Observers Guide to the JKT RBS

Phil Rudd *

20 September 1996

*La Palma Observatory

Contents

1 Scope of this Guide

This guide is *not* intended to replace Roger Edwin's *The St Andrews RBS User Manual*, which should always be consulted before using the instrument. However the *User Manual* is seriously out of date, and contains no guidance about actually setting up the CCD, and the dispersion tables refer only to the small RCA type CCD's. Updating the latter for EEV and TEK will be the next task. This guide is a first draft and may contain errors - please inform the author of any discrepancies, so that they may be incorporated in later versions.

2 AFTERNOON ACTIVITIES

- Fill cryostat with LN2 (usually every 12 hours)

2.1 Computers

See computer startup instructions on wall above each system console. Usually computers are left up and running, since installation of UPS. Check for response from keyboards.

```
TCS3210 (TCS) - will give UI> prompt.
ICS3220 (ICS) - will give * prompt.
```

2.2 Adam Login

```
* SI XYZ,n,n       XYZ=observer n= PE account (see whiteboard).
                   Write initials on board, dates resident and
                   write NO in the 'ok to delete?" column.

* ADAM             and answer prompts: f/15, A&G+RBS, EEV7/TEK4 etc,
                   run#(n) and D to dump to disk only.

                   To abort from an Adam command press break, then
                   SEND CON:, unless the Adam terminal hangs during
                   readout, in which case type RESET at the ICS
                   system terminal, which forces an automatic restart.

                   To abort from Adam altogether press break then
                   * CA (cancel).
```

Note that the new SCSI ICS disk drives are 2Gb capacity, and can store up to approximately 450 full-frame big chip images, a factor of 3 improvement over the old drives, with the Sparcstation having 18 Gb capacity.

2.3 Setting up the RBS

2.3.1 Changing Optics

The RBS has exchangeable optics, optimised for blue or red (>5000A). Changing the optics is straightforward, and can be done in about 20 minutes. Follow the instructions in Roger Edwins *The St Andrews*

RBS User Manual, and you can't really go wrong. There are up to five components to change: slit assembly (either 1 or 1.5 arcs), collimator, grating, camera mirror and corrector unit. The change procedure for each optical component is accurately described in the Manual: note only that the screw on cap protecting the collimator is very stiff, due to some unfortunate impact with the telescope pier, so care must be taken when replacing the cap, to prevent cross-threading. All the RBS optics are stored in an aluminium case in the left-hand cupboard below the worktop in the "darkroom", adjacent to the dome area. You will also need Allen keys to remove the grating and camera mirror assemblies.
Before you start to set up the RBS, ensure that you have the correct optics mounted, and with the grating angle set for the appropriate spectral region, for the grating in use.

2.3.2 RBS external controls

Good, so you've changed the optics. The RBS is a **REAL** spectrograph, all RBS functions being controlled from the observing floor. Externally there are four controls of interest during setting up, and to a lesser extent during observing: grating angle clamp, slit and dekker slide, Hartmann mask, and finally the micrometer on the camera mirror unit, used for focussing.

The grating angle is changed by first unclamping the grating using the bronze knurled clamp on the grating scale, rotating the grating to the desired angle using the knob on the side of the spectrograph, labelled *Unclamp grating before rotating*, then re-clamping.

The slit and dekker slide has two detents, although finding the inner one can be a little tricky, as it is not well defined:

```
Fully In     -  whole slit covered
Inner detent -  star slot uncovered - central 2mm exposed
Outer detent -  arc slots uncovered - 2 x 2mm exposed
Fully out    -  whole 20mm slit exposed - Longslit
```

A 2mm slit length projects to about 0.5mm wide spectra at the camera focus. During observing stellar and comparison spectra are usually exposed on separate frames, using Longslit mode (slide fully out).

The Hartmann mask has three positions:

```
In      -  first Hartmann position
Detent  -  second Hartmann position
Out     -  for normal operation, secured in stowed position
              using fork clamp.
```

The micrometer on the camera mirror is used to adjust the spectrograph focus. **Initial focus for the red optics is about 7.5mm, and 7.4mm for the blue**. Unless the focus is apalling, micrometer increments of 0.1mm should be used initially. The Hartmann focus test is described later, but beforehand the mounting of the cryostat itself should be discussed.

