Telescope Control System User Interface (TCS UI) Manual

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1 Introduction

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TCS is the online Telescope Control System developed by the Australia Telescope National Facility (ATNF). The system consists of

- The TCS user interface (TCS UI) written in Glish/Tk running on a unix workstation. This is most often run via its graphical user interface, the TCS GUI, but may also be run from the Glish command-line or via a Glish script.

  The TCS UI was written by Mark Calabretta, 1997-2012. It began life as `tkmulti` which was written by David Barnes, 1996-97. It is now maintained by John Reynolds and Mike Kesteven.

- The telescope controller; this directs the various telescope sub-systems (antenna, receiver, correlator, etc.) to perform the observation. The controller may or may not run on the same host as the TCS UI.

  The controller was written by Michael Kesteven and more recently, John Reynolds.

- A pair of Glish clients running on the same host as the TCS UI provide socket-based communications between the TCS UI and the controller.

  One of these clients, referred to as "*ctrl*", handles normal communications and the other, "*intr*", handles out-of-band messages such as [`STOP ...`] (p26) requests.

The rest of this manual is primarily concerned with the TCS GUI, the graphical aspect of the TCS UI.

1.1 Starting TCS

TCS is capable of running on Sun workstations under Solaris, or on Debian Linux (32 or 64 bit architecture). At Parkes it is now run mostly on the virtual Linux hosts 'joffrey' and 'myrcella', under the user account 'pksobs'.

At Mopra TCS runs on the Linux host 'bigrock' under the user account 'atcaobs'

Ensure that the `DISPLAY` environment variable is correctly set before starting, e.g. with `setenv DISPLAY :0.0` (this is not normally required). Then type `tcs` to start the TCS GUI.

1.1.1 TCS repository

A `tcs` subdirectory will first be created under the account's home directory if it doesn't already exist. This serves as a repository for the various TCS auxiliary files described later.

[1] Last change: Id: Introduction.tex,v 1.3 2013/11/16 04:57:37 rey052 Exp

1.1.2 The *startup menu*

The main TCS GUI does not appear immediately, instead a ***startup menu*** pops up. This allows the observer to specify the nature of the observation, in particular, to provide information needed by the TCS UI to start the controller. Mutually exclusive configurations are

- [`Unrestricted`][2]: the local observatory with all of the TCS UI's internal options available.
- [`Epping`]: used for code development and testing at the Epping Radiophysics Lab.
- [`Mopra`]: the 22m dish at Mopra, near Coonabarabran.
- [`MOPS`]: the MOPra Spectrometer - the only back-end currently supported there.
- [`Parkes`]: general systems on the 64m Parkes radiotelescope.
- [`Multibeam correlator`]: the Multibeam system including the original correlator.
- [`HIPSR`]: the Multibeam HI-Pulsar Signal Processor, in spectral-line mode. This back-end is intended to replace the Multibeam Correlator (eventually).
- [`Digital F'bank (time-binning)`]: Digital Filterbank 3 (DFB3) used in spectral-line mode (optionally with time-binning).
- [`Pulsar observing modes`]: All pulsar observing modes, including back-ends DFB3, DFB4, APSR, BPSR and CASPSR.

The *startup menu* also offers the following options:

- [`Allow remote observing`]: the TCS UI knows its physical location and by default, configurations relating to remote observatories are disabled. For example, when TCS is invoked at Parkes the [`Parkes`], [`Multibeam`], [`HIPSR`], [`Generic`], and [`Unrestricted`] configurations are enabled and [`Epping`] and [`Mopra`] are disabled.

  This option enables all configurations, so, for example, someone at Parkes could do remote observing at Mopra. The name of the remote host that will run the controller needs to be specified. The version of TCS to be used can also be specified but should normally be left at the ddefault value.

  The user account needs to have remote Glish client invokation enabled to use this facility.

  Note that remote observing at Parkes does not use this feature but instead uses VNC, with TCS runing inside a VNC session on the observing server (joffrey).

- [`audio host`]: Specifies the remote host to which the TCS sound effects ('bird noises') should be directed. Valid values are;
  - [`monica`]: the standard value for observing at Mopra and Parkes. Directs TCS to send the sound effects to the local MoniCA server and thence to the WWW-based observing diagnostic pages (FROG at Parkes, TOAD at Mopra).

[2] In this manual items which appear in square brackets denote GUI widgets - buttons, entry boxes, etc. - the word or phrase is as written on or near the widget

- [`host`]: play the sound effects on the specified host, which must have either the audioplay utility installed (Solaris) or the rplay utility (Linux). The value *localhost* is recognised as the local host.
- [`null`]: disable sound effects

- [`Demonstration only`]: run the TCS UI in demonstration mode, it replaces the controller with a stub and hence does not attempt to drive the telescope or take data. This mode is useful for demonstration and testing.
- [`Sched record mode only`]: if this is selected the TCS UI will start up in a stand-alone state where actions are recorded in a "`sched`" file rather than dispatched to the controller. This `sched` file can be submitted to the controller at a later time.

  This mode is useful for preparing observations ahead of time or while another instance of TCS is running the telescope.
- [`Expert mode`]: provides extra facilities for debugging purposes, not normally of interest to the ordinary user.
- [`Recover last exit state`]: recover all UI variables as they were set at the last exit of the TCS UI in the selected configuration.

  Lastexit file names are composed of a project identifier and name. The button with a "right-arrow" is connected to a ***`filebrowser`*** (p7) which allows a particular lastexit file to be selected.

  Un-selecting this option will instruct TCS to start with 'vanilla' default values.

The main TCS GUI starts when the [`OK`] button is pressed in the ***`startup menu`*** and it should greet you with the sound of a Laughing Kookaburra. Its initial actions can be monitored as output in the terminal window in which it was started and also in the TCS GUI's log window. These actions are to load the last exit state (if required), then load the parameters for the configuration selected, and then start the controller and communications clients.

The controller will check to see that there aren't any other instances of TCS running and then initialize itself. You should check that it and the communication agents have successfully established themselves.

If another instance of TCS is found the controller will issue an appropriate warning and instruct the user to type "control-C" in the start window to kill the TCS GUI .

1.2 GUI overview

This section describes general features of the TCS GUI.

1.2.1 Glish/Tk features

Some features of the TCS GUI are intrinsic properties of Glish/tk and these are worth noting at the outset:

- "Check" buttons have a square "indicator light" which goes red when the button is in a selected state.

- “Radio” buttons are similar to check buttons but occur in groups (or “nests”) and have diamond shaped indicators. Only one button in the nest can be selected at a time (like a car radio channel selector).

- Enabled buttons are highlighted when the cursor passes over them. Disabled buttons are not highlighted and also have grey text.

- Sub-menu buttons (i.e. menus within menus) have an arrow pointing towards the right.

- The cursor changes to an *i-bar* when it passes over a widget where text can be copied or pasted such as an entry box or text widget.

  To copy and paste text, first position the i-bar at the start point of the text to be copied; press the left mouse button and then drag the i-bar to the end point. The selected text will be highlighted. It may then be pasted elsewhere by positioning the i-bar at the required insertion point and pressing the middle mouse button.

  Note, however, that some widgets may not be write-enabled for text insertion (e.g. the logger window).

- The left mouse button is used exclusively for all operations such as pressing buttons, positioning the insertion cursor in an entry box, highlighting text, selecting an entry from a listbox, dragging scrollbars and sliders, etc.

  The middle mouse buttons is used to paste text.

  The right mouse button is not used.

- A range of entries in a listbox (with *arrow* cursor rather than i-bar) may be selected in the same way as a range of text, i.e. left mouse-button click-and-drag, or click-SHIFT-click. The selection may be augmented via use of the CONTROL key.

  Do not confuse this with copying and pasting text - it is the listbox entries which are selected rather than the text they are composed of.

  Note, however, that multiple entry selection is only enabled for listboxes where this makes sense (e.g. the catalogue browser within the ***skyviewer*** (p35)).

- Enabled entry boxes, buttons (other than menu buttons), scroll bars and sliders receive keyboard focus when the cursor is moved onto them and this is indicated by a thin black line around the perimeter of the widget. A flashing *insertion-cursor* also appears within entry boxes.

  Keyboard focus is retained when the cursor is moved away provided that another widget does not gain the focus in the process.

  Characters can be typed into an entry box when it has keyboard focus.

  When a button has keyboard focus pressing the SPACEBAR or RETURN key effects a button press.

  A scrollbar or slider can be manipulated via the arrow keys when it has keyboard focus.

- Keyboard focus can be moved from one widget to the next by pressing the TAB key to move forward or SHIFT-TAB to move backwards.

  When an entry box obtains focus via this method its contents will appear highlighted and will be replaced by the next keystrokes.

1.2.2 Stylistic features

The TCS GUI is divided in two halves, left and right. The left half is devoted to parameter entry; the right half has action buttons in the top quarter and system status information in the remainder.

The TCS GUI uses stylistic features consistently:

- Read/write entry boxes used for parameter entry are sunken.
- Non-writable message boxes used mainly for displaying status information have a ridged border.
- Panels containing related widgets have a wide, ridged border.
- Menu buttons have a grooved border.
- Plain buttons (except some help buttons), check buttons and radio buttons are raised.
- Help buttons are blue; those associated with each panel are flat rather than raised.
- Buttons which start a separate subwindow have ellipsis (i.e. "...") on their labels.
- Automatic log window scrolling is deactivated when the vertical scroll bar is moved up. The pad at the base of the scroll bar goes red to indicate this condition.

1.2.3 Help

Widget help messages are written in a long strip running along the bottom of the main window. These provide a brief explanation of the widget that the cursor is currently pointing at. The TCS user manual (this manual) should be consulted if further explanation is needed.

This manual can be accessed within `Netscape` by clicking the [`HELP`] (p26) button in the top right-hand corner of the TCS GUI. It can also be displayed by clicking on any of the seven blue labels in the TCS GUIin which case the browser will scroll to the relevant section of the manual.

1.2.4 Parameter validation

The TCS UI validates all parameters. As far as its GUI interface is concerned, this relates only to values typed into the entry boxes - naturally, values selected from a menu are always valid!

Strings typed into entry boxes are converted internally to their proper type. For example, a frequency in MHz entered as "1720.5300" (OH radical) would be stored internally as a double precision value, 1.72053×10^3. For display purposes this would be reformatted as "1720.5300"; note that the number of significant decimal digits is preserved.

