

JRT

Job's Radio Telescope



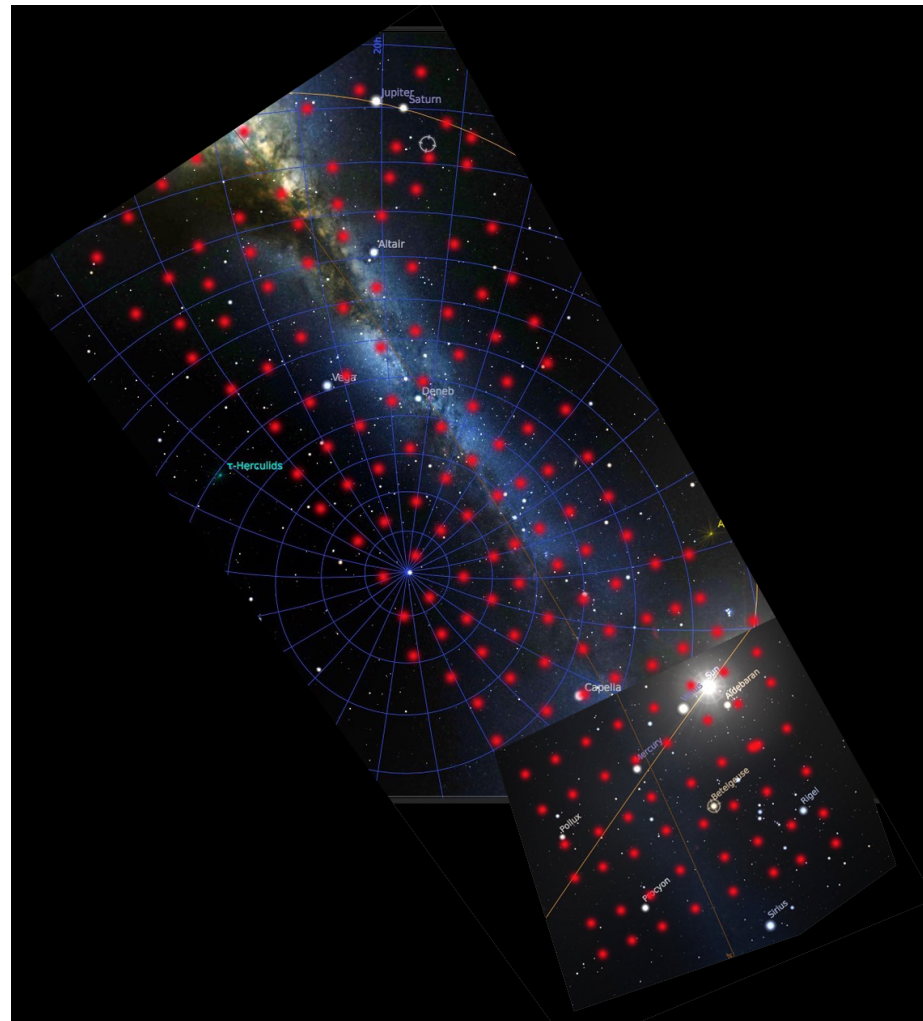
Neutral Hydrogen Plot of the Galaxy (Milky Way)

from longitude 20 to 230 on 1 June 2020
By Job Geheniau

The idea was to plot a map of the Milky Way in the whole visible range within reasonable marges (altitude >20) in my region The Netherlands. That is between longitude 20 to 230.

Steps roughly about 10 degrees.

The plot is made in Neutral Hydrogen detection with my 1.5-1.9 meter Radio Dish.
First I roughly divided the Galactic Plane in 21 lines with 8 measuring points per line:



Then I made an Excel and .txtfile with all the 168 (!) RA-DEC coordinates.

The screenshot shows a Windows desktop with a starry background. On the left, a command prompt window titled 'C:\Windows\system32\cmd.exe' displays the following text:

```
Declination for sample 163: -7d18m0s
-----
Right ascension for sample 164: 7h3m0s
Declination for sample 164: -4d16m0s
-----
Right ascension for sample 165: 7h30m0s
Declination for sample 165: -1d56m0s
-----
Right ascension for sample 166: 7h51m0s
Declination for sample 166: 0d1m0s
-----
Right ascension for sample 167: 8h26m0s
Declination for sample 167: 2d2m0s
-----
Right ascension for sample 168: 8h49m0s
Declination for sample 168: 5d45m0s
-----
Total observation time will be 504 minutes

Would you like to produce a calibrated spectrum at the
end of your observation (requires off_nchan.dat cal
ibration reference file in directory)? [Y/N]: y
Start observation in... [sec]: 49320

-----
Observation will begin automatically in 49320 seconds
. Please do not press anything...
-----
```

