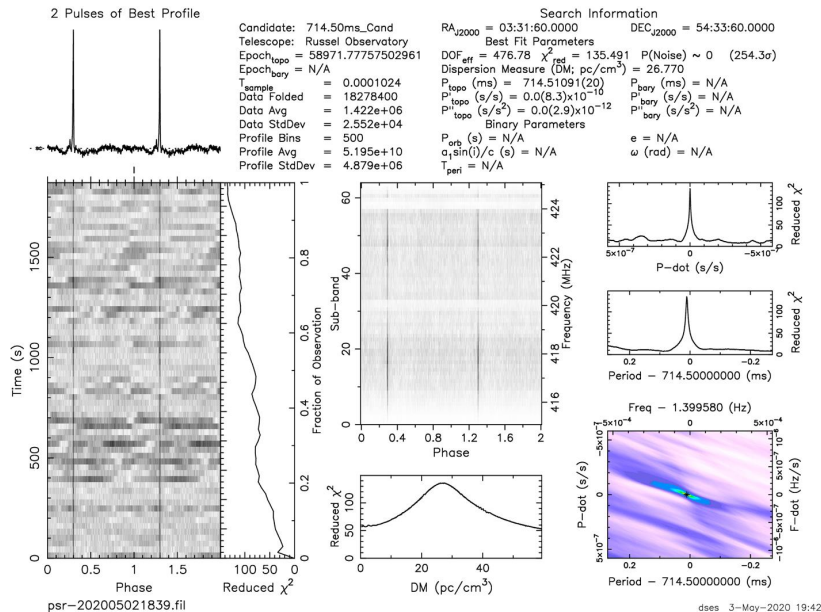


Deep Space Exploration Society Science Meeting



May 25, 2020

Dr. Richard Russel

DrRichRussel@netscape.net

DSES First Pulsar Detection
B0329+54

Information

- 9 ft Dish – Down because hard drive crashed
- SuperSID – Down because of hard drive crash
- Radio Jupiter – still need to get a new receiver and setup at site (new member project?)
- Pulsar – Last observation trip Saturday – site power down
- SARA East Conference – recommend everyone virtually attend: August 1-2 www.radio-astronomy.org
- DSES Pulsar featured on Neutron Star Group website <http://www.neutronstar.joataman.net/>

First DSES Pulsar Observation

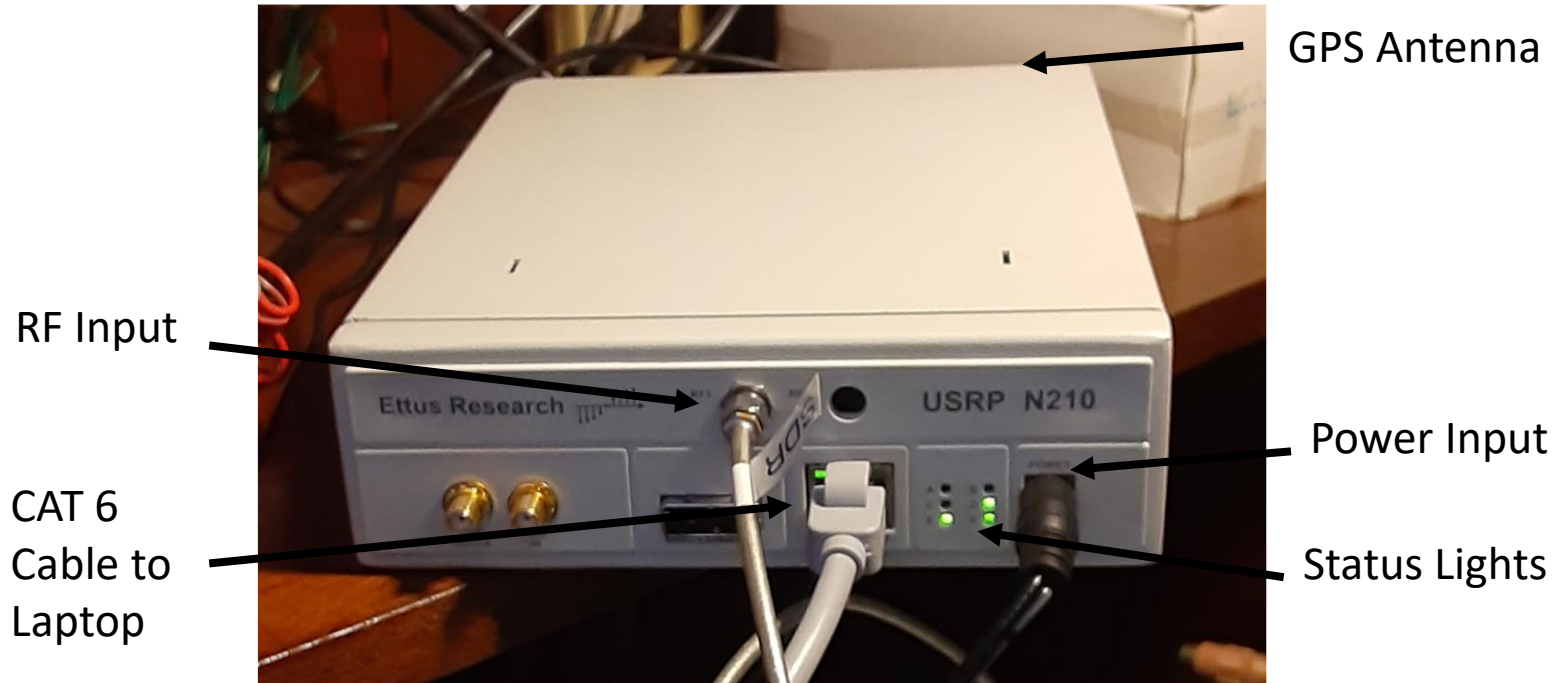
May 2, 2020

- Pulsar B0329+54
- Observers: Rich Russel, Ray Uberecken, Bob Haggert
- Antenna: 60 ft DSES Dish - Haswell, CO
- DSES Members all contributed to this success!
- Special recognition to Steve Plock for getting the pulsar system started!

