

**TOW 2023**  
**VLBI Session Pre-Checks**  
**For VGOS Systems Class Discussions**

Alex Burns, aburns6@mit.edu  
Mike Poirier, mpoirier@mit.edu

**1. Walking into your VGOS/VLBI site**

- a. What do you see, hear, or smell?

**2. Experiment SNAP and procedure files**

- a. We must retrieve and create the .snp and .prc files for your session

- i. `fesh <schedulename> -d`

- b. **Legacy:**

- i. Retrieve your .skd file from CDDIS

- ii. `Drudg <sessionname>.skd`

- 1. Create the SNAP and procedure file.

- 2. Print hardcopies of the schedule and session notes.

- iii. Edit the session procedure file to insert station-specific parameters such as IF distributor attenuator settings needed for your station.

- iv. Be sure to create a new procedure file for each session from the .skd or .drg file.

- 1. *Do not use default set-up procedures in the station procedure file*

**3. Computer control**

- a. Start the FS by issuing the following command:

- i. `fsclient` This should bring up the standard operational windows

- b. Check that the FS is controlling the VLBI terminal and antenna. Some stations have multiple operational control systems.

#### **4. Station timing**

- a. All station clocks should be identified and confirmed synced within spec prior to any VLBI session.
- b. PCFS CPU (2 weeks)
- c. PCFS (correct second)
- d. ACU (Antenna) (Correct second)
- e. GPS ( Offset from station equipment <50 us)
- f. R2DBE (4) (correct second)
- g. R2DBE epoch (4) (time from last sync?)
- h. Mark6 (correct second)
- i. NTP
- j. GPS 1 PPS Offset
  - i. Using a counter with time interval measurement accuracy <100 ns, measure the time interval between the 1pps signals from:
    - 1. R2DBE and GPS receiver
    - 2. Maser and GPS receiver.
  - ii. This offset should be within a few microseconds of each other. This number should be monitored as it could be the first indication of a possible system failure.

#### **5. Feed polarization**

- a. Some stations may have multiple receivers and configurations. Before each session you should make sure that the feed polarization is correct.
  - i. For geodetic S/X observations, the correct polarization is RCP.
  - ii. For VGOS use linear X (H) and Y (V).

#### **6. Receiver**

- a. Confirm Your receiver choice is VGOS and all receiver cable connections are correct
- b. Check that the physical temperatures of the 20 K and 70 K stations in the Dewar are within their normal ranges and are not rising.
- c. Check that other receiver parameters (helium pressure, voltages, currents) that are monitored are within their normal ranges.

## 7. RF distributor

- a. Confirm output cables are connected to the correct UDC inputs

## 8. Antenna focus

- a. Some antenna sites have moveable feed positions.
  - i. For VLBI observations, the focus should be stationary in its correct position.

## 9. Antenna pointing

- a. Check antenna pointing:
  - i. If possible using two or more widely-separated sources.
  - ii. Position the antenna on a source
  - iii. **fivept** this will generate the offset numbers
- b. Pointing errors in both axes should be smaller than beamwidth/10 at the highest observation frequency.

## 10. System Equivalent Flux Density (SEFD)

- a. Once you confirm your pointing offsets. Have the system generate your SEFD numbers
- b. **onoff** This measures the SEFD in each frequency band and polarization and the station compares against the nominal historic value.
- c. ONOFF should be run after you open the log file for the session you are about to start
  - i. Using a strong radio source of known flux density, measure  $T_{source}/T_{sys}$ .
  - ii. Convert to SEFD by dividing  $T_{source}/T_{sys}$  into the source flux density (corrected for size effect if the source angular extent is comparable to, or larger than, the antenna beamwidth).

## 11. System temperatures

- a. With the antenna pointed near zenith (clear sky), measure the system temperatures in all broadband channels, and compare against nominal values.

## 12. Phase calibration signal

- a. Confirm your PCAL levels are correct on your PCFS monitor window or using a spectrum analyzer.

