Chapter 2

Observing: A Pocket Cookbook

2.1 What to Bring to the Telescope

Your observations will be more efficient and you will achieve better results if you have thoroughly prepared for your observing run before arriving at the telescope. Most of this work can be done at the time the proposal is written (see Chapter 1). For both spectral line and continuum observations, you should prepare the following before coming to the telescope:

Source List: A source list with RA and Dec coordinates (either epoch 1950 or 2000) or (lII, bII) Galactic coordinates. For spectral line observations you will also need the source V_{LSR}. Keep in mind that the beam sizes for the SMTO can be quite small at higher frequencies (e.g. 15 ″at 490GHz). See Chapter 6.5 for details.

Mapping Offsets: A list of mapping offsets if you desire to map a source.

Line Lists: Your line list, and if your lines are exotic or redshifted, then the frequencies. While we have several extensive line lists on site, it is always best to have your line frequencies with you. Note that if you are going to do frequencies at the edges of our tuning bands, please advise the staff so that we can try out tunings in advance of your arrival.

Observing Setup: The backends you desire, and an idea of the T_{rms} you wish to achieve.

Off Positions: If you are doing continuum observations or position switching, then you should have some idea of where good off positions might lie. For many molecules of interest, a position a few arc minutes away will suffice. For some abundant species, however, some care in the off position may be required.

In the case of beam-switching, our maximum throw is around 240 arcseconds at most. If you can limit your wobble throws to 200 arcseconds or less, you will obtain the most stable baseline results.

With this information in hand, your conversations with the Friend of the Telescope should help make your observing as efficient as possible!

2.2 An Overview of Where Things Are

When the first time observer confronts the SMTO setup, it can seem very overwhelming. However, once one has a sense of where things are, then, it is easy to get started.

2.2.1 The Control Room

The Control Room is where observers spend most of their time. There are three computers that are important: KRONEN, FRANKENHEIM, and Jever. In addition, there are several important racks that contain useful displays (Phase Lock, Tau Meter, AOS Bandpass), building controls, and telescope controls.

2.2.1.1 KRONEN

Kronen is the main data-taking workhorse. The observer controls and monitors the telescope through various windows that are run on KRONEN.

Kronen and Frankenheim displays run on three monitors: Hachenburger, Frankenheim, and Koenigbacker.

From Left to Right in the control room, these monitors are:

Hachenburger: 4 windows, running from top left clockwise around. These should always be running - contact the FOT if there is a problem.

- Color Monitor — Monitors the telescope status. It is a copy of the BLUE screen that is behind the observer's chair to the right.
- SDH Display — Displays the source/observing status. It shows what source and observing mode is being used.
- Error Log — Shows the start/stop status of scans and any error messages that the various computer processes send to the observer.
- Phase Lock/AOS Chiller Status - Displays the status of the Phase Lock for each SIS/HEBOL receiver and the AOS CHiller.

Frankenheim: This is the central computer at the observer's station. There are processes that are Frankenheim processes and processes that are really Kronen processes.

The Kronen processes are:

- OBST — The OBST process, i.e. the control program for the telescope.
- BEORGA — BackEnd ORGAnizer, i.e. the control program for all all backends.
- FEORGA — FrontEnd ORGAnizer, i.e. the control program for all frontends.
- KRONEN — A Kronen window on Frankenheim

The Frankenheim processes are:

- CHEF — a Frankenheim window that starts up in the observer's directory. Can run programs on Frankenheim like offline CHEF or CLASS here.
- CLASS – a Frankenheim window that starts up in the observer's directory. Can run programs on Frankenheim like offline CHEF or CLASS here.

One can also open additional Frankenheim windows of course.

Koenigbacher: Starts up with 3 Decterm windows (which are all SMTSYS windows) that can be used to start a XEPHEM process. In addition, when OBST is started, then several windows (ONDIS, OBSERVE) start up. The TOOLBOX and Online CHEF windows are started as well. These are all Kronen processes.

2.3 An Overview of the Commands

The observing program **OBST** is run on the FRANKENHEIM screen. Here a number of windows are started by the login process to assist the observer with both observing and off-line data reduction. All of the observing procedures are accessed through the OBST window on FRANKENHEIM. For those familar with the Effelsberg or IRAM 30 meter systems, our OBST system will be very straightforward to learn.

Typing 'help' at the 'OBST>' prompt will provide a list of the available procedures; however, a subset of tasks should suffice for most observing needs.

You can obtain the current settings for each of these procedures (or any OBST procedure) by typing "show_curr taskname". For example, "show source" will display the current and default values for the source, catalog and VLSR.

In addition, you can obtain help on most OBST procedures by typing "help procedure_name" in the OBST program.

The gory details of each task can be found in Chapter 6. However, in the rest of this chapter we present some examples and short descriptions to get you started.

2.3.1 Setup

Here is a list of the most likely commands that you are going to use for setting up your observing run.

SOURCE - used to specify the source name and which catalog you wish to use.

SET CATALOG_C - used to make a particular source catalog the default source catalog.

RX - broad setup routine. Based on the receiver name and the observing mode you put in, it sets up the front end (executes FESET if necessary), the backend (executes either L_MODE or C_MODE, loads the relevant pointing model, selects the appropriate channels from DRUMBEAT (if necessary), etc.

LINE - defines the frequency that you will be observing. We have a large number of lines prefined in the LINEFREQ catalog. For these lines, you can simply give the line name. For less well known lines, you will need to give the exact line frequency.

SET CATALOG_L - Used to define a catalog as the DEFAULT line frequency catalog.

BACKEND - defines the backends you wish to use for your observations.

BE_FE - defines which backend is assigned to which frontend.

WOBBLE - sets up the wobbler parameters.

SET W_POS - used to set the wobble throw

DRUMBEAT - sets up the continuum backend (Digital Recording Using Multi-channel BackEnd with AT).

At a minimum, for SIS/HEBOL observations you will have to use the SOURCE, RX, LINE, BACKEND, BE_FE commands. Other commands may have to be invoked if the default values are not the desired ones.

For bolometer observations, the minimum number of setup commands are SOURCE and RX. The commands WOBBLE and DRUMBEAT may have to be used if the default values are not the desired ones.

A variety of commands exist to modify the observing setup still further. These commands are discussed in Chapter 6.

2.3.2 Pointing

Listed below are the most commonly used commands for pointing. POINT, ZFOCUS, XFOCUS, and CORR commands can be used with any of the receivers. The LPOINT and LWPOINT commands obviously are restricted to line observations.

POINT - Drift scan in azimuthal direction and elevation across a source. Online CHEF obtains pointing fits. It is a continuum scan. Harder due to narrower bandwidth for the SIS/HEBOL receivers than for the bolometer.

SET BOLO - used to set the bologain (an attenuation factor used in pointing/continuum observations. Usually this is set at 1, but for a few planets, you will have to increase to avoid saturation.

LPOINT - observations at points in a cross-shaped pattern in azimuth and elvation about a source to obtain a pointing fit. It uses line spectra and position switched scans. Online CHEF produces a fit and displays the data.

LWPOINT - similar to LPOINT except uses beam switched line spectra. Online CHEF produces a fit and displays the data.

ZFOCUS - varies the z focus and obtains a fit to the z focus. Done only in continuum mode. Usually done on Planets.

XFOCUS - varies the x focus and obtains a fit to the x focus. Done only in continuum mode. Usually done on Planets.