As an example of parameter validation, a zero or negative frequency would not be accepted. The following error message would appear on the terminal where TCS was invoked in response to an attempt to set the frequency to zero

```
Invalid parameter assignment (<= 0):
   ignored [freq1 = 0] (double type)
   remains [freq1 = 1720.53] (double type)
```

1.2.5 Sexagesimal notation

The TCS UI has a flexible sexagesimal format parser. For example, in a context where either a time or angle may be specified, as for a right ascension, the following representations are all recognized and equivalent:

```
 23h57m17.330s          +359d19'19".95
 23h 57m 17.330s        +359d 19' 19".95
 23h57 17.330           +359d 19 19.95
 23h57:17.330           +359d 19:19.95
 23h.954814              359d.32221
 23.954814h              359.32221d
-00h02m42.670s            -0d40'40".05
    -2m42s.670              -40'40".05
    -2m42.670s              -40'40.05"
    -2m42.670               -40'40.05
 -0h.045186               -0d.67779
 -0.045186h               -0.67779d
```

Moreover, in a context where a time value is expected, e.g. right ascension, the following *generic* sexagesimals would be equivalent to the above:

```
 23:57:17.330
 23: 57: 17.330
 23 57 17.330
 23.954814
-00:02:42.670
-00 02 42.670
 -0.045186
```

On the other hand, in a context where an angle in degrees is expected, these generic sexagesimals would be interpreted as an angular quantity in degrees, minutes and seconds.

Whether the TCS UI accepts a sexagesimal angle or time or both depends on the particular parameter. For example, while it is permissive in accepting longitudes (right ascension, hour angle, azimuth and galactic longitude) as either a time or an angle, it rejects latitudes specified as a time as being non-sensical.

Angles and times specified in sexagesimal notation are all converted internally to degrees as a double precision value. For some parameters the value may be normalized in an appropriate range, e.g. $[0, 360°]$ for right ascension or $[-180°, 180°]$ for hour angle. For others the value is validated against an allowed range, e.g. $[-90°, 90°]$ for a latitude. For display purposes these values are formatted as sexagesimal strings of the appropriate type with the requisite decimal precision. For example, the generic sexagesimal, `23:57:17.330`, when entered for a right ascension would be stored internally as $359°.32221$ and displayed as `23h57m17.330s`. When entered for a declination it would be stored as $23°.954814$ and displayed as `23°57'17".330` (n.b. with a proper degree symbol). This should make it clear how the TCS GUI has interpreted the sexagesimal value.

1.3 Auxiliary TCS widgets

The TCS GUI has a number of auxiliary browsers, viewers, and miscellaneous graphical utilities. Usage of most of these is self-evident but a few have features which require further explanation.

1.3.1 *filebrowser*

File selection, whether of existing files or files which are to be created, is accomplished by means of the ***filebrowser*** utility. It appears from within the schedule file editor, ***scheditor*** (p42), ***skyviewer*** (p35), and ***startup menu*** (p2) as well as from various places within the main TCS GUI.

The ***filebrowser*** displays the contents of the directory whose name is displayed in the entry box at the top of the browser. Clicking on the `[Dir]` button causes the list to be updated.

Directory listing options are provided by the `[Options]` menu button in the bottom left corner. This provides for a long directory listing, full directory listing (i.e. of *dot-files*), and forward or reverse sort on a choice of sort keys including the file name and last modification time.

A file may be selected by a single, left-button mouse click followed by clicking on the `[Okay]` button, or simply by a double mouse-click on the file name.

Once a file is selected the browser normally disappears but this can be circumvented by checking the `[Stay up]` button. The browser may be dismissed at any time without making a selection via the `[Dismiss]` button.

The ***filebrowser*** usually allows directory navigation but may sometimes appear with this disabled. If navigation is enabled the entry box at the top of the browser will be enabled for input and it may be used to enter a directory pathname. This may be either absolute or relative to the current directory, if relative it will be replaced with the corresponding absolute pathname.

If directory navigation is enabled the parent directory and all subdirectories will appear with a trailing slash within the directory list. Single-, or double-clicking on one of these entries effects the change of directory.

In file-creation mode the ***filebrowser*** contains a `[File]` entry box for keyboard entry of a new file name. A file name selected by single-clicking on the directory listing will be copied to this entry box and may be modified if desired.

1.3.2 *infoviewer*

The ***infoviewer*** logs time-stamped values. A value is either a simple message string or a keyword/value pair, the value of which may be updated at a later time. Each of the five telescope subsystems, antenna, focus, local oscillator, attenuator and correlator has a pair of ***infoviewer***s, one for diagnostics and the other for informational purposes.

1.3.3 *recordbrowser*

The ***recordbrowser*** displays the contents of files which contain information in tabular format and allows an entry or range of entries to be selected. It is used, for example, to view and select entries from source and frequency catalogues.

The *recordbrowser* displays the contents of the file whose name is given in the entry box at the top of the browser. Clicking on the [`File`] button causes the list to be updated.

A record may be selected by a single, left-button mouse click followed by clicking on the [`Okay`] button, or simply by a double mouse-click on the file name. Normally only one entry may be selected but in some cases the browser may be enabled for multiple input. A range is selected via left mouse-button click-and-drag, or click-SHIFT-click. The [`Okay`] button must be used to accept the selection in this case.

If the [`Info`] button is enabled it provides access via a *textviewer* (p8) to explanatory material in the header of the file.

Once an entry is selected the browser normally disappears but this can be circumvented by checking the [`Stay up`] button. The browser may be dismissed at any time without making a selection via the [`Dismiss`] button.

Very large files are displayed in multiple "chunks" of about 3000 entries each. If a file has been dissected in this way a slider will be provided to move between chunks.

The *recordbrowser* may appear with [`Next`] and [`Prev`] buttons if it was invoked on multiple input files. This may happen to display the result of a catalogue search if a source is found in more than one catalogue.

1.3.4 *remhost*

The *remhost* window only appears when the TCS GUI starts up for remote observing. It allows the observer to specify the name of the remote host on which to activate the controller.

1.3.5 *scheditor*

The schedule file editor, *scheditor* (p42), is a special purpose graphics-based editor designed explicitly for creating and modifying schedule files. It is described in detail in §12, p42.

1.3.6 *skyviewer*

The *skyviewer* (p35) window provides an interactive, graphical representation of the sky providing point-and-click control of the telescope. It is described in detail in §11, p35.

1.3.7 *startup menu*

The *startup menu* (p2) has already been described.

1.3.8 *textviewer*

The *textviewer* is a simple, resizable, utility for displaying text. It is used by the TCS GUI for such things as displaying the latest news and (via the *recordbrowser* (p7)) the explanatory prologue to the source and frequency catalogues.

1.3.9 *warning popup*

An orange-coloured ***warning popup*** appears if any of the telescope subsystems is disabled. These serve only to reinforce the orange warning status indicated for the subsystem on the TCS GUI.

1.3.10 *exit popup*

When the [Exit] button is pressed on the TCS GUI a small confirmation window appears. This also contains a checkbox which indicates the name of the lastexit file and provides the opportunity to exit without saving state.

2 [OBSERVATION ID]

[3] The top-left panel of the TCS GUI provides for entry of bookkeeping-type information, some of which is simply for recording in the header of the output RPFITS file.

2.1 [Telescope]

Name of the telescope to be recorded in the INSTRUME card of the RPFITS header. This may be set automatically by particular ***startup*** (p2) configurations.

2.2 [Project id]

Project identification. ATNF projects have names of the form C*nnn* for the compact array, M*nnn* for Mopra, and P*nnn* for Parkes, and a string of one of these forms is required.

2.3 [Project name]

A name for the project. Together with the project id this is used to construct the name of the file used to store the lastexit state when the TCS UI exits.

2.4 [Observer(s)]

Name or initials of the observer(s) recorded in the OBSERVER card of the RPFITS header.

[3] Last change: Id: Observation.tex,v 1.1 2001/03/28 05:48:25 mcalabre Exp

3 [ANTENNA CONTROL]

[4] The variety of parameters shown in the [ANTENNA CONTROL] panel depends on the [Observation type] (p13). There are two basic observation modes: *tracking*, in which the telescope follows a fixed coordinate, or *scanning*, in which it moves uniformly from one coordinate to another.

3.1 [Source name]

At the most basic level the [Source name] menu button and entry box simply provides a means of setting the name of the source to be recorded in the OBJECT card in the output RPFITS file.

However, the menu button also provides access to source catalogue lookup and search facilities.

3.1.1 [Browse source catalogues]

The [Source name] menu button reveals a [Browse source catalogues] sub-menu with entries

- [Standard...]: Browse catalogues held in the TCS system area (/nfs/online/<version>/aux/tcsgui/catalogues).
- [Own...]: Browse catalogues held in the user's own area (~/tcs/catalogues).

Selecting either of these options will invoke a ***filebrowser*** (p7) on the selected directory. If a catalogue is selected it's explanatory prologue will appear within a ***textviewer*** (p8) and the catalogue contents made available for perusal within a ***recordbrowser*** (p7). If a selection is made the relevant information is extracted and the TCS GUI widgets updated:

- Source name.
- Source coordinates.
- Coordinate system.
- Recession velocity, in km/s.

Note that this facility provides a convenient means of using source lists prepared in advance. Such lists (catalogues) may be stored in either of two ways:

- Fixed format: each line of the catalogue consists of blank-separated fields
  - Source name.
  - Right ascension (azimuth, hour angle, or galactic longitude). Sexagesimal fields must be colon-separated.
  - Declination (elevation, or galactic latitude). Sexagesimal fields must be colon-separated.
  - Coordinate system, being one of the following case-sensitive strings:

[4] Last change: Id: Antenna.tex,v 1.1 2001/03/28 05:48:25 mcalabre Exp

    * `J2000`
    * `B1950`
    * `AZEL`
    * `HADEC`
    * `GALACTIC`
  - Recession velocity, in km/s.

- Free format: the first line of the catalogue contains a format specifier, there follows an optional header, and then the body of the catalogue. The catalogue is parsed in accordance with the format specification. For example, the following is the format specifier for the Molonglo Reference Catalogue:

```
record-format: 58 75 1:8 11:20 28:36 B1950 0
```

  The fields are interpreted as follows:

  1 The identifier string "record-format:".

  2 The last line of the file header. This defines the extent of the catalogue's explanatory header including the format specification. If there is no additional prologue this should be set to 1.

  3 *recordbrowser* (p7) window width, in characters. The *recordbrowser* has a horizontal scroll bar but the display width may set to obviate its use without wasting any screen space.

