Northern Sky HI Survey with JRT

October - November 2020

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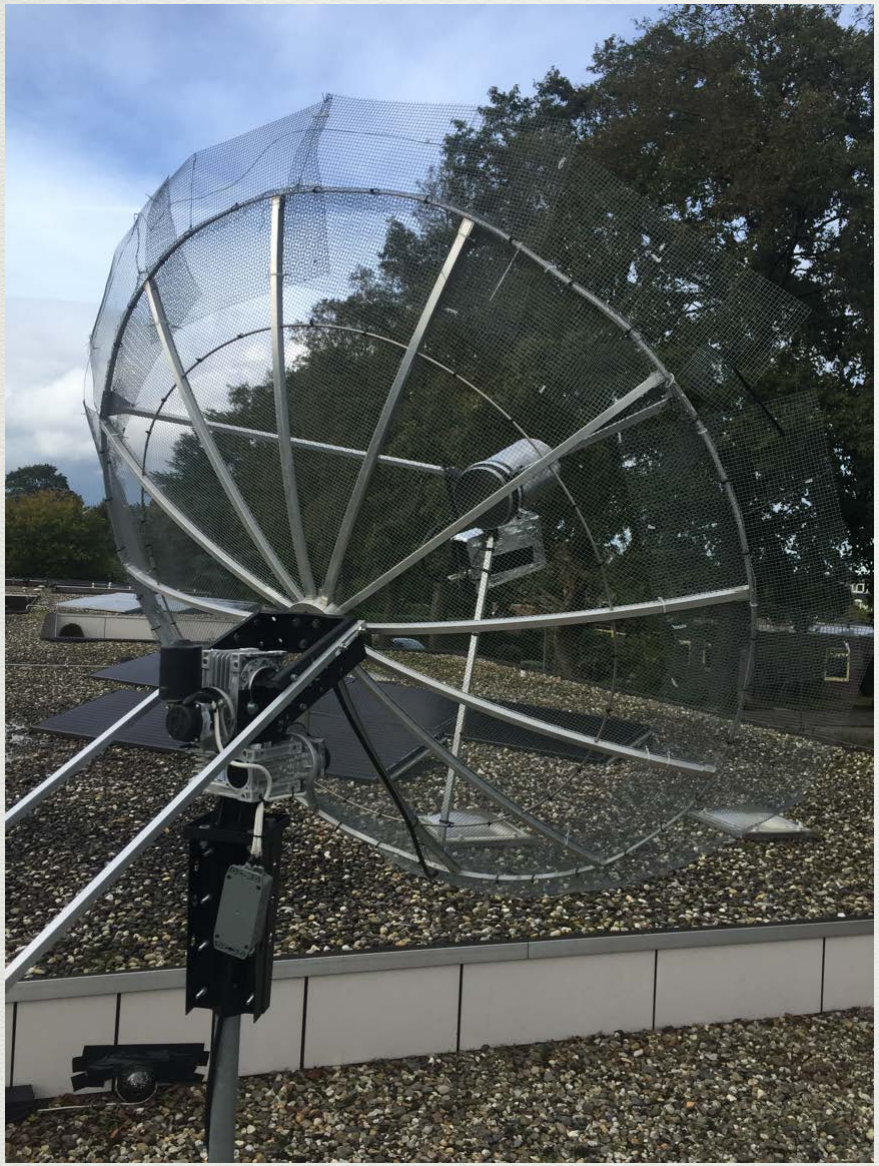
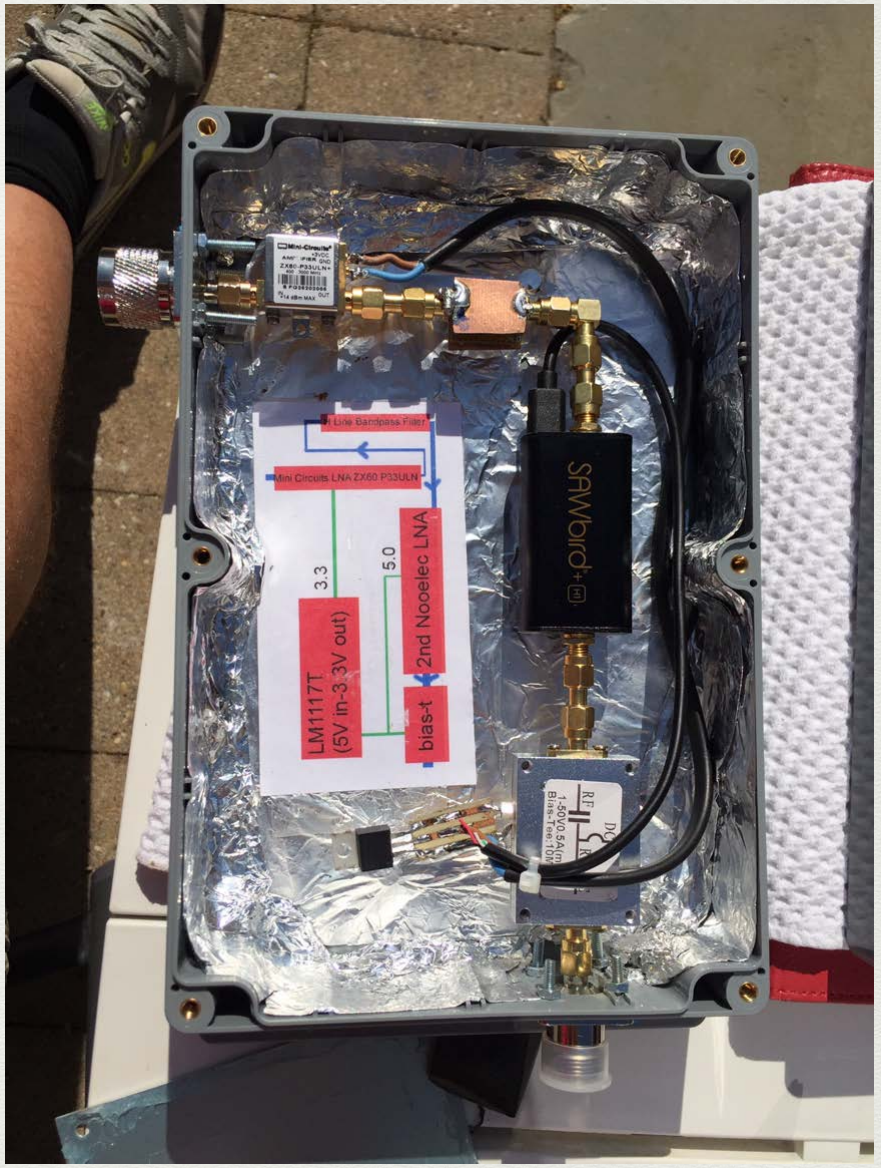
