1 The new OBSINP Observing Program

Since July 2010 a new antenna control and observing software is used at the Effelsberg 100m telescope. The interface for the observer is still called OBSINP, but it is now a graphical based control program. However, once the observer knows the system it allows to load complete observing lists prepared in advance that can be stored in a queue for further processing at the telescope. The structure of the program is shown in Fig. 1.
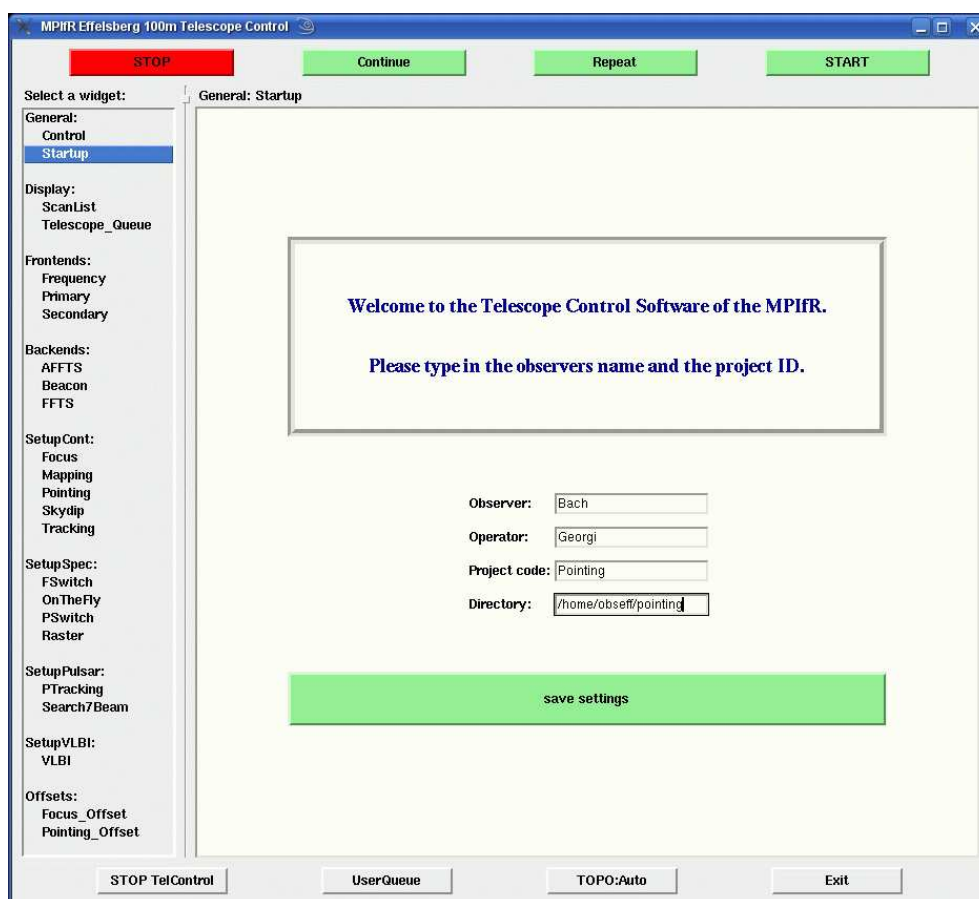

Figure 1: Startup screen of OBSINP. Some basic information and the observing directory should be given.

On the left side the observer can choose from various menus on different topics that are mainly structured in a way that they guide through the observations. The general setup is made at the beginning including frontend and backend settings. The SetupCont menu contains windows for pointing and focus that every observation should start with and the other modes like spectroscopy, Pulsar and VLBI follow.

In detail there are:
General (Section 1.1, p. 3):

- Control: Allows to send commands directly to the telescope control software (take care! you have to know what you do). At the bottom the active queue can be selected.

- Startup: Observer-name, Operator, Project-Code, and the working directory should be set here. The working directory contains the observes catalogues and scripts. If not

existing the program will create new directories called "Catalogues" and "Scripts".

Display (Section 1.2, p. 3):

- ScanList: Shows a scan list of the most recent 100 scans.

- Queue: Opens the QueueManager where the next scans in the selected queue can be inspected and modified.

Frontends (Section 1.3, p. 3):

- Primary: Selection of prime focus receivers.

- Secondary: Selection of secondary focus receivers.