The CCD cryostat is mounted on the RBS using the familiar RGO kinematic mounting plate. This has three capstans with micrometers - the capstan settings are contained in the black RBS logbook in the control room, and should be set-up initially by the Duty Engineers. Hope and pray that these are correct, and that the CCD is orthogonal to the RBS focal plane, as correcting any tilt on the CCD is not for those of a nervous disposition - suitable tranquilisers may be found in the RBS optics case: these will almost certainly be required when squaring-on TEK4. The capstans are mounted at about 8, 4 and

1 o'clock, and are referred to by the letters A (Cone), B (Slot) and C (Flat), engraved on the kinematic mount. The cryostat is mounted so that it's dispersion direction is horizontal when viewed from behind the cryostat so A and B should correct tilt in the dispersion direction, and C, spatial tilt. If you do determine new capstan settings for a particular detector, please ensure that these are recorded in the RBS logbook for future reference.

The other crucial adjustment is the micrometer controlling cryostat rotation, thus allowing the dispersion direction to be accurately aligned with the rows of the CCD. Before attempting to adjust the micrometer the six 10mm faceplate bolts must be loosened.

The Ellis A&G, on which the RBS is mounted has 2 hollow cathode calibration lamps and a Tungsten lamp for flat fields. All three can be fitted to the integrating sphere on the A&G box, or alternatively either of the hollow cathode lamps can be mounted directly on the same A&G port, secured by a locking collar. Note that the Tungsten gives flat-fields about as flat as La Palma when used in the integrating sphere; use dome or sky FF's instead. The three lamps are connected to a power supply on the A&G as follows:

```
CuNe   Position 1
CuAr   Position 2
W      Position 3
```

Since the control room reorganisation during 1995, with the electronics racks being moved into the ICS room, the RBS handset can no longer be used (as the cable is not long enough), instead all handset functions are now controlled by Adam commands, as follows:

```
CUNE ON/OFF       turns on/off the cune lamp
CUAR ON/OFF       turns on/off the cuar lamp
TUNG ON/OFF       turns on/off the tungsten lamp

COMP IN/OUT       moves the Comp/Acq mirror into/out of the beam
SLIT IN/OUT       moves the slit view mirror into/out of the beam
```

The point to watch here is that if one mirror assembly is in the beam and you want the other mirror, you **MUST** move the unwanted mirror out of the beam before attempting to move the other into the beam. Failure to observe this may lead to Adam becoming confused and acting strangely (nothing new there!). So for example, if you've just done an arc, and want to return to slit view, you must type COMP OUT and then SLIT IN. Each mirror movement will take about 25 seconds, so be patient.

2.3.3 CCD rotation

First set-up priority is to ensure that the CCD rotation is correct, and that the dispersion direction co-incides exactly with the rows of the CCD. The RBS is very critical here, since a 2mm slit length projects to about 0.5mm at the detector. Ensure that the micrometer on the camera mirror has been set to 7.5mm for the red optics, and 7.4mm for the Blue optics, or check the RBS logbook for the most recent values. Rotation is best done using arc lines, so take an arc with the dekker in longslit mode and the Hartmann shutter out, and measure the centroids at top, middle and bottom. Adjusting the cryostat rotation requires the six bolts on the cryostat faceplate to be loosened, and the cryostat rotated away from the stop. Do **not** attempt to rotate the cryostat with the micrometer - back off, move the micrometer, rotate the cryostat back until it touches the micrometer, then retighten the bolts, and try again. Ideally the rotation along the dispersion direction should not exceed 0.1 pixels.

2.3.4 Correcting for CCD Tilt

Now take an exposure with the right Hartmann shutter in, and then one with the left Hartmann in, still in longslit mode (dekker out). Measure the centroids of the arclines in the right and left Hartmann images. The difference between the left and right Hartmanns gives the focus shift as a function of CCD position (i.e. the tilt). Once the tilts are known, adjust the capstans, and repeat, until the tilt in both spatial and dispersion directions is <0.3 pixels. Capstans A and B should correct for tilt along the dispersion direction whilst C, or C and A/B should correct for tilt along the less critical spatial direction.

2.3.5 Focussing the RBS

In longslit mode (with dekker out), make two exposures as above, with the right and then the left Hartmann shutters in. Measure the centroids of the arclines in both images, the difference being the focus shift as a function of CCD position. Adjust the camera focus until the shift is zero.

2.3.6 LOG IT!!

After all your painstaking efforts please ensure that you record the capstan settings, rotation micrometer reading and camera mirror focus micrometer readings in the RBS logbook in the control room, date it, sign it, and indicate clearly which detector was mounted and which optics set was installed.

