CENTRO ASTRONOMICO DE YEBES

Informe Técnico 1990.8

Guia de usuarios del interferómetro milimétrico de Owens Valley (Caltech)

Pere Planesas

Contenido

El interferómetro milimétrico de Owens Valley, del California Institute of Technology (Caltech), ha sido el instrumento de su clase más productivo hasta la fecha. Consiste en tres antenas de 10.4 m de diámetro que pueden ser colocadas en 25 estaciones, con un espaciado máximo de 220 m en dirección Norte-Sur y 200 m en Este-Oeste. Cada antena está equipada con receptores SIS refrigerados, que funcionan en las bandas de 2.6 y 1.3 mm de longitud de onda. Sus temperaturas de ruido son de 100-200 K, cuando están sintonizados en banda lateral única (SSB). Las líneas de base más largas permiten obtener resoluciones próximas a los $2''$, a 115 GHz, y a $1''$, a 230 GHz.

Durante 1989 este instrumento fue dotado de un nuevo programa de control y se modificaron, en consecuencia, los procedimientos de calibración del instrumento, observación astronómica y gestión de los datos obtenidos. La experiencia adquirida por el autor del presente informe en la verificación, corrección y uso de los nuevos programas, así como su colaboración en la preparación de nuevos procedimientos, condujo a que se le solicitara la redacción de una documentación sobre el uso del instrumento. A fin de permitir la actualización permanente de tal documentación decidí realizarla en forma de fichero de ayudas basado en el propio sistema operativo VMS del ordenador de control. En las páginas siguientes se puede encontrar el listado de las diferentes entradas en dicho fichero de ayudas.

Se ha decidido incluir tal documentación en la biblioteca del Centro Astronómico de Yebes a fin de que sirva de referencia general sobre las tareas que se realizan en tal tipo de instrumentos. Ello resulta del máximo interés en la actualidad debido a la participación del IGN en el Instituto de Radio Astronomía Milimétrica (IRAM) y la puesta en marcha de un instrumento similar, aunque más potente, en el Plateau de Bure (Francia) perteneciente a tal institución.

OWENS VALLEY RADIO OBSERVATORY

MILLIMETER INTERFEROMETER HELP GUIDE

Pere Planesas

1990

HELP @MMI

MILLIMETER INTERFEROMETER HELP GUIDE
Pere Planesas, 1990

This help is intended to provide an on-line explanation of several programs that will be needed during an observation with the mm interferometer, as well as information about actions and procedures that should be done before to, during or after an observation.

Type "$ HELP @MMI" to get the list of existing arguments for HELP.

For getting started in the use of MMA type:
"$ HELP MMA STARTING".

To print one of the HELP topics, type:
"$ LPRINT [MMPROG.HELP]topic.HLP"

All the topics have been printed and included in the "MM USERS' GUIDE". Feel free to suggest modifications and additions to this HELP by writing comments in the 'GUIDE' or sending mail to DEIMOS::PP.

Additional information available:

ANTDATA	Backups	Baselines	Calibration		Checklist
Configuration		Directories		GETRAW	Guides
HELP	LaserWriter		LOOK	MMA	MMRTD
MMTOTAPE	MOON	New_season	Paperwork	PLOG	Pointing
Reboot	RELOAD	RESOLV	SIMBEAM	Snow	TLOG
Trouble	TUNING	UPTIMES	USED_CAR	Utilities	Windows

Additional help libraries available (type @name for topics):

OVROHELP CROSS_REF

1 ANTDATA

Allows one to plot several antenna, receiver and weather parameters versus time for one or several consecutive data files (either RAW or FPD).

This program is used by "$ GETRAW" to produce some of the printouts.

Example of use:

```
    Enter file names and scan numbers. Files should be time ordered

    Format is: Filename StartScan# EndScan#
    or enter @filename to get file names and scan numbers from a file.
    Unspecified scan numbers cause all scans in the file to be used.

    File: FPDL:10JAN90.FPD          <== your input
    File: RAW:10JAN90A.RAW          <== your input
    File:

    Searching...
    Filename              Scan Range    Current Scan   UT Day #
    fpdl:10jan90.fpd         1 to  70     ***Done***
    raw:10jan90a.fpd         1 to  63     ***Done***

    Do you want terminal plots or laserwriter plots (t/l) ?
    L       <== your input

    1 = Line stabilizer          9 = Tilt Direction
    2 = Hot                     10 = 2nd Stage Temperature
    3 = Sky                     11 = Sideband Ratios
    4 = Tsys                    12 = Baseline Gains
    5 = Sidecab temperature     13 = Receiver 3rd Stage Temp
    6 = Tilts(A/F)              14 = Return Oil Temperature
    7 = Tilts(L/R)              15 = Backend Aux Channels 1-3
    8 = Tilt Magnitude          16 = Backend Aux Channels 4-6
                                17 = Telescope Aux Chans A
                                18 = Telescope Aux Chans B
                                19 = Weather
               20 = Read New Files
               21 = Change Plot Device
               22 = Dir mmdisk[10m.raw]*.raw
               23 = Quit, exit, bye

    What data do you want to plot? (enter one number) xx  <== your input
```

1 Backups

The standard procedure consists in saving the files in a cartridge tape every day. This is mainly to guard against disk crashes on OVMM. This is an incremental backup, so the same tape is used several times. Type: "$ HELP MMTOTAPE" for a detailed explanation. The cartridge is to be stored at OVRO.

The RAW data files as well as the daily LOG files are stored on two different magnetic tapes for safety purposes. One of the tapes is stored in the Robinson computer room for general use in retrieving data. These tapes are made by Chris Wilson on campus and the observer has no responsibility for this.

When an observer is about to leave, he/she should take the manila folders with reduced data to Campus, but ONLY WHEN THE CONFIGURATION IS COMPLETE. They are then available to all observers to check for typical behaviour in that configuration. This also reduces any confusion about which tracks have been obtained.

The manila folders should be distributed to the owners of the data. The observer should also bring:

- a copy of the cartridge backup logs, and
- a copy of all the observing logs taken during the run.

and these should be given to Chris Wilson. Type HELP PAPERWORK to be sure not to forget anything.

1 Baselines

2 Collecting data

Get a good system temperature. This usually means tuning away from high atmospheric opacity (away from 12CO(1-0)). Make sure that the location offsets are all zero (use QUERY LOC). Then begin data collection by running forever the schedule MMSTD:BASE or MMSTD:1MMBASE. For example:

```
SCH MMSTD:BASE reps=100
```

The data are stored in special baseline data files in [10m.baselines]. The files are ascii text and are stored by UT day, e.g. 07MAY90.baseline. No data is stored in the raw data files. There is no need to stop data collection to do the baseline solution. Just keep collecting data until you get a good solution.

2 Solution

You may attempt solutions while the baseline data is being collected. A minimum of 30 sources should be observed to get a meaningful solution. It may take more if the weather is poor or the system sensitivity is down. Data taken around sunset or sunrise have been known to give poor solutions and may have to be removed from the data set.

All the work for the solution should be done in the directory [MM.BASE]. Make sure that you leave the final date.baseline file used for your solution. To get a solution, there are two programs that must be run sequentially: BTRAN and BASEFIT. If you need to remove data it may be done in the input to BTRAN (date.baseline file) or the input to BASEFIT (dateX.Bnn files). You can delete data using any text editor on the files. The objective is to get a meaningful solution that is correct to at least lambda/10. Keep trying until you get a good solution.

A good solution (from BASEFIT) has the following qualities:

```
closure < lamba/10           (lambda/20 for very good data)
east and north locs < 10mm
up loc < 2mm
residuals < 100millilobes   ( < 50millilobes for very good data)
```

If you are having trouble getting a solution try changing the S/N threshold in BTRAN and/or removing sunset/sunrise data. If this doesn't help you will need more or better data. Remember that a solution will be more difficult at longer baselines, with poor atmospheric coherence or with poor s/n.

When you have a good solution, enter it with the LOC commands into mma>. Label the printout with the configuration and the date and put it into the baseline folder.

3 BTRAN

This program translates a new style (OCT89) baseline file containing data from all baselines and both sidebands into the old style set of files each containing a single baseline and a single sideband for input into the BASEFIT program.

- Set default to the work directory
  $ SET DEFAULT [MM.BASE]

- Copy the baseline data file to the baseline work area, e.g.
  $ COPY [10M.BASELINE]14JAN90.BASELINE [MM.BASE]
  If the baseline acquisition data has occurred between two UT dates, you must transfer the two corresponding files.

  If you have copied two files, edit the first of them and include the other at the end, i.e. they must be concatenated.

- Run the program BTRAN using the defaults. You are now ready to run the BASEFIT program.

3 BASEFIT

Run this program with the defaults after running BTRAN. The input file name should be dateL for lower sideband and dateU for upper, e.g. 07MAY90L. If the system is not too single sideband, do both (sequentially) and compare the results.

There are 3 input files to this program:

dateS.B12
dateS.B23
dateS.B31

where S is the sideband (U or L).

