

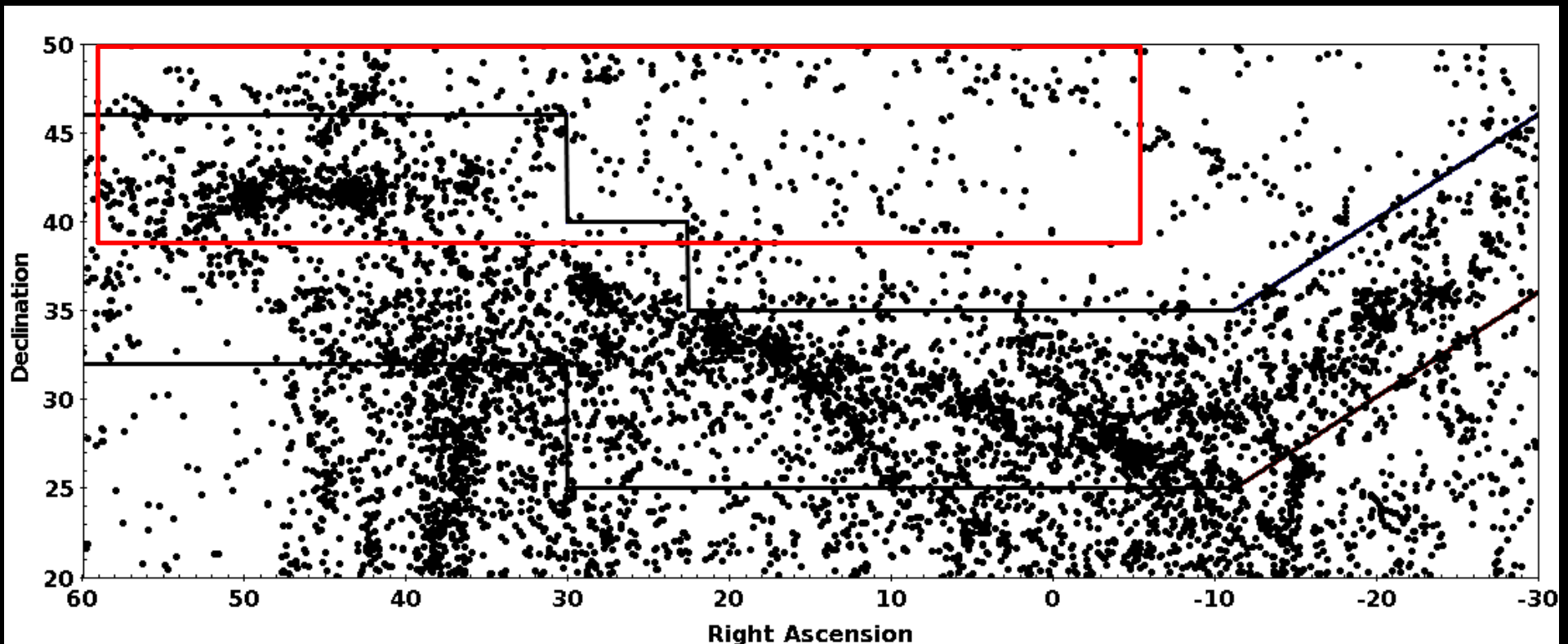
Observing with the GBT

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(WVU/GBO)



Your task:

- Measure HI in galaxies in the Perseus-Pisces Supercluster that are not visible to Arecibo



Your resources

- We have 4 hours of GBT time allocated to our project from 7:30am-11:30am on Friday.
- This is time purchased by WVU for our use.
- Either myself or Evan (or both of us) will be present to assist with observations.
- Also, for the faculty, we have 2 hours of drift scan observing from 5:30-7:30pm for practice.

GBT vs. Arecibo

- Arecibo is really big (really sensitive). Why use GBT for HI?
 - Can observe more of the sky.
 - Unblocked aperture means you can get good data during the day.



How will this work?

- ASTRID: Use to control the telescope
- CLEO: Use to monitor/control telescope
- GBTIDL: Use to look at our data

We will be observing on titania

We can run GBTIDL on any computer; during observing we will use ariel for this.