- Frequency: To choose other than the default frequency of the selected receiver.

Backends (Section 1.4, p. 6):

- AFFTS: Initialization of the AFFT Spectrometer.

- Beacon: Reserved for the beacon continuum backend. No action yet.

- FFTS: Initialization of the FFT Spectrometer.

SetupCont (Section 1.5, p. 6):

- Focus: Prepare for a focus scan.

- Mapping: Control menu for continuum on the fly maps. Allows to prepare single maps by "hand" or loading of templates for maps or complete list of sources to be mapped.

- Pointing: Control menu for cross scans (pointings). Allows to prepare single cross scans by "hand" or loading of templates for the cross scan parameters or complete list of sources to be send to the queue.

- Skydips: Do a sky dip.

- Tracking: Just track a source for a given time.

SetupSpec (Section 1.6, p. 11):

- FSwitch: Control menu for frequency switched spectroscopic observations.

- OnTheFly: Allows scanning of on the fly spectroscopic maps.

- PSwitch: Control menu for position switched spectroscopic observations.

- Raster: Setup a raster map observation. Can be used with FSwitch and PSwitch.

SetupPulsar (Section 1.7, p. 13):

- PTracking: Pulsar Tracking mode.

- Search7Beam: Pulsar Search with the 21 cm 7-Beam RX.

SetupVLBI (See VLBI-Handbuch):

- VLBI: Activates the VLBI Queue and listens to a port to receive command from the VLBI Field system.

Offsets (Section 1.5, p. 6):

- Focus_Offset: Is needed to load the automatic correction of a focus scan to the antenna. Allows also manual corrections at any time.

- Pointing_Offset: Allows to load the pointing correction of a pointing scan that was done with "POINTcorr 0" or manual corrections of the pointing at any time (see p. 8 for more details).

1.1 General

The General Menu has to sub topics Control and Startup. In the Control widget (Fig. 2) the observer can send commands directly to the telescope control software (take care! you have to know what you do). The syntax for this is written down elsewhere. It is possible to prepare configuration files that can be load by typing '@config-file'.
At the bottom the active queue can be selected. The "normal" queue for the observer is the UserQueue, but if e.g. the operator has to test something in between or the observer wants to insert a scan without changing his current queue, the active queue can be change to the OperatorsQueue and filled with alternative scans, be observed, and changed back to the UserQueue for further observations.

The Startup widget is the first screen that appears when you call OBSINP and should be filled with the information that is requested: Operator, Observer, Project-Code, and the working directory. The observers directory will contain the folders for his own catalogues and scripts. The directories are called Catalogues and Scripts and will be created by the system if not already existing.
The new catalogue format is somewhat cryptic and therefore it is recommended to just convert your old VAX-catalogues using catalog.py. A new catalogue preparation tool is planed. The preparation of scripts is described later in the Pointing and Spectroscopy sections.

1.2 Display

The ScanList shows the most recent 100 scans with some basic information about observing modes and receivers used (Fig. 3, top).
The Telescope_queue (or Queue Manager) displays the current queue and allows to shift and delete scans from the queue (Fig. 3, bottom). The current UserQueue is written as single files for each action in the /home/obseff/Queue/User directory. To prepare observations in advance or save queues for repeated observations like monitoring it is possible to save the queue-files or directory at some other place and restored it later again. For example you can write the files in a compressed tar-archive: change into the UserQueue directory and run "tar -czf ../../<dir-name>/todays_queue.tar.gz *" to save all files into your directory in todays_queue.tar.gz. "tar -xzf todays_queue.tar.gz" will extract the files in the current directory.