On the right, a Notepad window titled 'Galaxy Plot coordinates - Notepad' contains a table of RA-DEC coordinates for 21 samples. The table is as follows:

Sample	RA (h:m:s)	Dec (d:m:s)
1	18h38m0s	-2d51m39s
2	18h2m0s	1d18m0s
3	17h27m0s	4d7m0s
4	17h2m0s	8d25m0s
5	19h53m0s	1d3m0s
6	19h23m0s	4d8m0s
7	18h46m0s	18h46m0s
8	18h8m0s	9d34m0s
9	17h35m0s	12d32m0s
10	17h4m0s	14d3m0s
11	21h38m0s	-0d17m0s
12	21h11m0s	3d1m0s
13	20h40m0s	10d9m0s
14	20h4m0s	16d5m0s
15	19h29m0s	19h29m0s
16	18h32m0s	23d35m0s
17	18h5m0s	23d56m0s
18	17h21m0s	25d31m0s
19	21h57m0s	12d10m0s
20	21h29m0s	17d59m0s
21	20h59m0s	22d24m0s
22	20h17m0s	26d12m0s
23	19h40m0s	30d12m0s
24	18h59m0s	32d43m0s
25	18h10m0s	35d28m0s
26	17h24m0s	37d7m0s
27	22h40m0s	19d47m0s
28	22h07m0s	25d26m0s
29	21h23m0s	30d23m0s
30	20h42m0s	35d15m0s
31	20h0m0s	38d46m0s
32	19h24m0s	43d25m0s
33	18h48m0s	48d47m0s
34	18h7m0s	50d49m0s
35	23h4m0s	28d11m0s
36	22h37m0s	35d41m0s
37	22h3m0s	44d45m0s
38	21h35m0s	50d48m0s
39	20h37m0s	57d15m0s
40	19h33m0s	60d12m0s
41	18h37m0s	62d32m0s
42	17h35m0s	61d51m0s
43	0h9m0s	29d12m0s
44	23h35m0s	40d21m0s
45	23h18m0s	49d7m0s
46	22h50m0s	56d0m0s
47	22h4m0s	64d43m0s
48	21h6m0s	71d30m0s
49	19h58m0s	76d32m0s
50	17h48m0s	76d57m0s
51	0h54m0s	37d31m0s
52	0h47m0s	44d58m0s
53	0h32m0s	52d57m0s
54	0h9m0s	63d19m0s
55	23h35m0s	71d45m0s
56	22h30m0s	78d55m0s
57	20h26m0s	83d41m0s
58	16h43m0s	82d0m0s
59	1h35m0s	37d20m0s
60	1h40m0s	44d29m0s
61	1h44m0s	50d47m0s
62	1h53m0s	55d14m0s
63	2h0m0s	61d47m0s
64	2h30m0s	67d29m0s
65	3h14m0s	74d28m0s
66	5h4m0s	81d13m0s
67	2h29m0s	29d45m0s
68	2h37m0s	34d46m0s
69	2h45m0s	44d23m0s
70	2h58m0s	51d20m0s
71	3h30m0s	60d0m0s
72	4h14m0s	68d33m0s
73	5h42m0s	75d3m0s
74	8h22m0s	75d41m0s
75	2h49m0s	24d5m0s
76	3h0m0s	35d15m0s
77	3h13m0s	42d27m0s
78	3h30m0s	49d34m0s
79	3h49m0s	55d59m0s
80	4h22m0s	65d11m0s
81	5h55m0s	68d28m0s
82	7h33m0s	68d25m0s
83	3h25m0s	24d47m0s
84	3h53m0s	34d25m0s
85	4h1m0s	40d51m0s
86	4h38m0s	51d0m0s
87	5h25m0s	57d33m0s
88	6h8m0s	63d26m0s
89	6h55m0s	68d51m0s
90	8h14m0s	68d24m0s
91	4h5m0s	22d8m0s
92	4h23m0s	28d34m0s
93	4h40m0s	34d58m0s
94	5h7m0s	41d15m0s
95	5h37m0s	47d43m0s
96	6h6m0s	51d34m0s
97	6h45m0s	53d16m0s
98	7h38m0s	55d42m0s
99	4h1m0s	17d21m0s
100	4h18m0s	20d37m0s
101	4h33m0s	24d21m0s
102	5h12m0s	29d55m0s
103	5h37m0s	33d42m0s
104	6h1m0s	37d12m0s
105	6h40m0s	42d28m0s
106	7h30m0s	48d8m0s
107	4h20m0s	10d10m0s
108	4h35m0s	14d53m0s
109	5h4m0s	21d37m0s
110	5h36m0s	24d3m0s
111	6h1m0s	27d16m0s
112	6h22m0s	29d31m0s
113	7h2m0s	32d23m0s
114	7h40m0s	34d32m0s
115	4h27m0s	4d25m0s
116	4h56m0s	8d4m0s
117	5h29m0s	11d36m0s
118	6h1m0s	16d17m0s
119	6h22m0s	17d45m0s
120	6h52m0s	21d44m0s
121	7h24m0s	22d54m0s
122	7h54m0s	26d42m0s
123	4h49m0s	-5d38m0s
124	5h20m0s	-1d23m0s
125	5h55m0s	3d13m0s
126	6h26m0s	7d4m0s
127	6h46m0s	12d52m0s
128	7h14m0s	16d7m0s
129	7h47m0s	18d27m0s
130	8h21m0s	20d40m0s
131	5h7m0s	-13d5m0s
132	5h32m0s	-7d22m0s
133	6h1m0s	-3d4m0s
134	6h37m0s	-1d49m0s
135	7h5m0s	1d27m0s
136	7h40m0s	5d10m0s
137	8h2m0s	8d51m0s
138	8h27m0s	12d35m0s
139	5h13m0s	-16d11m0s
140	5h55m0s	-11d46m0s
141	6h27m0s	-7d18m0s
142	7h3m0s	8h49m0s
143	-4d16m0s	7h30m0s
144	-1d56m0s	7h51m0s
145	0d1m0s	8h26m0s
146	2d2m0s	8h49m0s
147	5d45m0s	5d45m0s