CORR - enters pointing and/or focus corrections. Will accept fits from Online CHEF or inputs from the observer. The complete command name is "CORRECTIONS", but usually typed in as "CORR".

2.3.3 Calibration Of Data

There are several types of calibration that have to be applied. For example, to establish the temperature scale for spectral line observations, one will take a measurement of the sky, a known hot load, and a known cold load. This is done at the SMTO with the CAL command. Another type of observation is a SKYDIP, where the actual opacity of the sky at the observed frequency is measured through a series of observations at different airmasses. The telescope efficiency (i.e. how well it couples to sources of various sizes) can be measured through several different types of measurements.

The following commands allow the user to make a calibration scan which then is applied to subsequent observations, or to estimate the sky optical depth, or to measure the telescope efficiency.

CALIBRATION - makes a SKY-HOT-COLD (which we call a cal-cold) or SKY-HOT calibration scan (called a T_{rec}cal), if one has previously taken a cold cal. The SKY and HOT subscans are taken automatically. The cold subscan waits for the user to insert a cold load.

A Dark scan is automatically taken before the calibration scan.

Thus, a total of 2 scans are taken for every CAL.

Usually typed in as "CAL", though you have to use "SHOW CALI" to look at the parameter values.

DARK - Takes a DARK for the AOS and FBS backends specified by the BACKEND command. Typically, this command does not have to done separately by the observer.

SKYDIP - makes a skydip observation. If observed with a spectral line receiver, it also expects a hot and cold load at the end of the scan. The hot load is automatic, the cold load must be applied by going up to the appropiate receiver cabin.

EFFICIENCY - Will do an efficiency measurement on the source using a continuum observation. The only option is the number of repeats for the on-source, off-source observations. Typically we might wish to do 3 observations. This command does a pointing, then a CTRACK on source, a CTRACK off source, a hot load, two cold loads, and then repeats it as many times as requested. It finishes with a SKYDIP.

This type of efficiency observation makes use of continuum measurements of the source, sky, hot load, and cold load to estimate the telescope efficiency. It is very sensitive to sky stability.

An alternative way is to measure the T_A^* *directly by doing a cold cal, followed by either a PSWITCH or WSWITCH scan.* This second method is now our preferred method.

2.3.4 Continuum Observations

Continuum observations can be done with any of the receivers. Usually, the bolometer is the only receiver that will be used in continuum mode for science, with the other receivers occansionally using the continuum mode for pointing or efficiency observations.

CONOFF - makes a continuum on-off scan. This is done by switching the beam by the specified beam throw. While at one of the beam positions, the beam is wobbled between the right and left positions of the wobbler. Our wobbler ONLY moves in azimuth.

The observer typically will want to have the source in one of the beams in both the 'on' and 'off' subscans, which requires that the beam throw and the separation of the on and off beams be equal (i.e. the absolute difference in wobble positions). If the wobble throw is -100, 100, then the CONOFF offset would be CONOFF -200. If the wobble throw is -60, 60, then the CONOFF offset would be CONOFF -120. Note that for the 19-channel bolometer array the phases are set up in a way that we recommend changing the signs of the wobbler throw, which means using a throw of e.g. 60 -60, and a CONOFF offset of CONOFF 120. If the throw has to be over 240 arcseconds to get off source, the observer may wish to consider a CTRACK observation.

CTRACK - makes a ON observation. This is useful for objects which are typically too extended to do with a beam-switched scan.

Typically, the observer would take a CTRACK on source and then move off source and repeat the observation. The difference in counts between the two scans would be the source flux in counts. By observing a standard, the observer can calibrate the counts/Jy.

If the source is expected to be weak, then one would set up a series of CTRACK scans on and off the source, each relatively short in time.

CMAP - makes a continuum map in an on-the-fly pattern by scanning in azimuth, stepping in elevation.

Calibration of the observations is relatively straightforward. Standard sources can be found in the SMTO calibration folder (we recommend Goeren Sandell's MNRAS paper).

If one can observe a standard source at the same airmass, then a direct conversion of counts to Jy is trivial. However, if the standard is at a different airmass or done under different tau conditions, then one needs to correct for the effects of sky opacity when converting count flux to Jy. Thus, we recommend that you note carefully your bologain and taumeter values for each observation.

One further caution: Remember to observe your standard and source with the same procedures if possible. This will minimize problems of flux calibration. I.e. if your source requires a CTRACK, do the standard with a CTRACK as well.

2.3.5 Spectral Line Observations

These commands apply only to the line receivers. One should always do a CAL before these scans so that the data is scaled correctly.

The key parameters are the off position, the length of the subscans, and the total integration time.

PSWITCH - makes a spectral line position-switched scan. The user controls the reference position, the integration time (seconds), and the number of subscans. Online CHEF shows the results of the integration as subscans accumulate. The observer defines an off position (usually an AZ (azimuth) throw - which measures the SKY at the same elevation). The observer can also chose a fixed offset (fixed in RA, Dec) to avoid possible containation of the ON scan.

WSWITCH - makes a spectral line beam-switched scan. Maximum recommended throw is 240-280 arcseconds, preferred throw less than 200 arcseconds. The user controls the beam throw, the number of subscans, the reference position in AZ, and the total integration time. Our wobbler moves in AZ only.

Note: important to make wobble throw and the wobbler positions consistent.

PRASTER - makes a spectral line position-switched map. The map does a point by point mapping. It can be stopped and restarted to permit calibration scans (or pointing checks). You actually have to do a two step command—PRASTER, followed by a START.

WRASTER - makes a spectral line beam-switched map. The map does a point by point mapping. It can be stopped and restarted to permit calibration scans (or pointing checks). You actually have to do a two step command—WRASTER, followed by a START.

Maximum recommended throw is 240-280 arcseconds, preferred throw less than 200 arcseconds. The user controls the beam throw, the number of subscans, the reference position in AZ, and the total integration time. Our wobbler moves in AZ only.

Note: important to make wobble throw and the wobbler positions consistent.

PMAP - makes a spectral line on-the-fly map using position switching. The gory details are given in Chapter 6.10. For strong lines in particular, this is likely to be the preferred option. You actually have to do a two step command—PMAP, followed by a START.

START - Actually starts a PRASTER/WRASTER/PMAP at the specified subscan. The usual start place is the first subscan, or beginning of the raster/map.

As a reminder, we recommend that where possible you observe a standard source to establish your final line calibration.

2.3.6 Other Useful Commands

There are a large number of OBST commands. Please refer to Chapter 6 for a more extended discussion.

HELP command - online help information for that command.

MBC command - sends a command to ONLINE CHEF via the communication mailboxes. For example, use if you want to reset the Trec or some other parameter in ONLINE CHEF.

MBC HA/PL - makes a hardcopy of the current ONLINE CHEF plot.

SET OFFSET - used to set an offset position in the source position. For example, if you wish to observe a point 30" in RA from the catalog position, this is the command you would use.

SHOW command - used to display the current and default values of a command. Thus, if you want to see the current backends, you would type "SHOW BACKEND"

STOW - stows the telescope (moves the antenna north and to the horizon). The observer should always put the telescope in stow *FIRST* if shutting down or closing the doors.

RENAME - a command to rename the SPECTRA.SMT file from inside OBST. Online CHEF will slow down as the SPECTRA.SMT file gets large (a few thousand SPECTRA.SMT scans). To restore its speed, the observer should use the RENAME command, which sets up a new SPECTRA.SMT file for Online Chef.