1 Calibration

To carry out the flux calibration of an observation you can follow the steps we describe below. It is assumed that you have reduced the data using GETRAW (that makes use of MINT).

1. Choose the main flux calibrator:

   1st choice: a planet
   (if you have two choices, use the less resolved planet)
   Its flux is determined using the program RESOLV.
   GO TO 3

   2nd choice: a strong quasar
   Its flux is determined by the average of the few last calibrations, which you can find at the end of the file
   [MM.FLUX]FLUXES.current_season

2. Having chosen the strong quasar, you should compute what we call "scale factors" (OVRO slang).
   First you should calculate an approximate value for the flux (see 1.)
   Then you should write in the REDUCTION LOG the name and flux of the STANDARD SOURCE you are using.
   Next you should find the average value of the amplitude measured for each baseline: these should be in one of the laser writer printouts.
   Then you divide each of those values by the flux in Janskys.
   Those are the first approximation to the scale factors.
   GOTO 6

3. One of the outputs of GETRAW is a list of the scans for the data file.
   You will find in it several values you need to use RESOLV:
   - name of the planet (2nd column).
   - date (name of the file, but you can also find it in the header).
     Check that there has not been a change of date before the observation of the planet (column 4)
   - UT (column 5)
   - Hour angle (column 8)

4. In another printout you will find the average intensity detected for each baseline for the chosen planet. The units are arbitrary, and we call them "counts".

5. Start the program RESOLV and input the previous values. Example:

   The planet is Mars.
   The date is Jan 4, 1990.
   The UT is approximately 19.50 (i.e. 19h 30m, i.e. 19:30 in OVRO slang).
   The hour angle is +1.84 (i.e. 01:50).
   The configuration is 60N 00 40N. ("QUERY LOC" in MMA, if you are lost)
   The frequency is 115.27 GHz.
   The average counts for Mars are: 16.52, 15.12, 17.66
   So:

```
$ RESOLV
> UT 01/24/90 19:30      ! first entry, mm/dd/yy hh:mm
> PLANET MARS            ! do not enter planet before UT
> HOUR 1:50
> CONF 60N 00 40N
> FREQ 115.27            ! should be corrected for Vrad
```

```
> COUNT 16.52 15.12 17.66
> SH                        ! for SHow, to see that all entries are ok
> GO                        ! to compute the results
```

The results you should keep (and write down on the REDUCTION LOG) are:

```
flux = 25.64 Jy
counts/Jy = 0.666 0.615 0.696
```

We call these last three values "scale factors".
In fact those are just the first approximation.

6. Calculation of the scale factors:
The goal is to obtain the best scale factors for the primary source averaged over the entire track. This better estimation of the average scale factors valid for the whole track is obtained using the phase calibrator amplitudes.

   a) Look for a printout of the average amplitudes corresponding to the source that has been used as a phase calibrator (usually called *\CAL). If there is not such a source, you should use MINT to get those values.

   b) Compute the flux in Janskys for that source, by dividing the counts measured for each baseline by the corresponding scale factor, and averaging the three values.

   c) Compute the new (and final) scale factors using the counts and the flux corresponding to the phase calibrator. Write them on the REDUCTION LOG.

   Example:
   a) following our example using 04JAN90, the phase calibrator is 1418+546\CAL (printout *\CAL) and the counts are: 1.23 0.97 1.22.
   b) The flux is:
      (1.23/0.666 + 0.97/0.615 + 1.22/0.696) /3 = 1.73 +/- 0.14 Jy
   c) The scale factors will be:
      1.23/1.73 = 0.711
      0.97/1.73 = 0.561
      1.22/1.73 = 0.705

7. If there are other continuum sources, you should compute their fluxes using the measured counts and the scale factors (assuming that the scale factors are constant over the track).

   Example:
   If in the previous file we have observed the source 3C345 and had a printout showing the following measured counts:
      2.85, 2.59, and 2.73,
   the measured flux would have been:
      (2.85/0.711 + 2.59/0.561 + 2.73/0/705) /3 = 4.2 +/- 0.4 Jy

8. Edit the file
      [MM.FLUX]FLUXES.current_season
   adding the file name, the name and flux of the primary calibrator (planet or quasar), and the names and fluxes of all other continuum sources.


```
    File         Quasar      Flux (Jy)  Calibrator      Line
 -----------     ------      ---------  -----------     ----
```

1 Checklist

checklist to start an observation

1. data reduction
   - open a new file (or a JUNK file) using the FILE command.
   - You can start GETRAW to autoprocess the previous data file. Type HELP GETRAW and HELP CALIBRATION for more information.

2. tuning:
   - IDLE the telescopes
   - set line, sideband and source with FREQUENCY command:
     e.g. FREQ 12CO UP NGC253
     The source velocity in the catalog will be used.
   - schedule the last tuning file used for this transition and velocity:
     e.g. SCH MMTUN:12COV220
     If such a file does not exist, you should first create it by running the program TUNING for that transition and velocity:
     e.g. $ TUNING 12COV220
     Then, execute it.
   - correct the GUNN# values, if necessary. In some cases you may need to specify also a value for VTUNE different of 1.
   - proceed with the tuning, as it is explained in
     HELP TUNING PROCEDURE
   - update the tuning file with the new values for GUNN, BA, LO, Tsys, SBR. For this purpose you should execute again:
     e.g. $ TUNING 12COV220

3. side band ratios:
   - don't forget to input the new sideband ratio values, SBR#. (Use TSYS SSB when pointed on a strong object to get them.)

4. new data file:
   - use QUERY FILE to know the name of the current data file.
   - open a new data file, if you haven't done it before. It should have a name like 14JAN90A.RAW and the first scan number should be 1.

5. schedule file:
   - check the schedule file provided by the astronomer. Read all the comments he/she has written in that file. You can find it in [MM.SCH]. You can print it using LPRINT.

     a) Comment out the commands to set the frequency
     b) Make sure that there is a passband calibrator. Add one if necessary, at the beginning or the end of the track; usually 3C84, 3C273, 3C454.3.
     c) Check to see if either Mars or Uranus is included in the schedule file.
        1) If it is, check UPTIMES to make sure that the observation occurs when the planet is up. Change the schedule file if necessary.
        2) If not, and one of the planets is up during the track, you may add it, preferably at start or end of track, but in middle if necessary.
     d) Make sure that the start and stop times are consistent, and that there are no gaps.
     e) If there is much time left between the end of this

observation and the beginning of the next one, schedule the observation of several quasars at the end. (Its not necessary to edit the schedule file for that purpose: you can write and schedule a new file later).
- if you have any doubts, phone the person responsible for that file.

6. spectrometer:
   set the filter banks that are requested in the schedule file:

   BANK MHZ1-MHZ5 or BANK MHZ1-KHZ50

7. tilts and pointing:
   do between tracks if there is time before the next track starts.
   - tilts: if it's not windy, execute TILT once a day.
   - pointing: You should also update the radio pointing constants every other day. See HELP POINTING RADIO MEANS.

8. observing:
   - schedule the observing file

     SCH MMSCH:observingfile

   - schedule other additional files, if any.

9. observing log:
   - write down the information about source, raw data file, tuning, weather (WEATHER), etc.

2 Troubles

If you realize that there is something wrong in a file that you have already scheduled,you can remove it using the "DEQUEUE" command. You can also stop any procedure that is in progress (POINT, INTEGRATE) typing "CANCEL".

Type "$ HELP TROUBLE" for information about other possible troubles.

1 Configuration

2 Change of configuration

List of tasks that should be done after a change of configuration.

```
- update locations in MMA> LOCATION# 0 0 0 PAD=xxx (Ron Lawrence)
- update az encoder offsets with optical fiducial  (Ron Lawrence)
- adjust attenuator to set reference level          (Ron Lawrence)
- measure a first approx to the delay offsets       (Ron Lawrence)
- measure TILT if the wind is low                   (Ron Lawrence)
- tune to 13CO (or, better, CS) in double sideband
- point to an intense quasar
- fine tune the delay offsets to maximize sensitivity
- determine rough aprox for sideband ratios
- measure carefully the delay offsets using that source
- determine the sideband ratios
- check the pointing
- check the focus
- begin execution of the baseline schedule file:
  SCH MMSTD:BASE REPS=1000
- after about 3 hours of data have been collected,
  set your default directory to [mm.base] and
  run "$ BTRAN" to change the format of the baseline data
  and then run "$ BASEFIT" to get the baseline solution
  Repeat every hour until a good solution is found
  Type "$ HELP BASELINE" for more information.
- install the solutions with LOC# e.ee n.nn u.uu
- determine sideband ratios again
```

Type HELP TUNING and HELP BASELINE for detailed information about some of these tasks.