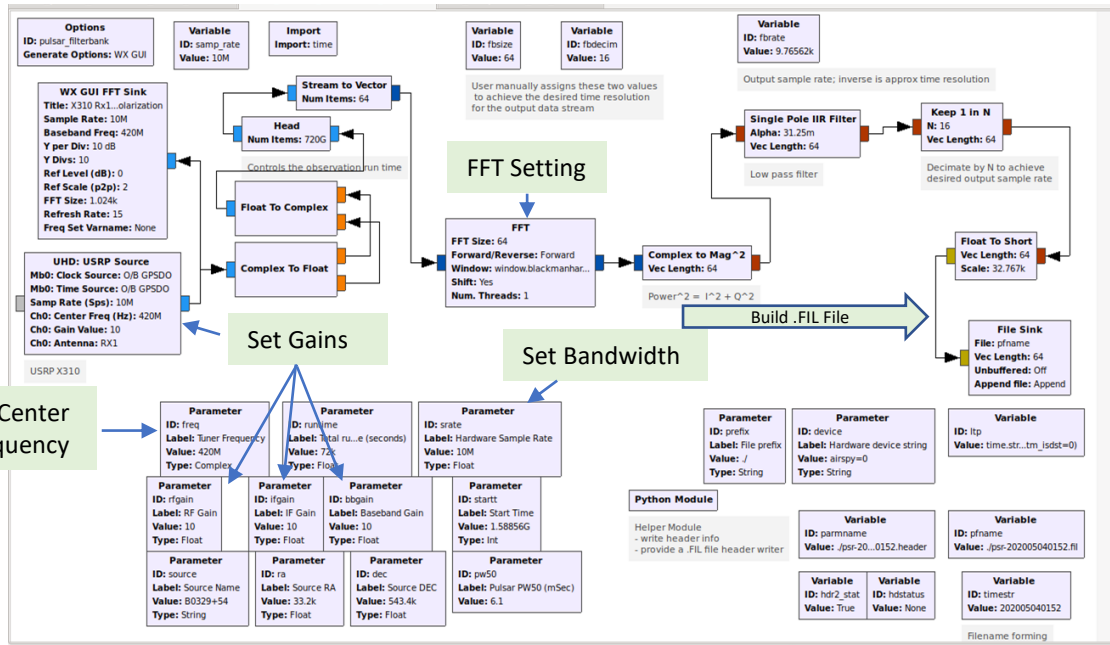


Ettus Research USRP N210

Software Defined Radio



GNU Software developed by Dr. Joe Martin (K5SO)



Status updates

```

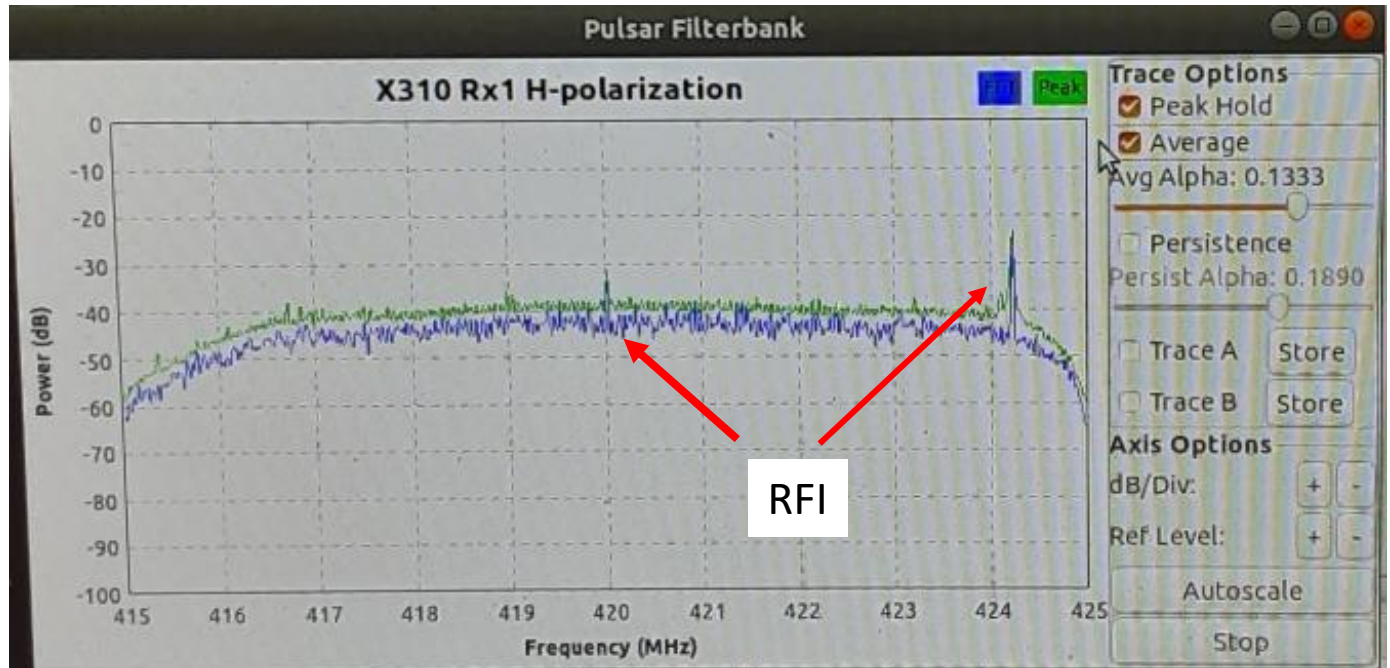
Loading: "/home/dses/KSSO_filterbank_grc/KSSO_pulsar_filterbank_1chnl_25M.grc"
>>> Done

Loading: "/home/dses/KSSO_filterbank_grc/KSSO_pulsar_filterbank_1chnl.grc"
>>> Done

Loading: "/home/dses/WX_strip_chart_detector/WX_stripchart_1in_1out.grc"
>>> Done
    
```