REINIT - a command to reinitialize the ONLINE CHEF. This should be done if there appear to be problems with the ONLINE CHEF. It reinitializes the communication mailboxes and the graphic display and some calibration parameters (SB gain, efficiency, ...). We recommend doing a CAL immediately if you have to REINIT.

2.4 Starting Up

The day dawns bright! Or, if you are on a night shift, the stars are alight!.

Time to Observe!

For most observing sessions, the following sequence will get you going. Have a Friend of the Telescope or site manager walk you through this part the first time or two.

If you are replacing another observer, then the only things you will have to do is to log into FRANKENHEIM and set up receivers upstairs.

- Login in as OBS on FRANKEHEIM.

  The computer will ask you for the project number and your initials. It will create a sub-directory for you using your initials, and then start up a huge number of processes. On Koenigsbacher, several processes including TOOLBOX, OBSERVE, and ONDIS (online display text window) will pop up. The ONLINE CHEF plot window will pop up only when the first scan is completed. FRANKENHEIM will also have a number of processes appear, including BEORGA and FEORGA.

- If you are not replacing another observer, the telescope likely will be off. This means that you will have to start up the telescope and building drive systems.

  The building/telescope start up procedure is on the next page.

- At this point, you will set up your receiver in **OBST**, and also go tune your receiver (or any other adjustments that need to be made).

Ready to start collecting data!

2.4.1 Telescope/Building Drive Start Up

OPENING THE DOORS SHOULD ONLY BE DONE WHEN THE TELESCOPE IS AT THE STOW POSITION. IF THE TELESCOPE IS NOT THERE, THEN EXECUTE A STOW COMMAND IN OBST. OBSERVERS WHO HAVE NOT BEEN APPROVED FOR OPENING THE DOME BY THE FRIEND OF THE TELESCOPE/SITE MANAGER SHOULD HAVE A HHT STAFF MEMBER DO IT.

IF THERE HAS BEEN SNOW OR ICE, THEN ONLY AN HHT STAFF MEMBER SHOULD OPEN THE DOORS. (Yes, this means you can wake us up if we are sleeping!).

On the Building Drive Control Panel (on the wall):

- 1) Turn the Panel Control Power switch from off to on.
- 2) Press the Azimuth System Reset. - the Orange light on the Azimuth System Operate goes on.
- 3) Go downstairs and turn on power switches on the drive. (if on, turn them off and then back on). This will allow the telescope to reset relative to the building drives.
- 4) Press the Azimuth System Operate start button. You will probably feel or hear a little click as the building and telescope get ready to boogie!
- 5) Look at the telescope. Make sure there are no obstructions before you move it! If it is NOT at the STOW position, then issue the OBST command and move the telescope to STOW.
- 6) Go over to the Shelter Control Panel (aka Interlock Status Controller) above the button array panel (the one with LOAD, CANCEL, etc ...).

  If there are no error conditions in the left hand display and no red light in the left-most column of buttons, then the telescope drives are ready to go. Check the right display-it should say DOORS CLOSED, and the green closed light (center row of buttons) should be lit.

  If so, then you can open. Press the OPEN button. The roof and door panels (starting with the roof panels) will slowly open in sequence. This is automatic and will take about ten minutes. You will see appropiate messages on the right-hand display. When the doors are done, the right-had display will state SHELTER OPEN, and the OPEN button will be a steady green.

  IF THE LIGHTS OR BUTTONS INDICATE AN ERROR CONDITION, SEEK ASSISTANCE IMMEDIATELY. DO NOT GO BLINDLY ON!

Hurray-you are ready to go!

2.5 Continuum Observations

Continuum observations are very straightforward with any of the receivers. Most (non-pointing observations) will be done with the 19channel array or the 4-color bolometer. Remember to go up to the 4-color bolometer and set the appropiate parameters for the desired wavelength on the bolometer.

Also, remember to move the tertiary mirror to the right hand side for both the bolometer and HEBOL receivers. This can be done from the control room by pressing the appropiate button on the button panel.

We present an example of a continuum session with the B130C4 receiver. Examples for the 19chan array are discussed in Chapter 4.

```
OBST> source mars                - set the source.
OBST> rx B130C4                  - set the receiver
                                   Change mirror to RHS
                                   Go upstairs and verify BOLOMETER setup.
OBST> set bolo 5                 - Mars is bright, bologain=5.
OBST> wobble/w_p -100 100        - Set wobble throw to +/-100 arcseconds
OBST> point                      - Do a pointing on MARS with default setup.
OBST> corr f f                   - Accept good pointing fit.
OBST> zfocus                     - Do a zfocus test on MARS.
OBST> corr * * f                 - Accept good zfocus fit.
OBST> xfocus                     - Do a xfocus test on MARS.
OBST> corr * * * f               - Accept good xfocus fit.

OBST> source MYFAV /cat cat:SMTCONT
                                 - Set up on your source MYFAV, located
                                  in the system catalog SMTCONT.CAT

OBST> drumbeat/bologain 1        - Alternate way to set bologain.
                                 - Our source is weak-so bologain=1.

OBST> conoff -200 0 az /time 30 30 /sub 5 /def
                                 - Do 30 sec subscans, 5 in each beam.
                                   with the wobble defined above,
                                   the source will be in either the
                                   negative or positive beam at all times.
                                 - /def = makes this the default CONOFF

OBST> source MYFAV2 /cat MYCAT   - Set up on your source MYFAV2,
                                   this time located in your directory
                                   in the file MYCAT.CAT
OBST> conoff                     - use defaults.
```

To understand the gory details of the commands, see Chapter 6.
For those of you who wish some more examples, read the following!

2.5.1 Setting the Source: SOURCE

Let us see the different ways you might call a source located in a catalog.

Note that the standard default catalog is SMTCONT.CAT, located in the SMTO standard catalog area. You can reset this if you wish to some other catalog located in either the SMTO catalog area or in your own subdirectory.

Here are some examples of ways to define your source.

OBST> sour fav_source

- This loads your source. Usually you will need to specify a particular catalog as well, unless the catalog has been set as the default.

To define a source catalog, use:

OBST> SET CATALOG_C your_fav_catalog

OBST> sour MARS - sets the source to the planet MARS

OBST> sour MYFAV /cat MYCAT - sets the source MYFAV from the catalog MYCAT.cat in your area on FRANKENHEIM.

OBST> sour IRS32 /cat sys$smt:[smt.cat]xyz.cat

- sets the source in a non-default catalog, here the catalog xyz. The sys$smt:[smt.cat] directory is where the SMTO standard catalogs are located.

OBST> sour IRS32 /cat cat:xyz.cat

- sets the source in a non-default catalog, where "cat:" is the alias for the system catalog area (sys$smt:[smt.cat]).

Section 6.5 discuss how to set up a source catalog.

2.5.2 Setting the Receiver (4 Color Bolometer): RX

The following command will execute pretty much everything you need, with the only change being which color of the 4 color bolometer you choose.

OBST> rx B130C4

- sets up the 4 color bolometer.

In this case, the observer will use the 1300 μm wavelength. Other channels are B087C4 (870 μm), B045C4 (450 μm), and B035C4 (350 μm). See section 3.2 for details.

OBST> rx 19chan

- sets up the 19-channel bolometer.

2.5.3 Setting the Receiver (SIS/HEBOL): RX

In the case of the SIS receiver, you can use the following to specify the frequency that you desire.

OBST> rx SIS345 - sets up the SIS345 receiver for use in either continuum or line mode.