  4-8 A colon separated range of column numbers for each of the five fields listed above for fixed format catalogues. If there is no corresponding column (for example the Molonglo catalogue has no columns for the coordinate system or recession velocity) then specify a string to return (`B1950` and `0` for Molonglo).

3.1.2 [`Automatic source lookup`]

The [`Source name`] menu button also contains a check button to enable [`Automatic source lookup`]. This feature provides automatic searching for a source in a set of catalogues whenever a new source name is entered in the entry box with ensuing carriage return. (Manual, *one-shot*, searching is also available under the [`Catalogue position`] (p14) menu button)

There follows a nest of radio buttons which specify which source catalogues are to be used for the lookup:

- [`Standard catalogues`]: only consult the catalogues held in the TCS system area (`/nfs/online/<version>/aux/tcsgui/catalogues`).

- [`Own catalogues`]: only consult the catalogues held in the user's own area (`~/tcs/catalogues`).

- [`Standard and own`]: consult both sets of catalogues.

Typically a source will be found in several catalogues, a message will appear in the log window indicating the number of matches found. Each entry will be displayed in turn in a *recordbrowser* (p7) which in this instance will be equipped with [Prev] and [Next] buttons to allow navigation between catalogues.

Note that *grep*-type regular expressions may be specified for the source name in auto-lookup mode. The expression in the entry box will be replaced by the name of the source selected. This provides a very powerful source selection capability.

3.2 [Coordinate system]

The [Coordinate system] menu button provides a selection of coordinate systems for specifying celestial positions.

Note that changing the coordinate system does not cause the coordinates to be transformed but may affect normalization and formatting (see §1.2.5, p6). For example, an angle displayed as `18h02m42.669s` for a right ascension will be displayed as `-05h57m17.331s` for an hour angle, or `270°40'40".04` for a galactic longitude.

3.3 [Observation type]

What appears in the rest of the [ANTENNA CONTROL] panel depends on the particular observing mode.

The [Observation type] menu selects from two basic classes of observation, *tracking* and *scanning*. Tracking-type observations, with parameters described in §3.4, p14, are:

- [TRACK]: simply track the position for the specified length of time.
- [TRACK-PAIR]: the signal position is tracked and then the reference position, chosen as the point with the same starting azimuth and elevation, is tracked for the same length of time.
- [MX] (Parkes Multibeam system only): the position is tracked in turn by each of the thirteen beams of the Parkes Multibeam system.
- [MXCAL]: similar to [MX] except that the correlator runs in total power mode and when the observation is finished the *mbcal* utility is invoked automatically on the data so obtained.
- [SiO-POINT] (Mopra only): run the SiO pointing procedure.
- [SPOT]: track the source and four offsets in each quadrant.

Only one scanning-type observing mode is currently defined; its parameters are described in §3.5, p15:

- [SCAN]: two end-points and a rate are defined; the telescope scans from one end to the other at (close to) the requested rate. The true rate is displayed.

  The scan end-points may be defined directly, or indirectly by specifying the start point and scan length, or the scan centre and scan length.

Other observing modes which may be added in future are:

- GRID: track each point on a regular grid for a specified time.
- MOSAIC: a generalization of GRID where the position offsets are obtained from a file.
- RASTER: mode will provide a raster-scan capability.

As a reminder, the type of observation selected is reflected in the label of the [Start] (p26) button, for example, [Start TRACK].

3.4 Tracking parameters

When a tracking-type observing mode is selected a particular set of widgets will appear to define the relevant parameters.

3.4.1 [Catalogue position]

Fiducial coordinates in the coordinate system chosen via the [Coordinate system] (p13) menu button. Optional position offsets (§3.4.2, p14) may be applied to this fiducial position.

The [Catalogue position] menu button reveals a [Lookup from source name] button which is the *one-shot* version of [Automatic source lookup] (p12).

3.4.2 [Source offset type]

The [Source offset type] menu allows offsets to be added conveniently to the catalogue position in tracking modes and this may be found useful when mapping the field surrounding the source of interest.

Two separate offset types are provided, [SIGNAL] and [REFERENCE]; "S" is appended to the field name for signal offsets and "R" for reference offsets.

- [NONE]: track the catalogue position without applying any offset.
- [SIGNAL]: track the catalogue position plus signal offset.
- [REFERENCE]: track the catalogue position plus reference offset.

When a [SIGNAL] or [REFERENCE] offset is selected the relevant widgets will be colour-coded as a warning that a position offset is being applied.

3.4.3 [Signal offset]

Offset to be added to the catalogue position when [Source offset type] is set to [SIGNAL].

3.4.4 [Reference offset]

Offset to be added to the catalogue position when [Source offset type] is set to [REFERENCE].

3.4.5 [Longitude offset is]

The offset applied to the longitude coordinate (e.g. right ascension) may be interpreted in either of two ways:

- [ARCLENGTH]: the offset is to be interpreted as an angular distance on the sky; in other words it will be divided by $\cos(\delta)$ before being added to the longitude of the fiducial point.
- [INCREMENT]: the offset is simply added to the longitude of the fiducial point.

3.4.6 [Duration]

Length of the observation. May be specified in a variety of units: [CYCLES] (an integration unit, normally lasting 10 seconds), [SECONDS], [MINUTES], or [HOURS].

3.4.7 [Reference track]

In [TRACK-PAIR] mode, whether the reference track is performed [BEFORE] or [AFTER] the signal track.

3.5 Scan parameters

When a scanning-type observing mode is selected some or all of the following widgets will appear to define the relevant parameters.

3.5.1 [Scan definition]

This menu button allows the scan end-points to be defined in the most convenient way as [Centre-Range], [Start-End], or [Start-Range]. The labels on the scan end-point entry boxes are updated to reflect the selection made.

3.5.2 [Scan centre]

The central position of the scan (active if the scan definition is [Centre-Range]). This menu button reveals the same catalogue lookup functions as the [Catalogue position] (p14) button in tracking modes.

3.5.3 [Scan start]

The start position of the scan (active if the scan definition is [Start-End] or [Start-Range]). This menu button reveals the same catalogue lookup functions as the [Catalogue position] (p14) button in tracking modes.

3.5.4 [Scan end]

The end position of the scan (active if the scan definition is [Start-End]).

3.5.5 [Scan range]

The length of the scan (active if the scan definition is [Centre-Range] or [Start-Range]).

3.5.6 [Longitude offset is]

When the scan definition is [Centre-Range] or [Start-Range] the range for the longitudinal coordinate (e.g. right ascension) may be interpreted in either of two ways:

- [ARCLENGTH]: the range is to be interpreted as an angular distance on the sky; in other words it will be divided by $\cos(\delta)$ before being added to the longitude of the start or centre point.
- [INCREMENT]: the range is simply added to the longitude of the start or centre point.

3.5.7 [Duration/Rate]

This menu button allows the length of the scan to be defined either as a [Duration] ([CYCLES] (an integration unit, normally lasting 10 seconds), [SECONDS], [MINUTES], or [HOURS]) or as a [Rate] ([DEG/MIN], or [ARCMIN/MIN]). Duration and rate values are remembered so toggling this button brings back the previous setting.

3.5.8 [True rate]

The actual scanning rate as reported by the telescope. This is a status value.

4 [RECEIVER CONTROL]

[5] The [RECEIVER CONTROL] panel allows for selection of the receiver and control of its position and orientation (focus).

4.0.1 [Receiver]

The [Receiver] menu lists all known receivers but only allows selection of those currently installed.

The Parkes telescope, with its prime focus translator system, usually has several available, but at Mopra and elsewhere only one may be installed at a time.

4.0.2 [Focus offset]

A pair of [Focus offset] entry boxes specify the tangential (y) and axial (z) offsets from the nominal focus position, in mm.

In some *startup* (p2) configurations this item may allow input for focussing control. In others it may serve only to display the value reported by the controller. The type of entry box border will indicate which.

4.0.3 [Reference beam]

The [Reference beam] entry box is provided in selected *startup* (p2) configurations. It specifies the beam to use as the pointing reference in multibeam observations, i.e. the beam which points to the source.

If set to anything other than 1 a warning will be issued and the background of the entry box will turn orange as a reminder.

4.0.4 [Parallactic angle tracking]

The [Parallactic angle tracking] menu offers [CONTINUOUS], [STEPPED] or [BEAMTRK] modes or for tracking to be [DISABLED] altogether. This item may be disabled with a message [Not available] in some *startup* (p2) configurations.

4.0.5 [Position angle]/[Feed angle]

The beam [Position angle] entry box appears if [Parallactic angle tracking] is enabled (in one mode or another), otherwise it becomes the beam [Feed angle].

In some *startup* (p2) configurations this item may allow input to control the beam orientation. In others it may serve only to display the value reported by the controller. The type of entry box border will indicate which.

[5] Last change: Id: Receiver.tex,v 1.1 2001/03/28 05:48:25 mcalabre Exp

5 [CORRELATOR]

[6] The correlator configuration file and mode of operation may be set in the [CORRELATOR] panel which also includes some basic correlator commands.

5.1 [Mode]

Correlator mode, [Normal], [Total power] or [PSR].

Total power mode is set automatically for some settings of [Observation type] (p13) such as [MXCAL]. Otherwise, setting total power mode will change the label on the [Start] (p26) button from, for example, [Start TRACK] to [Start calTRACK] as a reminder that the correlator is not in its normal setting.

5.2 [Configuration file]

This menu button provides and option to [Browse config files...] which invokes a browser for all available correlator configuration files.

The [Generate filename] and [Decode filename] menu items provide *one-shot* options to generate or decode the configuration file name if [Auto-generate] or [Auto-decode] are not enabled.

5.2.1 [Auto-generate]

Automatically generate the name of the appropriate correlator configuration file from the number of LOs enabled, their [Bandwidth] (p21) and number of [Channels] (p21) as set in the [LOCAL OSCILLATOR] (p20) panel whenever they change.

If no configuration file matches the selected parameters then a warning will be issued and (unavailable) will appear in red in the [Configuration file] entry box.

5.2.2 [Auto-decode]

Automatically decode the correlator configuration file and update the [Bandwidth] (p21) and number of [Channels] (p21) in the [LOCAL OSCILLATOR] (p20) panel.

5.3 [Averaging]

The correlator can average integrations to reduce the amount of data written. This entry box allows the averaging to be specified.

5.4 [Commands]

The following commands instruct the correlator to perform basic functions:

[6]Last change: Id: Correlator.tex,v 1.1 2001/03/28 05:48:25 mcalabre Exp

5.4.1 [`Close file`]

Close the current output data file and open a new one.