### 13. Cable calibration

- a. The cable counter should be operating in single-sample mode, not averaging.
- b. The cable counter reading should be in the normal range.
- c. Single-sample readings should be stable to  $\pm 1 \mu\text{sec}$ .
- d. Check that the cable calibration system measures cable length changes correctly.
  - i. **1. cable** this puts the cable reading into the log
  - ii. Insert a short cable length in the cable from the ground unit to the antenna unit, and log the cable reading using the following command:
    - 1. cablelong**
  - iii. Remove the short cable and log the cable reading again
    - 1. cable**
  - iv. Compare the change in readings with the nominal value.
    - 1. cablediff**

### 14. Mark 6 Recording systems

- a. 8-Pack module Installation –
- b. Remove the 8-pack from the shipping box and anti-static bag.
- c. Inspect for damage.
- d. Pull front lever down so that it is horizontal.
- e. Slide 8-pack easily into Mark6 machine until it stops.
- f. Lift front lever which will insert the 8-pack into the connector. DO NOT PUSH**
- g. Insert the data cables into the correct connectors on the front of the module
- h. Turn the key switch to the right until it stops.
- i. The module lights will blink in a specific order and pattern
  - i. Recognize this and confirm all lights indicate correctly
  - ii. This may be your first detection of a module problem
- j. Individually repeat this for multiple modules if required for the session

### 15. Conditioning the modules

- a. If there is time each 8-pack that is received at a station should be conditioned before it is used to verify there has been no shipping damage. This can be done in any appropriate lengthy gap in operations. With the larger modules it may take

multiple days to condition. These larger modules should be done over the weekend if possible when there are no operational sessions. Please see attached conditioning memo.

## **16. Meteorological sensors**

- a. Check that the values of barometric pressure, temperature, and relative humidity reported by the 'wx' command are reasonable and repeatable.

## **17. More extensive testing**

- a. After any **equipment, software changes** or if a long period of time has elapsed since the last VLBI session, more extensive testing of the VLBI systems should be carried out. More rigorous testing should also be conducted on a periodic basis (monthly to annually). Such tests could include:
  - i. Measure pointing offsets over the full sky.
  - ii. Check for RFI and for jumps in the phase cal phase and cable cal as the antenna is slewed across the sky.
  - iii. Measure the DC level and AC ripple in the any system or equipment power supplies.
  - iv. Clean all equipment filters and cooling fan port

## **18. Begin Pre/Ops Checklist**

## IVS Operations workshop TOW 2021

### 1. Starting a schedule

- a. The basic steps in starting a schedule are:
- b. Reporting problems when you need urgent help.
- c. An e-mail list has been set up for items needing urgent attention by the IVS Coordinating Center.  
The address is: [ivs-urgent@lists.nasa.gov](mailto:ivs-urgent@lists.nasa.gov)
- d. This list should be used by anyone needing urgent attention by or advice from the Coordinating Center. You can expect an answer normally within a few hours, if the message is sent during US East Coast working hours. Messages sent on weekends or after hours may take a little longer.
- e. Please use this address rather than sending messages to [ivs-ops@lists.nasa.gov](mailto:ivs-ops@lists.nasa.gov) or [ivs-stations@lists.nasa.gov](mailto:ivs-stations@lists.nasa.gov) . If the reply from the Coordinating Center is of interest to a broader audience, we will copy the appropriate lists on the response.
- f. Anyone can post a message to this list. The only recipients for this list are the Coordinating Center staff: [Dirk Behrend](#), Ed Himwich, Cynthia Thomas, Mario Bérubé, and John Gipson.
- g. Examples of the types of messages that should be sent to this list are: problems with schedules, problems running drudg or the Field System, schedules that seem to be made for the wrong date, schedules that do not

include the right stations, operational problems during observing, and any urgent issue that impacts operations and you need advice on how to handle.

## 2. Review session notes

- a. This provides one last opportunity to verify that nothing special has been missed in the set-up for this experiment.

## 3. Start schedule

- a. Confirm the antenna source is in the correct wrap zone for your antenna
- b. The preferred form of the "schedule" command uses the line number to start with, e.g., "schedule=na225gc,#1", to start at line 1.