1.3 Frontends

Selection of secondary and primary focus receivers. Each receiver has different versions. For most continuum observations the Continuum BroadBand (BB) is the right decision and for spectroscopy observations one of the VLBI/Line SchmalBand (SB) with 100 MHz or the VLBA/Line
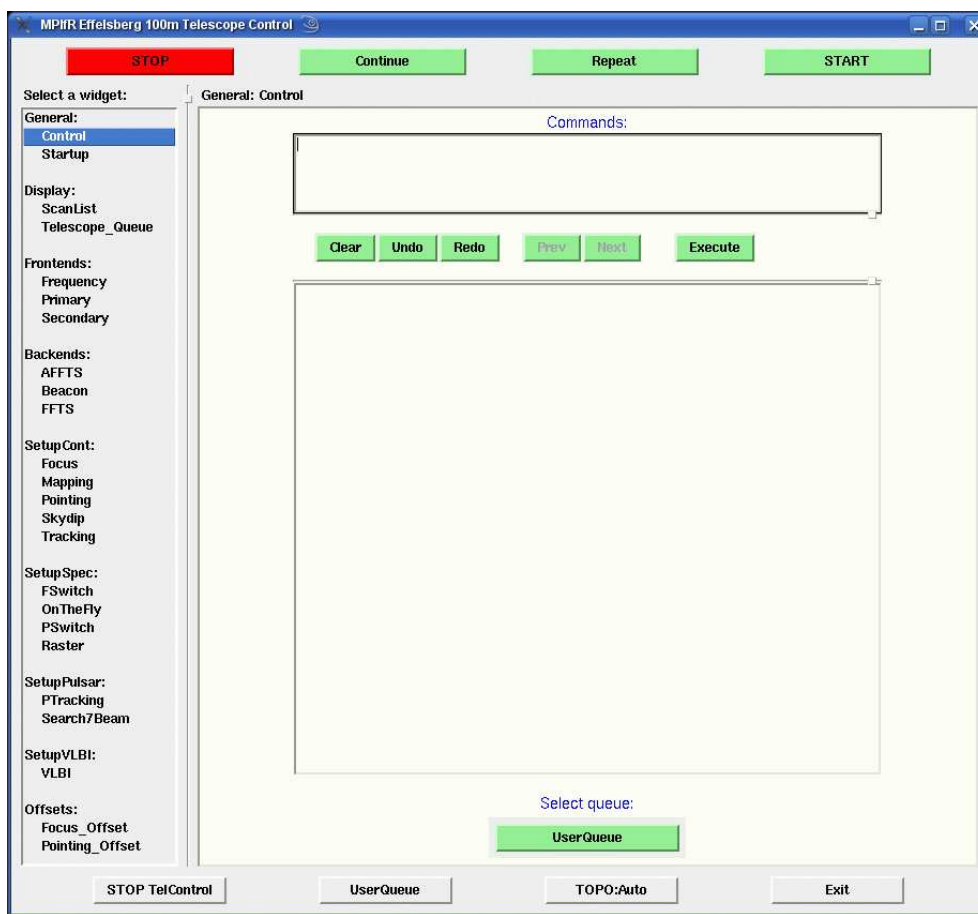
Figure 2: The Control screen allows to send commands directly to the telescope control software (take care! you have to know what you do). At the bottom the active queue can be selected.
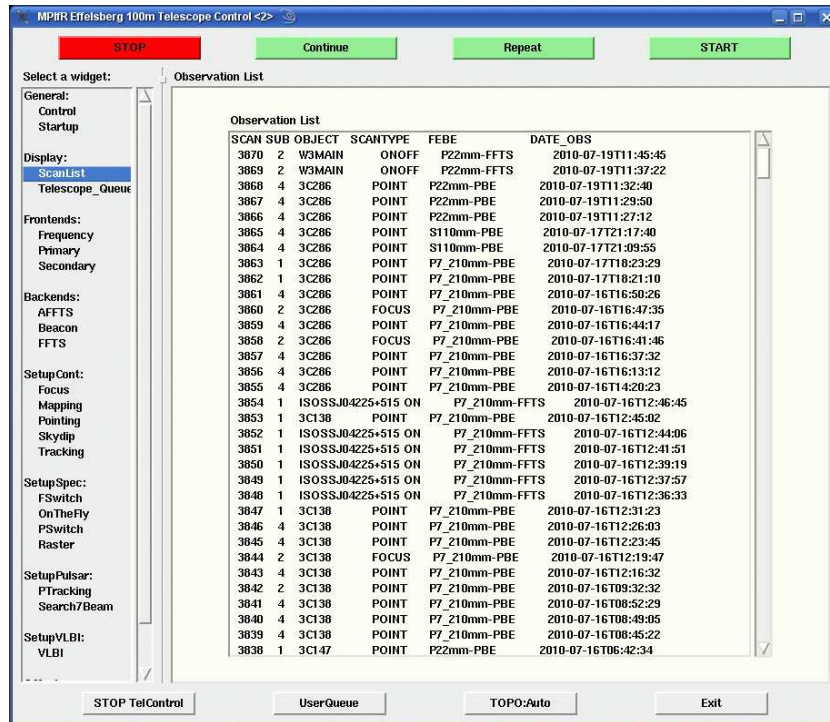
Figure 3: **Top:** The ScanList shows the most recent 100 scans with some basic information about observing modes and receivers used. **Bottom:** Example for a queue filled with pointing scans using different secondary focus receivers.

with 500 MHz band width versions are correct.