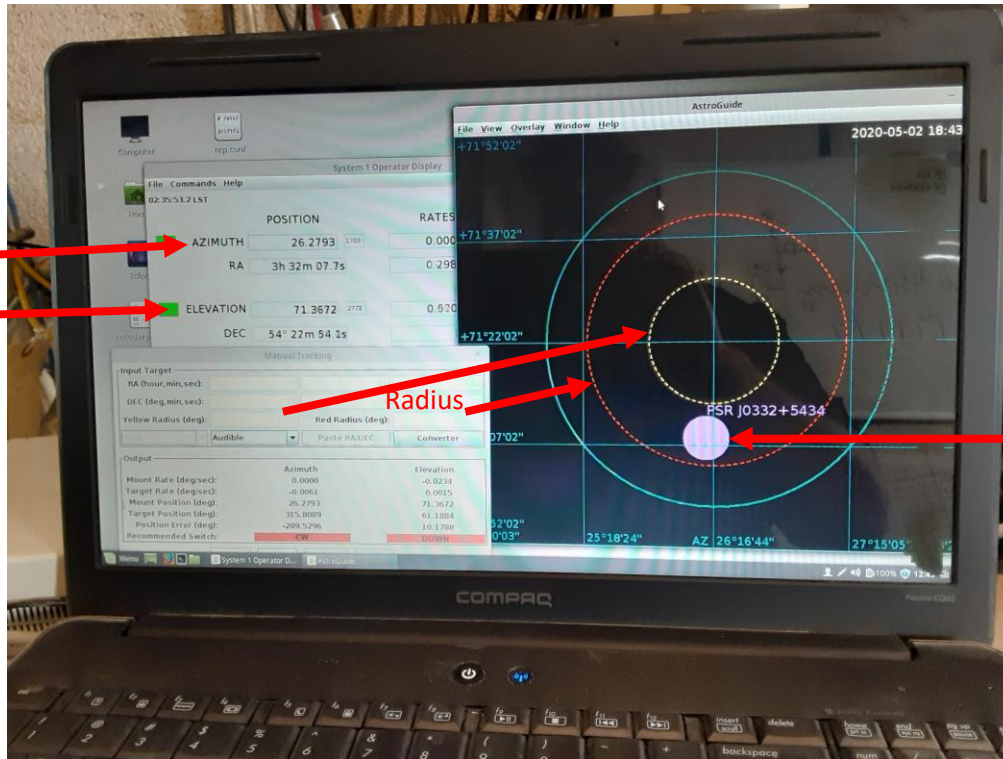
Id	Value
Imports	
import_0	import time
Variables	
fbdecim	16
fbrate	(float(samp_rate)/float(fbsize))/fbdecim
fbsize	64

Spectrum Plot During Observation



System 1 Pointing Software

Azimuth
Elevation



Target
Goal Keep inside
circles

Trailer Setup

Manual
Antenna
Control



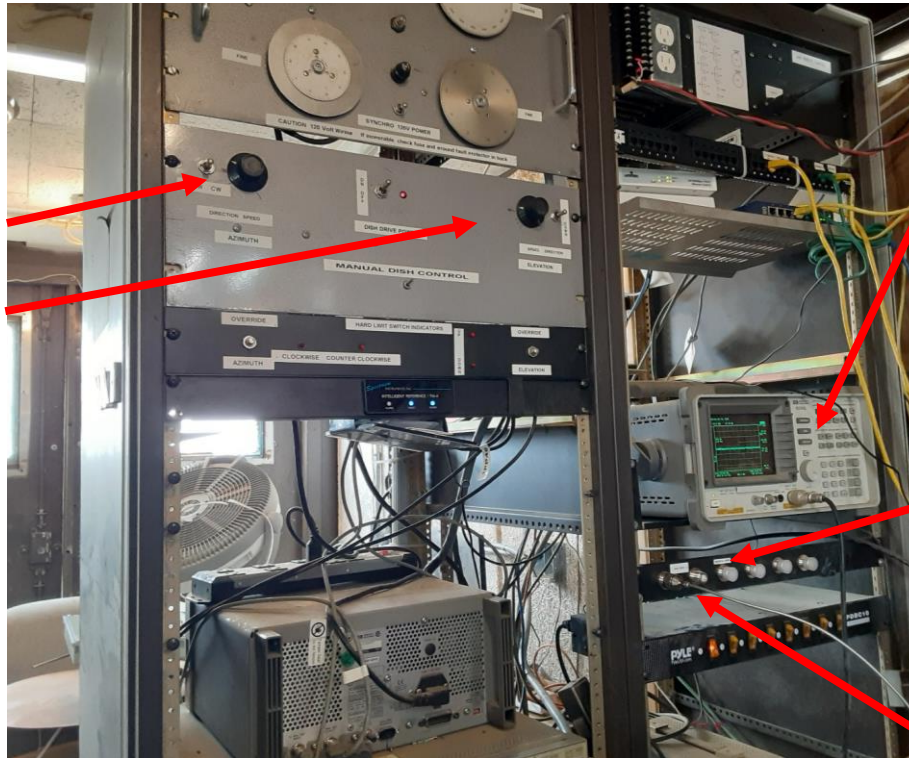
RF Preamp
Power and
Antenna
Output

SDR (behind
laptop)

