Appendix A

Pointing

A.1 Taking Pointing Data For Fun and Profit

Pointing measurements are used to create an improved pointing model for the telescope. Since there is error in any measurement and some pairs of model parameters contribute in similar ways in small regions of the sky, it is essential that many measurements be done and that they be as widely spaced and uniformly spaced as possible. Redundant measurements help cancel out the measurement errors and allow one to throw out spurious measurements caused by sky variations that happened at a critical time in the measurement. Widely spaced data allows the fitting process to determine more accurately the value of pairs of parameters whose functions only differ from each other significantly over large angles. And if large areas of sky aren't measured at all, the pointing model in those areas is poorly constrained and may deviate from the true model by large amounts in order to fit too accurately, data in an area a large distance away. Finally, if many data points are clustered in the same area of the sky, that portion is weighted too highly and partly cancels out the benefit of widely spaced data.

There are not many objects strong enough to use as pointing calibrators. The strongest objects are the planets Venus, Mars, Jupiter, Saturn, and Uranus. (The Moon is the strongest of all, but it is so large that it is usually more trouble than it is worth, since a different observing procedure from all the rest would have to be used to measure it. Mercury is never far enough away from the Sun, 30 degrees, to observe safely.) A few galaxies and quasars are strong enough to use. A list of those which have been successfully been detected can be found in the Observer Documentation binder. Additional objects may be added in time as there is now a second observing procedure to use which ought to be better for measuring fainter objects. A third procedure that will work by measuring a small object with a strong spectral line will be added soon.

Before beginning observations, check that the PC that reads out the weather station is still doing so. Occasionally it halts with an error message. Continuing the BASIC program (strike F5) usually cures this, but sometimes a reboot is necessary. If so, login as VISITOR when it asks for a username after the boot. When the boot is complete, type weather to start the program. The weather data is used to compute the index of refraction needed to correct the object apparent positions for refraction.

A.1.1 XEPHEM

Next start the xephem program: type XEPHEM in one of the windows on an X-terminal. After about 30 seconds a window will pop up. Pull down the View menu and select Sky View. Another window will pop up showing a map of the sky with the pointing calibrators above 10 degrees elevation. If this window overlaps the Update bar on the first window, reposition one of them so that you can press Update periodically. Each time this is pressed, the object positions on the sky are recalculated for the present time. Pull down the View menu on the Sky View window and select Grid. An Azimuth-Elevation grid will appear. The circles are lines of constant elevation spaced 5 degrees apart from 10 to 85 degrees. The lines are drawn every 30 degrees of azimuth with south at the bottom and east at the left. The scroll bars can be used to change the view, but this is not recommended. The scroll bar at the left sets the size of the field of view. It should be 160 degrees so that the last elevation circle is for 10 degrees elevation. The scroll bar at the right selects which elevation should be at the center of the circle (90 degrees). The scroll bar at the bottom selects the azimuth at the bottom of the circle (180 degrees).

Find a blank Azimuth-Elevation grid in the Control Room. If one is not available, you can print another one by typing:

```
KRONEN> PLOT TEL$POINTING:SKY_TEMPLATE
    or
FRANKE> PLOT TEL$POINTING:SKY_TEMPLATE
```

You should write the date and time on this sheet and mark the positions of the objects as they are observed in order to document the sky distribution of the (successful) measurements.

The names of the objects are written on the map alongside the dots marking their positions. The size of each dot is an indication of the radio flux from the object at 1.3 mm wavelength. (The dots for the planets also indicate their relative brightness, but these are on a different scale.) If one moves the mouse pointer onto the map and presses the left button, the Elevation ("Alt") and Azimuth of the pointer are shown on the top corners and the Right Ascension and Declination in the bottom corners. If one drags the mouse button, the SEP value in the upper right corner shows how far you have moved. (This can be used to checking how far an object is from the sun.) If one points at an object and presses the right button, the name and coordinates of the object are printed. (This is particularly useful when the names overlap each other.) Some other options are also available with the right mouse button. Create Trail... lets you see where an object will move as time passes. The first time it pops up the following selections are recommended: Path-Right orientation, 1 Hour interval, time stamp None, and start Now. Press OK and the pop-up will disappear and the trail is drawn. If a different object is right-clicked, one can select Create Trail... then press OK in the pop-up and a trail with the previous selections will be drawn. Right-clicking an object that already has or once had a trail brings up an additional option, Trail, which can be used to re-draw or erase the original trail. The Point and Point & Zoom options should probably avoided as they change the center of the map and the magnification which then must be restored in order to get back to the view corresponding to the Azimuth- Elevation grid used to record the object positions.

The catalogs for the XEPHEM program are in the directory:

```
KDATA:[SMT.CAT]          !SMT Catalog Directory
  or
KRONEN$DUA2:[SMT.CAT]    !Long form of the same address.
```

The standard pointing sources are in the file:
BOLO.EDB

Any files you wish to use for XEPHEM must end in EDB. The format of the files is, alas, not the same as the OBST pointing catalogs (see Chapter 2). The reader is referred to the online help files for all the options possible in XEPHEM. (Hint: look in the HELP area in the Data Base window, which is brought up by clicking the Objects (Data Base) entry on the main XEPHEM menu.) There is also a hardcopy of the XEPHEM manual to be found in the ASTRO/CLASS/etc... manual at the back.

An example format is given below:

```
#My favorite pointing source
W3OH, f|S|B5, 02:23:16.5, +61:38:57, -8.2, 1950
#end of file!
```

The # is a comment line.

The next line is the source entry, in this case W3OH. If we parse the line up, we get the following breakdown.

```
 W3OH        ! Source Name, can include - or + or . or _
             ! Examples: W3OH, 1757-240, 2230+114, G45.1, CW_Leo

 f|S|B5      ! Source type.  Depending on the choice, one has
             ! the ability to provide very detailed information.
             ! For example, here it is a fixed source (no proper
             ! motion) (f), Stellar (S), spectral type B5.
             ! If you examine the pointing list, we use this
             ! as a default...
             ! See the manual for the fancy stuff!

 02:23:16.5  ! RA
+61:38:57    ! Dec
 -8.2        ! Magnitude of source - relative brightness
 1950        ! Epoch (optional - assumes 2000.0 if not given).
```

Following this example, you can create your own catalog file for use in XEPHEM if you wish.

A.1.2 OBST commands: POINT, GPOINT, CORR

The OBST window on Frankenheim is used to select the objects and start the observations. Currently, the observations are done via two observing procedures in OBST, POINT and GPOINT. One first selects the object with the command,

SOURCE $< name >$

(Note, only enough letters of any OBST command to make it unique need be typed: usually 3.)

