Guide to the NRAO Observation Preparation Tool

(Version for EVLA receivers with the VLA correlator)

L. O. Sjouwerman

March 8, 2009

HTML version available at `http://e2e.nrao.edu/opt/OPTMANUAL/OPTMANUAL.html`.

ABSTRACT:

During the EVLA transition, the expanded receiver frequency coverage on the VLA allows for observing these newly available frequencies using an array of EVLA antennas with the VLA correlator. However, these new frequency ranges at L, C, K and Ka band (950 MHz to 2 GHz, 4.5 to 7.8 GHz and 18 to 26 GHz and 30 to 40 GHz respectively) are not known to existing scheduling programs. To support the scheduling of the EVLA using the WIDAR correlator a new web based scheduling tool has been developed which can also fully support observing in these new bands. This Observation Preparation Tool (OPT) includes the Source Catalog Tool (SCT) and the Instrument Resource Catalog Tool (RCT). Guiding the observer through the OPT, SCT and RCT to create an observation script readable by the EVLA control computers to allow scheduling of projects accepted at the February 2009 proposal deadline (or later) using this new scheduling tool is the current purpose of this document. It is anticipated that this document will evolve with new capabilities and user feedback while WIDAR is commissioned.

Contents

Chapter 1

Basics and overview of the Observation Preparation Tool web application

1.1 Purpose of this document

The current (March 8, 2009) purpose of this document is to provide help to the individual preparing EVLA observations tuned to the expanded frequency coverage not available on non-upgraded VLA antennas. This document consists of an introduction to the new "Observation Preparation Tool" (OPT) web application, hints and preliminary "cookbook"-like approaches to a successful observing schedule, and a list of contacts for further assistance. This document is not suited to learn, nor intended to teach, observing strategies and good observing practices; it is assumed that the individual either has prior knowledge of this, or will educate himself (herself) on this subject before finalizing an observing schedule. During the transition period, these EVLA array observations will still use the VLA correlator (i.e., not the new EVLA WIDAR correlator, which should start to become available sometime after the year 2009). The target audience is a successful proposer at the February 2009 (or later) deadline that proposed for EVLA array observations in the expanded frequency ranges in L, C, K and Ka band. Depending on progress of the VLA to EVLA transition, user feedback, upgrades to the software and new capabilities, this manual on the OPT web application scheduling tool may be updated, expanded and made available for other observations in the near future.

An observing schedule for these new bands using the EVLA electronics is made through the OPT, the Observation Preparation Tool, and consists of a sequence of observing scans. To make full use of the OPT, it is usually necessary to predefine (i.e., enter) sources to be observed using the SCT, the Source Catalog Tool, and to possibly predefine the frequency and correlator settings to be used using the RCT, the hardware and instrument configuration Resource Catalog Tool. This document should aid in creating source and resource lists, and in creating the final observing schedule (a Jython script). Alternatively, if no user catalogs are defined, one can resort to observing VLA calibrator sources using NRAO default correlator settings, although using these catalogs only is rather restrictive in scientific discovery space. Once familiar with the concept, one will probably recognize some similarity with the observe list, source list and user defaults as previously used in Jobserve; there are, however, major differences.

1.1.1 Abbreviations used in this document

The OPT, SCT and RCT abbreviations were introduced in the previous section. When referring to the "OPT" in the remainder of this document, most of the time it is implicitly referring to the tool that creates a sequence of observing scans. On the other hand, when we refer to the "OPT *web application*" we refer to the combination of tools consisting of OPT, SCT and RCT.

The use of the term "(re)source" is short-hand for the text "source and resource": the sentence applies to both "source" and "resource". Similarly, "project (etc.)" allows us to avoid having to write "project, program block(s), scheduling block(s) and scan(s)" which otherwise would make sentences confusing. For "program block" and "scheduling block" we will use "PB" and "SB", respectively, or "blocks" when we mean either or both.

We will further use PST and PSC to refer to the Proposal Submission Tool and Proposal Selection Committee, which have some interaction or influence on what goes on in the OPT web application.

1.2 The Observation Preparation Tool web application

The OPT web application

The OPT web application is started by pointing your web browser to https://e2e.nrao.edu/opt (note the extra "s" in https for encrypted connection). It will require you to log in to the NRAO user data base, for which you probably already registered as otherwise you would not have been able to submit the proposal. (Re)Register again with an email address known to NRAO if necessary, e.g., if you are a co-investigator who did not submit the proposal. Do not use someone else's registration as this will upset the system.

After logging in to the NRAO user data base there should be a menu item (using the "Dashboard" tab, on the left hand side, under "Options") called "Observation Preparation Tool" or "OPT". Click it!

This will redirect you to the OPT web application interface; you will notice the top two bars, one with file manipulation labels (File, Edit, Help) and a navigation bar (NRAO $>$ User Portal $>$ ..). The web application opens up in the OPT (i.e., the scan sequence tool, in the navigation bar labeled as "Observation Preparation"), but also lets you navigate to the SCT and RCT (in the navigation bar using the links labeled "Sources" and "Instrument Configurations", respectively). You may have to re-enter your login information when you switch between the different tools – we're working on that. We have tried to keep the tools and, e.g., editing concepts as similar as possible so that the look and feel in one tool should be similar to that of the other.

Note that the OPT is a web application. It should thus be available and perform similarly on most common web browsers and operating platforms. For us the big advantage is that we can keep everybody up to date with the latest code while more and more features of the WIDAR correlator (and the EVLA receivers) are commissioned. A drawback is that it may take a while to connect and reconnect between user web browser and NRAO user data base, that it has to time out at a certain point, and that connections may be interrupted unexpectedly and/or inconveniently. We have a separate chapter on what to do in which case. To exit gracefully, go to "File" in the menu strip and choose "Exit" (which is typeset as FILE - EXIT from here).

Please, do not use the browser "back" button to navigate to the previous page. This may give you browser errors and might prevent you from working on your project for a few hours. Also please be patient; when you enter or click something it may take a few seconds to connect back and forth between your browser and the NRAO data base. You want to avoid clicking or entering before the previous action was completed. Be patient and watch the "busy" icon of your browser to cease.

The OPT, SCT and RCT tools

The Observation Preparation Tool (OPT) is one of the three tools (OPT, and SCT and RCT below) of the OPT web application, and is used to schedule an observation by creating a list of scans and to generate an observing (Jython) script from that list. Each scan consists of a telescope pointing direction (selected from the SCT below) using a specific hardware and instrument configuration (selected from the RCT below) combined with an observing mode action lasting for a time interval (specified using this OPT). A schematic flow diagram with these components is shown in Figure 1.1.

The Source Catalog Tool (SCT) is the OPT web application tool that is used to specify a collection of telescope pointing directions, from which the OPT can select when creating a list of scans.

The Resource Catalog Tool (RCT) is the OPT web application tool that is used to specify a collection of hardware and instrument configurations, from which the OPT can select when creating a list of scans.

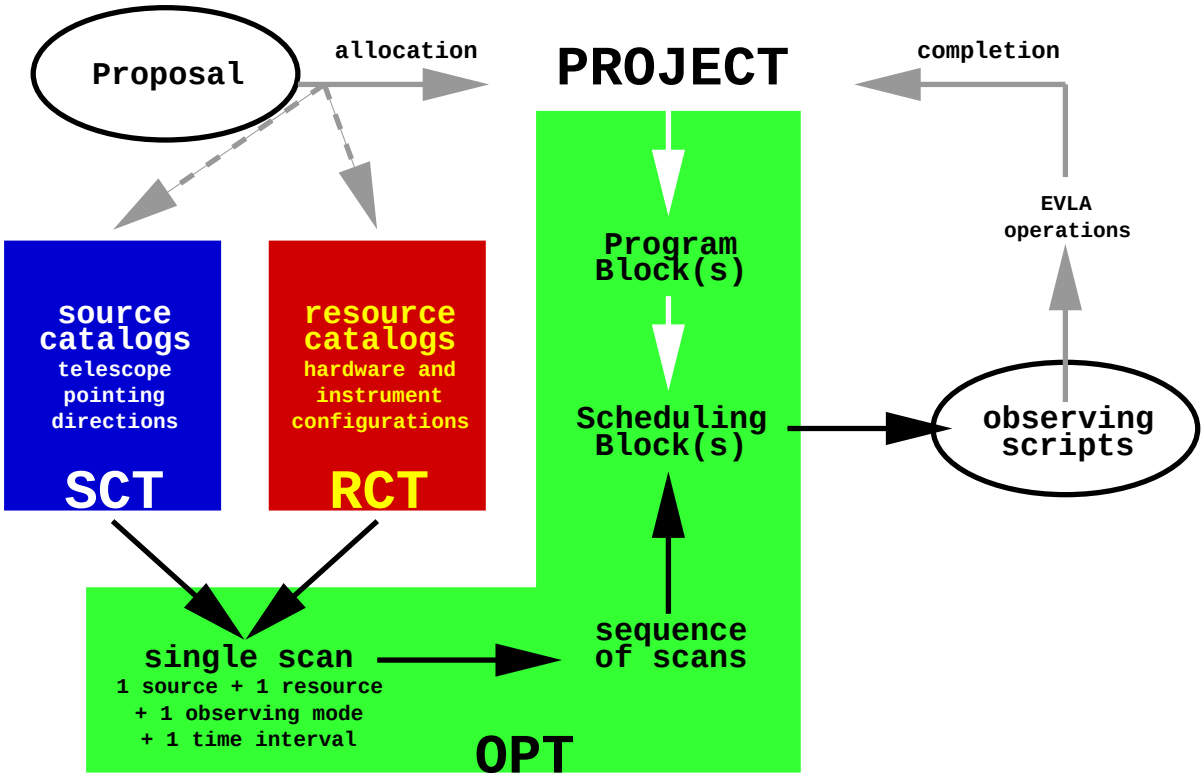

Figure 1.1: *Schematic flow diagram from an accepted proposal to completion of all observations for a project. The purpose of the Observation Preparation Tool* web application *is to get from the proposal to the observing scripts. Flow along the gray arrows is the responsibility of NRAO. Either NRAO or the user will have to fill out the path along the flow of the white arrows. The flow along the black arrows is the responsibility of the user, using the SCT (blue box), the RCT (red box) and the OPT (green area) in the NRAO OPT web application.*

Projects, program blocks and scheduling blocks

A **"project"** (an orange P: P; Figure 1.2) consists of at least one **"program block"** (PB, a blue PB: PB), which is defined as a collection of observations for a single proposal, using a single telescope or an EVLA array configuration (or a sequence of consecutive configurations). That is, typically a PB does not extend to another allocation trimester; e.g., if you were allocated time for the A array and the CnB array, one PB would be defined for the A array and one would be reserved for the CnB array observations in a following allocation trimester. A PB is made up of at least one **"scheduling block"** (SB, a green SB: SB), which consists of a sequence of **"scans"** (a radio telescope:): combinations of a timed telescope pointing direction (a **"source"**) using a specific hardware and instrument configuration (a **"resource"**) in a specified observation mode. Scans may be grouped in scan **loops** (a looping circle:).

For **fixed date observing**, each allocated time slot will typically be equivalent to a SB. For **dynamically allocated observing time**, a SB is not necessarily the same as a complete observing run; one can think of an observing run as a random order of several executions of a SB on the sources of interest, whether or not on the same observing day, possibly interspersed with a SB performing flux calibrations, a SB performing observations at a different frequency, etc.

In general, SBs may be many different snippets of an observing run, i.e., groups of consecutive scans that constitute a complete observation (a PB), but an observing run may as well be defined in a single SB. It depends on what the user finds convenient; for example one can define a template calibration SB on J1331+305 that can be copied to each new PB assigned by the PSC. However, observing time typically is allocated in 30 minute LST slots, in which case the user will probably typically schedule a PB in SBs with a length of an integer number of 30

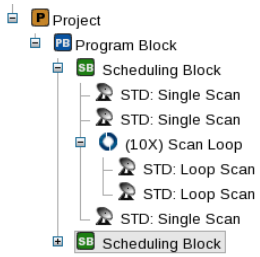

Figure 1.2: *The* PROJECT *tree consists of at least one* PROGRAM BLOCK *(PB); A PB is made up of at least one* SCHEDULING BLOCK *(SB), which consists of a sequence of* SCANS *with or without* LOOPS *of scans.*

LST minutes. *For the final SBs, the ones that through the OPT are submitted for observation, the duration of the observation of the SB is required to be an integer number of 30 LST minutes.* This is not necessary for template SBs or SBs that will not be submitted.

1.2.1 Page layout of the tools in the OPT web application

The front page of the Observation Preparation Tool (OPT) is is the page shown directly after redirection by the NRAO user data base. The front page shown after navigating to the SCT or RCT is very similar. The web browser window is set up in four main panels (Figure 1.3):

- The **menu and navigation strips** at the top
- The **interface feedback strip** at the bottom
- The **left hand side column**; in the OPT it contains a collection of projects, in the SCT it contains a source search section on top and a collection of source catalogs below it, and in the RCT it contains a collection of resource catalogs (hardware/instrument settings).
- The **main editing window**; a project (etc.), source or resource manipulation field where most of the editing for each of the different tools occurs.

The relative sizes of these panes can be modified by dragging the dividing lines with the mouse button pressed.

