Update on A-Array Configurations for UHF

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This report summarizes two comparisons of A-array configurations for a 16-element array on Upper Harkless Flat. The objectives of this report are (1) to determine if the measured pad locations provide acceptable beams and uv coverages compared to the proposed locations, and (2) to define an acceptable A-array configuration without a far-north pad (N9).

1. Beams and Coverages for the Measured A-array.

Pad locations on UHF were identified and measured by S. Scott and M. Hodges. With one exception, they were able to place pads at the request positions within the Star Configuration. The exception was the pad labeled SW6 which was moved to avoid a limestone mound. The outrigger stations were placed near the requested location, but generally the terrain dictated the exact locations. The major exceptions here were the W8 and ERS1 pads. Three alternative positions were actually measured for the ERS1 pad. Table 1 lists the pad locations, requested and measured.

Figure 1 shows the measured pad locations superimposed on a contour map of the elevation. The beams and uv coverages for HA=$\pm$5 hour tracks are shown in Figures 2 and 3 for the requested (Figure 2) and measured (Figure 3) pad locations. Each figure has a left column displaying the synthesized beam and a right column with the corresponding uv coverage. The four panels in each column correspond to four source declinations: -20, -5, 18, and 55 degrees. Table 2 reports the beam sizes and sidelobe levels for each of the beams presented. As can be seen from the Figures, the maxima and minima in the sidelobes do not necessarily fall within the plotted regions of the beam.

For the measured array, the three alternative locations for the ERS 1 pad were evaluated. The ERS1 b locations were slightly better than the other two positions. Figure 3 and the beam statistics reported in Table 2 are for the ERS1 b position.

The differences between the beams and sidelobe levels between the requested and measured arrays are minor. The largest difference is in the sidelobe level for the declination of -5 degrees. It is not surprising that this source declination is more sensitive to changes in antenna locations. It is possible that further refining of the star pads utilized in the A-array could decrease the sidelobe levels.

Conclusions

The measured locations are acceptable.

Pad Name	Requested East (meters)	Location North (meters)	Measured East (meters)	Location North (meters)
N 5	-26.8	177.4	-26.8	177.5
N 7	-67.0	443.5	-67.1	443.8
E 7	286.5	143.4	286.7	143.6
SE 5	121.5	-123.2	121.6	-123.3
SE 7	303.7	-308.0	303.9	-308.2
SW 7	-213.8	-412.5	-213.9	-412.8
W 3	-53.1	8.8	-53.1	8.8
W 7	-331.9	55.0	-332.1	55.0
SE 8	-205.0	-760.0	-197.	-782.
N 8	-100.0	670.0	-100.	670.
N 9	-136.1	1005.2	-159.	972.
W 8	-632.1	-128.0	-562.	-87.
ERN 1	675.0	40.0	700.	47.
ERN 2	783.1	534.6	810.	540.
ERS 1a	620.0	-470.0	667.	-418.
ERS 1b	620.0	-470.0	620.	-467.
ERS 1c	620.0	-470.0	765.	-525.
ERS 2	965.0	-625.0	960.	-688.

Table 1: A-Array Configuration Antenna Positions

2. A-array configurations without a far-north pad.

Due to the trees along the northern extension from N8 to N9 creating a possible environmental concern and the possibility of significant additional cost in extending the array to N9, we will consider alternative A-configurations without N9.

There are two approaches for alternative arrays: (1) to seek to preserve the resolution by extending to the south and northeast, or (2) to seek to minimize the sidelobe levels without significantly extending the previous A-array. The first alternative will keep the resolution at a cost penalty. The second will preserve a clean beam and minimize cost. We present configurations for both options here.