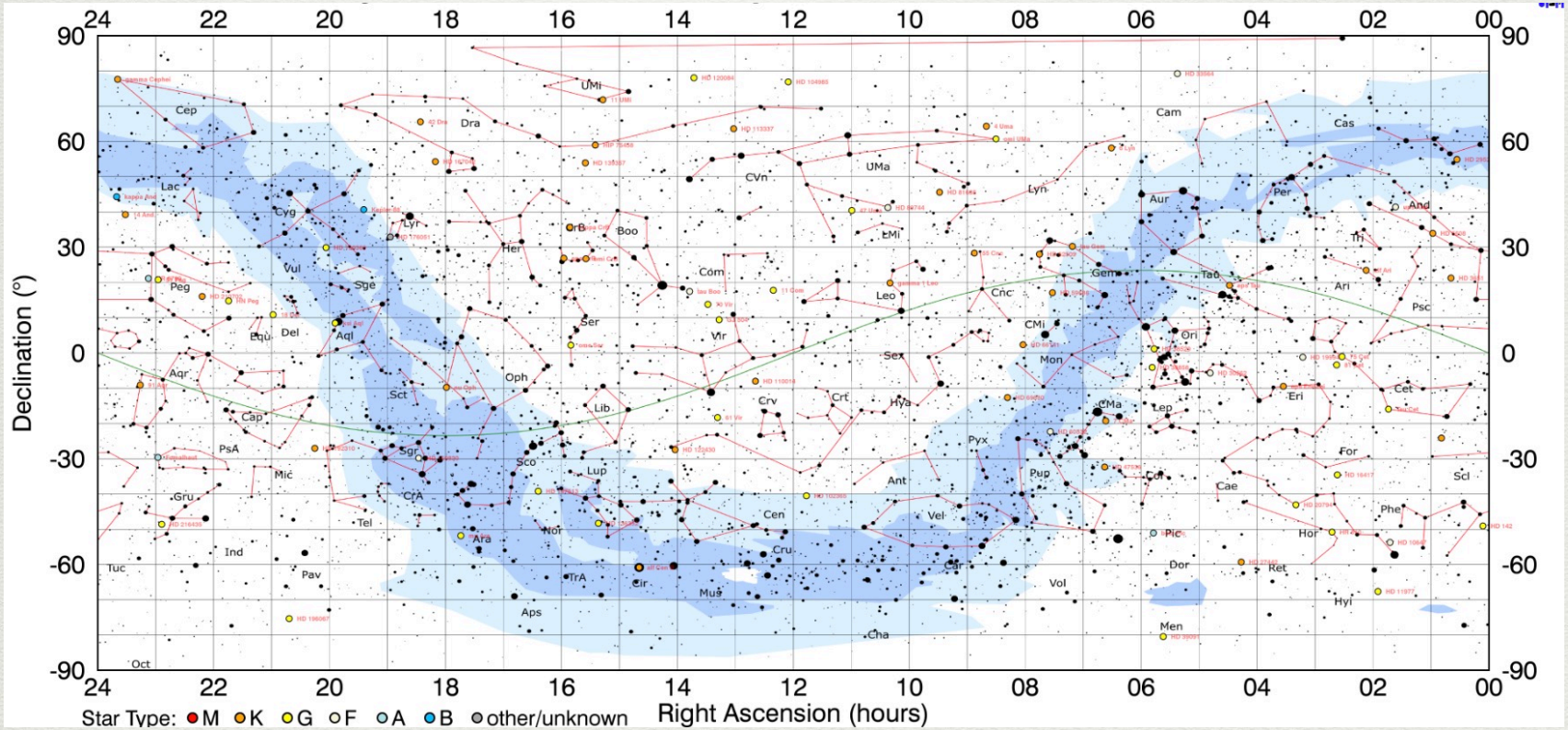
JRT - Job's Radio Telescope -
is a 1.5 meter diameter radio astronomy dish.
It is capable of receiving Neutral Hydrogen Emission
at 1420.405 MHZ.
With 2 lna's (Low Noise Amplifiers) and a bandpass filter,
the signal is transferred to a rtl-sdr receiver
and processed with VIRGO software to generate a spectrum.