The Frequency menu allows the selection of lines by name from a line catalogue or the direct input of a frequency in GHz. You can add private line catalogues to your Catalogues directory. The catalogue should have the extension .lin. The format is
Line-Name - Frequency in GHz, e.g.
H58gamma   93.775900

1.4 Backends

For the continuum backend Beacon there are currently no options. From the two menus for the FFT Spectrometers (FFTS and AFFTS) the IF channel, the number of channels, and the filter (total band width) can be selected.

1.5 SetupCont

Every observing session should start with a sequence of pointing, focus, and pointing observations to verify that the system is working properly. Bright suitable sources are displayed on the AstroPC in the control room. Many of the primary flux density calibrators are suitable for that and can be directly used for calibration. For spectroscopy it is also recommended to observe a known line source to verify the proper functionality of the FFTS (see 1.6).

1.5.1 Focus

The only axis that needs to be adjusted is the z-lin axis (along the optical axis) of the sub-reflector. The distance to drive should be about twice the wavelength in millimetre at least for wavelength of 6cm and smaller. Much larger distances than 150 mm are not recommended because of the driving limits of the sub-reflector. The software will automatically limit those to shorter distances and the focus might become asymmetric. This doesn't hurt (the fitting will work either) but it is not nice so just stay in the limits. The default driving speed of 2 arcmin/min is okay for most purposes.

After completion of the focus scan the active queue will be stopped and the antenna is waiting for new input. If the fit was successful the focus correction will now appear in the Offsets: → Focus_offset menu at the bottom of the left widget list in the ZLinear field. If the fit failed or the value needs to be corrected by hand for some reason this can be done now. Pressing Load to telescope queue will load the corrections to the first position in the queue independent of how many other scans are there already. The antenna will continue observing with the new corrections after the Start button is pressed. Pressing the Start button will continue the observations without using any focus corrections.

1.5.2 Mapping

The Mapping menue allows to cover a defined area around a given position of an (extended) radio source with many divers options. Ususaly, the position of the source is taken as the reference point (but not necessarily the map center) with the parameters ObjectName and its coordinates given in the coordinate system chosen by CoordinatSystem, Equinox, and Projection (either Cartesian or as Sanson-Flamsted (SFL)), with the corresponding coordinates written in ObjectLongitude in [hh.mm.ss] and ObjectLatitude in [°.′.″]. Instead of typing in the coordinates you can automatically select them from a source catalog chosen in Catalog where you also can

access one of your private catalogs. For observations with multihorn receivers you should always scan along azimut so that all horns will cover the source subsequently. Therefore please choose Azimth/Elevation in Scanning_in. In this case it doesn't matter what you choose in CoordinateSystem.

Figure 4: Example of how to fill the mapping template.

If you wish to get a rectangular map of your source (which is the standard way), please choose UserSystem = Descriptive. The option Absolute will give the map in absolute coordinates.

The coverage usually starts at the lower left corner of the map, scanning either along Longitude or Latitude as chosen in SCANDirection. With the parameter SCANSpacing you choose the distance of the next subscan of your map above the first one along which the telescope drives backwards. The telescope's beam will cover the total map with this SCANSpacing forwards and backwards (if you choose ZigZag= True) with a velocity given by SCANVelocity (give [unit]/sec, i.e. $30''$ means $30''$/sec) starting with the SubSCANStart (which is 1 if you start the map from the beginning). Notice, that you need e.g. 21 subscans for a mapsize of $30' \times 20'$ (with SCANDirection=Longitude) if your SCANSpacing is $1'$. With SCANRepeat you choose how often you repeat one subschan, it is usually set to 1.

The total map extent is given in ExtensionLongitude and ExtensionLatitude. Please give the units explicitely, either in $''$, $'$, or $°$, no unit means by default [$°$]. You may also define an offset of the map center relative to the source position in longitude with LonOff and in latitude with LatOff which is necessary for multibeam observations. With ScanRotation the total map can be rotated relative to the chosen coordinate system.

