Pittsburgh Cylinder Simulations

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December 2

Cylinder Simulation Program

- Based on **"Formulation of Cylinder Visibilities"**
  - http://projects-docdb.fnal.gov/cgi-bin/ShowDocument?docid=778

Formulation of Cylinder Visibilities

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Feed Amplitude

The voltage received at a feed located at coordinate r is:

$$\frac{v(\vec{r})}{\sqrt{2R}} = \iint_{\Omega} f(\Omega)a(\Omega)e^{-j\vec{\beta}(\Omega)\cdot\vec{r}}d\Omega \tag{1}$$

The sky flux amplitude is:

$$|f(\Omega)d\Omega|^2 = \frac{kT_{sky}(\Omega)}{\lambda^2}d\Omega_{\mathrm{pow}} \tag{2}$$

where $d\Omega_{\mathrm{pow}}$ is the differential power solid angle area. The incoming wave vector is:

$$\vec{\beta}(\Omega(\theta,\phi)) = \frac{2\pi}{\lambda}(sin(\theta)\hat{x} + cos(\theta)sin(\phi)\hat{y}) \tag{3}$$

The collecting area of the feed is:

$$A(\Omega) = |a(\Omega)|^2 \tag{4}$$

The noise power generated by the feed amplifier is:

$$P_z = |p_z|^2 \tag{5}$$

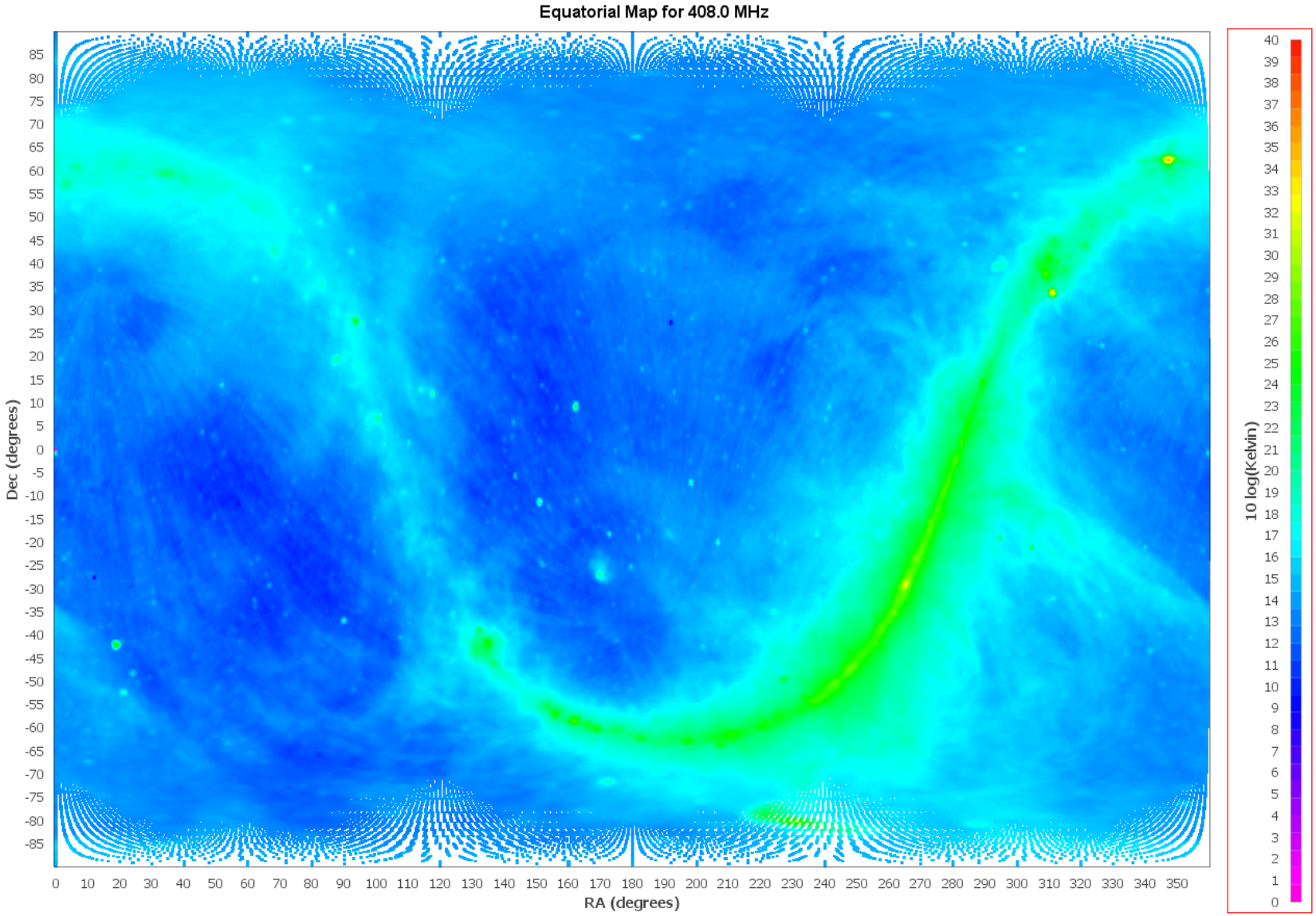
If the sky is pixelized into **q** pixels then, the signal amplitude at feed **n** of cylinder **m** is:

$$p_{n,m} = p_{z_{n,m}} + \sum_q \Delta\Omega_q f_q a_{q,n,m} e^{-j\vec{\beta}_q\cdot\vec{r}_{n,m}} \tag{6}$$