Then, if the command defaults are set properly, one simply types either POINT or GPOINT. These commands both make observations in the shape of a cross aligned in azimuth and elevation and centered on the object. The POINT command causes the antenna to drift along the arms of the cross at a constant rate and the GPOINT command causes observations to be made while the antenna is held at evenly spaced points along the arms (usually 3 on each arm).

During the observation, plots are made periodically displaying the data already accumulated. At the end of the observation, a curve is fitted to the full set of data and the position where the object would have the peak brightness is estimated. This data is automatically recorded on disk for later input to the pointing model fitting program. The final plot shows the pointing error at this position in the sky and the recommended values to two of the pointing constants, COL* and NULE, which could zero that error, at least at this position in the sky. These are simply constant offsets to be applied in azimuth and elevation, respectively. The recommended values are automatically transmitted to the OBST program. (Temporarily, the REFRESH command must be typed in order to see the fitted values on the OBST window before the CORRECTIONS command is executed.) In order to adopt both of them, type the command

CORRECTIONS F F

To accept only the azimuth correction, COL*, type

CORRECTIONS F

and to accept only the elevation correction, NULE, type

CORRECTIONS * F

Optionally, one may explicitly type number(s) for the COL* and NULE values on the CORRECTIONS command:

```
CORRECTIONS <azimuth correction (=COL*)> <elevation correction (=NULE)>
    or
CORRECTIONS <azimuth correction (=COL*)>
    or
CORRECTIONS * <elevation correction (=NULE)>
```

If the corrections are small (a few arcsec), the nominal position of the object measured nearly the peak intensity and the CORRECTIONS command may be skipped. If the corrections are half the size of the antenna beam (the beam is about 32 and 22 arcsec wide at 1.3 mm and 0.9 mm wavelength, respectively), the peak intensity measured was less than half the true peak intensity and the position error estimate may be inaccurate. In this case, the CORRECTIONS command should be executed and the pointing measurement repeated with the cross better centered on the peak.

When making measurements with the POINTING command, the most accurate results are obtained when each arm of the cross is measured in both the forward and reverse directions. The Drumbeat backend makes a slight error in assigning a time to the observation which then results in a slightly wrong position of the antenna being attached to the datum. This systematic error is exactly canceled by combining forward and reverse scans. Since the antenna is not scanning across the object during a GPOINT command, this error does not apply. However, at low elevation, the attenuation of the atmosphere may be changing significantly with time due to the change in the amount of atmosphere between telescope and the object with elevation. A forward and reverse scan may also be beneficial in these circumstances, especially along the azimuth arm.

When a successful pointing measurement is made, the name of the object, the azimuth and elevation (as marked on the pointing fit plot), and the COL* and NULE recommended by the fit should be marked on the log sheet (regardless of whether the CORRECTIONS command was executed after the fit). One should also press the Update bar on the xephem window and mark the object's position on the Azimuth-Elevation grid. The name of the object is not needed, but it is sometimes helpful to note down the recommended COL* and NULE for that position in the sky. Sometimes, the current pointing model is so poor that one must continually change the COL* and NULE. After a number of measurements, one might recognize a pattern and anticipate the correction when moving near an area of the sky already measured.

It is a good idea to make more than one successful pointing measurement on an object, especially when first starting a pointing session. This rule may be relaxed later if one is finding that the measurements always repeat to a couple of arcsec.

A.1.3 When to Adjust BOLOGAIN

When a pointing session is begun, it is recommended to first point on a planet (preferably above 25 degrees elevation). Some planets are so bright that the signal may saturate near the peak with the bolometer gain normally used for faint objects. The Drumbeat data is saturated if the numbers are near +-250000 and the peak of the drift scan is flat-topped. For the brightest planets set the Drumbeat gain to 4 (or 5) with the command

DRUMBEAT /BOLOGAIN 4

When fainter objects are observed, set the gain back to the normal 1 to get the best signal-to-noise ratio. (The "gain" is mis-named. It would more logically be called attenuation.)

DRUMBEAT /BOLOGAIN 1

Normal operating mode for observations/pointing will be /BOLOGAIN 1.

A.1.4 OBST Focus Commands: ZFOCUS, XFOCUS

After making a successful pointing measurement and applying the CORRECTIONS, check the axial focus with the ZFOCUS command. And the ZFOCUS measurement should also be done several times to be sure that the measurement is consistent to 0.1 mm. If there's a choice, the focus procedure is more sensitive if the angular diameter of the planet is small. However, even focusing on Jupiter is better than nothing. The CORRECTIONS command will adopt the last focus fit if one types

CORRECTIONS * * F

Or one can substitute a number for F as with COL* and NULE.

If the above ZFOCUS was successful, a few measurements of the vertical focus with the XFOCUS command is wise (after checking and correcting any pointing errors with another POINTING observation and a CORRECTIONS). The fourth parameter for CORRECTIONS is the X focus value. So to accept the XFOCUS fit, type

CORRECTIONS * * * F

Again, one can substitute a number for F as with COL* and NULE.

When choosing the next object for pointing, one should select an object based upon its being positioned in an area of the sky with few or no other measurements and which will not require a long slew of the telescope. Ideally, one should systematically work one's way from one sky area to an adjacent area until the whole sky has been measured. But the few objects available for pointing rarely are positioned to make this possible.

The minimum number of objects required for a good pointing model fit is about 30 if they are well spaced over the sky. The more objects, the better the fit and the less suseptible the fit is to being spoiled by a spurious measurement. Although the signal to noise ratio goes down with elevation, it is important to make measurements at as low an elevation as is feasible. But note that the "horizon" as seen by the HHT is not at zero elevation, but ranges from 15 degrees in the south to 30 degrees in the north. A plot of this horizon vs azimuth is posted on the bulletin board.

A.2 Syntax of OBST commands ("verbs"):

Verbs begin with the verb name followed by zero or more parameters followed by zero or more adverbs (they begin with a /) each adverb followed by zero or more parameters. All items are separated by blanks (equal signs are not allowed). Verb and adverb names may be abbreviated to as few letters as will make them unique. Usually, only the first letter of non-numeric parameters is checked. The adverbs may be given in any order but the order of the parameters of verbs and adverbs is significant. Every verb will accept the adverb /DEFAULT. This means that the parameters specified become the defaults for future executions of the command. The "current" and default values of the parameters of any verb and its adverbs may be displayed by typing

SHOW < *verbname* >

The "current" values are the values used in the most recent execution of the command.

Like in VMS command syntax, an up arrow will recall the previous command which may then be modified before < *Return* > is struck to execute the command. To recall earlier commands, press PF1 then up arrow as many times as desired. The next previous command will be displayed with each strike of the up arrow. One may recall the previous command which began with < *string* > by typing REC < *string* >.

