfunctions is explained in the section below.

Of the 3 micro switches by far the most troublesome is that on the gate giving access to the observing floor. The gate must be fully closed in order for the floor to be operative. At present the vibration of moving the floor is sufficient to open the gate and the floor will stop for no apparent reason. The other micro switches, which are less likely to be of concern, detect whether the rising floor hatches are open and whether the ladder of the rising floor is in place.

Three emergency stop buttons are also provided one by the gate, one on the floor control paddle, and one near the under floor access next to the control room door. These can be depressed accidentally. If the floor fails, check these stops are fully out - particularly the one by the gate.

12.2.3 Malfunction of the rising floor

If the rising floor does not work but power is present to other things e.g. shutters then:

1. Check micro-switches on gate, hatches, ladder.
2. Check all three emergency stops are fully out.
3. Check switch and circuit breaker under the floor (follow the cables from the large motor to identify these).
4. Check circuit breaker in basement (on the large panel of switches to the left of the Buffer Set in the plant room there is one labelled for the rising floor).

12.3 The TV acquisition camera

12.3.1 Introduction and warnings

The acquisition and guide box (JAG) currently used on the JKT features a travelling flat mirror which when in place directs the telescope beam to a high gain TV camera. This is a very powerful system in many senses of the word and so care must be taken in its use. The best way to ensure that you do not damage the TV and what is more get the most out of its facilities is to READ THE REST OF THIS SECTION.

****WARNING*********WARNING********WARNING********WARNING****

The very high-gain TV camera can be quickly and permanently DAMAGED BY OVER-ILLUMINATION. Do not, therefore, operate the TV until you have read all of this Section and preferably have also been shown how to use it.

****WARNING*********WARNING********WARNING********WARNING****

12.3.2 Looking after the safety of the TV

1. Ensure that all dome lights, including torches, are turned off before turning on the camera. The fluorescent lights are interlocked so that they cannot damage the TV but not so the variable Tungsten lamps controlled from outside the control room door.

2. Always view a field in DIRECT mode first, NEVER in AVERAGE.

3. Turn the gain up SLOWLY: there is a lag of about 3 seconds between operating the gain control and the full effect being seen.

4. Never do a long integration with a bright star in the field.

5. Always turn the camera gain off BEFORE MOVING the telescope. You just never know which first-magnitude star is lurking around the corner.

6. DO NOT TWIDDLE knobs at random. Think about what you are doing and if you don't understand some function look it up in the manual (here!).

7. If in doubt, press the FREEZE button and turn the gain down. This ensures that the TV read beam is not blanked and therefore any over- illumination is discharged. Other panic measures, e.g. hitting the red OFF button, do not guarantee this and so should be avoided. It is always safer to turn the gain control to its clicked-off position than to operate the OFF button.

12.3.3 Powering up the TV system

The TV control box is at present in Bay 1 of the telescope control console. There are two monitors associated with the TV. The first is the 'raw video' monitor which is on top of the control console and secondly there is the all-singing, all-dancing Grinnell monitor which is incorporated into the control console to the left of the main GD4K display. Below the Grinnell monitor is an array of feature-selection buttons. The final piece of hardware in the TV system is a joystick controller box which normally resides on the telescope control console desk - or nearby.

To operate the system follow these steps:

1. Make sure all lights are out in the dome.

2. Turn on the power to the two monitors of the TV system and let them warm up, so that you can see if any image is on the TV camera.

3. Ensure that the gain control of the TV control box is turned fully off (turn anti-clockwise until it clicks).

4. Press the black ON power button on the control box. The two lights labelled DELAY & RESET will come on. Wait (about 15 secs) until they go out and the green ON light comes on. If RESET does not go out, press OFF, check step (3) and try again. If these lights are still reluctant to go off a gentle anti-clockwise turn on the gain control switch will usually do the job.