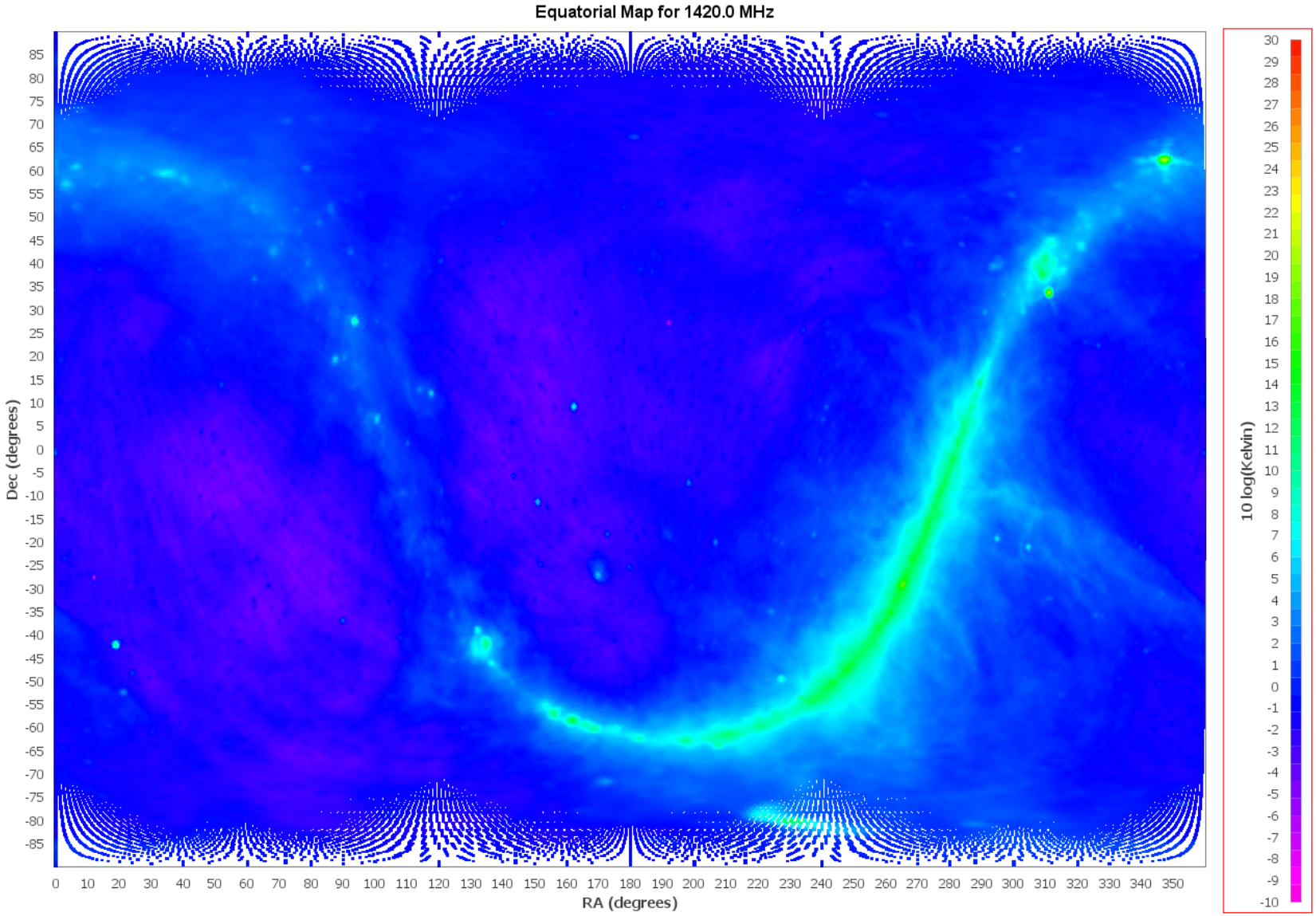
Cylinder Amplitude

A spatial Fourier transform will be taken of the cylinder feed voltage.