A.2.1 Details on the POINTING command:

The full syntax of the POINTING command is:

```
POINTING /LENGTH\_PT <arcsec>
         /TIME\_PT <time(s)> /SUB\_PT <nsub(total)> [BY\_2]
         /ORIENTATION <direction(L,B,A,E)> [ONLY]
```

Where $< arcsec >$ is the length of each arm of the cross in arcsec, $< time(s) >$ is the length of time to drift from one end of the arm to the other in seconds, $< nsub(total) >$ is the sum of the number of drift scans done on both arms of the cross (should be an even number), BY_2 if present means that drifts along the arms of the cross should be done alternately, two at a time (forward and reverse; and $< nsub >$ ought to be a multiple of 4), otherwise $< nsub >/2$ scans are done on one arm (alternating forward and reverse) followed by the remainder on the other arm, $< direction(L, B, A, E) >$ is the direction of the first arm of the cross: L=LONGITUDE/R.A., B=LATITUDE/DEC., A=AZIMUTH, E=ELEVATION, and ONLY if present means do NOT do the perpendicular arm of the cross.

Usual values for the pointing command are:

```
Planet: /LEN 180 /SUB 4 /TIME 30
Bright radio source: /LEN 180 /SUB 4 /TIME 60
Fainter radio source: /LEN 180 /SUB 8 BY\_2 /TIME 60
Really faint: /LEN 180 /SUB 12 BY\_2 /TIME 60
```

If the CORRECTIONS are likely to be large, /SUB 2 may be used (without the BY_2) for the first POINTING to get a quick estimate of the CORRECTIONS needed to roughly center the object.

A.2.2 Details of the GPOINT command:

The GPOINT syntax is similar to the POINTING command. The full syntax of the GPOINT command is

```
GPOINT /LENGTH\_GPT <arcsec>
       /TIME\_GPT <time(s)> /NUMBER <pts>
       /SUB\_PT <nsub(total)> [BY\_2]
       /ORIENTATION <direction(L,B,A,E)> [ONLY]
```

Where $< arcsec >$ is the length of each arm of the cross in arcsec, $< time(s) >$ is the length of time in seconds spent averaging the signal at each point on the cross, $< pts >$ is the number of points on each arm of the cross, $< nsub(total) >$ is the sum of the number times ¡pts¿ observations are made on both arms of the cross (should be an even number), BY_2 if present means that measurements along the arms of the cross should be done alternately, two at a time (forward and reverse; and $< nsub >$ ought to be a multiple of 4), otherwise $< nsub >/2$ scans are done on one arm (alternating forward and reverse) followed by the remainder on the other arm, $< direction(L, B, A, E) >$ is the direction of the first arm of the cross: L=LONGITUDE/R.A., B=LATITUDE/DEC., A=AZIMUTH, E=ELEVATION, and ONLY if present means do NOT do the perpendicular arm of the cross.

The GPOINT command is too new to have "usual" values. We expect that $< arcsec >$ ought to be 32 arcsec at 1.3 mm wavelength, 22 arcsec at 0.9 mm if $< pts >$ is 3. Alternatively, if better results are obtained with $< pts >= 5$, $< arcsec >$ ought to be increased by about 30%: 42 and 29, respectively. /TIM should be 20-30, and /SUB between 4-10 depending on the strength of the source and the repeatability. BY_2 should only be specified if /SUB is 8. GPOINT should not be used on planets or strong radio sources, as the dead time between subscans will make POINTING more efficient.

There are several options for the fit Chef performs on the GPOINT data. The fitted curve can be a Gaussian or a Parabola. The default is parabola.

```
OBST> MBC SUPPLY GRIDPOINT GAUSSIAN
      or
OBST> MBC SUPPLY GRIDPOINT PARABOLA
```

changes Chef's action. The parabolic fit takes much less time and is the better choice if $< pts >$ is only 3. The center points of one arm may be used in the fit of the opposite arm (the default). This may not be a good idea if the atmospheric emission is changing significantly with time. To prevent this, and accept only center points bracketted in time by the two end points, type

```
OBST> MBC SUPPLY GRIDPOINT BRACKET
      or
OBST> MBC SUPPLY GRIDPOINT NOBRACKET
```

to restore the default.

A.3 The Pointing Model

The Heinrich-Hertz Telescope (HHT) is a 10 m radio telescope located on Mt Graham in Arizona, USA. Receivers are mounted at both Nasmyth foci. (A tertiary mirror which can be flipped 180 degrees determines which Nasmyth focus is being used.) The telescope is outfitted with both bolometers and heterodyne receivers.

The pointing history at the HHT is very short. In November of 1994, Wilhelm Altenhoff and Juergen Schmidt made the first pointing model fit to measurements they made with a 1.3 mm wavelength bolometer. They fit the 8-term pointing model used at the Effelsberg 100 m telescope to the data. The RMS residuals of their fits were 3.7-5.0 arcsec. This pointing model together with a table of additional (empirical) pointing corrections was then used until mid-1995. Since then there have only been a half-dozen full sky pointing measurements plus about a dozen other pointing sets with less than full sky coverage. Thus we are still learning about the pointing performance of the telescope and what can be done to improve it.

It is now realized that a ninth term must be added to the 100 m pointing model to describe the horizontal misalignment of a receiver at the Nasmyth focus. The nine terms arise from twelve sources of pointing errors likely to be present in the telescope. Since there are more sources than terms, one cannot measure the magnitude of the twelve from pointing measurements alone. Also, the terms are by no means orthogonal to each other. That is, some terms may have very similar effects upon the pointing corrections, especially in certain parts of the sky. To determine the coefficients of all the terms accurately, it is necessary to measure the telescope pointing errors over a wide distribution of points in the sky. The error sources are named below. For those familiar with the pointing model used at the Effelsberg, the corresponding "P" numbers are also given.

Name	P#	Description
NulA	P1	Azimuth encoder zero point error
Col*	P2	Collimation error in azimuth
Perp	P3	Deviation of the azimuth and elevation axes from orthogonality
IncW	P4	Westerly tilt of the azimuth axis from the zenith
IncN	P5	Northerly tilt of the azimuth axis from the zenith
P6	P6	No obvious physical effect. Would arise if the catalog declinations of all objects were systematically too large.
NulE	P7	Elevation encoder zero point error/elevation collimation error
EFlx	P8	Flexure in elevation proportional to the component of gravity in the elevation direction.
ZFlx	--	Flexure in elevation proportional to the component of gravity along the axis of the primary. (Arises, for example, if the subreflector is not supported at its center of mass and therefore twists.)
OHor	--	Horizontal offset of a receiver from the elevation axis at the Nasmyth focus
OVer	--	Vertical offset of a receiver from the elevation axis at the Nasmyth focus
T0	--	Error in the sidereal time

The coefficients of the nine terms which can be determined by pointing measurements are:

	Az Term	El Term
NulA + OHor + T0*sin(latitude)	cos(el)	--
Col*	1.	--
Perp - OVer	sin(el)	--
IncW - T0*cos(latitude)	cos(az)*sin(el)	-sin(az)
IncN	sin(az)*sin(el)	cos(az)
P6	sin(az)	cos(az)*sin(el)
NulE	--	1.
EFlx + OVer	--	cos(el)
ZFlx + OHor	--	sin(el)

Since there are nine terms and twelve unknowns, one cannot solve for all twelve. One strategy would be to simply redefine nine new pointing constants equal to the above coefficients. However, it is mathematically equivalent to arbitrarily assume three of them are zero and solve for the remaining nine. We choose the latter option at the HHT. However, one must remember that the physical interpretation of these nine will be wrong if the three are not zero.