2.3.7 Wavelength Calibration

If the observers central wavelength is known, then set the grating angle accordingly for the grating in use (from the RBS Manual), and take an arc exposure. Identify the lines in the resulting spectrum using the arc maps in the *IDS Calibration Lamp Arc Maps* manual ,*La Palma Technical Note No. 70.* SQUISHing the image may help here since the Lexidata only shows the central region of the chip. Should the orientation of the spectrum be incorrect there are three commands available which will flip the image:

```
Adam:>  XYSWAP=1
        LRSWAP=1
        TBSWAP=1
```

Finally, in preparation for observing, ensure that the Hartmann mask is fully out, and secured in place with the plastic fork clamp, and that the dekker slide is also fully out, in longslit mode.

Put the kettle on - You've earned it!

2.4 D Tape Dumping

With the introduction of the Perkin-Elmer to Sparcstation networking, image and header files are transferred to the Sparc as soon as they become available at the Perkin-Elmer. Consult Gary Mitchell's notes on how to set the networking in motion, which should be near the Sparc.

For all data, two tapes are generated. The D tape is made by the observer, normally at the end of each observing session, and goes into the ING data archive. Before then, it is copied, either by the observer or by the tape copier, to produce the copy or C-tape, for the observer.

General rules for D tape usage are to append data to them, not to use a new one each night, and to not append more that say 300-500 files to a single D-tape, since this makes data retrieval from the archive laboriously slow. The D tape must always be a DAT tape, although the C tape can be either DAT or EXAB.

2.4.1 D tapes

At the end of the session, insert the D-tape into the lpss6 Sparc DAT drive. Make sure that all your files have been transferred to the Sparc, then pull up a new Xterm window and type:

```
AUTOFITS    and answer the prompts
```

Within AUTOFITS is an option to initialise the tape. **DO NOT do this unless it is a NEW tape**. If you initialise a tape which contains data, then any data on that tape will be irrecoverably lost.

Whenever you are dumping data, please leave a note on the terminal to say which files you are dumping, and give your name and time you started dumping.

2.4.2 C-Tapes

You have two choices here. Either copy the data yourself and verify it using the FITSLIST option within the TPCOPY facility in the WHT, or fill in a Mag Tape Copy Request form and let the tape copier do it.

To do it yourself, load a C-tape in the DAT drive again of the Sparc and repeat AUTOFITS as described above. This tape **MUST** then be verified using the TPCOPY facility in the WHT terminal area.

Alternatively, fill out a MTCR form for the tape copier and leave it in the filing tray in the control room.

2.5 Purging files from disk

After all files have been dumped to D tape and copied to C tape you will have to delete them from the disk, to maintain your working space. The command to use for this is PURGE, which will only delete those files which have previously been archived to tape. Before you PURGE any files contact your SA who will check the JKT tapes status (maintained by the tape copier), which will indicate which D tapes have been copied and verified. The tape copier (or observer, if producing and verifying their own C tapes) should write YES in the 'ok to delete?' column on the whiteboard, but the tape status file must always be checked before purging any data.

```
lpss6% more /home/lpss1/vbf/tapes/jkt.tapes

Adam:> PURGE     which will delete a specified range of files
                    from the disk. The prompts are:
                       which disk volume> SYS
                       Detector> CCD
                       Initials> XYZ (as for Login)
                       Files to be purged> R1-R150

                 The above will purge files:

                       SYS:CCDxyz.001  to
                       SYS:CCDxyz.150  incl.
```

2.6 Bias frames

```
Adam:> RUN 0 "BIAS"     does a zero second exposure (reading
                           out CCD with shutter closed), and
                           creates a bias frame, with title
                           "bias".

Adam:> MULTRUN          takes multiple bias frames. Simply
                           reply to the prompts.
```

Check bias value using STATS mode of PHOT. If different from default value when you initialised Adam, enter:

```
Adam:> NEW_BIAS n
```

3 TWILIGHT/EVENING ACTIVITIES

3.1 Telescope

- Fill cryostat.
- Check observing floor, and lower rising floor so instrument will not foul floor during observing.
- Telescope power ON (Engineering mode).
- RUN oil pump and cancel alarm(s) if necessary by pressing CANCEL button and green RESET button, if lit. The alarms may have to be cancelled twice.