The Notepad window shows the cursor at line 43, column 57. The Windows taskbar at the bottom shows the time as 1:20 PM on 5/30/2020.

With the help of Greek student Apostolos Spanakis-Misirlis, we changed his program VIRGO that it could automatic read all the coordinates from the RA-DEC text file, point the telescope radio dish for every coordinate, make a recording of 180 sec, save the data and go to the next coordinate.

All done in 1 night (!), while I was asleep....

Learned a lot in coding Python.

```
### POINT THE DISH TO SOURCE
```

```
UDP_IP = "127.0.0.1"
```

```
UDP_PORT = 12000
```

```
#If chosen for multiple , use rotator
```

```
if cal:
```

```
MESSAGE = ("<PST><AZIMUTH>" + str(directions[i].split(',')[0]) + "</AZIMUTH></PST>")
```

```
sock = socket.socket(socket.AF_INET,
```

```
socket.SOCK_DGRAM) #UDP
```

```
sock.sendto(MESSAGE, (UDP_IP, UDP_PORT))
```

```
sleep(1)
```

```
sock = socket.socket(socket.AF_INET,
```

```
socket.SOCK_DGRAM) #UDP
```

```
sock.sendto(MESSAGE, (UDP_IP, UDP_PORT))
```

```
os.system('cls' if os.name == 'nt' else 'clear')
```

```
print('\n*****')
```

```
sleep(0.3)
```

```
print('V      V      I  RRRRRR  GGGGGGG  0000000')
```

```
print(' V      V      I  R      R  G      0      0')
```

```
print('  V    V      I  RRRRRR  G    GGG  0      0')
```

```
print('    V V      I  R  R      G      G  0      0')
```





















```
print('      V      I  R      R  GGGGGGG  0000000')
```

```
print('')
```

```
print('VIRGO: An easy-to-use spectrometer & radiometer for Radio Astronomy based on GNU Radio')
```