The dish is controlled by an alt/az rotator
and fully remote controlled.

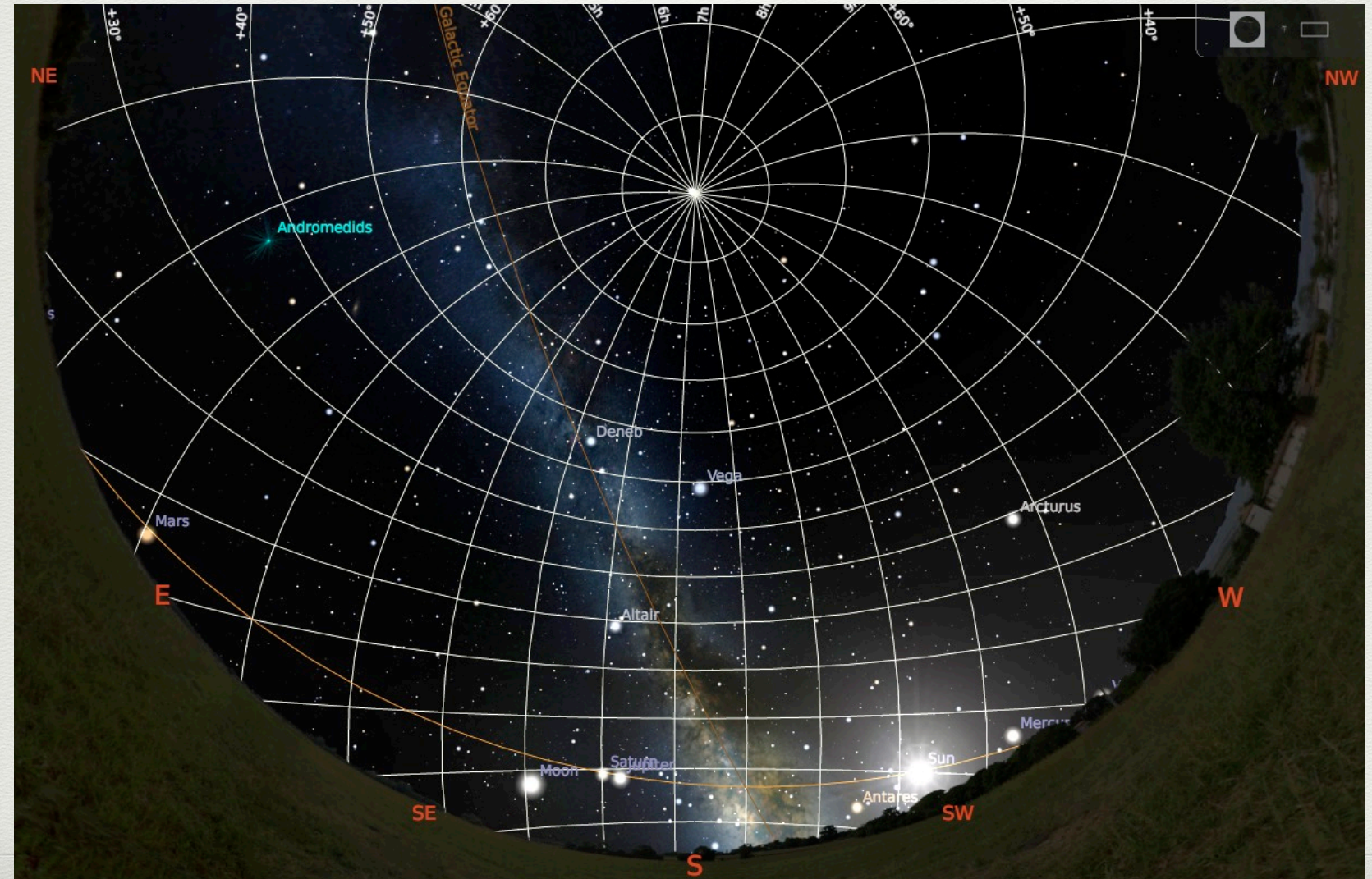



1 Line Bandpass Filter
Mini Circuits LNA ZX60 P33ULN
3.3
5.0
LM1117T
(5V in-3.3V out)
2nd Nooelec LNA
bias-t
SAWbird+

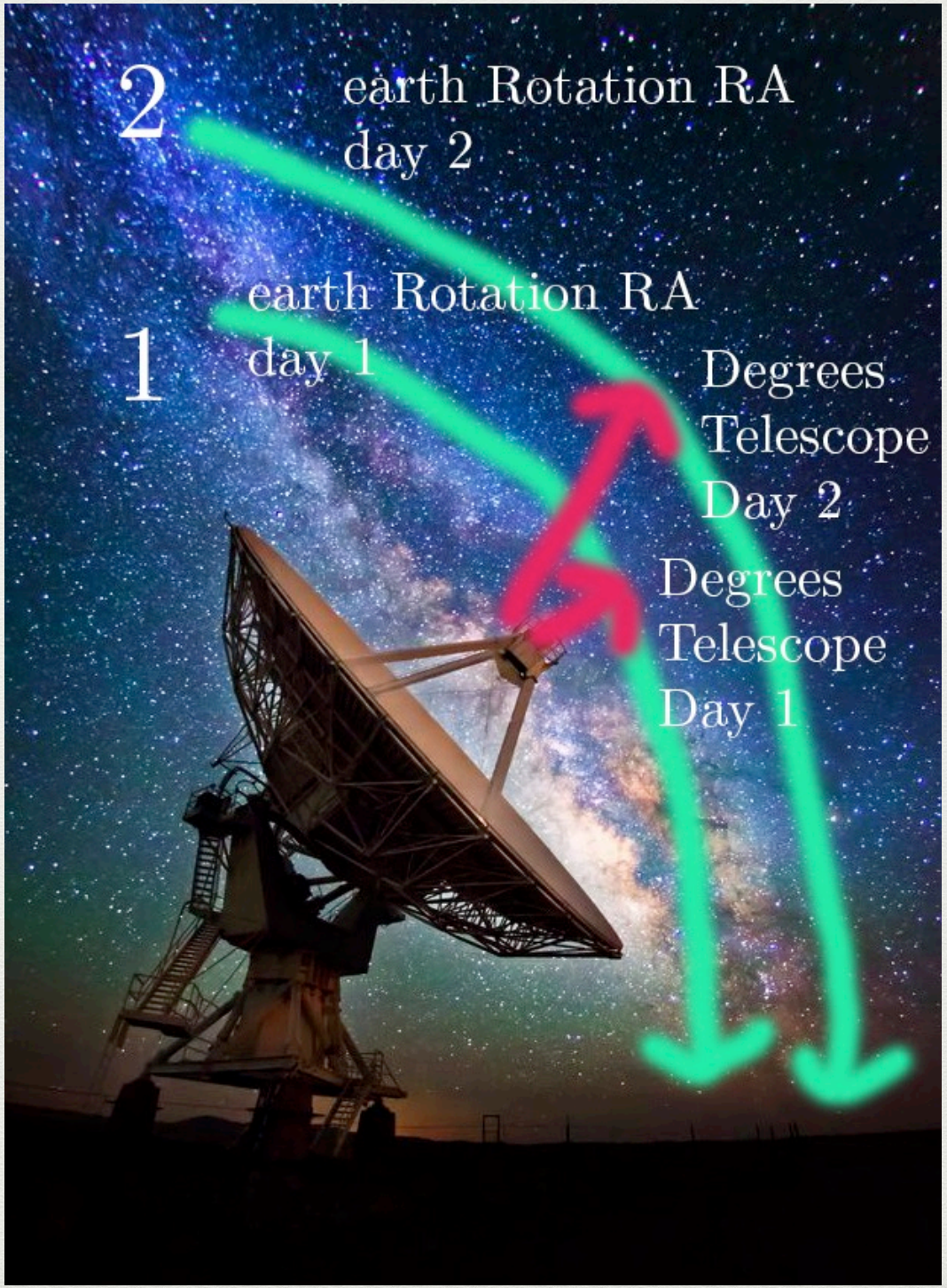
This project was ment to cover the whole visible Northern Sky
in Neutral Hydrogen (HI).
The Milky Way Galaxy contains a lot of HI,
so when we measure the whole sky
in which the Milky Way only covers a part of,
we will be able to map the structure of the Milky Way.



