



# Pulsar Observing

2021 Winter Observer Training  
Workshop



# Some import terms...

- **Astrid:** *Astronomers Integrated Desktop*; Interface for controlling the GBT and monitoring observations
- **Scheduling Block:** A list of observing commands submitted through Astrid
- **Configuration/Config:** A special set of keywords and values that are used to setup the GBT for various types of observations
- **CLEO:** *Control Library for Operators and Engineers*; Useful tools + expert control of all GBT systems
- **Talk & Draw:** A CLEO chat tool

# Tabs for different Astrid windows

The screenshot shows the Astrid ONLINE MONITOR ONLY interface. At the top, there are tabs for 'ObservationManagement - 1', 'DataDisplay - 1', and 'GbtStatus - 1'. Below these are 'Edit' and 'Run' buttons. The main area is divided into three sections: a 'List of scheduling blocks' on the left, a 'Scheduling block editor' in the center, and a 'Scheduling block validation' window on the right. The 'List of scheduling blocks' contains a scrollable list with 'B\_config\_search' selected. The 'Scheduling block editor' shows a configuration for 'B\_config\_search' with parameters like receiver, testfreq, obstype, backend, pol, swmode, swtype, noisecal, swper, svfreq, nwin, and deltafreq. The 'Scheduling block validation' window shows the output of a validation script, including the start and end times and a message stating 'Your observing script is syntactically correct'. On the right side, there is a 'GBT Status' panel with three status indicators: 'SB Executing' (green), 'Running' (green), and 'Notice' (yellow). Below these are 'Queue Control' buttons ('Halt Queue') and 'Observation Control' buttons ('Pause', 'Stop', 'Abort', 'Interactive'). At the bottom, there is a large pink area labeled 'Observing log and message area' and a row of log tabs: 'ObservationManagement Log - 1', 'DataDisplay Log - 1', 'GbtStatus Log - 1', and 'Command Console'.

**GBT Status**

**Scheduling block edit/run tabs**

**Scheduling block editor**

**Scheduling block validation**

**List of scheduling blocks**

**Observing control**

**Observing log and message area**

# Tabs for different Astrid windows

The screenshot shows the Astrid ONLINE MONITOR ONLY interface. At the top, there are tabs for 'ObservationManagement - 1', 'DataDisplay - 1', and 'GbtStatus - 1'. Below the tabs is a menu bar with 'File', 'Edit', 'View', 'Tools', and 'Help'. A toolbar contains icons for file operations and navigation. The main area is divided into several sections:

- Left Panel:** A 'Scheduling Blocks' list with items like 'A\_easy\_start', 'A\_test\_MSPs', 'B\_config\_search' (highlighted), 'C\_run\_survey', 'ionPump', 'Lband\_RFI\_test', 'X\_350MHz\_coherent\_cal', 'X\_350MHz\_coherent\_search', 'X\_RFI\_test', 'X\_RRAT\_search', and 'X\_RRAT\_search\_433'. A red circle highlights this list, with a label 'List of scheduling blocks' below it.
- Center Panel:** A 'Scheduling block editor' showing a configuration file 'B\_config\_search' with parameters such as 'receiver = 'Rcvr\_342'', 'restfreq = 350.0,350.0', 'obstype = 'Pulsar'', 'backend = 'GUPPI'', 'pol = 'Linear'', 'swmode = 'tp\_nocal'', 'swtype = 'none'', 'noisecal = 'off'', 'swper = 0.04', 'svfreq = 0.0, 0.0', and 'nwin = 1'. A red circle highlights this editor, with a label 'Scheduling block editor' below it.
- Right Panel:** A 'Scheduling block validation' window showing 'Validation Output' with details like '\*\*\* Begin Validation - 2015-05-15 15:47:42', 'Default values are', 'beam = B1', 'outbits = 8', 'old\_dumptime = 60', 'fold\_bins = 256', 'dm = 0', and 'if3freq = [0, 0]'. A red circle highlights this window, with a label 'Scheduling block validation' below it.
- Far Right Panel:** A 'GBT Status' panel showing 'Observation State: SB Executing', 'GBT State: Running', and 'GBT Status: Notice'. Below this are 'Queue Control' buttons ('Halt Queue') and 'Observation Control' buttons ('Pause', 'Stop', 'Abort', 'Interactive'). A red circle highlights the status and control buttons, with a label 'Observing control' below it.

At the bottom, there is a large red-shaded area labeled 'Observing log and message area'. Below this are tabs for 'ObservationManagement Log - 1', 'DataDisplay Log - 1', 'GbtStatus Log - 1', and 'Command Console'. A label 'Scheduling block edit/run tabs' points to the 'Edit' and 'Run' buttons in the top left. A label 'GBT Status' points to the status panel. A label 'Export Log' is located near the bottom right.