Most commands such as POINT or CONOFF will now set the modes properly by invoking C_MODE (which sets the system to do continuum observing) themselves. However, if you wish and are desparate for fun and excitement, you can also use the C_MODE command,

OBST> c_mode /freq 345.0 LSB

- set up for continuum mode. Default is beam switching.

OBST> c_mode T /freq 345.0 LSB - set up for total power continuum mode.

2.5.4 Setup

In almost all cases, we have defined the defaults so that they will be what the observer might need. However, in a few cases like observing a planet (where one has to change the bologain) or an extended object (where you might wish to change the throw or offset position), you might need to alter some of the default parameters.

OBST> set bologain 2 - sets the DRUMBEAT attenuator (BOLOGAIN) to 2. The default bologain setting is '1'; bologain is actually something of a misnomer in that it actually represents the amount of attenuation with '1' being the lowest and '9' being the highest. Each increment in the bologain indicates a change in the power level by a factor of 2. For most sources, you will use '1'. For bright planets, you will use '5' typically if using the 4 color bolometer. For the SIS/HEBOL receivers, the smaller bandwidth means that the gain can be left at 1.

If the total number of counts exceeds 400,000, you are saturated and should increase the bologain.

OBST> set w_pos -45 45

- A way to define the wobbler position. This will then become the default value, and thus is the way that we recommend. Typical wobble setups are:

Total throw of 240 arcseconds = '-120 +120',

Total throw of 200 arcseconds = '-100 +100',

Total throw of 120 arcseconds = ' -60 +60'

There are other possibilities as well:

OBST> drumbeat /bologain 2 - another way to set the bologain, makes 2 the default value.

OBST> wobble /w_pos -45 45 /w_n 2 /w_b 2 2 /wfrq 2.0

- The wobbler is enabled automatically. However, the command C_MODE B (or just C_MODE since beam switching is the default) also automatically enables the wobbler.

The default wobbler settings are for a beam throw of 120 arcseconds between two positions, -60 arcseconds and +60 arcseconds, centered between the two beams.

The W_BEAM parameter is (and should) be set to '2 2' to center the positive beam on the source during an "on" subscan.

If you want to change these defaults, you must explicitly execute the wobbler command. Typically for a pointing observation, the W_BEAM is set to '2 2'. For mapping, one usually wants to set W_BEAM to '0 0'.

The wobbler frequency is set by to the /wfrq value or alternatively by 'set wfrq XX.X'. Typically, we are using 2.0 Hz. This is used for virtually all observations at all wavelengths.

Consult with the FOT if you wish to consider changing the frequency.

2.5.5 Pointing: POINT

Now we're finally set to make some observations. Let's start with a pointing.

OBST> pointing

The default values will do a 3' (180") cross at a drift rate of 6'/minute. It will do a two scans in elevation (up and down) and two scans in azimuth (east and west). To slow down the drift rate to 3'/minute:

OBST> pointing /time_pt 60 - This does 60 seconds per cross.

OBST> pointing /len 400 - This does 400 arcseconds per cross.

Note that you will probably want to adjust the integration time if you have to adjust the length, since the integration per point is the total length/total time.

ONLINE CHEF will display the fit, the correction factors, and the beam size.
If the online display looks like it found a good fit, you may enter the fit by typing:

OBST> corrections F F
or

OBST> corr F F

This accepts the fit.

If you would like slightly different values, you can enter those by typing:

OBST> corr 20 -10

where 20 is the col* (azimuth) and -10 is the nule (elevation) fit value.

2.5.6 Focus: ZFOCUS,XFOCUS

If you're convinced you've got a good pointing, it might be nice to check the focus on a planet or other bright point-like continuum source.

There are two focus directions that you can adjust. ZFOCUS and XFOCUS. In general, if you start with the standard values that we suggest (usually posted below the OBST screen), then you will be close. The focus values *do not change* dramatically over the course of a day-due to the excellent thermal properties of the telescope. However, a focus check is always good if you have the time.

To set the FOCUS values to "z", "x":

OBST> CORR * * z x

z and x are the desired ZFOCUS and XFOCUS values. The '*'s indicate 'leave the col* and nule values unchanged'.

ZFOCUS - The default focus will move +0.5 wavelengths in the z-direction, then to the zero point, and finally -0.5 wavelengths.

OBST> zfocus

To alter the length of the focus or the number of points, type:

OBST> zfocus /nwav_fcz .8 /step_fc n

to go +/- .4 wavelengths in z in n steps. Currently /step_fc must be 3 for ONLINE Chef to make a fit to the focus. /step_fc must be odd to go through the zero position.

If you like the obtained fit:

OBST> corr * * f

The '*'s indicate 'leave the col* and nule alone!' but take the fit for the focus. Again you can specify a specific value by replacing 'f' with a number.

XFOCUS

It is very similar to the ZFOCUS example above.

OBST> xfocus

OBST> corr * * * f - if you like the fit! Note that it is different from ZFOCUS above.

2.5.7 Taking Beam-Switched Data: CONOFF

At this point, you may want to take some data on your favorite source! For example, let us assume that our wobble throw is -100,+100:

OBST> conoff -200 0 az /time 30 30

> This will perform a continuum on-off scan between the source and the reference position of 200 arcseconds in azimuth with 30 seconds per on/off. For the wobble throw of -100,+100, this scan will have the source in the negative beam during the first subscan and the positive beam during the second subscan.
>
> The sequence is OFF-ON-OFF-ON...

To reduce these data, you would use the program ONOFF (for the 4-color) or ONOFF21(for the 19 channel) in an FRANKENHEIM window. However, for the 19-channel array, you can also use NIC or MOPSI (as described in Chapter 3.2).

Note: ONOFF assumes that the source alternates between the positive beam and the negative. This is set up when you properly match the beam throw to the CONOFF parameters). If this is not the case, the counts will be halved.

Moral: Always take your calibration data with the same setup as your source.

2.5.8 Taking Stare Data: CTRACK

OBST> ctrack /time 15

> This will do a ON observation for 15 seconds.
>
> Since the observation is effectively a "stare" mode, the observer must observe ANOTHER position to measure the sky. This would be done by setting the offset position and repeating the observation.

OBST> set offset -1800 0 0 LAM

> This would set the telescope to -1800,0 in RA,DEC.

OBST> ctrack /time 15

> This would take a CTRACK scan.

The observer must then reduce the data and take the difference to measure the source flux (ON source - OFF source). This is done by using Kreysa's skydip program on FRANKENHEIM. The skydip program will take the CTRACK subscan and tell you how many counts are in the scan. (It will also complain about missing data-since it is a skydip program, not a ctrack program!)

To calibrate the flux, you will need to observe one or more standard sources (on and off CTRACKs). Remember to correct for airmass effects. To do that you will either want to do standards at the same elevation (at similar tau), or to measure the relationship between tau_{225} and $tau_{bolometer}$ through a SKYDIP.

2.5.9 Taking Mapping Data: CMAP

OBST> cmap /map 240 8 240 8 azm /time 60 60 /sub 1

This will perform a 4 x 4 arcminute map in a raster pattern scanning in azimuth with 8 arcsecond spacing (recommended for the 19 channel bolometer array) and in elevation with 10 arcseconds spacing between lines. The integration time per line would be 60 seconds (drift rate=4 arcminutes/minute).

CMAP has an option that allows the observer to skew the map orientation. See our bolometer chapter (Chapter 3.2) for more gory details.