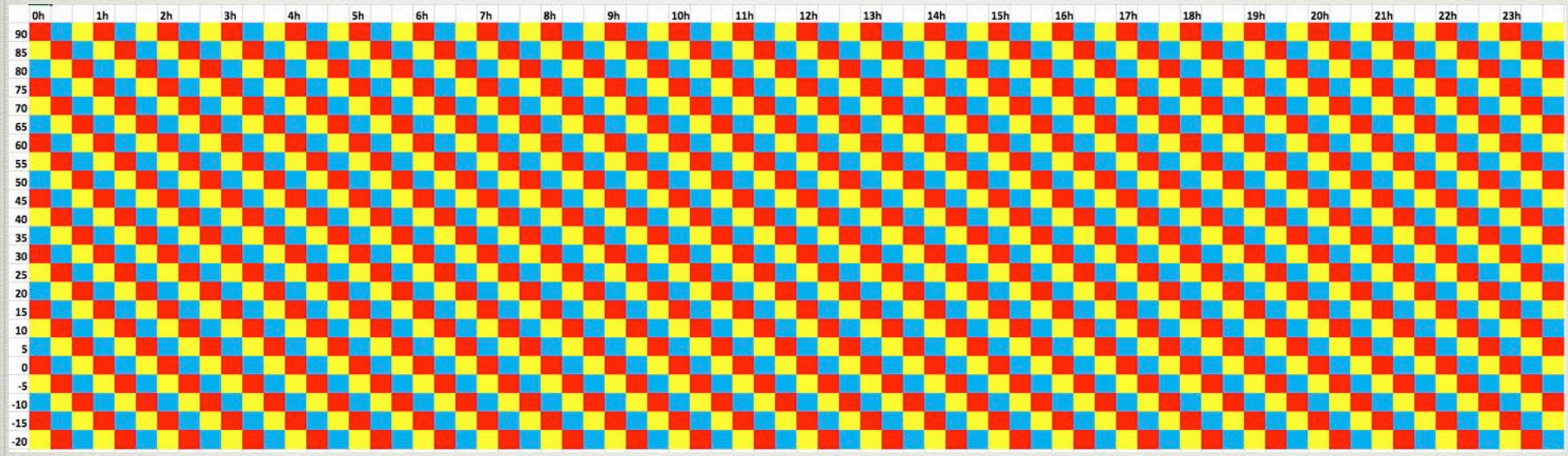
We can divide the sky in parts. Horizontal lines (RA = Right Ascension) and vertical lines (DEC = Degrees)
JRT has a beam width of 8 degrees, so when we divide RA and DEC in pieces of 5 degrees, it will cover everything.



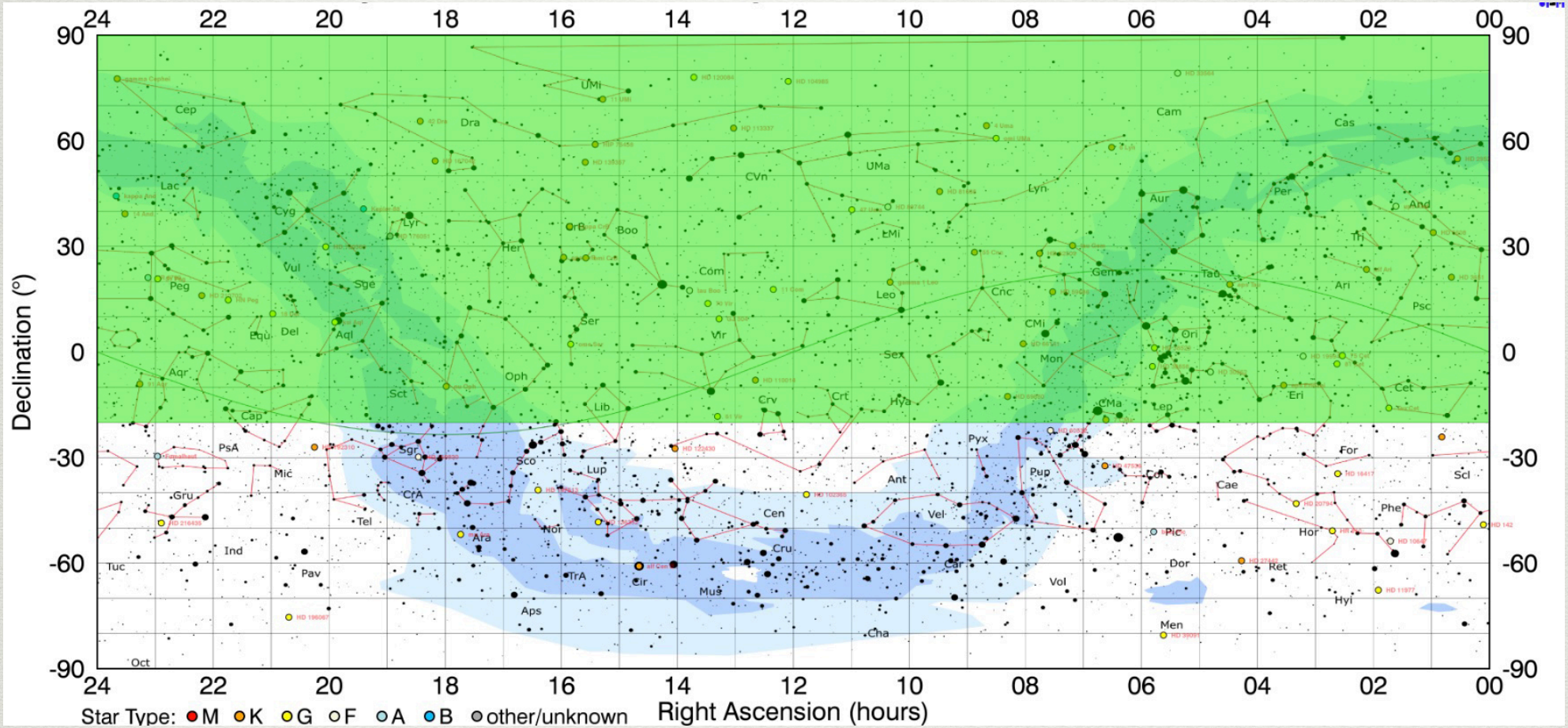
If we choose to point the telescope to a fixed point (drift scan) in the sky (in degrees) the sky will make a full round in 24 hours. The lowest point visible in The Netherlands is -20 degrees. So that will be 23 days of observation (-20,-15….85,90).