There are two other options if you don't like to start observing your map in the lower left

corner: if you choose the SCANVelocity negative, the telescope starts the first subscan driving along minus longitude, with a negative value for SCANSpacing it goes down (instead of up) from one subscan to the next one. Hence, if you choose both parameters negative, the telscope starts at the upper right corner of the map.

With the option Load to Telescope queue you can add this specific mapping menue to the end of the telescope queue.

1.5.3 Pointing

The Pointing menu allows to customize the cross-scans parameters and load scans into the active queue. The Defaults button will reset all parameters. To fill the template first select a Catalog, type in the source name ObjectName and press Search (Fig. 5). The source name must be written exactly as in the catalogue. No minimum match option is available. A successful search will fill the ObjectLon. and ObjectLat. fields with the correct values and will set the CoordinateSystem and Equinox as given in the catalogue. The new catalogue format is somewhat cryptic and therefore it is recommended to just convert your old VAX-catalogues using the program "catalog.py". A new catalogue preparation tool is planed.
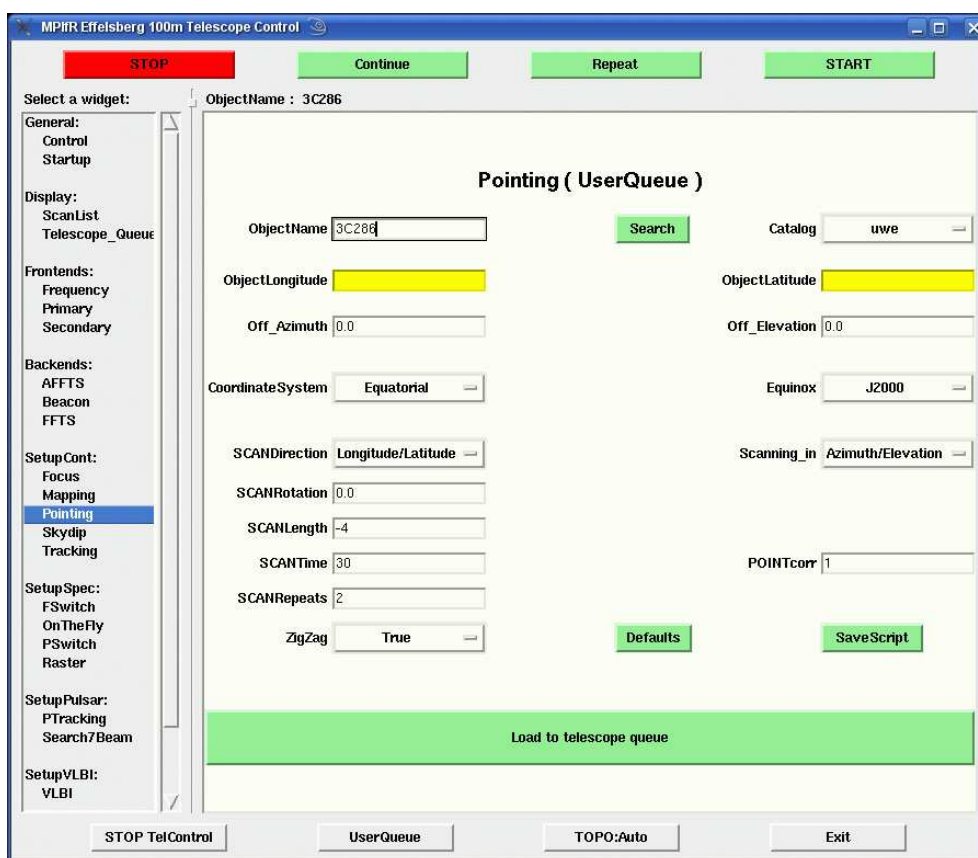

Figure 5: Search in the catalogue for a new source.