5.4.2 [`Send cycle`]

Dispatch integration parameters to the correlator. This is a configuration option which should not be needed in general practice.

5.4.3 [`Reconfigure`]

Instruct the correlator to reconfigure itself. Should not be needed in general practice.

6 [LOCAL OSCILLATOR]

7

The [LOCAL OSCILLATOR] panel contains two separate sub-panels, one for each of two LO systems, at least one of which must be enabled at any time. If only one LO is enabled and it is disabled via the check button at the top of the sub-panel then the other will be enabled automatically.

If [Auto-generate] (p18) is enabled in the [CORRELATOR] (p18) panel then the correlator configuration file will be updated as LOs are enabled or disabled.

Alternatively, if [Auto-decode] (p18) is enabled in the [CORRELATOR] panel then LOs will be enabled or disabled appropriately whenever the correlator configuration file is changed.

6.1 [REST/SKY]

Doppler correction may be enabled or disabled independently for each LO via the menu button at the top of each sub-panel. If [REST] is selected the spectral range will be centered on the Doppler shifted frequency computed via the parameters given at the bottom of the sub-panel. Alternatively, if [SKY] is selected the centre frequency will be set as given.

It is important to realize that Doppler tracking is not performed during the course of an observation; the LO system is configured for a particular frequency at the start of an integration and thereafter remains unchanged. The Doppler correction simply ensures that the frequency of interest falls near the middle of the bandpass being observed. Topocentric velocity effects are assumed to be negligible over the timespan of an integration.

If the frequency specified is the rest frequency of a radio line then one would normally select [REST] to have the Doppler correction applied so that the line falls near the centre of the band. On the other hand, surveys with fixed frequency limits such as HIPASS and ZOA would select [SKY] to disable it.

6.2 [Frequency]

The frequency, in MHz, may be entered directly into the [Frequency] entry box for either LO. Alternatively, the [Browse line frequencies] sub-menu may be selected from the [Frequency] menu to allow selection from either the [Standard] line rest frequency catalogue or the user's [Own...] catalogue(s).

The standard catalogue was constructed from the NIST (Lovas, 1991) database of molecular line frequencies augmented with a small set of hyperfine transitions for hydrogen, helium and sodium, as well as the full set of hydrogen recombination lines for the alpha, beta, gamma, delta and epsilon transitions computed from the Rydberg formula in the range 0.3 - 120 GHz. Full details are provided via the [About spectral line catalogues...] menu item.

The standard catalogue is large so for practical reasons it has been dissected in three ways, [By frequency...], [By molecular formula...] and [By molecular name...]. Each of these sub-sub-menu items invokes a *filebrowser* and subsequently a *recordbrowser* to select an

[7] Last change: Id: LO.tex,v 1.1 2001/03/28 05:48:25 mcalabre Exp

entry from the catalogue.

Users may maintain their own frequency catalogues in the `~/tcs/lines` directory. The frequency is extracted from the first field of the record, additional fields may be used as comments to identify the line.

The line rest frequency is extracted from the catalogue into the [`Frequency`] entry box of whichever LO sub-panel(s) are enabled. To set the two LOs to different frequencies one must temporarily disable one and enable the other.

6.3 [`Bandwidth`]

Menu of allowed bandwidths. The list may be restricted by particular ***startup*** (p2) configurations.

If [`Auto-generate`] (p18) is enabled in the [`CORRELATOR`] (p18) panel then the correlator configuration file will be updated whenever this value is changed.

Alternatively, if [`Auto-decode`] (p18) is enabled in the [`CORRELATOR`] panel then this value will be updated whenever the correlator configuration file is changed.

6.4 [`Channels`]

Menu which provides selection of the number of channels. The number is of the form $2^n + 1$, where the odd channel arises as the result of the complex-to-real FFT performed by the AT correlator (i.e. not as a "channel-0" containing the integrated spectrum). Allowed values may be restricted by particular ***startup*** (p2) configurations.

If [`Auto-generate`] (p18) is enabled in the [`CORRELATOR`] (p18) panel then the correlator configuration file will be updated whenever this value is changed.

Alternatively, if [`Auto-decode`] (p18) is enabled in the [`CORRELATOR`] panel then this value will be updated whenever the correlator configuration file is changed.

6.5 [`Channels recorded`]

A subset of the channel range may be recorded in the output file if it is desired to reduce the bulk of the output data by eliminating the ragged ends of the spectra.

The [`Channels recorded`] menu contains check buttons [`Always record all #1`] and [`Always record all #2`] which, if enabled, ensure that all channels will be recorded. If disabled, a pair of entry boxes are provided in the relevant LO sub-panel to allow a channel range to be specified. A "`0`" specified for the end channel range means the last channel.

6.6 [`Frequency switching`]

The LO system can do fast or slow switching between a pair of frequencies. The [`Frequency switching`] menu contains two non-switching settings [`SIGNAL (off)`] and [`REFERENCE (off)`] which fix the LO frequency at either the value specified in the [`Frequency`] entry box or to that value plus an offset set in the [Frequency offset] entry box. The remaining menu items set the [SLOW] or [FAST] frequency switching modes.

While observing the current frequency will be notified for each LO chain in the [Freq 1] (p31) and [Freq 2] (p31) status values in the [SYSTEM STATUS] (p29) panel.

6.7 [Frequency offset]

When frequency switching, the reference frequency is specified as an offset (positive, negative or zero) to the [Frequency] (p20) value via the [Frequency offset] entry box.

6.8 [Velocity], [Frame], [Convention]

If [REST] (p20) is selected in the [REST/SKY] menu, the spectral range will be centered on the Doppler-shifted value of the frequency specified in the [Frequency] (p20) entry box. Otherwise, for [SKY] (p20), it will be centered on the value as given.

The Doppler shift is computed for the source velocity specified in the [Velocity] entry box; the velocity is positive if the source is moving away from the observer. The reference frame for which this velocity was computed and the nature of the velocity convention may be specified via the [Frame] menu ([LSR-KINEMATIC], [LSR-DYNAMIC], [BARYCENTRIC], [GEOCENTRIC], [TOPOCENTRIC]) and the [Convention] menu ([RADIO], [OPTICAL], [RELATIVISTIC]). Typically this information comes from a source catalogue. Of the two Local Standards of Rest (LSR) the kinematic reference frame is the one more frequently used.

If an [LSR-KINEMATIC] source velocity is specified, the Doppler velocity will consist of this minus the component of the observer's LSR-kinematic velocity towards the source. The observer's LSR-kinematic velocity is the vector sum of the 20 km/s velocity of the barycentre towards $18^{\mathrm{h}}03^{\mathrm{m}}50^{\mathrm{s}}.3, +30°00'17"$ (J2000), plus the 30 km/s orbital velocity of the earth around the barycentre, plus the 0.5 km/s rotational velocity of the earth on its axis.

If an [LSR-DYNAMIC] source velocity is specified, the Doppler velocity will consist of this minus the component of the observer's LSR-dynamic velocity towards the source. The observer's LSR-dynamic velocity is the vector sum of the 16.6 km/s velocity of the barycentre towards $17^{\mathrm{h}}49^{\mathrm{m}}58^{\mathrm{s}}.7, +28°07'04"$ (J2000), plus the 30 km/s orbital velocity of the earth around the barycentre, plus the 0.5 km/s rotational velocity of the earth on its axis.

If a [BARYCENTRIC] source velocity is specified, the Doppler velocity will consist of this minus the component of the observer's barycentric velocity towards the source. The observer's barycentric velocity is the vector sum the 30 km/s orbital velocity of the earth around the barycentre, plus the 0.5 km/s rotational velocity of the earth on its axis.

If a [GEOCENTRIC] source velocity is specified, the Doppler velocity will consist of this minus the component of the observer's geocentric velocity towards the source. The observer's geocentric velocity consists only of the 0.5 km/s rotational velocity of the earth on its axis. This frame might be appropriate for observing an object in the solar system.

If a [TOPOCENTRIC] source velocity is specified, the Doppler velocity will consist of this alone. This is effectively the same as switching Doppler tracking off (i.e. selecting [SKY]), except with a constant, velocity-based shift of the frequency range.

The velocity conventions are defined as follows:

$$
\begin{aligned}
v_{\text{radio}} &= c\,\frac{\nu_0 - \nu}{\nu_0}\,, \\
v_{\text{optical}} &= c\,\frac{\nu_0 - \nu}{\nu} = c\,\frac{\lambda - \lambda_0}{\lambda_0}\,, \\
v_{\text{relativistic}} &= c\,\frac{\nu_0^2 - \nu^2}{\nu_0^2 + \nu^2}\,.
\end{aligned}
$$

where ν is the measured line frequency, ν_0 is the line rest frequency and c is the velocity of light.

If the velocity was obtained from a radio catalogue then it will almost invariably have been computed via the radio convention. This convention is used in radio astronomy because the channels of a radio spectrum are usually spaced uniformly in frequency. Thus, the radio velocity, being proportional to the frequency shift, forms a linear scale on these spectra.

On the other hand, optical spectra are usually spaced uniformly in wavelength. For these the optical velocity, based as it is on the wavelength shift (redshift), forms a linear scale.

In general, the radio velocity is a much better approximation to the relativistic velocity than is the optical velocity which diverges for relativistic velocities approaching the speed of light. However, for velocities below about $0.2c$ there is not much difference between any of them.

As explained previously, the Doppler correction simply ensures that the frequency of interest falls near the middle of the bandpass being observed. The spectra are always labelled with the actual observed (i.e. sky or topocentric) frequency. Thus in most cases little harm would be done to specify a slightly incorrect velocity or to use the wrong reference frame or convention.

7 [PULSAR BACKEND CONTROL]

[8]

The [PULSAR BACKEND CONTROL] panel...

[8]Last change: Id: Pulsar.tex,v 1.1 2002/03/18 02:17:53 mcalabre Exp

8 [CALBOX CONTROL]

[9]

The [CALBOX CONTROL] panel...

[9] Last change: Id: Calbox.tex,v 1.1 2002/02/12 05:26:43 mcalabre Exp

9 [ACTION PANEL]

[10]

Generally the [ACTION PANEL] contains buttons for controlling an observation based on the parameters set elsewhere in the TCS GUI.

9.1 [Start skyviewer...]

The [Start skyviewer...] button launches a separate *skyviewer* window. This is described in detail in §11, p35.

9.2 [NEWS]

The [NEWS] button invokes a *textviewer* (p8) to present news about the latest developments to TCS.

9.3 [HELP]

The [HELP] menu button displays the hypertext form of this manual in either [Netscape] (the usual selection) or [Lynx] (a text-oriented browser which cannot display images).