3.2 Zeroset encoders

- In ENG mode with dome lights on.
- Set slew rate knobs set to green marks.
- Drive telescope >3 degs from ZP in HA and Dec, manually.

```
UI> ZEROSET     - hit <cr> to begin. Drive back through zenith in
                  each axis until each pair of illuminated green
                  arrow keys goes out. If only one pair
                  illuminate then press ACK to abort, and try
                  again, without moving the telescope. Repeat
                  also if Zeroset drops out immediately.
```

- Turn off dome lights.
- Switch to COMP mode using keyswitch.
- Press GUIDE to energise handset.

3.3 Dome shutters and mirror petals

- Open dome shutters (hold button in)
- Open primary mirror covers and check not stuck
- Lower blind

3.4 Flat Fields

The easiest method would be to illuminate the slit with the Tungsten lamp in the integrating sphere attached to the Ellis A&G box. Tungsten flats should be used for the dispersion direction, and sky flats for correcting pixel-to-pixel variations in the spatial direction. For sky flats do the following:

```
UI> IN BLANK        inputs catalogue of blanks fields, suitable
                      for sky (twilight) flat-fields.

UI> L              lists directory.

UI> N BLANKn GO    marks next target as BLANKn, and slews to it.


Adam:> GLA n       initiates a glance run of n secs.

                   Note:

                        WINK n   n secs, image stored in Scratch,
                                 with no header packets, so used for
                                 quick peeks only.

                        GLANCE n  n secs, image stored in Scratch,
                                  but with header packets. If
                                  you decide to keep it use KEEP
                                  which puts it into your directory,
                                  which prompts for a name.

                        RUN n "title", creating a named file where
                                  n is the exposure in seconds.


Adam:> DIP 2 0 65000    changes display range of Lexidata to
Adam:> DISP                0 to 65000 ADU's. The 2 specifies that
                           all 16 bits of digitised data be
                           displayed.
```

If counts are satisfactory then the Glance file may be saved from scratch to a disk file using the KEEP command:

```
Adam:> KEEP "title"
```

3.5 SNAFU

The SNAFU procedure is necessary to define the collimation and index errors, and incorporate these into the pointing model.
(During set-up the slit centre should be marked on the TV, using the following procedure: illuminate the narrow star dekker by the tungsten lamp, with the SLIT mirror in the beam. You must type OPEN at the Adam terminal first to open the above slit shutter, otherwise you wo'nt see anything. Mark the slit centre on the TV then revert to longslit dekker afterwards.)

- Go to bright star (5-6mag).
- Turn TV on. Check gain control in clicked-off position. Press ON. Wait 10-15secs til delay light goes out. Select DIRECT. Turn gain up *slowly.*
- Type OPEN on Adam terminal to open the above slit shutter.
- Adam:> COMP IN to put the slit-view mirror in the beam.

```
UI> SNAFU          Use the green console buttons to centre star on
                   slit centre mark on TV (see above).

Press ACK          to acknowledge (lower right of control desk).
```

This is the first SNAFU, using the Comparison mirror. In case there is any displacement between the Comp and slit mirrors, repeat with the slit-mirror, which is more important.

```
Adam:> COMP OUT    to move the comp mirror out of the beam

Adam:> SLIT IN     to move the slit-view mirror into the beam

UI> SNAFU          Use the green console buttons to centre star
                   on slit centre.

Press ACK          to acknowledge (lower right of control desk)
```

3.6 Focus

The slit jaws are reflective to aid target acquisition and field identification. Unfortunately the optimum focus must be determined visually from the TV - using a small number of on-target integrations to sample the seeing, is probably easier than using the direct TV. The best procedure is as follows:

- Select manual focus on lower control desk
- Use the focus controls on the engineering panel to select optimum focus, using fast/slow mode as necessary.
- When satisfied with the focus, deselect manual focus to revert to automatic focus tracking, having noted the new focus value first.
- Adam:> SETFOC to new focus value.