# Session Info (Editable)

The screenshot displays the Astrid ONLINE MONITOR ONLY interface. At the top, a menu bar includes File, Edit, View, Tools, and Help. Below the menu, there are tabs for ObservationManagement - 1, DataDisplay - 1, and GbtStatus - 1. The main area is divided into several sections:

- Session Info (Editable):** Located at the top, it includes fields for Project (AGBT14A\_507), Session (183), Observer (Ryan Lynch), and Operator (Rob Whalen). Arrows from the title box point to these fields.
- Available Scheduling Blocks:** A table listing various scheduling blocks and their last modified times. A red oval highlights this table, with a label "List of scheduling blocks" pointing to it.
- Session History:** A section for tracking session history, highlighted with a red oval and labeled "Running/Runned blocks".
- Run Queue:** A section for managing the run queue, highlighted with a red oval and labeled "Queued blocks". It includes buttons for Move Up, Move Down, and Remove.
- Observation State:** A panel on the right showing the current state: Idle, Ready, and Fault (highlighted in orange).
- Queue Control:** A panel with a Halt Queue button.
- Observation Control:** A panel with buttons for Pause, Stop, Abort, and Interactive.

At the bottom, there are tabs for ObservationManagement Log - 1, DataDisplay Log - 1, GbtStatus Log - 1, and Command Console. An Export Log button is also present.

# Session Info (Editable)

The screenshot displays the Astrid (ONLINE MONITOR ONLY) interface. At the top, a menu bar includes File, Edit, View, Tools, and Help. Below the menu, there are tabs for ObservationManagement - 1, DataDisplay - 1, and GbtStatus - 1. The main area is divided into several sections:

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- Available Scheduling Blocks:** A table listing various scheduling blocks and their last modified times. A red oval highlights this table.
- Session History:** A section for tracking session history, with a red oval highlighting it.
- Run Queue:** A section for managing the run queue, with a red oval highlighting it.
- Control Panels:** On the right side, there are several control panels: Observation State (Idle), GBT State (Ready), GBT Status (Fault), Queue Control (Halt Queue), and Observation Control (Pause, Stop, Abort, Interactive).

At the bottom, there are tabs for ObservationManagement Log - 1, DataDisplay Log - 1, GbtStatus Log - 1, and Command Console. An Export Log button is also present.

Scheduling Block	Last Modified
A_easy_start	2015-05-11 17:55:56
A_test_MSPs	2015-05-14 00:00:23
P_config_search	2015-05-12 18:31:26
C_run_survey	2015-05-14 00:00:37
ionPump	2014-02-28 15:47:47
X_350MHz_coherent_cal	2014-02-28 15:49:02
X_350MHz_coherent_search	2014-02-28 15:49:56
X_RFI_test	2014-05-03 17:12:29
X_RRAT_search	2014-02-28 15:50:52
X_RRAT_search_433	2014-02-28 15:51:31

List of scheduling blocks

Running/Runned blocks

Queued blocks

<b>Observer:</b>	unknown	<b>Last Update:</b>	2015-05-20 15:50:19
<b>Project ID:</b>	AGBT14B_342_29	<b>UTC Date:</b>	2015/05/20
<b>Status:</b>	Fault	<b>UTC Time:</b>	19:50:19
<b>LST:</b>	06:23:33	<b>MJD:</b>	57162.8266152

<b>Az commanded (deg):</b>	162.652	<b>EI commanded (deg):</b>	25.808
<b>Az actual (deg):</b>	162.6524	<b>EI actual (deg):</b>	25.8079
<b>Az error (arcsec):</b>	-0.631	<b>EI error (arcsec):</b>	-0.758
<b>Coordinate Mode:</b>	J2000	<b>Antenna State:</b>	Tracking
<b>Major Coord:</b>	07:31:06 (RA)	<b>Minor Coord:</b>	-23:41:47 (Dec)
<b>Major Cmd Coord:</b>	07:31:06 (RA)	<b>Minor Cmd Coord:</b>	-23:41:47 (Dec)
<b>LPCs Az/XEI/EI ("):</b>	(0.000 0.000 0.000)	<b>LFCs (XYZ mm):</b>	(0.00 0.00 0.00)
<b>DC Az/XEI/EI ("):</b>	(0.000 -6.727 11.441)	<b>LFCs (XYZ deg):</b>	(0.00 0.00 0.00)
<b>AS FEM Model:</b>	On	<b>DC Focus Y (mm):</b>	-2.322169312
<b>AS Zernike Model:</b>	On	<b>AS offsets:</b>	On
<b>AS Zernike Thrm Mdl:</b>	Off		

Observation State:  
SB Executing

GBT State:  
Ready

GBT Status:  
Fault

Queue Control:  
Halt Queue

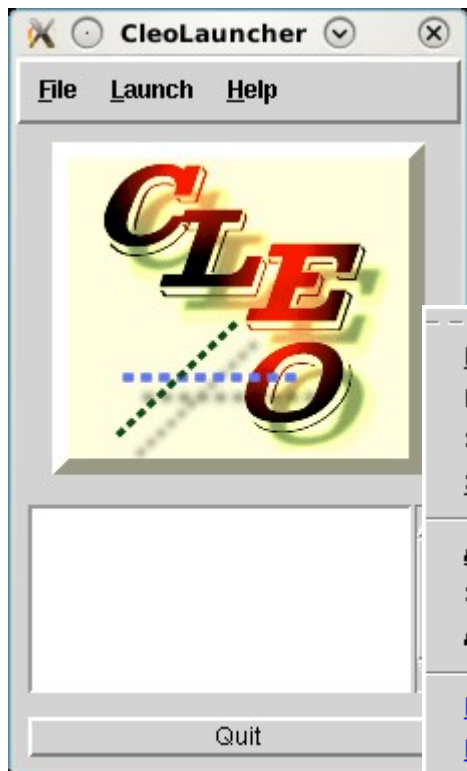
Observation Control:

Pause

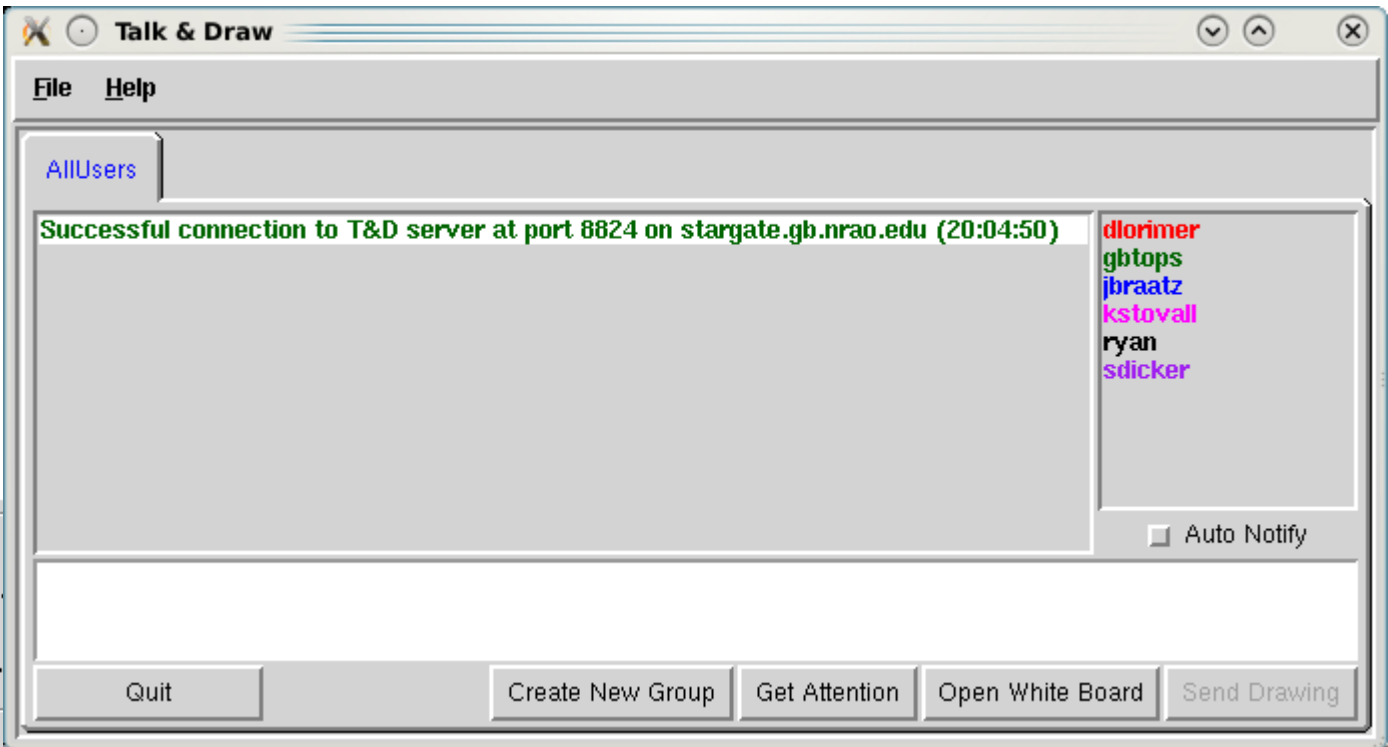
Stop

Abort

Interactive



- Messages...
- Manager Control..
- Status...
- Scan Coordinator
- Antenna...
- Servo Monitor...
- Active Surface...
- Receivers ▶
- I.F. / L.O. ▶
- Backends ▶
- Weather...
- Operator Tools ▶
- Observer Tools ▶
- Miscellaneous Tools ▶
- Cleo Container...
- Multi Launch...
- Font Size ▶
- Simulation Mode
- Fast Start Mode



- Scheduler & Skyview...
- Talk and Draw...
- Spectral Line Configuration Tool...
- Weather Forecasts...



- Key parts of scheduling block are
  - Catalog(<catalog>): Loads a list of sources
  - Slew(source): Moves the telescope to a source
  - config: Defines backend and IF/LO parameters
  - Configure(config): Executes config instructions
  - Balance: Adjusts power levels to optimal range
  - Observing Directive
- There are *lots* of Astrid commands, and you can use python to make fairly complicated scripts
  - When in doubt, try Catalog(pulsars\_all\_GBT)
  - Note that this catalog may not be up-to-date with the brand new pulsars
- Let's look at the config portion more carefully...