Astrid

The screenshot displays the Astrid software interface, which is currently in an offline state. The main window is divided into several sections:

- Top Bar:** Includes the title "Astrid (OFFLINE)" and a menu bar with "File", "Edit", "View", "Tools", and "Help".
- Left Panel:** Contains a "Project:" dropdown menu set to "AGBT17A_404" and a "Scheduling Blocks:" list with items "APPSS_1" through "APPSS_8".
- Editor:** The central area for editing the observing script. It shows the following code:

```
1 # Observing file for GBT17A-404 on 6/16/17
2 # DJP
3
4 execfile("Users/dpivano/GBT17A-404/gbt17a-404.config")
5 Configure(Config_HI)
6
7
8 # Flux calibrator observation
9 offpos=Offset('J2000','00:05:00','00:00:00',cosv=False)
10 Catalog(fluxcal)
11 Slew(3C48)
12 Balance()
13 OnOff('3C48',offpos,30,'1')
14
15 # HI calibrator observation
16 c=Catalog("Users/dpivano/GBT17A-404/gbt17a-404calib.cat")
17 OnOff(c.keys()[0],offpos,180,'1')
18
19 #Observe first 5 sources
20 hic=Catalog("Users/dpivano/GBT17A-404/gbt17a-404.cat")
21 sourcenames=hic.keys()
22
23 for s in sourcenames[0:5]:
24     OnOff(s,offpos,300,'1')
25
```
- Validation Output:** A panel on the right showing the results of script validation. It includes messages such as "Your observing script is syntactically correct!" and "*** End Validation - 2017-06-14 19:24:01.57 ***".
- Buttons:** At the bottom of the editor, there are buttons for "Save to Database", "Delete from Database", "Import from File", "Export to File", "Validate", "Simulate", and "Export".
- Observation Log Options:** A section below the editor with checkboxes for "Comment", "Trace", and "Sounds".
- Right Panel:** Contains status indicators for "Observation State:" (NotConnected), "GBT State:" (NotConnected), and "GBT Status:" (NotConnected). It also includes "Queue Control:" buttons (Halt Queue) and "Observation Control:" buttons (Pause, Stop, Abort, Interactive).
- Bottom Bar:** A log area with tabs for "ObservationManagement Log - 1", "DataDisplay Log - 1", "GbtStatus Log - 1", and "Command Console".

Observing Procedure

- Configure Instrument
- Load Catalogs
- Observe flux calibrator (with known flux).
- Observe known HI source.
- Observe science targets.
- Not all 8 scripts include all of these. Each should run about 1 hour.

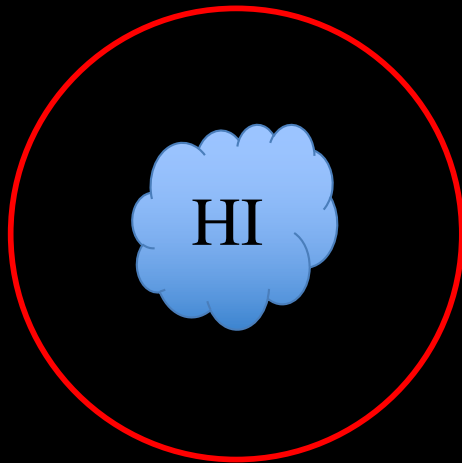
The screenshot shows the Astrid (OFFLINE) software interface. The main window is titled 'Astrid (OFFLINE)' and has a menu bar with 'File', 'Edit', 'View', 'Tools', and 'Help'. Below the menu bar is a toolbar with various icons. The interface is divided into several panes. On the left, there is a 'Project' pane showing 'AGBT17A_404' and a 'Scheduling Blocks' pane listing 'APPSS_1' through 'APPSS_8'. The 'APPSS_1' block is selected. The main pane is an 'Editor' showing a Python script for 'APPSS_1'. The script contains comments and code for configuring the instrument, loading catalogs, and observing targets. Red arrows point from the list on the left to specific lines in the script: from 'APPSS_1' to line 4, from 'APPSS_2' to line 9, from 'APPSS_3' to line 10, from 'APPSS_4' to line 11, from 'APPSS_5' to line 12, from 'APPSS_6' to line 13, from 'APPSS_7' to line 16, and from 'APPSS_8' to line 23. The script code is as follows:

```
1 # Observing file for GBT17A-404 on 6/16/17
2 # DJP
3
4 execfile("/users/dpisano/GBT17A-404/gbt17a-404.config")
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8 # Flux calibrator observation
9 offpos=Offset('J2000','00:05:00','00:00:00',cosv=False)
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11 Slew('3C48')
12 Balance()
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15 # HI calibrator observation
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17 OnOff(c.keys()[0],offpos,180,'1')
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19 #Observe first 5 sources
20 hic=Catalog('/users/dpisano/GBT17A-404/gbt17a-404.cat')
21 sourcenames=hic.keys()
22
23 for s in sourcenames[0:5]:
24     OnOff(s,offpos,300,'1')
25
```