The data would be reduced with MOPSI or NIC and a quick cookbook is discussed in Chapeter 3.2.

2.5.10 Related Commands: SKYDIP

OBST> skydip

This does a skydip observation at the current azimuth. Use "skydip 220" to do a skydip at azimuth 220. The program will abort if you are too near the sun at any time during the observation, so make sure you move far enough away in AZ so that you will not encounter the sun limit at any elevation.

The data is reduced *outside* of OBST.

If the observations are done with a bolometer, then use the program SKYDIP to reduce the data in any FRANKENHEIM window. (If the data is array data, use MOPSI or NIC instead.)

FRANKE> skydip

The program will ask you for a scan number and channel number. It will then solve for the skydip and can produce a plot of the fit.

If a line reciever (SIS or HEBOL) receiver is used, reduce the data using the macro PLOT_SKY.

2.5.11 Quick Data Reduction

As mentioned above, for ONOFF (i.e. CONOFF) data, you can use the program ONOFF in any FRANKENHEIM window. The program will ask you three questions:

1.) Do you want to have the output go to a file ONOFF.DAT?

We recommend that you put in a different file name, since the ONOFF.DAT file is created anew every time the ONOFF program is run.

2.) Where is the data stored?

The default is the current raw data directory, kdata:[smt.data].

3.) What is the scan number you wish to reduce?

This scan has to be a scan that is finished-and taken with CONOFF.

2.6 Spectral Line Observations

Spectral line observations have more paramters, and hence more opportunities to get confused. Below, we present a sample set of observations for a typical spectral line session.

First, set up your receivers/backends properly:

```
OBST> source MYFAV /cat MYCAT          - set the source MYFAV from
                                       - your catalog MYCAT.cat
OBST> rx SIS230                        - set the receiver
OBST> backend aosa fbs                 - define the backends
OBST> be_fe aosa 1                     - link AOSA to receiver 1(SIS230)
OBST> be_fe fbs 1                      - line FBS to receiver1 (SIS230)
OBST> line cs(5-4)                     - set up freq of line desired
OBST> go                               - load parameters into the
  -    synthesizers.
                                       - Other commands like PS or WS
                                         would also do load the freq.
                                         into the syntesizers upstairs

               Go upstairs, lock, tune receiver.

OBST> cal /cal cold                    - Take a cold calibration
                                       - While the sky and hot load are done
                                       - automatically, you have to
                                       - insert cold load yourself.
```

At this point, you will want to check the levels on the AOSs and the filterbanks to make sure that the levels are where you want to be. For the AOSs, you will adjust the amount of IF attenuation or individual AOS attenuation. For the filterbanks, you need to set the gain level so that the hot load is between 500 and 750 on the readout in the FBS rack.

A useful command for setting the gain for the filterbanks by the way is:

```
OBST> obsinp atn7 fbsgain              - tells obsinp to set fbs gain
                                       - to "fbsgain"
OBST> go                               - forces filterbanks to update.
```

If the calibration of the receivers looks okay, let us get some pointing/calibration data.

```
OBST> source mars                          - load planet mars
OBST> point                                - point on mars using defaults
OBST> corr f f                             - accept good pointing fit
OBST> zfocus                               - do a zfocus
OBST> corr * * f                           - accept good zfocus fit
OBST> xfocus                               - do a xfocus
OBST> corr * * * f                         - accept good xfocus fit


OBST> source egg neb /cat cat:lpoint       - load a line pointing source
                                           - The catalog LPOINT is in the
                                             SMTO default system directory
                                             (sys$smt:[smt.cat])
OBST> lwpoint /be_lpt aosa /def            - do a line pointing, with defaults
                                           - use only backend aosa for fit.
                                           - important to define one backend
                                             only for fit!
OBST> corr f f                             - accept good lwpoint fit.


OBST> set w_pos -100 100                   - set wobble throw +/-100 arcsec
OBST> cal /cal trec /def                   - take a hot/sky calibration scan
OBST> wswitch -200 0 az /time 30 30 /sub 3
                                           - while here, get calibration data
```

Some examples of how one might take some data on source:

WSWITCH example:

```
OBST> source MYFAV /cat MYCAT            - finally! ready to go to source
                                         - The catalog MYCAT will be in
                                           your directory [obs.yourinitials]
OBST> cal /cal trec /def                 - take a hot/sky calibration

OBST> wswitch -200 0 az /time 30 30 /sub 10 /def
                                         - take a wswitch scan
                                           (10 subscans per beam)


OBST> show wsw                           - show wswitch scan parameters.
OBST> cal                                - hot/sky calibration is default
OBST> wswitch                            - use default wswitch scan
```

PSWITCH example:

```
OBST> cal/cal trec /def                  - hot/sky calibration is set default
OBST> set off -200 0 0 LAM               - offset the scan center
                                           by (-200,0) in RA,DEC.
OBST> pswitch -1200 0 az /time 30 30 /sub 10 /def
                                         - take a pswitch scan
                                           at the OFFSET position,
                                           set these parameters as default.

OBST> source MYFAV3 /cat MYCAT2          - source MYFAV3 is in a different
                                            catalog (MYCAT2)
OBST> cal                                - hot/sky calibration is default
OBST> pswitch                            - use defaults.
OBST> pswitch /sub 20 /def               - change number of subscans.
                                           Make new default.
```

PMAP example (On-the-fly):

```
OBST> set catalog_c MYCAT                    - set the source catalog default
     to MYCAT (located in this
                                               example in your directory
                                                 [obs.yourinitials]
OBST> source MYFAV2 /cat MYCAT               - source MYFAV2
OBST> cal/cal trec                           - hot/sky calibration scan
OBST> pmap 1000 0 /map 120 5 60 10 lam /time  3 30
  - set up a PMAP (On-the-fly) map.
OBST> start                                  - start the PMAP
```

WRASTER example:

```
OBST> source MYFAV2 /cat MYCAT               - source MYFAV2
OBST> cal                                    - hot/sky calibration scan
OBST> set off -900 0 0 lam                   - set the center position to
                                               (-900,0) in (RA,DEC)
OBST> wraster 200 0 /map 120 10 120 10 lam /time 30 30
  - set up a map using wswitch scans
     for the raster map.
OBST> start                                  - start the WRASTER
```

Those of you wishing to know about the various options for a specific command, please check out Chapter 6.

The next few pages have more detailed examples of some of the commands.

2.6.1 Setting the Source

Let us see the different ways that you might call a source located in a catalog.

OBST> sour fav_source This loads your source. Usually you will need to specify a particular catalog as well, unless the catalog has been set as the default.

To define a source catalog, use: OBST> SET CATALOG_C your_fav_catalog

OBST> sour MARS - sets the source to the planet MARS

OBST> sour MYFAV /cat MYCAT - sets the source MYFAV from the catalog MYCAT.cat in your area on FRANKENHEIM.

OBST> sour IRS32 /cat sys$smt:[smt.cat]xyz.cat

- sets the source in a non-default catalog, here the catalog xyz. The sys$smt:[smt.cat] directory is where the SMTO standard catalogs are located.

OBST> sour IRS32 /cat cat:xyz.cat

- sets the source in a non-default catalog, where "cat:" is the alias for the system catalog area (sys$smt:[smt.cat]).

Since these are spectral line observations, you may wish to alter the velocity of the source from that specified in the catalog.