**receiver = 'Rcvr1\_2'**  
**restfreq = 1500.0**  
**obstype = 'Pulsar'**  
**backend = 'VEGAS'**  
**pol = 'Linear'**  
**swmode = 'tp\_nocal'**  
**swtype = 'none'**  
**noisecal = 'off'**  
**swper = 0.04**  
**swfreq = 0.0**  
**nwin = 1**  
**deltafreq = 0**  
**ifbw = 0**  
**bandwidth = 800**  
**tint = 81.92e-6**  
**vlow = 0**  
**vhigh = 0**  
**vframe = 'topo'**  
**vdef = 'Radio'**

**vegas.obsmode = 'search'**  
**vegas.numchan = 2048**  
**vegas.polnmode = 'full\_stokes'**  
**vegas.scale = 10000**  
**vegas.outbits = 8**  
**vegas.fold\_dumptime = 10**  
**vegas.fold\_bins = 256**  
**vegas.fold\_parfile = "/users/rlynch/myparfile.par"**  
**vegas.dm = 50**

- **swmode**: Switching mode ('tp' or 'tp\_nocal')
- **swtype**: Only used for frequency switching
- **noisecal**: Controls noise diode ('lo' or 'hi' or 'off')
- **swper**: Switching period (always 0.04 [25 Hz] for pulsar observing)
- **swfreq** : Only used for frequency switching
- **nwin**: Number of spectral windows (usually 1 for pulsar observing)
- **deltafreq**: Offset of spectral windows (always 0 for pulsar observing)
- **ifbw**: BW of filter in IF rack (80 for 100 MHz total bandwidth, otherwise 0)

- vegas.obsmode
  - fold, cal, search, coherent\_{fold,cal,search}
- vegas.numchan
  - $2^n$ ,  $n = 6 \dots 11$  (64...4096 [8192])
  - Max depends on bandwidth
- vegas.polnmode
  - full\_stokes or total\_intensity
- vegas.scale
  - Varies with setup, but fairly stable
- vegas.outbits
  - Always 8

- `vegas.fold_dumptime`
  - Typically 10
- `vegas.fold_bins`
  - Typically 256, higher for coherent modes
- `vegas.fold_parfile`
  - Always make sure this is correct!!
- `vegas.dm = 50`
  - Specific to `coherent_search`

# A word on tint

$$\text{tint} = \text{acc\_len} * \text{vegas.numchan}/\text{bandwidth}$$

- `acc_len` is a hardware parameter not directly set by the user
  - `acc_len > 4` for 100 and 200 MHz modes
  - `acc_len > 16` for 800 MHz mode
  - `acc_len < 100` recommended

- Write a simple observing script to observe B1937+21 in search mode for 30 minutes
  - 2048 channels, 40.96 us time resolution, total intensity, 800 MHz bandwidth
  - L-Band receiver
  - Center frequency of 1500 MHz
- Ask yourself
  - How will Astrid know the location of the source?
  - How do things need to be configured?
  - Is the system balanced?
  - How do I tell Astrid to start taking data?
- You may reference

[https://safe.nrao.edu/wiki/bin/view/CICADA/VegasPulsarObservingInstructions#Example\\_Configurations](https://safe.nrao.edu/wiki/bin/view/CICADA/VegasPulsarObservingInstructions#Example_Configurations)

Catalog(<path on disk>)

config\_string = ""

receiver = 'Rcvr1\_2'

...

""

Configure(config\_string)

Slew(<source name>)

Balance()

Track(<source name>, None, 1800)



```
head=name ra dec
0034+69 00:33:13.03200000 +69:43:45.4800000
0510+38 05:09:31.78854365 +38:01:18.0575238
0636+51 06:36:04.84542630 +51:28:59.9831111
0742+66 07:40:45.79660905 +66:20:33.5892639
1124+78 11:25:59.83760878 +78:19:48.7496278
1649+80 16:41:20.84202477 +80:49:52.9304759
1816+45 18:16:35.93390826 +45:10:33.8680587
1939+66 19:38:56.91758504 +66:04:31.7513018
1309-23 13:09:27.42463533 -23:33:25.1647258
```

I

```

format=spherical
coordmode=J2000
head = name  jname      alias      ra          dec          S1400_Jy
# Flux calibration sources from PSRCHIVE fluxcal.cfg
1413+1509    J1413+1509    1413+15    14:13:41.660  +15:09:39.524  0.525662
3C48         J0137+3309    0137+33    01:37:41.300  +33:09:35.13   16.2554
3C123        J0437+2940    0437+29    04:37:04.375  +29:40:13.82   48.3292
J0444-2809   J0444-2809    0444-28    04:44:37.708  -28:09:54.403  6.88461
J0519-4546   J0519-4546    PicA       05:19:49.723  -45:46:43.855  67.1838
3C138        J0521+1638    0521+16    05:21:09.900  +16:38:22.12   8.56402
3C147        J0542+4951    0542+49    05:42:36.127  +49:51:07.23   22.1705
3C196        J0813+4813    0813+48    08:13:36.056  +48:13:02.64   14.4286
3C218        J0918-1205    HyDA       09:18:05.669  -12:05:43.95   44.0132
3C274        J1230+1223    M87        12:30:49.423  +12:23:28.04   212.310
3C286        J1331+3030    1331+30    13:31:08.284  +30:30:32.94   15.0838
3C295        J1411+5212    1411+52    14:11:20.647  +52:12:09.04   22.4993
3C348        J1651+0459    HerA       16:51:08.024  +04:59:34.91   47.6466
3C353        J1720-0058    1720-00    17:20:28.150  -00:58:46.80   57.4059
3C380        J1829+4844    1829+48    18:29:31.781  +48:44:46.159  13.142
3C405        J1959+4044    CygA       19:59:28.357  +40:44:02.097  1579.96
3C444        J22214-1701   2214-17    22:14:25.752  -17:01:36.290  9.07134
3C190        J0801+1414    0801+14    08:01:33.52   +14:14:42.2    2.46364
1445+0958    J1445+0958    1442+101   14:45:16.440  +09:58:35.040  2.35757
3C43         J0129+2338    0129+23    01:29:59.79   +23:38:19.4    2.83034
3C394        J1859+1259    1859+129   18:59:23.3    +12:59:12      2.88127
B2209+080    J2212+0819    2212+08    22:12:01.5685 +08:19:15.5868 1.70936
NGC7027      J2107+4214    2107+42    21:07:01.530  +42:14:11.500  1.43339