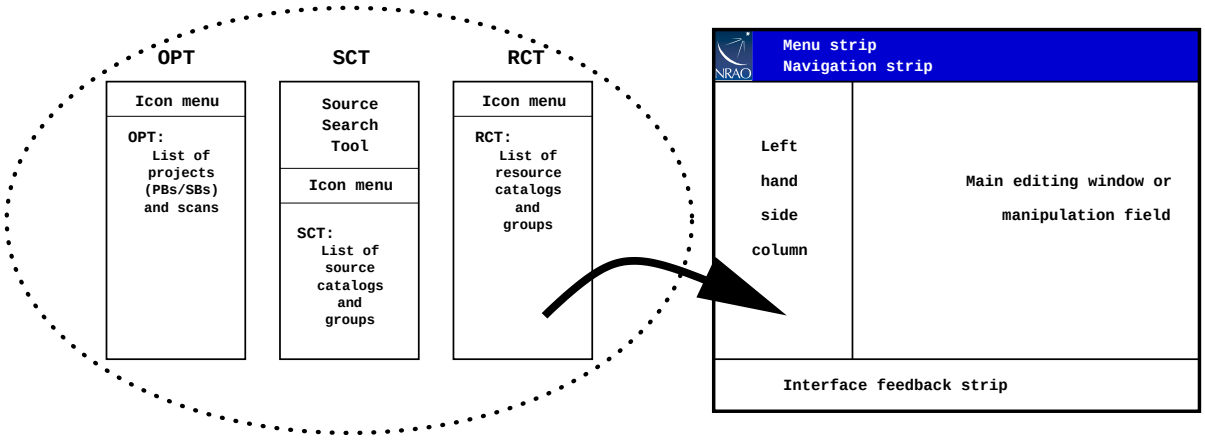

Figure 1.3: *General layout of the Observation Preparation Tool web application page in the web browser. For the SCT, the left hand side column includes a source search tool and thus looks slightly different (see inset left).*

The menu and navigation strips are the first and second line, respectively, at the top of the web interface with menu/navigation items written in white letters on a dark blue background.

The menu strip is used to manipulate – import/export, create/edit, save/delete – projects (etc.) and (re)sources. The navigation strip allows one to switch between the three components (OPT, SCT, and RCT) of the scheduling software; the bold-faced name is the current tool and the underlined names are links to the other tools.

More on using the menu items can be found in following chapters.

The interface feedback strip is the strip over the full web page width at the bottom of the page. This strip is used to display feedback information such as error messages (in red font) and warning messages (in blue font) generated by the web interface when entries made through the web interface are validated. It is advised to pay attention to these messages as it may be the only indication that a schedule is faulty. An observing script with errors cannot be submitted, but a script with warnings may be submitted if the observer persists.

The left hand side column, depending on which tool is selected (OPT, SCT or RCT), should have at least one project, source catalog or resource catalog visible.

- OPT (Observation Preparation)

  At the very least, the OPT project column should contain the program for which you were awarded observing time. Other catalogs may be visible, in particular if you had previous observing programs or if you were awarded observing time for more than one project in this proposal round. Different icons in the tree depict different items: P for projects, PB for program blocks, SB for scheduling blocks, and for scans or for scan loops. When using this for the first time, the project tree should be visible all the way to the first scan level (otherwise it may only show the P). Some of the information may have been entered from the details of your proposal and should be read-only.

  A small plus-sign (+) icon in front of a project or catalog means that there are items defined within that item; click on it to expand and display a tree-view of these items. For example, clicking on a plus-sign icon in front of a project (orange P) will expose, or "expand", a list of PBs in that project, etc. Clicking a small minus-sign (−) icon will hide, or "collapse", all content within that item.

  Above the project list and each of the source and resource catalog lists, there is an **icon menu**. In the SCT case this icon menu will be located between a source search tool (on top) and the source catalog list below it. These icons can be clicked to save, cut/delete or copy/paste entire PBs, SBs or scans, or (re)source catalogs or (re)source groups. The options of this icon menu only act on the items in the tree, not on the items in the main editing window. In contrast to the small icons in front of a tree item, plus-sign and minus-sign icons in the icon menu expand or collapse the *entire tree* under a selected (highlighted) item. Arrow icons in the OPT, visible whenever a scan is selected, move items around in a tree. Navigating between projects, blocks and scans in the OPT is simply done by selecting (click to highlight) any such item name in the tree. Similarly one can navigate between a tool's catalogs and groups in the left hand side column trees (in SCT and RCT).

- SCT (Sources)

  At the top of the left hand side column of the SCT is an interface to search for sources. The source search is performed on a *source name only* in the selected source catalog (highlight it by clicking) in the list of catalogs in the bottom part. Alternatively, the source is looked up in the SIMBAD data base when the external search field and button are used. Check the alias box if you have not entered the name of the source in the selected catalog, but e.g. its 3C name. Use "Advanced Search" if you want to search on something else than a source name in a single catalog.

  In the bottom part of the left hand side column of the SCT, there should be at least one source catalog visible in red italics, namely source catalog "*VLA*", containing the VLA calibrator list. There may be other source catalogs visible, in particular calibrator lists from other telescopes and catalogs that you have defined yourself. Catalogs in red italics are read-only. Small plus-sign icons mean that there are groups of sources defined within a catalog; click on it to expand and display these groups. Groups may also contain (sub)groups that can be expanded.

- RCT (Instrument Configurations)

  At least one resource catalog is visible in the RCT resource catalog column, in red italics, namely resource catalog *"NRAO defaults"*. It contains the NRAO default hardware/instrument settings as closely as applicable defined as in the VLA Jobserve scheduling program. Other resource catalogs may be visible, i.e., if any were defined previously. The same editing and navigation rules apply as for SCT catalogs, e.g., catalogs in red italics are read-only.

More on manipulating PBs, SBs and scans in the OPT, manipulating (re)source catalogs and (re)source groups, and using the source search tool can be found in following chapters.

The main editing window, or manipulation field, exposes different information fields per tool. However, the SCT and RCT in first instance both show a very similar table of catalog contents, i.e., a table of entries in the selected catalog or group. First we describe the OPT case as it is the first you will see when logging in to the OPT web application.

OPT When a project is selected (highlighted), the main project (etc.) manipulation field will show the details of this project (and PB, SB or scan details on underlying levels). Most of this upper level information may have been entered and fixed (read-only) by the Proposal Scheduling Committee (PSC) or other NRAO staff. The information in this OPT window will be different according to the item that is selected. If instead of a project a PB is highlighted, information on array configuration (for EVLA projects) and underlying SBs appear. The information on selecting a SB is spread over three pages, each accessible via its own tab at the top of the main window (in this case *SB Details* with e.g. LST start time, *SB Summary* with e.g. a scan list, and *Generated Script* with the "Submit Schedule" button). Selecting a scan deploys another three or four tabs in the main editing window.

SCT Selecting a source catalog or group within a source catalog in the SCT will show the sources in this catalog or group in the form of a table listing in the main source manipulation field. If the list contains more than 25 sources, this list will occupy multiple pages, which can be browsed using the page selection buttons at the bottom of this table in the main window. Instead of 25, one can select a higher number of entries per page at the top of the page. The source table contains a source per row with a check box, an editing icon (), a field for the source name, and the coordinates. The coordinate frame used for display in the table is listed above the source table, and may be re-selected. A button "[>>>]" at the top right hand side corner expands the table with extra source information. A "[<<<]" button hides this information.

RCT A selected resource catalog or group within a resource catalog shows a similar table listing in the main resource manipulation field, but now with resources. Again, initially there are up to 25 entries per table (i.e., per page) shown, and the different pages are navigable using the buttons at the bottom. The resource list contains a resource per row with a check box, an editing icon, a field for the resource name, the telescope, frequency band and back-end of the resource, and a field for user comments.

More on manipulating block and scan information, or on manipulating (re)source information can be found in following chapters.

1.3 Suggestions, help and contact

The remainder of this document concentrates on a cookbook-like hands-on detailed description of the OPT, SCT and RCT. However, before digging into this, we already here want to mention that we are interested in your comments and suggestions on improving this document (and the OPT web application) for future users. Also, if you find yourself stuck and need help with the tools, if you have excessive problems with web interface issues or if you just need some hints or pointers for optimal user convenience, we can be contacted by email: send your message to vlahelp@nrao.edu . Please use "OPT" in the subject line, preferably at the beginning.

As all of this will be new to you and fairly new to us as well, please

do not wait until the last moment to schedule your observations!

The same holds when asking for help. If possible, we suggest that you start at least two weeks before your planned observations, allowing enough time to address any scheduling problems and possible bugs in this new software. We may need to do a short test observation and analyze the results before your schedule is approved, which of course takes extra time.

1.4 First things first: before you start

It is suggested you pay attention to the following guidelines. We list them here in some preferred order to allow you to avoid the most obvious problems. Of course you can change the order of items listed here, but so far our limited experience with this new tool indicates that the order below in general is a good way to proceed. Also, we have set up this manual to make you familiar with the tools, features, possibilities, concepts and practicalities in a relatively natural way, so that a next step becomes almost intuitive. (This of course is due to an excellent effort of the programming staff! which were helped by detailed comments from scientific staff.)

1) Collect proposal information to remind yourself the details of your observing proposal. It is good to have your proposal handy; it should be available in the Proposal Submission Tool (PST; accessible from the NRAO user data base just like the OPT web application) if you have not printed a copy already. For continuum observations you will need the positions of your target sources (and calibrator sources if you specified them) and frequency bands of your observations. For spectral line observations you also need either an exact sky frequency or a combination of rest frequency, velocity and velocity reference frame information on your target sources, a bandpass calibrator and the details of the correlator setting.

2) Collect post-proposal information and check the comments of the PSC; they may have given you advice on technical limitations on current developments, probably assigned you a technical contact person, and perhaps determined a fixed observing date and/or limited your requested observing time. As guide lines on the "EVLA returns" page may have changed in the meantime, it is also wise to reread the EVLA returns page (http://www.vla.nrao.edu/astro/ and referenced links therein). Another good resource on current information about the (E)VLA is the Observational Status Summary (http://www.vla.nrao.edu/astro/guides/vlas/current/), and the (E)VLA web pages in general (http://www.vla.nrao.edu/astro/). Ask your assigned technical contact person if you have any questions (or email vlahelp@nrao.edu if you can't reach this person).

3) Outline the project in terms of program/scheduling blocks as at this stage it is not completely known what information from the PST is transferred to the OPT web application (and thus fixed and read-only for you). This read-only information will likely be the project code, PB and allocated time, and possibly (at some stage) array configurations, SBs, and (re)source catalogs.

You should at least figure out how many SBs you need and which sources with which resources you want to observe in each SB. Note that you can reuse the same SB if the only difference in SBs is having multiple observation runs of the same source/resource combinations to increase the observing time on your target source beyond the time your target is above the horizon.

1.4.1 Directly after logging in to the OPT web application

The page shown directly after logging in to the OPT web application should be the OPT front page with your project tree consisting of a PB, an (empty) SB and an empty first scan. Some information on this page should be already filled out and read-only. Check this information with the information you gathered in the previous section

and inform us as soon as possible if you think there is an error in any of these fields; the sooner you check this the sooner we can have it corrected, and the sooner you can start struggling with the tool... Fortunately, it most likely won't be that complicated, but it is a good idea to allow yourself ample time to get used to the tools and to let us help you with your questions.

For the remainder of this document, we'll guide you through the different components to create an observing schedule in the following chapters. As it seems that the RCT is the easiest (for now, which probably changes with the new WIDAR correlator), we'll start with that one. The SCT and OPT use many features or concepts that are similar to the features or concepts in the RCT, so that should help to get to know the other tools. As the OPT must use information defined both in the SCT and in the RCT, we'll continue with a chapter on the SCT before the chapter on the OPT. The chapter after the OPT deals with some common problems we already have encountered, so check there first if you, e.g., find yourself bumped out of any of the tools.

If at any time you wish to exit, use FILE - SAVE ALL if there is work done on catalogs or projects that you want to keep. A dialog box asking whether you want to save changes if any unsaved changes remain will pop up if you exit using FILE - EXIT. Note that if you navigate from one tool to another, using the links in the "navigation strip", your changes in the tool you are leaving will be automatically saved.

As an advance hint on user friendliness, it is a personal experience that it is convenient to keep the RCT and SCT catalogs or groups as compact as possible because you need to select from these catalogs in the OPT. That is, it is best to keep only the sources and resources you want to use in a single SB in a (group in a) catalog. What is meant by this and why will become clear later on.

1.5 Recap

This chapter should have made you familiar with the purpose of this document, accessing and exiting the OPT web application, its page layout, navigating between the OPT, SCT and RCT components, and their tree structures in the left hand side column. You should understand what a SB (scheduling block) and a resource is, know where to find help and how to prepare for creating an observing schedule.

Chapter 2

Using the RCT, the Resource Catalog Tool

Assuming you already have successfully logged in to the OPT web application, look for the navigation bar at the top. If “Instrument Configurations” is not in bold face, but in normal font and underlined, click it with your mouse button to navigate to the RCT (Figure 2.1).

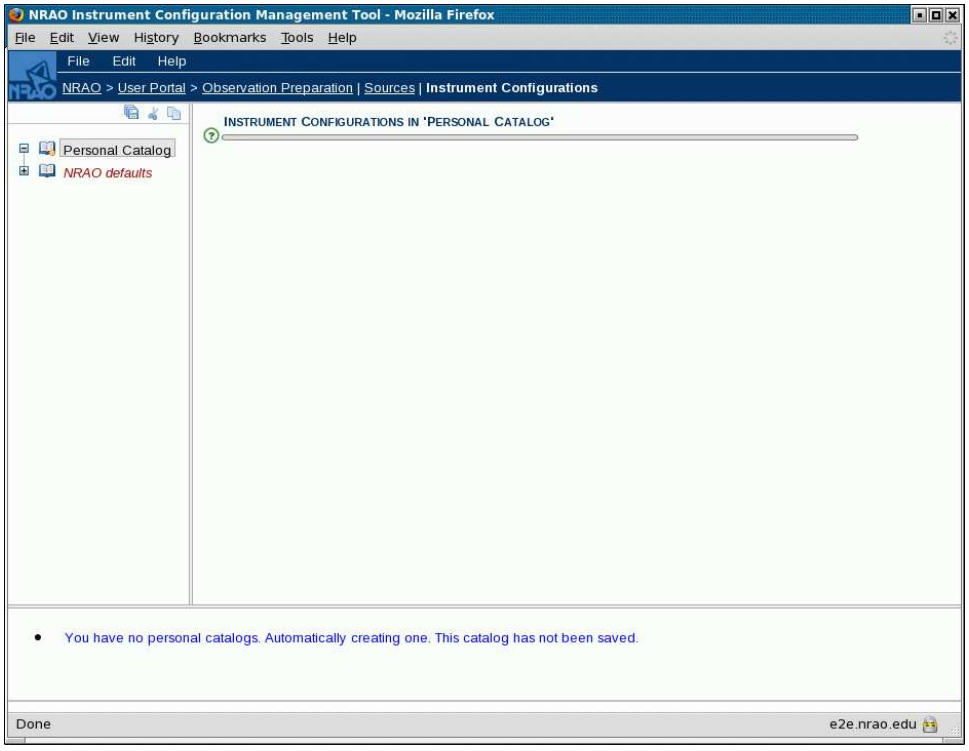

Figure 2.1: Web browser screen shot of the RCT opening page.