At the HHT, one bolometer is designated the "prime" bolometer, and a pointing fit is made assuming that T0, OHor, and OVer are zero. When another bolometer or receiver is used for observations, the first guess for the pointing model for it is that of the prime bolometer. If the receiver/ bolometer is at the same Nasmyth focus, it ought have the same pointing errors as the prime plus deviations due to OHor and OVer. A least squares fit for only OHor and OVer is then made to the pointing measurements after subtracting the prime model. The values of OHor and OVer so determined are not displacements of the new receiver/bolometer from the Nasmyth focus, but are displacements relative to the OHor and OVer of the prime bolometer which were assumed to be zero. When a receiver/bolometer is located at the opposite Nasmyth focus, its pointing model ought to be the prime model, plus the (relative) OHor and OVer, plus the error introduced by the misalignment of the tertiary mirror. This misalignment can be corrected by modifying the values Col* and NulE in the prime model. So one subtracts the prime model, then fits the remaining pointing errors by solving only for OHor, OVer, Col*, and NulE. (The Col* and NulE from this fit are then added to those of the prime model to produce the model for this receiver.)

One might ask why we do not solve for a complete pointing model independently for each receiver/bolometer. This would be a better method, "all things being equal". But things are never equal. The reason is sensitivity. A bolometer is more sensitive than a heterodyne receiver to continuum radiation. Thus there are more objects which can be quickly detected, and therefore one usually has better sky coverage for the pointing model fit. And the longest wavelength bolometer typically has the best sky coverage of all since the atmosphere is more transparent at longer wavelengths. The above strategy is needed only when there is not enough sky coverage for a full fit to the data from a non-prime receiver/bolometer.

Pointing measurements are almost exclusively made by scanning the telescope at a constant velocity in azimuth or elevation across an object. The intensity measured is plotted against position in the scan and a gaussian is fit in order to find the position of the peak and the beam width. Currently, we achieve the following accuracies at the HHT with the 1.3 mm bolometer:

```
Formal Errors from Gaussian Fits of Planets:        0.20-0.35 arcsec

RMS from repeated measurements of Planets:          0.7-1.1 arcsec

RMS residuals after full pointing model fit:        2-3 arcsec

(RMS errors before a fit to a new pointing model:   4-7 arcsec)
```

The planets have such high signal to noise that measurement errors due to bolometer/sky instabilities are negligible. The scatter in repeated measurements of planet positions is about three times greater than the accuracy of the gaussian fit. This is probably due to atmospheric (seeing) effects. We believe the telescope drive tracks smoothly to about 0.2 arcsec. At the shortest wavelength that the HHT will be used (0.35 mm), its beamwidth is 7 arcsec. The goal is therefore a pointing model with an RMS of 0.7-1 arcsec over the whole sky. The cause(s) for the actual RMS of 2-3 arcsec have not yet been determined.

The strategy of using a prime pointing model and only solving for the 2-4 terms which describe the offset of a receiver relative to the prime receiver has only been applied a few times. The results are mixed. Sometimes it seems to result in a good pointing model, other times it doesn't. We are confident that we can ultimately resolve the problem, but first we must find the cause. The following illustrates our recent experience. (The 1.3 mm and 0.9 mm bolometers were mounted at the same Nasmyth focus and the 345 SIS was at the opposite focus.)

Receiver	Pointing Model Terms Fit	Number of Measures	RMS residuals Az	RMS residuals El
1.3 mm Bolometer	All 9	34	1.4"	3.3"
(2 days later:)				

0.9 mm Bolometer	2 Nasymth	24	2.3"	2.4"
(Adjusting above 0.9 mm by the fit and combining with the above 1.3 mm:)				
1.3 mm \& 0.9 mm	All 9	58	1.9"	2.9"
(1 week later:)				
1.3 mm Bolometer	All 9	49	1.6"	2.6"
(Adjusting 0.9 mm as above and combining:)				
1.3 mm \& 0.9 mm	All 9	73	2.0"	2.7"
(10 days later:)				
345 SIS	4 Tert. \& Nas.	29+0	1.5"	4.6"
(3 days later:)				
345 SIS	4 Tert. \& Nas.	21+7	2.9"	6.5"
(All 345 SIS combined:)				
345 SIS	4 Tert. \& Nas.	50+7	2.9"	6.4"
345 SIS	All 9	50+7	2.1"	2.8"

(Where two numbers are given for the number of measurements, the number made on planets is given first followed by the number on objects at other declinations.)

The bolometer measurements demonstrate that the 0.9 mm measurements only differ from the 1.3 mm bolometer measurements by the Nasmyth offsets, and remain consistent with the 1.3 mm bolometer data even when combined with data taken a week later. But the 345 SIS measurements appear to differ by more than just the 4 offset terms. The fit of the 345 SIS data to all 9 terms indicates that the data are consistent with themselves and can be fit to the pointing model. But there were such large gaps in the sky coverage, that one would hesitate to depend upon the model in those gaps where it is unconstrained.

Examples of model fits to two different sets of 1.3 mm bolometer pointing measurements, and to the combined set follow:

Fit Name	(A)	(B)	(C)
Date	8-9 Feb 96	17-18 Feb 96	8-9, 17-18 Feb 96
Model Constants:			

NulA	348+-5"	373+-6"	370+-5"
Col*	4+-6"	-11+-8"	-22+-6"
Perp	0+-5"	14+-6"	23+-4"
IncW	-2+-1"	-8+-1"	5+-1"
IncN	10+-1"	11+-1"	12+-1"
P6	2+-1"	3+-1"	2+-1"
NulE	-321+-7"	-348+-8"	-324+-6"
EFlx	-25+-6"	-14+-6"	-28+-5"
ZFlx	10+-6"	36+-6"	18+-4"
N obs.	41	57	98

RMS of residuals:

	Az	El	Az	El	Az	El
8-9 Feb	1.6"	2.1"	---		1.4"	4.7"
17-18 Feb	---		2.9"	2.0"	3.3"	2.3"
8-9,17-18 Feb	---		---		2.7"	3.4"

(Two RMS pairs are listed for the 8-9 Feb and 17-18 Feb data sets. The second is the RMS of the residuals in solution (C) for only those points.)