2 List of configurations

```
conf. A =  65W  50W  20W
conf. B =  65W  30W  10W
conf. C =  00N  40N  60N
conf. D =  30E  30W  10N
conf. E =  30E  30W  30N
conf. F =  30E  30W  80N
conf. G =  50E  50W 100N
conf. H = 100E 100W 140N
conf. J =  00N  30N  80N
```

2 declination/configurations

For 6-8" resolution:

```
dec>40       requires 2 tracks: configurations A and B
40 >dec>20   requires 3 tracks: configurations A, B and C
20>dec>-15   requires 4 tracks: configurations A (or B), C, D and E
dec>-15      requires 4 tracks: configurations A, B, C (or J) and F
```

For 2-3" resolution:

as above for each declination range plus configurations F, G and H.

1 Directories

Directory structure of the users disk, called either USER: or MMDISK:

[MM] area accessible to all observers. Catalogs, schedule and tuning files, and paperwork are in some subdirectories.

[SCRATCH] The only large disk area that can be used by the observers for temporary files. It is also used by some reduction programs, like GETRAW.

[EPHEM] ephemerides files for planets, sun and moon.

[10M] These subdirectories contain the files generated by several UIP tasks (continuum and spectral data, pointing, holography, ...). Observers have readonly privileges.

[MMPROG] This area contains the software used for data reduction. Observers have readonly privileges.

2 MM

area accessible to all observers. Catalogs, schedule and tuning files, and paperwork are in the following subdirectories:

```
[.BASE]          baseline solution files
[.CATALOGS]      source catalogs for each season
[.FLUX]          lists of calibrations. Observers should update them
[.LISTS]         observed sources for each configuration. Update them.
[.MOON_EPHEM]    auxiliary subdirectory for moon ephemerides
[.SCH]           schedule files. Also called MMSCH:
[.TUN]           recent schedule files for tuning. Also called MMTUN:
        [..DATE]   library of tuning files with date as the extension
```

2 SCRATCH

The only large disk area that can be used by the observers for temporary files. It is also used by some reduction programs. For example, GETRAW uses the subdirectory:

```
[.FPD]     where the FPD files are stored. Also called FPDL:
```

2 EPHEM

Contains the ephemerides files for planets, sun and moon.

2 10M

These subdirectories contain the files generated by several UIP tasks. Observers have readonly privileges.

```
[.BASELINE]      baseline data
[.CALIBRATION]   system temperatures
[.CATALOGS]      catalogs for standard quasars (VLA.CAT)
[.CCP]           restore .sch files
[.CDS]           continuum data files (used for MMRTD)
[.DIP]           skydips data
[.HOLO]          holography data
[.LOG]           log files
[.POINT]         pointing data
[.RAW]           raw data files. This directory is also called RAW:
```

```
     [.TILT]          tilts data
     [.TIP]           tip data

2  MMPROG
        This area contains the software used for data reduction.
        Observers have readonly privileges.

     [.ATM]
     [.BASEFIT]
     [.CALIB]
     [.HELP]
     [.MEANS]
     [.MMSTD]
     [.MOON]
     [.PASSBAND]
     [.POINT]
     [.RDX]
             [..ANTDATA]
             [..LOOKFPD]
             [..MINT]
     [.UPTIMES]
     [.UTILITIES]
```

1 GETRAW

Reduces a spectral line data file in a standard way.

After finishing an observation and opening a new raw data file for MMA (by typing FILE or FILE JUNK), you execute

```
$ GETRAW filename       (ex. 14JAN89)
```

A copy of the .RAW file will be created as a .FPD file. An automatic process will start that will perform plots of Tsys, Thot and Tsidecab vs. time, and it also will run MINT executing several tasks.

If you want a complete reduction of the data, you should answer Y to the question:

```
Do you want to apply the calibration to the data? (Y/N)
```

In such a case, a full analysis will be executed using MINT. By default GETRAW will use *\CAL as the phase calibrator, *\PASS as passband calibrator and *\DATA as data source. But you are allowed to change these defaults (see Examples).

2 printouts

You will get some printouts and plots on the laser printer:

- scan list (the first you will get, followed by a message on screen)
- plot of amplitude vs. time for the phase calibrator
- plot of amplitude vs. uv-distance for the data sources
- phase calibration fits for the phase calibrator with SMOOTH 0 0.
- passband calibration fits, with first order polynomials for the 1 MHz backend. For the 5 MHz backend is BFIT 2 3, and for the 50 kHz backend is BFIT 0 1.
- amplitudes for phase calibrator, passband calibrator, several quasars (if observed) and planets (if observed).

The flux calibration is not applied. You should do it after using RESOLV to compute the scale factors for each baseline based in a planet's flux.

It takes around 15min to get all plots on the laser printer.

2 Examples

1. If you just want to copy a .RAW data file to the FPD area, it's not necessary to use GETRAW. From DCL type:

   ```
   $ COPY  RAW:filename.RAW  FPDL:filename.FPD
   ```

2. If you have observed two passband calibrators, and you want to use only one of them you must change the default name\qual. If your phase calibrator does not have a \CAL qualifier, you

must specify it manually. Currently, GETRAW does not reduce more than one primary source. If a track contains more than one source (e.g. multiple positions or velocities), first run GETRAW for one of the primary sources, then run MINT afterwards to calibrate the other.

Example: the track contains NGC1000\V1 and NGC1000\V2 as primary source, and NRAO100\V1 and NRAO100\V2 as phase calibrators.
The GETRAW defaults can be changed to:

```
          phase calibrator?  NRAO100\V1
          source? NGC1000\V1
```

Afterwards, run MINT using:

```
          GA> STAND NRAO100\V2
```

to calibrate the phase and apply it to:

```
          CA> SOURCE NGC1000\V2
```

Type "$ HELP MINT" for more information.

1 Guides

There are several guides in the control room to help you before, during and after the observations.

1. "MM Users' Guide" (dark blue book):
   It has the reports about the features of the new interferometer control program, as well as updates in the status of the system. It also contains a printout of the MMI help, and printouts of several catalogs (VLA, OPTICAL, the old MMCAT, ...).

2. "Users' Guide tho the OVRO MM interferometer" (white book):
   It has information about the old control program, but some of the explanations about procedures or auxiliary programs still hold.

3. "LO Tuning Curves" (small light blue book):
   It contains information about changes of Gunns and LO tuning curves for each telescope.

4. "10m collected notes" (black book):
   It has lots of small memos about the system and about procedures (How would you obtain the single dish aperture efficiencies?).

5. "OVRO Millimeter Wave Interferometer Class Notes" (in press):
   It contains information of computers, local oscillators, receivers, cryogenics, pointing, calibrations, instrument caracterization, etc.

In each sidecab you will find information about the corresponding tuning curve and also about the cooling down and warming up of the receiver.

```
1  LaserWriter

The queue for the laserwriter in the control room is called MCBLW,
for Mayer Control Building LaserWriter.

Printing:
- to print an ASCII file use:
                 $ LPRINT filename
  where LPRINT is really PSPRINT/HEAD/QUE=MCBLW.
  See HELP PSPRINT for more information and options.
- to print a PostScript file use:
                 $ PRINT/QUE=MCBLW filename
- to print a TEX file, it is required that fonts should be loaded after
  the laserwriter is powered up. If your TEX file only makes the
  laserwriter blink but no paper comes out, you should load the fonts
  and try again:
                 $ PRINT/QUE=MCBLW SYS:[TEX]PSLOAD.PS
                 $ PRINT/QUE=MCBLW filename

Plotting:
- with PGPLOT use the device: SYS$MCB_LASER/PS for landscape,
  and: SYS$MCB_LASER/VPS for portrait.

Queue:
- to display the queue status use:  $ SHOW QUEUE MCBLW  or $ QSHOW
- to start the queue use:           $ GMLASER

Device:
- the device name is sys$mcb_laser
```

1 LOOK

Provides simple dumps of the raw data.
Can read in a RAW data file (specify RAW:filename.RAW) or
in a calibrated (FPD) file (specify FPDL:filename.FPD).

Commands:

BLK	display raw disk blocks from data file
DCL	spawn DCL
EXI	exit from program
HEL	display commands listing
NEW	open new input data file
RHD	display record header information. It has many options.
SHD	display scan header information. It has many options.
STS	do noise statistics analysis

1 MEANS

This program analyzes radio pointing data and tiltmeter zero data for several consecutive days. It also allows to plot the values in the laser writer.

This program should be run every day to update the radio pointing constants. It generates a schedule file called

MMSCH:PNT_OFFSETS.SCH

that should be scheduled in MMA in order to update the radio pointing constants in the observing program. The new values should appear in WINDOW ARRAY 1.

1 MMA

Starts a mm interferometer Terminal Interface Program (TIP).

There is additional information of MMA commands and related programs that are run in DCL (these are preceeded by the dollar sign, $).

2 Starting

When you execute "$ MMA" you start a TIP (Terminal Interface Program) in 'monitor mode': you can see what the interferometer is doing, but you cannot control it. Typing "voc[abulary]" you will see the commands that you are allowed to execute (aprox 20 of them).