2.1 Orientation

A short introduction to the layout of this tool’s page has been given in the introduction (Chapter 1). There should be at least one “NRAO defaults” catalog visible in the left hand side column, the catalog browser. For orientation and to get a feel for the tool(s), it is instructive to walk through this catalog. After this orientation it should be almost intuitive to create your own personal resource catalog(s) which you will use in your project’s SB scans.

2.1.1 Example of a resource catalog: the “NRAO defaults” catalog

The “NRAO defaults” catalog is a collection of hardware and instrument configurations (front-end receivers, VLA correlator integration time plus IF and lag channels, frequency tuning, etc.). They have been used previously to perform VLA continuum and spectral line observations. Empirically these configurations have been determined to be good standards for observations in the VLA era, i.e., using the receivers and correlator available to the observers before the EVLA upgrade started. These defaults, except for Ka band, were already available in the Jobserve (and observe) VLA scheduling software and are mostly useful for VLA continuum bandwidth observations. Because this proposal round still uses the old VLA correlator, even though with some new EVLA receivers, we have retained these defaults in the RCT. This also allows the user to become familiar with the RCT using well-known VLA settings.

Note that “NRAO defaults” is in red italics, which means that this catalog is read-only. The plus-icon in front of the open book icon (📖) indicates that this catalog includes sub-catalogs which are referred to as “groups”. A catalog does not need to contain groups, but at some point it may be more convenient to have them. If you click the plus-icon or “NRAO defaults” these groups will appear in the catalog tree. If you clicked on “NRAO defaults”, you will also see a table of contents of the highlighted “NRAO defaults” catalog in the main RCT window, the big field to the right hand side of the catalog column. This table list combines the contents of the groups and possible entries in the catalog that do not belong to a group (though in this case there are no such free-agent entries). Groups are, e.g., “VLA C band” and “EVLA Ka band”. When highlighted or selected using the mouse button, the right-hand side window with the table of contents will only show the resources which were grouped in this sub-catalog. For example, selecting the “VLA C band” group will now only list the NRAO default resource for C band continuum observations. Similarly, the “EVLA Ka band” will show the (new) NRAO default resource for Ka band continuum, with additional useful resources for pointing scans in X and Ka band (see below).

2.1.2 Catalog tables in the RCT, but also in the SCT !

Click “NRAO defaults” in the left-hand side column to return to the “NRAO defaults” catalog. The table at the top of the main RCT editing or manipulation window (Figure 2.2 has a header line with obvious meanings. (If not, we should have supplied a fly-over help tool-tip for it; the tool-tip help shows up when the mouse hovers over the item for a second or so.) When you move the mouse over the headers you will see that they switch color to orange. Every table column with a header showing this behavior can be sorted by clicking the header. This is so for all other tools as well. A table with more than 25 entries may span multiple pages. All pages in the catalog are used in the sorting which means that catalog entries may move from one page to another. When a column is sorted, it will show a small orange arrow next to the header name, pointing up if the column is sorted in ascending order (going to larger values when going down in the table), and pointing down when the sorting is in descending order. A sorted table can be re-sorted in the opposite direction by clicking the column again (note that the header of a sorted column, the one with the arrow, might not change to the orange color anymore).

Each line in the table represents one resource with a name and some descriptive information. A line starts with a tick-box and an icon. The tick-boxes can be used to select one or more entries in the catalog for copy/paste as described in the next section. A shortcut to select all, or to deselect all catalog entries *on the current page* can be found above the table. Selecting and copy/paste has to be redone for every page. The icon is used to access the details of the resource entry in the catalog, i.e., the specifics of the hardware and instrument configuration.

2.1.3 Show and edit catalog entries in the RCT and in the SCT

The resources for continuum observations and for spectral line observations are similar but different, and therefore each is discussed separately below. Remember that the resources in this “NRAO defaults” catalog are read-only, and selections are hard coded. Entries therefore appear slightly different from entries in a personal resource.

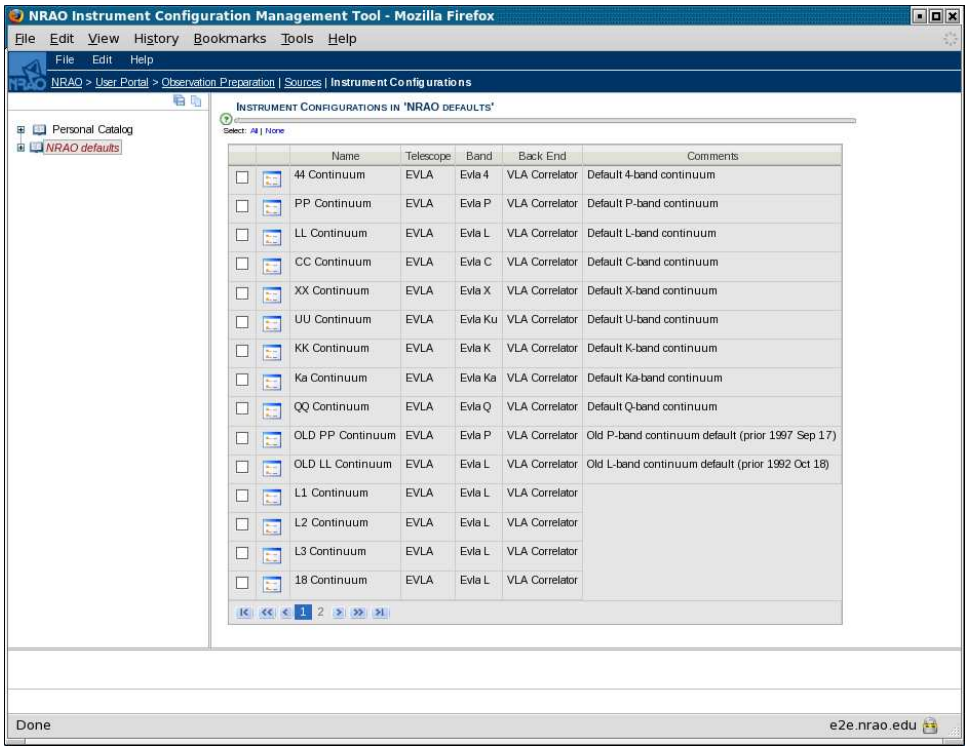

Figure 2.2: Web browser screen shot of the RCT when “NRAO defaults” is selected.

Continuum resources

As an example of a continuum resource, click on the icon (with fly-over help tool-tip “Show/Edit properties for this catalog entry”) in front of the “CC continuum” resource to see the user selectable hardware and instrument options used in this resource. To get to “CC continuum” when “NRAO defaults” is highlighted, navigate through the table, or select group “VLA C band” in the left hand side column.

The information displayed is the resource summary in the table on the top, followed by the correlator integration time (3.3 seconds) and correlator mode (Continuum), and finally a table with the remainder of the IF setting. That is, 50 MHz bandwidth is selected for both IF pair AC and IF pair BD (as shown by the ticked circles; using VLA bandwidth code 0 if you are familiar with that). Furthermore, the bottom of the table shows that IF pair AC is tuned to a fixed sky frequency centered on 4.8851 GHz and that IF pair BD is tuned to a fixed sky frequency centered on 4.8351 GHz.

Navigate back to the “NRAO defaults” catalog either by clicking “NRAO defaults” in the catalog column tree, or by clicking “Return to NRAO defaults” (or “VLA C band”, depending on how you got there) at the top of the page. Please do not use the browser “Back” button anytime.

Spectral line resources

As an example of a spectral line resource, select resource “OH Line” in the “VLA L band line” group (Figure 2.3). The differences with continuum resources are:

- a different correlator mode, in this case mode 2AD
- an extra table, following the correlator mode, with channel processing options, here Hanning smoothing
- in the final table, an extra column with number of channels per BW code, here 127 for BW code 6

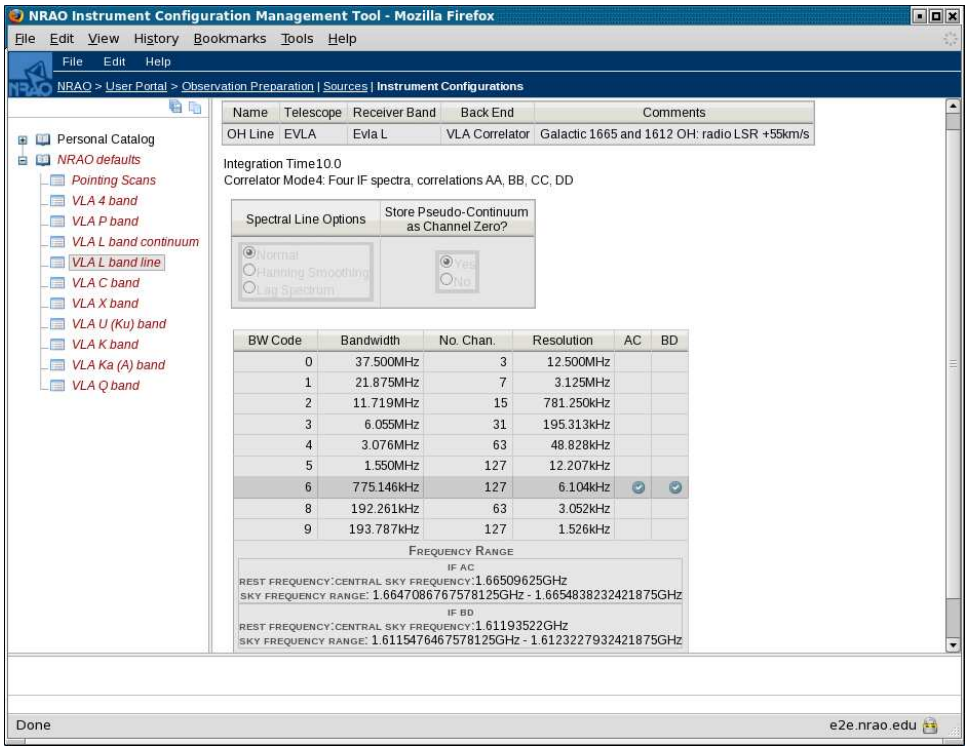

Figure 2.3: Web browser screen shot of the “OH Line” resource.

- in the final table, an extra column with frequency separation of the channels per BW code, here 775 kHz

Because the correlator mode is 2AD, it uses IF A and IF D. Each of the AC and BD IF pairs thus needs a tick for a BW code setting – they need not necessarily be the same. The bottom of the table shows that IF A (pair AC, but IF C is not used in this correlator mode) is centered on the 1665 MHz mainline of the rotational ground state transition of OH, and that IF D is centered on the 1612 MHz satellite line. In this particular case the lines are observed as fixed sky frequencies, not Doppler tracked (don’t ask why). Note that Doppler tracking or not in the OPT is part of the resource catalog, whereas in Jobserve this was part of the user defaults (on a scan level); the OPT has no scan-level user defaults.

2.2 Creating a personal resource catalog

Even when you are planning simple continuum observations at default VLA frequencies only, and thus all anticipated resources are already defined in the “NRAO defaults” catalog, it is strongly suggested that you make separate personal catalogs for your different PBs/SBs. Not only will the reason become clear later on, it also creates an opportunity to get used to the tool and you will find that scheduling using small catalogs will be faster over the web interface. If you plan a spectral line observation, it is instructive to read the continuum case first as this saves repeating information. Resources for continuum and spectral line observations may be mixed in the same resource catalog and resource group.

After creating a (re)source catalog, the new information needs to be saved in the data base. Upon FILE - EXIT, if there are any unsaved changes, a dialog box will appear with the question whether to save the changes or not. Navigating between the tools will implicitly save changes in the tool you are moving away from. To be absolutely sure your changes are saved, use FILE - SAVE ALL before exiting or navigating to another tool (or at any other convenient occasion). If in the meantime your session has expired, you will find an “Autosave: ..” catalog (with the same name of the catalog that had unsaved data) that contains the unsaved changes at the moment your session

expired; you have the option to continue with that catalog and delete the old catalog, or start with the old catalog and simply delete the "Autosave: .." catalog. In the former case you may rename your "Autosave: .." catalog using EDIT - CATALOG PROPERTIES.

Frequency bands may not exactly be what is selectable in the resource summary "Band" in the table at the top of the page. It is known that some receivers are "usable" beyond the nominal range given in the band selection. Always check the "EVLA returns" web page for the latest news, e.g., on the number of available EVLA receivers on the array. Table 2.2 lists the anticipated extended (1dB) and extreme (3dB) ranges for currently available EVLA receivers (see the VLA Observational Status Summary for VLA receivers).

Band	Lowest (3dB) GHz	Lower (1dB) GHz	Low (nominal) GHz	High (nominal) GHz	Higher (1dB) GHz	Highest (3dB) GHz
L						
C		to				
K			be			
Ka				filled		
Q					out	

2.2.1 Continuum resources

Before creating or modifying anything it is a good idea to save what you have now; in the icon menu click the left-most icon (Save projects/catalogs in this tree), or use FILE - SAVE ALL.