```

- How do we calibrate pulsar data?
  - Raw data are recorded in units of “counts”, which change depending on how the system is balanced
  - We want physical units (Jansky)
- 1) Observe a standard source of known flux density
- 2) Use this to measure the strength of the GBT noise diode
- 3) Balance the system at the position of the pulsar and observe the noise diode
- 4) Observe the pulsar **without rebalancing**, and use the noise diode to calibrate the pulsar data

- Write a simple observing script to observe J1713+0747 using coherent fold mode for 20 minutes
  - 512 channels, 800 MHz bandwidth, (what is tint?)
  - Include all the necessary steps to fully **calibrate** the data
- You may reference [https://safe.nrao.edu/wiki/bin/view/CICADA/VegasPulsarObservingInstructions#Example\\_Configurations](https://safe.nrao.edu/wiki/bin/view/CICADA/VegasPulsarObservingInstructions#Example_Configurations)

- Scheduling blocks use Python!

```
sources = ["B1937+21", "J1713+0747"]
```

```
for src in sources:
```

```
    Slew(src)
```

```
    Balance()
```

```
    Track(src, None, 20*60)
```

```
for src in sources:
    config = """
    ...
    vegas.fold_parfile = "/home/gpu/tzpar/{src}.par"
    """ .format(src=src)
```

```
srcdict = {
    "B1937+21": {"DM":50, "parfile": "mypar"},
    "J1713+0747": {"DM":100, "parfile": "mypar2"}}
for src in srcdict:
    config = """
    ...
    vegas.fold_parfile = {parfile}
    """ .format(parfile=src["parfile"])
```

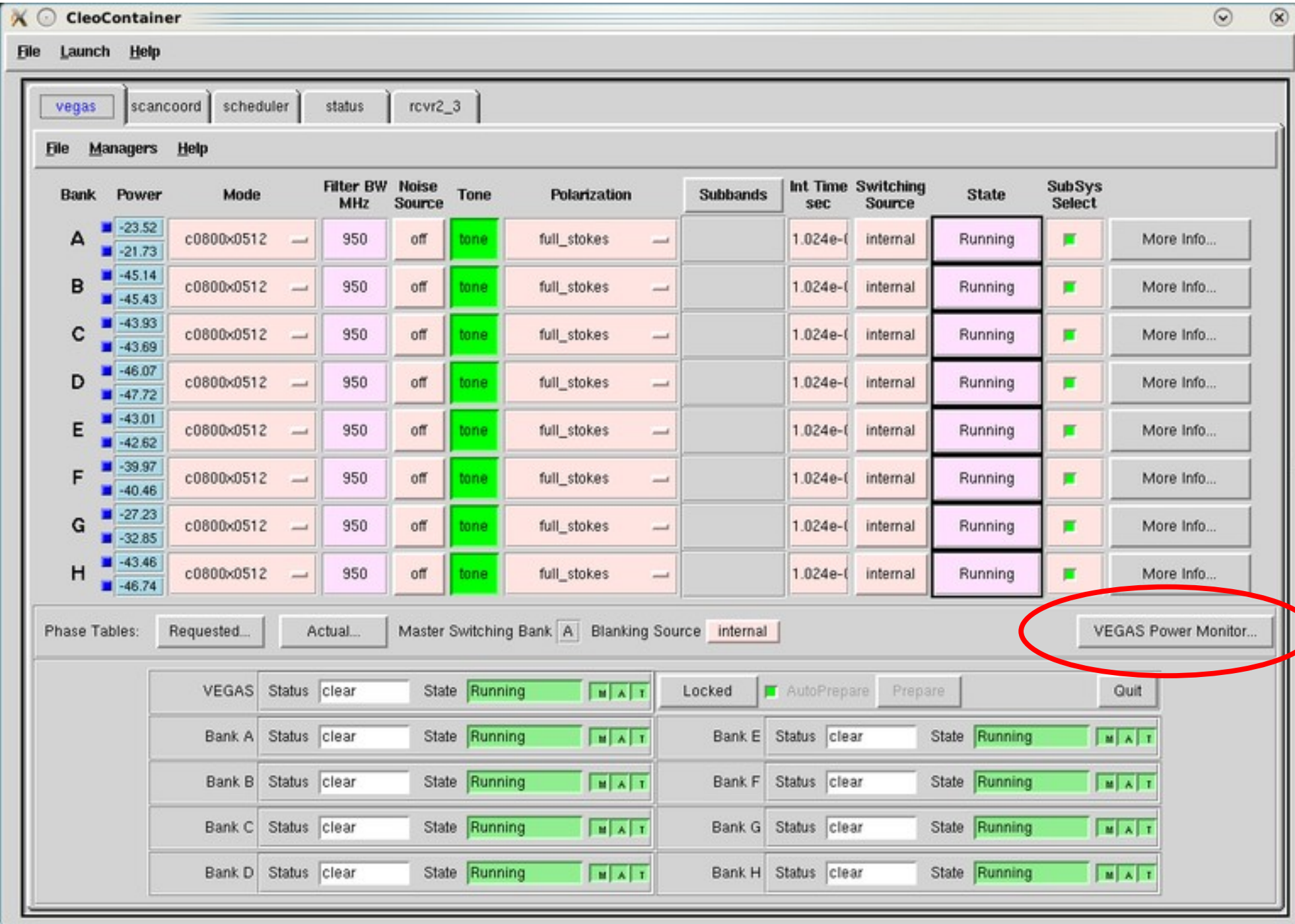
- Astrid has a number of useful convenience functions and options
  - Track() can take startTime and stopTime instead of scan length
  - Horizon() objects can be used to define times based on a source's elevation (.e.g., start observing when a source rises or stop when it sets)
  - OnOff() is useful for flux calibration scans
    - Observe an On source and Off source position automatically
  - AutoPeakFocus() necessary at high frequencies (roughly C-band and above)