The Scanning_in, SCANDirection, -Rotation, -Length, -Time, and -Repeats options are more or less self-explanatory, but to be save: the SCANRoation parameter allows to rotate a cross-scan by the given amount in degrees, the SCANLegth is by default given in multiples of the beam size (e.g. at 6cm the beam is about 146 arcsec and −4 means 4 times 146 arcsec= 584
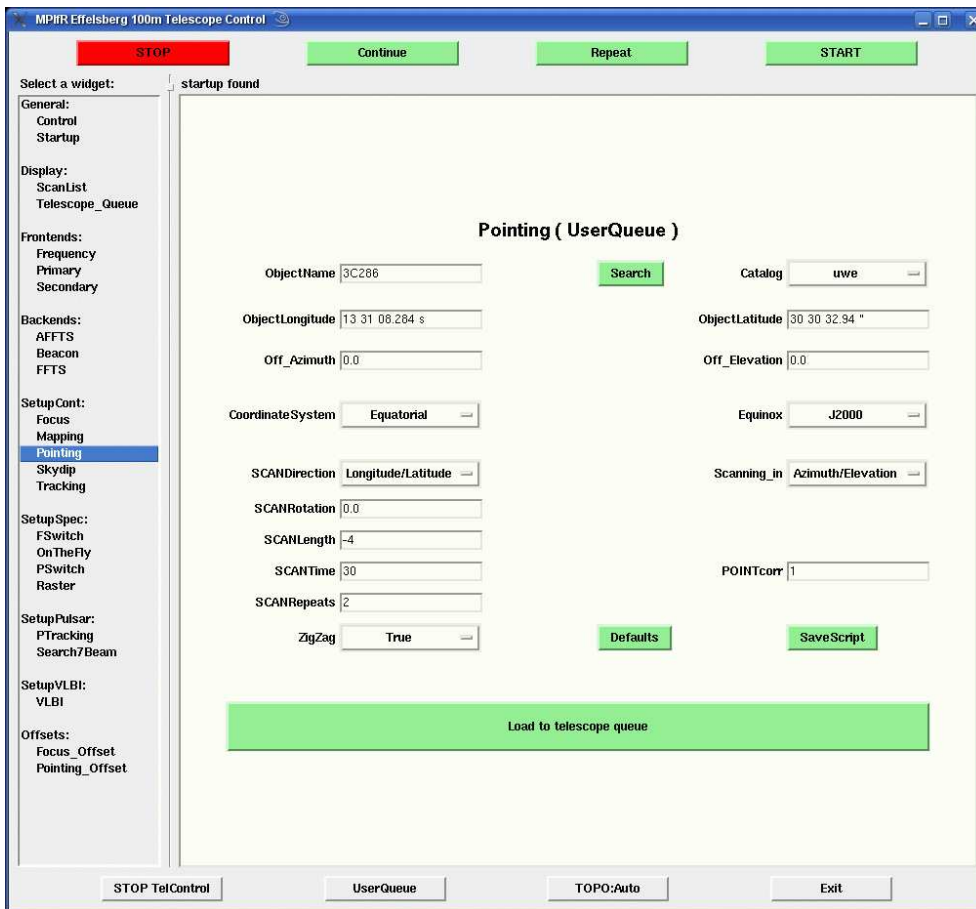
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Figure 6: Completely filled cross-scan form before it can be loaded to the queue.

arcsec), a positive number means degrees (take care even small numbers can mean very long scans) but the $'$ and the $''$ symbols behind a given number can be used to denote minutes or seconds, respectively, if beam sizes are not desired, the SCANTime per subscan has to be specified in seconds and SCANRepeats mean repeats per sub scan. So SCANRepeats 2 will do two in Azimuth and two Elevation, four subscans in total. The parameter POINTcorr allows to control the automatic pointing correction (see Tab. 1).

Table 1: Meaning of different numbers in POINTcorr.

Value	Meaning
−1	no corrections applied, queue is continued without interruption
0	no corrections applied, queue is halted. Observer needs to decide whether he wants to correct manually using the Pointing_Offset menu
1	corrections are applied automatically, if amount is less than one beam
2	corrections are applied automatically, if amount is less than two beams
...	continues like this but doesn't make much sense

A completely filled form is shown in Figure 6. Pressing load to telescope queue will send the pointing scan to the queue and a more scans can be added. The Start button will start the queue and more scans can be loaded while the antenna is running. If the queue is ones empty and new scans are added the Start button has to be pressed again to continue observing. If the antenna stops for some reason or the observations are stopped by the user the current scan can be repeated from the beginning by pressing Repeat. Continue will continue the current scan at the subscan where the antenna was stopped. Pressing Start will abort the stopped scan and continue with the next scan in the queue.