Suppose your SB consists of VLA continuum observations in C band and in L band, and that you want to populate your personal catalog in first instance with these default continuum resources. For this particular example, this is what to do:

- Make sure you have navigated to the RCT.
- From the top menu strip, select FILE - CREATE NEW - CATALOG.
- A white dialog window shows up on the top left; name your catalog and press [ok].
- Make sure your new catalog in the tree is highlighted (or select it). The tiny yellow dot on the open book icon indicates that there are unsaved changes in this catalog.
- At this stage you can opt to group your resources. This is not necessary, but convenient if you are going to have many resources. If you want to group resources in this catalog, select FILE - CREATE NEW - GROUP, name your group and press [ok].
- Select the "NRAO defaults" resource catalog.
- In the resource table to the right (main editing window), check "CC Continuum" and the L band continuum options you want (LL, L1, L2, L3, OLD LL, 18, 21, or HH Continuum). If you don't know which L band resource to select, study the details of each before selecting one, or simply select all.
- From the top menu strip, select EDIT - COPY - COPY INSTRUMENT CFGS..
- Select your newly named resource catalog (or group within it).
- From the top menu strip, select EDIT - PASTE - PASTE INSTRUMENT CFGS.. The resources now show up on the right hand side
- This can also be achieved by copy/paste of entire groups and/or entire catalogs using the top menu strip options or the menu icons at the top of the (left hand side) resource catalog column. Use the fly-over tool-tip help to identify the proper icon for each action.

- Maybe you want to check the resource properties using the "Show/Edit" icon for each catalog entry, *especially if you copied one of the spectral line resources* as you would probably want to change the sky frequency to a rest frequency (to be used with Doppler tracking). You can also reorganize your resources by adding groups (FILE - CREATE NEW - GROUP) and move your resources around using the column icon menu, or using EDIT in the top menu strip. Unwanted resources can be deleted using "Cut".
- If you are unhappy with the name of the catalog or group you can always rename it using the top menu strip: EDIT - CATALOG PROPERTIES or EDIT - GROUP PROPERTIES.
- From the top menu strip, select FILE - SAVE ALL. This can also be done by clicking the left-most icon from the icon menu at the top of the resource catalog column. Notice that the interface feedback strip on the bottom shows "Saved catalog ..." in blue font.
- Check that the little yellow dot on the open book icon has gone (otherwise your catalog was not saved).

If you want to change some parameters, choose the relevant items in the next list. This list is the list of items in order to create your own resource from scratch:

- Make sure you have navigated to the RCT.
- From the top menu strip, select FILE - CREATE NEW - CATALOG.
- A white dialog window shows up on the top left; name your catalog and press [ok].
- Make sure your new catalog in the tree is highlighted (or select it). The tiny yellow dot on the open book icon indicates that there are unsaved changes in this catalog.
- At this stage you can opt to also group your resources. This is not necessary, but convenient if you are going to have many resources. If you want to group your resources in this catalog, select FILE - CREATE NEW - GROUP, name your group and press [ok]. Next, select your group.
- From the top menu strip, select FILE - CREATE NEW - INSTRUMENT CONFIGURATION. You will be presented with a blank-slate resource page.
- In the first table on top, name your resource, select an observing band and enter some descriptive information in the comments field. The latter will be useful at some stage, really.
- Choose a correlator integration time, or leave it 3.3 seconds if you don't really care.
- For this continuum observation you typically would want to keep the correlator mode set to "Continuum". Low frequency observers who want to observe so called pseudo continuum would set up a spectral line observation at a fixed sky frequency as described in the next subsection.
- For this continuum observation you typically would want to keep the BW code set to "0", i.e., the maximum of 50 MHz bandwidth per IF. Observations close to RFI, or observations that scientifically require narrower bandwidths would have the user set a different IF bandwidth for each of the IF pair AC and BD. To select a bandwidth different from 50 MHz, simply click the blue circle of the desired option in the AC and BD columns. Selections for AC and BD need not be the same.
- For IF pair AC and BD, enter the frequency (and unit) you require at the center of the band you wish to observe at. Unit-less frequencies are assumed to be in Hz. Check your frequencies!
- For this continuum observation you typically would want to keep the frequency as a central sky frequency (tick mark in front of "central sky frequency", not in front of "rest frequency"). The frequency range of this setting will be reported below the field you just entered. There may be scientific arguments that would require to observe in a very narrow continuum band on a line. This line then needs to be Doppler tracked and therefore one would select "rest frequency"; a frequency range is dependent on the actual calculated sky frequency and thus not reported here.
- Check your resource, from top to bottom. If you create more than one resource, check each of the resource properties using the "Show/Edit" icon for each catalog entry. You can also reorganize your resources by adding groups (FILE - CREATE NEW - GROUP) and by moving your resources around using the column icon menu, or using EDIT in the top menu strip. Unwanted resources can be deleted using "Cut".

- If you are unhappy with the name of the catalog or group you can always rename it using the top menu strip: EDIT - CATALOG PROPERTIES or EDIT - GROUP PROPERTIES.
- From the top menu strip, select FILE - SAVE ALL. This can also be done by clicking the left-most icon from the icon menu at the top of the resource catalog column. Notice that the interface feedback strip on the bottom shows "Saved catalog ..." in blue font.
- Check that the little yellow dot on the open book icon has gone (otherwise your catalog was not saved).

Incorrect or unfinished template resources – the ones which generate red errors in the interface feedback strip – may be saved for future use. They will however not be usable when assigned to a scan in the OPT. The resource first must be fixed in the RCT after which it can be assigned to a scan in the OPT. Resources with warnings can be assigned to a scan, but the warning should be understood before continuing with OPT scheduling. This behavior also applies to sources in the SCT.

Regardless of how you create (or how NRAO fills) your (re)source catalog entries, make sure they are correct before you continue with using them in the OPT. Unlike Jobserve, the OPT does not have the "User Defaults" capability; when you have modified a resource you have to use the OPT to reassign the new resource separately to every source that needs it. Also, "global edit" has not yet been implemented. Check your catalogs before making scans!

Options from the menu strip and icon menu

In the previous recipes some usage of the options in the menu strip were given (e.g., FILE - CREATE NEW - CATALOG). The menu strip options under FILE and EDIT are grayed out or missing if that particular option is not valid for the current selection (highlighted item in the catalog tree in the left hand side column). If the action you want to perform shows up as an invalid option (e.g., EDIT - GROUP PROPERTIES to change the name of your group of resources) this usually means that you are not at the right place in the tree (e.g., not in the group, but in the upper level catalog). The names of the actions are quite self-explanatory, so we only list them for reference:

FILE	CREATE NEW	CATALOG	EDIT	[ADD TO GROUP]	
		GROUP		[REMOVE FROM GROUP]	
		INSTRUMENT CONFIGURATION		CUT	CUT CATALOGS
	SAVE ALL				CUT GROUPS
	EXPORT...				CUT INSTRUMENT CFGS.
	IMPORT...			COPY	COPY CATALOGS
	EXIT				COPY GROUPS
					COPY INSTRUMENT CFGS.
				PASTE	PASTE CATALOGS
					PASTE GROUPS
					PASTE INSTRUMENT CFGS.
				CATALOG PROPERTIES	
				GROUP PROPERTIES	

A similar list of menu strip options is available in the SCT and OPT, but with options specific to the tools - we will present those lists in the SCT and OPT chapters. Menu strip options may act on both items in the left hand side column as well as items in the main editing window.

The icon menu is the line of little icons at the top of the resource catalogs in the left hand side column. They have the same functionality as the options from the menu strip, although not every menu strip option is represented as they are not used as often. Only valid actions will have an icon in the menu, i.e., pasting an item may only be performed after copying or cutting the item first – until then the paste-icon will not appear. Hovering over an item with your mouse will display a fly-over help tool-tip to remind you of the action attached to the icon, but we also show them for reference below:

- Save projects/catalogs in this tree
- Cut (or delete) selected tree item
- Copy selected tree item
- Paste selected tree item

The same icon menu can be found in the SCT; for the OPT we will present extra icons for more options related to ordering scans in the OPT chapter. Remember that these icons only act on left hand side column items.

2.2.2 Spectral line resources

Creating a spectral line resource is very similar to creating continuum resources as outlined above, except for the extra choices for the correlator mode, IF channel setting and exact frequency tuning. There are some hints to spectral line features in the recipes in the previous section. In the grand scheme of end-to-end operations, resources with the requested correlator settings may be pre-filled from information submitted to the PST during the observing time allocation procedure. However, at this stage none of this has been implemented.

The "NRAO defaults" resource catalog contains a few spectral line resources. If they appeal to you, you can copy/paste them in a personal catalog just as for the continuum resources above and edit them as needed. Check the spectral line resource properties very carefully as the spectral line resources in the "NRAO defaults" have a fixed sky frequency whereas you probably want to use a rest frequency in combination with Doppler tracking. Most likely, however, you will opt to create your own resource from scratch, just like creating a continuum resource previously. Some items that may need extra attention are described below.

The correlator mode and other details should have been specified during the proposal submission stage. You may have received alternate suggestions by the PSC. In short, if this is not a continuum resource, you implicitly would have selected a mode for the correlator input signals in your proposal; a single (RCP or LCP) or dual (RCP and LCP) observing polarization, and one or two tunable observing bands (IF pairs) at this polarization. The correlator accepts a selection of a single IF (mode 1A–1C), two IFs (the pair A+C or B+D for mode 2AC or 2BD, or a mix of combinations for one IF from either A or C and one from B or D for all other 2 IF modes), or four IFs (mode 4, which feeds signals from both IF pair AC and BD to the correlator). If cross-correlations between the polarizations are requested in the output visibility data set, either IF pair AC or BD is used (mode PA or PB). Optionally the spectrum can be on-line Hanning smoothed or a lag spectrum can be requested. Selecting the correlator mode (and possibly extra options such as Hanning smoothing) will expose the available combinations of a total bandwidth, number of channels and channel separation per IF in the next table.

The bandwidth code or IF pair bandwidth and channel setting is selected by checking (ticking) the blue circle ( ) for the activated IF pairs for the correlator setting you require.

Frequency tuning and frequency definition ("sky" or "rest") need to be set at the bottom of the table. Also supply the unit with your frequency (Hz, kHz, MHz, GHz), otherwise it assumes Hz by default. Select and enter the "Rest Frequency" if you anticipate Doppler tracking on a spectral line, or "Central Frequency" if you know your exact sky frequency and do not want to apply Doppler tracking. Note that for Doppler tracking you need a velocity and reference frame, which you assign to the source in the SCT, or which you enter for each scan in the OPT.

2.2.3 Additional resources

The previous subsections on resources were dealing with resources defined to do the scientific astronomical observations you proposed for. However, to get the most out of your data, it sometimes is helpful to add some specialized scans to the SB in order to optimize the observations or to aid in the calibration of the instrument.

Typical for high frequency (higher than $\sim$ 15 GHz) are pointing scans and tipping scans. The observing mode for such scans (pointing or tipping) is selected at the scan level in the OPT. For pointing scans, typically one would use resources that are different from your scientific observation resources, e.g., a different bandwidth, correlator setting, or even a different observing band. We have added some of these resources to the "NRAO defaults" catalog, available to the OPT at the scan level or to copy/paste to your personal resource catalog.

Pointing scans are used to improve telescope pointing accuracy which increases the sensitivity of the observations. As the instantaneous telescope pointing is only accurate to several arcseconds, this error may become a considerable fraction of the primary beam at high frequencies. Solving for this error is done using "primary" pointing scans on a strong source at X band, after which a "secondary" pointing may be performed at the observing frequency. The actual pointing action is selected as "Interferometric Pointing" under "scan mode" in the scan details (see OPT), which may use the resources named "Pointing" presented in the "Pointing Scans" resource group in the "NRAO defaults" resource catalog.

Tipping scans are used to obtain a measurement of the atmospheric opacity at high frequencies, which allows for an estimate of the loss of sensitivity due to absorption of emission from the source of interest by the atmosphere. The actual telescope tipping action is selected as "Tipping" under "scan mode" in the scan details (see OPT). Because you typically want to do tipping scans at your observing frequency you would either use resources from the "NRAO defaults" catalog or you would reuse your own resource at the frequency you want; no new resources are needed.

2.2.4 Resources at Ka band

Currently there is an issue with specifying the frequency of IF pair AC at Ka band. That is, tuning any part of the AC IF pair band below 32.24 GHz will not result in valid data. Only the BD IF pair can be tuned to frequencies below 32.24 GHz; use the BD IF pair instead of AC IF pair when you only need one IF pair for your resource with a frequency tuning below 32.24 GHz. If the OPT web application validation detects that any part of the bandwidth of IF pair AC is tuned below this 32.24 GHz it will try to swap the AC IF pair with the BD IF pair. If this is not possible, it will issue an error (in red font) in the interface feedback strip if this frequency is specified as a fixed sky frequency. It will issue a warning (blue font) for rest frequencies, as the particular tuning depends on the details of observing date, telescope pointing direction and source velocity definitions. Note that a rest frequency above 32.24 GHz may shift to below 32.24 GHz once it is assigned to a scan in the OPT. This should give you an error in the OPT; you should be aware of this possibility and pay attention to this. However, it is better to assign IF pair BD to the resource if you anticipate this might happen, if you still have this freedom in your resource of course.

The very wide bandwidth of the Ka band receiver, from 26.5 to 40 GHz, would suggest that IF separations of up to $\sim$13 GHz are possible. Restrictions in the signal path, however, limit this separation to 10.5 GHz. The OPT web application validation will issue an error if the separation between IF pairs AC and BD is more than 10.5 GHz in sky frequency (with IF pair AC tuned the higher frequency one). A separation of more than 10.5 GHz in rest frequency will result in a warning as, e.g., highly red-shifted lines may end up with less separation when the actual sky frequencies are calculated.

2.3 Sharing catalogs

Of course you would want to avoid having to recreate all resources (and sources and projects, etc.) if you decide to delegate scheduling by, or accept scheduling for another co-investigator. For this purpose there is the option to export and import the catalogs (and projects) through locally saved files. When saved locally you have all freedom to communicate and share with your co-investigators. You would want to check your catalogs for correctness if you aren't absolutely sure you have already done so before saving. Exporting unused catalogs and projects (which later can be imported if needed) also keeps the information contained in the OPT web application limited which

will speed up the operation over the web. From the top menu strip select FILE - EXPORT or FILE - IMPORT to interact with a dialog window. All dialog boxes in any of the tools can be moved around by dragging the dialog box header to a new part of the browser window. The default OPT web application file transfer export or import format is XML. The upload field or pressing the download button will interact with your local computer environment according to your browser upload and download rules.