## 4. Send the Ready message.

- a. **rdbemsg** this will send the information in a standard format and is recommended by the IVS
- b. This message summarizes your status and lets the world know you are ready. It should be sent to [ivs-ops@lists.nasa.gov](mailto:ivs-ops@lists.nasa.gov). Be sure to include the session name in the subject line. Please include the following information.
  - i. Comments about anything that may affect the data quality. If you have more than one polarization available it is recommended that you check the polarization to make sure it is correct and note that it has been checked.
  - ii. The source and start time for the first scan. This assists the coordinator center in determining if you have the right schedule if an update was issued.
  - iii. R2DBE to GPS clock offset. This is needed by the correlator to find fringes. If the backend 1 PPS starts the measurement please report this as the RDBE to GPS offset; if GPS 1 PPS starts, please report it as the GPS to RDBE offset.
  - iv. WX: temperature, pressure, humidity, and sky conditions. This assists the analysts in understanding the atmospheric conditions and interpreting the SEFD and Tsys data.
  - v. Cable difference. Please report whether a longer cable makes the reading larger or smaller. Please also report the difference you observed in the reading when you

lengthened the cable and whether it was nominal (as expected) or not.

- vi. Pointing values: Please report both band and polarization SEFDs, source used for measurement, its azimuth and elevation when measured, and the pointing offsets on each axis. You can include as many sources as you think are useful.
- vii. Tsys values. Please report the system temperature all bands and polarizations.

## **5. Send the Start message**

- a. This lets the world know that you started and whether there are any problems. Any additional useful information for the record doesn't hurt either. The message should be sent to [ivs-ops@lists.nasa.gov](mailto:ivs-ops@lists.nasa.gov) via your automated system. If this is not functioning an email to the correct address including all of the data can be sent.

## **6. Making comments in the log**

- a. Making comments in the log when problems occur is one of the most important functions of an operator. It is the primary way of information about problems to get to the correlators. Please provide as full a description of a problem and its consequences as possible. Many of the data analysts are not familiar with the acquisition hardware.
- b. It is important to describe the problem even if not fully understood at the time of detection. If the problem is resolved a full description and solution should be entered into the log.
- c. In this time of more remote and un-attended operations all local information regarding function entered into the session log is critical.

## **7. Periodic monitoring, I: each scan is correct:**

- a. For each scan the following information should be verified:
  - i. source
  - ii. equipment status, scan-check, system errors?
  - iii. on-source

## 8. Periodic Monitoring II

- a. These items need to be checked less frequently than every scan. Every hour is a reasonable interval.
- b. Sky conditions entered as comments  
  
in log Cloud cover, wind,  
  
precipitation, etc.
- c. Disk pack full?
- d. Check `mk6=mstat?` all output to see whether a disk pack has filled up and if so, swap it out with a fresh one. The disk pack that is not being recorded should always be a fresh one and a full disk pack should always be swapped out as soon as possible. This applies even if the one currently being recorded “should” be the last.

## 9. System failures

- a. This may include failure of the main site power, Antenna system, Receiver, Cryogenics, R2DBE, UDC, Mark6, Disk Modules, networks, and power supplies,
- b. All impact data collection and analysis. The decision to continue observing or stop and repair the system depends on the nature of the failure.

## 10. Post experiment

- a. The post-experiment checks provide an opportunity to "close-the-loop" on the pre-experiment checks and verify that some things that cannot be checked during the experiment, such as the SEFDs, are still okay.
- b. Check cable calibration
- c. This verifies that the cable system still detects the calibrated cable correctly and hence has not failed during the experiment.