The combined data set results in a reasonable model fit, but the constants fitted don't always agree within their formal errors with the separate fits. For example, IncN and P6 are consistent for all three fits, but the others can differ by four times their formal error. Looking only at solutions (A) and (B), one might conclude that most of the sources of pointing error had changed in the eight days between the measurements. While some may have indeed changed, I suspect that most of the apparently significant changes are caused by small-number statistics combined with fact that some of the parameters of the fit are correlated with one another, and with the less than ideal sky coverage of the measurements. When two parameters are correlated, their combined effect on the pointing correction in a given area of the sky may be well determined, but their individual values may not. Small measurement errors may be magnified as regards their effect on the individual values. This ought to be reflected in the formal errors of these parameters, but small-number statistics may give unrealistic values for the estimates of these errors.

A.4 Sample Pointing Session

After reading the past few sections, the observer may wish to see an example of a pointing session which would illustrate how a quick pointing/focus might go for a planet and typical bright secondary pointing source.

To check the defaults:

```
OBST> SHOW POINT             ! See the POINTING setup
OBST> SHOW ZFOCUS            ! See the ZFOCUS setup
OBST> SHOW XFOCUS            ! See the XFOCUS setup
```

Point on Mars.

```
OBST> SOURCE MARS            ! Select MARS-a nice way to begin!
OBST> DRUMBEAT /BOLOGAIN 4   ! Wonderfully bright!
OBST> POINT                  ! Usually the defaults are fine...
```

The scan completes, and the ONLINE CHEF/TOOLBOX fits look good. Some change in COL and NULE is suggested. You decide to accept and repeat.

```
OBST> CORR F F               ! Accept the corrections to COL*, NULE
OBST> POINT/APPEND           ! /APPEND will add together the two
                             ! pointing observations and store
                             ! only the final correction in the
                             ! POINTING.LOG
OBST> CORR F F               ! Scan completes, you accept corrections
```

Now time to turn to checking the focus. Mars, Uranus, Neptune are good for this-as are the brighter secondary sources sometimes.

```
OBST> ZFOCUS                 ! Do a ZFOCUS, using the defaults
OBST> CORR * * F             ! Scan was nice, accept the correction
OBST> ZFOCUS                 ! Decide to repeat
OBST> CORR * * *             ! No change-move on to XFOCUS

OBST> XFOCUS                 ! Do a XFOCUS, using the defaults
OBST> CORR * * * F           ! Accept XFOCUS Corrections
                             ! Decide no need to redo...
```

After doing a ZFOCUS, XFOCUS (and changing something), it is a good idea to just repeat the POINT.

```
OBST> POINT                   ! Repeat the Pointing observation
OBST> CORR F F                ! Wonderful-accept corrections...
```

Point on Another Source:

At this point, you decide to go to a pointing source closer to your object and point up at that location.

```
OBST> DRUMBEAT /BOLOGAIN 1    ! Reset for normal operations-or
                              ! you might wonder where your
                              ! source went!
OBST> SOURCE W3OH             ! Set up new source (in Default catalog)
OBST> POINT                   ! Do pointing observation
```

If the source were weak, you might increase the integration time or the number of subscans. (i.e. POINT /TIME 60 or POINT /TIME 60 /NSUB 4). The scan in our example completes, the fits look great in ONLINE CHEF/TOOLBOX. Decide to accept, and repeat since a modest change occurred.

```
OBST> CORR F F                 ! Accept new COR*, NULE
OBST> POINT /APPEND            ! Repeat pointing, append last point
                               ! Scan in POINTING.LOG
OBST> CORR F F                 ! Scan completes, looks great, accept...
```

Continue for as many sources as you feel the need for!

Note: If you did POINT /TIME 60 and did not set the /DEF flag, then if you do a /APPEND, you want to input POINT /TIME 60 /APPEND. Same applies for other things like /NSUB.

Have fun Pointing!

Appendix B

Pointing sources

As described in section 6.5.1, you can specify your own source lists. In this section, we present the current (March 97) master continuum source list. The sources are taken from the standard IRAM catalog, with a few local additions.

One set to note are those that include "HATCHES" and "STOW". HATCHES is a position that allows access to the telescope hatches so that we can transport equipment up to the upper floors without risking the telescope. STOW is our favorite location to put the telescope at night.

In addition to the planets, there are a number of relatively bright 1.3mm sources available for pointing included in our list. However, as you go up in frequency, the non-thermal continuum sources are not going to be very bright. Instead, focus your attention on YSOs like W3OH.

A copy of this list can be printed out at the site by (on kronen or frankeheim) typing

```
PRINT KDATA:[SMT.CAT]SMTCONT.CAT
```