To get information about what is being done, you can use the windows. (See HELP WINDOWS for a more detailed information.) In particular, you can type "WINDOW LOG" to see what is being written in the log file: inputs to the control program and outputs of the system. Typing "WIND ARRAY 1" you will know what source is being observed and typing "WIND ARRAY 5" (or "PAGE 5") you will know the observing frequency.

"WI CCP" will tell you who is in control of the observation, usually someone in the control building. To take control of the interferometer (if you are allowed to) you should type "USURP". Typing "VOC" you can see that now you have many more commands allowed. Some of them are dangerous: be careful how you use them, especially because minimum match is used for the commands.

The general syntax for commands is of the form:

```
command/qualifiers argument=value ....
```

"VOC command" will give you information about the qualifiers, arguments and possible values for some special arguments allowed for a given "command". To know the current values of these qualifiers and arguments, you should type "QUERY command". This is extremely useful, remember it.

Use the different windows and their pages in order to get familiar with the system and with the location of the information.

It's also particularly important to be familiar with the TV screens located in the control building. They also have several pages, that can be chosen by typing "TV page". They are usually set to page 6, because it shows information about local oscillators, receivers, cryogenics, and alarms. (You can also see this information in pages 2,4,5 and 6 of the WINDOW ARRAY.) This page is used when tuning the receivers and to monitor the behaviour of the cryogenic systems. If you see flags (inverse video) related to temperatures (T2, T3, T4), Gunn oscillators unlocked, voltage overflows (IFLV) or any other irregularity, call for assistance.

The TV screen for the backend computer shows a couple of parameters which are not accesible to the UIP. Of particular importance is the status of the current procedure, i.e. whether the interferometer is currently taking data ('integrating'), and the cumulative integration time for the current record.

There are commands other than WINDOW and QUERY that give information. For example, "SHOW sourcename" tells if the source is in the catalogs and, if so, its coordinates, rising and setting (UT and LST times), and current elevation. This command also works for the planets.

Read the checklist that is used to start an observation ("$ HELP CHECKLIST") and explore (using QUERY) all the commands that are used.

The program MMRTD will also provide you some information about the current observation. Type "$ HELP MMRTD" to learn how to use it. You will need a graphic terminal to execute it.

2 start/stop

```
--------------------Starting and stopping------------------------------
$ MMA          starts a mm interferometer TIP (Terminal Interface Program)
USURP          takes control of the interferometer
ABDICATE       relinguishes control of the interferometer
EXIT           exits the TIP program (the current observation goes on)
$ RELOAD MM    stop and restart the CCP (the Central Control Program)
WINDOW CCP 1   shows current TIPs, and status of computers and processes
-----------------------------------------------------------------------
```

2 sources

```
--------------------Sources--------------------------------------------
CATALOG        adds or deletes (/DEL) a catalog in the catalog list
SHOW_SOURCE    coordinates and uptimes of a planet or source if in catalog
OBSERVE        go to the given source (should be a planet or in a catalog)
WINDOW CAT     shows the available catalogs
WINDOW ARRAY 1  shows pointing and positional offsets info
-----------------------------------------------------------------------
```

2 moving

```
--------------------Moving the telescopes------------------------------
MOVE[#]        moves the telescope(s) to the given (AZ EL) position
IDLE[#]        stops telescope(s)
OBSERVE        go to the given source (should be a planet or in a catalog)
OBSERVE STOW   stows telescopes
OFFSET[#]      sets AZ EL offsets
WIND ARRAY 3   shows position and tracking info
-----------------------------------------------------------------------
```

2 data

```
--------------------Data collection------------------------------------
FILE           opens new RAW data file
BANKS          sets filter banks (MHZ1-MHZ5 , MHZ1-KHZ50)
INTEGRATE      initiates data-taking (spectr., continuum, base, holo)
FLUX[#]        measures total power flux with a single telescope(s)
POINT          executes a radio pointing measurement
ACQLIM         sets positional tolerance for data acquisition
LIMITS         sets several limits for data acquisition
-----------------------------------------------------------------------
```

2 LO

```
--------------------LO setting-----------------------------------------
WIND ARRAY 4  shows LO and GUNN information
FREQUENCY     sets observing frequency; also sets several LOs
GUNN[#]       sets GUNN# value
MONITOR_LO#   to get LO o reference in the spectrum analyzer
-----------------------------------------------------------------------

2  receiver

--------------------Receiver setting-----------------------------------
WIND ARRAY 2  shows receiver information (VJ,BA,LO_atten)
TUNE[#]       tunes receiver (VJ,BA,LO_atten) (you can use keypad, PF1)
ATTEN[#]      sets ATTEN# value (displayed on TV screen #4 page 1)
WIND ARRAY 5  shows cryogenics information
-----------------------------------------------------------------------

2  array

--------------------Array setting--------------------------------------
DELAY[#]      changes delay offset of a telescope (# 2 or 3 only)
DMODE         delay mode for VLBI
LOCATION[#]   sets pad locations
-----------------------------------------------------------------------

2  calibration

--------------------Calibration, Gains & Baseline----------------------
TSYS          measures system temperatures and SBRs (can also set SBRs)
SBR[#]        manually sets sideband ratios
ABSORBER      controls the position of the absorber (IN,OUT)
FOCUS[#]      changes the focus of a telescope (units are mm)
PHASE         corrects phase for closure phase purposes
DIP           executes skydip
GAIN          sets band, software and baseline gains
SCH MMSCH:BASE  executes baseline data schedule file
CALIBRATION_FIL sets the filterbank calibration files
-----------------------------------------------------------------------

2  pointing

--------------------Radio and Optical Pointing-------------------------
POINT               executes a radio pointing measurement
FOFFSET[#]          changes the fixed pointing offset for a telescope
SCH MMSCH:PNTRAD    executes radio pointing schedule file
OBSERVE/OPTICAL     observes a source for optical pointing (& holds sched)
OPTICAL_CAMERA#     controls the optical telescope(s) camera & cap position
                    ***   note: ON = camera on and optical cap off   ***
SCH MMSCH:PNTOPT    executes optical pointing schedule file
                    (PF2 enables keypad)
$ MEANS                   runs radio pointing averaging program
SCH MMSCH:PNT_OFFSETS     loads pointing offsets calculated by MEANS
PNT_CONSTANTS     sets the optical and radio pointing constants
TILT              measures and inputs tiltmeter zeros
-----------------------------------------------------------------------

2  scheduling

--------------------Schedules and file execution-----------------------
WINDOW SCHEDULE shows current (nested) schedule and queued schedules
```

```
SCHEDULE          enters a schedule file into the scheduler queue
DEQUE_SCHEDULE    dequeues a scheduled file
CANCEL_PROCEDUR   cancels the procedure currently being executed
HOLD_SCHEDULER    holds the scheduler to allow interactive command inputs
CONTINUE_SCHEDU   continues the held scheduler
WAIT              puts scheduler in waiting state until specified time
REL_WAIT          puts scheduler in waiting state for a given amount of time
ENDWAIT           puts scheduler in running state
SUBFILE, ENDSUB   defines/ends a subfile section executable by SCHED/SUBF
LOOP , ENDLOOP    define a loop within a schedule file
@                 executes (immediately) a command file (default .COM)
------------------------------------------------------------------------
```

2 displays

```
-------------------- Displays and help ------------------------------------
PAGE              selects a page for the current window
WINDOW ARRAY      AN position, receiver, LOs, cryogenics, alarms information
WINDOW ARRAY 1    shows pointing and positional offsets info
WINDOW ARRAY 2    shows receiver information (VJ,BA,LO_atten)
WINDOW ARRAY 3    shows position and tracking info
WINDOW ARRAY 4    shows LO and GUNN information
WINDOW ARRAY 5    shows cryogenics information
WINDOW ARRAY 6    shows some current warnings and alarms for each telescope
WINDOW SCHEDULE   shows current (nested) schedule and queued schedules
WINDOW CCP        shows mm TIP users and control program information
WINDOW LOG        shows last few lines of .LOG file (substitutes printer)
WINDOW OFF        exits window mode (automatically done every 10 min) (^W)
REPAINT           refreshes the current screen (also ^R)
VOCABULARY        prints information of a given command or the list of all
QUERY             prints the current values of a given parameter
TVPAGE[#]         selects a page for the TV screen(s), use /B for backend TV
HELP              tells you to use QUERY or VOCABULARY
---------------------------------------------------------------------------
```

2 alarms

```
----------------------Alarms-----------------------------------------------
ALARM             clears alarms
SYSALARMS         enables or disables one of the system alarms
TELEALARMS[#]     enables or disables one of the telescope alarms
TEMP_LIMITS[#]    sets sidecab temperature limit and LO heater box alarm
WIND ARRAY 6      shows some current warnings and alarms for each telescope
TVPAGE/B 3        shows status of alarms on backend computer
---------------------------------------------------------------------------
```

2 miscellaneous

```
----------------------Miscellaneous----------------------------------------
DCL   , LO        starts/stops a DCL process without exiting the TIP
DEFINE,UNDEFINE   define/undefine new commands or keys
SAVEDEFS          saves defined commands in a .COM file
LOG               sends a line message to the LOG file and the upper window
SNAPSHOT          copies the current screen to a SNAP.SHOT file
WEATHER           shows atmosphere information
keypad PF1        enables numerical keypad for receiver tuning
keypad PF2        enables numerical keypad for optical pointing
keypad .          keypad HELP, when enabled
keypad PF4        disables numerical keypad
```

1 MMTOTAPE

This is a procedure to backup .RAW data files to a tape cartridge.