Sky Map at 408 MHz



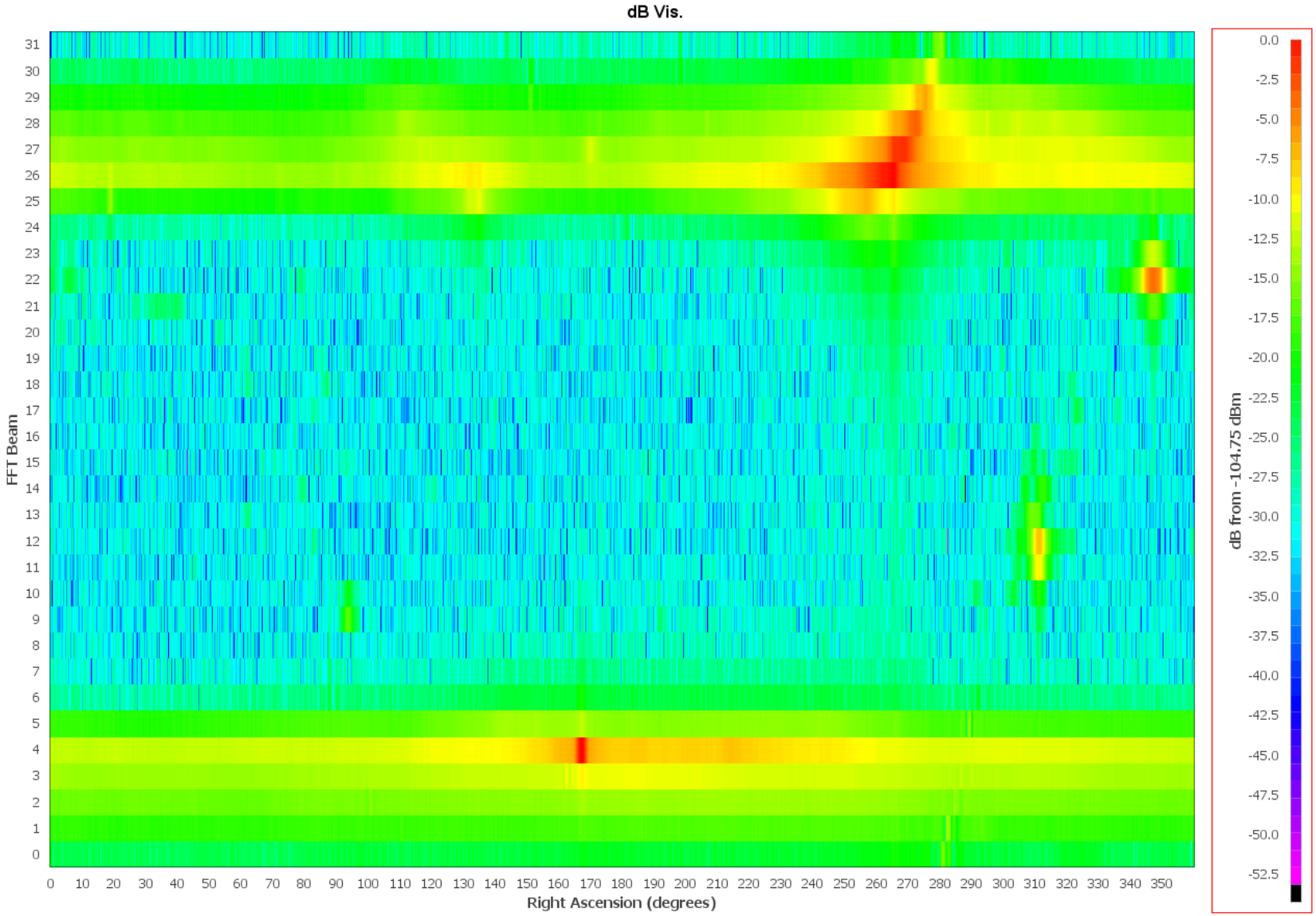
Sky Map at 1420 MHz



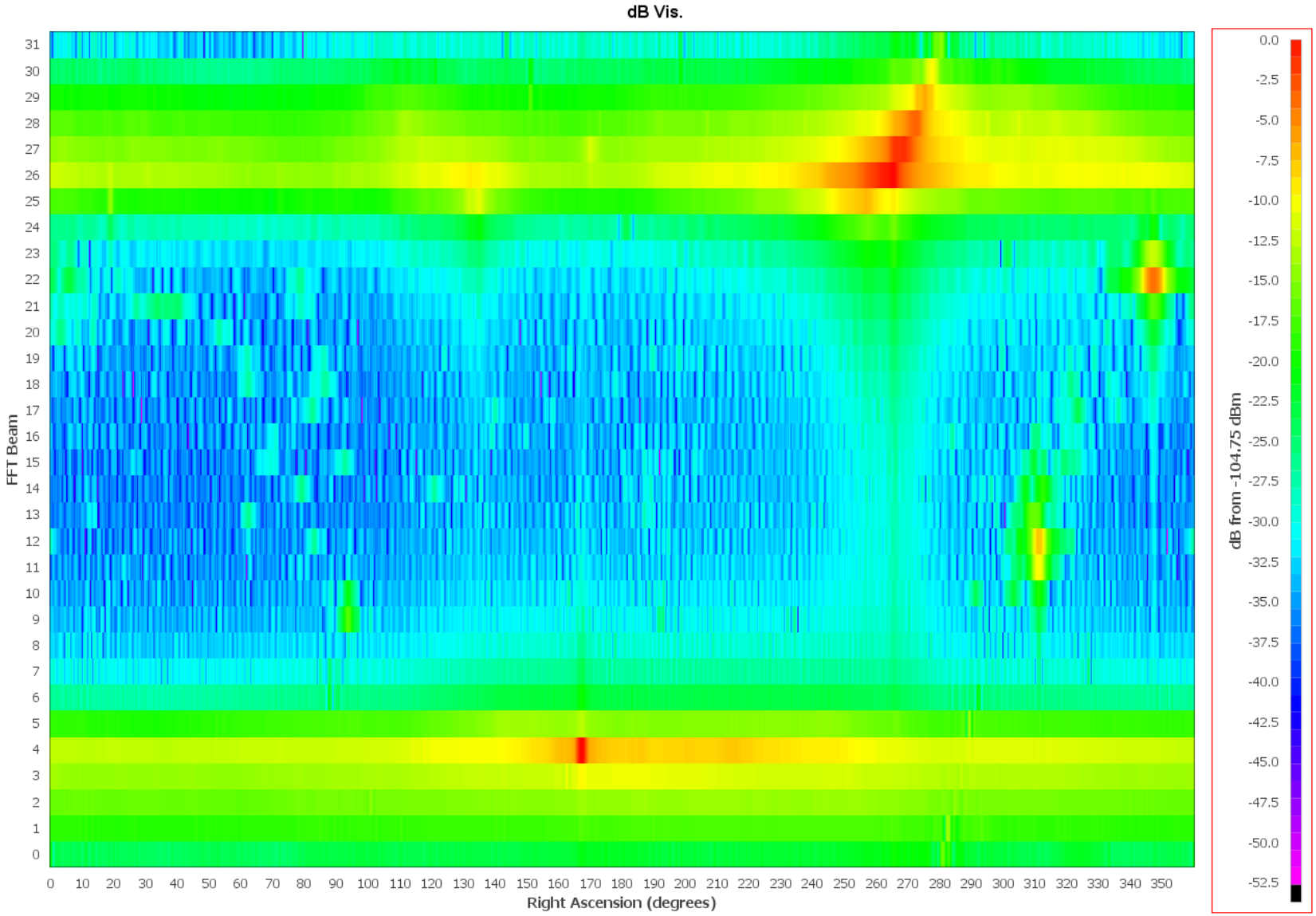
Input

- Frequency = 1400 MHz
- Number of Feeds = 32
- Feed Spacing = 14.5 cm
- Feed Power efficiency = 50%
- Effective cylinder width = 7 m
- Cylinder Spacing = 10m
- Amplifier Temperature = 75K
- Latitude = 43 degrees North
- Resolution Bandwidth = 25MHz

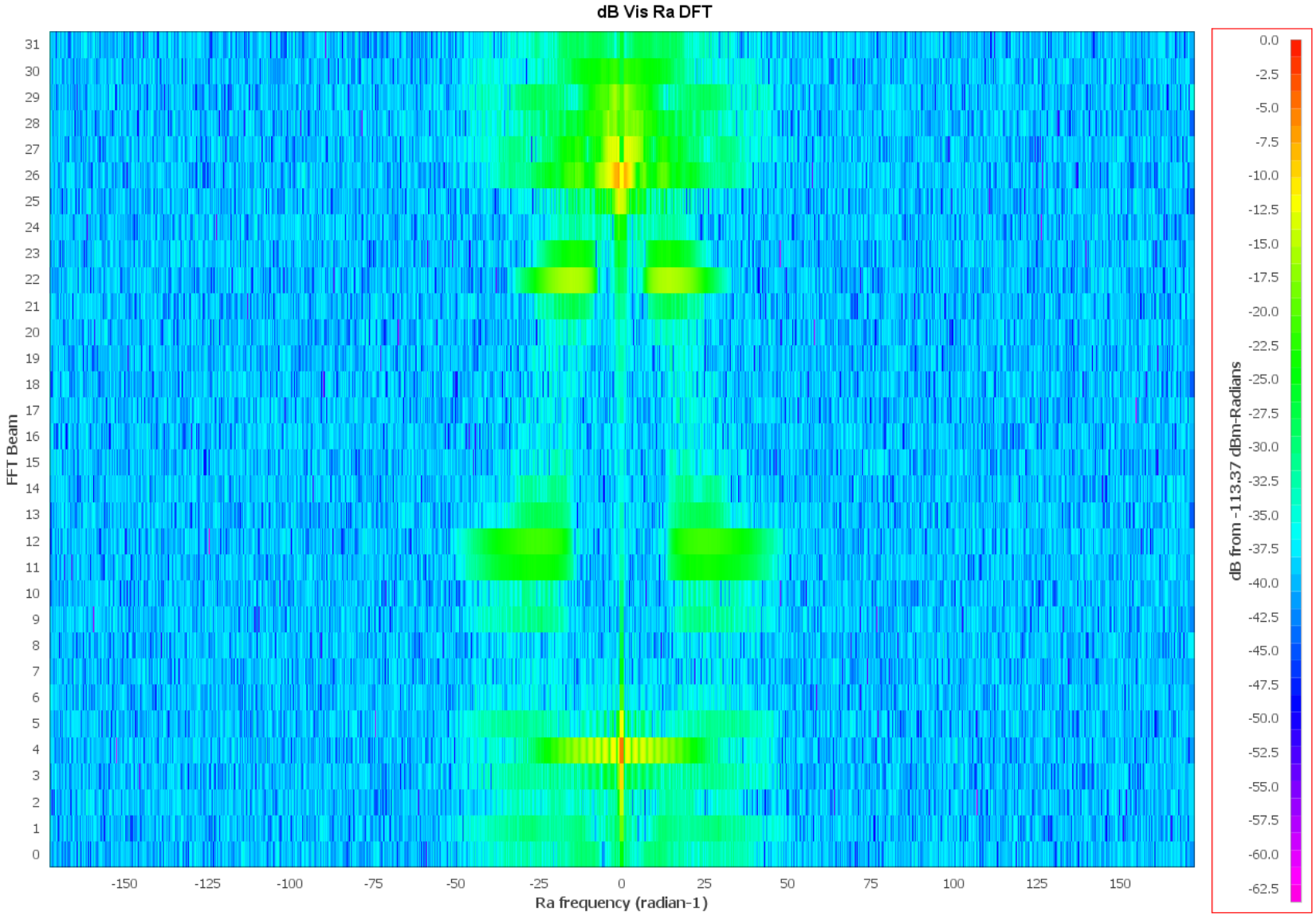
1 Day Scan - Visibility Magnitude – Y pol.



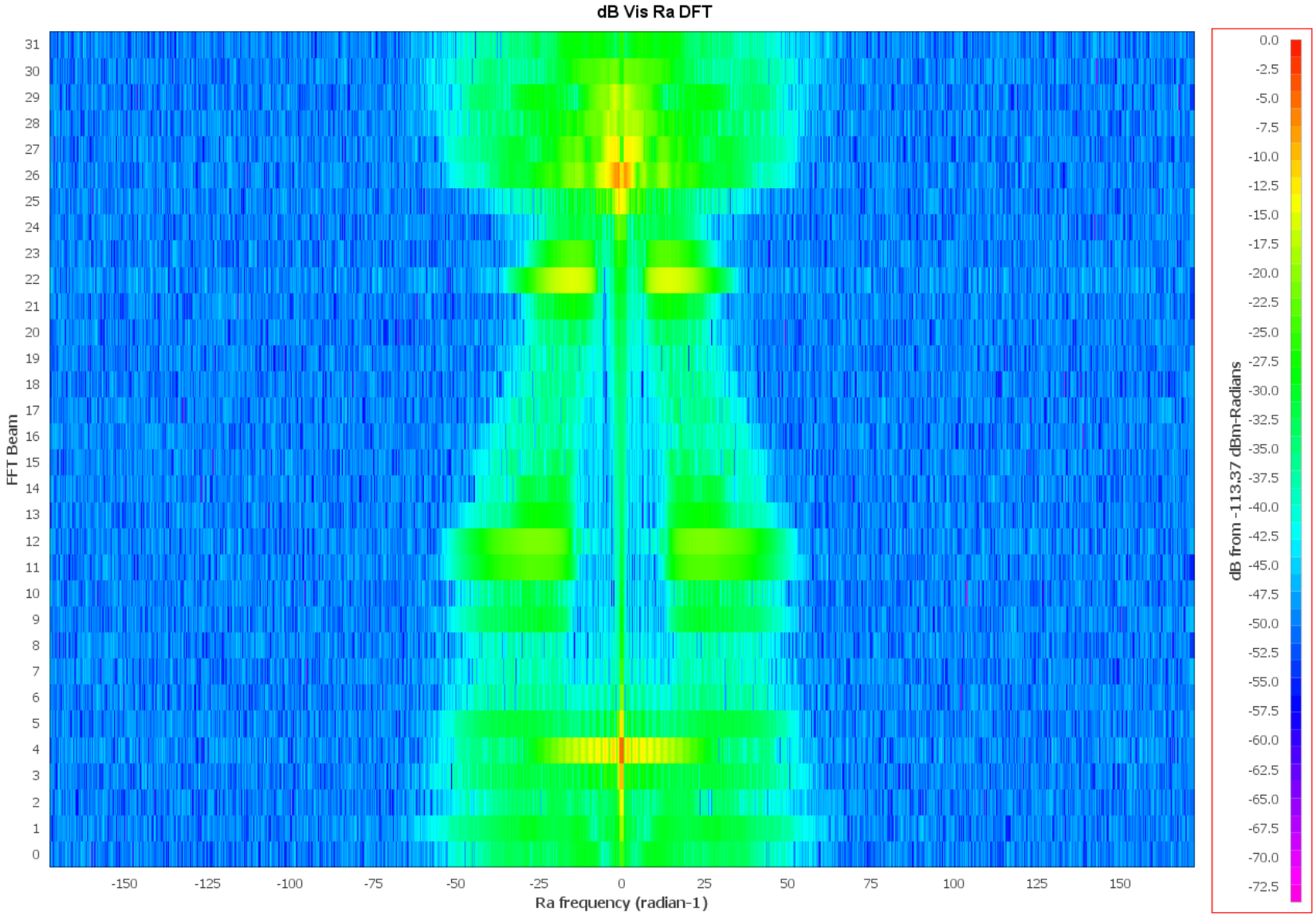
100 Day Scan - Visibility Magnitude – Y pol.