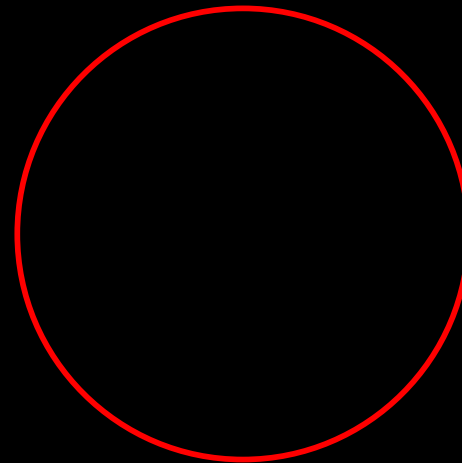
At the bottom of the editor, there are buttons for 'Save to Database', 'Delete from Database', 'Import from File', and 'Export to File'. Below the editor, there is an 'Observation Log Options' section with checkboxes for 'Comment', 'Trace', and 'Sounds'.

OnOff Observations

$$T_A = \frac{ON - OFF}{OFF} T_{sys}$$



On



Off

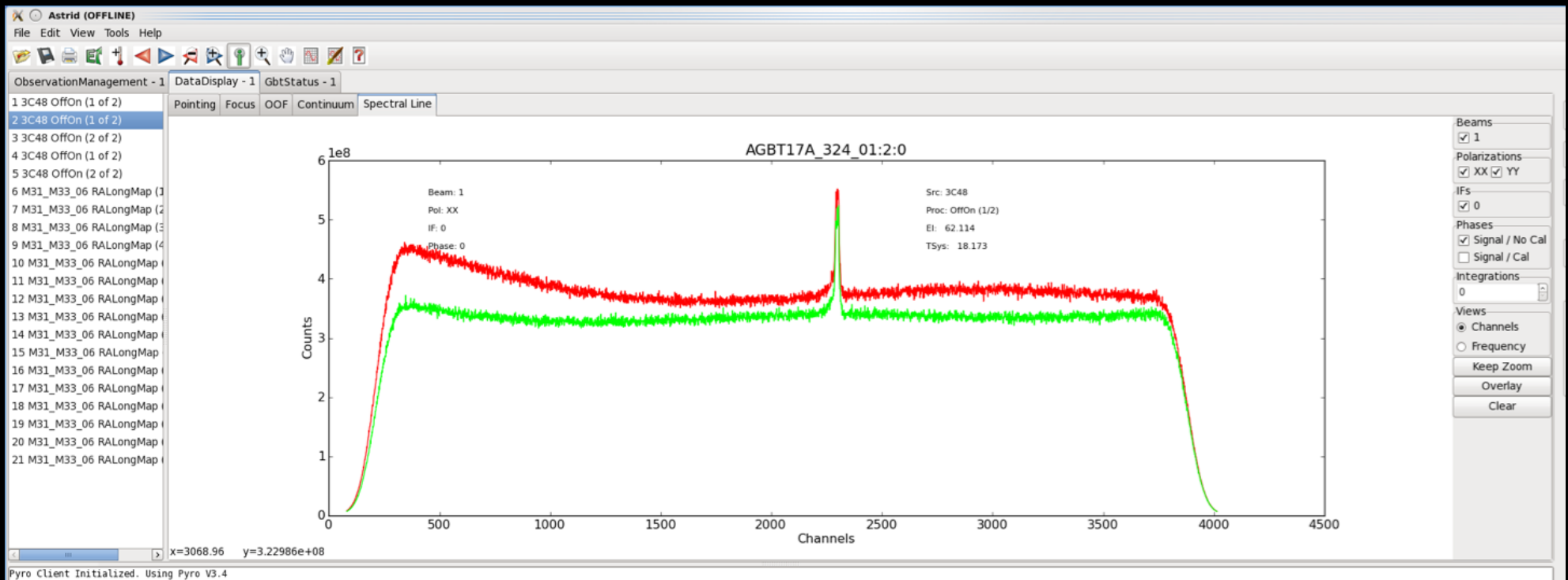
OnOff Observations

$$T_A = \frac{ON - OFF}{OFF} T_{sys}$$

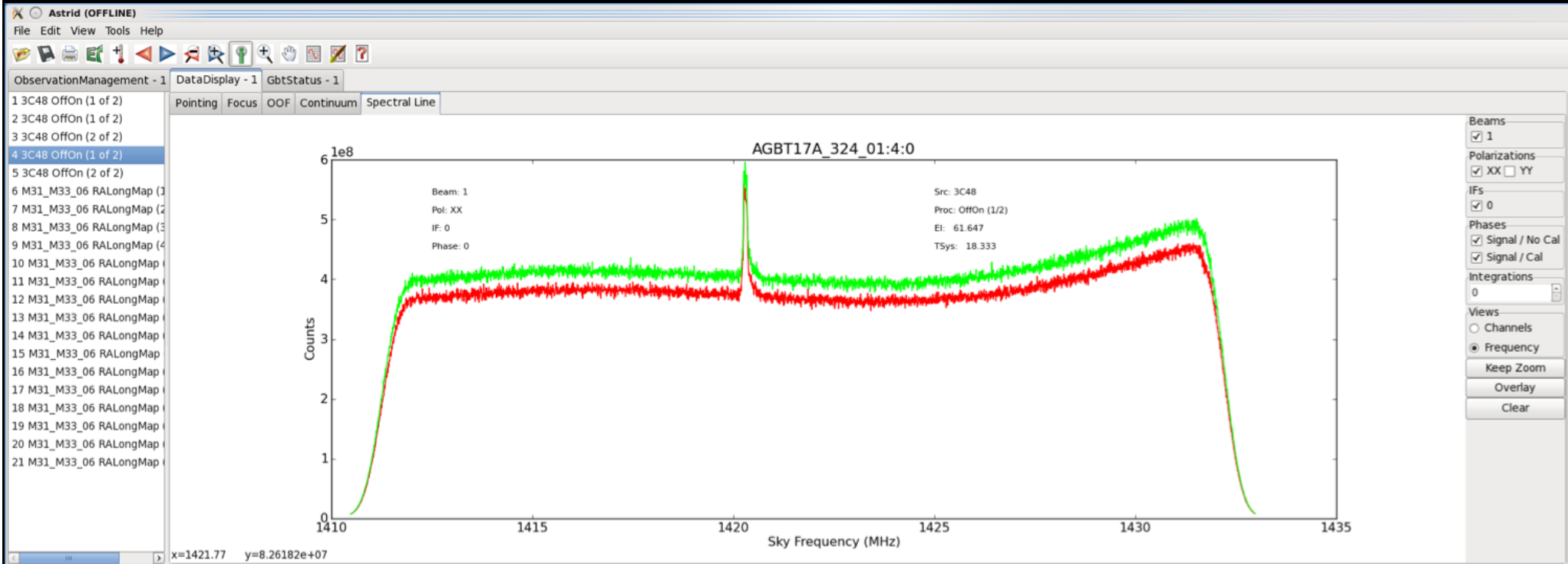
Can also form “OFF” in other ways:

Track your source and switch your observing frequency, i.e. frequency-switching.

Monitoring Observations



Monitoring Observations



Monitoring the GBT: cleo status

Status

File Launch Help

Status: clear State: Ready M LST 11:57:14 UTC 23:42:46

Device	Status	State
LO1	clear	Ready
RcvrPF_1	clear	Ready
IFRack	clear	Ready
ConverterRack	clear	Ready
AnalogFilterRack	clear	Ready
SwitchingSignalSelector	clear	Ready
Measurements	clear	Ready
GUPPI	clear	Ready
IFManager	clear	Ready