2.4 Recap

This chapter should have made you familiar with resources, tables and sorting columns in tables, using copy/paste and other options from the menu strip and icon menu while creating resources, how changes are saved and how to share your catalogs and projects with your co-investigators, etc.

Chapter 3

Using the SCT, the Source Catalog Tool

Assuming you already have successfully logged in to the OPT web application, look for the navigation bar at the top. If “Sources” is not in bold face, but in normal font and underlined, navigate to the SCT (Figure 3.1).

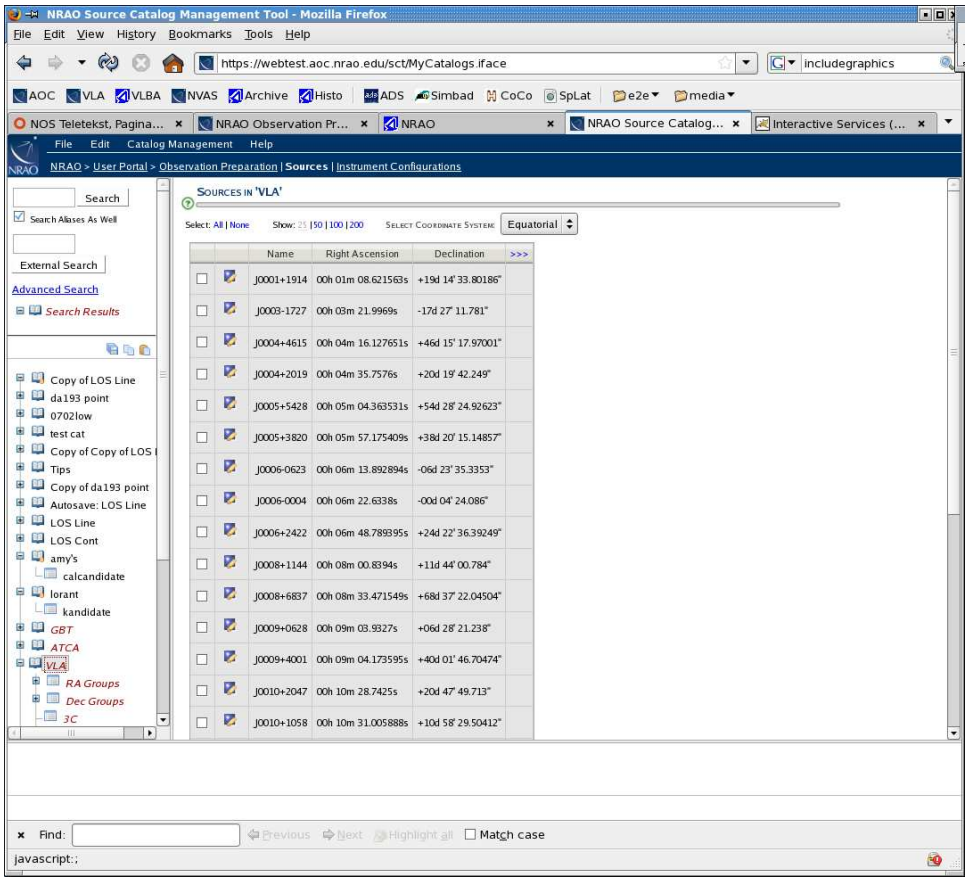

Figure 3.1: Web browser screen shot of the SCT opening page.

3.1 Orientation

A short introduction to the layout of this tool's page has been given in the introduction (Chapter 1), and more details on some of the features to expect were presented in the RCT tour (Chapter 2). It is assumed that the contents of these chapters are familiar. There should be a source search tool at the top in the left hand side column and at least one "VLA" catalog visible in the catalog browser in the bottom part (Figure 3.1. Like for the RCT, for orientation and to get a feel for the tool(s), it is instructive to walk through this catalog. After this orientation it should be almost intuitive to create your own personal source catalog(s) which you will use in your project's SB scans.

3.1.1 Example of a source catalog: the "VLA" (calibrator) catalog

The "VLA" catalog is the VLA calibrator list, a collection of radio sources also available in the Jobserve (and observe) VLA scheduling software. Browsing this source catalog is instructive to become familiar with the information available for sources. The basic catalog rules, use of icons, browsing, table viewing, and the mechanics of creating and editing of source catalogs is almost identical to that of the RCT tool. The source search tool is an extra feature, and the presentation of information in the main editing window differs from the RCT due to the use of page tabs (see below).

The "VLA" source catalog is in red italics and has a plus-icon in front of it. You know this means that this catalog is read-only and has groups. If you click the plus-icon or "VLA" these groups will appear in the catalog tree, and you will see that the "RA Groups" and "Dec Groups" also have (sub)groups. Clicking "VLA" differs from clicking the plus-icon in that it will expose the total content of the catalog in the main window, with 25 sources per page, starting with source J0001+1914. At the bottom of the table (you may need to scroll down, e.g., using the window scroll bar), you will notice that the bottom line is a small page navigation menu. This "VLA" catalog contains more entries that fit on the page (25), and in this case is distributed over many pages. The menu icon buttons mean, from left to right:


first page of the catalog (or group)


10 pages backward in the catalog (or group), or as many as possible if less than 10 exist


previous page in the catalog (or group)

1, 2, .. individual page numbers in the catalog (or group), with the current page highlighted
click to select another page from this small list (up to ten page numbers) if desired


next page in the catalog (or group)


10 pages forward in the catalog (or group), or as many as possible if less than 10 remain


last page of the catalog (or group).

If you find the default of 25 lines per table page too few, you can change to a larger number of lines per page (50, 100, 200) on the top of the page. Every table column with a header turning orange when the mouse hovers over it can be sorted on using a click of the mouse button (like in the RCT tool). All pages in the catalog are used in the sorting which means that catalog entries may have moved from one page to another after a sort.

As a small exercise, use the navigation tools at the bottom to confirm that the catalog has 75 pages! Using the table header sort, confirm that the source with the most southern Declination is J1118−4634. With the "[>>>]" button on the top right hand side of the table you can view (or hide) extra information on the sources: flux densities at different frequency bands, UV-restrictions and aliases for the source in non-sortable columns. Above the table on top of the page, it is shown that the coordinates in the table are in the "Equatorial" coordinate system. If another coordinate system is selected, e.g., "Galactic", the positions are recalculated from the positions entered originally, which is indicated by a small red asterisk next to the coordinates.

Select a random source (not J1118−4634) and expose the source details (in the table, click on the editing icon before the name of the source of which you want to view the properties). The source properties in the main editing window are divided over three tabs, shown on top, labeled with the source's name, "Image Links" and "Notes". Each of these tab-pages has groups of information divided by a gray horizontal bar. Most of the useful information

is in the first tab, labeled with the source's name: the source name, its position, its velocity (if applicable) and its brightness (if applicable). Another useful piece of information is in the "Notes" tab, under "Notes". Press the blue circle with the white triangle/arrow to show the VLA calibrator manual entry for this source (and press it again to hide this information). This and some extra information in a different form is given in the same tab under "User Defined Values".

Other read-only catalogs may contain or use slightly different source properties and auxiliary information. In particular, the source names are those of the original catalogs; not necessarily according to the J2000 IAU convention as for the "VLA" catalog.

3.1.2 Searching for sources

Select the "VLA" source catalog. Source names follow IAU naming convention and aliases can be found by extending the table with the hidden columns (through [>>>]), or by viewing the source properties (through the editing icon). To find source 3C286 may take a while, even if you know this source is J1331+3030 in the IAU convention. Entering "3C286" in the source search tool in the upper part of the left hand side column will search the *selected* source catalog for the source *name*. If the "Search Aliases As Well" tick-box is not ticked, the search will only be matching for the name entered in the catalog (for "VLA" these are IAU names, but in your personal catalog you could have named your source "3C286" or "skippy", etc); it will only find this source in the "VLA" source catalog if "J1331+3030" is entered. Therefore the aliases tick-box is by default ticked, but because searching is done on partial strings you may want to remove the option if you otherwise expect many matches (e.g., if you are looking for your source matching on the string "C" and don't want all 3C-sources to appear).

Because the search is performed on a Searching on the partial string "−" (a minus sign), for example in the "VLA" catalog, will return a (16 page) table with all VLA calibrators with negative Declination (J2000), plus some extra sources with a minus sign in the name if you left the "Search Aliases" tick box ticked. A search on "1331+" will return 3C286 (as J1331+3030). Searches are not case sensitive. Two wild-cards are allowed: "?" and "*". They have the usual meaning of a single arbitrary character and any number of arbitrary characters, respectively. However, they are only useful between two other characters in the search string, as the search on `''string''` is automatically performed as a search on `''*string*''` (and an empty search string thus returns the whole catalog).

A source may also be obtained using the "External Search" if it is unknown to any of the existing catalogs. This search will be performed on the names, including aliases, in the SIMBAD data base, using the same search and character rules.

Advanced Search

The "Advanced Search" link (Figure 3.2) is used to search in an existing, selected catalog for other criteria than source name (or alias). A common example is to search for a calibrator at a position nearby your source of interest. This "Advanced Search" link will bring up a dialog box in the main editing window. In that window, select the catalog(s) in which the search should be performed, and select the table(s) with the required parameters by ticking the upper left tick-box of the relevant tables. Only when you tick a table, its options and editing fields become active. More than one catalog and more than one parameter table may be selected; the search interprets additional parameters as an "AND" condition.

A "Cone Search" searches a radius, entered in degrees, around a position (J2000). The resulting table should be sorted in increasing distance from the position, though you would want to check that; the table can be resorted if desired (by clicking the table header if it turns orange). Positions are interpreted as decimal degrees if not supplied as, e.g., "1h 37m [41.3s]" for R.A., and "[+]33d 9' [35"]", a group of three numbers separated by a space or a colon, or otherwise recognized as a sexagesimal entry. Always check the coordinates after entering each position or after pressing the "Search" button; it will replace your values with the interpretation of the validation procedure. *You should check these values;* the validation procedure will always be able to convert your entered values with these rules, but you are the only one to know whether the validation conversion is sensible! For example, if you

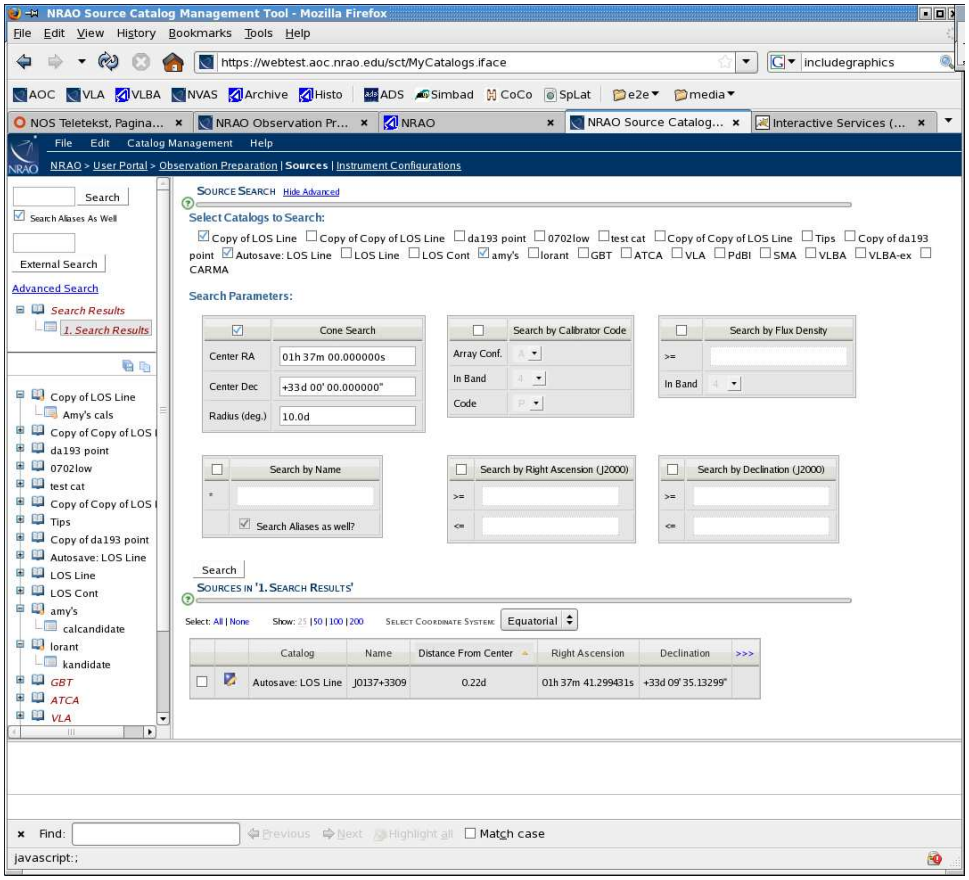

Figure 3.2: Web browser screen shot of the “Advanced Search” options.

type “01 37” in the R.A. field, i.e., without indication of hour or minutes, you will see that it ignores the space and interprets this R.A. as 137 degrees (9h 8m) – funny eh? We’re working on it.

Activating the “Calibrator Code” search allows to search for sources with a code *equal or better than* the code selected for a certain observing band and VLA array configuration.

A “Flux Density” search searches for flux densities above the given limit in the selected observing band. This is of course only useful when flux densities are included in the catalog(s) selected.

The “Name” search is the same search action with the same string rules as for the string entered in the top search tool in the left hand side column, with the difference that here more than one catalog can be searched, and that other constraints can be included.

The “Right Ascension” and “Declination” searches are performed on a coordinate range, with the equal or larger than (>=), or equal or smaller than (<=) operators on the given limits. It uses the same rules on entering positions as for the “Cone Search”. When both limits are given, the search returns the sources between the limits (i.e., you will see proper results for a search on sources with R.A. between 23 and 01 hours).