Only files that have not been backed-up before will be backed-up.
The raw data file currently locked by MMA will not be backed-up.

This is an incremental backup, so the same cartridge will be used several times.

--- Use of MMTOTAPE ---

- Logon to the account MMTOTAPE. The password is CARTRIDGE.
  The program will start automatically.

- You should put the tape in the OVMM cartridge drive, and then move the lever toward the right to the lock position (write enable). The tape will be moving for 20 sec before being available for use (yellow light not flashing).

  [The cartridge tape to be used is in the upper shelf on the right small bookcase in the terminals area in the mm control building. You can find new cartridges in the middle shelf of the high bookcase next to Ray's office.]

- The program requests you to load the tape. Answer "Y" after doing it.

- The program asks you if it is necessary to initialize the tape. If you are using a partially filled tape or a continuation tape, say "N". If you answer "Y", the question will be asked again to prevent the accidental loss of data.

- Several messages will inform you when the tape is mounted and the backup starts.

- An error message will appear at the end if something goes wrong. The tape may not be unloaded automatically at the end, as indicated by the light. You should unload it by pressing the "unload" button on the tape drive.

- If the tape is over, you will be requested to load a new labeled tape. You will find those on the bookcase close to Ray's office. There are several tapes already labelled: use them sequentially. (The program will tell you which label is expected.)

- when the procedure is finished the tape is dismounted and a logout is performed.

- Three lists of the backed-up data will be sent to the laser writer. They are for: (1) Steve Scott, (2) Campus archiver, (3) the folder in the control room.

2 Warnings

- The whole procedure takes several tens of minutes to execute!

- If the procedure stops and the tape remains mounted for the user MMTOTAPE, you can unload it manually pressing the button "unload".

1 MMRTD

The millimeter realtime display program (MMRTD) provides a means for displaying realtime plots of the data coming in from the interferometer. There is also a non-realtime mode for viewing parts of the data at higher resolution. MMRTD has a menu type user interface at it's use is fairly straight forward. Use arrows to move around menus, and press <return> to enter your selection or a parameter value.

The program is invoked by typing MMRTD when logged into the millimeter interferometer workstation. This brings up the input menu which allows the user to specify things like the baseline(s) to be plotted, the start time, stop time or length of the time axis, the plotting device, the sideband to be plotted, etc.

By default, the data corresponding to all baselines, all sources, all records for the current day are plotted on your graphics terminal. The command that actually allows you to select what parameter to plot and executes such a plot is DO_PLOT.

When MMRTD starts up it makes a reasonable guess as to what the plot device should be based on what type of terminal or workstation the user is using. To plot on the color realtime display in the millimeter area select MM_Realtime_Display in the DEVICE menu.

You can also specify:

* the SOURCE and/or QUALIFIER to be plotted. Default=ALL.
* the SOURCE and/or QUALIFIER not to be plotted. Default=NONE.
* SIDEBAND. Default=signal band.
* BASELINE. Default=ALL.
* PLOT_TYPE: scan averages or record values. Default=RECORD.

* the DO_PLOT menu allows you to choose the parameter to plot: AMPL, PHASE, COH, SN,..., and executes the plot. Press <return> to go back to the main menu.

Note:The coherence plotted is defined as the ratio of the vector average amplitude of the records within a scan divided by the scalar average amplitude of the records.

* REALTIME_MODE:
While many users may run MMRTD simultaneously, only the first one to run it is allowed to get realtime display updates. The other invocations of MMRTD will be locked out of realtime mode. This is because the UIP updates MMRTD by writing to a mailbox which only one other program is allowed to read.

* SNAPSHOT:
Produces a printout of the current plot on the laserwriter.

* TIME_AXIS:
When specifying times in MMRTD, the standard OVRO time format is used. Some examples of allowed and disallowed time formats follow.

```
-------------Input-----------Interpretation (UT)---------

            03:12:02.23      TODAY:03:12:02.23
```

```
53:               TODAY:00:53:00.0
100:1:            illegal hrs field
-01:01:11.22      illegal sign
1:2:3.4           TODAY:01:02:03.4
32MAR90:::        illegal day field
23::11.44         TODAY:23:00:11.44
13:               TODAY:00:13:00.0
13::              TODAY:13:00:00.0
3.4:10:9.2        illegal
: :4.5            illegal
14Jul87:::        14JUL87:00:00:00.0
14jUL:::          14JUL(current year):00:00:00.0
tom:::            TOMORROW:00:00:00.0
toD:::            TODAY:00:00:00.0
```

Note that specifying a stop time or an implied stop time (with a start time and an axis length) automatically turns off realtime plot mode. Also, specifying a stop time and no start time defaults the start time to the stop time minus 12 hours and specifying start time, stop time and axis length is not allowed.

Files:
The files that are used to initialize the MMRTD data bases are the continuum data system (CDS) files and are generated on a per day bases. They can be found in USER:[10M.CDS]DDMMMYY.REC and DDMMMYY.SCAN.

2 Example

To get a printout of the coherence for the phase calibrator during a track:

```
menu      option     comments
========= ======     ========
QUALIFIER CAL        set the phase calibration source.
                     Sometimes is also necessary to set SOURCE xxxx
TIME_AXIS 12MAR90:02:30:00 12MAR90:15:00:00   set the track time interval
DO_PLOT   COH        plot coherence
SNAPSHOT             send snapshot to MCB laser writer
```

- The maximum number of blocks available in one cartridge is 160,000.

2 save sets

The tape label is BCKRAW and it contains two save sets for each execution of this program. The save set labels are like:

ddmmmhhmm.BCK [day-month-hour-minute]

(ex.: 13DEC0356)

The observing log files can be found in save sets named:

ddmmmhhmm.LOG

(The year is in the tape header and in each save set header.)

To list the contents of the tape you can execute the program USED_CAR.

2 Campus Backups

The RAW data files as well as the daily LOG files are also stored on two different magnetic tapes in Campus. These tapes are made by Chris Wilson and the observer has no responsibility for this. Type "HELP BACKUPS" for more information.

1 MOON

Program MOON reads [EPHEM]MOON1HR.EPHEM written in the 1989 new format and generates 7 files in [MM.MOON_EPHEM] to be used for observations of the Moon with the mm interferometer. The Moon is often used to establish the channel-to-channel calibration of the interferometer.

The ephemerides MOON12HR.EPHEM is not suitable for the interferometer because PRP is not capable of calculating horizontal parallax correctly for a source as close as the Moon. This program takes that ephem as input and removes parallax by moving the source to 99 AU and computing its apparent position. In the process it creates 7 ephemerides (all .EPHEM):

```
MOON00        Center of Moon
MOON12WX
MOON23WX
MOON31WX
MOON12WN
MOON23WN
MOON31WN
```

The ephemerides for the various baselines are for the limb at locations tangential to the baseline on the brighter side of the waxing (WX) and waning (WN) moon at transit.

1 New_season

System tests for start of a new observing season of the mm interferometer

---

1. Update locations in MMA if there has been a change of configuration:
   LOCATION# PAD=xxx

2. Tune to 13CO (or, better, CS) in double sideband.
   Determine approximate sideband ratios.

3. Measure TILT if the wind is low.

4. Measure a first approx to the delay offsets (Ron Lawrence).

5. Point to a intense quasar (3C84, 3C273). Measure carefully the delay offsets for telescopes 2 and 3 using this source.

6. Point to a strong point source (3C84, 3C273) and measure carefully the focus for all three telescopes.

7. Execute the baseline schedule file: "SCH MMSCH:BASE REPS=100" for 4-5 hours.

8. Obtain the baseline solution:
   - run "$ BTRAN" to change the format of the baseline data
   - run "$ BASELINE" to get the baseline solution
   If same configuration, solution should not change without a cause (e.g., large earthquake, major physical adjustment of telescope mount).

9. Test the new solution by observing 3C84 or 3C273 from rising to setting, and check for phase stability.

10. Optical pointing: observe a complete set of stars, executing:
    OPTICAL ON
    SCH MMSCH:PNTOPT
    OPTICAL OFF
    Take at least 50 points.
    Can be done during a warm up, but not during a cool down.

11. Obtain solution using "$ POINT".
    Enter optical pointing constants in MMA: SCH MMSCH:PNTOPT.

12. Observe for 30-60 min a bright star (Vega, AAUR, ABOO) without correcting the telescope position, in order to detect periodic movements in AZ or (more typically) in EL, or sudden jumps in position.