3.7 Enter Sources / Create Catalogue (at User Interface)

```
Rules: - only 80 char records allowed.
       - filename must consist of 8 alphanum chars or less,
            starting with a letter and have the extension .CAT.
       - no more than 500 objects per file.


UI> DEL/ALL        to delete all entries in UI directory.

UI> SO name  R hh mm ss.s  D dd mm ss.s  EQ B1950 (or J2000 etc.)

Repeat above for each target. At end:

UI> SAVE MY.CAT    saves catalogue with name MY.

UI> IN MY          inputs catalogue on subsequent nights.

UI> L              lists catalogue just INputted.

UI> N name GO      Slews to Next target 'name'.


Standard catalogues, loaded into dictionary using UI> IN name :

   PTGRID          pointing grid, with  4 subsets for measuring
                      seeing:

      SEE0006      0 hr < RA < 6 hr
      SEE0612      6 hr < RA < 12 hr
      SEE1218      12 hr < RA < 18 hr
      SEE1824      18 hr < RA < 24 hr

   SPECPHOT        spectrophotometric flux standards.
```

3.8 Network transfer from PE to Sparcstation

By the stage you may well have a few runs under your belt, and even if you have'nt, now would be a good time to start the network software to allow automatic file transfer between the Perkin-Elmer and the Sparcstation (lpss6), and start AUTOFITS if you have'nt already done so. The following is **NOT** intended to replace Gary Mitchells' more comprehensive notes, which should be beside the Sparcstation, *only* to be a concise summary. If you experience any problems (or even if you don't!), please read Gary's notes before taking further action.
In the following summary, assume I signed into Adam account 2 (e.g. si pjr,2,2). The necessary dialogue is then:

```
Pull up a command tool window, which is referred to as the "Server"
window.
```

```
% which peserver
  /home/lpss1/guest/apps/peserver

% obsdata              (lists obsdata partitions)
% cd /obsdata/lpss6n   (n=a,b,c,d from preceeding command)
% mkdir yymmdd
% cd yymmdd
% peserver nnnn    (port number used later)

  to break from server use Cntrl-C

----------------------------------

Next pull up an xterm window, which is referred to as the
"Xterm terminal"

% telnet jktpe
* si phil,2,2      (different name but same account, used in Adam)

% peclient
     > lpss6
     > CCD
     > pjr         (same initials as used in Adam)
     portnumber> nnnn  (as used in Server window)
     first file> 1
     last file > 100   (network grabs each file as it becomes
                        available)

  to break from xterm use  Cntrl-]
                           telnet> send brk
                           * cancel
                           * so
```

3.9 OBSERVING

3.9.1 Target Acquisition

```
UI> N name GO       Slews to Next target 'name', which is the
                       name of your SOurce entry in your
                       catalogue.
```

3.9.2 Exposing

Before starting an exposure it is best to window the chip in the spatial direction:

```
Adam:> WINDOW       and reply to prompts, which expect lexidata
                    co-ordinates, so use PHOT to get these first.
```

```
                    To revert to full chip readout enter:

                       Adam:> UNWINDOW


Adam:> RUN t "title"  to do a t seconds integration, which will
                       be called "title".

                    Alternatively to do multiple exposures of
                       t secs each enter:

                       Adam:> MULTRUN n t "name"

                       Note that when using MULTRUN, the images
                       are NOT displayed automatically after
                       each exposure. To abort from MULTRUN use
                       the command KILLMULTRUN.


 While the RUN is in progress it is possible to monitor or
 change its status by using the following:

    Adam:> RUNSTAT      for elapsed time.

    Adam:> PAUSE        to pause exposure.

    Adam:> CONTINUE     to continue exposure after a PAUSE.

    Adam:> ABORT        to abandon observation - no file produced.

    Adam:> STOP         to force read-out at that time.

    Adam:> TIME         to change exposure time.

Other useful commands are:

    Adam:> DISP Rn      displays run number n from disk.


If the RA button sticks, switch to INC and type:

    UI> HA/I 0          so that increment is zero. Then move
                           stars by either stopping telescope or
                           with the REV button.
```

3.9.3 Displaying Big CCD images

Since the Lexidata display has only 640 x 512 pixels, attempts to display large CCD images using DISP causes only the central part of the image to be displayed. One rather cumbersome way to display other areas of the image is to set the Lexidata variables LXXC and LXYC explicitly, and then resetting them to their default values at the end, e.g.

```
Adam:> LXXC=320
Adam:> LXYC=256
```

