
# ngVLA Memo 100
# Configuration: Rev E Staggered Spiral Tests

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**Abstract**

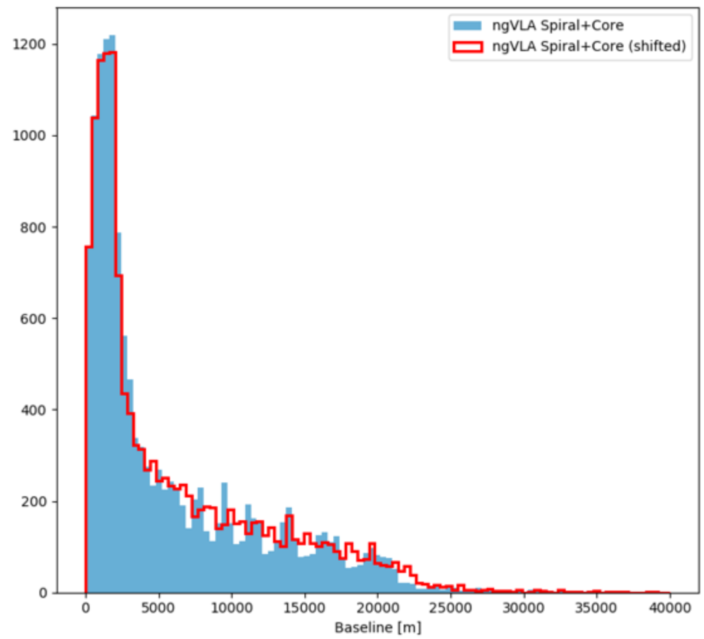
We consider a staggered starting radius for the arms of the spiral to smooth out the sawtooth pattern seen in the snapshot UV radial histogram when including the core, as seen in Figure 3b of Rev D description document (ngVLA memo 92). We find that a graduated starting radius for each arm from 0m to 1200m does smooth out the sawtooth. Imaging simulations of a model of Cygnus A shows no clear advantages or disadvantages in image quality between Rev D and Rev E. This staggered spiral will be incorporated as default Rev E spiral for PDR.

## Process

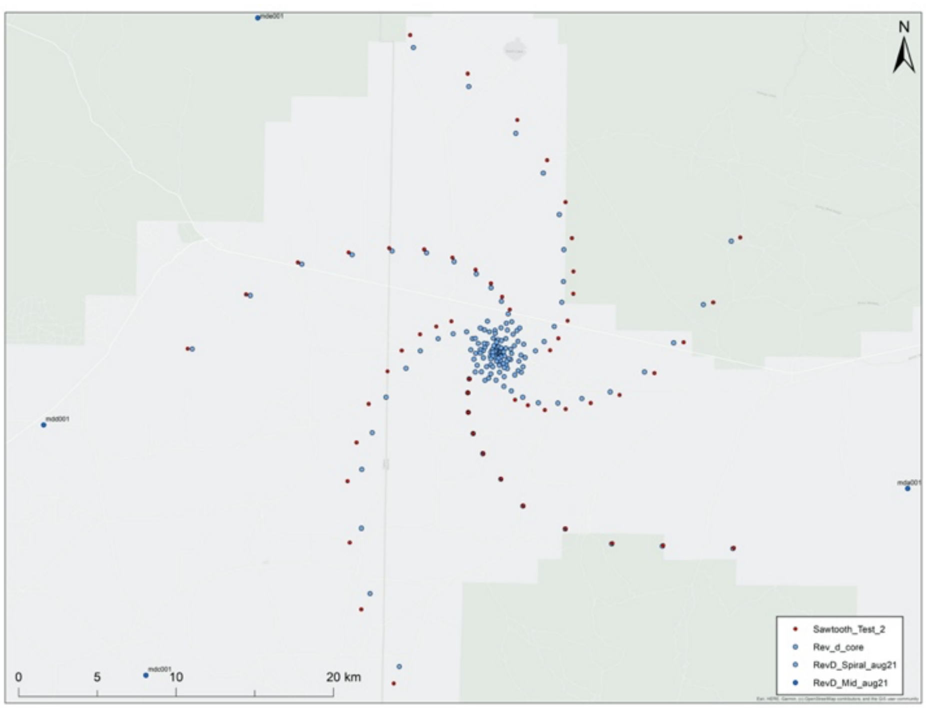
The Rev D spiral plus core histrogram of the UV radial distribution shows a distinct sawtooth pattern with a period of about 2 km (Fig 1 below and ngVLA memo 92 Figure 3b). In order to smooth out this sawtooth pattern, we adjusted the starting point for each arm radially outward in a sequence from 0m to 1200m, in steps of 300m, where 0m implies the current Rev D starting position. Each antenna in a given arm was moved out radially by the same distance.