Pointing
Laptop

Pulsar
Software
Laptop

Rack Equipment



Azimuth Control

Elevation Control

Spectrum Analyzer
-use to check for RFI

Required to set
center frequency
and bandwidth

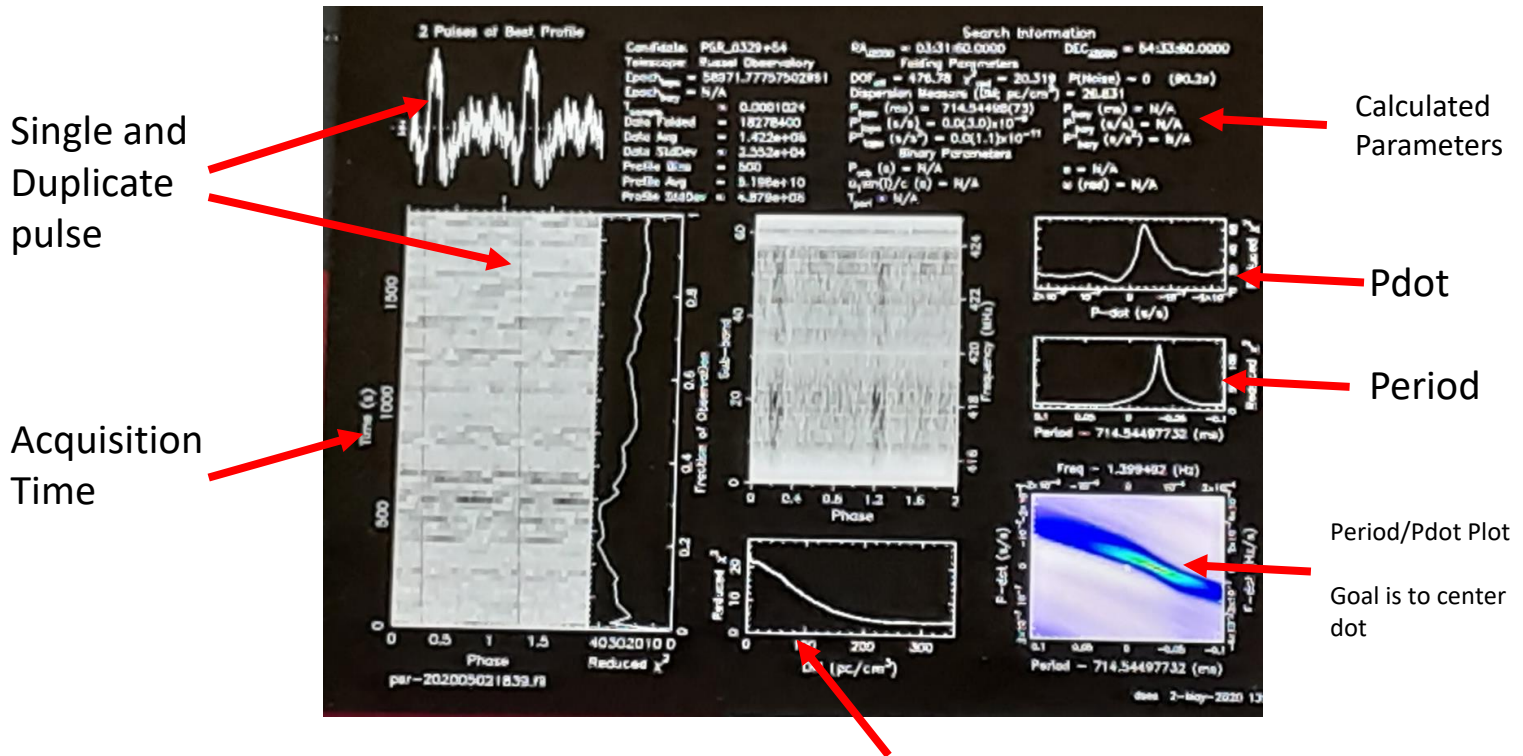
Preamp Power
Switch

20 dB Preamp
(behind)

RF Output from
antenna system

B0329+54 Initial Processed .FIL File

Pulses too wide – (wrong period input)



PRESTO Software

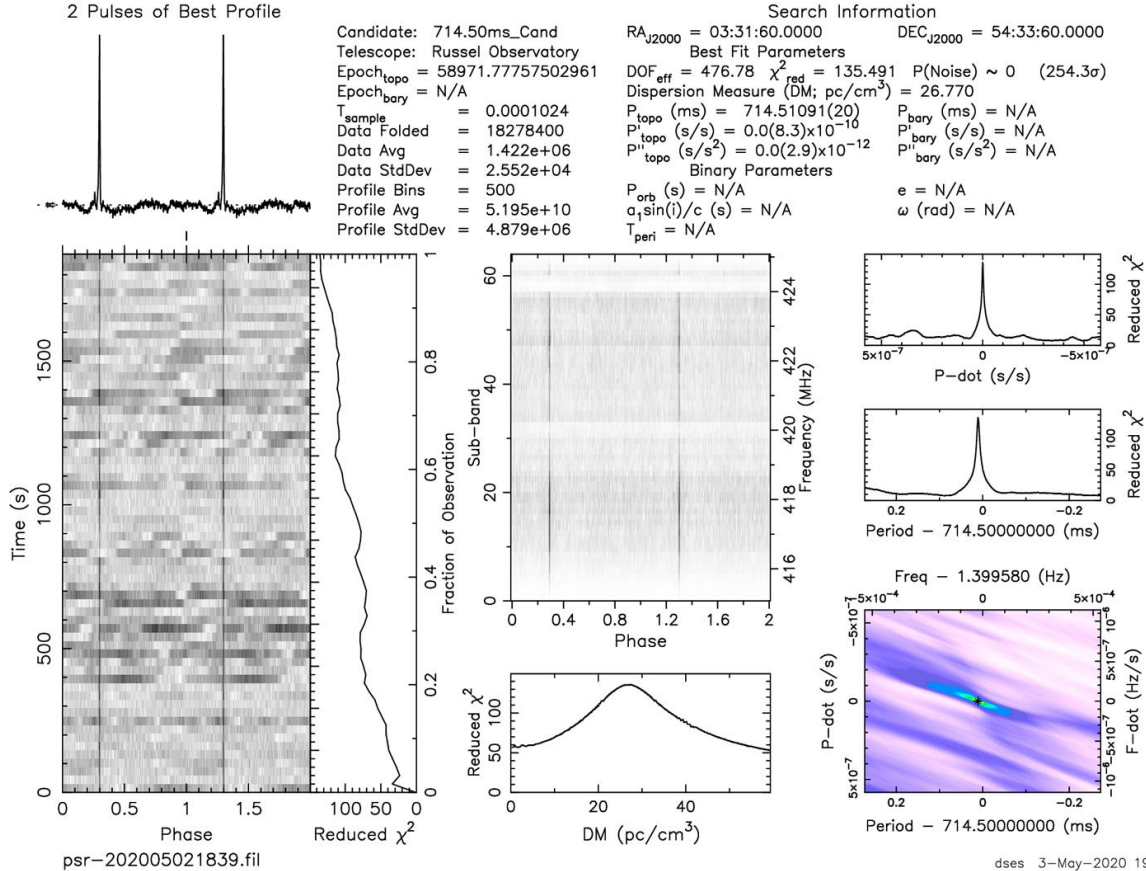
Homepage: <http://www.cv.nrao.edu/~sransom/presto/>