The SaveScript button will save the current pointing parameters into a file called "Pointing" in your Scripts directory. This can be used to reload the parameters at a later time again. Such scripts are called from the Pointing menu by typing "@Pointing" in ObjectName and press Search. All fields will be filled with the parameters found in the script. Pressing load to telescope queue will send the new scan to the queue. Such saved scripts can also be used as templates to make new scripts by "hand", but most parameters does not need to be changed so one can also reduce the scripts to the parameters that might change from scan to scan. All parameters need to be separated by a ";" and the parameter from its values is separated by a blank. E.g. to simply load two scans at a time to the queue use the following script:

```
3C286 ; POINTcorr 1 ; SCANRepeats 2 ; SCANTime 25 ; TopoMode AUTO
3C286 ; POINTcorr 1 ; SCANRepeats 2 ; SCANTime 25 ; TopoMode AUTO
```

To load more different scans on different sources, parameters can be changed. The source needs to be always at the first position other parameters don't need to be in some order.

```
3C286 ; POINTcorr 1 ; SCANRepeats 2 ; SCANTime 25 ; TopoMode AUTO
3C48 ; SCANRepeats 4 ; POINTcorr 1 ; SCANTime 30 ; TopoMode AUTO
3C147 ; SCANTime 25 ; POINTcorr 1 ; SCANRepeats 2 ; TopoMode AUTO
```

If no parameters change you only need to note them once and the following scans will be done with the same settings. E.g.

```
3C286 ; POINTcorr 1 ; SCANRepeats 2 ; SCANTime 25 ; TopoMode AUTO
3C48
3C147
```

More useful might be scripts without a source name at the beginning. E.g., if you prepare a script called "cal2":

```
; POINTcorr 1 ; SCANRepeats 2 ; SCANTime 25 ; TopoMode AUTO
; POINTcorr 1 ; SCANRepeats 2 ; SCANTime 25 ; TopoMode AUTO
```
it can be used to do two cross-scans after each other just by typing "@cal2:3C286" or "@cal2:3C48" to make

two cross-scan on that source.

With the "FE:" key one can also select different secondary focus receivers to be loaded automatically. Versions are controlled by the "VERn" option and frequencies can be changed by the "Frequency" key. A script for all receivers looks like this:

```
FE:S60mm
; POINTcorr 1 ; SCANLength -5.0 ; SCANRepeats 2 ; SCANTime 25 ; TopoMode AUTO
; POINTcorr 1 ; SCANLength -5.0 ; SCANRepeats 2 ; SCANTime 25 ; TopoMode AUTO
FE:S36mm
; POINTcorr 1 ; SCANLength -5.0 ; SCANRepeats 2 ; SCANTime 25 ; TopoMode AUTO
FE:S110mm
; POINTcorr 1 ; SCANLength -5.0 ; SCANRepeats 2 ; SCANTime 25 ; TopoMode AUTO
FE:S28mm
; POINTcorr 1 ; SCANLength -5.0 ; SCANRepeats 2 ; SCANTime 25 ; TopoMode AUTO
; POINTcorr 1 ; SCANLength -5.0 ; SCANRepeats 4 ; SCANTime 25 ; TopoMode AUTO
FE:S20mm ; VERn 3
; POINTcorr 1 ; SCANLength -5.0 ; SCANRepeats 2 ; SCANTime 25 ; TopoMode AUTO
; POINTcorr 1 ; SCANLength -5.0 ; SCANRepeats 4 ; SCANTime 25 ; TopoMode AUTO
FE:S13mm ; VERn 3
; POINTcorr 1 ; SCANLength -5.0 ; SCANRepeats 2 ; SCANTime 25 ; TopoMode AUTO
; POINTcorr 1 ; SCANLength -5.0 ; SCANRepeats 4 ; SCANTime 25 ; TopoMode AUTO
FE:S7mm
; POINTcorr 1 ; SCANLength -5.0 ; SCANRepeats 2 ; SCANTime 25 ; TopoMode AUTO
; POINTcorr 1 ; SCANLength -5.0 ; SCANRepeats 4 ; SCANTime 25 ; TopoMode AUTO
FE:S9mm ; VERn 2
; POINTcorr 1 ; SCANLength -5.0 ; SCANRepeats 2 ; SCANTime 25 ; TopoMode AUTO
; POINTcorr 1 ; SCANLength -5.0 ; SCANRepeats 4 ; SCANTime 25 ; TopoMode AUTO
```

Such a script can be again combined in another script to observe a number of sources at all available receivers. E.g. a script called "go_poi" might contain

```
# Calibrator
@all:NGC7027
# Targets
@all:3C454.3
@all:BLLac
@all:CTA102
# 2318 only at low frequency receivers
@low:2318+049
# Calibrator
@all:NGC7027
```

Lines starting with "#" denote comments. This script will measure first NGC7027 at all secondary focus receivers and then 3C 454.3, BL Lac, and CTA102. 2318+049 is only observed at the lower frequencies and NGC7027 again at all. Such a script will run for about 3.5 hours.