- d. Complete end check-list
- e. There are several other items on the end of experiment check-list. This should all be completed. The results of some of the tests will go in the End Message.
- f. Send the Stop Message
  - i. The End Message lets the world know you have completed the experiment and your status at the end. This is especially useful for the correlator since it will help them prepare for correlating the data. This information should all be reported in comments in the log as well. It should be sent to [ivs-ops@lists.nasa.gov](mailto:ivs-ops@lists.nasa.gov). Be sure to include the session name in the subject line. The End Message should have the following components:
    - ii. Scans missed
    - iii. List the scans missed, not by line numbers, but by the time spans that data was lost for.
    - iv. Comments
    - v. Please describe any unusual conditions that affected data collection. Please describe any equipment problems. This might not be limited to things that affected the data collection, but also include items that require maintenance.
    - vi. Please include any other information that you think might be useful for the correlator or the data analysts.
    - vii. Stop time
      - 1. Indicate the time data collection stopped.
    - viii. Clock offset information
      - 1. Report the final clock offset information. Use the same format as described above for the Ready message. Reporting the clock offset a second time may seem redundant but it has two purposes. First in case there was an error in reporting the first value, it provides a back-up. Secondly if there was no error in the first value it can be used to a rough estimate of the clock drift rate. Please also include any information about clock jumps and the time span of data affected by any jumps.
    - ix. Disk Pack

- x. Report the module inventory in the 'End' message.
- g. Close log
- h. As with the pre-experiment tests, the post-experiment tests should be done as much as possible in the experiment log. Once the post-experiment tests have been completed, you can close the log, either using the "schedule=..." command with a null or non-existent schedule, by changing the log file with a "log=station" command, or by terminating the FS.
  - i. Send Log (plog -l) **That is a lowercase L**
  - ii. Additional Module Shipping Information
- i. If you have any additional information about the shipping such as the routing, this would be a good place to send it.

## 11. Additional Experiments Comments

- a. If you have become aware of any additional problems or if there is any special information you either have discovered since the experiment ended or forgot to place in the Stop message, this is a good place to send it. You can of course send follow-up information as often as necessary.

## 12. Running "logpl"

- a. This section describes the basics of running "logpl", a graphically oriented program for plotting data from the log. This program is a more modern version of the old "logex" program (which is still available). Please refer to the "logpl" manual available in PostScript form on the FS servers in the doc sub-directory.
- b. Interactive Use
- c. "logpl" can be started from a shell prompt by just entering "logpl". The program uses the X display, so the starting user must have access rights to the X display. If you are using X server and open new window (C-S-W) and type "logpl" at the prompt, it should start okay.
- d. Selecting a log file
- e. If the FS is running, the log that is open will be selected automatically. If

the FS isn't running or if you want to use a different log, use the "File" menu item and select the "New Log File" option. Enter the name of the log file you wish to examine. The directory will default to "/usr2/log" and the extension to ".log".

f. Plotting Data

- g. You can plot up to four "channels" of data simultaneously. The menu items "Channel1", "Channel2", and so on are pull-down menus that let you select the data to be plotted for each channel. The "Options" menu item allows you select whether the plot are superimposed or shown separately and whether to connect the points with a line.

h. Entering New Parameters

- i. You can enter new parameters to plot either by updating the logpl.ctl" control file and restarting "logpl" or by interactively using the "Options" menu item and selecting "Edit Selections" options. Any changes that are made interactively are not preserved when "logpl" is terminated.

i. Printing Plots

- j. Once you have a plot you would like to print, you can print it as PostScript either to a printer or to a file. Use the "File" menu item and select the "Print" option to print the file.

k. Non-interactive Use

- l. "logpl" also has a non-interactive, or command mode, for automated processing. This is particularly useful for automatically generating plot of ancillary data for inspection at shift changes and after the experiment is over. To use "logpl" in command mode use the "-cmd" command line option: "logpl -cmd". You can start processing from a command file automatically by entering: "logpl -cfile xxx" where "xxx" is the name of the command file. You can even select the log file to process on the command line by entering "logpl -log lll -cfile xxx", where "lll" is the name of the log file.