- `Track(src, None, 3600)`
- `Track(src, None, 3600, startTime="15:15:00")`
- `Track(src, None, startTime="15:15:00", stopTime="16:15:00")`
  
- `myhorizon = Horizon(6.0)`
  - `Track(src, None, stopTime=myhorizon)`
  - `Track(src, None, startTime="15:15:00", stopTime=myhorizon)`
  
- `OnOff("3C48", Offset(0,1,cosv=False), 90)`



- Write an observing script that will loop over B1937+21, J1713+0737, and J1124+78
  - Perform a cal scan and online folding scan on each using coherent modes
  - You may specify the parfile in any way you choose
  - Do a 90 second cal scan and a 20 minute pulsar scan

- VEGAS is controlled through the GBT but there are standalone tools used to monitor observations
- Some are always used, some are specific to coherent and incoherent modes





```
status
File Edit View Scrollback Bookmarks Settings Help
Current GUPPI status:
SRC_NAME : 0034+69          OBSERVER : Ryan Lynch
RA_STR   : 00:34:11.8560    DEC_STR  : +69:43:18.8400
TELESCOP : GBT             FRONTEND : Rcvr_342
PROJID   : AGBT14A_507_155  FD_POLN  : LIN
TRK_MODE : TRACK           OBSFREQ  : 350.0
OBSBW    : -100.0          OBS_MODE : SEARCH
CAL_MODE : OFF             SCANLEN  : 305.0
BACKEND  : GUPPI           PKTFMT   : FAST4K
DATAHOST : bee2-10         DATAPORT : 50000
POL_TYPE : AA+BB           CAL_FREQ : 25.0
CAL_DCYC : 0.5             CAL_PHS  : 0.0
OBSNCHAN : 4096            NPOL     : 1
NBITS    : 8               PFB_OVER : 12
NBITSADC : 8               ACC_LEN  : 2
NRCVR    : 2               ONLY_I   : 0
DS_TIME  : 1               DS_FREQ  : 1
TFOLD    : 1.0             NBIN     : 256
PARFILE  : None            OFFSET0  : 0.0
SCALE0   : 1.0             OFFSET1  : 0.0
SCALE1   : 1.0             OFFSET2  : 0.5
SCALE2   : 1.0             OFFSET3  : 0.5
SCALE3   : 1.0             DATADIR  : /data1/rlynch/AGBT14A_507/201
50 CHAN_DM : 0.0           NBITSREQ : 8
STT_IMJD : 57121           STT_SMJD : 13115
STT_OFFS : 0               SCANNUM  : 1
TBIN     : 8.192e-05       CHAN_BW  : -0.0244140625
RA       : 8.5494          DEC      : 69.7219
AZ       : 354.0103        ZA       : 71.0801
DAQPULSE : Wed Apr 8 23:39:42 2015  DAQSTATE : running
LST      : 41318           BMAJ     : 0.588920316797
BMIN     : 0.588920316797  DISKSTAT : waiting(11)
NETSTAT  : receiving       DROPavg  : 8.56141e-15
DROPTOT : 0               DROPBLK  : 0
STTVALID : 1               CURBLOCK : 10
FOLDSTAT : exiting         CURFOLD  : 6

Current data block info:
PKTIDX  : 819200

Last update: Wed Apr 8 23:39:43 2015 - Press 'q' to quit
```

- Launched by typing vpmStatus
- Must logged be vegas-hpc1 (or vegas-hpc2, vegas-hpc3...)

```
vegas status
File Edit View Scrollback Bookmarks Settings Help

HPC Node Status:
node      OBSFREQ  NETSTAT  DISPSTAT  CURBLOCK  DROPTOT
vegas-hpc1: 1850.78  exiting  exiting   3         0
vegas-hpc2: 1750.78  exiting  exiting   7         0
vegas-hpc3: 1650.78  exiting  exiting   7         0
vegas-hpc4: 1550.78  exiting  exiting   7         0
vegas-hpc5: 1450.78  exiting  exiting   7         0
vegas-hpc6: 1350.78  exiting  exiting   7         0
vegas-hpc7: 1250.78  exiting  exiting   7         0
vegas-hpc8: 1150.78  exiting  exiting   7         0

Manager Logs:
vegas-hpc1: Wrote subint 3 (total time 30.7s)
           Wrote subint 4 (total time 41.0s)

vegas-hpc2: Wrote subint 3 (total time 30.7s)
           Wrote subint 4 (total time 41.0s)

vegas-hpc3: Wrote subint 3 (total time 30.7s)
           Wrote subint 4 (total time 41.0s)

vegas-hpc4: Wrote subint 3 (total time 30.7s)
           Wrote subint 4 (total time 41.0s)

vegas-hpc5: Wrote subint 3 (total time 30.7s)
           Wrote subint 4 (total time 41.0s)

vegas-hpc6: Wrote subint 3 (total time 30.7s)
           Wrote subint 4 (total time 41.0s)

vegas-hpc7: Wrote subint 3 (total time 30.7s)
           Wrote subint 4 (total time 41.0s)

vegas-hpc8: Wrote subint 4 (total time 41.0s)
           Wrote subint 5 (total time 51.2s)

Last update: Fri Feb 16 03:53:21 2018 - Press 'q' to quit
```