A third menu item, [PostScript], invokes *gv* to display the PostScript form of the manual which, while generally better formatted, lacks hypertext cross-references.

9.4 [STOP ...]

Stop the observation. Stop requests travels via the "out-of-band" communications channel and are serviced immediately by the controller.

As a reminder, the [STOP ...] button is labelled with the action currently in progress, for example [STOP TRACK].

[STOP ...] is implemented as a check button which is active when a stop request is scheduled and deactivated once serviced.

9.5 [Start ...]

Start the observation; all parameters are read from the TCS GUI and sent to the controller which is then told to go.

As a reminder, the [Start ...] button is labelled with the value currently selected in the [Observation type] (p13) panel, for example [Start TRACK].

The crack of an Eastern Whipbird signals the end of the observation.

[Start ...] is implemented as a check button which is active when a go request is scheduled and deactivated once serviced.

[10]Last change: Id: Action.tex,v 1.1 2001/03/28 05:48:25 mcalabre Exp

9.6 [Drive]

Drive the telescope to the specified coordinates but do not take any data. If celestial coordinates are specified the telescope will continue to track them.

[Drive] is implemented as a check button which is active when a drive request is scheduled and deactivated once serviced.

9.7 [Tsys]

Initiate the mm-wavelength Tsys calibration procedure. This is meaningful only at Mopra and this button is not present for most other *startup* (p2) configurations

[Tsys] is implemented as a check button which is active when a mm_tsys request is scheduled and deactivated once serviced.

9.8 [Stow]

Stow the telescope.

[Stow] is implemented as a check button which is active when a stow request is scheduled and deactivated once serviced.

9.9 [Check]

Systematically read all widgets and send the values to the controller which does a further check on their validity.

This is not usually required. The TCS GUI checks all parameter values on entry, and all widgets are read and their values passed to the controller before any action is performed.

9.10 [Sched]

The bottom two lines of the action panel are devoted to generating and using "sched" files. These are basically batch observing procedures.

The [Sched] entry box can only be changed via a *filebrowser* (p7) which can be activated directly via the [Sched] menu (or indirectly via the *scheditor* (p42)):

- [Standard...]: Browse sched files held in the TCS system area (/nfs/online/local/tcs/sched).
- [Own...]: Browse sched files held in the user's own area (~/tcs/sched).
- [Edit...]: Invoke the *scheditor* (p42) to edit the sched file whose name is currently displayed.

As in most invokations of the *filebrowser* (p7) directory navigation is allowed. However, unlike most, a changed sched directory will be remembered the next time the browser is invoked.

9.11 [`Start sched`]

Tells the controller to start executing the schedule file. Further actions will be disabled while the schedule runs. However, once the schedule starts it is possible to enter parameters for the next observation in the left half of the TCS GUI. These “deferred mode” entries will be used when the next action is started.

[`Start sched`] is implemented as a check button which is active while the schedule file is running and deactivated once it has finished.

The carolling of Australian magpies signals that the controller has finished executing the schedule file.

9.11.1 [`Start`] (sched)

The sched file may contain a number of items. This entry determines which to start on.

9.11.2 [`End`] (sched)

Which sched item to finish on. May be specified as “0”, “end” or “last” which all mean the same.

9.11.3 [`Repeat`]

How many times to repeat the loop between the start and end sched items.

9.12 Schedule [`Record mode`]

In schedule [`Record mode`] parameter entry and actions are appended to a sched file rather than sent to the controller. The sched file written is that indicated in the schedule file name entry box.

9.13 [`Next`]

Sends a `Drop` request to the controller which causes it to abandon the current schedule item and proceed to the next one. The `Drop` request travels via the “out-of-band” communications channel and is serviced immediately by the controller.

9.14 [`Finish`]

Tells the controller to finish the schedule once the current item has come to a natural end. The `Finish` request travels via the “out-of-band” communications channel and is serviced immediately by the controller.

10 [SYSTEM STATUS]

[11]

10.1 Status flags

Most of the lower right portion of the TCS GUI is devoted to system status messages. With a few exceptions these are non-active, read-only widgets.

A row of coloured status indicators shows at a glance the overall status of the various telescope subsystems:

- Green means that the system is functioning normally.
- Orange means that the system is not in use. If a subsystem is disabled by the user an orange-coloured ***warning popup*** (p9) also appears as a reminder. This serves only to reinforce the orange warning status and can safely be dismissed.

  A warning is also recorded in the log which is accompanied by the scream of a Rufous owl.
- Red indicates subsystem failure, initially signalled by a Curlew's mournful sigh. The error message recorded in the log will then be accompanied by the call of a Sulphur-crested cockatoo.

  Timestamped diagnostic messages are accumulated for display in an ***infoviewer*** (p7) which will be invoked automatically when an error is signalled.
- Sky blue (which should never occur) indicates that the TCS UI has received an unknown status value for the subsystem from the controller. This will be accompanied by a warning in the log to that effect.

The subsystem status indicators are actually menu buttons which provide the following options:

- [`Enable/Disable`]: enable or disable the particular subsystem.
- [`Diagnostics...`]: invoke an ***infoviewer*** (p7) to display timestamped diagnostic messages.
- [`Information...`]: invoke an ***infoviewer*** (p7) to display timestamped informational messages received from the controller. These may consist of ***startup*** (p2) parameters and other general information about the subsystem.

10.1.1 [`antenna`]

Antenna status, green, orange, red. The [`Antenna`] (p30) status display provides more information on what the antenna is currently doing.

[11] Last change: Id: Status.tex,v 1.1 2001/03/28 05:48:25 mcalabre Exp

10.1.2 [focus]

Focus controller status, green, orange, red. Many telescopes do not have focus control and this status is typically orange.

10.1.3 [LO chain]

Local oscillator system status, green, orange, red.

10.1.4 [attenuator]

Attenuator system status, green, orange, red.

10.1.5 [correlator]

Correlator status, green, orange, red. In operation the correlator sends "all-is-well" messages every cycle and these are made audible as the ping of a Bell miner.

10.2 System status

This status display provides a brief description of the action currently being executed by the telescope.

10.3 [ETA]

When an action is initiated this pair of status displays indicate the "estimated time of arrival" at the start of the observation (in minutes), and how far the antenna is from reaching its target (in degrees).

10.4 [scan]

When the controller is executing a schedule file this indicates the current scan number in the cycle defined in the [ACTION PANEL] (p26).

10.5 [rpt]

When the controller is executing a schedule file this indicates the current repeat number in the cycle defined in the [ACTION PANEL] (p26).

10.6 [Antenna]

What the antenna is currently doing, (TRACKING, SLEWING, etc.).

10.7 [`Position (J2000)`]

The current antenna position, J2000 right ascension and declination. This is slightly delayed, the time for which it applies is shown in the [`at UTC`] display.

10.8 [`at UTC`]

Time at which the antenna position was current.

10.9 [`Astronomical clock`]

Shows UTC, local civil time, and local mean sidereal time. Timezone information for the civil time is set in the ***`startup`*** (p2) configuration file. The observatory longitude for the LMST comes from the ***`startup`*** configuration file, or if this was not specified, Greenwich mean sidereal time is reported instead. The clock should be accurate to within a few seconds.

10.10 [`Percent completed`]

A bar chart shows how far the current observation has progressed.

10.11 [`focus-y`], [`focus-z`], [`focus-r`]

The current focus platform position (mm), tangential and axial, and rotation (deg).

10.12 [`Freq 1`], [`Freq 2`]

The current frequency setting of the first and second local oscillator chain. Black indicates the "signal" frequency (i.e. the non-offset value) and blue indicates the reference frequency.

During slow frequency these will be seen to toggle between signal and reference. However, in fast switching this would become a blur so it is shown simply as `FAST`.

10.13 [`Output file`]

The name of the RPFITS file currently being written by the correlator.

10.14 [`Controller`]

The current controller status (`busy`, `waiting`, etc.).

10.15 [`Log window`]

Log window into which timestamped messages are written. The messages are colour coded and some are accompanied by audio signals:

- black: Unexceptional messages.
- red: Serious errors. The double-barrelled squawk of a Sulphur-crested cockatoo will leave you in no doubt that something is wrong.
- orange: Warnings. These are accompanied by the scream of a Rufous owl.
- dark cyan: Messages sent to the controller.
- olive green: Messages received from the controller.
- sky blue: Sched record mode.
- purple: Debugging messages.

While the verbosity of the log window may be controlled to some extent via options in the [`Utilities`] (p32) menu, all messages are recorded in log files with names of the form `~/tcs/logs/YYYY-MM-DD.tcs.log`. These serve as a detailed observing logs, but note that *log files more than five days old are deleted* when the TCS UI starts up. Thus to preserve the log file it must either be renamed or copied elsewhere.

The TCS controller maintains separate log files in `/nfs/online/logs/` with names of the form `YYYY-MM-DD.tcs_ctrl.log`. These contain timstamped entries which include some of the lower-level commands sent to the various telescope subsystems.

The TCS UI and controller log files are occasionally required either separately or in combination for debugging purposes.

10.16 [`Log message entry`]

Comments concerning the observation can be incorporated directly into the log via this entry box. The entry box is preloaded with the string "`Remark:`" which serves to distinguish such messages in the log. However, this may be erased if desired.

10.17 [`Utilities`]

The [`Utilities`] menu contains options which modify the state of, or general behaviour of the TCS GUI itself.

10.17.1 [`Save state...`]

Invokes a *`filebrowser`* (p7) (with directory navigation disabled) to specify a file in which to save the current parameter settings.

10.17.2 [`Recall state...`]

Invokes a *`filebrowser`* (p7) (with directory navigation disabled) to specify a file from which to recover parameter settings.

10.17.3 [Diagnostics]

The [Diagnostics] sub-menu contains options to control how the TCS GUI presents information to the user.

10.17.4 [Log sent events]

Record in the [Log window] (p31) the name and value of all messages sent to the controller (such messages are always recorded in the log file). Messages sent via the normal communications channel are labelled "*ctrl*" while those sent via the out-of-band channel are labelled "*intr*" (interrupt).

10.17.5 [Log received events]

Record in the [Log window] (p31) the name and value of all messages received from the controller (such messages are always recorded in the log file).

10.17.6 [Receive log filtering]

This sub-sub-menu provides coarse control over which messages received from the controller are to be logged in the [Log window] (p31) (all messages are logged to file). Mutually exclusive options are presented as a nest of radio buttons:

- [Log everything]: nothing is filtered.
- [Filter some]: drops the status display updates. The current values are on display so only the historical information is lost from the [Log window] (p31) (not the file).
- [Filter most]: drops everything except error messages and notices of successful completion.