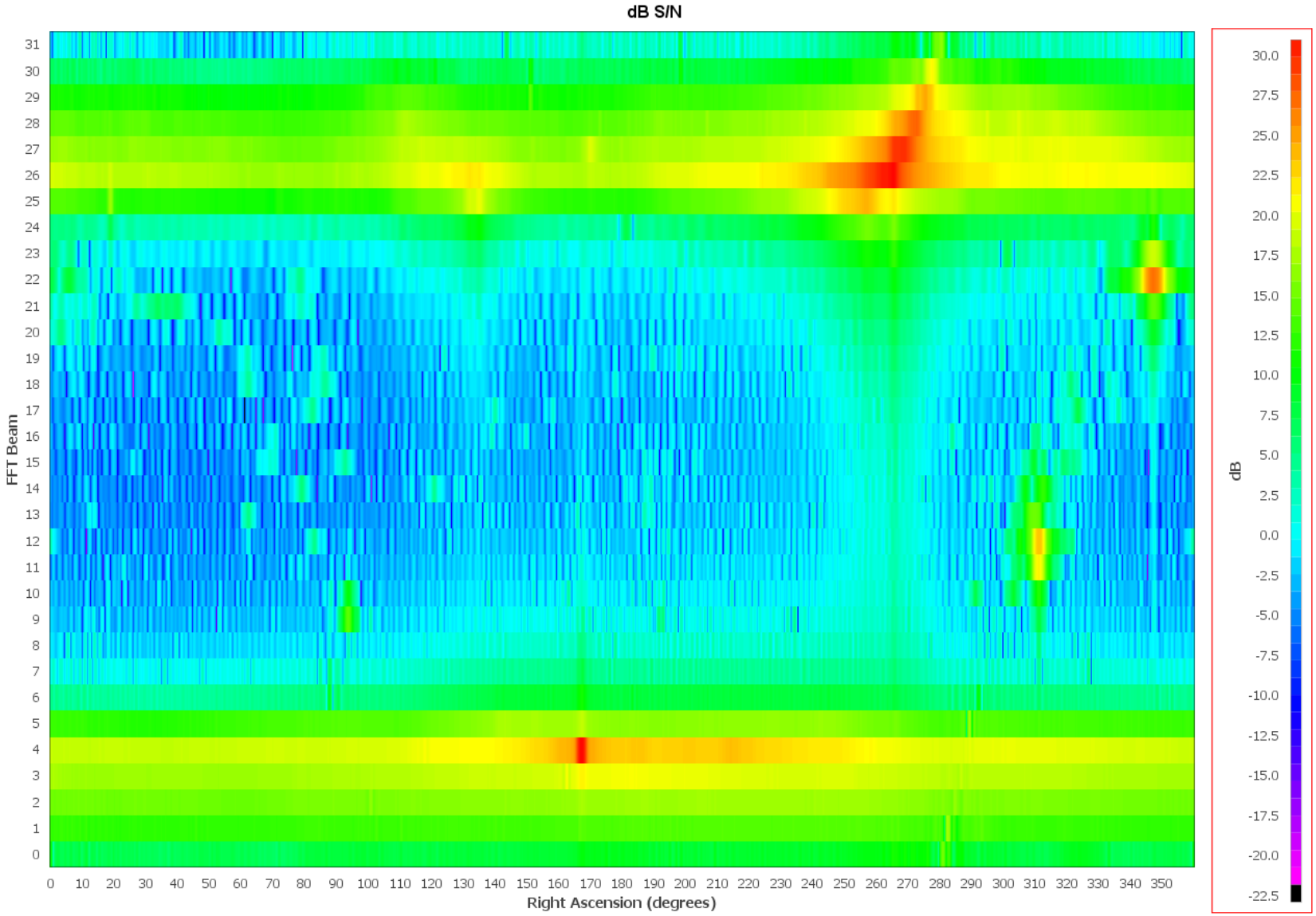
1 Day Scan - Visibility RA DFT – Y pol.



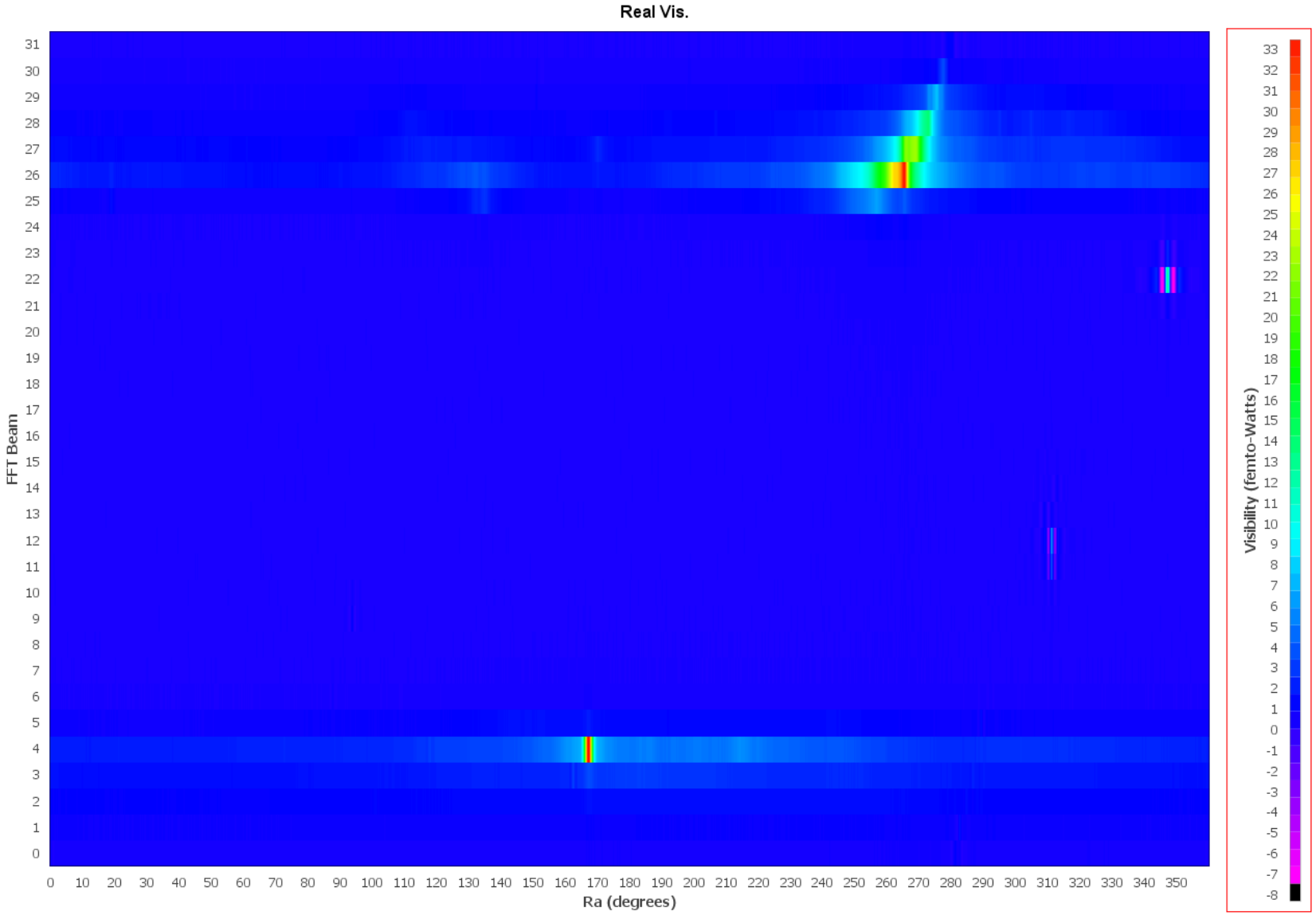
100 Day Scan - Visibility RA DFT – Y pol.