Search Results

Remember that a search automatically selects and switches to the “Search Results” catalog at the bottom of the search tool. The results of a search are displayed read-only in the familiar SCT table format in a “Search Results” tree structure with the possibility to sort on different columns. Except for the “Advanced Search”, previous searches are saved in this tree for convenience – navigating to a previous search is done by simply selecting that

search. Note that a search will always change from the selected catalog to selecting the search results. Before performing another search in the same catalog, re-select the catalog! Sources presented in the search results – or the whole "Search Results" catalog – can be selected, and added to a personal source catalog using copy/paste, etc. To delete the results of a search, select the "Search Results" catalog in the search results tree and use EDIT - REMOVE SEARCH RESULTS form the menu strip.

Search results when using the "Advanced Search" are displayed in a table at the bottom of the page and added in the "Search Results" tree if it is sufficiently new (i.e., not started from the "Search Results" page). Following searches, when not leaving the "Advanced Search" tool, will overwrite the current table with the new search results. Search results are cleared when you log out from the OPT web application.

3.2 Creating a personal source catalog

The icon menu between the source search tool and the source catalog list in the left hand side column was introduced in the previous chapter. Here the menu icons behave exactly the same as in the RCT. The fly-over help tool-tip will help remind you of their actions.

Also introduced in the previous chapter was the use of the options in the menu strip (e.g., FILE - CREATE NEW - CATALOG). The menu strip options in the SCT are slightly different, again with names that are quite self-explanatory about their actions:

FILE	CREATE NEW	CATALOG	EDIT	[REMOVE SEARCH RESULTS]	
		GROUP		[ADD TO GROUP]	
		SOURCE		[REMOVE FROM GROUP]	
		SOURCE POSITION		CUT	CUT CATALOGS
		SOURCE VELOCITY			CUT GROUPS
		SOURCE IMAGE LINK			CUT SOURCES
		SOURCE BRIGHTNESS			CUT SOURCE POSITIONS
	SAVE ALL				CUT SOURCE VELOCITIES
	EXPORT...				CUT SOURCE IMAGE LINKS
	IMPORT...				CUT SOURCE BRIGHTNESS
	EXIT			COPY	COPY CATALOGS
					COPY GROUPS
					COPY SOURCES
					COPY SOURCE POSITIONS
					COPY SOURCE VELOCITIES
					COPY SOURCE IMAGE LINKS
					COPY SOURCE BRIGHTNESS
				PASTE	PASTE CATALOGS
					PASTE GROUPS
					PASTE SOURCES
					PASTE SOURCE POSITIONS
					PASTE SOURCE VELOCITIES
					PASTE SOURCE IMAGE LINKS
					PASTE SOURCE BRIGHTNESS
				CATALOG PROPERTIES	
				GROUP PROPERTIES	

Below we will comment on each of the choices for "Source Position(s)", "Source Velocity(ies)", "Source Image Link(s)", and "Source Brightness",

3.2.1 Adding sources to your personal catalog

There are three obvious ways to add sources to your personal catalog, each described below. A fourth one is that the OPT gets filled with information from the PST once the PSC has approved observing time for your project,

but this is currently not completely functional.

Importing source lists used with the PST

If you or a co-investigator uploaded a source list with your proposal in the PST, you should be able to get a head-start by uploading the same source list to the OPT. Use FILE - IMPORT... to communicate with a dialog box. Choose PST as input format and name your source catalog. As a reminder, the PST format is/can be found in Section 4.4.4 of the PST manual (e.g., from the NRAO proposal portal documentation link https://my.nrao.edu/nrao-2.0/PSTMANUAL/PSTMANUAL.html) in case you decide to make such a file at this stage. You may want to check the details of some sources to convince yourself that the information has ended up correctly in the source property definitions, in particular the velocity reference frame and definition. Checking it now may save you more trouble downstream when scheduling SBs.

Copy/paste from existing catalogs

It is likely that your anticipated calibrator sources are already defined in, e.g., the VLA calibrator source catalog. You can search for your named, or a nearby, calibrator source using the search tool described earlier in this chapter. In the catalog (or group) or in the search results you can select one or more sources you desire to add to your personal catalog by ticking the check-box(es) in front of the source name and editing icon using the top menu strip EDIT - COPY - COPY SOURCES, etc. Then select the destination catalog or group and simply paste the copied sources: EDIT - PASTE - PASTE SOURCES, etc. You have to redo this action for each catalog or search results table page. Again convince yourself that the source information in your personal source catalog is correct, e.g., by adding velocity information for spectral line observations, before starting to assign source information to scans in the OPT.

Enter source information from scratch

If you do not use the PST upload file and your source does not appear in any of the existing catalogs, you would create a new source in a source catalog (or group) after selecting (or creating) the catalog or group you want to place the source in: (FILE - CREATE NEW - CATALOG/GROUP,) FILE - CREATE NEW - SOURCE. You will be presented with a blank-slate source page consisting of three tabs (or pages) labeled "New Source", "Image Links" and "Notes". Name your source, perhaps something convenient to search for at a later point. Maybe you also care to fill out the origin of your data for your own reference, possibly useful for later (PST file name, SIMBAD data base, scooped draft paper, etc.).

3.2.2 Source positions

There are three different types of positions you can enter: a simple position, a sequence of positions including motion terms and time ranges, and an ephemeris table. The default, in the first tab-page below the source name and aliases, is "simple position". Select a coordinate system (and equinox) in which you specify the coordinates and if you care, also supply distance (if known) and the uncertainties. For anything else than the default ("simple position") use FILE - CREATE NEW - SOURCE POSITION. The dialog box will ask you which type of position you require, and a new selection will redraw the position table accordingly with all variables defaulted. You can upload an ephemeris table (click the link for an example of the ephemeris table format), or you can specify the position and some motion terms valid for some time range. Motion terms are entered as polynomials in time (position at Reference Time in Equinox + value(1)$\times$time + value(2)$\times$(time)^2 + value(3)$\times$(time)^3, etc) – press the [+] for each extra motion term, enter the value and choose the order of the polynomial in time. The motion term units and uncertainty will help recalculating the position (and error) at the time of observations, though this is currently (early 2009) not yet implemented. Leave the motion terms at zero if the source is considered not to move in the specified time interval. If you need another position and/or different motion terms for another time interval, simply add another position to the previous one using the same FILE - CREATE NEW - SOURCE

POSITION. Delete old or obsolete positions using the tick-box in the upper left of a position table and EDIT - CUT - CUT SOURCE POSITIONS.

3.2.3 Source velocity information

In the next table under the source position, a source velocity can be entered using FILE - CREATE NEW - SOURCE VELOCITY. Enter the value and select a rest frame and rest frame convention. Just like a position you can add more than one velocity, but valid for another frequency range. Removing old or obsolete velocities is also a very similar procedure: tick the unwanted velocity and use EDIT - CUT - CUT SOURCE VELOCITIES.

3.2.4 Additional information

In addition to specifying a position and possible velocity needed to track a "source", some extra reference information may be specified for this catalog entry. These items however are not necessary for the observation and are provided for your own reference.

Source Brightness: With FILE - CREATE NEW - SOURCE BRIGHTNESS you are asked which type of brightness distribution you want to add to your source properties. For unresolved (point-like) sources you would probably choose type "Point", and fill out the "Flux Density" at some "Frequency Range". A slightly resolved source perhaps would be better described by a "Gaussian" model with a "Major Axis" and "Minor Axis Diameter" at some "Position Angle". Planets also use the "Limb Darkening" property of the "Disk" models. You can specify more than one brightness model for a source, or provide a FITS image or clean-components model file.

Image Links: If you want to keep a catalog of image URL links, e.g., to the images in the VLA archive, use FILE - CREATE NEW - SOURCE IMAGE LINK as many times as desired.

Notes: This tab-page is where you can collect all other information you wish to attach to this source. For example, for a target source you can remind yourself of the nearby calibrators you have found to be useful at some frequency, a reference to a paper mentioning an alternate position or a source property, or anything else you want to note. Click the blue expand button or "(New Note)" to add information to the "Notes" field. You can, e.g., also add links to papers or any other URLs for that matter. User defined values can be added at the bottom, e.g., the UV-range you determined to be proper for a point source calibration model, the color of its eyes, etc; whatever you deem useful.

When you are happy with your (re)sources, at any time you can save the changes you made. At this point it would be a good time: FILE - SAVE ALL.

3.2.5 Setting up pointing scans and tipping scans

Pointing scans are typically done at X band (8 GHz) on strong (> 300 mJy) continuum sources near your target source, i.e., within about 15 to 30 degrees. Most likely you will find such a source, e.g., in the "VLA" calibrator catalog; no new sources are needed. You may want to add the pointing source to your personal source catalog, if it is not in there already. If you plan on doing "secondary reference pointing scans" (see next chapter) and your intended pointing source is not strong enough at the observing frequency you wish to use for the secondary reference pointing scan, you may need to add another pointing source that is strong enough at this frequency, or even revisit your first choice.

Tipping scans on the other hand are typically done independently of your sources. The only interest is the observing frequency and the direction, in Azimuth, of the main distribution of your sources. Tipping scans currently are set up in the OPT only; no extra sources are needed.

3.3 Sharing catalogs

After all this data entering, make sure you check your catalogs for correctness and save them (with the icon menu or FILE - SAVE ALL). It is important that your positions and velocities are correct before creating scans in the OPT, and before storing to disk or sharing your catalogs with your collaborators. Exporting (and importing) in XML format is the same as for the RCT catalogs in Chapter 2. Next to XML, for the SCT the PST format should allow you to read (and write) the same file as you used to submit your source list to the PST (but currently you will have to supply your velocity reference and definition in the SCT). The latter is as yet not thoroughly robust, but should obviously be very useful for long lists.

3.4 Recap

This chapter should have made you familiar with source searches, source details such as the different types of positional information or specifying velocities for different frequency ranges, and creating source catalogs.

Chapter 4

Using the OPT, the Observation Preparation Tool

Assuming you already have successfully logged in to the OPT web application, look for the navigation bar at the top. If “Observation Preparation” is not in bold face, but in normal font and underlined, click on it (Figure 4.1).

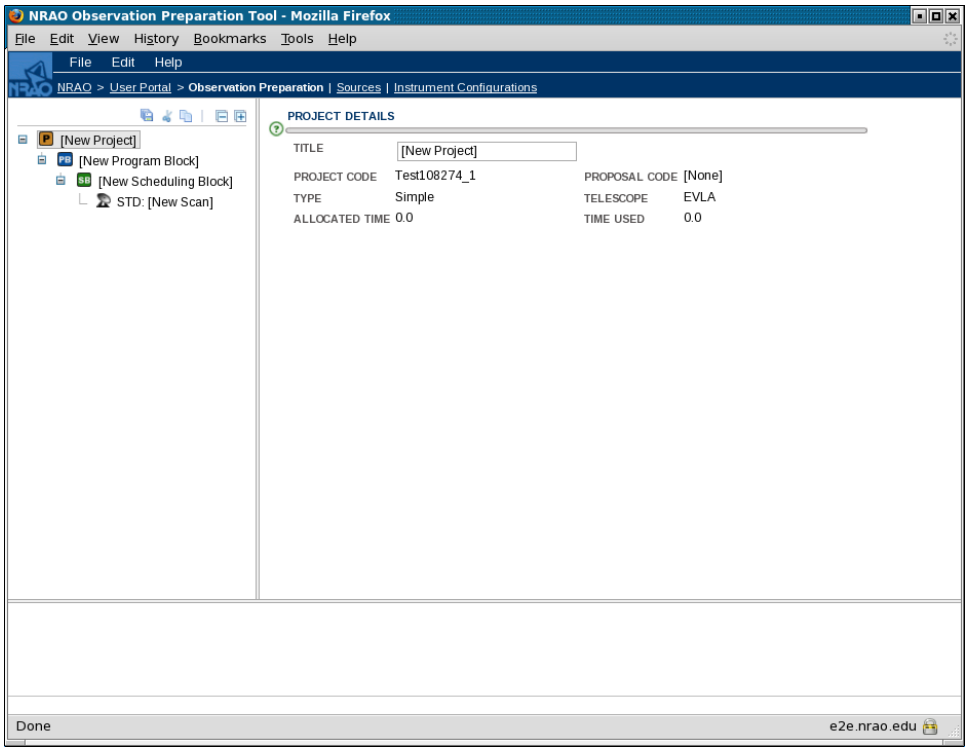

Figure 4.1: Web browser screen shot of the OPT opening page.

4.1 Orientation

A short introduction to the layout of this tool’s page has been given in the introduction (Chapter 1). This chapter uses the information contained in the resource catalogs (Chapter 2) and information contained in the source

catalogs (Chapter 3). It is assumed that the contents of these chapters are familiar, and that the information in the (re)source catalogs is correct. There should be at least one project tree visible in the project browser, with a PB, a SB and a scan.

If you need to define an additional (test) project or if your project was not filled from the PST, use FILE - CREATE NEW - NEW PROJECT. In the latter case, for a non-test project uncheck the "Test Project" check box, in the dialog window and enter your project (legacy) code without spaces (e.g., AS987) and your proposal code (e.g., 09A−191) before clicking "Add". Note that these codes only work if your projects with these codes were previously approved by the schedulers and you were notified of this by email. This should create a new project tree that you can name and edit. Both the slanted names in a project tree and a yellow dot on the icons means that it is unsaved data.

The purpose of the OPT is to combine a source from one of your source catalogs with a resource from one of your resource catalogs, and to specify an observing mode and time interval for this combination. Repetitive combinations will build an observing schedule that defines a SB observation. The Jython script generated for this SB may be executed by EVLA operations. The sequence of scans in a SB will show in the left hand side column in the project (etc.) tree.

It is useful to outline the project in terms of the PB and SBs in advance. Use information from the proposal, etc. (see Chapter 1) and create (re)source catalogs with only the subset of (re)sources that will be used in the SB you are about to create. Having your (re)sources in small personal catalogs is convenient and faster than having large catalogs or switching back and forth between your personal catalog(s) and, e.g., the "VLA" catalog . Also consider exporting and removing (in that order!) all other (re)source catalogs and projects that you don't need. Check the remaining (re)sources for correctness before you continue.