5. The TV control box has two scan reverse toggle switches (which allow the orientation of the TV display to be changed to match finding charts for example.) Initially, however, they can be used to test the status of the system. When the monitors are powered up, and adjusted in brightness to give a visible background, switching the toggle switches will, if the system is OK, result in the bright edge of the TV cathode traversing the screen. If this is not seen then check the monitor brightness settings. If there is still no response then call for help.

12.3.4 Complete restart of the TV control system

If the TV system has been completely shutdown then check that the following units are on.

1. The large Grinnell systems unit at the base of the CAMAC rack (power switch bottom left).
2. The Westinghouse camera control unit (front switch).
3. The rack immediately below (2) - power switch at the back.

The camera control software is now held in ROM and the only startup/reset procedure consists of pressing the RESET button on the Grinnell control panel.

12.3.5 Further safety rules

1. Before viewing a source, select the DIRECT viewing mode on the Grinnell buttons.
2. When pointing at a field, even if you know it only contains 18th magnitude objects, turn up the gain SLOWLY whilst observing the effects on the direct (raw video) TV camera monitor.
3. As the object or field of interest appears on the direct screen, adjust the gain control to give a sensible picture on the Grinnell monitor.
4. If the gain control reaches maximum without ill-effects on the direct screen and further gain is required, then select AVERAGE mode on the Grinnell and adjust the number of frames of integration ONE step at a time waiting between steps to see the resultant image. When the Grinnell is in the AVERAGE mode, the direct monitor will flash the integrated signal with a period equal to the integration time.

   Finally, at the risk of being boring, be EXTREMELY CAREFUL ON BRIGHT STARS - if an object looks too bright in the monitor then it IS too bright so turn down the gain p.d.q.

12.3.6 The GRINNELL TV controls

The main 3x3 block of controls reading left to right and top to bottom have the following functions:

1. AVERAGE - Recursively filters on-target integrations. On-target integrations are selected by the INTEGRATION rotary switch.
2. T-INT - ON-target summation of 2**n frames. Selected via the INTEGRATION rotary switch.
3. DIRECT - Real time digitisation at normal frame rates.
4. FILL - Fills in the alternate lines of a stationary (FROZEN) picture. Considerably improves the appearance of faint, extended objects.
5. FREEZE - Freezes the current picture.
6. HARDCOPY - Put up full screen crosswire.
7. OVERLAY-ONE - Enables/disables the first graphics overlay plane (i.e. the border, the orientation and the scale).
8. OVERLAY-TWO - Enables/disables the second graphics overlay plane (i.e. the integration, tau, background and contrast information)

The three rotary switches below the panel buttons act as follows

INTEGRATION - The absolute position of this switch determines the number of frames of integration.

BACKGROUND - Makes the background blacker or whiter. There is no absolute position, the effect is determined by the direction and number of steps moved.

CONTRAST - As for the BACKGROUND switch but it controls the contrast i.e. softens or enhances.

Off to the left of the rotary switches are three more push buttons labelled MENU, SELECT and RESET. Pressing the MENU button will freeze the image and cause page 1 of a 2-page image processing menu to be displayed. A cursor is also displayed and may be positioned on the menu by multiple depressions of the SELECT button. The joystick may be used instead of the SELECT key for menu selection if preferred. The joystick controller box also contains the buttons to enable and disable the movement of any displayed cursor. Press the ENTER button on the joystick controller to enter the menu selection. The functions available from the menu are described in the next Section. The RESET button causes a complete reset of the system - all overlays etc will be lost.

12.3.7 Functions available from the GRINNELL menu

When the menu is displayed on the Grinnell TV monitor, move the cursor to the function required and press the ENTER button on the joystick controller to process the selection. When the function selected requires further positional information, up to 4 cursors can be enabled on the screen depending on the function. When they appear they may well be overlaid and so only appear as one. On the joystick controller the cursor switches determine which cursor(s) the joystick will control at any one time (for these switches, UP is ON). Once the cursors have been positioned as desired, ensure that at least cursor switch 1 is ON, and then press ENTER again to initiate the processing. A quick guide to the menu is given in the following table.