10.17.7 [Flash on read (pink)]

Flash widgets (entry boxes or buttons) when they are read. Provides some indication of what the TCS GUI is doing.

10.17.8 [Flash on write (lime)]

Flash widgets (entry boxes, buttons or status values) when they are written. Provides some indication of what the TCS GUI is doing.

10.17.9 [Debug parameter updates]

(Expert mode only.) Log the parameters to function setparm() whenever it is called. This function is central to the TCS GUI in modifying parameters and sending their values to the controller. This option is provided for software debugging purposes only.

10.17.10 [Debug communications]

(Expert mode only.) Instructs the communications agents (*ctrl* and *intr*) to report all messages sent between the TCS GUI and the controller. These appear on the terminal where the TCS GUI was started. Any corrupted messages are always reported.

10.18 [Volume]

Audio volume control on a scale from 0 to 100 by steps of 5. Set this to zero to disable audio (except for error conditions). Audio associated with errors is boosted by +10 and for warnings by +5.

A Boobook owl obligingly calls as the slider is adjusted so as to indicate the volume.

10.19 [Command]

(Expert mode only.) A command may be entered in this entry box for execution by the controller. Clearly this assumes some knowledge of the controller's workings.

The command travels via the normal communication channel and hence is queued behind any outstanding requests.

10.20 [Exit]

This button invokes the *exit popup* (p9) to confirm or cancel exit from the TCS GUI.

Beware that exiting the TCS UI also kills the controller and doing this while an observation is underway may have undesirable consequences!

11 The *skyviewer*

12

The *skyviewer* window provides an interactive, graphical representation of the sky[13] as currently seen by the telescope. It employs a cylindrical equidistant (plate carrée or "Cartesian") projection scaled so that equal distances in x and y correspond to equal drive times in azimuth and elevation. The azimuth range extends beyond the conventional 360° to cover the full azimuth drive range of the telescope and azimuth wrap information is preserved.

The sky plot shows the current position of the telescope and of the sun and allows general sources to be plotted - either via manual entry of equatorial coordinates or by extraction from catalogues.

Aside from being a valuable display tool, the *skyviewer* can also be used to control the telescope directly, either by selecting the source of interest or by dragging the telescope marker. Source sequences may also be defined for semi-automatic operation.

11.1 [`Info`]

This pop-up window displays the parameters used to construct the *skyviewer* graphic. It also shows the current zoom factor and update interval, and a brief description of the mouse button usage. The popup should appear[14] simply by moving the cursor onto this button.

11.2 [`Options`]

A menu button which contains buttons which allow the user to control the behaviour of the *skyviewer*.

11.2.1 [`Default colour`]

The colour to use when adding new sources to the display, or when changing the source colour may be set in this sub-menu.

11.2.2 [`Brightness control...`]

Provides a small popup window with four sliders which allow the brightness of the azimuth-elevation and right ascension - declination grids to be adjusted for personal preference. The brightness of the visible and non-visible (nadir) regions of the sky can also be adjusted.

[12] Last change: Id: Skyviewer.tex,v 1.1 2001/03/28 05:48:25 mcalabre Exp

[13] Due to a bug in Glish the *skyviewer* sometimes appears with nothing in its graphics window (but allow at least five seconds for it to initialize). If this happens, simply dismiss and reopen it.

[14] Another Glish bug may cause the popup frame to flicker rapidly as it opens and closes. Repositioning the *skyviewer* window slightly in any direction will fix this.

11.2.3 [`Double-click shortcuts`]

The meaning to be ascribed to double-clicking the left mouse button may be set in this sub-menu. All operations apart from panning are implemented elsewhere in the *skyviewer*. Mutually-exclusive choices are implemented via a nest of radio buttons:

- [`Ignore double-clicks`]: the default double-click behaviour is to do nothing.
- [`Pan to point`]: the selected point will be brought as close to the centre of the window as possible. Note that this may be undone by the next update if "following" is enabled.
- [`Delete from list`]: the selected source will be deleted from the *skyviewer*'s internal source list.
- [`Recolour`]: the colour of the marker for the selected source will be changed to the current default colour.
- [`Prepend to sequence`]: the selected source is prepended to the current sequence.
- [`Append to sequence`]: the selected source is appended to the current sequence.
- [`Delete from sequence`]: the selected source is deleted from the current sequence.
- [`Drive to source`]: drive the telescope to the selected source.
- [`Observe source`]: observe the selected source.

11.2.4 [`Wrap ambiguity`]

The *skyviewer* preserves wrap information. Azimuths in the range $[-360°, 0)$ have negative wrap with positive wrap in the range $[0, 360°]$.

Wrap ambiguity may arise when the current source is set by entering equatorial coordinates in the entry boxes or by selecting a single source from a catalogue. Should this source become visible on both wraps the rule to determine which wrap is chosen may be selected from the following nest of radio buttons in the [`Wrap ambiguity`] sub-menu:

- [`Nearest`]: select the wrap closest to the current telescope azimuth.
- [`Positive`]: select positive wrap.
- [`Negative`]: select negative wrap.

When a source is chosen by selecting it with the mouse the wrap selection is honoured explicitly.

11.2.5 [Zoom/pan]

The *skyviewer* can be made to zoom in by clicking the middle mouse button and zoom out by clicking the right mouse button. The point of expansion will be the point selected provided that "following" is not enabled (see below).

The [Zoom/pan] sub-menu provides control over zooming and panning:

- [Zoom off]: disable zoom (a shortcut for pressing the right mouse button multiple times).
- [Follow object]: Source or telescope motion may become rapid at high zoom ratios because of the exaggerated scale, particularly near the zenith. The *skyviewer* may be set to "follow" one thing or another via the [Follow object] sub-sub-menu which contains the following nest of radio buttons:
  - [Nothing]: don't follow anything.
  - [Telescope]: follow the telescope.
  - [Current source]: follow the current source.
  - [Target source]: follow the source currently being observed.
- [Follow at zoom ratio]: The zoom ratio at which object following is activated.

11.2.6 [Automatic updates]

This check button controls whether the *skyviewer* updates itself automatically to account for the apparent rotation of the sky. Updates become more frequent at progressively higher zoom ratios.

11.2.7 [Draw equatorial grid]

Enable or disable plotting of the right ascension - declination grid. This is usually the rate determining step for an update so at very high zoom ratios it may be beneficial to disable it.

11.2.8 [Mark observed sources]

Set the source marker for sources which have been observed to a five-pointed star rather than a filled circle.

11.2.9 [Recolour observed sources]

Set the colour of the marker for sources which have been observed to the current default colour. This is disabled by default since it could interfere with any user-defined colour coding set up to differentiate between source types.

11.3 `[New source]` / `[Current source]` / `[Drive to]`

The cluster of menu buttons and entry boxes in the centre of the *skyviewer* control panel allows entry or display of source parameters.

The *skyviewer* maintains an internal source list whose positions are plotted on the sky map. In its initial state the menu button labelled `[New source]` solicits user input to define source parameters. Although manual parameter entry is possible the most convenient interface is via predefined source catalogues.

Clicking on one of the source markers with the left mouse button makes it the `[Current source]`, a blue halo is drawn around the source marker and its parameters are copied into the entry boxes: name, right ascension, declination, equinox (J2000 or B1950), and radial velocity (km/s). These parameters are also downloaded into the main TCS GUI. The drive time to the source from the current telescope position is also displayed and a set of action buttons appears providing the option of driving to the source or observing it.

The telescope marker may also be dragged with the mouse and in this case the menu button is relabelled `[Drive to]` with the field coordinates and drive time shown in the entry boxes.

11.3.1 `[Browse catalogues]`

This button provides access to the same standard and user-defined source catalogues as are accessed via the `[Catalogue position]` button on the main TCS GUI. The only difference is that the browser here allows multiple source selection. Selections are made by selecting individual items or by selecting and dragging over several items. The `control` key is used to augment the selected items, and the shift key used to specify the beginning and end of a range of items to select.

Source selections are plotted in the *skyviewer* window and added to the internal source list. If a single source was selected from the catalogue it automatically becomes the current source.

11.3.2 `[Source list]`

Once a source list has been defined the following operations may be performed

- `[Show]`: displays the internal source list in a browser. Single or double-click mouse button operations on items in the browser (e.g. select, recolour, delete, etc.) are equivalent to those on the corresponding source marker (although wrap ambiguity resolution may be required for simple source selection). This provides a simple method of finding a particular source.
- `[Sort]`: sort the internal list by
  - `[Name]`: (lexical sort)
  - `[Right ascension]`: (numerical sort)
  - `[Declination]`: (numerical sort)
  - `[Azimuth]`: (numerical sort)
  - `[Elevation]`: (numerical sort)

The sort order only makes a difference to the order of the sources shown in the source browser.

- [Clear]: clear the source list.
- [Save]: save the source list in file skyviewer.sav.
- [Retrieve]: read the source list from file skyviewer.sav.

11.3.3 [Add to source list]

Add the source currently defined by manual parameter entry to the *skyviewer*'s internal source list. This option is only available when the menu button is labelled [New source].

11.3.4 [Current source]

Menu of operations which may be applied to the current source:

- [None]: deselect the current source so that there is none.
- [Recolour]: change the colour of the marker for the current source to the default colour.
- [Delete from list]: remove the current source from the *skyviewer*'s internal source list.

11.3.5 [Sequence]

Menu of operations applicable to sequences. A sequence is defined by clicking on the marker for a source and dragging to the next source in the sequence. The direction of the sequence is indicated by circumscribing the first source in the sequence with a triangle. Sequences may be appended to in the obvious way. A source may be inserted at any point in a sequence by dragging to it from the source which is meant to precede it in the sequence. Sources may be removed from a sequence by dragging them out of the window.

Once a sequence has been defined it can be run, i.e. each source in the sequence is observed in turn. Once a sequence is running it can be discontinued meaning that the sequence will stop after the current source has been observed. Once discontinued, a sequence may be resumed from the next source.

A light green line connects sources in the sequence which have yet to be observed. This portion of the sequence may be edited. The portion of the sequence which has already been observed is indicated with a dark green line. This part may not be modified.

- [Allow changes]: creation or modification of a sequence may be disabled to protect against inadvertent changes.
- [Show]: displays the sequence definition in a browser. Single or double-click mouse button operations on items in the browser (e.g. recolour, delete, etc.) are equivalent to those on the corresponding source marker (although wrap ambiguity resolution may be required for simple source selection).