Do to this,

OBST> sour IRS32 /vel XXX vlsr /cat xyz

- sets the source in a non-default catalog, here the catalog xyz. The velocity, however, has been set to XXX rather than that specified in the catalog. One can choose a different velocity frame from that specified in the catalog. See Chapter 6 for further details.

OBST> sour IRS32 /vel -30.0 vlsr /cat xyz

- Setting the velocity to -30.0. Until you reload the source, the velocity will be fixed at -30.0.

OBST> sour IRS32 /vel 0.05 z /cat xyz

- Setting the velocity to a REDSHIFT of 0.05.

2.6.2 Setting the Receiver: RX

We have tried to make the procedure as painless as possible for the observer. In general, one has a large number of options depending on what exactly one wants to do. See Chapter 3 for details on possible receiver options.

Also, talk over with your FOT what receivers you might use.

OBST> rx SIS230 This sets up the receiver parameters for the SIS230.

OBST> rx SIS345 This sets up the receiver parameters for the SIS 345 receiver.

OBST> rx SIS490 This sets up the receiver parameters for the SIS490 in the first IF.

OBST> rx HEBOL This sets up the HEBOL receiver.

You might wish to set up two receivers at the same time. Or perhaps use the second IF instead of the first.

If that be so, then the command is only slightly different:

OBST> rx * SIS490 This sets up the receiver parameters for the SIS490 receiver with IF 2.

OBST> rx SIS230 SIS490 This sets up the SIS230, SIS490 at the same time for simultaneous observing.

Section 6.5 discuss how to set up a source catalog.

2.6.3 Setting the Line Frequency: LINE

Usually we have the line that you want in our default line catalog (sys$smt:[smt.cat]linefreq.cat). However, sometimes you might have to load the line from another catalog or even input directly.

OBST> line CS(5-4) This sets up the observing frequency.

OBST> line test XXX.XXXXXX LSB

> This defines the line whose name will be "test", with frequency XXX.XXXXXXX, using LSB.

OBST> line myfavline /cat myfavline_catalog.cat

> If you have a special line catalog, then you can make that your default catalog by using the SET CATALOG_L command. This catalog can (and should) be placed in your own area for ease of use.
>
> OBST> set catalog_l myfavline_catalog.cat
>
> Note that if you then wanted to use our line catalog again, you could call:
>
> OBST> line cs(5-4) /cat cat:linefreq.cat

You can also modify the line/frequency information more directly. However, this should very rarely need to be done by the observer.

OBST> feset /harm 10 /mult 4 /if 1500.

> These values will be used by FEORGA (Front-End ORGAnizer) to calculate the values needed for the PLL and HP synthesizer. The frequency is updated every subscan. This command might have to be used if you were using the extended SIS230 range (above 270 GHz).

OBST> l_mode /freq 345.795975

> Will set up for spectral line observing (in this case CO J=3-2).

Section 6.5 discuss how to set up a source catalog.

Remember-you have to type a command like GO or PSWITCH to send the line information to FEORGA!

2.6.4 Setting the Backends: BACKEND and BE_FE

There are *two* steps involved with setting the Backends.

First, define the backends you wish to use.

OBST> backend aosa aosb This commands sets up AOSA and AOSB. One has to use the backend command to define ALL the backends one needs to use. Verify with SHOW BACKEND

Second, you have to connect each backend with the appropiate receiver.

OBST> be_fe AOSA 1 — Attaches AOSA to receiver 1.

OBST> be_fe AOSB 1 — Attaches AOSB to receiver 1. and if you have two receivers defined.

OBST> be_fe AOSA 1 — Attaches AOSA to receiver 1.

OBST> be_fe AOSB 2 — Attaches AOSB to receiver 2.

The case of the SIS345 receiver (which has two channels) is a little special.

OBST> be_fe AOSA 1a — Attaches AOSA to receiver SIS345 channel 1

OBST> be_fe AOSB 1b — Attaches AOSB to receiver SIS345 channel 2.

Remember-you have to type a command like GO or PSWITCH to actually update the backends.

OBST> show backend — Shows the backends you have set up.

OBST> show be_fe — Shows what backends are connected to which receivers.

OBST> GO — loads all parameters into OBSINP, goes to source, allows observer to tune/tweak receiver, backend settings to perfection, does not take data.

See Section 3 for a discussion of how to set the correct levels for each of the backends in use..

2.6.5 Calibration: CAL, EFF

We have tuned our receiver, are on source, and ready to get some data. First, we need a calibrate. The calibration observation is actually two scans - a dark (first scan) followed by the requested calibration scan (either a cold or T_{rec} calibration).

Generally we recommend 10 second integrations (so that during the cold subscan, the cold paddle does not warm up).

OBST> calibration /calmode cold

or

OBST> cal /cal cold

The scan will automatically take a sky scan, followed by a hot load. The cold load will be taken after the observer has placed a cold load (usually absorber placed into LN2 and then put in the Receiver path) and pushed the cold load button.

If the default for CALIBRATION is /calmode cold, then just "cal" would work.

To change the reference position for the sky to (-900,0) using the current coordinate system, do the following:

OBST> cal -900 0 /cal cold

To change the integration time to 10 seconds, do the following:

OBST> cal /cal cold /time 10 10

Once we have gotten a good cold calibration, we can just check the sky with a "trec" calibration. The receiver temperature from the previous "cold" calibration will be used. Again, two scans (a dark and a calibration) will be taken. However the calibration scan will have only two subscans (sky, hot load). ONLINE CHEF will use the T_{rec} found by the cold calibration scan.

OBST> cal /cal trec

As with the "cal cold", one can modify the reference position or the integration time.

2.6.6 Pointing: POINT, LPOINT, LWPOINT

We need to check our pointing before getting too excited about the data taking process!

OBST> POINT /len 180 /time 30

- point on a continuum source. The specific example will do 30 seconds per direction along the cross. The length of the cross is specified to be 180 arcseconds.

Needs to be several Jy at least to work well with any of SIS receivers due to the small bandpass actually measured. In most cases, only the strongest of our continuum pointing sources will be detectable.

OBST> LPOINT /len 30 /backend aosa

- line pointing, using position switched scans. See below.

OBST> LWPOINT /len 30 /backend aosb

- line pointing, using beam (wobble) switched scans and backend aosb.

The LWPOINT and LPOINT procedures will do a cross, 3 points in AZ, 3 points in El. The length of the cross is specified by the observer. We recommend that you use the beamsize for the length, unless the source is extended relative to the beam. For example, with IRC+10216 at CO(2-1), we have found 40 arcseconds for the length is better. In addition, line pointing only works well for compact sources, like evolved stars.

Line pointing is often the preferred method for pointing with the SIS receivers. We have identified about 20 evolved stars scattered around the sky that are bright enough in the CO(2-1), CO(3-2), and CO(4-3) lines to be used as line pointing sources. They are found in the CAT:LPOINT.CAT catalog. For some of these sources, other strong lines can be used. Also, consult the FOT on tricks of the trade (for example when observing near CO(3-2) in frequency, you often don't have to retune-just reset the line frequency to CO(3-2) and after line pointing, just reset to your line.)

It is possible for you to set up your own line pointing catalog, if you have some favs of your very own!

The observer MUST remember to define a single AOS for the actual pointing fit. The ONLINE CHEF program will try (but get confused) if you have multiple AOSs defined for the procedure. Note that you can have all the backends you want connected-but you need to specify a single AOS in the LPOINT or LWPOINT commands. We have set AOSA as the default for these commands.