SMTCONT.CAT begins on the next page.

```
! file: SMTCONT.CAT
!
! THIS IS THE SMT MASTER CONTINUUM SOURCE CATALOG, CONTAINING GUARANTEED
! POINTING SOURCES.
!
!********************************** june 1995 *** JGM ***************
! Copied from standard IRAM catalog (IRAM.CAT and BOLO.CAT)
!     (BOLO.CAT by C. Thum and given to SMT by W. Altenhoff) -- JGM
!
INDIVIDUAL: SNAM SBAS SLOP SBOP OLAM OBET SAZM SELV OAZM OELV CBE1 CBE2 CBE3
COMMON: SAZM; SELV; OLAM; OBET; SLOP; SBOP; SLAM; SBET; OELV; ! OAZM;
SNAM= LES8 ; SBAS= 5D; SLOP= 180D; SBOP= 57 17 54.2; OBET= 0*;
SNAM= HATCHES ; SBAS 10; SAZM 265 D; SELV 86 D;
SNAM= STAIRS ; SBAS 10; SAZM 60 D; SELV 2 D;
SNAM= ZENITH ; SBAS 10; SELV 90 D;
SNAM= BIRDBATH ; SBAS 10; SELV 90 D;
SNAM= AZEL ; SBAS 10;
SNAM= STOW ; SBAS 10; SAZM 345 D; SELV 10 D;
SNAM= INCLINOMETER; SBAS 10; SAZM 180 D; SELV 45 D;
!
* Flux densities are at 250 GHz, values marked "*" are near 90 GHz
*******************************************************************
*
*
INDIVIDUAL: SNAM SLAM SBET
COMMON: SBAS 1; VHEL= 0.0;
!
snam= 0003+38       ; slam= 00 03 22.3s ; sbet= 38 03 33; !    0.74 Jy.
snam= 0007+106      ; slam= 00 07 56.7s ; sbet= 10 41 48; !    0.57 Jy.
snam= 0048-09       ; slam= 00 48 09.98s; sbet=-09 45 24.25; ! 0.53 Jy.
snam= 0106+013      ; slam= 01 06 04.52s; sbet= 01 19 01.1 ;  ! 0.88 Jy.
snam= 0113-118      ; slam= 01 13 43.22s; sbet=-11 52 04.6 ;  ! 0.5  Jy.
snam= 0119+041      ; slam= 01 19 21.39s; sbet= 04 06 44.0;   ! 0.4  Jy.
snam= 0133+47       ; slam= 01 33 55.10s; sbet= 47 36 12.8;!    0.50 Jy.
snam= 0135-247      ; slam= 01 35 17.11s; sbet=-24 46 08.65;!   1.3  Jy.*
snam= 0202+149      ; slam= 02 02 07.40s; sbet= 14 59 51.0; !   1.50 Jy.
snam= 0212+735      ; slam= 02 12 49.87s; sbet= 73 35 40.2;!    0.56 Jy.
snam= 0221+067      ; slam= 02 21 49.96s; sbet= 06 45 50.5 ; !  0.56 Jy.
snam= W3 OH         ; slam= 02 23 16.50s; sbet= 61 38 57.0;!    8.25 Jy.
snam= 0224+671      ; slam= 02 24 41.175s; sbet= 67 07 39.7;!   1.4  Jy.
snam= 0234+285      ; slam= 02 34 55.57s; sbet= 28 35 12.1;!    2.0  Jy.
snam= 0235+164      ; slam= 02 35 52.63s; sbet= 16 24 03.9 ;!   1.8  Jy.
snam= 0239+108      ; slam= 02 39 47.10s; sbet= 10 48 16.3 ;!   1.1  Jy.*
snam= 0300+471      ; slam= 03 00 10.11s; sbet= 47 04 33.7 ;!   0.38 Jy.
snam= 0316+413 3C84 ; slam= 03 16 29.56s; sbet= 41 19 51.9 ; !  3.0  Jy.
```

```
snam= GL490          ; slam= 03 23 39.22s; sbet= 58 36 35.6 ; !  2.9  Jy.
snam= HH7-11         ; slam= 03 25 58.3 s; sbet= 31 05 47;    !  1.2  Jy.
snam=NGC1333IRAS4A  ; slam= 03 26 04.8 s; sbet=31 03 14 ; vlsr=0.0;
! 3 Jy (J. Glenn)
snam= 0333+321 nrao140 ; slam= 03 33 22.39s; sbet= 32 08 36.6 ;
!  0.9  Jy.
snam= 0336-019       ; slam= 03 36 58.95s; sbet=-01 56 16.9 ; !  1.1  Jy.
snam= 0342+679 IC342   ; slam= 03 41 57.00s; sbet= 67 56 32.0;
!   ???? Jy.
snam= 0355+508 NRAO150 ; slam= 03 55 45.26s; sbet= 50 49 20.3; ! 0.95 Jy.
snam= 0402-362       ; slam= 04 02 02.6 s; sbet= -36 13 11;  ! 0.94 Jy.
snam= 0403-132       ; slam= 04 03 13.96s; sbet=-13 16 18.8;  !  0.9  Jy.*
snam= 0415+379 3c111; slam= 04 15 00.60s; sbet= 37 54 19.0;  !  3.9  Jy.
snam= 0420-014       ; slam= 04 20 43.54s; sbet=-01 27 28.8;  !  1.3  Jy.
snam= 0422+00        ; slam= 04 22 12.5 s; sbet= 00 29 19. ;!    1.1  Jy.*
snam= 0426-380       ; slam= 04 26 54.71s; sbet=-38 02 52.05;!   2.9  Jy.*
snam= LkHa 101       ; slam= 04 26 57.25s; sbet= 35 09 55.3 ; !  0.61 Jy.
snam= L1551IRs5      ; slam= 04 28 40.2 s; sbet= 18 01 42. ;  !  1.72 Jy.
snam= 0430+052 3C120; slam= 04 30 31.60s; sbet= 05 14 59.5; !   1.24 Jy.
snam= HL Tau         ; slam= 04 28 44.44s; sbet= 18 07 35.2; !   0.82 Jy.
snam= 0439+360 CRL618; slam= 04 39 33.8s;  sbet= 36 01 15.0;!    2.6  Jy.
snam= 0454-234       ; slam= 04 54 57.29s; sbet=-23 29 28.7;!    2.1  Jy.*
snam= 0458-020       ; slam= 04 58 41.34s; sbet=-02 03 33.4; !   1.2  Jy.
snam= 0514-161       ; slam= 05 14 01.08s; sbet=-16 06 22.6; !   1.4  Jy.*
snam= 0521-365       ; slam= 05 21 12.9s ; sbet=-36 30 16.5;!    4.6  Jy.*
snam= 0528+134       ; slam= 05 28 06.78s; sbet= 13 29 42.3; !   2.8  Jy.
snam= 0529+075       ; slam= 05 29 56.49s; sbet= 07 30 38.1; !   1.3  Jy.
snam= 0552+398       ; slam= 05 52 01.34s; sbet= 39 48 21.9;!    1.4  Jy.
snam= 0605-085       ; slam= 06 05 36.03s; sbet=-08 34 20.3;!    1.1  Jy.
snam= 0607-157       ; slam= 06 07 26.00s; sbet=-15 42 03.1; !   2.1  Jy.