Source: GBT820-04130 Scan #: 28
Project: JMAINT SS Master: DCR
Start: 00:00:00 Length: 60.0
Countdown: ---:-- Remaining: 00:00:00
Observer: Duncan Lorimer
Obs. Type: UNKNOWN Switching: TPNOCAL
Proc Name: Track Sequence: 1 / 1
Rest Freq: 820 Velocity: 0
Frame: Local Vel Def: Radio

Time to Set: 09:41:07 Encoder:

Indicated Azimuth: 42.25390 Elevation: 77.84991
Commanded Azimuth: 42.25243 Elevation: 77.84987
Rate (°/min): 0.1 -0.1
Difference: -0.00147 -0.00004
Servo Err (°): 0.0 0.0

On Source: On Axis Fault/E-Stop: Off
Az LPC: 0.0000 EI LPC: 0.0000
Focus: 900.0 Polar: 0.00 X: 500.0
Config Model: Stopped
Default_PrimeFocus Coord Mode: CableWrap
Temp: 18.9
Wind: 2 V(m/s)
Temp: 2a T(C)

Dynamic Corrections: DC Pointing DC Focus Az1: 0.00 Az2: 0.00 EI: 0.00 Focus: 0.00

Devices IF Manager Messages

LO1 IF Center (MHz): 1080 Tolerance (Hz): 1.000 LO1A (Hz): 1900000000

RcvrPF_1 15 K: 16.60 Ext. Cal 70 K: 66.89 Noise X Vac (V): -0.00 Noise Y LO Pwr A: 4.03 IF Pwr A: 0.75 IF Pwr B: 0.70 IF Pwr C: -0.12 IF Pwr D: 0.03