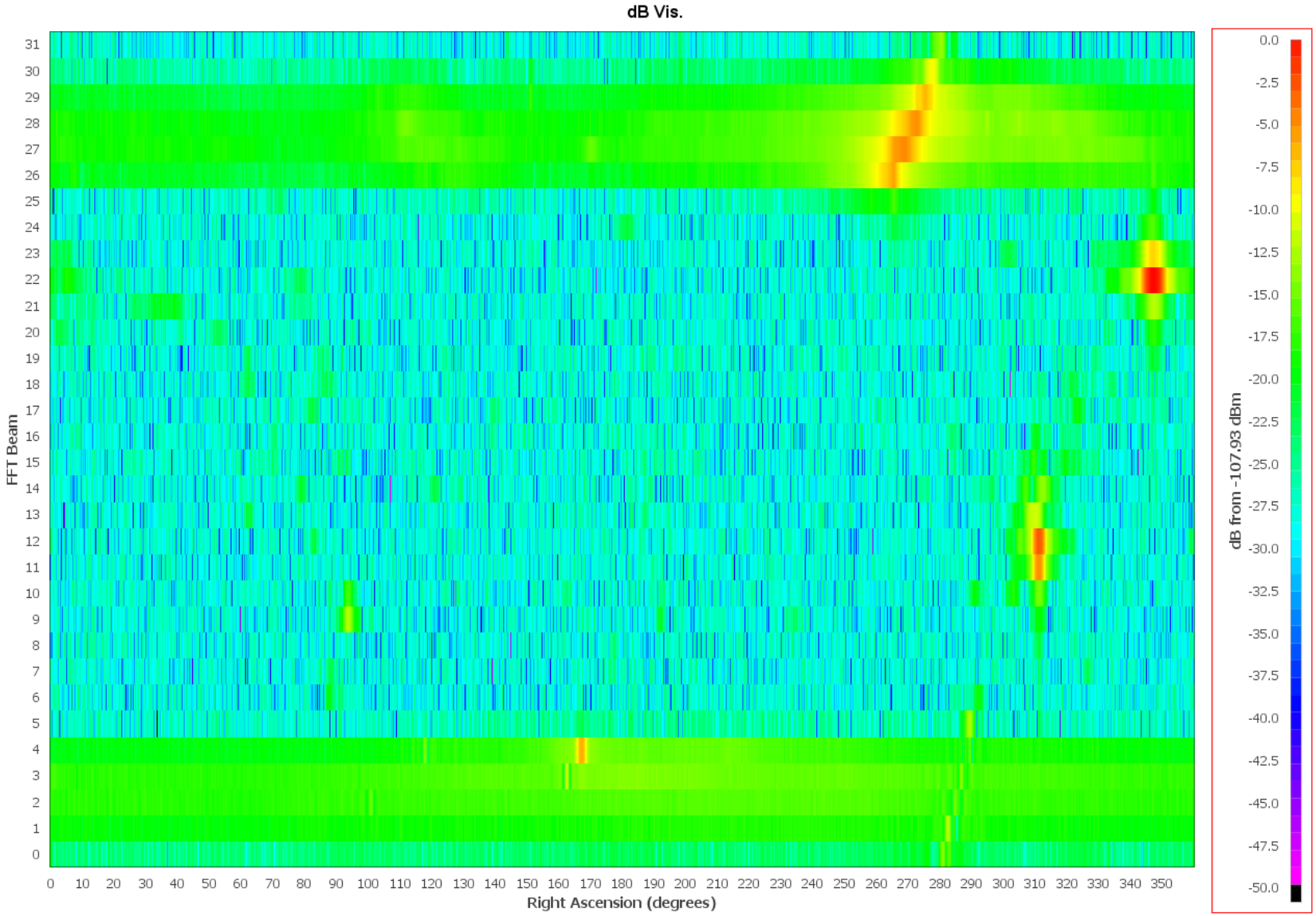
1 Day Scan - Visibility Signal/Noise – Y pol.



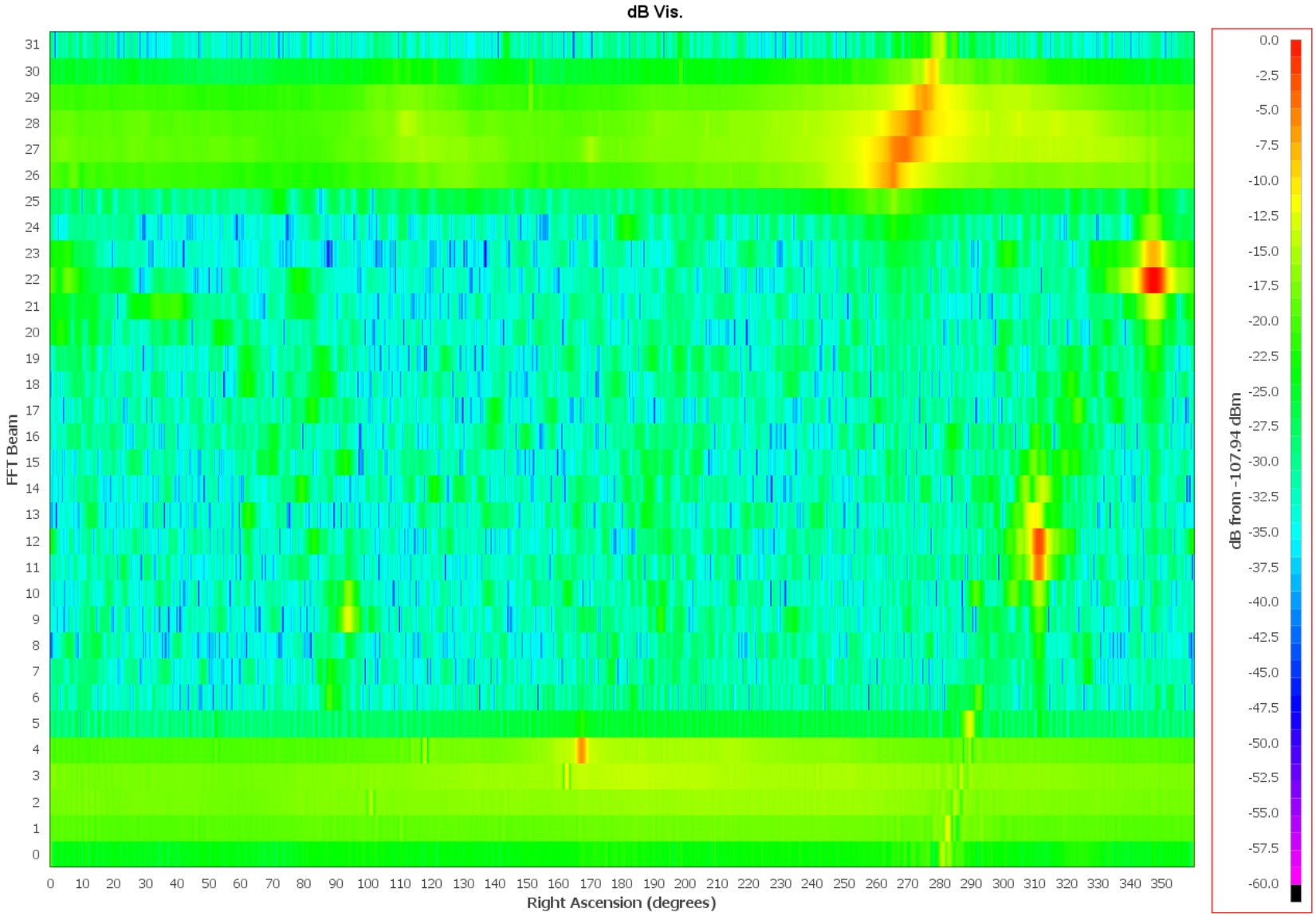
1 Day Scan – Real Part of Visibility– Y pol.