Inspection of the terrain set the order for the moves of arms: d-a-c-b-e, from 0m to 1200m, respectively, to avoid running into high terrain. An initial search for problematic antenna sites (eg. on route 60), shows the locations are clear of issues, to the same degree as the Rev D spiral.

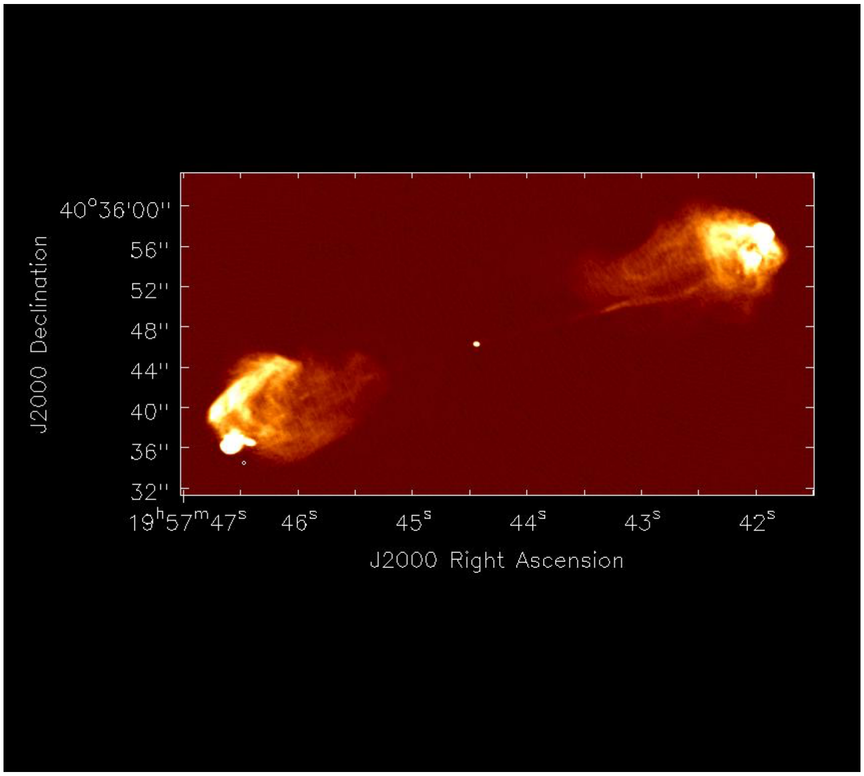
Figure 1 is the resulting UV histogram for the Rev D and Rev E core and spiral. The staggered start does smooth out the sawtooth pattern.




*Histograms of the radial UV distribution of Spiral plus Core. Blue is Rev D, with the same starting radii for all 5 spiral arms. The red curve is for Rev E with staggered starting radii for the spiral arms.*




*Antenna distributions of Core plus Spiral for Rev D (blue) and Rev E (red).*




*Resulting image of the Cygnus A model from Rev E.*

**Imaging Simulation**

- Model: Cygnus A 8 GHz VLA image with total flux density = 242 Jy, doctored to be a good test image as per ngVLA memo 62, including: blanking of off-source noise regions; cell size set to 0.01"; image size = 6.3k x 3.2k pixels; full source angular size ~ 1arcmin.
- Observation: 15min snap shot with 20s records with spiral+core configuration, generated with SIMOBSERVE
- Thermal noise of 0.6 mJy per visibility is added using setnoise.
- TCLEAN: image size = 4k x 2k, 0.025" pixels; multiscale = [0,7,25]; R = -0.75; niter = 30000; boxes set around emission regions.

| Configuration | FWHM PSF | rms mJy/bm | Peak Jy/beam | Total Jy | Dynamic Range | PSF Peak Sidlobe |
|---|---|---|---|---|---|---|
| Rev D | 0.306''x0.252''@80° | 1.00 | 5.55 | 241 | 5550 | +8.4%, -6.0% |
| Rev E | 0.294''x0.245''@86° | 1.01 | 5.22 | 242 | 5200 | +8.6%, -6.2% |

**Results**

The table lists a few of the image metrics for the two simulations with Rev D spiral vs. Rev E staggered spiral. The rms noise is essentially the same in each, and the images are dynamic range limited (the thermal noise is orders of magnitude lower). The total flux density is recovered, and the PSF peak sidelobes are similar. The synthesized beam is slightly smaller for Rev E (about 6% in area). The cause for this can be seen in Figure 2, where the increased radius of the start leads to slightly longer arms[1]. The peak surface brightness reflects the difference in synthesized beam area.

[1]Moving the staring points inward would push some of the antennas into the core, which we have tried to avoid.