13. Optimize the alignment of the mirrors in each telescope.

14. Radio pointing: take data for three hours, executing
    SCH MMSCH:PNTRAD

15. Run the program "$ MEANS" to reduce the previous data.
    Input the results in MMA by executing:
    SCH MMSCH:PNT_OFFSETS

16. Line stabilizer: need to be able to change velocities by ~5-10 km/s

without changing the phase. Observe a strong continuum source at several nearby velocity settings and make sure no phase jumps occur.

17. Baseline gains: establish baseline gains after pointing, focus, and delay offsets have been optimized.

18. Antenna efficiencies: measure the single dish flux of a strong planet (Jupiter,...) using the command FLUX. Calculate the antenna efficiency for each telescope (should be 0.6-0.7).

19. Overall gains: observe Uranus and Mars. These gains should not change much from one season to the next without due cause.

20. Narrow-band channel-to-channel calibration (CALCOR), usually done on the Moon. After solution, test its reliability by observing the Moon for 10-15 minutes with the 50 kHz filterbank.

21. Sideband separation: observe a strong line and obtain S/N>20 in the sideband with the line. Check the opposite sideband to ensure that the software is assigning all the line flux to the correct sideband. Need only shortest baseline. Possibly good sources for 1MHz and 5MHz are: Orion, S287, L1527; for 50kHz, HH34.

22. Correct frequencies: observe a line of known velocity/frequency which is strong enough in the narrow-band channels to ensure that the velocity is correct. Need only the shortest baseline.

23. Noise tests: observe both the sky and a continuum source in all filterbanks, and compare actual and theoretical noise estimates. Use the program LOOK to analize results.

24. Determine fluxes for a set of continuum sources, including Mars or Uranus. Among them: 3C84, 3C273, 3C345, 3C454.3, 1921-293, 1730-130, 2145+-67, 2223-052, ...

25. Write down all results in a memo and store all relevant printouts in the right place.

1 Paperwork

Preface: please write up the observing logs in BLUE or BLACK ink.
Pencil and red ink don't copy very well.

OBSERVING LOGS:

Should be filled out by the observer at the beginning of and during the observation. Please be sure to record any information which may be of use to someone who is trying to calibrate the data several months later.
A xeroxcopy of each observing log should be included in the manila folder corresponding to the data reduction of the track.
A second copy of each observing log should be brought back to campus and given to Chris Wilson.

OBSERVING FOLDERS:

Put all information related to a track in a manila folder.
Label it with source name, file name, and configuration.
Put in a copy of the corresponding observing log.
Do a GETRAW after each track is completed.
Check the resulting plots to ensure that the track was adequate.
Put the plots in the folder.
The reduction log should also be included in the folder:

REDUCTION LOGS:

Should be filled out after the first reduction of the data, even if this is done using GETRAW. In particular, the observer should do the flux calibration and write down the results: this usually requires to run RESOLVE to get the flux of the planets, and to get the quasar fluxes based on the planet scaling factors.

FLUXES:

The quasar fluxes determined for each track should also be written in a file, called:

```
[MM.FLUX]FLUXES.current_season     (e.g. 89_90)
```

LISTS:

After each track the observer should update the file called:

```
[MM.LISTS]CONFIG#.LIST
```

where # stands for the name of the configuration (A, B, ...).
The Hour Angle Range actually acquired should be written, as well as a comment on the completeness of the observation: something like *DONE*, *HALF DONE*, *TO REPEAT*.
Do not type *DONE* if you think the track was bad or lost many hours. Obviously, a loss of 2 hours on a northern source is acceptable, but a loss of 2 hours on a southern source which gets 5 hours at best is not acceptable.

BACKUPS:

The backups of raw data on OVMM produce three printouts.
One of them is to be given to Steve Scott, another one to be taken to the Campus archiver, and another put on the shelf.
Type: $ HELP BACKUPS for more information.

END OF CONFIGURATION:

Make sure that all files noted in the observing logs have been completely reduced.
Make sure that each manila folder contains the reduction log and a copy of the appropriate observing log.
Make sure that all files have been backed-up on cartridge tape.

Make a copy of all observing logs for the configuration and take to the Campus Archiver for filing in Pasadena.
Take also to Campus one set of the printouts produced when the cartridge backup is done.

Distribute the folders to the corresponding researchers in Campus.

For any further question about paperwork, call Anneila (x6622).

1 PLOG

Command file to print a .LOG file on the laserwriter.

```
For the current UT date, type:      "$ PLOG",
for a previous UT date, type (eg.): "$ PLOG 05MAR90".
```

1 Pointing

2 Radio

3 MEANS

This program analyzes radio pointing data and tiltmeter zero data for a specified time range. It allows plotting of the data on the terminal or the laser writer.

MEANS should be run every day to update the radio pointing offsets. It generates a schedule file called

MMSCH:PNT_OFFSETS.SCH

that should be scheduled in MMA in order to update the radio pointing offsets in the observing program. The new values should appear in WINDOW ARRAY 1.

MEANS reads pointing data from the file RADIO.DATA, and tiltmeter data from TILT.DATA. Either pointing data, tilt data, or both can be analyzed in one run of the program. One can specify a time range of data to analyze, or one can simply use the last ten days of data by typing '0' when queried for the time range (the usual practice). The azimuth and elevation ranges of data to be analyzed can also be restricted if desired. One can use medians or weighted means to find the pointing offsets and tiltmeter zeros. The current radio pointing constants and calculated pointing offsets are outputted to the screen in the pointing analysis, and the calculated tiltmeter zeros are outputted to the screen in the tilts analysis.

2 Optical

1 Reboot

If you feel there is no other recourse, you may reboot the workstation by logging into a special account. Note that others may be using the workstation so caution is advised. Ask for help if experts are on site. The special account is

Username: REBOOT
Password: NOHOPE

The reboot will take around 5 minutes. You will be logged-out. The reboot automatically does a "RELOAD MM". Do "$ HELP RELOAD" and follow the instructions for actions after a RELOAD.

1 RELOAD

A reload of the observing software system is sometime necessary (see "$ HELP Trouble" for more details). To reload, give the command

```
$ RELOAD MM
```

****

One of the most serious mistakes to make is to do a RELOAD when a previous RELOAD has not completed execution of the restore schedule. The system can exhibit bizarre behavior such as no fringes, bad pointing, etc!!!
If you are trigger happy you will be rewarded with many hours of frustration.

****

The RELOAD command also reloads any satellite computers that have crashed (about 2 minutes each).
Follow the RELOAD command with:

```
$ mma
mma> win log
```

and then watch the important schedule that is being executed.
When a TIP connects while the restore file is running, the CCP sends a message to the command window to notify the user. The restore schedule restores the system to its previous state; if it is dequeued then some of that information will be lost. If it necessary to manually run this schedule, it will be found in [10m.ccp]restore.sch. Old versions are also located there.

When the restore schedule has successfully completed the system is ready for use (a phase jump may have occurred due to clock resync however).

Note that a REBOOT automatically does a RELOAD so after a REBOOT make sure that the restore schedule runs to completion.

2 SATRESET

Program that resets one of the satellite computers (MM1, MM2, MM3, BE1, WT1)
It should be run if RELOAD MM doesn't fix a problem with one of the satellite computers. You should run RELOAD MM again afterwards:

```
$ SATRESET
What satellite? <satellite_name>
$ RELOAD MM
```

1 RESOLV

Calculates the resolution corrections for the planets.

A small angular size planet should be used as a flux calibrator, as the quasars are variable. Mars and Uranus are typically used.

Inputs: UT time and date, planet, hour angle, configuration,
        frequency, counts for each baseline.
Outputs: unresolved flux for the planet, and the visibility
         and scale factor (counts/Jy) for each baseline.

2 Example

```
$ RESOLV
> UT 01/24/90 19:30      ! first entry, mm/dd/yy hh:mm
> PLANET MARS            ! do not enter planet before UT
> HOUR 1:50
> CONFIG 60N 00 40N
> FREQ 115.27            ! should be corrected for Vrad
> COUNTS 16.52 15.12 17.66
> SH             ! for SHow, to see that all entries are ok
> GO             ! to compute the results
```

results:

```
flux       25.64 Jy
radius     2.04 asec
visibil    0.909  0.959  0.990
counts/Jy  0.709  0.615  0.696
```

1 SIMBEAM

Calculates the UV coverage and synthesized beam for a set of configurations.

Display devices (as terminal):

Type /WS as display device for the VAXstation. It's tricky, for the UV map it requires a <return> to finish the plot.

Type /PS as display device to get PGPLOT.PS files, and answer YES to the inquires about plotting on the TERMINAL. However, you will not see the plots on the screen. All your PGPLOT.PS files will be sent to the MCB LaserWriter.

Don't try to print on the 'printer'. SIMBEAM will crash !.

High resolution beam simulations:

The default cell size for the beam plots is 2 arcsec. This value may be too large for some simulations, what makes the program crash. In case of HIGH frequency and/or HIGH resolution observations you should require the use of more than 64 pixels, and change the cell size by setting a smaller value for XYINT before executing the plot. You may also want to change the contour levels.