• PRESTO is freely available from github

<https://github.com/scotttransom/presto>

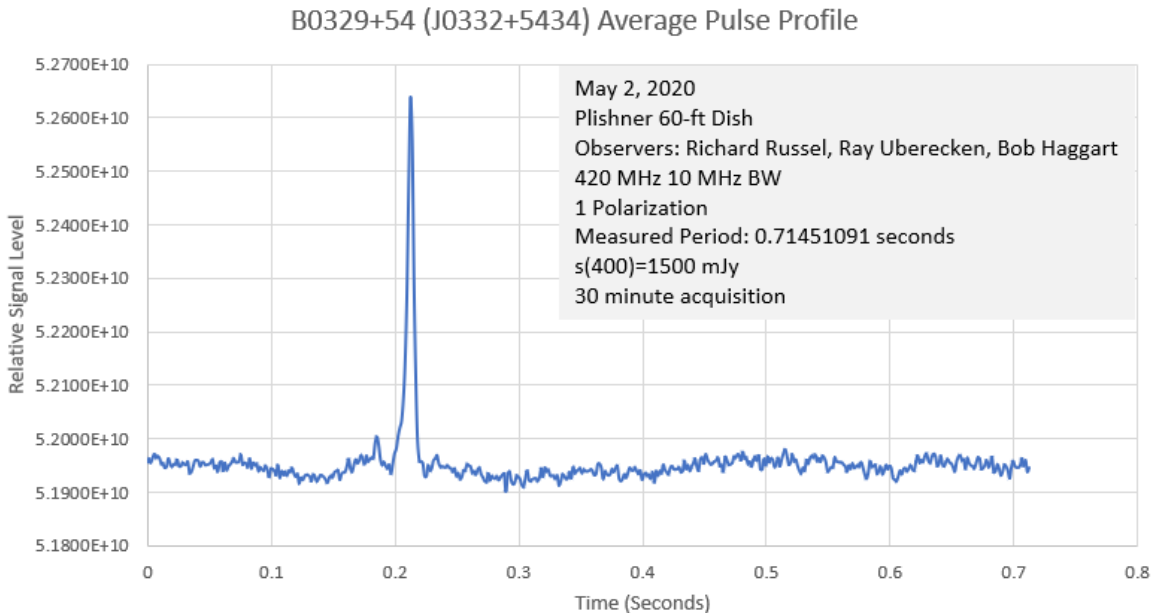
B0329+54

Processed .FIL File after Multiple Iterations of Period



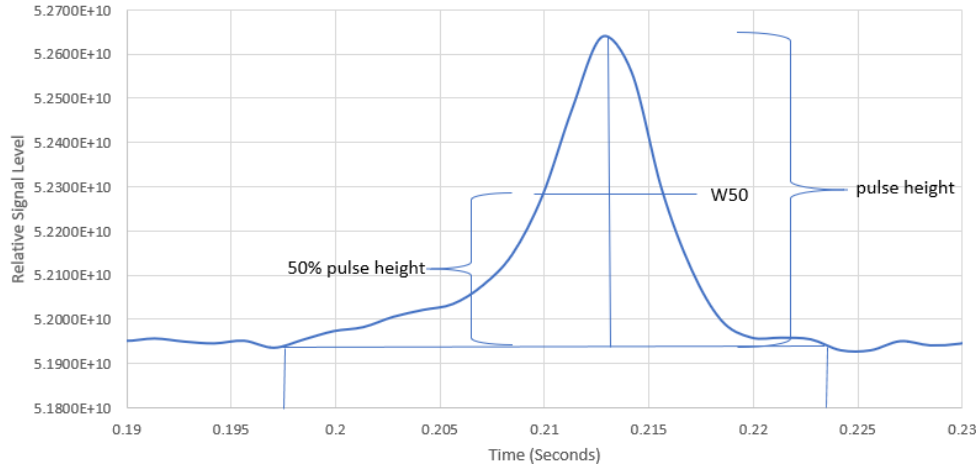
dses 3-May-2020 19:42

Data Output Plotted in Excel



Analyzing Data to Determine W(50)

B0329+54 (J0332+5434) Average Pulse Profile



Pulse Width (100%)	0.027 seconds
Pulse Height	0.0708
50% Pulse Height	5.2284
Pulse Width 50% (W50)	0.006 seconds 6 ms
ATNF W50	0.0066 seconds 6.6 ms