1. DRAW RESTRICTED PROFILE	Requires TWO cursors to be positioned in either the X or Y plane and draws the profile of the data contained in the displayed image between the 2 cursor points. At the start the cursors are overlaid. This function is used for seeing estimates as it gives the FWHM of a star image in arcsecs. The profile is automatically erased when DIRECT is pressed.
2. SET PHOTOMETER APERTURE	Enables the size of a circle which can be used to mark photometer apertures to be set numerically. The size (in arc seconds is displayed in the bottom right hand corner of the screen). The default value is 14" . To change this value i) Put FUN B UP ii) Put FUN A UP to increase the aperture size, DOWN to decrease. iii) Press ENTER n times. This will result in a change of n arcsecs. Limits of 5 and 30 arcseconds have been set. iv) To exit, press ENTER with both FUN A & B DOWN. The set value will be retained until specifically changed.

3. DRAW PHOTOMETER APERTURE	i) Move cursor 1 to the required position. ii) Press ENTER Multiple cursors can be drawn (without going back to MENU) by ensuring that FUN A or B is UP. A single aperture is drawn if both are down and this is also the exit mode. Apertures have to be specifically eased using ERASE OVERLAY.
4. CALCULATE MAGNITUDE	Requires one cursor to be positioned over the object, and displays the integrated magnitude of the object. There is an arbitrary zero point for the magnitude scale.
5. DRAW CCD O/L	Draws the outline of the CCD chip on the TV screen
6. CALCULATE DISTANCE	Calculates the distance in arcsecs between 2 cursor positions.
7. INITIALISE	Initialises the TV system. No cursors. Resets Parameters to f/15 focus.
8. ERASE ALPHANUMERICS	Clears the areas of the overlay planes used for displaying information.
9. ERASE OVERLAY	Erases overlay plane number 2.
10. ERASE IMAGE	Erases the image plane.
11. ERASE PROFILE	Erases that area of overlay used to display the profiles.
12. NEXT PAGE ...	Displays the second page of the menu which consists of ...
13. TEST PATTERN 0,1,2,3	Displays the Grinnell test patterns.
14. ERASE TEST PATTERNS	Erases a test pattern.
15. INTEGRATION PARAMETERS	Displays the current integration parameters (i.e.the status of the rotary switches).
16. DRAW SLIT	Requires all 4 cursors to be positioned independently and then joins them up. Intended to be used for marking slits, but can be used to draw any quadrilateral.
17. DRAW CIRCLE	Requires 2 cursors to be positioned to define the diameter of a circle which is then drawn. Useful for defining the position of photometer apertures.

18. DRAW BOX	Two cursors are enabled which are used to define the side of a rhombus. The line joining the two points must have a positive gradient in the X-Y plane of the screen. If the 2 cursors have the same Y position, they will define the top side of a square. If they have the same X position, they define the left hand side of a square.
19. ZOOM	Zoom factors are determined by the state of the function switches FUN A & FUN B on the cursor controller. Setting one or both of these switches followed by ENTER causes a new zoom factor to become operational. The factors are : FUN A set, zoom = 4 FUN B set, zoom = 2 FUN A+B set, zoom = 8 The zoomed image can be panned via the joystick. To exit from zoom, turn both function (FUN) switches off (down) and press ENTER. This facility requires the TRACK switch to be up (on).
20. F/8 FOCUS	Changes the scale of the displayed image to correspond to the scale at the F/8 focus. Never needed as there is no TV at f/8. To return to f/15 do a MENU initialise.

13 Appendix F: TROUBLE SHOOTING

There is up-to-date information available on the JKT Online help page http://www.ing.iac.es/~jht/jkt.html and on the JKT Software page http://www.ing.iac.es/~sheila/jkt.html .

13.1 Telescope runaway

One of the most worrying problems that can occur with the telescope control is that the telescope begins to slew uncontrollably. In this event, having read the following few actions in advance may save a lot of panic and, who knows, may even help to stop the telescope before the limit switches do. The actions are listed in order of seriousness.