- Launched by typing `vpmHPCStatus`

```
vpmHPCStatus
Menu Edit View Scrollback Bookmarks Settings Help

HPC Node Status:
node      OBSFREQ      NETSTAT      DISPSTAT      CURBLOCK      DROPTOT
vegas-hpc1:      N/A          N/A          N/A          N/A          N/A
vegas-hpc2:      N/A          N/A          N/A          N/A          N/A
vegas-hpc3:      870.78125   receiving    processing    1            0.00629097
vegas-hpc4:      770.78125   receiving    processing    2            0.00565464
vegas-hpc5:      N/A          N/A          N/A          N/A          N/A
vegas-hpc6:      N/A          N/A          N/A          N/A          N/A
vegas-hpc7:      N/A          N/A          N/A          N/A          N/A
vegas-hpc8:      N/A          N/A          N/A          N/A          N/A

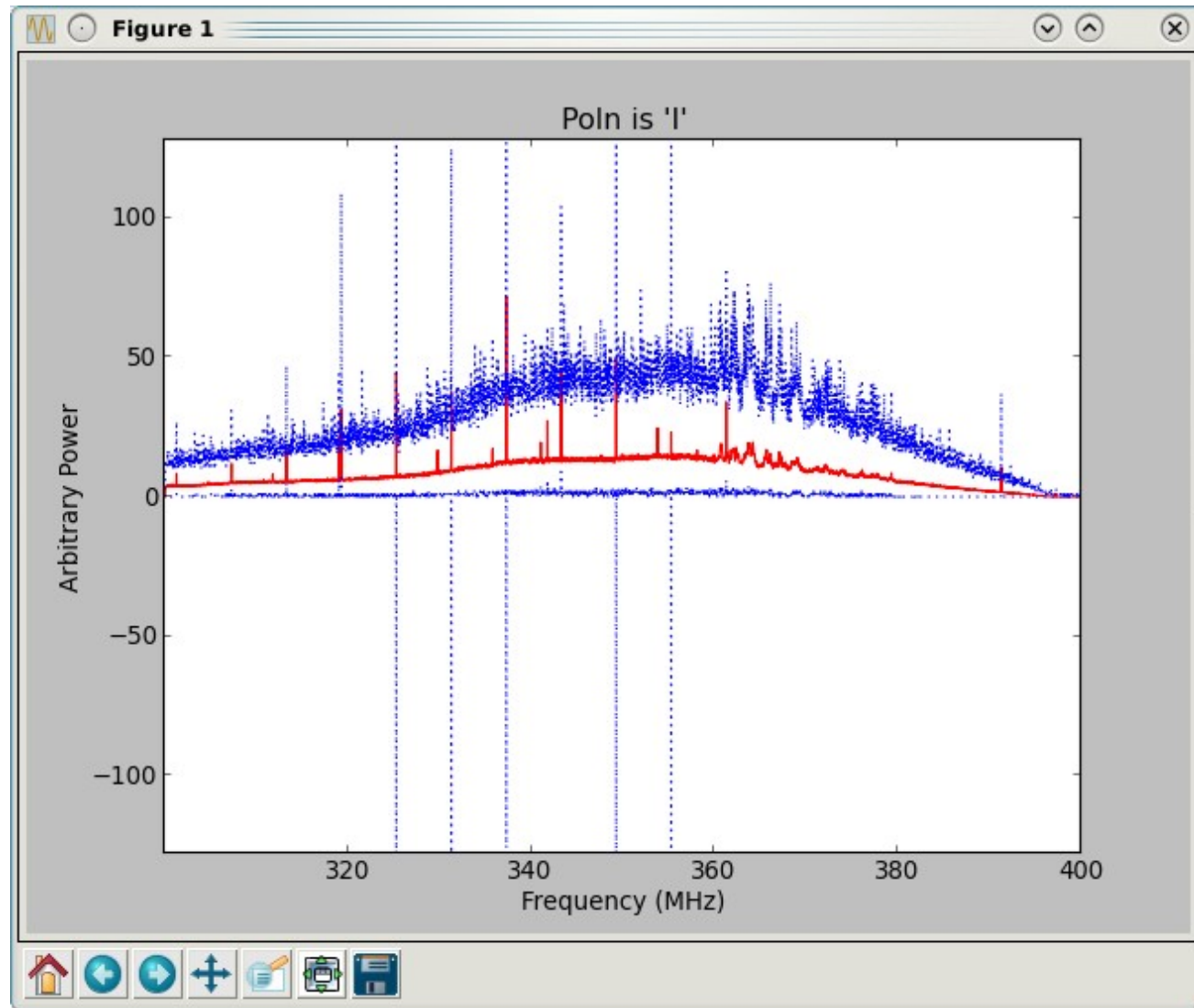
Manager Logs:
vegas-hpc1: This bank is not currently in use
vegas-hpc2: This bank is not currently in use
vegas-hpc3: Wrote subint 6 (total time 59.8s)