2
earth Rotation RA
day 2
earth Rotation RA
1
day 1
Degrees
Telescope
Day 2
Degrees
Telescope
Day 1

Every 20 minutes a radio spectrum is made from 5 minutes.
That is 3 spectra per hour, 72 in total in 24 hours.
That's a total of 1656 spectra!

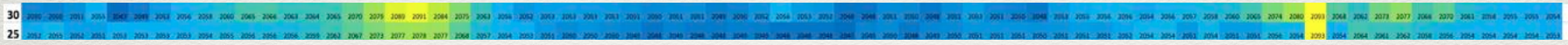


The Northern Sky Survey covers RA from 0H to 24H and DEC from -20 Degrees to 90 degrees



Every spectrum I received can be seen as 1 pixel. Substitute those spectra values (pixels) in Excel and compare the highest values (Neutral Hydrogen) with the lowest and you got a map.
The highest value gets a color (yellow)
and the lowest gets color blue. Colors don't matter.

So day by day, spectrum by spectrum (pixel) a chart will be visible



20h			21h			22h			23h			
1	1	1	1	1	1	1	1	1	1	1.01	1.01	1.02
1	1	1	1	1	1	1	1	1	1.01	1.01	1.01	1.01
1	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
1	1	1	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
1	1	1	1	1	1	1	1	1.01	1.01	1.01	1.01	1.01
1	1	1	1	1.01	1.01	1.01	1.01	1.02	1.02	1.02	1.02	1.02
1	1	1	1	1.01	1.01	1.02	1.02	1.03	1.02	1.01	1.02	1.01
1	1	1.01	1.01	1.01	1.01	1.02	1.01	1.01	1.01	1.01	1.01	1

After 72 days the final result is The Northern Sky Survey in HI.
Because I measured a spectrum of Hydrogen
from the Milky Way Arms, it is possible with some mathematics to compute the speed of the Hydrogen gas.
The lowest speed measured was -170 km/second
(Blue Shifted, moving away from us) and the highest speed was
70 km/second (Red Shifted, moving towards us).

$$Vr=c*(f0-fr/f0-Vlsr)$$

Final Result