The left hand side column in the OPT contains a collection of projects, instead of a list of catalogs. Projects are subdivided in a tree of PBs, each subdivided in SBs, which each contain scans. This column, per SB, thus holds the scan list, i.e., the column represents the observing schedule. In contrast to the RCT and SCT, much of the editing in the OPT will be performed in the left hand side column as well as in the main editing window.

The icon menu in the OPT has more options than in the RCT and SCT. The common icons have the same functionality as the icons in the RCT and SCT, but as more editing is done in the left hand side column some extra icons (with their fly-over help tool-tip) are added. Only icons valid for the selected items (e.g., PB or scan) are displayed. A *full* list of icons and their meanings:


Save projects/catalogs in this tree

Cut (or delete) selected tree item

Copy selected tree item

Copy selected tree item and paste it directly after this item

Paste selected tree item
Icon menu separator (no action)

Promote selected item up, above the current tree branch (out of loop)

Demote selected item down, in the next current tree branch (into loop)

Move selected tree item up in current tree branch (before previous scan)

Move selected tree item down in current tree branch (after next scan)
Icon menu separator (no action)

Collapse/hide all items in the selected tree

Expand/show all items in the selected tree

The menu strip options in the OPT are a bit more complicated and at this time some of the options are disabled or non-functional. The options that are currently relevant in creating your schedule are given in the table above.

FILE	CREATE NEW	NEW PROJECT	EDIT	CUT [ITEM NAME]
		NEW PROGRAM BLOCK		COPY [ITEM NAME]
		NEW SCHEDULING BLOCK		PASTE AFTER/INTO [ITEM NAME]
		NEW SCAN		PASTE BEFORE [ITEM NAME]
		NEW SCAN LOOP		
	SAVE ALL			
	EXPORT CURRENT PROJECT			
	IMPORT PROJECT...			
	EXIT			

4.2 Defining your project's PB and SB(s)

There should be at least one project in your tree (if not, use FILE - CREATE NEW - NEW PROJECT) with, when you expand it using the plus-icon in the icon menu, a PB, a SB and a scan. Click on your project and give it some descriptive title if it has not been filled in from the PST information. Similarly, click on your PB and name it.

Each PB is defined for an observing trimester, typically a single VLA array configuration with some hybrid configuration and move time configurations. For your PB, select the array configuration for which this PB is valid by dragging the array configuration name from the right hand side column to the left hand side column. More than one (consecutive) array configurations, or "Any", can be specified. If your project spans more than one clearly different observing runs per trimester, e.g. some southern sources in BnA array and some more northern sources in B array, simply add more PBs to this project using FILE - CREATE NEW - NEW PROGRAM BLOCK. The table at the bottom is a read-only administrative table. It keeps track of the total time scheduled in the SB(s) in this PB.

When you next click on the SB, you are presented with three tab-pages in the main editing window. In the first tab ("SB Details"), name your SB and select whether it is a fixed-date SB or a dynamic SB – the tab-page will change with different scheduling constraints depending on the choice made; they should have self-explanatory labels and fly-over help tool-tips.

For fixed-date allocations you will have to fill out the starting day (VLA day, i.e., modified Julian day number on the VLA schedule) and LST time of your allocation. To schedule in UT time, e.g., for VLBI scheduling, you can use the UTC tick-box. The "Array Starting Position" is an option to aid you in anticipating a worst case scenario of the antenna wrap, or when you know where the array will be pointing at the end of a previous observation. For the latter choose "Equatorial" to enter a (J2000) Right Ascension and Declination, or for the former choose "Horizontal" to enter an Azimuth and Elevation of the anticipated array starting position.

For dynamically allocated observing time you are asked if there are any scheduling constraints. Possible constraints are a range of possible (or convenient) LST starting times, a first date of possible observations, and a starting position of the array. Other constraints deal with the weather at the site. If atmospheric phase stability is important, tick the box in front of "API" to enter your constraint (better than the entered value in degrees). If pointing might be an issue, you can tick the "Wind Speed" box to constrain observing to a wind speed less than the entered value (in $\mathrm{m \cdot s^{-1}}$).

This tab-page also contains a field in which you can communicate your notes, requests, concerns, other constraints, etc, to the operator. If your observations for this trimester include sources that cannot be observed in one consecutive time interval in the time allocated, or if you have more than one fixed-date allocations, you can define different SBs for the different LST ranges or fixed-dates, again by using the menu strip at the top: FILE - CREATE NEW - NEW SCHEDULING BLOCK. If your observing runs are very similar, simply copy the SB and adjust the new SB as required.

The other two tab-pages are not relevant at this stage and will be described below. You are now ready to start making scans in this SB.

4.3 Building your SB

The idea is to define a sequence of scans in the left hand side column, each with a source, a resource, an observing mode and a time interval. Each time a scan is added you need to specify these items. However, it is not always straightforward to assemble this scan list in the sequence you want the first time around, and you will need to move scans around. This is easily done! That is, there is no need to panic if you make scans (a bit) out of order; it is almost straightforward to add, e.g., an extra bandpass calibration scan, to move some scans to the middle of the observation, or to redefine source loops after the main framework of your schedule is set up.

4.3.1 The first scan

Select your first scan (click on "[New Scan]" next to the telescope icon and "STD" in the left hand side column); it contains default parameters such as a scan mode "Standard Observing" for 5 minutes "on source" (previously known as "dwell time"), and you will notice three tabs at the top. The number of tabs depends on the scan mode. Current scan modes are "Standard Observing" (tracking a sidereal position in the sky), "Interferometric Pointing" (for improving telescope pointing) and "Tipping" (for measuring opacity curves). Each mode has a different code that shows next to the telescope icon: STD, IP and TIP respectively. Next we will describe "Standard Observing" (STD), which is equivalent to"Standard Interferometer" in Jobserve. IP and TIP modes will be described further below.

Selecting "Standard Observing" (STD) for "scan mode" displays three tabs: "Overview", "Intents" and "Comments". In "Overview" you set up the actual scan, whereas in "Intents" you specify one or more purposes for the scan, and in "Comments" you enter anything specific for this scan for your own reference.

Within the "Overview" tab two tables are displayed. In the first, you name your scan. Note that the scan name is just for the scheduling display in this tree (and in the summary); it is the source name specified in the SCT catalog that ends up in your data. It is followed by scan mode ("Standard Observing"), the antenna wrap, whether or not you want to apply the solution from a previous pointing scan, and whether observing "over the top" is acceptable (most likely not). The antenna wrap and reference pointing are described further below.

The second table contains the actual target source, the hardware setup (with Doppler tracking settings), and scan timing. Each of these fields must be completed, and an error will result if any of these fields is unspecified.

Target source

The "target source" column either shows you the name of the target source (i.e. telescope pointing direction) or tells you that no source is assigned. A source needs to be specified and if it is not the one you want, press the "change" button. This brings up a dialog box to interact with the source catalogs that are in your SCT data base. Select the source catalog and the group within that catalog you want to extract a predefined source from. Simply tick the source name – you may have to scroll down your list to find the desired one. Note that you cannot define sources "on the fly"; only sources specified previously in a source catalog in the SCT can be selected. You may need to switch to the SCT if you desire to observe a source that was not previously defined and do so at this time.

As you will be doing this changing of sources potentially for every scan, you probably see that it might be useful to collect all sources that you want to use in this SB in a single catalog (group), i.e., with your target sources *but also with your calibrator and tipping sources* from, e.g., the "VLA" list. Otherwise you will be switching back and forth and scrolling up and down a lot.

Hardware setup and Doppler tracking

The “hardware setup” column is very similar; it shows the hardware setup selected if one was assigned. Click “No Change” to select the exact resource setting of the preceding scan (it must be defined for that preceding scan of course). Click “Change” to get a similar dialog box to select your resource catalog, resource group and resource from (only) the predefined resources in the RCT. Resources cannot be defined “on the fly”. Also here it is useful to specify all hardware resources (and pointing scan setups) in this SB in a single resource catalog (group), but because resource catalogs typically are not as extensive as source catalogs it is less of a hassle if you don’t.

Spectral line resources that were set up with a rest frequency instead of a fixed sky frequency have to be specified with an option for the Doppler tracking. Choices are to use the information in the source catalog for the source used in the scan (typically done if this is your target source scan), to use another source in any of your catalogs (typically one would choose the target source if this is your calibrator scan for that target), or you can specify another direction in the sky and another velocity to track. The recalculated sky frequencies for the starting time of the completed SB will show in the scan listing mentioned further down. Also here the “No Change” option will keep all frequency and electronics settings the same as the preceding scan, provided it is defined first.

Scan timing

The scan timing determines the length of the scan, either in LST (sidereal) or in UT. The difference is about ten seconds in an hour. Options are to set the exact time the scan has to end (“Stop Time”, only useful for fixed date schedules), the total (maximum) time the scan may take from the end of the previous scan including telescope slewing time (“Duration”), or the time the telescopes should track the source regardless of telescope slewing time (“On Source”, previously known as “Dwell”). Note that in the end, the duration of the SB should be an integer multiple of 30 LST minutes (or slightly less).

Intents tab

In the intents tab you should indicate the intent of the scan. By default is set to “Observe Target” (for “Standard Observing”), but you can add more than one intent to it. For example for your phase calibrator you would tick “Complex Gain Calibration”, for 3C286 you would choose “Flux Calibration” and for any suitable source you intend to use for bandpass calibration you would select “Bandpass Calibration”. The most common options are shown, and the more specialized options that you probably would not want to use are hidden behind the “More” button. More than one intent may be ticked, and will be useful for later use, in particular for automated pipelining. Note that if you leave the intent to the default (Observe Target), *you will not have calibrator codes with your data* which may complicate your data reduction.

Comments tab

Write anything you like here; it is a comments and notes field for your own reference.

4.3.2 Subsequent scans

There are a few ways to add extra scans. A blank-slate scan can be obtained using the menu strip: FILE - CREATE NEW - NEW SCAN. It will be inserted after the current highlighted scan in the tree, and will become the active (newly highlighted) scan.

Another way to obtain a new scan is by using the icon menu. It has several icons dealing with creating scans. Using the icons for copy and paste, a new scan can be created from a previously created scan, and be pasted at any position in the scan tree after selecting (highlighting) the scan it has to follow in the tree. The same can be achieved using the icon with the little green dot ( ), although this will paste the new scan directly after the scan that is copied, which is useful when building your scans sequentially.

You probably want to change your source of the scan if you place the new scan directly after the previous one (otherwise it is the same scan). Please take an effort to fill out the correct scan intent for each scan.

4.3.3 Calibration

Most observers would want to include calibration scans next to their target source scans. Almost always you would schedule one or two scans on a flux density scale ("amplitude" or "primary") calibrator (e.g., 3C286, J1331+3030) somewhere in the schedule where it is convenient. Spectral line observers would also include one or more scans on a bandpass calibrator if the flux density calibrator is not suited for this (if it is, please select both flux density scale and bandpass calibration as "intents" for this calibrator source). The target source position scan typically is sandwiched between complex gain ("phase" or "secondary") calibrator scans. To increase integration time beyond the coherence time on a target source, at higher frequencies it is customary to do this as a "fast switching" scan in Jobserve, i.e., not to schedule it as a sequence of new individual scans. Whether or not, the resultant procedure is to *loop* between your calibrator and target sources.

4.3.4 Scan loops

Setting up a "scan loop" is done using the menu strip: FILE - CREATE NEW - NEW SCAN LOOP. It will show you a "Scan loop details" page in the main editing window; assign a descriptive name to it and specify the number of iterations of this loop. The tick-box for **bracketed** means to copy the first scan in the loop to the end of the loop, i.e., add another calibrator scan so that the last target scan is also bracketed between two calibrator scans when the first scan in the loop is on a calibrator source. The four tree setups of scans in the table of examples below are equivalent; they all enclose scans on a target with a scan on a calibrator source before and after each target scan, i.e., they all result in the sequence *Cal - Target - Cal - Target - Cal*.

No Loop individual scans	Normal Loop two different orderings		Bracketed Loop should start with Cal
SB No Loop STD: Cal STD: Target STD: Cal STD: Target STD: Cal	SB Loop1 STD: Cal (2X) Target+Cal STD: Target STD: Cal	SB Loop2 (2X) Cal+Target STD: Cal STD: Target STD: Cal	SB Bracketed Loop **(2X) C/T+addCal STD: Cal STD: Target

In the example on the right hand side (the most compact, bracketed loop) the double-star after the loop icon, in front of the number of iterations of this loop, indicates that this loop is a bracketed loop. To achieve bracketing of the target source(s) with scans on the calibrator source, the bracketed loop *must begin* with the calibrator source scan. Of course one is free in choosing any of the possible scheduling solutions; the resulting observing script is the same either way, but the scan listing summary will differ in compactness and clarity. Note that you can use the "No Change" resource option in the first scan of a loop only if you have set up a resource directly prior to entering the loop, bracketed or not.

A loop can contain any number of sources, not necessarily only a calibrator scan and a single target scan. If your target sources are near in the sky and you can get away with a single calibrator for all of these targets you can group them in a loop with more than one, say four, target scans before returning to your calibrator. Loops may

also contain loops. If your loop is selected, adding a new scan will place this new scan in the scan loop. The only difference with a normal scan is that this scan will be scheduled as many times as the "Loop iterations" specified, consecutively in a loop with the other sources in the loop. When finished with defining a loop, you may want to highlight it and then collapse it (using from the icon menu) for a more compact display in the tree.

4.3.5 Other calibration scans

Besides the "Standard Observing" mode on the scan page, you can select "Interferometric Pointing" and "Tipping" scans. These are special observing modes for calibration, typically applied when observing at high frequencies (above $\sim$ 15 GHz).