1. If in computer mode, type STOP at the TCS User Interface.
2. Press the large red EMERGENCY STOP button (upper right of control console). There is a second emergency stop button on the telescope primary cell which works equally well.
3. Check that the handset is plugged into the "observer" socket. If it is there must be some other problem. Call for help.

N.B. The emergency stop buttons for the rising floor have no effect on the telescope!

13.2 Releasing telescope from the limit switches

If the actions of Section 13.1 fail, or more likely if you weren't watching or were too slow, then the telescope will be stopped by the horizon limit switches. To get away from this proceed as follows:

1. Switch telescope to engineering mode.
2. Press the clear alarm button.
3. Turn the key marked LIMITS NORM/OVERRIDE clockwise and keep it turned whilst simultaneously pressing whichever of the HA+, HA-, DEC+, DEC- buttons is required. The telescope should now rise away from the limits.

The encoder readings for RA & Dec will probably be corrupted entailing a fresh ZEROSET and CALIBRATE.

13.3 If the dome won't turn

1. Check grey panel on dome wall is ON.
2. Check it is switched to remote/local, whichever you want. (Remote = control from the control room).
3. Check that the speed control is at maximum.
4. Check that the console button 'Select manual controls – DOME' is off.

If the dome turns but the reading on the information display doesn't change:

1. Check interface next to the grey panel is switched on.
2. Check the gear wheel is still located in the chain (North end of dome).
3. Call Duty Engineer.

13.4 FOX errors

Recovering a file which is read out with a 'pixels missing' error:

There are two errors that you may see due to the FOX interface. One is reported as
'Fox Error - too few pixels in image'
the other is
'Fox Flood'

In both cases try the PROMOTE command to save the image (you may need to Ctrl-Z and BG the run, then type ABORT if it has not finished).
Type

```
SYS> dasreset
```

at the command prompt in the DAS computer (lpss12).

If DASRESET cannot clear the problem, the second stage of repair is to shut down the DAS on lpss12 using SHUTDOWNOBSSYS (no need to shut down on the system computer, lpss10). Then restart with STARTOBSSYS first on the DAS computer then on the system computer.

Remember to restore the settings you may have made to the CCD such as readout speed, window and binning.

Write a fault report whenever this happens!

13.5 No stars seen

Pretty obvious, but:

- Are the dome and mirror petals open?
- Is the dome in the correct position?
- Also check that the dome is not set to manual on the lower row of buttons on the central section of the control desk.
- Is it cloudy?
- Are the position and equinox in the TCS correct?
- If you're using the TV have you typed TV ON on the ICS to put the TV flat in, and is the camera turned on?
- If you're using the CCD, not the TV, does the shutter open and close - check the Mimic?

13.6 No guide stars found

- First check that you have entered the correct position and equinox into the GSS.
- Are the guide probes at their requested position on the Mimic? If not repeat the GDXY command.
- From the Mimic, check the autoguider ND and Colour filter codes. Using Table 3, check that BOTH of these correspond to clear, UBK7 filters, matched to the thickness of the CCD filter you're using. If the colour one were set to UV, you're not going to see very much on the autoguider raster.
- Check that the UT and LST of the TCS computer are the same of that in the INT and/or WHT.

- Given the fairly awful pointing of the JKT, unless you have finding charts and use the TV for acquisition, then your target (and guide star) could possibly be more than 60 arcs from where you expect it to be, in which case it was fall outside the 2 arcmin autoguider raster.
- Faint guide star - bright moon?
- The calibrate was not done centred on the actual rotator centre. Maybe the translucent ring needs to be moved on the TV monitor.

13.7 Rising floor won't!

There are a number of microswitches and emergency stop buttons which can prevent the rising floor from working:

- The gate onto the observing floor must be closed.
- The ladder to the observing floor also has a microswitch. May need to be given a push down from the observing floor.
- Emergency stop button by gate.
- Microswitch beneath cargo door adjacent to the control room.
- Emergency stop button by cargo door.