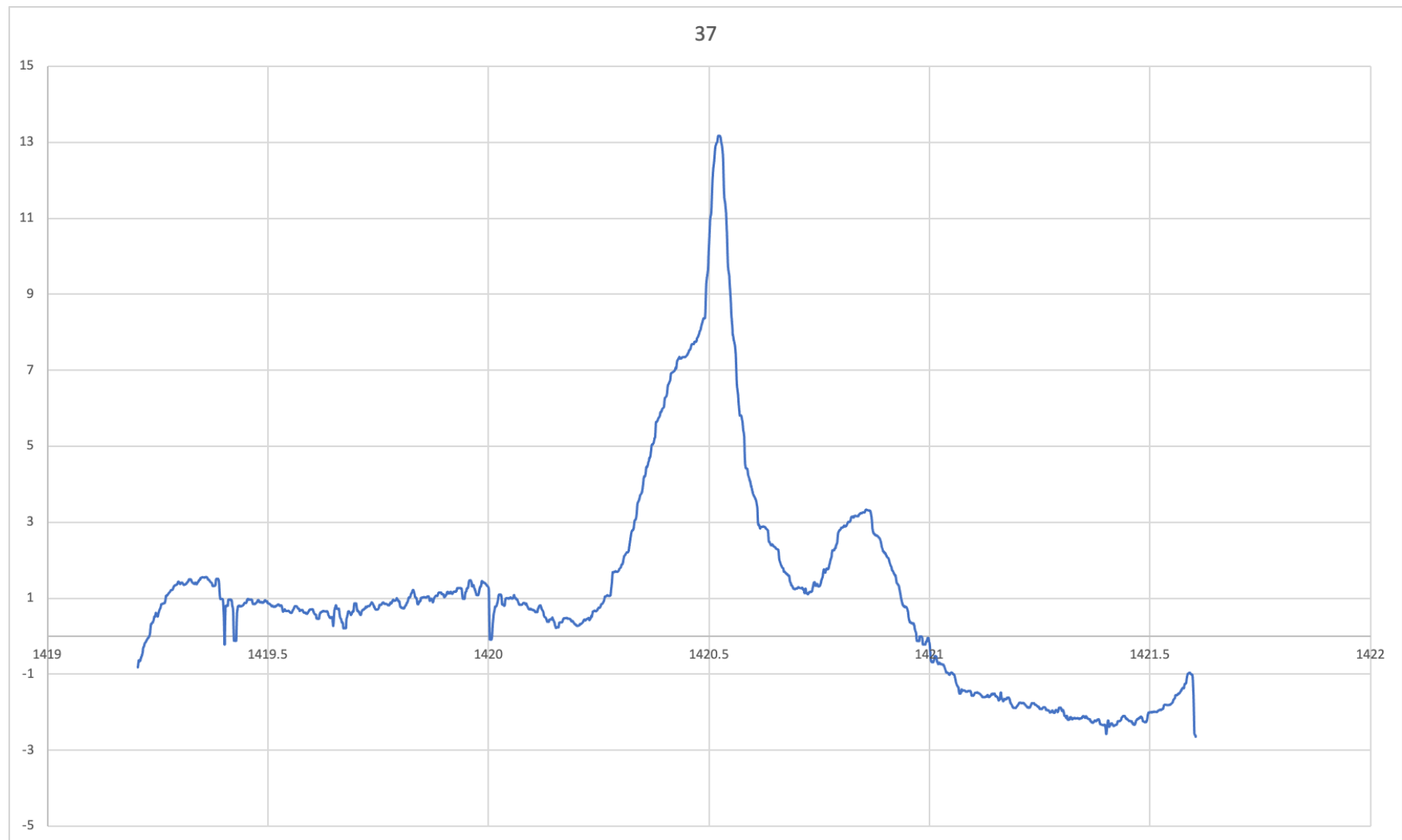
```
print('')
```

```
print('main developer Apostolos Spanakis-Misirlis, side developer Job Geheniau')
```