snam= 0642+449       ; slam= 06 42 53.01s; sbet= 44 54 30.8; !   0.69 Jy.
snam= 0646-306       ; slam= 06 46 19.22s; sbet= -30 40 54.3;!   1.0  Jy.*
snam= 0716+714       ; slam= 07 16 13.03s; sbet= 71 26 15.3 ; !  0.6  Jy.
snam= 0727-115       ; slam= 07 27 58.1s ; sbet=-11 34 52.6; !   1.0  Jy.
snam= 0735+178       ; slam= 07 35 14.13s; sbet= 17 49 09.3; !   1.1  Jy.
snam= 0736+017       ; slam= 07 36 42.51s; sbet= 01 44 00.2;!    1.4  Jy.
snam= 0745+241       ; slam= 07 45 35.75s; sbet= 24 07 55.4;!    0.55 Jy.
snam= 0754+100       ; slam= 07 54 22.60s; sbet= 10 04 39.5 ;!   0.72 Jy.
snam= 0804+499       ; slam= 08 04 58.40s; sbet= 49 59 23.1 ;!   1.3  Jy.
snam= 0805-078       ; slam= 08 05 49.55s; sbet=-07 42 22.5; !   0.67 Jy.
snam= 0814+425       ; slam= 08 14 51.67s; sbet= 42 32  7.7 ;!   0.25 Jy.
snam= 0820+560       ; slam= 08 20 53.21s; sbet= 56 02 27.4 ;!   0.3  Jy.
snam= 0823+033       ; slam= 08 23 13.56s; sbet= 03 19 15.4;  !  1.7  Jy.
snam= 0851+202 OJ287; slam= 08 51 57.25s; sbet= 20 17 58.4 ; !  1.5  Jy.
snam= 0923+392 4C+39.25; slam= 09 23 55.316s; sbet= 39 15 23.5 ;
```

```
     !  2.2  Jy.
snam= CW Leo        ; slam= 09 45 14.84s; sbet=  13 30 40.5 ;
     !  1.53 Jy.
snam= 0945+408      ; slam= 09 45 50.08s; sbet=  40 53 43.3 ;!  1.1  Jy.*
snam= 0952+698 M82  ; slam= 09 51 42.00s; sbet=  69 54 57.0 ;!  ???  Jy.
snam= 1012+232      ; slam= 10 12 0.505s;  sbet= 23 16 12.1 ;!  0.4  Jy.
snam= 1034-293      ; slam= 10 34 55.83s; sbet=-29 18 26.9 ; !  1.2  Jy.
snam= 1039+811      ; slam= 10 39 27.79s; sbet= 81 10 23.7; !   0.36 Jy.
snam= 1044+719      ; slam= 10 44 49.75s;  sbet= 71 59 26.9 ;!  0.23 Jy.
snam= 1045-188      ; slam= 10 45 40.09s;  sbet=-18 53 44.2; !  0.58 Jy.
snam= 1055+018      ; slam= 10 55 55.31s;  sbet= 01 50 03.7;!   2.0  Jy.
snam= 1116+128      ; slam= 11 16 20.78s; sbet= 12 51 06.6 ;!   0.47 Jy.
snam= 1124-186      ; slam= 11 24 34.02s; sbet=-18 40 46.5 ;!   0.28 Jy.
snam= 1144-379      ; slam= 11 44 30.9 s;  sbet=-37 55 31.  ; ! 1.2  Jy.
snam= 1144+402      ; slam= 11 44 21.02s;  sbet= 40 15 14.1 ; ! 0.46 Jy.
snam= 1156+295      ; slam= 11 56 57.791s; sbet= 29 31 25.65;!  0.74 Jy.
snam= 1213-172      ; slam= 12 13 11.61s;  sbet=-17 15 05.25;!  0.58 Jy.
snam= 1226+023 3C273; slam= 12 26 33.248s; sbet= 02 19 43.29;! 11.0  Jy.
snam= 1228+127 Virgo A ; slam= 12 28 17.6 s;  sbet= 12 40 02. ;
     !  1.8  Jy.
snam= 1244-255      ; slam= 12 44 06.71s;  sbet=-25 31 26.5; !  1.1  Jy.
snam= 1253-055 3C279; slam= 12 53 35.838s; sbet=-05 31 08.04;! 13.   Jy.
snam= 1308+326      ; slam= 13 08 07.56s; sbet= 32 36 40.2; !   1.4  Jy.
snam= 1313-333      ; slam= 13 13 20.054s; sbet=-33 23 09.65;!  2.8  Jy.
snam= 1334-127      ; slam= 13 34 59.809s; sbet=-12 42 09.8; !  4.3  Jy.
snam= 1354+195      ; slam= 13 54 42.086s; sbet= 19 33 43.95;!  0.29 Jy.
snam= 1413+135      ; slam= 14 13 33.910s; sbet= 13 34 17.4;!   1.4  Jy.
snam= 1418+546      ; slam= 14 18 06.18s; sbet= 54 36 58.0;!    0.6  Jy.
snam= 1451-375      ; slam= 14 51 18.3 s; sbet=-37 35 22. ; !   1.15 Jy.
snam= 1502+106  4C10.39; slam= 15 02 00.159s; sbet= 10 41 17.71;
     !  0.28 Jy.
snam= 1504-167      ; slam= 15 04 16.419s; sbet=-16 40 59.25;!  0.48 Jy.
snam= 1510-089      ; slam= 15 10  8.903s; sbet=-08 54 47.55;!  1.1  Jy.
snam= 1514-241      ; slam= 15 14 45.275s; sbet=-24 11 22.55;!  0.70 Jy.
snam= 1538+149      ; slam= 15 38 30.23 s; sbet= 14 57 21.8 ;!  0.84 Jy.*
snam= 1546+027      ; slam= 15 46 58.293s; sbet= 02 46 06.05;!  0.52 Jy.
snam= 1548+056      ; slam= 15 48 06.933s; sbet= 05 36 11.25;!  0.42 Jy.
snam= 1606+106      ; slam= 16 06 23.40 s; sbet= 10 36 59.7 ;!  0.37 Jy.
snam= 1611+343      ; slam= 16 11 47.89 s; sbet= 34 20 19.7 ;!  1.6  Jy.
snam= 1622-297      ; slam= 16 22 57.25 s; sbet=-29 44 41.1 ;!  0.7  Jy.
snam= 1629-24       ; slam= 16 29 21.05 s; sbet=-24 22 15.5 ;!  5.3  Jy.
snam= 1633+382 4C+38.41; slam= 16 33 30.628s; sbet= 38 14 10.05;
     !  0.3  Jy.
snam= 1637+574      ; slam= 16 37 17.432s; sbet= 57 26 15.7; !  0.52 Jy.
snam= 1638+398      ; slam= 16 38 48.172s; sbet= 39 52 30.08;!  0.64 Jy.
```

```
snam= 1641+399 3C345; slam= 16 41 17.608s; sbet= 39 54 10.82;!  5.31 Jy.
snam= 1642+690      ; slam= 16 42 18.08 s; sbet= 69 02 13.2 ;!  0.37 Jy.
snam= 1652+398      ; slam= 16 52 11.73 s; sbet= 39 50 25.1 ;!  0.83 Jy.*
snam= 1655+077      ; slam= 16 55 43.98s; sbet= 07 45 59.1;  !  0.50 Jy.
snam= 1657-261      ; slam= 16 57 47.72s; sbet=-26 06 29.25; !  1.5  Jy.