13.8 Images elongated or show jumps

- The JKT is very sensitive to imbalance. Ensure the black bag is fitted (and not fallen off) around the bottom of the mirror cell. Another cause of imbalance is oil accumulation in the Dec axis, if the oil scavenging system is not working properly.
- If autoguiding, the star could be too faint to centroid properly.
- Is it windshake?
- It's also possible that the mirror support system is oscillating.
- Especially for sources that are in the west at a zenith distance of more than 50 degrees, we have observed double images due to mirror jumps. These jumps are typically a few to 15 arcsec long. If this is the case, move to a different object (closer to zenith).
- The JKT secondary is mounted in a way that allows it to flop when the telescope goes through the meridian. If you are observing on the meridian you might experience this; the images are affected by a jump of about half an arcminute.

13.9 Field vignetting

- If there is evidence of vignetting on CCD frames, suspect that the filter wheel has lost its encoder position, probably because it's become loose. There are notes on how to check the status of the main CCD and autoguider filters in the *JKT Quality Control* folder in the control room. In the first instance though it's probably easier to go and check the filter wheel, and make sure that it's located securely, with the white clamp underneath, hand-tight. You must do a ZEROSET MAINFILT from the ICS to initialise the filter wheel afterwards.
- The drift table may have moved

13.10 Unable to identify field on TV

- Check that you have the correct position and equinox on the TCS.
- On the TV control unit there are two switches, which control field orientation. The nominal position for these switches is shown by red arrows.
- Incidentally, if these switches are wrong, and you CALIBRATE, then your pointing will crazy. Restart the TCS with the correct switch positions.

13.11 CCD telemetry out of range

If the temperature is out of range (CCD warming up), fill immediately. SITe2 has an off-centre filler tube which means that at very high and very low ZD's, then liquid Nitrogen can syphon out, rapidly reducing the hold-time. The danger is under-filling the cryostat: continue to fill until liquid Nitrogen is seen escaping from the filler tube or side vent. If the 5v digital line goes out of range, ignore it, but log it in the database.

13.12 Servo amps alarm

This alarm sounds occasionally, and may or may not stop the telescope tracking. This condition is very hard to reproduce in daytime, so if the alarm sounds please don't cancel it immediately. Go downstairs and enter the TCS room (CLIP centre), which is opposite the main door. On your immediate left is a bank of four racks. These racks are interchangable between the INT and JKT, RA and DEC, drive and torque (antibacklash), so they're not clearly labelled. If any rack shows a red fault light, note which rack it is, then enter it in the FAULT database, once you've cancelled the alarm.

13.13 Hydrogen alarm

There are two gas alarms mounted on the control room wall, relating to the photographic plate Hydrogen soak plant outside. If these sound they can be muted by unscrewing the transparent covers, and pressing the mute button. Call the Duty Tech, who can gain access to the plant using the keys in the key press in Phil Rudds old office.

13.14 No communication between TCS and ICS/DAS

This becomes apparent when the INFODISP on lpss12 stalls or disappears, and when TCS related commands cannot be issued through the ICS/DAS interface anymore. Additionaly, no telescope related headers are transfered to the FITS files and to the night log. These are all symptoms of a crashed TELD task.

On the TCS Xterminal, check whether the TELD task is still running. If not, start another telnet session to lpas1, login and type OPTIONS. Then type TELD to restart the task. Do a STARTOBSSYS on lpss10.

13.15 Autoguider ACQUIRE doesn't pull in

The ICS JPROBE task makes it possible to let the TCS move the guide probes. When doing an ACQUIRE in the default guide star aqcuisition mode, the TCS sends commands to the ICS to change the guide probe position such that the guide star will appear in the middle of the autoguider field.

If the JPROBE task is dead, ACQUIRE will go on endlessly but will achieve nothing. You can solve this by stopping the guider and then a STARTOBSSYS on lpss10.