2.6.7 Position Switching: PSWITCH

PSWITCH - or position switching - allows the observer to select reference position quite far away (if the source is extended) or quite close. In position switching, the telescope will move on the off scan to the specified off position, integrate for the requested subscan time, and then to the source position, where the telescope will integrate for the subscan time. After every two subscans (OFF-ON), ONLINE CHEF will display the current spectra results for all defined backends.

The basic parameters that you must decide on are the reference position, the number of subscans, and the integration time.

To perform a position switched scan of your source:

OBST> pswitch 1800 * AZI * /time_l 60 60 /subscan 2

> This will do a position switch in azimuth (ref position is 30' in azimuth), 60 seconds for the on subscan, 60 for the off subscan.

In many cases, the observer will want to do a position offset from the (0,0) position defined by the SOURCE command. In those cases, you need to do as follows:

OBST> set off -30 0 lam orig **or**

OBST> set off -30 0

> This command will define the source position OFFSET relative to (0,0).
>
> You can take a PSWITCH then by

OBST> pswitch 1800 * AZI O /time_l 60 60 /subscan 2

> where the scan on position is (-30,0) and the reference position is (1800,0 in AZ) where the O defined the reference position as relative to the origin (i.e. 0,0).

The position offset will remain until reset by another SET OFFSET or SOURCE command.

Note that the SOURCE command will reset ALL position offsets to zero.

2.6.8 Beam Switching: WSWITCH

WSWITCH is extremely useful in cases where you wish to get the best baselines and your source is expected to be very compact. The beam throw is restricted to be less than 280 arcseconds, hence extended regions are not feasible. Also, note that our wobbler will only move in AZ (azimuth).

WSWITCH will wobble the telescope between the on and off beam positions for each subscan. The source will be in the negative beam for one subscan, with the positive beam on sky. In the next subscan, the source will be in the positive beam, and the negative beam will be on sky. (This applies only if the wobble throw and the wobble positions are consistent, see sections 6.6.7 and 6.8.8 for fun details! The number of subscans requested refers to the number of subscans with source in positive beam-so the total number of subscans is twice that requested in the WSWITCH command.

The basic parameters that you must decide on are the wobble throw, the number of subscans, and the integration time.

To perform a beam switched scan of your source:

OBST> wobble /w_pos -60 60 - Make sure the wobble parameters are set.

OBST> wswitch -120 /subscan 2

This command will take a beam switched observation consisting of 2 pairs of data (for a total of 4 subscans).

In many cases, the observer will want to do a position offset from the (0,0) position defined by the SOURCE command. In those cases, you need to do as follows:

OBST> set off -30 0 **or**

OBST> set off -30 0 lam orig - if wish to specify coordinate system more precisely.

This command will define the source position OFFSET relative to (0,0).

You can take a WSWITCH then by

OBST> wswitch -200 /time_l 60 60 /subscan 2

where the scan on position is (-30,0) and the reference position is (-200 in AZ).

The position offset will remain until reset by another SET OFFSET or SOURCE command. Note that the SOURCE command will reset ALL position offsets to zero.

2.6.9 Raster Maps Using position switching: PRASTER

Raster maps will do point by point maps, with each on-subscan being the next position in the map. Only one on subscan is taken per position, so signal-to-noise is achieved by repeating the map as often as necessary and summing offline. The PRASTER map uses position switching between the off (reference) position and the various points specified in the map. The observer can choose in good weather to take 2 or 3 on subscans per off. However, the default is 1 off for every on.

The key parameter is mapsize (the map size and coordinate system). The observer will define the length of the map followed by the spacing in that direction followed by the height of the map and spacing in that direction - all in arcseconds. Usually people will want to map in RA, DEC.

The number of points in one direction will be equal to the (length/spacing +1). So a 30 second length and 10 second spacing will result in 4 positions being taken in that direction.

We recommend that the total map time (number of onscans + number of offs times the integration time per subscan) be only about 10 - 20 minutes. This will permit the observer to do calibration scans frequently enough. Typically for 30 second subscans (1on-1off), that will be a map of about 9 or 16 points.

To do a position switched raster map:

The position switched mapping routine is called 'praster'. The observer loads the parameters and then OBST expects you to check your inputs (using a SHOW PRASTER command). To actually take data you have to type START!

OBST> praster 1000 0 azi * /mapsize 20 10 20 10 lam

OBST> start - Required to actually start the map.

This command will do a 20"x20" map with 10" spacing in ra and dec. The off (reference) position is (1000,0) in azimuth.

OBST> praster 1800 * azi * /mapsize 150 30 150 30 azm /time 10 10 /on_offs 1

OBST> start - Required to actually start the map.

This command will do a 2.5'x2.5' map with 30" spacings in azimuth and elevation and doing 1 off for every on. The off (reference) position is (1800,0) in azimuth.

In many cases, the observer will want to do a position offset from the (0,0) position defined by the SOURCE command. In those cases, you need to do as follows:

OBST> set offset 30 30 lam

You then follow it with a PRASTER, START sequence.

The position offset will remain until reset by another SET OFFSET or SOURCE command. Note that the SOURCE command will reset ALL position offsets to zero.

2.6.10 Beam Switching Maps: WRASTER

Raster maps will do point by point maps, with each on-subscan being the next position in the map. Only one on subscan is taken per position, so signal-to-noise is achieved by repeating the map as often as necessary and summing offline. The WRASTER map uses position switching between the off (reference) position and the various points specified in the map. The observer can choose in good weather to take 2 or 3 on sub scans per off. However, the default is 1 off for every on.

The key parameter is mapsize (the map size and coordinate system). The observer will define the length of the map followed by the spacing in that direction followed by the height of the map and spacing in that direction - all in arcseconds. Usually people will want to map in RA, DEC.

The number of points in one direction will be equal to the (length/spacing +1). So a 30 second length and 10 second spacing will result in 4 positions being taken in that direction.

We recommend that the total map time (number of onscans + number of offs times the integration time per subscan) be only about 10 - 20 minutes. This will permit the observer to do calibration scans frequently enough. Typically for 30 second subscans (1on-1off), that will be a map of about 9 or 16 points.

To do a beam (wobble) switched raster map:

The beam (wobble) switched mapping routine is called 'praster'. The observer loads the parameters and then OBST expects you to check your inputs (using a SHOW PRASTER command). To actually take data you have to type START!

OBST> set w_pos -100 100

OBST> wraster -200 /mapsize 20 10 20 10 lam /time 10 10

OBST> start - Required to actually start the map.

> This command will do a 20"x20" map with 10" spacing in ra and dec. The off position is -200 in az. 10 second integrations per subscan.

OBST> wraster -200 /mapsize 150 30 150 30 azm /on_offs 1

OBST> start - Required to actually start the map.

> This command will do a 2.5'x2.5' map with 30" spacings in azimuth and elevation and doing 1 off for every on. The off (reference) position is (-200) in azimuth.

In many cases, the observer will want to do a position offset from the (0,0) position defined by the SOURCE command. In those cases, you need to do as follows:

OBST> set offset 30 30 lam

> You can then follow it with a WRASTER, START sequence.

The position offset will remain until reset by another SET OFFSET or SOURCE command. Note that the SOURCE command will reset ALL position offsets to zero.

2.6.11 On-the-Fly Mapping: PMAP

On-the-fly observations scan the telescope along, taking samples every few seconds. It can be a very efficient way to map a region, and can be used even on relatively weak sources if the maps are repeated.