snam= 1730-130 NRAO530 ; slam= 17 30 13.534s; sbet=-13 02 45.78;
     !  2.7  Jy.
snam= 1732+389      ; slam= 17 32 40.487s; sbet= 38 59 46.9;!   0.6  Jy.
snam= 1739+522      ; slam= 17 39 29.01 s; sbet= 52 13 10.4 !   1.2  Jy.
snam= 1741-038      ; slam= 17 41 20.615s; sbet=-03 48 48.88;!  1.44 Jy.
snam= 1749+096      ; slam= 17 49 10.386s; sbet= 09 39 42.8; !  2.7  Jy.
snam= 1757-240 OH5.89-0.39; slam= 17 57 26.8s; sbet=-24 03 57.0;
     ! 14.0  Jy.
snam= 1803+784      ; slam= 18 03 39.179s; sbet= 78 27 54.3; !  0.94 Jy.
snam= 1807+698 3C371;slam= 18 07 18.543s; sbet= 69 48 57.08;!   0.61 Jy.
snam= 1823+568      ; slam= 18 23 14.949s; sbet= 56 49 18.05;   0.80 Jy.
snam= 1828+48 3C380 ; slam= 18 28 13.54s; sbet= 48 42 40.5;!    0.5  Jy.
snam= 1830-211      ; slam= 18 30 40.621s; sbet=-21 06 00.3;!   1.7  Jy.
snam= 1908-202      ; slam= 19 08 12.465s; sbet=-20 11 55.10;!  1.0  Jy.
snam= G45.1         ; slam= 19 11 00.42 s; sbet= 10 45 42.9 ;!  3.7  Jy.
snam= 1921-293 OV236; slam= 19 21 42.233s; sbet=-29 20 26.12;!  8.6  Jy.
snam= 1923+210      ; slam= 19 23 49.788s; sbet= 21 00 23.20;!  0.32 Jy.
snam= 1928+738      ; slam= 19 28 49.347s; sbet= 73 51 44.9; !  0.69 Jy.
snam= 1954+513      ; slam= 19 54 22.469s; sbet= 51 23 46.4;!   0.60 Jy.
snam= 1958-179      ; slam= 19 58 04.605s; sbet=-17 57 16.9;!   0.96 Jy.
snam= K3-50A        ; slam= 19 59 50.10s; sbet= 33 24 19.4;!    7.5  Jy.
snam= ON1           ; slam= 20 08 09.91s; sbet= 31 22 42.3;!    2.9  Jy.
snam= 2005+403      ; slam= 20 05 59.559s; sbet= 40 21 01.75;!  0.40 Jy.
snam= 2007+776      ; slam= 20 07 20.435s; sbet= 77 43 58.1; !  0.96 Jy.
snam= 2013+37       ; slam= 20 13 37.01  ; sbet= 37 01 44.51;!  1.4  Jy.
snam= 2021+317      ; slam= 20 21 18.920s; sbet= 31 43 19.30;!  0.54 Jy.
snam= 2023+336      ; slam= 20 23 12.98s;  sbet= 33 33 10.5 ;!  0.92 Jy.
snam= 2029+121      ; slam= 20 29 32.66 s; sbet= 12 09 28.8 ;!  0.93 Jy.*
snam= MWC 349       ; slam= 20 30 56.85 s; sbet= 40 29 20.2 ;!  1.67 Jy.
snam= 2037+511 3C418; slam= 20 37 07.45s ; sbet= 51 08 35.7; !  0.62 Jy.
SNAM=DR21CONT       ; SLAM=20 37 14.8s  ;  SBET=42 08 56   ; VLSR=0.0  ;!C
snam= NGC 7027      ; slam= 21 05 09.40s;  sbet= 42 02 03.0;!   3.94 Jy.
snam= 2121+053      ; slam= 21 21 14.78 s; sbet= 05 22 27.4 ;!  0.92 Jy.
snam= 2128-123      ; slam= 21 28 52.67s;  sbet=-12 20 20.6 ;!  0.28 Jy.
snam= 2131-021      ; slam= 21 31 35.13s;  sbet=-02 06 39.9 ;!  1.0  Jy.*
snam= 2134+004      ; slam= 21 34  5.205s; sbet= 00 28 25.08;!  0.76 Jy.
snam= LkHa 234      ; slam= 21 41 57.6 s ; sbet= 65 53 07. ; !  0.83 Jy.
snam= 2145+067      ; slam= 21 45 36.08 s; sbet= 06 43 40.9; !  2.33 Jy.
snam= 2149-306      ; slam= 21 49 00.59 s; sbet=-30 42 00.1 ;!  0.84 Jy.*
snam= 2200+420  BL Lac ; slam= 22 00 39.359s; sbet= 42 02 08.57;
```

```
     !  1.4  Jy.
snam= 2201+315      ; slam= 22 01 01.44s; sbet= 31 31 05.85;!   0.35 Jy.
snam= 2210-257      ; slam= 22 10 14.131s; sbet=-25 44 22.5;!   0.25 Jy.
snam= 2216-038 4C-03.79; slam= 22 16 16.38s; sbet=-03 50 40.7; !0.30 Jy.
snam= 2223-052 3C446   ; slam= 22 23 11.08s; sbet=-05 12 17.8; !1.45 Jy.
snam= 2230+114 4C+11.69; slam= 22 30 07.802s; sbet= 11 28 22.77;
     !  1.52 Jy.
snam= 2234+282      ; slam= 22 34 01.727s; sbet= 28 13 23.2;!   0.34 Jy.
snam= 2243-123      ; slam= 22 43 39.796s; sbet=-12 22 40.25;!  0.60 Jy.
snam= 2251+158 3C454.3; slam= 22 51 29.521s; sbet= 15 52 54.31;!7.35 Jy.
snam= 2254+617 Ceph A ; slam= 22 54 19.0s ; sbet= 61 45 47.2;!  4.9  Jy.
snam= 2255-282      ; slam= 22 55 22.47s; sbet=-28 14 25.8;  ! 1.1  Jy.
snam= NGC 7538      ; slam= 23 11 36.66s; sbet= 61 11 49.6;  ! 5.46 Jy.
snam= 2318+049      ; slam= 23 18 12.129s; sbet= 04 57 23.45;!  0.20 Jy.
INDIVIDUAL: SNAM SLAM SBET VLSR
COMMON: SBAS 1;
snam= irc2          ; slam= 05 32 47.03s;  sbet=-05 24 23.9; VLSR= 5.5;
snam= S6            ; slam= 05 32 45.9s;   sbet=-05 26 06.0; VLSR=5.5;
snam= IRC+10216     ; slam= 09 45 14.8s;   sbet= 13 30 40.0; VLSR=-26.0;

!_________________________________________________________________________
snam= ORIONA_MM     ; slam= 05 32 30.7s;   sbet=-4  37 34.0; VLSR=0
snam= SGRB2N        ; slam= 17 44 9.5s;    sbet=-28 21 20.0; VLSR=62
snam= SGRB2M        ; slam= 17 44 11.0s;   sbet=-28 22 0.0; VLSR=62
snam= SGRB2(OH)     ; slam= 17 44 11.0s;   sbet=-28 22 30.0; VLSR=62
snam= W3OHTEST     ; slam= 02 23 16.5s;   sbet= 61 38 57.0; VLSR=-40
```