Example:

```
    * XYINT 0.5        (arcsec), to change resolution.
    * CONT -10,10,30,60,90 (%), to change levels, commas required.
    * SHOW                    , to see the defaults.
    * /                       , to generate the plot.
```

1 Snow

How?

The best method for snow removal appears to be the use of a squeegee that conforms to the dish surface reasonably well to remove as much snow as possible. Most of the snow will be pushed out through the center hole except for a small amount that can be pulled/pushed over the edge. This will require at least a 3 man crew. Those working in the dish need to wear safety belts or harnesses tied to a feed support leg to prevent injury in case of slips and falls.

After most of the snow has been removed, a construction type heater blower will be used to heat the dishes from the back side to melt snow from the inter-panel spaces and back-up structure. This is particularly important so that repeated thawing and freezing in the inter-panel spaces does not damage the panel.

Tracking the sun should also be used to melt snow and ice on the front surface if possible.

Who?

The responsibility for snow removal will be Wayne Hutton's crew.
John Marzano will be the contact in Big Pine (938-2293).
If John is not available, contact Wayne Hutton (933-2285).
Other contacts if needed are Steve Scott (873-6810) and Dave Woody (873-8634).

When?

John Marzano will keep an eye on the weather if snow is predicted. He will determine when to remove the snow. Currently, he plans to remove the snow when it accumulates to 3". During the nights when observations are being made, he may ask the observers to monitor snow depths.

If observations are stopped because of snow, the antennas should be stowed at the zenith.

The maximum snow depth that should be allowed to accumulate is 12". Therefore, if there is exceptional heavy snow fall rate to the point that the 12" maximum is likely to be exceeded during the night, the observer should call John Marzano and let him know so that the dishes can be cleared. Anyone on the staff may be called on to help with the snow removal if needed.

(From T. Seiling 19Jan89 and D. Woody 1/6/89 Memorandums.)

Page 1: SCR:[PP.HELP]TLOG.HLP;2

1 TLOG

Command file to type a .LOG file on the terminal.

For the current UT date, type: "$ TLOG",
for a previous UT date, type (eg.): "$ TLOG 05MAR90".

1 Trouble

Computer troubles (hardware and software).

SATELLITE COMPUTER CRASH

If a satellite computer crashes the symptom with be a message (to the upper window of MMA) that a computer (eg MMn or BE1) is being taken OFFLINE. You will also see this in WINDOW CCP. The only recourse is to do a RELOAD (see "$ HELP RELOAD").

CCP CRASH

If the response to an MMA command is "Timeout on write to CCP mailbox" then the CCP (Central Control Program) has crashed. You must do a RELOAD.

POWER FAILURE

The system will automatically do a RELOAD on reboot. Be patient. Follow instructions for steps *after* the automatic RELOAD command.

UNRESPONSIVE WORKSTATION

If you think the system is hopelessly messed up, follow the instructions under "$ HELP REBOOT".

SCHEDULE STOPS FOR NO REASON

Record the state of all errors on all computers from the control building TV monitors and report them to Steve Scott (during normal working hours). Then restart your schedule.

OUT OF DISK SPACE FOR RAW DATA

There is nothing you can do; call Steve Scott or in his absence Ray Finch. Check space with $SHOW QUOTA/USER=10M.

SICK SATELLITE COMPUTER

If you want to force a reload of the software for a satellite computer you must first kill it with $SATRESET satname where satname is MM1, MM2, MM3 or BE1. Then reload the whole package with $RELOAD MM.

1 TUNING

Searches for a dated tuning file, in order to modify it and/or to create a schedule file.

Format:

```
TUNING transition+velocity
```

Examples:

```
TUNING 12COV220    (for 12CO and V=220 km/s)
TUNING 13COVM120   (for 13CO and V=-120 km/s)
```

This program SHOULD ALWAYS BE USED to generate new tuning files. This is not just for your comfort, but for keeping a catalog of all tuning files that have been used during the season.

TUNING allows you to search the dated tuning file directory in order to find a tuning file for a given transition and velocity. This program chooses the last of such files that has been edited. If it is an old file (date previous to the present date), a new file for the current date can be created as a copy of the file found. The new version of the file can be edited to introduce changes. If no file is found for a given transition and velocity, one can be created from a model.

The edited file will be copied to the directory [MM.TUN] as a schedule file. This last file can be executed from MMA (UIP) by typing

```
sch MMTUN:13COV220
```

2 Vj defaults

The tuning files should not change Vj.
The default values are in the MMTUN:DPW_VJ.SCH file.
Dave Woody changes them when necessary.
The recommended values for Ij are also listed in this file.
You should use the LO attenuator to set these values.

Type: "$ HELP TUNING PROCEDURE" for more information.

2 subdirectories

The structure of the 'tuning' subdirectories is as follows:

MMDISK:[MM.TUN] contains the schedule version of the tuning files, that is: their extension is .SCH
This subdirectory is also known as the device MMTUN:

MMDISK:[MM.TUN.DATE] contains the versions for different dates for each transition+velocity. Their extension bear the UT creation dates.
This subdirectory is accessed automatically by the program TUNING.

2 procedure for tuning

From "The fantastic all new improved modern tuning procedure" by DPW.

This is the procedure used to tune the 3mm receivers during the 89_90 season.

- Use the FREQ command to set the various Local Oscillator frequency parameters, e.g. "FREQ 12CO UPPER L1642". The source name should be used in preference to the VLSR option.

- Generate a new schedule file for that transition and velocity using the program TUNING, e.g. "$ TUNING 12COV260".

- Execute the tuning file, e.g. "SCH MMTUN:12COV260". This should mechanically tune the Gunn oscillator to achieve phase-lock on all three dishes. Some help may be needed if a Gunn doesn't phase lock. Try using "GUNN#/MANUAL xxxx" and/or "GUNN# JOG=xx" commands to achieve phase lock. You may also try to lock the Gunn at a VTUNE not unity, use "GUNN# xxxx VTUNE=x.xx".

- Once all three Gunn oscillators are locked you can proceed to optimizing the SIS mixer tuning. There are three parameters which affect the mixer performance: the junction bias voltage "VJ", the backshort position "BACKSHORT" (or "BA"), and the junction current Ij which is indirectly controlled by the LO attenuator "LO_ATTEN" (or "LO").
  It turns out that only the backshort position is frequency dependent and that the optimum bias voltage and current evolve slowly with time or dramatically with receiver changes. The present strategy is to have the tuning schedule call upon the schedule file

  [MM.TUN]DPW_VJ.SCH

  to set "VJ" for the mixers. This file is maintained by DPW. It also contains comments telling you what the optimum junction currents Ij's are.

- There are a set of predefined keypad functions which make tuning a lot easier. The "PF1" key sets up the keypad definitions and lists their definitions. The period key relists the definitions when you have forgotten them. The key "PF4" undefines the keys so that an accidental hitting of a key doesn't change the tuning.

- Put the hot load in ("ABSORBER IN") in order to have a higher value in the "Total power" and reference more constant than the atmosphere.

- After running the tuning schedule file you should have the correct "VJ" and close to the correct "BACKSHORT" setting. The next step is to adjust "LO_ATTEN" to get close to the Ij value listed in the "DPW_VJ.SCH" file. Ij is a fairly soft parameter and getting it within 10% is sufficient.

- Now observe a strong source (3C84, 3C273, 3C454.3) so that the system noise temperatures in the signal sideband can be minimized. The "TSYS" command measures the upper and lower sideband system temperatures. Note that it seems to require S/N > 30 to get reliable sideband ratios and thus reliable single sideband Tsys's.

- Several "TSYS" commands may be required in a row to build up confidence that the values are correct. There will be problems if the sideband ratio of one of the receivers is extreme, i.e. < 0.1 or > 10. In this case you will have to temporarily detune that receiver so that the sideband ratios for the other receivers can be determined accurately.

- The procedure for optimizing the mixers is to move the "BACKSHORT" in steps of about 5-20 counts and repeating the above process of setting Ij via the "LO_ATTEN" and measuring "TSYS". The best BACKSHORT setting should be close to where you started with a single local minimum within 100 counts.

- If you are ambitious, a small search in "VJ" and Ij space can be performed. "VJ" should be kept within 50 counts and Ij should not be increased more than 50% above the value in "DPW_VJ.SCH". If you find a significant change in optimum "VJ" or Ij, please inform DPW.

- The "BACKSHORT" AND "LO_ATTEN" parameter MUST BE UPDATED in the current tuning schedule when you are done, e.g. [MM.TUN]12COV260.SCH. This is done using again the "$ TUNING" program. This program conveniently allows you to call up the most recent tuning file, edit it, save it with a date extension, i.e.

  [MM.TUN.DATE]12COV260.14JAN90

  and leave the new tuning file in [MM.TUN] for use by the observing tuning file.

- Be sure to undefine the keypad using "PF4" when you are done.