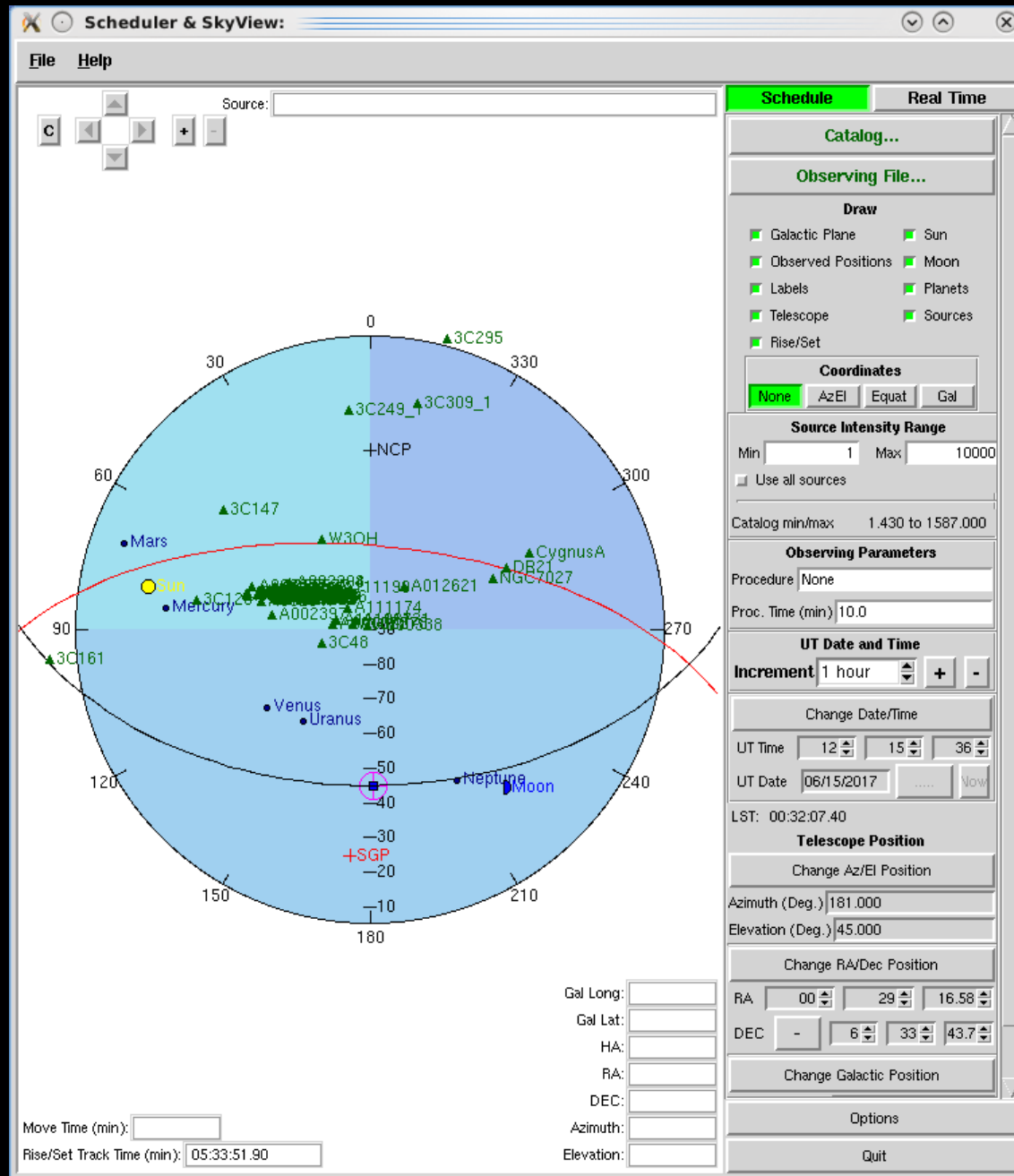
IFRack OD1: 0.78 OD3: 0.86

ConverterRack CM4: 3.56 CM8: 2.41

SG SG

Auto Scroll: Off 10 Phase Table... Other Devices: Retrace IF

Monitoring the GBT: cleo scheduler



Looking at your data: GBTIDL

- Start by typing “gbtidl” from command line.
- To access data in near real time, type “online” in GBTIDL.
- To look at data (after On and Off observed):
GBTIDL>
getps,scan#,plnum=0 or 1
- This does the ON-OFF calibration.

```
dpisano@newton:~/Documents
File Edit View Search Terminal Tabs Help
dpisano@newton:~/GBT17A-404
[dpisano@newton ~/Documents]$ gbtidl
IDL Version 7.1.1 (linux x86_64 m64). (c) 2009, ITT Visual Information Solutions
Installation number: 15269-1.
Licensed for use by: National Radio Astronomy Observatory

Starting GBTIDL

Display Device : X
Visual Class   : TrueColor
Visual Depth   : 24-Bit
Color Table Size: 256
Number of Colors: 16777216
Decomposed Color: 0

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Welcome to GBTIDL v2.10.1

For news, documentation, enhancement requests, bug tracking,
discussion, and contributions, visit:

http://gbtidl.nrao.edu

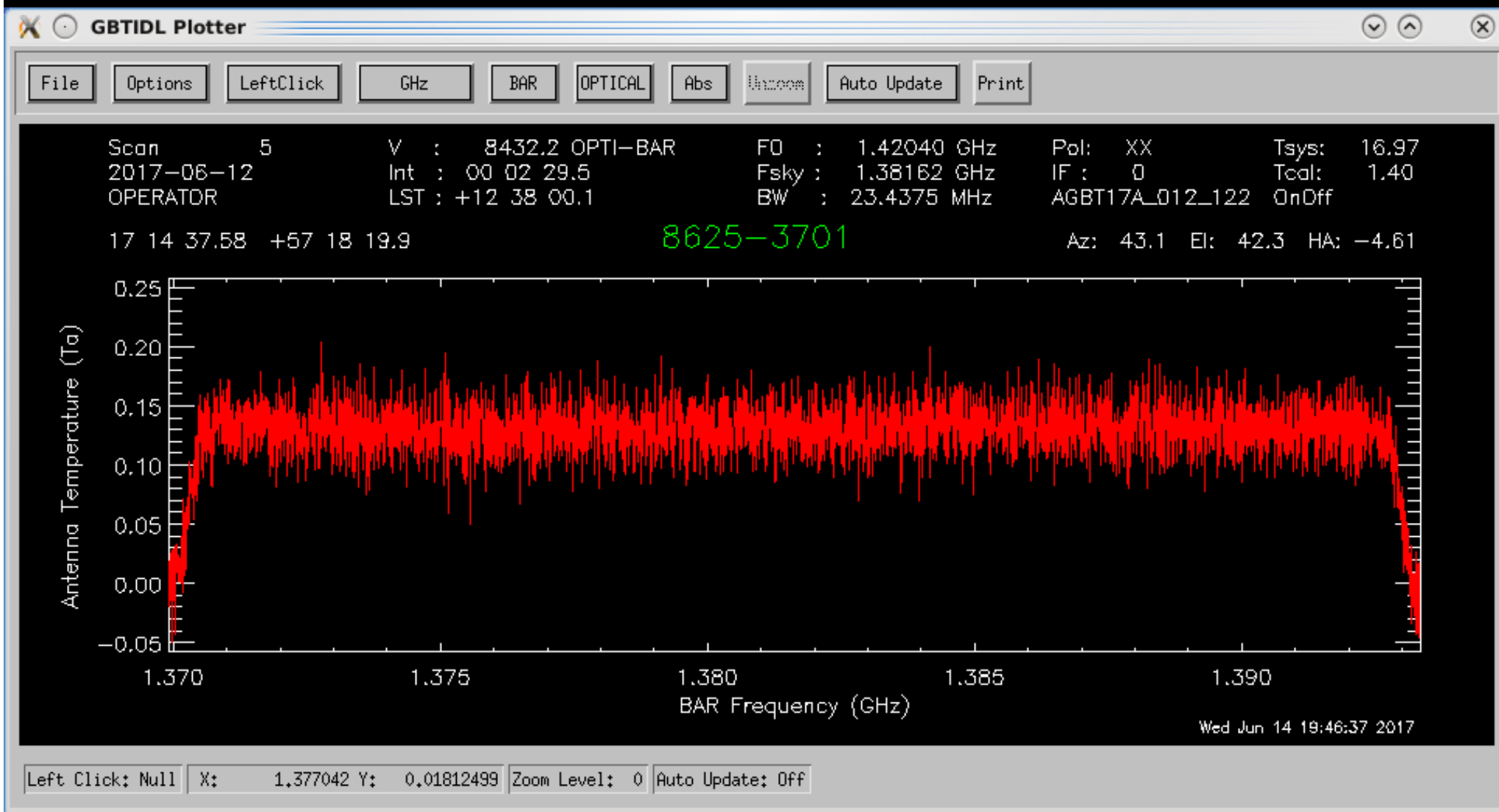
For help with a GBTIDL routine from the command line, use
the procedure 'usage'. For example:

usage, 'show' ; gives the syntax of the procedure 'show'