# Helium System Procedures

## Cold Head Purging procedure

This procedure is to be used:

- A. Cold head replacement
- B. Line failure resulting in pressure dropping below 30psig
- C. Compressor failure resulting in replacement of compressor
  1. Attach the maintenance manifold to the disconnected ends of the return and supply inlet at the cold head connection.
  2. Reduce the pressure in the cold head to a level of 30 psig by using the maintenance manifold. Reducing the pressure in the cold head to below 30 psig (200 kPa) may introduce more contaminants into the helium circuit. (Ignore this step if cold head was replaced or line failure lowered helium pressure to 0 psig)
  3. Attach a two-stage regulator (0-3000/0-400 psig) and charging line to a helium bottle (99.999% pure). DO NOT OPEN THE BOTTLE VALVE AT THIS TIME. Purge the regulator and charging line as introduced in steps a through d below. Do not use helium gas that is less than 99.999% pure.
    - a. Open the regulator a small amount by turning the adjusting knob clockwise until it contacts the diaphragm; then, turn approximately 1/8 to 1/4 turn more, so that the regulator is barely open.
    - b. Slowly open the bottle valve, and purge the regulator and line for 10 to 15 seconds. Turn the regulator knob counterclockwise until the helium stops flowing.
    - c. Loosely connect the charge line to the 1/8-inch Hoke valve on the maintenance manifold.
    - d. Purge the charge line again, as in step a, for 30 seconds, and tighten the charge line flare fitting onto the Hoke valve while the helium is flowing.
  4. Perform in sequence:
    - a. Backfill the cold head with helium to a static charge pressure of 195-205 psig (1345-1415 kPa) by adjusting the regulator to the required pressure, and opening the Hoke valve on the manifold. Close the Hoke valve when the pressure is correct.
    - b. Depressurize the cold head to 30 and 50 psig (200 and 330 kPa) by slowly opening the ball valve and allowing the helium to bleed out slowly. Do not reduce the pressure to less than 30 psig or the cold head may be further contaminated.
    - c. Perform the flushing steps a and b four more times.
    - d. Pressurize the cold head to a static charge pressure of 195- 205 psig (1345-1415 kPa) and run the cold head drive motor for 10 to 30 seconds.
    - e. Perform steps b through d four more times for a total of 25 flushes and 5 drive-motor runs.
  5. Verify that the cold head is pressurized to the static charge pressure of 195-205 psig (1345-1415 kPa).
  6. Disconnect the maintenance manifold from the helium return and supply lines.
  7. Reconnect the helium return and supply lines to the return and supply connectors at the rear of the compressor. The cryopump is now ready for operation.

## Helium Line Purge process

This procedure is to be used:

- A. Line failure resulting in pressure dropping below 30psig
  - B. Significant contamination
- 
1. Disconnect the return and supply lines at both the compressor and refrigerator
  2. Attach the maintenance manifold to the return and supply lines.
  3. Reduce the pressure in lines to a level of 30 psig by using the maintenance manifold. Reducing the pressure in lines to below 30 psig (200 kPa) may introduce more contaminants into the helium circuit. (Ignore this step if line failure lowered helium pressure to 0 psig)
  4. Attach a two-stage regulator (0-3000/0-400 psig) and charging line to a helium bottle (99.999% pure). DO NOT OPEN THE BOTTLE VALVE AT THIS TIME. Purge the regulator and charging line as introduced in steps a through d below. Do not use helium gas that is less than 99.999% pure.
    - a. Open the regulator a small amount by turning the adjusting knob clockwise until it contacts the diaphragm; then, turn approximately 1/8 to 1/4 turn more, so that the regulator is barely open.
    - b. Slowly open the bottle valve, and purge the regulator and line for 10 to 15 seconds. Turn the regulator knob counterclockwise until the helium stops flowing.
    - c. Loosely connect the charge line to the 1/8-inch Hoke valve on the maintenance manifold.
    - d. Purge the charge line again, as in step a, for 30 seconds, and tighten the charge line flare fitting onto the Hoke valve while the helium is flowing.
  5. Perform in sequence:
    - a. Backfill the lines with helium to a static charge pressure of 195-205 psig (1345-1415 kPa) by adjusting the regulator to the required pressure, and opening the Hoke valve on the manifold. Close the Hoke valve when the pressure is correct.
    - b. Depressurize the lines to 30 and 50 psig (200 and 330 kPa) by slowly opening the ball valve and allowing the helium to bleed out slowly. Do not reduce the pressure to less than 30 psig or the cold head may be further contaminated.
    - c. Perform the flushing steps a and b eight more times.
  6. If lines are longer than 20 feet repeat sets 1 through 4 at opposite end of line set
  7. Disconnect the maintenance manifold from the helium return and supply lines.
  8. Reconnect the return and supply lines at both the compressor and cold head