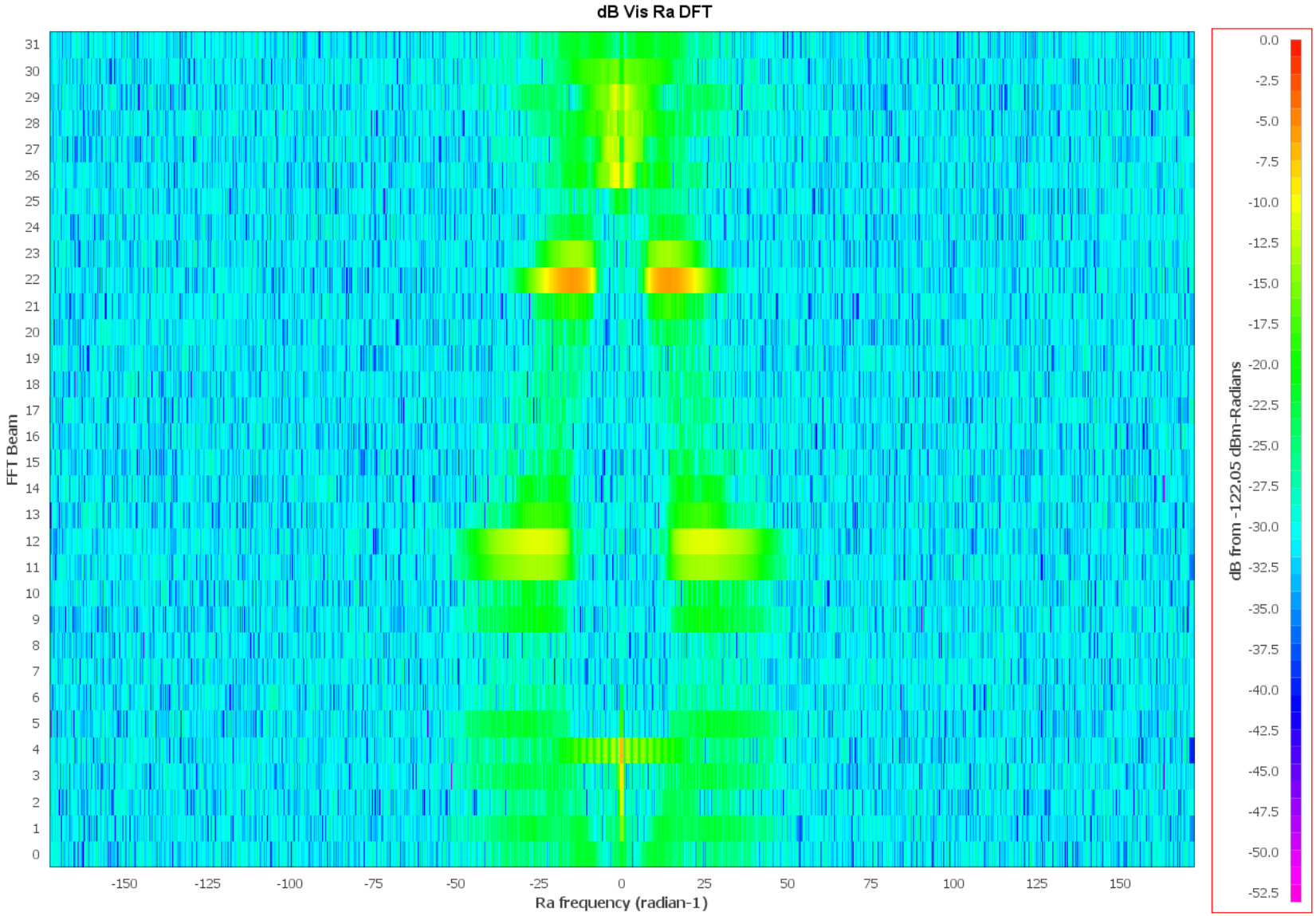
1 Day Scan - Visibility Magnitude – X pol.



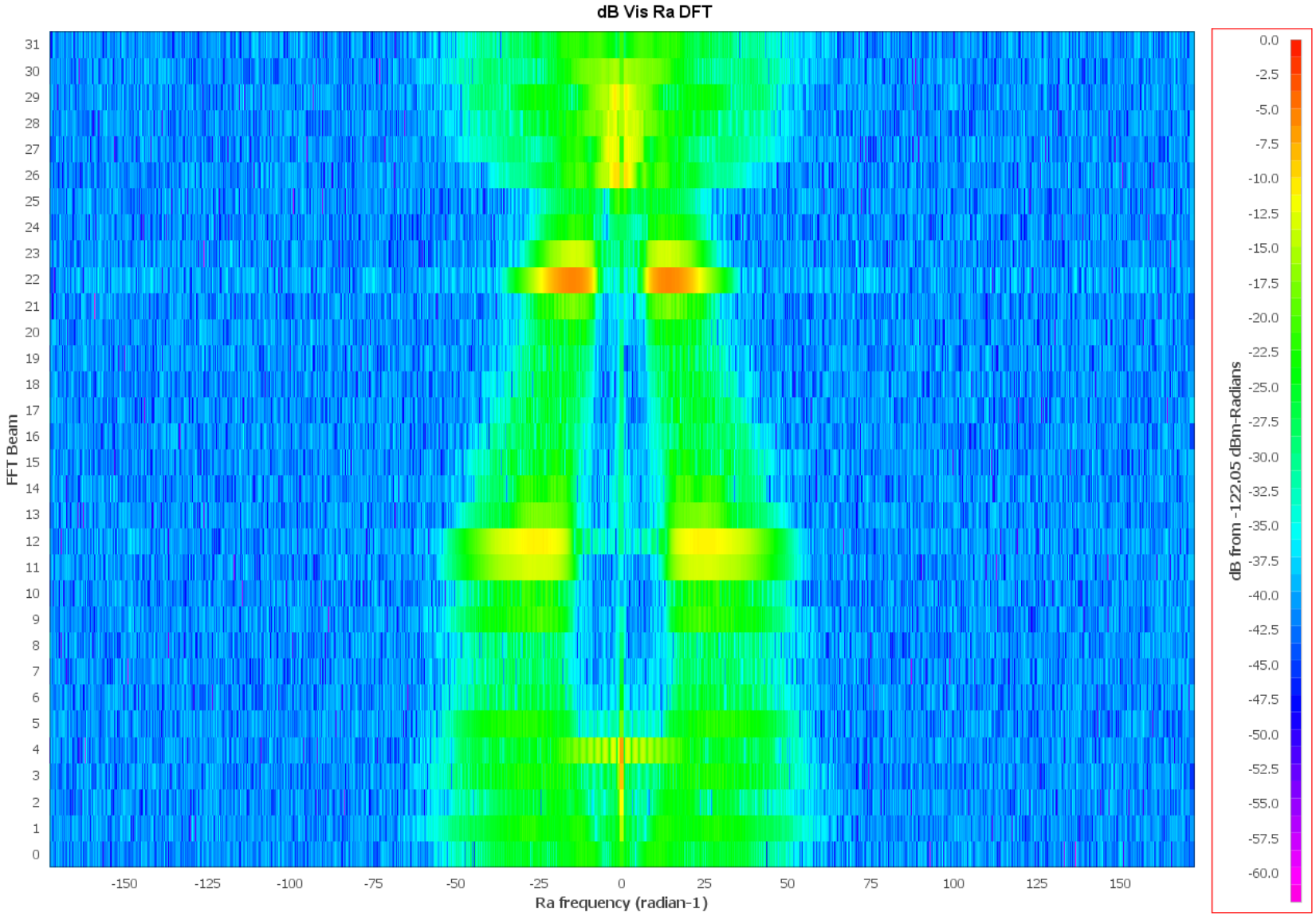
100 Day Scan - Visibility Magnitude – X pol.