The sequence list browser is indispensible when the sequence contains loops and/or repetitions.

- [Clear]: clear the sequence definition.

11.4 [Updated], [LMST]

The sky plot needs to be updated to account for sky rotation, telescope motion, etc. The [Updated] status value displays the local mean sidereal time (LMST) of the last update and a clock showing the current LMST is below that.

11.5 [Update]

This button in the top right-hand corner of the control panel forces an immediate update of the sky plot. Updates are normally performed periodically by the ***skyviewer*** although this feature may be disabled via the [Automatic updates] (p37) button in the [Options] (p35) menu.

11.6 [Dismiss]

The [Dismiss] button has the unsurprising effect of closing down the ***skyviewer***.

11.7 Action buttons

A set of action buttons appears when the current source is defined. The action buttons are disabled and the relevant button is highlighted while an action is in progress.

11.7.1 [Drive]

Drive to and track the current source position but do not commence an observation. This is provided as a convenient interface to the main TCS GUI.

11.7.2 [Start]

Start an observation of the current source using the parameters established in the main TCS GUI.

11.7.3 [Sequence]

This menu button controls sequences.

- [Run]: observe each source in the sequence in turn, starting from the beginning of the sequence.

  [Discontinue]: stop the sequence after the current source has been observed. Use the [STOP ...] (p26) button on the main TCS GUI to effect an immediate halt.

[`Resume`]: resume a sequence which was discontinued, starting with the next source. Colour coding of the sequence path in the *skyviewer* window shows how much has been observed.

12 Schedule file editor (*scheditor*)

[15]

The schedule file editor is a special purpose graphics-based editor designed explicitly for creating and modifying schedule files...

[15] Last change: Id: Scheditor.tex,v 1.1 2001/03/28 05:48:25 mcalabre Exp

13 Writing Schedule Files

[16]

13.1 Overview.

The schedule is intended to mimic the operations on the GUI - you enter some new fresh parameters (eg, a new source position), and launch operations (e.g., a scan). Any GUI command can be included in the schedule. Once a schedule has been invoked ("start") the schedule maintains control of TCS, shutting out most of the user-selectable functions of the GUI.

13.2 The schedule strategy.

The essential point to grasp is that the schedule operates in an incremental fashion - it need only change a few operating parameters before launching a fresh scan. The down-side is that you need to be sure that unspecified parameters are indeed what you expect.

When a schedule is started, the current GUI's parameter set is sent to TCS. These provide the initial set; the schedule then replaces as much or as little as it wishes.

A schedule contains a loose mix of parameters and actions; these are grouped in UNITS. The recommended procedure is to make each unit self-sufficient; each unit may contain a number of actions, and each action will be governed by all the parameters between the start of the unit and the action.

TCS reports the number of actions and units in a schedule; the schedule pointer increments on data collecting actions, not units. It is therefore in practice simpler to write schedules containing precisely one action per unit (though unit-based incrementing may be introduced in the future).

13.2.1 More detail on scheduling strategy

When the user requests TCS to start an observation by clicking on the "*start TRACK*"/"*start SCAN*" button on the main action panel (without using a schedule), TCS reads all the parameters from the GUI and uses these to define the observation.

When a schedule is used, by clicking on the "*Start sched*" button, TCS first reads all the GUI parameters, then steps through the schedule from the nominated starting point. **Any parameter defined in the schedule will therefore override the GUI value**. Further, the value displayed on the GUI will be immediately reset to the value defined in the schedule, so the new value persists indefinitely (until explicitly changed). Thus the GUI should represent accurately the parameters of any observation currently in progress. (If this fails to occur it is a reportable bug!).

A further important consequence of this model is that **parameters not specified by the schedule will default to the value displayed on the GUI**. This is important to bear in mind, particularly at the start of an observing session. Unintended settings on the GUI inherited from a previous observing session can be disastrous if not detected by careful checking!

[16] Last change: Id: SchedFiles.tex,v 1.2 2002/08/28 14:45:24 jreynold Exp

An observer can use TCS without ever using a schedule. For example, a series of repeated or similar simple observations of a list of sources might be accomplished more easily from the GUI alone, loading the source details from a user-prepared catalogue. This is the most interactive but also the most flexible style of observing.

The next level is to write a ”minimalist” schedule containing only those commands which change from one observation to the next (e.g. source details) and use the GUI for fixed parameters or those which change only occasionally (e.g. correlator configuration etc).

Alternatively, an observer can ”play it safe” and include every relevant setting in the schedule file. This gives protection against inheriting unwanted settings.

A hybrid scheme is to define all or most of the relevant parameters in the first ”unit” (integration) of the schedule, and thereafter specify only changes to parameter settings (rather than repeating them for every integration). This can be a very convenient mode of observing, but beware of re-starting a schedule midway through after an interruption - any GUI parameters that have been changed in the meantime may not get reset if you skip the first integration of the schedule.

13.3 Schedule details.

A schedule contains parameters (list A), immediate actions (list B) and OBS actions (= data collecting actions (list C).)

The parameters are keyword defined; for example:

- `epoch = j2000`
- `ra = 12:24:36.66`

The immediate actions are keywords - for example :

- `closefile`
- `disable dsd`

The OBS actions require two steps:

define the action:

`obstype = action` (eg, scan)

launch it :

`go`

13.3.1 Comments

Any schedule line beginning with the characters ”#” and ”!” is treated as a comment and ignored. Blank lines are also ignored. Comments can also be appended to a schedule line after a ”#” or ”!” character, eg;

doppler = T ! Turn Doppler tracking ON

13.4 The parameters — List A

13.4.1 Antenna Configuration:

- `NBEAM`: define the number of active beams
- `REFBEAM`: define the beam (of the Multibeam) to be on the pointing axis

13.4.2 Coordinate Configuration:

The coordinate input machinery was designed for a more relaxed time, with command line entry. Many options are available, now probably irrelevant. The coordinate keyword contains implicitly the coordinate frame (`j2000/b1950/galactic/hadec/azel`), and also defines the way the input is to be interpreted -

```
raj=12.5  J2000 frame; value is in hours.
az=180.5  AZEL frame; value in degrees.
```

Internally the values are all stored as degrees; defining explicitly the frame will override any previous implicit definitions - for example, az=180.75, el=21.5 and epoch=j2000 will define a source position as ra (j2000) = 12:03:00, dec(j2000) = 21:30:00. Common sense should prevail - keep it simple. The entries can be a decimals, formated angles (or hours), or with the units explicitly set. So the following are equivalent:

```
ra = 12:30:00.0
ra = 12.5
ra = 12h 30m
ra = 187.5d
```

When mapping a region with long integrations at a number of different points it is convenient to define a central position (with ra/dec), and then use:

- Signal offsets for the map; reference offsets for the baseline reference position. The schedule would simply update the signal position each time.
- Use `lngsig/latsig` for the "longitude" and "latitude" offsets for the signal position; `lngref/latref` for the reference positions.
- Be aware that these offsets are true angles on the sky. As $360° = 24^{\mathrm{h}}$ and remembering $1^{\mathrm{h}} = 15°$, $1^{\mathrm{m}} = 15'$ and $1^{\mathrm{s}} = 15''$ on the celestial sphere, to move the telescope 15" in RA, the offset used is 00:00:01. TCS applies the $15/cos(\delta)$ factor to the specified angle then adds it to the nominal RA to get the target RA.

Scans can be defined in one of two ways:

Centre-Range; Use `ra/dec/epoch` for the centre and `dra/ddec` for the range (this is the full extent of the scan). Note that there is no 1/cos(dec) correction!

Start/End points: You add a suffix to the coordinate keywords - 1 for the start, 2 for the end. Use `ra1/dec1` for the start, `ra2/dec2` for the end.

- `AZ`: Azimuth, in degrees
- `DAZ`: Scan extent (in az), in degrees
- `DEC`: Declination, in degrees
- `DECB`: B1950 declination, in degrees
- `DECJ`: J2000 declination, in degrees
- `DECH`: Declination, in degrees, for an HA/DEC pair
- `DDEC`: Scan extent, in dec, in degrees
- `DDECB`: Scan extent, in dec B1950
- `DDECJ`: Scan extent, in dec J2000
- `DDECH`: Scan extent, in dec HA/DEC
- `DEL`: Scan extent, in elevation
- `DGLAT`: Scan extent, in galactic lat. (in degrees)
- `DGLON`: Scan extent, in galactci long. (in degrees)
- `DHA`: Scan extent, in HA (hours)
- `DRA`: Scan extent, in ra (hours)
- `DRAB`: Scan extent in ra, B1950
- `DRAJ`: Scan extent in ra, J2000
- `EL`: Elevation, in degrees
- `EPOCH`: Coordinate mode - J2000; B1950; AZEL; HADEC;GAL
- `GLAT`: Gal. latitude in degrees
- `GLON`: Gal. longitude, in degrees
- `HA`: HA, in hours
- `LATREF`: Offset, in degrees, for the "REFERENCE" position
- `LATSIG`: Offset, in degrees, for the "SIGNAL" position
- `LNGREF`: Offset, for the "ref" longitude. Same units as the source position
- `LNGSIG`: Offset, for the "sig" longitude.
- `RA`: ra, in hours
- `RAB`: B1950 ra, in hours
- `RAJ`: J2000 ra, in hours
- `SRCOFF`: Controls the position offsets: NONE/SIGNAL/REFERENCE

13.4.3 Correlator Configuration

- `AVERAGE:` Number of integrations to average before dumping to the archives
- `BANDWID:` Bandwidth in MHz
- `CONFIG:` Config file name in lowercase, ie mb7_8_2048
- `CORRMODE:` NORMAL (spectral) or TOTAL_POWER (continuum)
- `FITSNAME:` RPFITS name
- `NPOL:` Number of polarisations/chain
- `START_CHAN:` First channel to record
- `STOP_CHAN:` Last channel to record

13.4.4 FCC Configuration

- `FPOS_R:` Platform rotation, in degrees
- `FPOS_Y:` Platform offset, axially, in mm
- `FPOS_Z:` Platform offset, in focal plane, in mm
- `FCC_P_T:` Parallactification mode
  - CONTINUOUS - receiver rotates during data taking
  - STEPPED - Multibeam mode; adjusted for a scan mid-point
  - BEAMTRK - similar to stepped, but with the scan direction as the reference direction (STEPPED uses the parallactic angle.)
  - DISABLE

In the STEPPED mode, the platform is rotated just before a scan starts, so it is exactly in the right orientation at mid-scan. BEAMTRK does a position tweak every 5 seconds during a scan, ensuring that the platform stays close to the scan axis all the time (good for scans near the south pole). BEAMTRK is essentially the same as CONTINUOUS, but with the addition that it does the hard work of determining the actual track on the sky during a scan, and positioning the platform relative to that axis (rather than the latitude lines, for example).