2 Gunn change

Adapted from "Changing LO bands", by SP, dec 89.

** If you have not done this before contact Steve Padin or Dave Woody **

Procedure to change the 3mm Gunns:

1. Move telescopes to elevation 45 deg. (MOVE EL=45) and IDLE them. Type ABSORBER IN in MMA.

2. Send the appropriate FREQ command before going to the sidecabs. Schedule the last tuning file used at this frequency (and with the same set of Gunns, if possible). The program will try to lock the current Gunns to a frequency out of their range, so the automatic loop will fail at this stage.

At each sidecab:

3. Read the bias voltage of current GUNN. You can see it in the display on the LO box (big black box on top of the receiver). This display shows Vbias when the upper rotary switch selects "LO LOOP 1 / VBIAS" and the lower knob (REF LOOP) is in vertical position.

4. Compare the Vbias with the corresponding one in the LO tuning notebook (you can find it hanging on the left wall of the sidecab). If the values are different, write the current value on the blackboard, date it and identify yourself.

5. Change the Gunn power connector (a round, grey plug [Bendix]) to the gunn you want to use. Be careful to engage the small inner keys correctly and to engage the plug completely (till 'click!').

6. Change the Gunn position controller (it's a rectangular ['D'] computer connector, with a slide latch) to the gunn you want to use.

Be careful to engage the slide latch on the connector correctly.

7. Move the waveguide switch. The lines on the top of the switch indicate the possible RF paths so the required position is obvious.

8. Set "Vbias" on the LO box to the value indicated in the LO tuning notebook. You should adjust "Vbias" by turning the BIAS control in the "LO LOOP 1" section of the LO box panel (it's a black dial on the upper right of the Vbias readout). Note that there is a locking lever on this "BIAS" control. Don't force the control if the lock is set.
(The LO box has a divide by 10 circuit so that 0.450 on the LO box meter means Vbias=4.50V.)

9. If Vbias is small and cannot be adjusted, the crowbar which protects the gunn oscillator may have tripped. Call an expert.
To reset this, reduce the "BIAS" control setting by about half a turn, disconnect the gunn oscillator power connector (round Bendix), reconnect the connector and increase "Vbias" to the required value.

10. Logon on the sidecab terminal, start MMA, usurp control, and send the GUNN# command required for the telescope# and the current frequency. You may need to use the 'manual' option:
    GUNN#/MAN xxxx
to get the gunn locked. You may also need to set a value for Vtune.

11. Check the sine wave. Above the LO box there is a switch ("RF switch") usually set in the "REM" (for 'remote') position. Change it to LO1 position. You will see at least one sine wave on the oscilloscope. If the Gunn is locked, there will be also a sine wave on the top of the oscilloscope screen.

12. If the Gunn does not lock, you should try to use the manual control ("Receiver tuning box", the black box on the bottom of the receiver), with the selector in position 3 (for GUNN control). Change the Gunn value in small steps. The oscilloscope will help you to know if you are close to lock.

13. Failure to lock can be due to the fact that a load is (is not) required on the isolator (little green box located between gunn and horn). If the problem persists, call Steve Padin or Dave Woody.

14. Set the RF swith (the one on the top) from LO1 back to REM.
(That allows to MONITOR the LO from the control room).
Remove the wooden box out of the "keep clear" area of the sidecab.

15. Put absorber in using the program MMA: ABSORBER IN.
Change LO atenuator (TUNE# LO=xxx) in order to get the expected Ij (junction intensity). It's recommended to have an total IF power of ~200+-15%. You can read it on the TV screen or in the rightmost readout in the receiver tuning box. just the output using the black double knob located to the right of the receiver box, close to the trap. The small knob steps are 1/10 of one big knob step.

16. Exit the program MMA and logout.

Back in the control room:

45. Proceed with the usual tuning procedure.

1 USED_CAR

Prints a listing of one backup cartridge tape.

It also prints the number of blocks already used in that tape. The total number of blocks available for storage is ~160,000.

An output file containing this information is created and printed on the MCB laser writer:

[SCRATCH]TAPE.LIS

1 UPTIMES

This is a program to assist observers in setting up observing schedules. The program asks the observer what sources he/she is interested in, and it then produces a schedule in plot form showing the times when the requested sources and various calibrators are above 20 deg in elevation. Shadowing calculations are done to determine when each source will be shadowed on at least one baseline.

This program plots the "uptimes" of any radio sources that have catalog entries on the MMA. It always includes the standard sources 3C84, 3C273, 3C454.3, W3(OH), VENUS, MARS, JUPITER, SATURN, URANUS, NEPTUNE, SUN, and MOON.

```
1  Utilities

   Auxiliary software for the mm interferometer:

---------------------------------------------------------------------------
        -- data reduction --
ANTDATA..........Plots data from headers of .FPD files.
LOOK.............Displays headers of .RAW or .FPD files.
MINT.............Millimeter interferometer data reduction.
RESOLV...........Calculate unresolved planetary flux for flux calibration.
GETRAW...........Copy a .RAW into a .FPD file and autoprocess it.
SIMBEAM..........Calculate UV coverage and synthesized beam.
        -- baseline solution --
BTRAN............Baseline format translator; run before BASEFIT.
BASEFIT..........Baseline fitting program.
        -- pointing solution --
POINT............Pointing data reduction package.
MEANS............Reduce radio pointing data and produce new offsets
        -- backup of raw data files --
MMTOTAPE.........Copy MMDATA.RAW files to cartridge tape.
USED_CAR.........Lists a RAW data cartridge and prints #blocks used.
        -- log observing files --
PLOG, TLOG.......Print or Type a log file (date is optional parameter).
        -- ephemeris --
MOON.............Calculate lunar ephemerides.
UPTIMES..........Calculate uptimes and shadowing for radio sources.
        -- tuning --
TUNING...........Update tuning files.
---------------------------------------------------------------------------
```

1 Windows

From "The new UIP and windows and pages", Ray Finch, Dec-90

The new UIP has several realtime windows available to the MMA (or TIP) program. Within each window there may be several pages.

The window command is used to bring up a window on the terminal screen. The syntax for the command is:

```
WINDOW name [page] [update rate]
```

where "name" is the window you want, "page" is the page within the window and "update rate" is the update rate for the realtime data in the window. Page is optional and defaults to the page that was last being viewed in this window or page 1 if the window has not yet been called up by your TIP. Update rate is also optional and defaults to once every 2 seconds for 9600 baud terminals. The exception to this is the array windows where data is only received from the satellite computers every 5 seconds so the clocks in the window will update every 2 seconds but the data only updates every five.

Once you have a window up, use the page command to maneuver around the pages in the window. The syntax for the page command is:

```
PAGE page# [update rate]
```

Asking for a page 0 or a page that is not defined for a particular window will give page 0 which is an index of the available pages.

The windows available in the MM UIP are:

ARRAY : Shows information from the telescope computers including pointing and tracking information, cryo temperatures, LO status, receiver status and error status. (6 pages)

CATALOG : Shows which catalog files are loaded. (1 page)

LOG : shows information going to the log file. (1 page)

SCHEDULE: Shows observing schedule information. (2 pages)

CCP : Shows information Command Control Program information including current schedule file, current command, status of satellite computers, etc. (2 pages)

DEBUG : Shows lots of debug information interesting to UIP programmers. (6 pages)

SYSTAT : A one line page showing the current schedule file name, the state of the scheduler, the current procedure and the LST.

OFF : turns the realtime window off. (0 pages)

Note that in order to save on CPU usage the realtime window automatically turns off after 10 minutes of inactivity at the keyboard.

2 definitions

In order to facilitate the change of windows and pages, you can define some symbols that you may remember more easily. For example:

```
DEFINE WC "WI AR 5"  ! cryogenics
DEFINE WL "WI AR 4"  ! LO
DEFINE WP "WI AR 1"  ! pointing
DEFINE WS "WI AR 1"  ! source
DEFINE WR "WI AR 2"  ! receiver
DEFINE WT "WI AR 3"  ! tracking and time info
DEFINE WX "WI SCH 1" ! schedule (see PAGE 2 for start/stop time info.)
DEFINE WHO "WI CCP"  ! users
DEFINE SPY "WI LOG"  ! log
DEFINE WO "WI OFF"
```

You can have definitions like those in a MMA_DEF.COM file that you execute in MMA typing "@ MMA_DEF". You can also include 'key' definitions, like:

```
DEFINE/KEY/TERM INSERT "ABSORBER IN"
DEFINE/KEY/TERM REMOVE "ABSORBER OUT"
```

Use "VOC" to decode your defined commands.

1 MEANS

Type "$ HELP POINTING RADIO MEANS" for more info.

1 Crash

Type "$ HELP TROUBLE" or "$ HELP RELOAD" for more info.

1 BTRAN

Type "$ HELP BASELINES SOLUTION BTRAN" for more info.

1 BASEFIT

Type "$ HELP BASELINES SOLUTION BASEFIT" for more info.