usage, 'show', /verbose ; gives more information on 'show'
-----

GBTIDL -> online
Connecting to file: /home/sdfits/AGBT17A_012_122/AGBT17A_012_122.raw.vegas
File has not been updated in 4089.55 minutes.
GBTIDL -> summary
Scan      Source      Vel      Proc Seq      RestF nIF nInt nFd      Az      El
-----
5         8625-3701    8432.2    OnOff 1      1.420 1 31 1 43.1 42.3
6         8625-3701    8432.2    OnOff 2      1.420 1 31 1 43.3 43.6
7         8625-12705   8812.2    OnOff 1      1.420 1 31 1 43.7 42.1
8         8625-12705   8812.2    OnOff 2      1.420 1 31 1 44.0 43.4
9         8625-12705   8812.2    OnOff 1      1.420 1 31 1 44.0 43.5
10        8625-12705   8812.2    OnOff 2      1.420 1 31 1 44.2 44.8
11        8625-3704    9012.4    OnOff 1      1.420 1 31 1 44.0 45.7
12        8625-3704    9012.4    OnOff 2      1.420 1 31 1 44.1 47.0
13        8625-3704    9012.4    OnOff 1      1.420 1 31 1 44.1 47.1
14        8625-3704    9012.4    OnOff 2      1.420 1 31 1 44.1 48.5
15        8625-3704    9012.4    OnOff 1      1.420 1 31 1 44.1 48.6
16        8625-3704    9012.4    OnOff 2      1.420 1 31 1 44.0 49.9
17        8625-6103    8992.5    OnOff 1      1.420 1 31 1 42.9 51.3
18        8625-6103    8992.5    OnOff 2      1.420 1 31 1 42.6 52.6
19        8625-6103    8992.5    OnOff 1      1.420 1 31 1 42.6 52.7