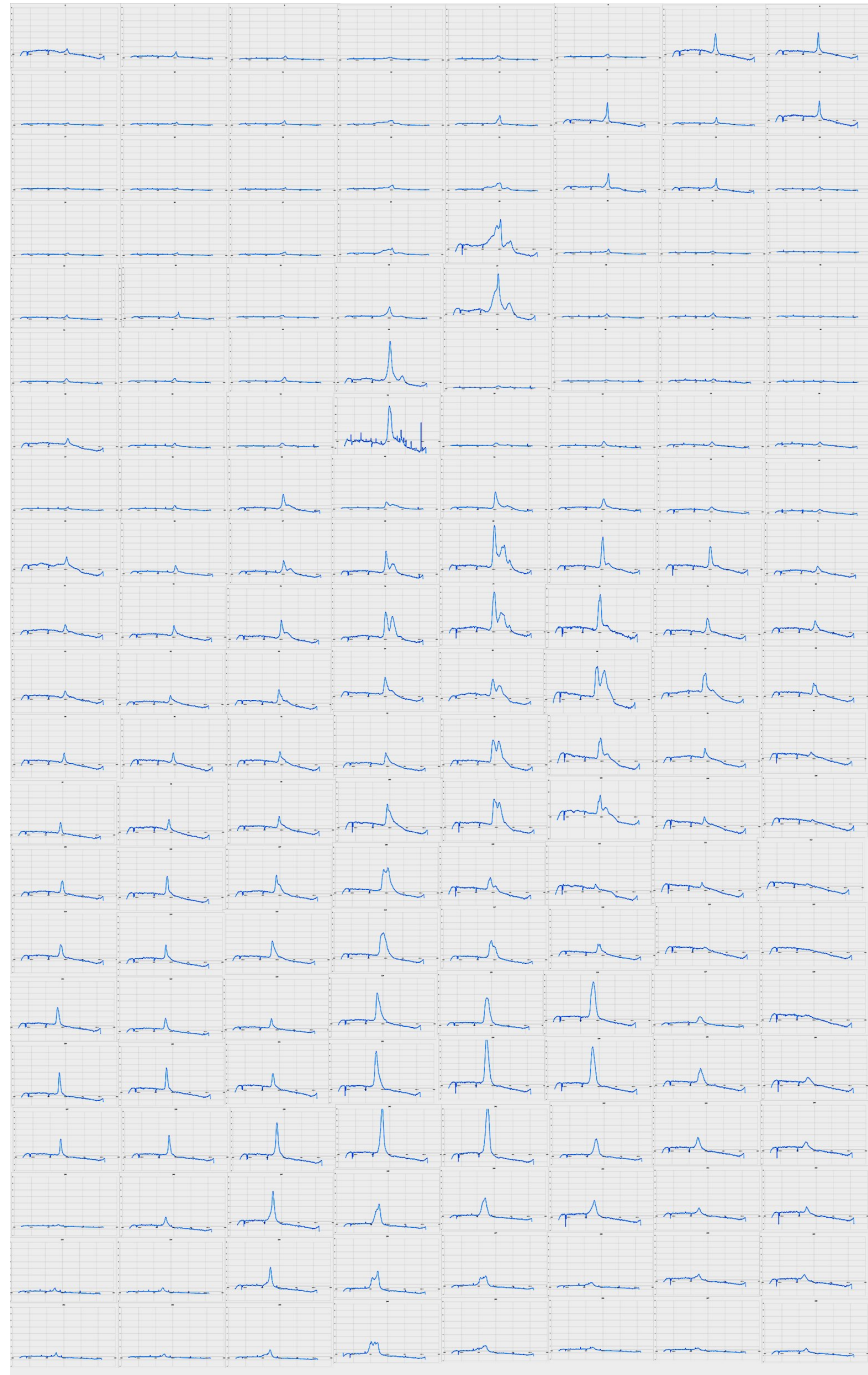

 plot150.png
 plot151.png
 plot152.png
 plot153.png
 plot154.png
 plot155.png
 plot156.png
 plot157.png
 plot158.png
 plot159.png
 plot160.png
 plot161.png
 plot162.png
 plot163.png
 plot164.png
 plot165.png
 plot166.png
 plot167.png
 plot168.png
 ra_dec.txt
 snr1.txt
 snr2.txt
 snr3.txt
 snr4.txt
 snr5.txt
 snr6.txt
 snr7.txt
 snr8.txt
 snr9.txt
 snr10.txt
 snr11.txt
 snr12.txt
 snr13.txt
 snr14.txt
 snr15.txt
 snr16.txt
 snr17.txt
 snr18.txt

The final result is a map with 168 data files (Signal/Noise, Frequency, Plot)

Each coordinate is converted to a Graph by hand:



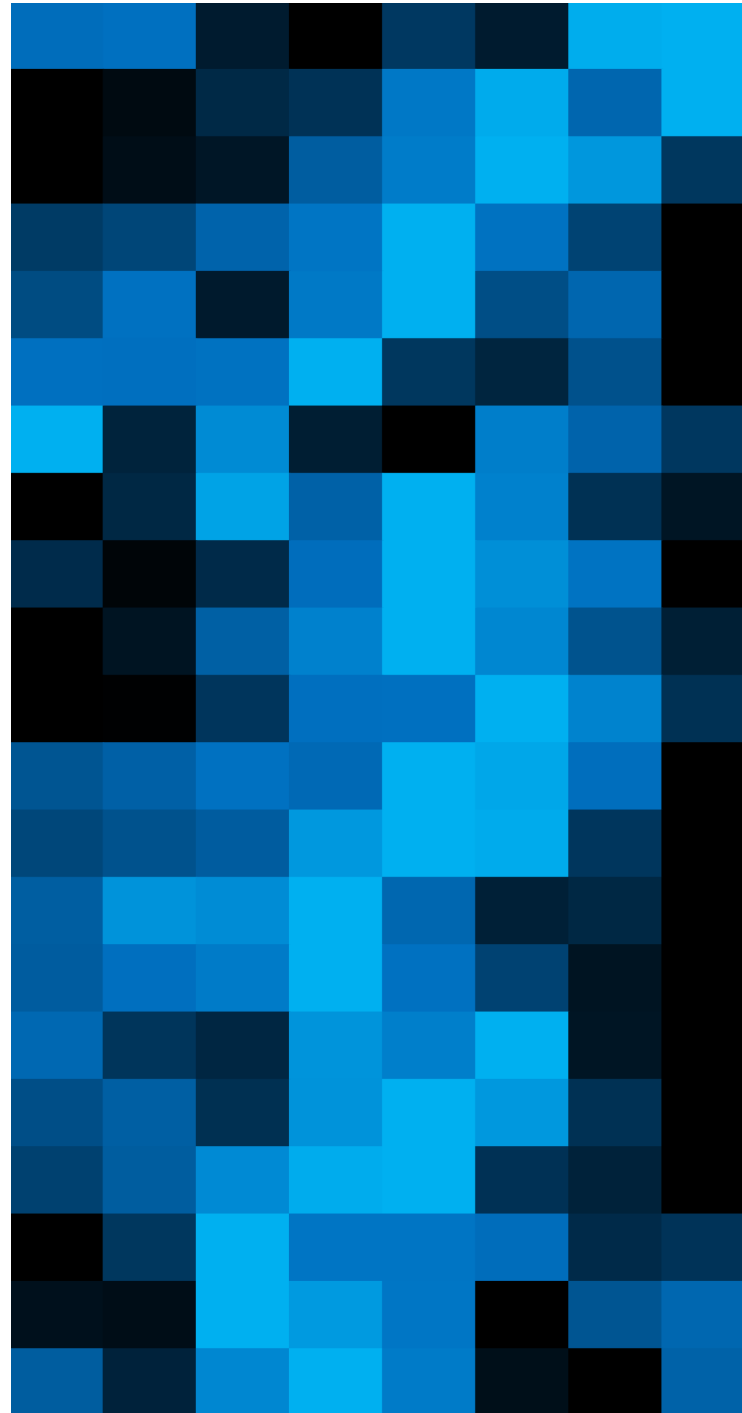
It is possible to put all the graphs together as the recordings are done:



Finally every recording is measured in Excel for the highest value in the Hydrogen plot.
Those are put in an 8 to 21 matrix in Excel.
With the function 'Conditional Formatting' the values are converted to colours.
Lowest value black, highest value is light blue.

	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
2																		
3		1	2	3	4	5	6	7	8									
4	1	1.404	1.502	0.731	0.503	0.971	0.73	6.762	7.001		1.404	1.502	0.731		0.971	0.73	6.762	7.001
5	2	0.356	0.506	0.949	1.08	2.504	5.819	1.829	6.097			0.356	0.949	1.08	2.504	5.819	1.829	6.097
6	3	0.258	0.374	0.453	1.067	1.861	4.473	3.205	0.734			0.258	0.453	1.067	1.861	4.473	3.205	0.734
7	4	0.423	0.495	0.684	1.583	9.707	1.072	0.475	0.043		0.423	0.495	0.684	1.583	9.707	1.072	0.475	
8	5	0.898	1.581	0.444	2.965	13.166	0.916	1.137	0.2		0.898	1.581	0.444	2.965	13.166	0.916	1.137	
9	6	0.939	0.92	1.288	12.182	0.5	0.366	0.7	0.09		0.939	0.92	1.288	12.182	0.5	0.366	0.7	
10	7	2.152	0.827	1.592	0.803	0.667	1.393	1.117	0.919		2.152	0.827	1.592	0.803		1.393	1.117	0.919
11	8	0.375	0.964	4.472	1.807	5.063	2.853	1.098	0.683			0.375	0.964	4.472	1.807	5.063	2.853	0.683
12	9	3.791	2.108	3.752	6.665	14.431	10.542	7.161	1.881		3.791	2.108	3.752	6.665	14.431	10.542	7.161	
13	10	2.524	3.146	5.493	7.929	13.131	8.659	5.091	3.493			2.524	3.146	5.493	7.929	13.131	8.659	3.493
14	11	2.342	2.39	4.146	6.094	6.144	10.844	7.524	4.003			2.342	2.39	4.146	6.094	6.144	10.844	4.003
15	12	3.439	3.649	4.033	3.808	7.961	7.439	3.894	1.906		3.439	3.649	4.033	3.808	7.961	7.439	3.894	
16	13	3.492	3.876	4.23	7.556	9.107	8.784	2.908	1.022		3.492	3.876	4.23	7.556	9.107	8.784	2.908	
17	14	4.358	6.696	6.363	8.038	4.692	1.985	2.286	0.759		4.358	6.696	6.363	8.038	4.692	1.985	2.286	
18	15	4.569	5.433	5.923	8.145	5.511	3.352	1.205	0.265		4.569	5.433	5.923	8.145	5.511	3.352	1.205	
19	16	6.166	3.75	3.05	10.017	8.008	12.668	2.207	1.191		6.166	3.75	3.05	10.017	8.008	12.668	2.207	
20	17	6.907	7.852	5.158	12.524	15.544	13.056	5.234	2.432		6.907	7.852	5.158	12.524	15.544	13.056	5.234	
21	18	5.693	6.977	11.342	15.699	16.182	4.941	4.214	2.624		5.693	6.977	11.342	15.699	16.182	4.941	4.214	
22	19	0.411	2.841	10.194	5.753	5.774	5.224	2.291	2.673			0.411	2.841	10.194	5.753	5.774	5.224	2.673
23	20	1.129	1.09	6.428	5.069	2.745	0.923	1.978	2.198		1.129	1.09	6.428	5.069	2.745		1.978	2.198
24	21	1.201	0.793	2.088	3.438	1.717	0.659	0.554	1.234		1.201	0.793	2.088	3.438	1.717	0.659		1.234