W(50) is 50% of pulse height

Expected value for B0329+54 is 6.6 ms

Value measured is approx. 6.0 ms

Better data analysis can help improve accuracy

Murmur Pulsar Planning

Enter Antenna Location

Antenna Calculations

Observation Planning

Pulsar Selection

Pulsar Parameters

Current Pulsar AZ/EL

Murmur 12.0.0 8 Oct.2019 mario.natali@gmail.com http://i0naa.altervista.org

Location Plishner 60-ft Latitude 38.3808 Longitude -103.1560 UTC Time Mon May 25 19:33:01 2020 Local Time Mon May 25 13:33:01 2020

Current Time Zone Name : Mountain Daylight Time (DST)

SAVE current set as default SET Observation location CALCULATE

TRACK noise sources Culminations Next 24h PSR visibility Next 24h PSR tracking
CALCULATE Noise Y-Factor 1 Month PSR visibility 1 Month PSR tracking

Rev. History
RESET Settings and EXIT
Check for updates EXIT

☒ Dish antenna ☐ Other antenna

Dish diameter 18 m
Dish efficiency 69 %
Frequency 420 Mhz
Line loss before LNA 0.1 dB
LNA Noise figure 0.35 dB
LNA gain 38 dB
Line loss after LNA 0.5 dB
Receiver noise figure 4 dB
T sky 4 K
T spillover 10 K
T atmosphere 0 K

Integration time 18000 sec.
Integration bandwidth 10000 kHz

Wave length 0.71 m
Effective ant. aperture 175.5 m²
Dish area 254.34 m²
Far field 907 m
Antenna gain 36.36 dBi
HPBW 2.78 deg
System noise temp. 45.75 K
System noise figure 0.64 dB
G/T ratio 19.75 dB/K
Noise floor -103.34 dBm
MDS 1.70 mJy

The analysis does not take into account the polarization of the signal as this parameter is strongly depending on the specific Pulsar. Please evaluate carefully case by case as this may deteriorate performance up to 3dB.

List of detectable PULSARS
PULSARS extracted with S400 flow >0 : 654
PULSARS extracted with S1400 flow >0 : 1762
ATNF Pulsar catalogue Version : 1.61

Sorted by S400
Above horizon
B0329+54
B0531+21
J0437-4715
B0950+08
B0740-28
B1133+16
B2111+46
B0628-28
B0736-40
B1508+55
B2217+47
B2154+40
B0818-13

Minimum S/N > 10
S/N >10 suggested for reliable results

Right Ascension (J2000 (RAJD)) 53.25 deg
Declination (DECJD) 54.58 deg
Pulse with @ 50% of peak (W50) 6.6 msec.
Barycentric period (P0) 0.71452 sec.
Dispersion Measure (DM) 26.76 cm⁻³ pc
Flow @ 400 Mhz (S400) 1500.0 mJy
Flow @1400 Mhz (S1400) 203.0 mJy
Distance (Dist) 1.00 kpc 3261.6 ly
Age (age) 5.53e+06 years
Max Integration BW 1,110 KHz
Expected S/N 9161.1
Azimuth 325.86 deg
Elevation 68.59 deg

Show all PSR List
PLAN Observation
Select object to track

Murmur 1 Month Schedule (B0329+54)

Design Transitions Animations S

Murmur 12.0.0 8 Oct.2019 mario.natali

Location Plishner 60-ft **Latitude** 38.3808 **Longitude** -103.1

Current Time Zone Name : Mountain Daylight Time (DST)

☒ Dish antenna ☐ Other antenna

Dish diameter 18 m
Dish efficiency 69 %
Frequency 420 Mhz
Line loss before LNA 0.1 dB
LNA Noise figure 0.35 dB
LNA gain 38 dB
Line loss after LNA 0.5 dB
Receiver noise figure 4 dB
T sky 4 K
T spillover 10 K
T atmosphere 0 K