20        8625-6103    8992.5    OnOff 2      1.420 1 31 1 42.2 54.0
21        8625-6103    8992.5    OnOff 1      1.420 1 31 1 42.2 54.1
22        8625-6103    8992.5    OnOff 2      1.420 1 31 1 41.7 55.4
23        8625-12701   9083.7    OnOff 1      1.420 1 31 1 42.4 55.6
24        8625-12701   9083.7    OnOff 2      1.420 1 31 1 41.8 56.9
25        8625-12701   9083.7    OnOff 1      1.420 1 31 1 41.8 57.0
26        8625-12701   9083.7    OnOff 2      1.420 1 31 1 41.0 58.2
27        8625-12701   9083.7    OnOff 1      1.420 1 31 1 41.0 58.3
28        8625-12701   9083.7    OnOff 2      1.420 1 31 1 40.1 59.6
29        7958-6103    10690.9   OnOff 1      1.420 1 31 1 86.0 61.4
30        7958-6103    10690.9   OnOff 2      1.420 1 31 1 87.1 63.0
31        7958-1901    11757.7   OnOff 1      1.420 1 31 1 88.2 64.1
32        7958-9101    11590.5   OnOff 1      1.420 1 31 1 92.9 66.3
33        7958-9101    11590.5   OnOff 2      1.420 1 31 1 94.4 67.9
34        7958-9101    11590.5   OnOff 1      1.420 1 31 1 94.9 68.4
35        7958-9101    11590.5   OnOff 2      1.420 1 26 1 96.6 70.0

GBTIDL -> getps,5
Blanked spectra: ignored 1 integrations
Scan: 5 (IF:0 FD:0 PL:0) units: Ta (K) Tsys: 16.51 16.64
GBTIDL -> getps,5,plnum=1
Blanked spectra: ignored 1 integrations
Scan: 5 (IF:0 FD:0 PL:1) units: Ta (K) Tsys: 16.97 17.10
GBTIDL ->
```