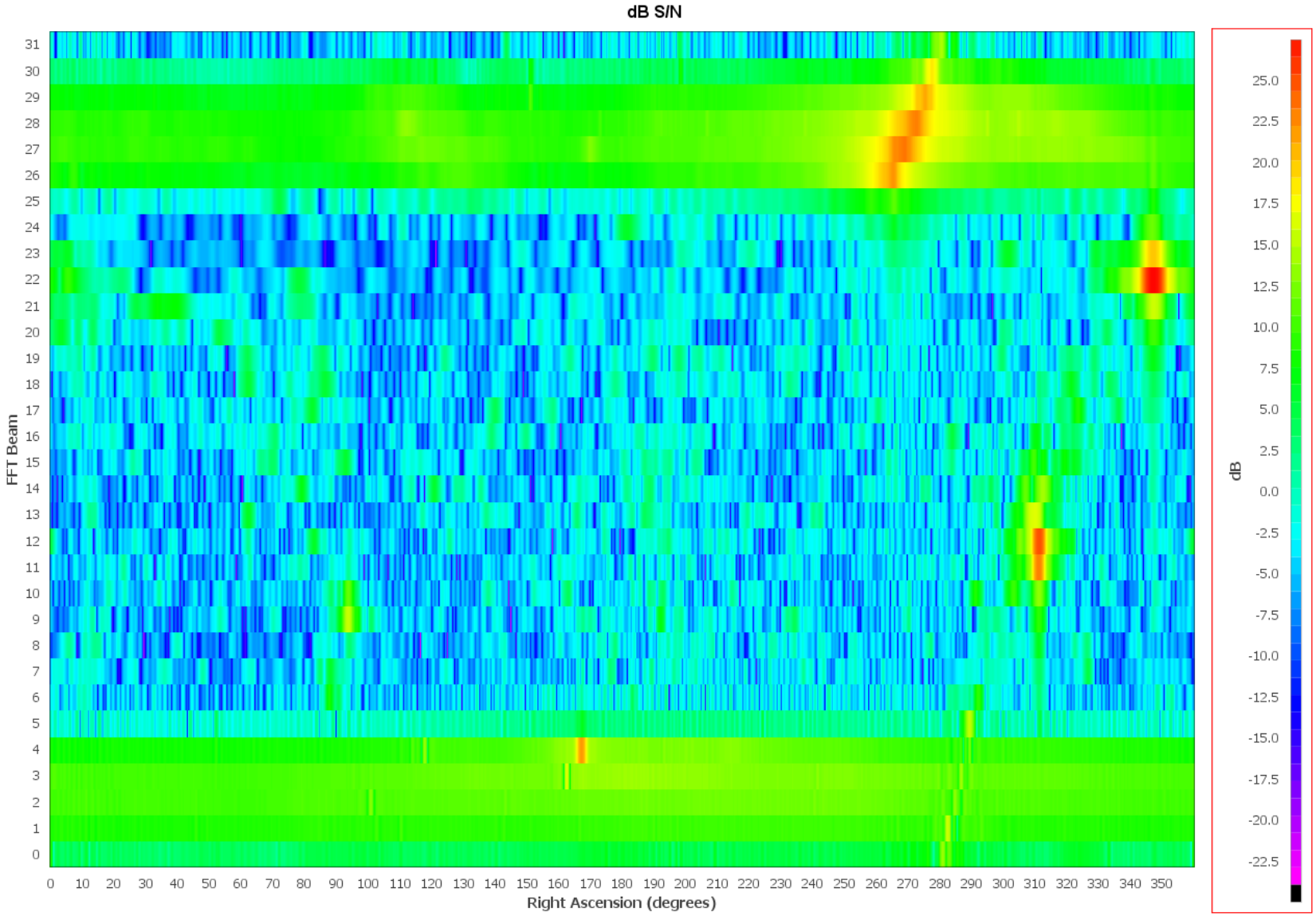
1 Day Scan - Visibility RA DFT – X pol.



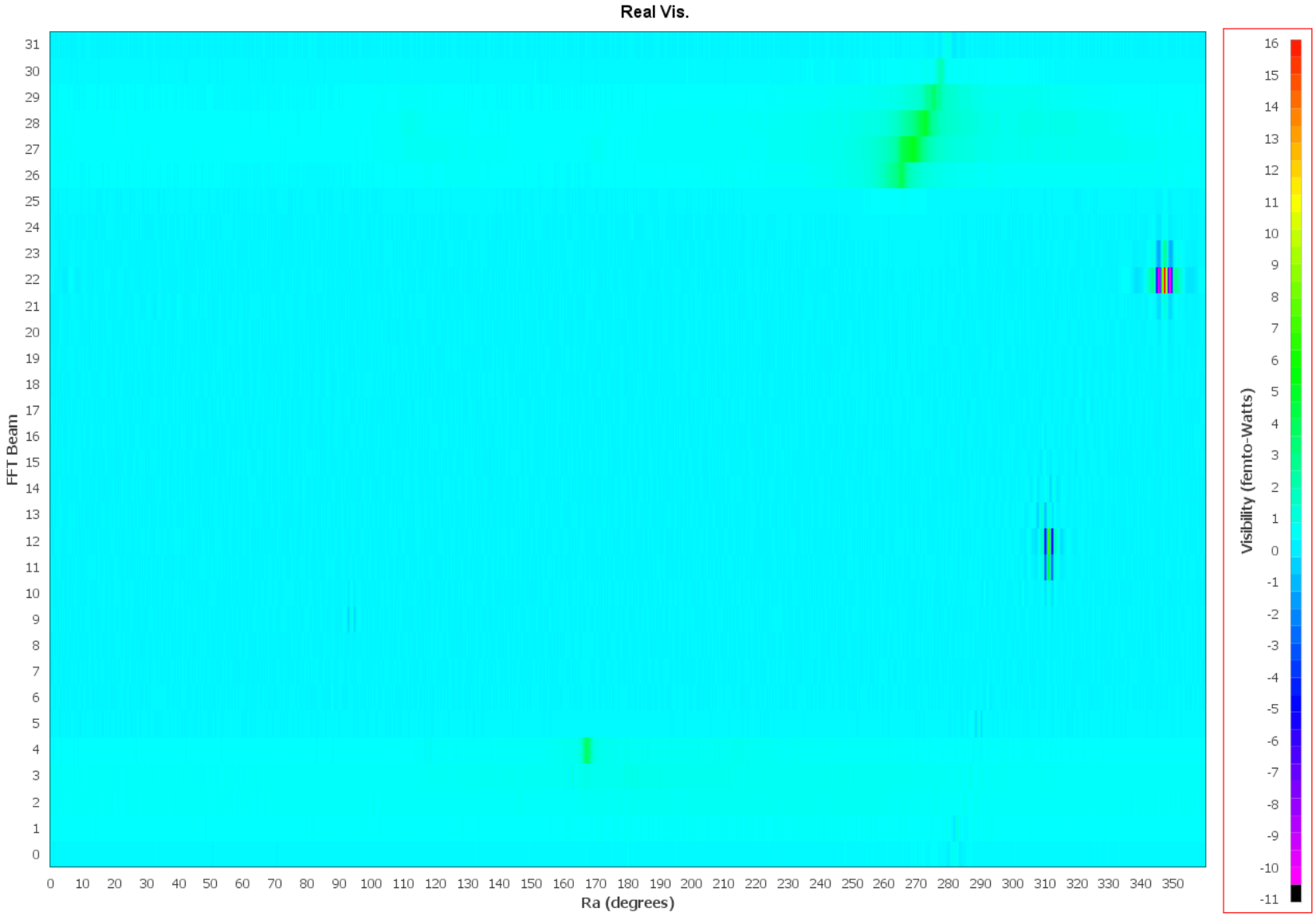
100 Day Scan - Visibility RA DFT – X pol.