A neater but more time consuming alternative is to compress or SQUISH the image by a factor of 2 or 3, and either display this 'squished' image using DISPSQ, or the more versatile BIGDISP, e.g.

```
Adam:> SQUISH Rn        prompts for x and y binning factors
                        (2 will barely fit an EEV image on the
                        Lexidata, 3 will do it comfortably).
                        This takes about 2-3 minutes.

Adam:> DISPSQ Rn        will display the squished image on the
                        Lexidata. A flexible alternative is
                        to use:

Adam:> BIGDISP Rn       will display the squished image and
                        run PHOT. Position the cursor on the
                        point you would like to have as the
                        centre of the full-scale image. Press
                        the blue READ button twice, with a
                        small time interval in between. Press
                        the EXIT button which will display
                        the selected area of the full-scale
                        image.
                        You then have the option of exitting
                        the procedure or displaying the
                        squished image again and choosing
                        another point as the centre of the
                        full-scale display.
```

BIGDISP is very versatile, and avoids having to change the Lexidata display variables LXXC and LXYC, although you *do* have to squish the image first, which introduces an appreciable time overhead.

3.9.4 Readout modes

```
Adam:> SETQUICK         turns on the fast readout mode, with
                        higher noise.

Adam:> UNSETQUICK       turns off fast readout mode. This is
                        the system default on start-up.


Adam:> BIN              used to enable on-chip binning. Two
                        parameters are prompted for, the
                        x and y bin size: binning can take place
                        up to a maximum of 4 x 4 pixels,
```

```
                        including combinations such as 2 x 1,
                        3 x 2 etc. BIN cannot be used with
                        parameters x=y=1, or in conjunction
                        with the WINDOW command.

Adam:> UNBIN            disables on-chip binning. This is the
                        system default on start-up. Alternatively
                        use the CHIP command.


Adam:> WINDOW           defines a window for readout. There are
                        four parameters which are prompted for:
                           xstart  | window origin relative to
                           ystart  | top RHS of Lexidata display.
                           xsize
                           ysize

Adam:> UNWINDOW         selects full-chip readout. Alternatively
                        use the CHIP command.
```

3.9.5 Logbooks

- Please feel free to use the red JKT RBS LOG on one of the shelves. Simply xerox at the end of the run (INT first floor, is the nearest).
- Automatic logging occurs anyway at the JKT, for every file produced. The data file is processed into Latex format by Mirza Asif (MWA) and placed in a file in the control room. Observers may copy these if desired or print the raw data file out on the Printronix in the ICS computer room. To do this, log into your PE account (if not already), ensure the printer is switched to ICS (on floor) and type PRINT LYYMMDD.NIT to the PE * prompt (i.e. you must *not* be in Adam).
- Enter in the OPERATIONS LOG BOOK times of opening/closing dome, filling cryostat, operational problems etc. As explained below please enter all faults into the Defect Database.
- Enter **ALL** faults in the Defect Database held on LPVS3. Login to FAULT and fill in the Fault template, using KP7 to access the next field, and KP8 to access the previous field. Prompts are given in the highlighted bottom line of the template, and use the help screen if you get stuck, by pressing KP0. When the template has been completed, press **PF3 to commit** the fault to the database and **PF4 to exit**. By all means enter anything you consider relevant in the log-sheets, but remember that this may not be seen unless you log the fault in the database first.

3.9.6 Humidity & Wind

- If >50% humidity in dome, turn on dry N2 to first 'notch'. Flow is controlled by the flowvalve hanging around the mirror cell, and should be adjusted to deliver 100 L/Hr.
- If >90% humidity outside, close down and wait until <80% or conditions seem stable.
- Windspeed limit for JKT is 50kph (steady, not gusts). Close dome if this limit is exceeded. If concerned, check with the INT Telescope Operator.

3.9.7 Copying Data

- Complete Tape Copy Request Form (in lower filing tray) and leave in top filing tray together with D tape at the end of each night. Copy (C) tape will appear in INT Visitors pigeon hole in due course.

- Otherwise produce your own C-tape as described in the earlier tape dumping section. PLEASE fill in a Tape Copy Request Form even if you backup your data yourself, otherwise the tape copier gets horribly confused.

4 MORNING ACTIVITIES

- Turn TV OFF.
- Press ZP button to zenith park telescope.
- Close mirror covers - check they're not sticking.
- Close dome shutters.
- Turn off oil pump and cancel alarm(s).
- Turn OFF telescope power.
- Adam:> SHUTDOWN to close down JAG and exit from Adam.
- Adam:> SO to sign-off from PE.
- Transfer any remaining files from the Perkin-Elmer to the Sparc, and dump to D tape as described in the earlier tape dumping section. Complete a MTCR form for the tape copier,
- Refill cryostat.
- Turn off dome lights.
- Put the cat out.
- Go to bed.