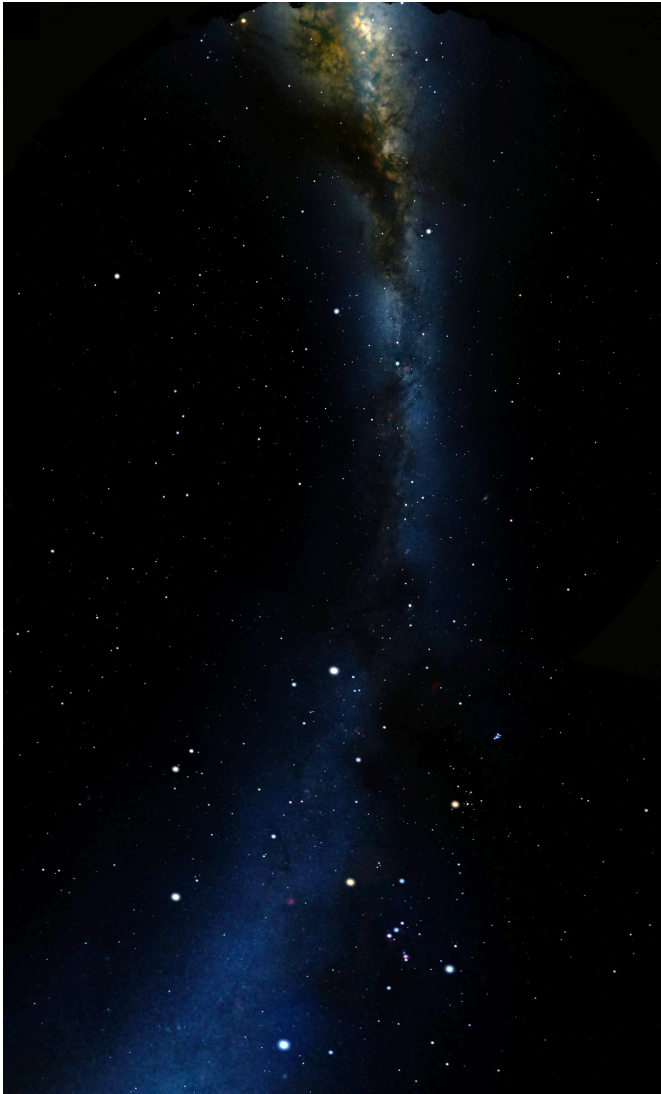
You get a rough Neutral Hydrogen plot from the whole Galaxy from 20 to 230.



Finally a Gaussian Blur and a projection over the Galaxy:

AND THE FINAL: RESULT!:

Visible Light



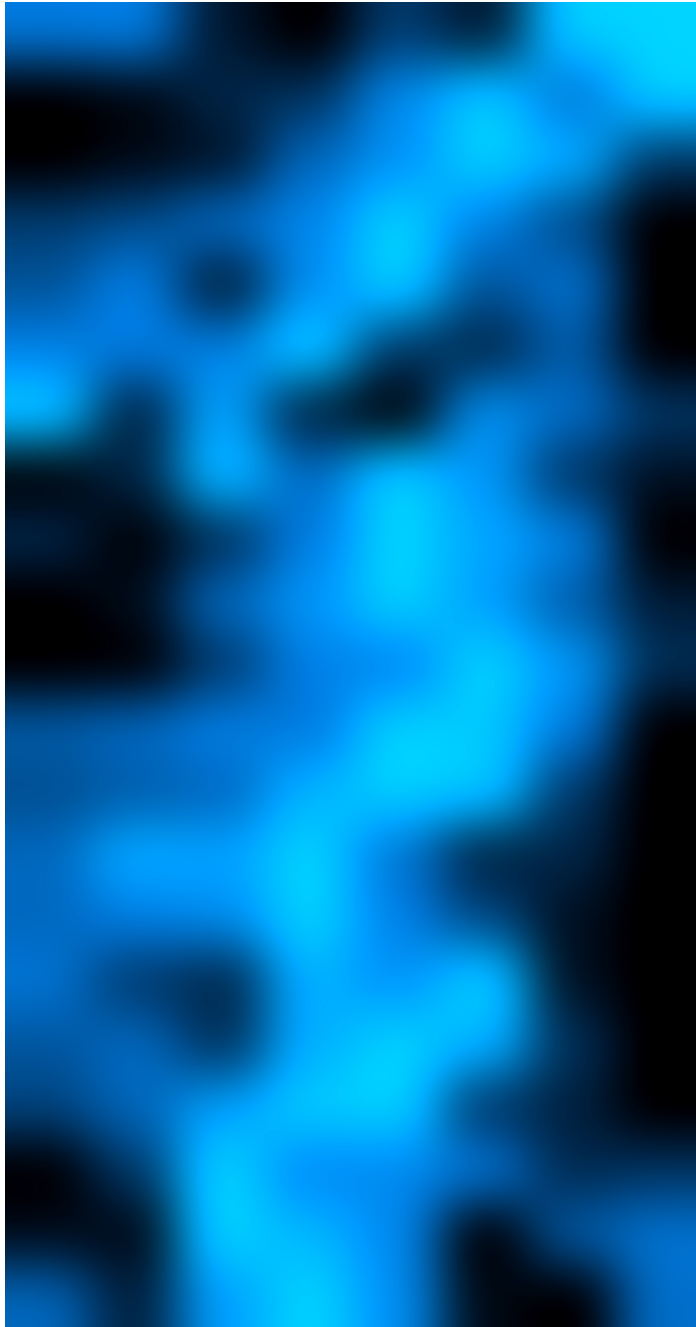
HI (Hydrogen) projection



Warped Projection

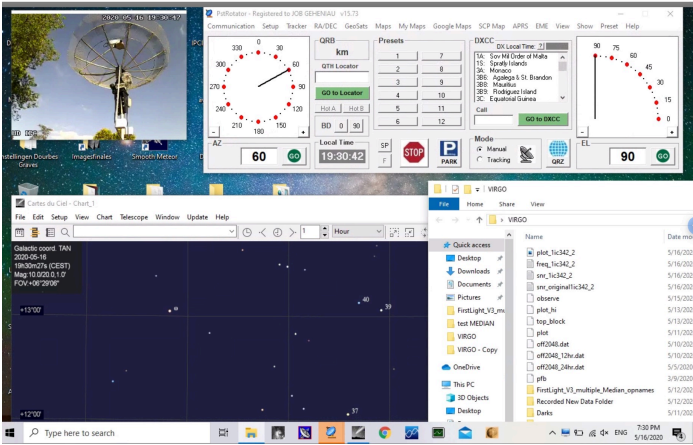
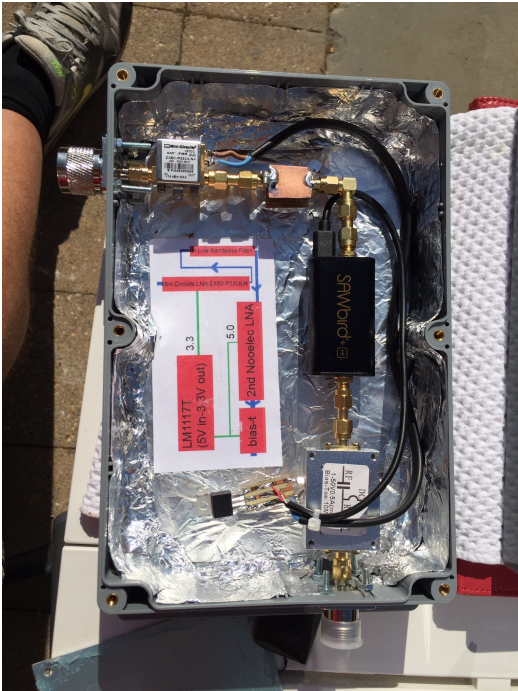


The Final Result





Setup:



1.5 Meter, extended Mesh 1.9 meter RF Hamdesign Radio Dish
1420 Mhz tuned Feed
LNA Mini Circuits ZX60-P33ULN
Bandpass filter
LNA NooElec Sawbird
Bias-T
RTLSDR
PsT Rotator Dish Rotating Software
VIRGO Soft
SDR#
Cartes du Ciel
Home made Netfilter

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