Integration time 18000 sec.
Integration bandwidth 10000 kHz

Effective area

System

System

The analysis is polarized strongly. Please even may date

T spillover
T atmosphere

1 Month Pulsar visibility

1 Month Pulsar visibility : B0329+54

Date Time (UTC)	Date Time (Local)	Azimuth (Deg.)	Elevation (Deg.)
Fri May 29 21:40:00 2020	Fri May 29 15:40:00 2020	313.67	40.54
Fri May 29 22:40:00 2020	Fri May 29 16:40:00 2020	316.85	32.23
Fri May 29 23:40:00 2020	Fri May 29 17:40:00 2020	321.40	24.50
Sat May 30 00:40:00 2020	Fri May 29 18:40:00 2020	327.08	17.59
Sat May 30 01:40:00 2020	Fri May 29 19:40:00 2020	333.76	11.76
Sat May 30 02:40:00 2020	Fri May 29 20:40:00 2020	341.30	7.25
Sat May 30 03:40:00 2020	Fri May 29 21:40:00 2020	349.52	4.27
Sat May 30 04:40:00 2020	Fri May 29 22:40:00 2020	358.15	3.00
Sat May 30 05:40:00 2020	Fri May 29 23:40:00 2020	6.85	3.51
Sat May 30 06:40:00 2020	Sat May 30 00:40:00 2020	15.27	5.78
Sat May 30 07:40:00 2020	Sat May 30 01:40:00 2020	23.13	9.67
Sat May 30 08:40:00 2020	Sat May 30 02:40:00 2020	30.20	14.97
Sat May 30 09:40:00 2020	Sat May 30 03:40:00 2020	36.32	21.45
Sat May 30 10:40:00 2020	Sat May 30 04:40:00 2020	41.37	28.85
Sat May 30 11:40:00 2020	Sat May 30 05:40:00 2020	45.17	36.95
Sat May 30 12:40:00 2020	Sat May 30 06:40:00 2020	47.38	45.49
Sat May 30 13:40:00 2020	Sat May 30 07:40:00 2020	47.24	54.19
Sat May 30 14:40:00 2020	Sat May 30 08:40:00 2020	43.02	62.61
Sat May 30 15:40:00 2020	Sat May 30 09:40:00 2020	30.82	69.83
Sat May 30 16:40:00 2020	Sat May 30 10:40:00 2020	5.59	73.70
Sat May 30 17:40:00 2020	Sat May 30 11:40:00 2020	336.68	71.77
Sat May 30 18:40:00 2020	Sat May 30 12:40:00 2020	320.14	65.42
Sat May 30 19:40:00 2020	Sat May 30 13:40:00 2020	313.67	57.29
Sat May 30 20:40:00 2020	Sat May 30 14:40:00 2020	312.34	48.62
Sat May 30 21:40:00 2020	Sat May 30 15:40:00 2020	313.83	39.98
Sat May 30 22:40:00 2020	Sat May 30 16:40:00 2020	317.11	31.70
Sat May 30 23:40:00 2020	Sat May 30 17:40:00 2020	321.74	24.02
Sun May 31 00:40:00 2020	Sat May 30 18:40:00 2020	327.49	17.18
Sun May 31 01:40:00 2020	Sat May 30 19:40:00 2020	334.23	11.42
Sun May 31 02:40:00 2020	Sat May 30 20:40:00 2020	341.82	7.00
Sun May 31 03:40:00 2020	Sat May 30 21:40:00 2020	350.08	4.13
Sun May 31 04:40:00 2020	Sat May 30 22:40:00 2020	358.72	2.98
Sun May 31 05:40:00 2020	Sat May 30 23:40:00 2020	7.41	3.61
Sun May 31 06:40:00 2020	Sun May 31 00:40:00 2020		