getps output



getps output

- Can change the x-axis between Frequency, Channels, and Velocity: freq, chan, velo.
- Can change y-axis to “Jy” by setting units in getps: getps,scan,plnum=0,units=‘Jy’
- Can zoom in on features: setx, sety.
- Can combine both polarizations by typing: “accum” after “getps” for both plnums. Then “ave” to see combined spectrum.

More on GBTIDL

- There is a tutorial for GBTIDL available on the meeting webpage.
- To do this you will be working on reducing the data we collected last year.
- You can follow this to reduce the data we will be collecting on Friday as well.

Summary

Today:

- Groups of 3 faculty each will get to practice observing (although the GBT will be stationary).

Friday:

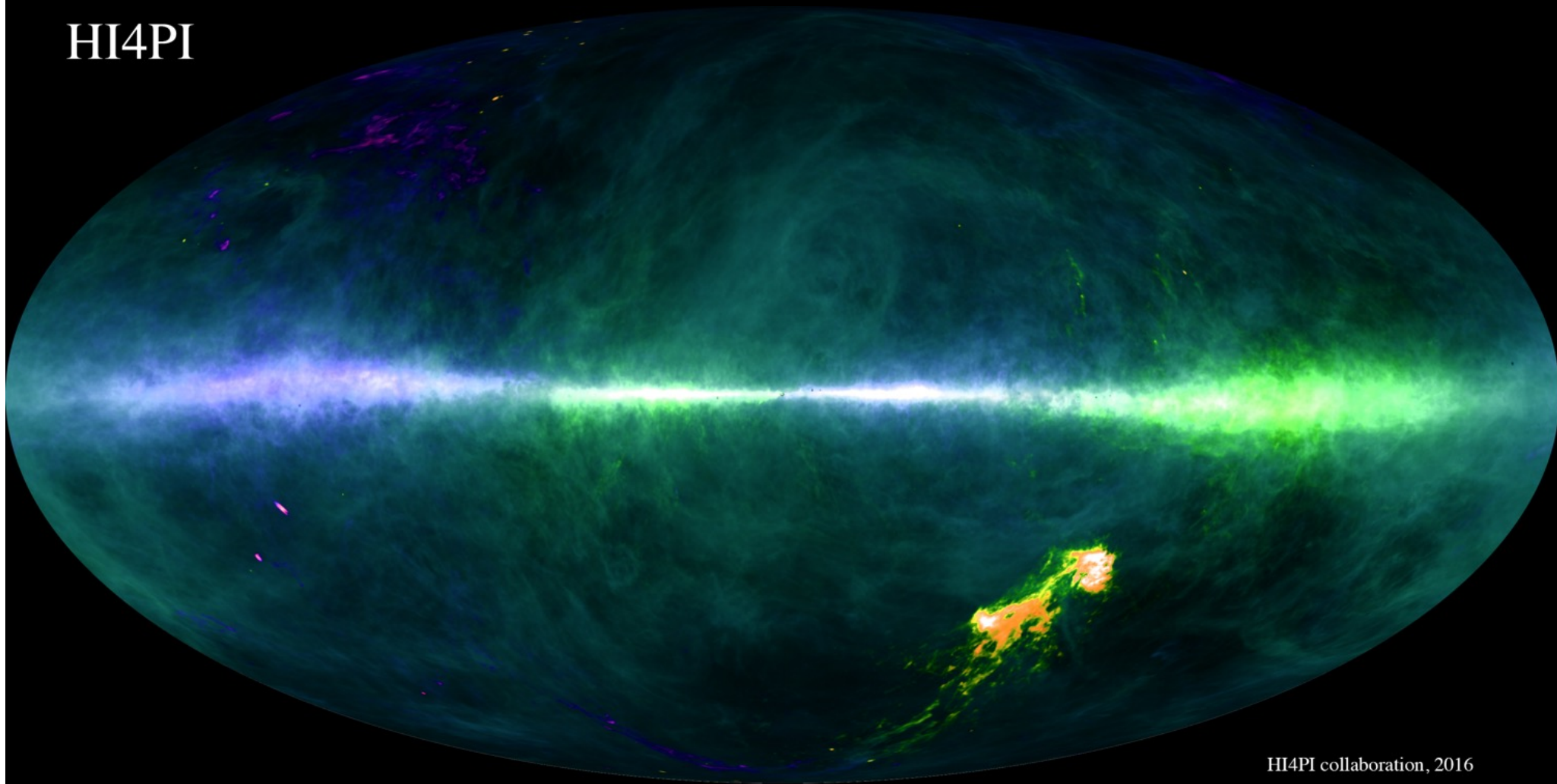
- Each group will get to start an observing script.
- Each group will look at one known HI source.
- Each group will then examine/reduce the science targets as they are observed in GBTIDL.

Today's Faculty Groups

Group A	Group B	Group C
Joe	Luke	Becky
David	Aileen	Grant
Martha	Greg	Adriana
~5:30pm	~6:10pm	~6:50pm

- Each group will have ~40 minutes on GBT.
- Meet with Evan or myself to go over scripts first.

HI4PI



HI4PI collaboration, 2016