## Cold Head / Compressor Decontamination Procedure

This procedure is to be used:

- A. The cold head is ratcheting
  - B. A significant failure has badly contaminated the helium system
  - C. Compressor Adsorber has been replaced
  - D. Helium Line failure caused helium pressure to drop below
- 
1. If the Cold head is already in operation and is ratcheting skip to step 4
  2. If the helium system dropped below 30psig while in operation first perform the “Cold head purging procedure” and add helium gas to compressor using “Adding helium gas to compressor procedure”
  3. Cool down the cryopump and operate it for one to three hours. If the system will not cool down, proceed to step 3. Operating the cryopump will isolate the contaminants by "freezing" them in the cold head. The contaminants in the helium-gas circuit of the cryopump tend to become frozen inside the cold head. The longer the cryopump is operated beyond the one-hour period, the greater is the amount of contamination that becomes isolated inside the cold head
  4. Shut down the cold head and compressor
  5. Immediately disconnect the helium supply and return lines from the gas-supply and gas-return connectors at the rear of the compressor. Leave them attached to the cold head.
  6. Attach the maintenance manifold to the disconnected ends of the return and supply lines.
  7. Reduce the pressure in the cold head to a level of 30 psig by using the maintenance manifold. Reducing the pressure in the cold head to below 30 psig (200 kPa) may introduce more contaminants into the helium circuit. (Ignore this step if cold head was replaced or line failure lowered helium pressure to 0 psig)
  8. Attach a two-stage regulator (0-3000/0-400 psig) and charging line to a helium bottle (99.999% pure). DO NOT OPEN THE BOTTLE VALVE AT THIS TIME. Purge the regulator and charging line as introduced in steps a through d below. Do not use helium gas that is less than 99.999% pure.
    - a. Open the regulator a small amount by turning the adjusting knob clockwise until it contacts the diaphragm; then, turn approximately 1/8 to 1/4 turn more, so that the regulator is barely open.
    - b. Slowly open the bottle valve, and purge the regulator and line for 10 to 15 seconds. Turn the regulator knob counterclockwise until the helium stops flowing.
    - c. Loosely connect the charge line to the 1/8-inch Hoke valve on the maintenance manifold.
    - d. Purge the charge line again, as in step a, for 30 seconds, and tighten the charge line flare fitting onto the Hoke valve while the helium is flowing.
  9. Perform in sequence:
    - a. Backfill the cold head with helium to a static charge pressure of 195-205 psig (1345-1415 kPa) by adjusting the regulator to the required pressure, and opening the Hoke valve on the manifold. Close the Hoke valve when the pressure is correct.
    - b. Depressurize the cold head to 30 and 50 psig 200 and 330 kPa) by slowly opening the ball valve and allowing the helium to bleed out slowly. Do not reduce the pressure to less than 30 psig or the cold head may be further contaminated.
    - c. Perform the flushing steps a and b four more times.

- d. Pressurize the cold head to a static charge pressure of 195- 205 psig (1345-1415 kPa) and run the cold head drive motor for 10 to 30 seconds.
  - e. Perform steps b through d four more times for a total of 25 flushes and 5 drive-motor runs.
10. Verify that the cold head is pressurized to the static charge pressure of 195-205 psig (1345-1415 kPa).
11. Disconnect the maintenance manifold from the helium return and supply lines.
12. Reconnect the helium return and supply lines to the return and supply connectors at the rear of the compressor. The cryopump is now ready for operation.