1.6 SetupSpec

Every observing session should start with a sequence of pointing, focus, and pointing observations to verify that the system is working properly. Bright suitable sources are displayed on the AstroPC in the control room. Many of the primary flux density calibrators are suitable for that and can be directly used for calibration (see 1.5 for details). For spectroscopy it is also recommended to observe a known line source to verify the proper functionality of the FFTS. If no source is known, it is likely that a Radio Recombination Line of Hydrogen is close to your target frequency (see the Spectral Line folder in the control room) that is observable on W3MAIN. The observable RR-Lines are listed in the RRL line catalogue and can be selected in the "Frequency" menu. The position of W3MAIN is in the default source catalogue.
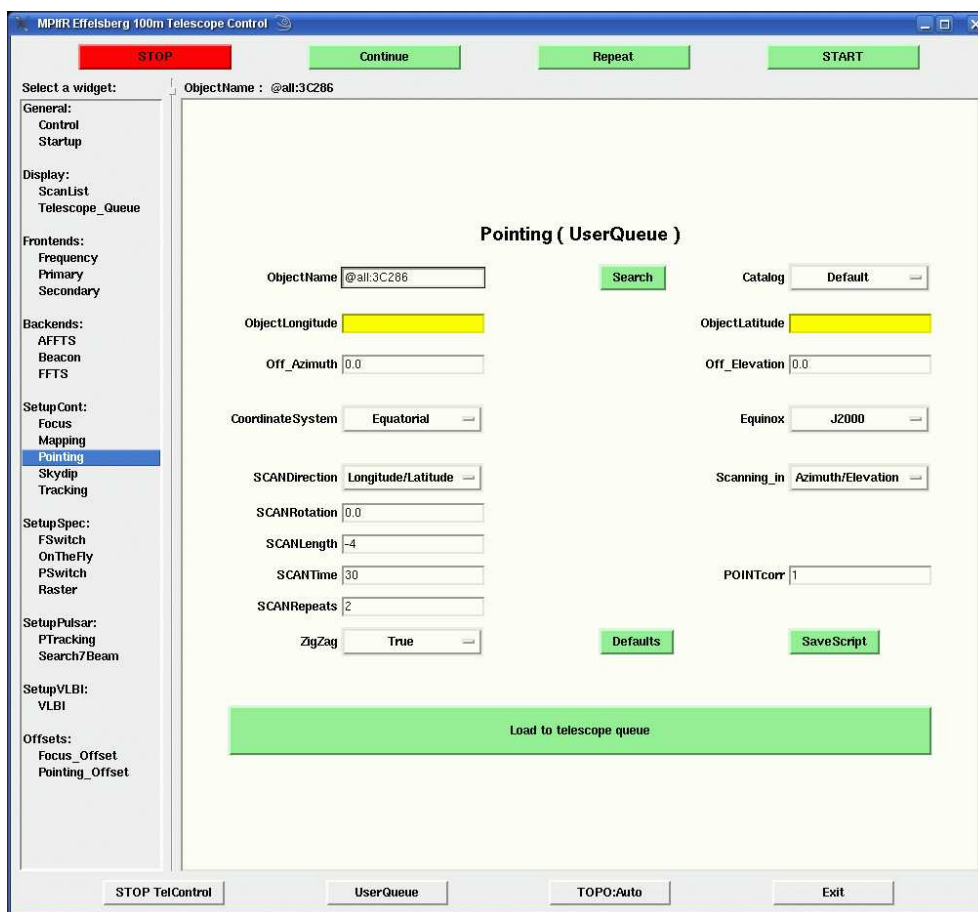
Figure 7: It is possible to load scripts that perform several pointings. To load a script into the queue type "@script" (if the source is in the script) or "@script:source" (if the source field is free) in ObjectName, then press Search and load to telescope queue.

1.7 SetupPulsar