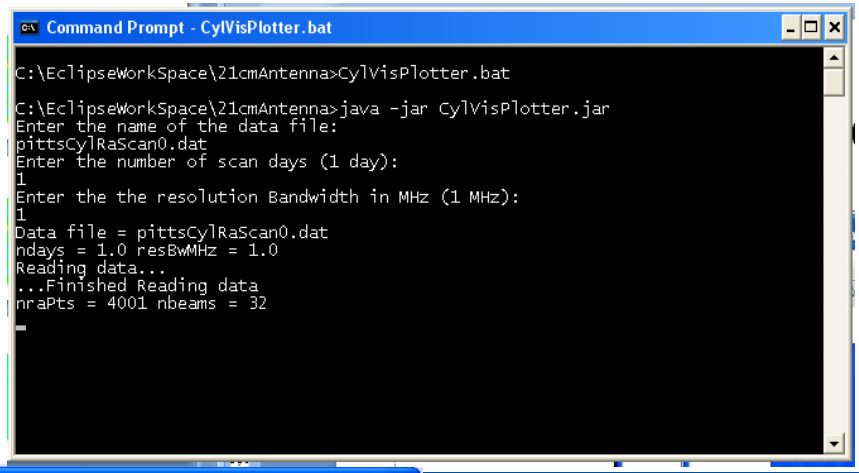
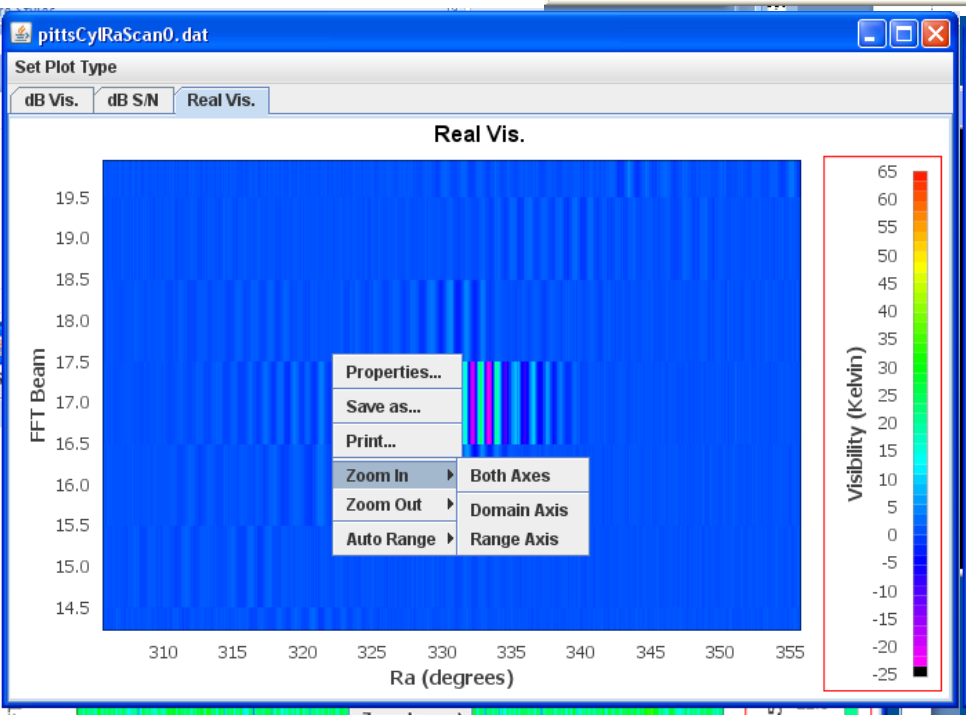
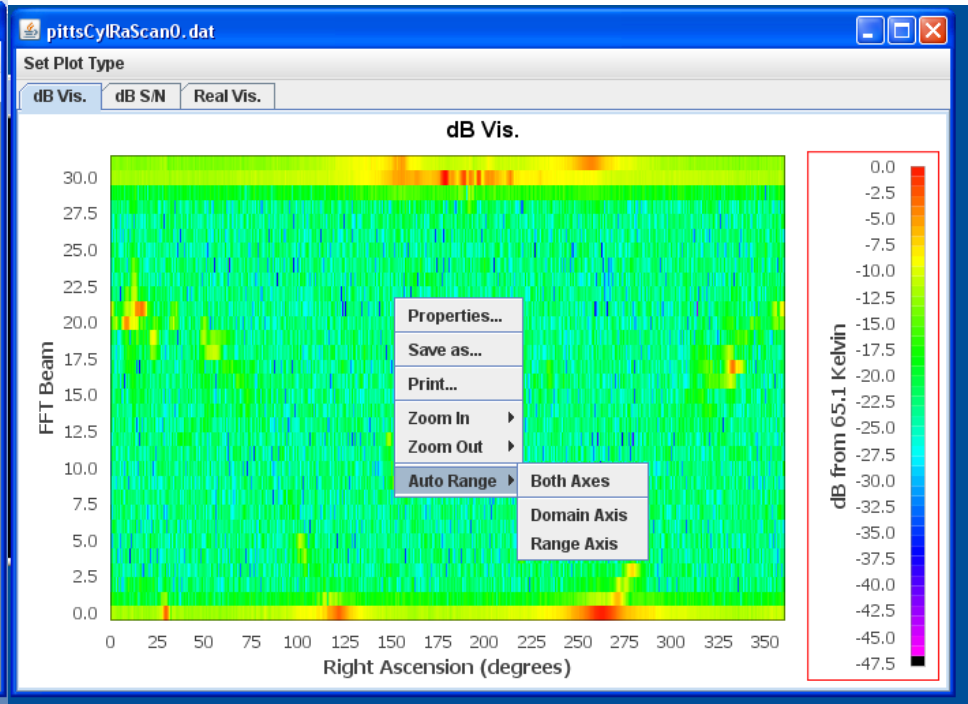
1 Day Scan - Visibility Signal/Noise – X pol.



1 Day Scan – Real Part of Visibility– X pol.



Data Viewer

- I have made a simple data viewer at:
  - http://crt21cm3.fnal.gov:8080/crt21cmData/
- Copy all files into a single directory
  - pitts0.dat = raw ascii Y polarization data
  - pitts1.dat = raw ascii X polarization data
  - CylVisPlotter.jar = java program file for data viewer
  - CylVisPlotter.bat = script file for running program
    - java -jar CylVisPlotter.jar

Data Viewer Screen Shots