A "Pointing Scan" (IP) may be needed at frequencies of about 15 GHz and higher (K, Ka and Q band). At these frequencies the antenna pointing accuracy (a few arcseconds) becomes a significant fraction of the primary beam. Observing with an inaccurate pointing thus may degrade the signal by a significant fraction. The antenna pointing is a function of the shape of the reflective surfaces and is influenced by, amongst others, gravity and temperature. Therefore, observing at high frequencies may require regular pointing scans to determine offsets from the pointing model. These pointing offsets are usually reasonable for target sources within, up to 30 degrees in Azimuth or Elevation from the pointing source. Therefore, typically one would redetermine pointing solutions when moving to a different portion of the sky, or roughly hourly when tracking a (group of nearby) target source(s).

Pointing scans are performed as a five-point raster observation on a strong (over 300 mJy) continuum calibrator, in first instance in X band continuum. This "primary **reference pointing**" scan usually yields sufficiently accurate pointing offsets, but if more accurate solutions are required a "secondary reference pointing" may follow at the (standard) frequency of the observing band, also in continuum mode (to be as sensitive as possible to the continuum source). Determining pointing solutions using spectral line sources, e.g., with SiO masers in Q band, has not been tested.

Default pointing resources are included in the "NRAO defaults" catalog in the group "Pointing Scans" for your convenience. You may want to copy the resources and pointing sources you wish to use from the standard catalogs to your personal catalog. *Do not forget to select "Interferometric Pointing"* for the observing mode and an "on source" time of *at least 2.5 (LST) minutes*. You want to start a block of high frequency observations with a pointing scan, and *tick the "apply reference pointing"* in the first tab-page of the scans in this block thereafter. This tick-box will actually apply the offsets that were determined in a previous pointing scan; if you forget you will be using the (most likely less accurate) default pointing model. Your very first scan may be a pointing scan, but as you don't know in what Azimuth the array starts, you want to allow for ample slewing time or anticipate a worst case scenario using the Azimuth starting conditions on the SB page.

If the pointing scan has not finished by the stop-time of this scan, no valid solutions can be applied. If it has determined a pointing solution before the stop-time has been reached it will continue with another five-point raster, which may or may not yield new solutions (which will be averaged with the first raster solutions). For "secondary reference pointing" scans, apply the solutions of the preceding "primary reference pointing" scan.

A pointing scan is for real-time calibration and, while very useful for real-time calibration, usually does not yield useful data for your project. The data is however included in the observations, be it that you need special switches to load the data in your data reduction package. You may study this data for reference, but the real-time corrections are already applied and cannot be undone.

A "Tipping Scan" (TIP) may be needed if you are concerned about calibrating the absolute flux density of your target source(s). The atmosphere absorbs some of the radiation, and the fraction of the absorbed radiation depends on the opacity, the transparency of the atmosphere. It is mainly dependent on the content of water vapor between the target source and the antenna(s), and can be derived from a series of system temperature measurements at various elevations. One would redetermine the opacity on the time scale in which significant changes are expected, i.e., the time scale in which the water vapor content of the atmosphere above the telescopes

changes. This is a strong function of baseline length and actual weather and no real guideline on time scales is available. Use common sense in the trade-off between overhead and usefulness of the scans in post-processing.

Tipping scans are performed toward an Azimuth direction close to your sources at about the observing frequency. The scan samples seven elevations between about 20 and 60 degrees for a system temperature and can be directed from top to bottom (down) or from bottom to top (up). When you select an Azimuth for your tipping scan, be aware that shadowing may occur, especially in C and D array configurations. Avoid the Azimuth directions of the arms, i.e., avoid measuring tips close to the Azimuths of 115, 236, and 355 (or -5) degrees.

You have to select "Tipping" for the observing mode to expose the tipping scan tab pages. Tipping scans are set up using one of your resources and probably are best done with the widest bandwidth available; make a new resource if you need it. You do not need a physical source. The "on source" time is fixed to 5 (on source LST) minutes, because it takes this much time to complete your tipping scan (in one direction, up or down). In the "Details" tab you will have to set the Azimuth and direction; do not forget this as otherwise you will be slewing to the default Azimuth of 0 degrees (North) and may hit a wrap constraint. It can consume half an hour of your observing time to return to your science observing. Always set the Azimuth.

You may place any number of tipping scans anywhere in your schedule as you feel fit to monitor the opacity during your observations, although you may want to do this close to your block(s) of high frequency observations. Your very first scan may be a tipping scan, but as you don't know in what Azimuth the array starts, you want to allow for ample slewing time or anticipate a worst case scenario using the Azimuth starting conditions on the SB page.

If the tipping scan has not finished by the stop-time of this scan, the data will contain those elevation samples (out of seven) that were completed. If it has completed the tip before the stop-time, it simply will continue with the next scan until the regular stop-time for that scan – this scan may be used to buffer the difference, e.g., absorb the extra time on your bandpass calibrator.

A tipping scan is for off-line calibration and may or may not yield useful data for your project. The data is included in the observations and you need special switches to load the data in you data reduction package. A "tip" would allow you to determine the opacity of the atmosphere during the tipping scan (i.e., during your observation), and you can use that value to correct for the atmospheric absorption in your data. Read the manual of your data reduction package on how to obtain and apply tipping scan data corrections.

4.4 Moving about

The schedule created may not be your most preferred schedule, both in the details of each scan and in the order of the scans. If you desire to rename a scan or a scan loop (or a SB or a PB), at any time select the scan and edit the name or time interval, or reselect a (re)source.

By using the menu strip or the icon menu it is possible to delete, cut/paste and add any number of individual scans (or scan loops) to any position in the tree at any time. Some handy icons are the arrows that move a selected scan (loop) up or down in the current tree (i.e., keeping loops intact as loops), and in or out of a scan loop. Currently still fragile, but useful, is to drag and drop the scan () or loop () icon to the desired location in the tree or loop. If you place the icon on top of another scan, this scan will be highlighted. When you drop the scan on top of another, highlighted scan, the scan will be placed directly after the highlighted scan; be patient when doing this as it will take some time to appear. This dragging only works on the icon, not on the name of the scan (which selects the scan). Always check the result.

Antenna wrap - direct the first scan - see also Az in scan list

4.5 Checking your SB

When you have created your sequence of scans for this SB, and no errors and warnings need further attention, go back to the SB page (click on the SB name in the tree of the scans). On the second line you will see how much

LST time the observing scans in this SB would consume. The total time is the time for the SB times the required number of repeating this SB in this PB. If this time is more than your allocated time, modify one or more of the scans in the SB (delete scans or adjust the time for scans). Remember that your SB length should be close to an integer number of 30 LST minutes and absolutely not longer than your allocated time. If the time is within your allocation, select the second tab-page ("SB Summary").

This tab-page summarizes your SB in three tables. The first table displays all unique resources used in this SB, the second shows all unique source-with-resource combinations, and the third table lists the sequence of scans with their details. Obviously, you should check these tables thoroughly for each tiny detail, e.g., whether you applied the reference pointing solutions ("Apply Ref. Ptg.") to the scans where this correction is useful. The table with the scan sequence will show loops (if any) initially in a collapsed form. It is strongly advised to click the expand-icon () to show the scan details of the scans in the loop. After verification that all these scans are as intended, the loop may be collapsed again.

Printing the SB scan listing can be done from the tab-page that holds the scan listing ("SB Summary"): click "Print" () in the upper left corner at the start of the tab. It will take you to a printer friendly frame from which you can use your browser's printing tool. You probably want to set the printing properties such that it shrinks the page to fit. You also would want to enable printing of background colors if you are interested to see the errors highlighted; offending values are also struck out to identify errors on your printed copy. Both the "SB Summary" page and the remaining error and warning messages from the interface feedback strip (if any) are printed. Loops in the scan listing are not automatically collapsed nor expanded; it will print as selected in the scan listing at the time of printing.

The generated SB observing script is kept in the third tab-page of the SB. Please, *do not press "Submit for Scheduling"* yet. If you are so inclined, you can have a look at the Jython script and download it (using the gray oval with a blue font "Download" button) to a local disk for your purposes. Note that this script has no use other than for EVLA operations – it cannot be used to recreate your OPT scan list or catalogs.

When you have created one or more SBs for this PB, go back to the PB page (click on the PB name in the tree of the SBs). In the table at the bottom you will find a summary of your SBs in this PB, with some accounting of the time each SB has consumed. You should check this before you submit your schedule, because your SBs will not be accepted for scheduling if they are using up more time than allocated for your project, or more than allocated for you fixed-date SB.

4.6 Submitting your schedule

Once everything is in order, when you are within your time limits and no errors remain, you can submit your SB schedule using the third tab on the SB page (click on the SB name and select the "Generated Script" tab page). It will send the script to the relevant places within EVLA operations and show you a message to that effect. All you need to do now is keep your fingers crossed...

4.7 Sharing projects, etc.

You can export your project containing your PBs and SBs to a local disk just like you can save the RCT and SCT catalogs (by selecting FILE - EXPORT). It is good practice to do so, and to delete obsolete projects and catalogs when the contents in the OPT web application data base gets large. You will appreciate the increase in speed over the network while you know you can always reload these catalogs and projects when you need them again.

4.8 Exiting

The proper way to exit the OPT web application is to use FILE - EXIT. You will be prompted about saving changes to your catalogs and projects if there are any, and if you have not saved your work previously using FILE - SAVE ALL.

Exiting can also be achieved, or happen, due to a period of inactivity (currently several hours, but this may change). A time out of the tool will collect all unsaved changes in a copy of the project and/or catalogs that were changed. You can recover these changes when you log in again; they are saved in the copy named “Autosave:” with the name of the project or catalog. These “Autosave:” projects and catalogs should also be created in case there is an ungraceful disconnect, i.e., when the Internet connection ceases.

4.9 Recap

This chapter should have made you familiar with creating scans from (re)sources, creating and checking an observing schedule (SB), and submitting your SB to operations.

Chapter 5

HELP!? - Problem Solving

5.1 UNDO! I did something I did not really wanted to do

Stop what you are doing immediately and read this first. Unfortunately there is no UNDO button, but there are ways to recover from a mistake, if you have not continued from that point. That is, do not navigate to a different tool and do not continue editing (cutting), do not exit, whatever. Breathe and read:

I deleted something

The most common unfortunate mistake is to delete your project (etc.) or (re)source catalog. You could have done this by either using the icon menu button for "cut" or by using the menu strip EDIT - CUT - CUT.... Recall that a "delete" is a "cut-without-paste". Whether or not it was a complete catalog or, e.g., a single scan, the salvage method probably is the same:

If you have used the icon menu "cut", and if you have not done anything else, the paste icon () from the icon menu will paste the "deleted" item back. You would probably first want to select the location to paste it back to (i.e., at the proper branch of the tree; individual scans can't be replaced as PBs).

If you used the menu strip EDIT - CUT - CUT... the solution is to select the proper place and replace the item with EDIT - PASTE - PASTE..., assuming nothing else was cut and placed in the paste buffer in between.

If meanwhile other operations have been performed, they could have interfered with the previous solutions. If you have not navigated to another tool, which implicitly saved your changes, an option then is to exit gracefully with FILE - EXIT without saving your work. You will not save any of your work done after your last save, but it may be less work to recover from that, than to recover from your mistake.

If you ended up saving your work, whether or not intentional, you may have to start from scratch to recreate what you have lost. Sorry, no UNDO button (yet).

I submitted an incorrect SB

If you are convinced that you have submitted the wrong SB, or a SB that you know is incorrect (e.g., you forgot to update the resource or a position for a source), do not panic. Notify the operator and the scheduler of your error and how to go about to correct it. That is, you would email them the project code, the observing date and LST time, the nature of the problem, when you expect to have the error corrected and resubmit the new SB schedule. For fixed date observations send your email to both schedsoc@nrao.edu and observe@nrao.edu; for dynamically allocated observing time send your email to both dynsoc@nrao.edu and observe@nrao.edu.

I exited before I was finished

Upon exiting you were asked whether you wanted to save your work in the tool you were editing in. Work in another tool would have been saved each time you left it to go to a different tool. Saved changes cannot be undone, but if you exited before finishing up, you can log in again and continue from there.

5.2 Bumped! I'm not connected anymore

Because the OPT is a web application your work depends on a real-time connection to the NRAO data base. This has both advantages and disadvantages. One of the main disadvantages is that something may happen to the connection between your web browser and the NRAO data base.

5.2.1 Timed out (graceful disconnect)

For several reasons it is unwise to allow an unlimited continuous connection between your web browser and the NRAO data base; there will be a time interval of inactivity that triggers a time out. We have tried to keep this time interval large (currently four hours), but in the unfortunate event that a time out happens before you had a chance to exit properly (with FILE - SAVE ALL), the disconnect will be a graceful one. The software will automatically save unfinished editing of your project (etc.) or (re)source catalogs in an "Autosave:" copy. Reload the page or redirect your web browser to the login page and continue either with your copy of the unedited data (i.e., the situation at your last, probably deliberate, save operation) or with the copy of the edited data (the "Autosave:" copy).

5.2.2 Ungraceful disconnect (browser/computer crash)

We hope that we have properly implemented a similar situation for an unfortunate crash as for the time out. Depending on the nature of the crash, however, it may not be possible to recover from the disconnect as in the time out situation. Try to remember your steps and log in again; you may be pleasantly surprised and see an "Autosave:" copy of your recent work. No guarantees though.

5.3 BUGS and "features"

Here we list, more or less randomly, some known problems. Some of them are being addressed or will be dealt with on short notice, others may take some time due to other priorities. We hope to update this list by removing the fixed issues, although it is not unlikely that we also need to add items to this list.

Real bugs

- Some here - Scan name in copy, Az in Tip, drag in long scan lists

Please report any suspected bug with information on how to reproduce your sightings to vlahelp@nrao.edu.

Features

- Sometimes when you are viewing some data in table form in the main editing window, ticking a tick-box will make the data disappear. What happens is that the table slightly expands horizontally and instead of adding a horizontal scroll bar the table wraps around and below the left hand side column. Scroll down, increase the browser window, or decrease your browser font to solve for this.

Please also inform us of any suspected "feature" or annoyance with it's description to vlahelp@nrao.edu.