           Wrote subint 7 (total time 69.9s)

vegas-hpc4: Wrote subint 7 (total time 69.9s)
           Wrote subint 8 (total time 80.0s)

vegas-hpc5: This bank is not currently in use
vegas-hpc6: This bank is not currently in use
vegas-hpc7: This bank is not currently in use
vegas-hpc8: This bank is not currently in use

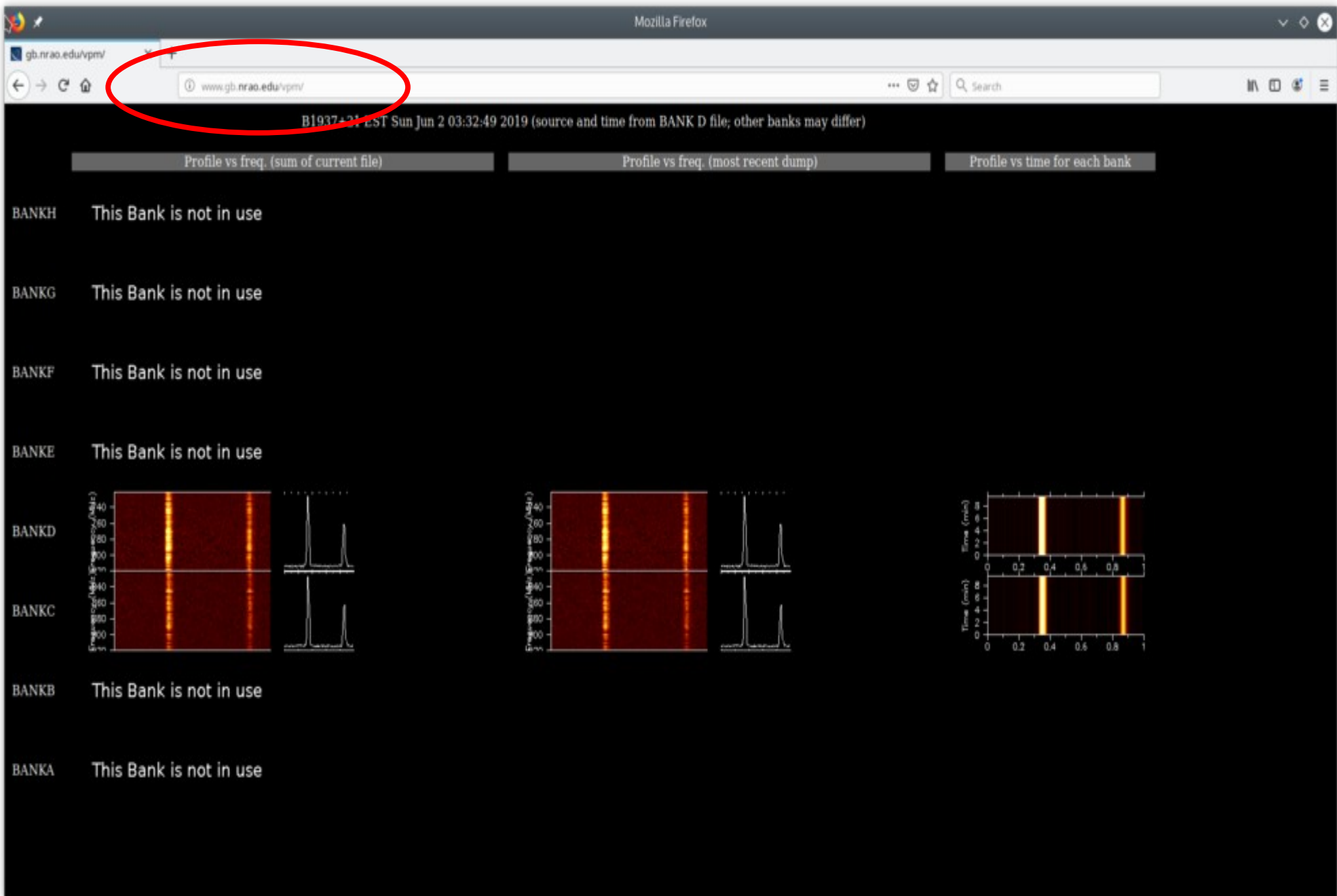
Last update: Sun Jun  2 03:34:09 2019 - Press 'q' to quit
```

- Launched by typing `vpmHPCStatus`



- Launched by typing `vpmMonitor` while data is flowing or by visiting [www.gb.nrao.edu/vpm/vpm\\_monitor](http://www.gb.nrao.edu/vpm/vpm_monitor)





[www.gb.nrao.edu/vpm](http://www.gb.nrao.edu/vpm)

- Final task: Write an observing script to observe some pulsars tonight, using incoherent search mode
  - Limit yourself to L-Band for tonight
  - You may choose sources, but they can't be part of an active project
  - Include a cal scan
  - You can be as pythonic as you want, or you can hard code things by hand
- When you are done, ask me to check your work