13.4.5 Conversion Chain Configuration

- `CONV:` The doppler convention (OPTICAL/RADIO/RELATIVISTIC)
- `DFRQSW:` Frequency switch offset, in MHz
- `DOPPLER:` Doppler corrections ON/OFF
- `FRAME:` Doppler frame : LSR-K/LSR-D/BARY/GEOC/TOPO
- `FREQUENCY:` Obs. freq in MHz. Suffixed, 1 or 2 (for the two freq. chains)

- `FQOFF`: A freq. offset, in MHz
- `NFREQ`: Coded number of frequency chains 1 .. use freq1; 2 .. use freq2; 3 .. use both
- `REFSW`: State of the frequency switch: SIGNAL/REFERENCE/SLOW(switching)/FAST
- `VELOCITY`: Doppler velocity, in km/s

13.4.6 RPFITS Header Configuration

- `INSTRUM`: Text identifier
- `OBSERVER`: Observer name(s)
- `PROJECT`: Project identifier
- `SOURCE`: Source name
- `TELESCOPE`: Telescope name

13.4.7 Receiver Configuration

This item is important (and increasingly so) - it will cause the FCC to move a receiver on-axis; it defines the pointing parameters; it defines the focus platform tracking; it defines the conversion chain operation.

- `RECEIVER`: Receiver name (e.g., MULTI)

13.4.8 Timing Configuration

- `CYCLE`: Duration of an observation, in integration cycles
- `OBSVAL`: Duration value
- `OBSUNIT`: Duration unit: CYCLE (default); [SEC/MIN/HOUR]

13.4.9 Obsolete/deprecated parameters

- `CALIBRATE`: Multibeam calibrate (each feed in turn)
- `CALSCAN`: Total power scan
- `DRIVE`: "GOTO"
- `FCC_ROT`: Platform rotation
- `MXCAL`: Multibeam calibrate
- `MX`: Multibeam MX obs.
- `SCAN`: Scan, collecting spcetra
- `TRACK`: Track, collecting spectra

13.5 The immediate actions — List B

- `CLOSFILE`: Correlator close file
- `DISABLE`: ANT; FCC; CORR; SYNTH; TSYS; ATT; DSD; MBSAMP
- `ENABLE`: ANT; FCC; CORR; SYNTH; TSYS; ATT; DSD; MBSAMP
- `OPENFILE`: Open an RPFITS file
- `PADDLE`: MOPRA only

13.6 The OBS actions - List C

- `OBSTYPE`:
  - MX - Visit each beam in turn
  - MXCAL - MX in continuum mode
  - SCAN - Scan from start to end
  - SPOT - Traditional SPOT PATTERN
  - TRACK - Track source only
- `CORRMODE`:
  - NORMAL - Collect spectra
  - TOTAL_POWER - Continuum mode

Launch a schedule file :

- `GO`

14 Example Sched Files

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14.1 Example CAL File

```
$ unit    1               !- define a new scan
freq = 1394.5             !- frequency in MHz
config = mb13             !- correlator mode (13 beams, 64MHz BW, 2048 ch)
bandwidth = 64            !- bandwidth in MHz (done above, but just to be safe)
fcc_p_trk = disabled      !- no parallactification
source   = 1934-638       !- source name
cycles =   5              !- number of 5 sec cycles
raj     =   294.8543d     !- RA(J2000) in degrees
decj    =  -63.71267d     !- DEC(J2000) in degrees
fcc_rot =    0.0000       !- Receiver rotation angle
calibrate                 !- execute calibration
refbeam 1                 !- returns reference beam to beam 1
                          !  (done by calibrate, but repeated here to be sure)
disable refbeam           !- disables reference beam mechanism (ditto).
```

14.2 Example SCAN File

```
$ unit 1                  !- define a new scan
config = mb7_8_2048       !- correlator mode (inner 7 beams, 8MHz BW, 2048 channels)
fcc_p_trk = continuous    !- parallactic tracking in continuous mode
bandwidth = 8             !- bandwidth in MHz (done above, but just to be safe)
freq = 1419.00            !- observing Frequency in MHz
fcc_rot = 19.10           !- receiver rotation angle
frsw = ON                 !- frequency swithching enabled
dfrqsw = 3.125000         !- frequency swithing range
obsval = 115              !- integration time...
obsunit = seconds         !- in seconds
source = P355_G245a       !- project ID _ source name
fitsname = P355_G245a.mbf !- output \RPFITS\ file name
raj1 = 121.50d            !- RA(J2000) start in degrees
decj1 = -29.50d           !- DEC(J2000) start in degrees
raj2 = 118.75d            !- RA(J2000) end in degrees
decj2 = -29.50d           !- DEC(J2000) end in degrees
scan                      !- start the scan from (raj1,decj1) to (raj2,decj2)
closef                    !- close the correlator file
```

[17] Last change: Id: SchedExmpl.tex,v 1.7 2002/08/28 14:48:03 jreynold Exp

14.3 Example TRACK File

In this example, we want to map around a source with a spacing of 30" with a reference position 30' to the east. Firstly, the telescope is driven to a reference position relative to the source ($unit 1). Next, the telescope goes back to the source position ($unit 2), and then offsets to the south ($unit 3), east ($unit 4), north ($unit 5) and west ($unit 6) before returning to the reference position ($unit 7). Note that signal offsets in RA are 00:00:02 (30"), and reference offsets in RA are 00:02:00 (30^m) (see §13, p43).

```
$ unit 1
raj = 18:18:55.34          !- RA (J2000) of main source
decj = -13:51:46.51        !- DEC (J2000) of main source
source = M16               !-
receiver = K-BAND          !-
freq =  22235.077          !- main frequency in MHz
bandw = 32                 !- bandwidth in MHz
chans = 1024               !- 1024 channels
vel =   -200.0             !- velocity of source
frame = LSR-dynamic        !- velocity frame
conv = Radio               !- doppler convention
average = 12               !- average 12 cycles before dumping to file
source = Off               !- label the position as reference
srcoff = REFERENCE         !- track reference position plus offset
lngref = +00:02:00.0       !- reference position is 30 arcmin east of source
latref =  00:00:00.0       !-
obstype = TRACK            !- observation type
corrmode = NORMAL          !- spectral mode
obsval = 12                !- observe the reference position for...
obsunit = cycles           !- 12 cycles
drive                      !- go to the reference position
go                         !-

$ unit 2                   !- central position
srcoff = NONE              !- track source without any offset
lngsig = 00:00:00.0        !-
latsig = 00:00.00.0        !-
go                         !-

$ unit 3                   !- SOUTH
srcoff = SIGNAL            !- track source position plus offset
lngsig =  00:00:00.0       !-
latsig = -00:00:30.0       !- position is 30 arcsec south of source
go                         !-

$ unit 4                   !- EAST
srcoff = SIGNAL            !- track source position plus offset
lngsig = +00:00:02.0       !- position is 30 arcsec east of source
latsig =  00:00:00.0       !-
```

```
go                        !-

$ unit 5                  !- NORTH
srcoff = SIGNAL           !- track source position plus offset
lngsig =  00:00:00.0      !-
latsig = +00:00:30.0      !- position is 30 arcsec north of source
go                        !-

$ unit 6                  !- WEST
srcoff = SIGNAL           !- track source position plus offset
lngsig = -00:00:02.0      !- position is 30 arcsec west of source
latsig =  00:00:00.0      !-
go                        !-

$ unit 7
srcoff = REFERENCE        !- track source position plus reference offset
lngref = +00:02:00.0      !- reference is 30 arcmin east of source position
latref =  00:00:00.0      !-
go                        !-
```

14.4 Example MX File

In this example, we want to observe a galaxy (point source) with seven (7) beams of the Multibeam receiver. The source is observed within each beam in turn. For each of the 7 beams, the source is observed for 32 cycles (=32x5 seconds).

```
$ unit 1                 !- Define new scan
observer = Walt          !- Identify observer(s)
project = P999           !- Identify project ID
doppl1 = T               !- Doppler correction ON
frame = topocentric      !- Velocity frame
conv1 = optical          !- Velocity convention
config = mb7_8_2048      !- Correlator config
fcc_p_t = disable        !- No parallactification
source = NGC205          !- Source name
fitsname = P999_NGC205   !- Output RPFITS name with project ID included
vel1 = 3543              !- Velocity of source
raj = 04 23 43           !- RA (J2000) of object
decj = +02 23 23         !- DEC (J2000) of object
fcc_rot = 0              !- Receiver rotation (deg)
cycles = 32              !- Number of 5 sec cycles
obstype = mx             !- Observing mode
go                       !- Start the observation
closef                   !- Close RPFITS file after observation finishes
```

15 Known Bugs

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Bugs and anomalies:

15.1 Version 1.20

- Invalid epoch in RPFITS files

  TCS is inappropriately writing the coordinate mode into the 'EPOCH' header of the RPFITS file output. For example, a file written in AZEL mode will contain EPOCH = 'AZEL ...' in its header. This is not really consistent: the true epoch is always J2000. (Although the 'EPOCH' header card is obsolete, non-numeric values cause e.g. ATLOD to crash).

  Status: Pending

- PSR mode problem

  Selecting correlator mode PSR (pulsar binning mode) erroneously forces fast-sampling mode for the Multibeam samplers, preventing any spectra from being formed and any RPFITS file from being opened.

  Status: Fixed at 1.21.

- GUI widgets "start" and "end" freeze

  The widgets "start" and "end" specifying the start and end scans for a schedule can "freeze" if they are accessed while a long schedule (e.g. a standard HIPASS schedule) is still loading. This is apparently a Glish "feature". The fix is to take the cursor outside the TCS GUI to any blank part of the screen and click the left mouse button. The widgets should then be OK. Avoid accessing these widgets until the log shows that the schedule has loaded.

  Status: Glish "feature"

- Can't run TCS without loboss

  If the loboss server is not running, any attempt to start a scan/track etc. fails with errors;

  ```
  07:21:38      configok received
  07:21:38 (E) <ERR> send failed in lo_ctrl
  07:21:40     Stop cmd
  ```

  Status: Pending

[18] Last change: Id: Bugs.tex,v 1.4 2002/02/12 05:25:21 mcalabre Exp

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