Please note that above table is calculated assuming DST ACTIVE

Local Date/Time

Elevation

Rise > 20 deg

Max Elevation

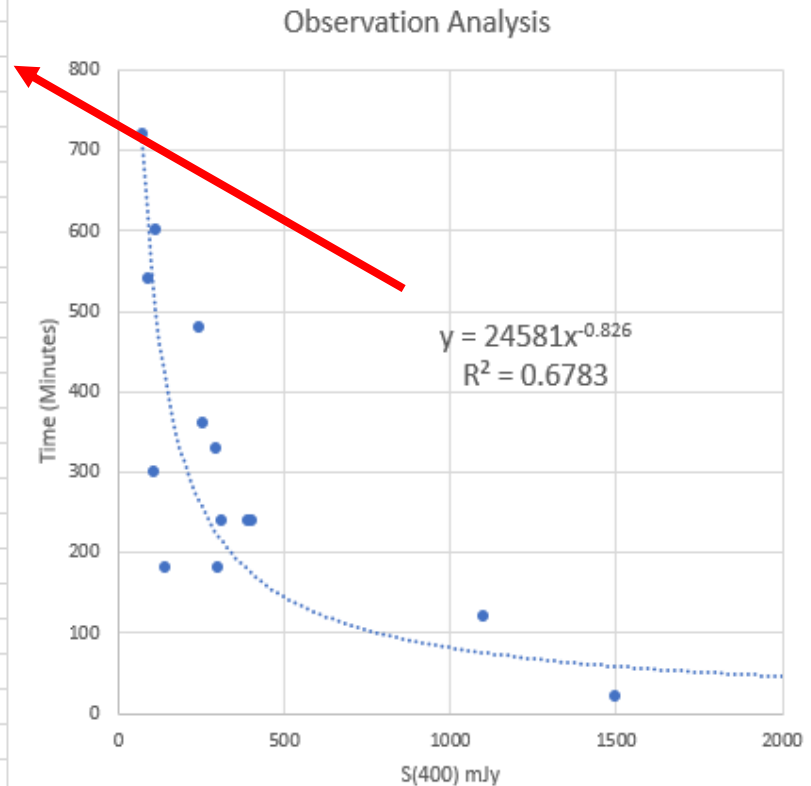
Set < 20 deg

Pulsar Observation Log

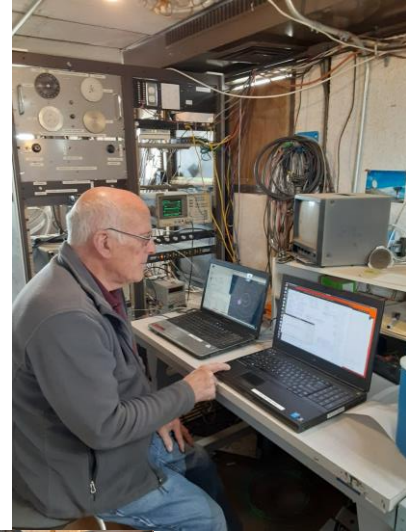
Pulsar BNAME	S400 (mJy)	Max Elevation	Local Time	Date	KSSO Obs Time (Min)	Calc Obs Time(min)	Date Observed	Period (s)	DM	W50 (ms)	RA (Deg)	RA (Hr)	DEC (Deg)	Start Time	End Time	Delta Time (hr:min)	File Name (.FIL)	Success (Y/N)
B1641-45	375	6	1:20	5/30/2020		184		0.45508	478.8	8.0	251.21	16.75	-45.99	0:00	0:00	0:00		
B1642-03	393	48	1:25	5/30/2020	240	177		0.38769	35.76	3.4	251.26	16.75	-3.3	0:00	0:00	0:00		
B1749-28	1100	23	2:46	5/30/2020	120	76		0.56256	50.37	6.1	268.24	17.88	-28.11	0:00	0:00	0:00		
B1929+10	303	62	3:30	5/30/2020	180	219		0.22652	3.18	5.7	293.06	19.54	10.99	0:00	0:00	0:00		
B1933+16	242	67	3:32	5/30/2020	480	264		0.35874	158.52	6.0	293.95	19.6	16.28	0:00	0:00	0:00		
B2016+28	314	80	4:35	5/30/2020	240	213		0.55795	14.2	14.9	304.52	20.3	28.67	0:00	0:00	0:00		
B2111+46	141	81	5:36	5/30/2020	180	412		1.01469	141.26	32.1	318.35	21.22	46.74	0:00	0:00	0:00		
B2154+40	105	85	6:40	5/30/2020	300	526		1.52527	71.12	38.6	329.26	21.95	40.3	0:00	0:00	0:00		
B2217+47	111	80	6:42	5/30/2020		503		0.53847	43.5	7.5	334.95	22.33	47.51	0:00	0:00	0:00		
B0329+54	1500		11:40	5/9/2020	20	58	5/9/2020	0.71452	26.7641	6.6	53.25	3.55	54.58	15:58	16:28	0:30	PSR-202005091558	Y
B0329+54	1500	73	11:40	5/30/2020		58	5/9/2020	0.71452	26.7641	6.6	53.25	3.55	54.58	0:00	0:00	0:00		
J0437-4715	550	4	12:44	5/30/2020		134		0.00576	2.64	0.1	69.32	4.62	-47.25	0:00	0:00	0:00		
B0531+21	550	73	13:41	5/9/2020		134	5/9/2020	0.03339	56.7712	3.0	83.63	5.58	22.01	18:28	19:28	1:00	PSR-202005091827	N
B0531+21	550	73	13:41	5/30/2020		134		0.03339	56.7712	3.0	83.63	5.58	22.01	0:00	0:00	0:00		
B0628-28	206	23	15:09	5/30/2020		302		1.24442	34.42	63.3	97.71	6.51	-28.58	0:00	0:00	0:00		
B0736-40	190	11	16:10	5/30/2020		322		0.37492	160.9	22.7	114.63	7.64	-40.71	0:00	0:00	0:00		
B0740-28	296	23	16:12	5/30/2020	330	224		0.16676	73.73	4.2	115.7	7.71	-28.38	0:00	0:00	0:00		
B0823+26	73	78	16:33	5/9/2020	720	710	5/9/2020	0.5366	19.4763	5.8	126.71	8.45	26.62	17:07	18:07	1:00	PSR-202005091706	N
B0823+26	73	78	16:33	5/30/2020		710		0.5366	19.4763	5.8	126.71	8.45	26.62	0:00	0:00	0:00		
B0835-41	197	10	16:36	5/30/2020		313		0.75162	147.29	4.4	129.34	8.62	-41.59	0:00	0:00	0:00		
B0818-13	102	37	17:13	5/30/2020		539		1.23813	40.94	21.7	125.11	8.34	-13.85	0:00	0:00	0:00		
B0833-45	5000	6	17:15	5/30/2020		22		0.08933	67.97	1.4	128.84	8.59	-45.18	0:00	0:00	0:00		
B0834+06	89	57	17:22	5/30/2020	540	603		1.27377	12.86	24.8	129.27	8.62	6.17	0:00	0:00	0:00		
B0950+08	400	59	18:39	5/9/2020	240	174	5/9/2020	0.25306	2.97	8.9	148.29	9.89	7.93	19:47	21:17	1:30	PSR-202005091947	N
B0950+08	400	59	18:39	5/30/2020		174		0.25306	2.97	8.9	148.29	9.89	7.93	0:00	0:00	0:00		
B1133+16	257	67	20:17	5/30/2020	360	251		1.18791	4.84	5.9	174.01	11.6	15.85	0:00	0:00	0:00		
B1508+55	114	72	23:19	5/30/2020	600	492		0.73968	19.62	10.9	227.36	15.16	55.53	0:00	0:00	0:00		

Use Historic Observation Times to estimate the formula for predicted observing time based on S(400) Level

Pulsar BNAME	S400 (mJy)	Max Elevation	Local Time	Date	K550 Obs Time (Min)	Calc Obs Time(min)
B1641-45	375	6	1:20	5/30/2020		184
B1642-03	393	48	1:25	5/30/2020	240	177
B1749-28	1100	23	2:46	5/30/2020	120	76
B1929+10	303	62	3:30	5/30/2020	180	219
B1933+16	242	67	3:32	5/30/2020	480	264
B2016+28	314	80	4:35	5/30/2020	240	213
B2111+46	141	81	5:36	5/30/2020	180	412
B2154+40	105	85	6:40	5/30/2020	300	526
B2217+47	111	80	6:42	5/30/2020		503
B0329+54	1500		11:40	5/9/2020	20	58
B0329+54	1500	73	11:40	5/30/2020		58
J0437-4715	550	4	12:44	5/30/2020		134
B0531+21	550	73	13:41	5/9/2020		134
B0531+21	550	73	13:41	5/30/2020		134
B0628-28	206	23	15:09	5/30/2020		302
B0736-40	190	11	16:10	5/30/2020		322
B0740-28	296	23	16:12	5/30/2020	330	224
B0823+26	73	78	16:33	5/9/2020	720	710
B0823+26	73	78	16:33	5/30/2020		710
B0835-41	197	10	16:36	5/30/2020		313
B0818-13	102	37	17:13	5/30/2020		539
B0833-45	5000	6	17:15	5/30/2020		22
B0834+06	89	57	17:22	5/30/2020	540	603
B0950+08	400	59	18:39	5/9/2020	240	174
B0950+08	400	59	18:39	5/30/2020		174
B1133+16	257	67	20:17	5/30/2020	360	251
B1508+55	114	72	23:19	5/30/2020	600	492



Pulsar Observing Trip Pics



Questions?