In our system, each subscan is a sample. Because the telescope is moving, we have to take samples often to prevent beam-smearing effects. We recommend that samples be taken at least every 1/3 of a beam in the scan direction. Ideally, one would take samples every 1/4 of a beam or more. For example, we recommend 5 arcsecond samples for observations at 345 GHz typically. In the non-scan direction, there is no beam-smearing, so the observer can chose to sample every beam if she/he wishes-though to get the best resolution maps, we recommend every half-beam (Nyquist sampling).

The data is reduced offline. See Chapter 6.10 for all the gory details!

OBST> pmap -1800 0 az /mapsize 100 5 50 10 lam /time 3 60 /on_off 1 no

OBST> start

The reference position can be in az,el or the source coordinate system.

The map can be in either the source coordinate system or (az,el). If you define lam, then you will scan in RA. If you define BET, then you will scan in Dec. Similarly if you define AZ, you will scan in azimuth and if you define EL, you will scan in EL. Most observers will want to do either RA or BET. (Actually if you are mapping several times, you will probably want to do both to build up a nice map).

The scan does 3 seconds per sample and 30 seconds per off. We recommend that the total off time be equal to the number of samples per on * time per sample * sqrt((ons per off). For the example above, the integration time per row (subscan) at 230 GHz (30 arcsecond beam) is 60 seconds (about as long as you would want to go). Hence the 60 second off scan time.

This scan does one on subscan per off. In good weather, you can probably do more ons per single off, though you would need to adjust your total off time to sqrt(#ons/#offs).

In many cases, the observer will want to do a position offset from the (0,0) position defined by the SOURCE command. In those cases, you need to do as follows:

OBST> set offset 30 30 lam - set the offset of map center to 30,30.

You can then follow it by a PMAP, START sequence.

The position offset will remain until reset by another SET OFFSET or SOURCE command. Note that the SOURCE command will reset ALL position offsets to zero.

No wmap (wobble switched on-the-fly) exists currently.

2.7 Shutdown

At the end of the observing period, follow the shutdown procedure:

- 1) Type 'stow' at the **OBST** prompt to rotate the antenna to the northern horizon.
- 2) After the telescope is at stow, turn off the button labeled "Panel Control Power" on the Building Drive Control Panel to the right of Frankenheim.
- 3) Hit the close button on the Shelter Control Panel (aka the Interlock Status Controller) above the button array(i.e. LOAD, CANCEL...) This will close the door and roof panels (about 10 mins).
- 4) Exit OBST, saving your setup if necessary before exiting.
- 5) Exit from OBS session if necessary.
- 6) Get some sleep and begin again tomorrow.

2.8 Tidbits of Information

The increased flexibility of the system means that it is more powerful. It also means that there are more interesting ways to go astray. Some commands that are helpful in sorting out what is the status of the system are:

SHOW_CURRENT - This command, which is followed by a VERB, shows the current status of the parameters. It also shows you the DEFAULT values. It is very good procedure to always do a show command before starting an observation of type command. This allows you to verify the setup is as you wish!

BE_FE - If you just type this command (with no adverbs), it will tell you the current configuration of the backends.

DISPL_CHAN - This command ("DISPL_CHAN ?") tells you what channel is being used by ONLINE CHEF for processing continuum data (i.e. the POINT command). This is important to know if you are using multiple receivers (say the SIS230/SIS490) at the same time.

To change channels, use the command "DISPL_CHAN X" where X is either 1 or 2 (for POINT). Channel 2 is used if you want to look at the second receiver's outpu when using two receivers or the second channel of a dual polarization receiver.

OBSINP ATN7 gainnumber - sets the gain level for the Filterbanks. Must do some scan (GO, PSWITCH, etc...) for the filterbanks to be updated. It is used for making sure the filterbanks are not saturated (i.e., total power level on hot load between 500 and 750).

SET OFFSET - sets the offsets from the SOURCE. If you invoke the SOURCE command, followed by GO or some observation, then any offsets are lost. (This prevents you from mapping some offset position, then moving to a new source only to not see anything because you forgot the offsets!)

Note that the OFFSET positions will be used for PSWITCH and similar commands UNLESS you use the /NOOFFSET option. Then the offsets are suppressed.

SET REF_POS - sets the reference position from the SOURCE. The observer has considerable control over the distance, the reference coordinate system (AZ, LAM) and whether the reference position is relative to the origin (i.e. the source position of zero offsets) or not.

RENAME - The observer's SPECTRA.SMT file can get quite large with time. This will eventually cause Online CHEF to slow down, particularly when processing LPOINT or LWPOINT data. It is therefore convenient to rename the SPECTRA.SMT when it approaches 10000 spectra. For the number of SPECTRA.SMT spectra, look at the ONDIS window on Koenigbacher. A new SPECTRA.SMT file will be created for you after the old one is renamed.

SKYDIPs - Both continuum and line observers can do skydips. To reduce the data, one can do the following in one of the FRANKENHEIM windows outside of the OBST program:

To reduce continuum skydips:

- skydip - this procedure will do run Kreysa's skydip program. It is used for the bolometer, but can't be used alone for SIS data since it uses load switched data, not total power data.

  Note: If one wishes to reduce continuum data taken with the bolometer receiver, then one should use Kreysa's skydip program.

To reduce spectral line skydips:

- plot_skydip - this procedure will take your SKYDIP done with the SIS receiver and process it. It will ask you for a scan number and the desired plot title. The plot is then produced automatically on the laserprinter.

Plot_skydip skydip is a script that consists of some skydip commands, get_skydip and fit_skydip. "Some skydip" commands occansionally aborts. In this case, you may be able to manually type them in and run the other two scripts.

- skydip - this procedure will do run Kreysa's skydip program. It is used for the bolometer, but can't be used alone for SIS data since it uses load switched data, not total power data.
- get_skydip - this procedure will get the skydip data, from Kreysa's skydip program and makes an output file suitable for Jeff Mangum's skydip program.
- fit_skydip - fit the skydip (from get_skydip) using Jeff Mangum's skydip program.

Note that the OBST procedure SKYDIP for SIS/HEBOL receivers will ask for a COLD load at the end of the scan!

We ask that observers note down on the logsheets the results of their skydips, the taumeter result, and the frequency observed. This will allow us to build up a table for local use on freq vs taumeter readings.

Changing OBST sessions - Sometimes (rarely) the observer will not wish to log out completely when changing a program or changing between two observers. How can one modify the output files and directories so that only one observer area is used?

- OBST> SAVE some_file - save the previous configuration so that the first observer can restore his OBST session.
- OBST> EXIT
- CHANGE_INIT —- FRANKEHEIM will then ask you for a new prompt.
- OBST — To start new OBST session.
- In the other FRANKENHEIM windows (i.e. GREG, CHEF), type the fix_prompt command if you want to change the prompt to reflect the current observer.
- You will also need to change directories in the FRANKENHEIM windows to the correct directory for your new initials. (Otherwise, you will still be working in the directories you started.) You then can use CHEF offline (or other procedures that you might need) in the correct directory.

Changing SPECTRA.SMT files - Sometimes you might wish to use a different SPECTRA.SMT file in your current OBS session, perhaps to put incoming data into a different person's project area.

- OBST> MBC FILE OUT sys$smt:[obs.INI]SPECTRA.SMT /supply
- OBST> MBC FILE IN sys$smt:[obs.INI]SPECTRA.SMT /supply