### Adding Helium Gas to Compressor Procedure

This procedure is to be used:

- A. Normal operational adjustment
- B. Line failure

1. Remove the flare cap of the gas charge fitting on the rear of the compressor.
2. Loosely attaching a charging line from the helium pressure regulator on the helium pressure bottle to the 1/4 inch male flare fitting installed on the helium charge valve. A user-supplied helium charging line terminating in a 1/4 inch female flare fitting and a pressure regulator rated at 400 psig delivery pressure is required.
3. Set the helium pressure regulator to 10 to 25 PSI. Allow helium gas to flow through the charging flare fitting for 30 seconds to purge the charging line of air. Then tighten the flare nut at the end of the charge line.
  - a. If the compressor is running under normal operating conditions, set the helium pressure regulator to 325 PSI and slowly open the helium charge valve in the rear of the compressor. When the helium supply pressure gauge rises to 250 to 260 PSI, tightly close the charger valve.
  - b. If the compressor is not running, set the helium pressure regulator to 250 psig and slowly open the helium charge valve. When the helium supply pressure gauge rises to  $190 \pm 5$  PSI, tightly close the charge valve.
4. Insure that the helium charge valve on the compressor is tightly closed. Then shut off the helium pressure regulator on the helium bottle. Remove the charging line from the male flare fitting and reinstall the flare cap.

# E-Transfer

## Instructions for mounting a RAID and starting a module copy

First step:

Get or create a RAID module from one of Chet's machines at Haystack. We have CentOS and our RAIDs are not compatible with Debian.

After the experiment is over:

Stop dplane:

```
systemctl stop dplane
```

Insert the RAID module into slot 4 and turn on the key. CentOS automatically assembles RAID groups when the module is inserted. The default device is md127. On Debian you would mount group 4 and the device would be md4. Mount the RAID:

```
sudo mount /dev/md127 /mnt/raid
```

At this point the RAID is mounted to /mnt/raid. You can change directory to /mnt/raid to see what data is there:

```
cd /mnt/raid (sometimes the data is in /mnt/raid/data)
```

and then list the contents:

```
ls (this is an L)
```

You can issue this 'LS' command in both the /mnt/raid and /mnt/raid/data directories to see what is inside.

if there is any data that needs to be kept **STOP** and use another RAID. Otherwise delete with:

```
su (then, type in root password when asked)
```

```
rm -f vo2147*.vdif (for experiment vo2147 data)
```

```
exit (to return as oper)
```

Now you can begin to copy the data with the 'gather' program. There is a python script called 'gator' that is used to limit keystrokes. Change back to oper directory, then start the gathering:

```
cd
gator -t (slot#) vo2174*.vdif /mnt/raid/
```

This example is for vo2174. If there is a data folder on the raid you could use:

```
gator -t (slot#) vo2174*.vdif /mnt/raid/data
```

Use the slot# of the experiment disk. You should get a message that it is gathering however many scans are on the experiment module. It will take about 24 hours to copy 32TB of data.

When the copy is done (no disk activity, and the Mark6 is either logged out due to inactivity, or returns the prompt to you) you can unmount the RAID:

```
sudo umount /mnt/raid
sudo mdadm --stop md127 (there are 2 minus signs here)
```

At this point you can turn off the key for slot 4. You may get some I/O block errors, according to Chet this is normal. Bring the RAID module to Chet for transfer from one of the Haystack Mark6's.

Unmount the experiment module as normal.

```
da-client2
>>group=close:<slot#>
>>group=unmount:<slot#>
```

Key off the module. Before the next experiment you will need to start dplane again:

```
systemctl start dplane
```

And re-commit the input streams. This is done during a normal setup during 'mk6bb' or can be done manually by using 'da-client' at the terminal:

```
da-client2
>>input_stream=commit;
```

To convert RAID to SG if needed:

Put in the RAID module, and key on. CentOS will automatically assemble the RAID to md127.

To unmake the RAID and convert to SG:

```
sudo mdadm --stop md127 (there are 2 minus signs here)
```

```
da-client2
```

```
>>mod_init=<slot>:8:<label>:sg:new; (normal mod_init)
```

If you don't stop the md127 device, the mod\_init will always fail.

**As Operators, we are the**  
**first link in building the**  
**chain of excellence.**

# **VLBI OPERATIONS**

**SYNCHRONIZED  
SWIMMING IN  
DIFFERENT POOLS**