First, we explore option 1. To preserve the resolution without the pad N9, it is necessary to extend the other arms of the array. The only real options for extensions are along the existing roads to the south, southwest, and northeast. I have estimated three possible new pad locations along each of the south and southeast roads, and one along the northeast road. I have run models populating various combinations of pads including the new potential pads, and removing antennas from previous A-configuration pads. The goals

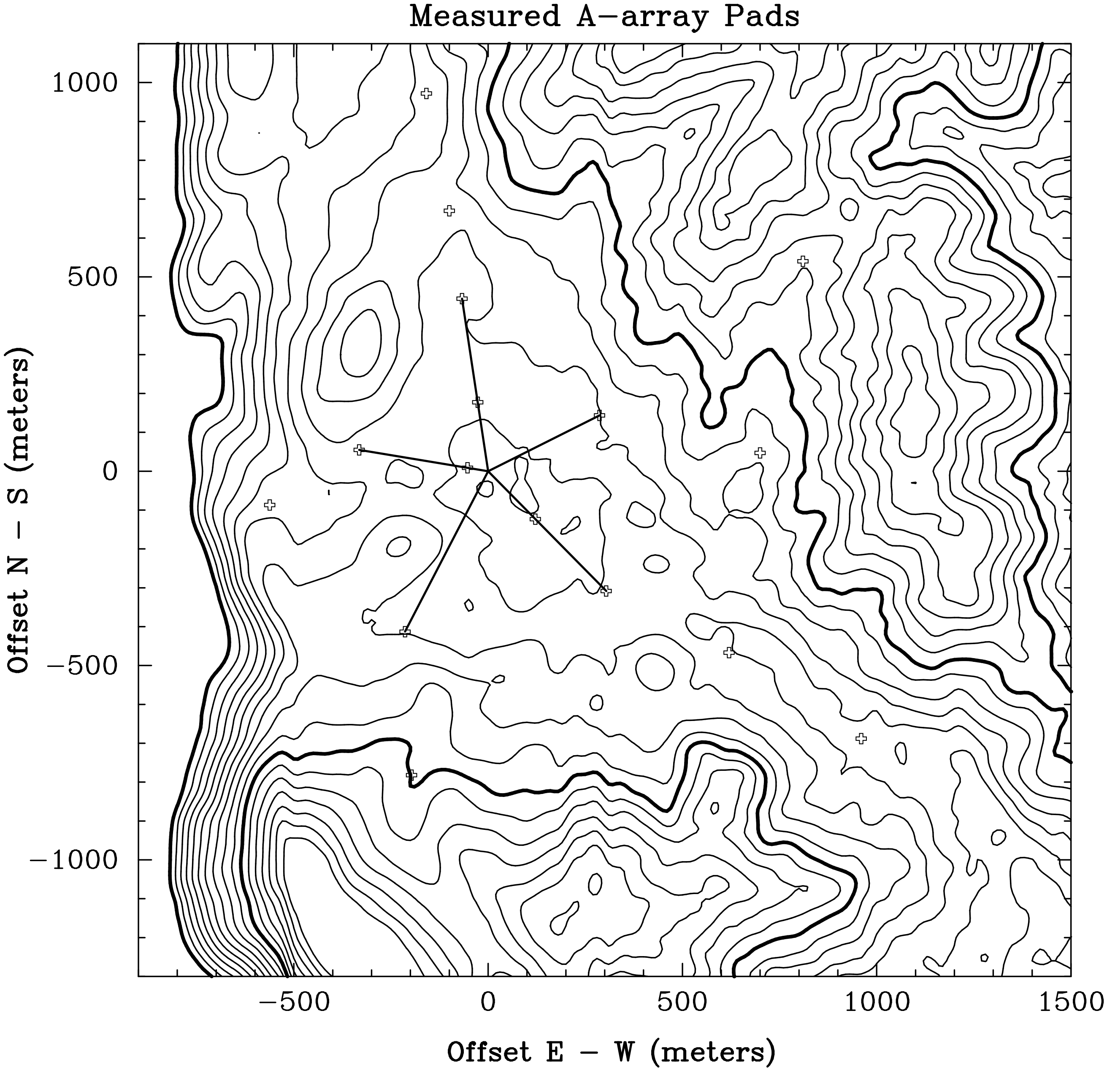

Fig. 1.— Measured antenna locations for A-Configuration overlayed on a contour plot of site elevations. The thin contours run from 2650 to 2690 meters in steps of 5 meters. The thick contours are at levels of 2600 and 2700 meters. The filled crosses mark the locations of antennas. The stick-figure star represents of location of the primary star layout for the D, C, and B configurations.

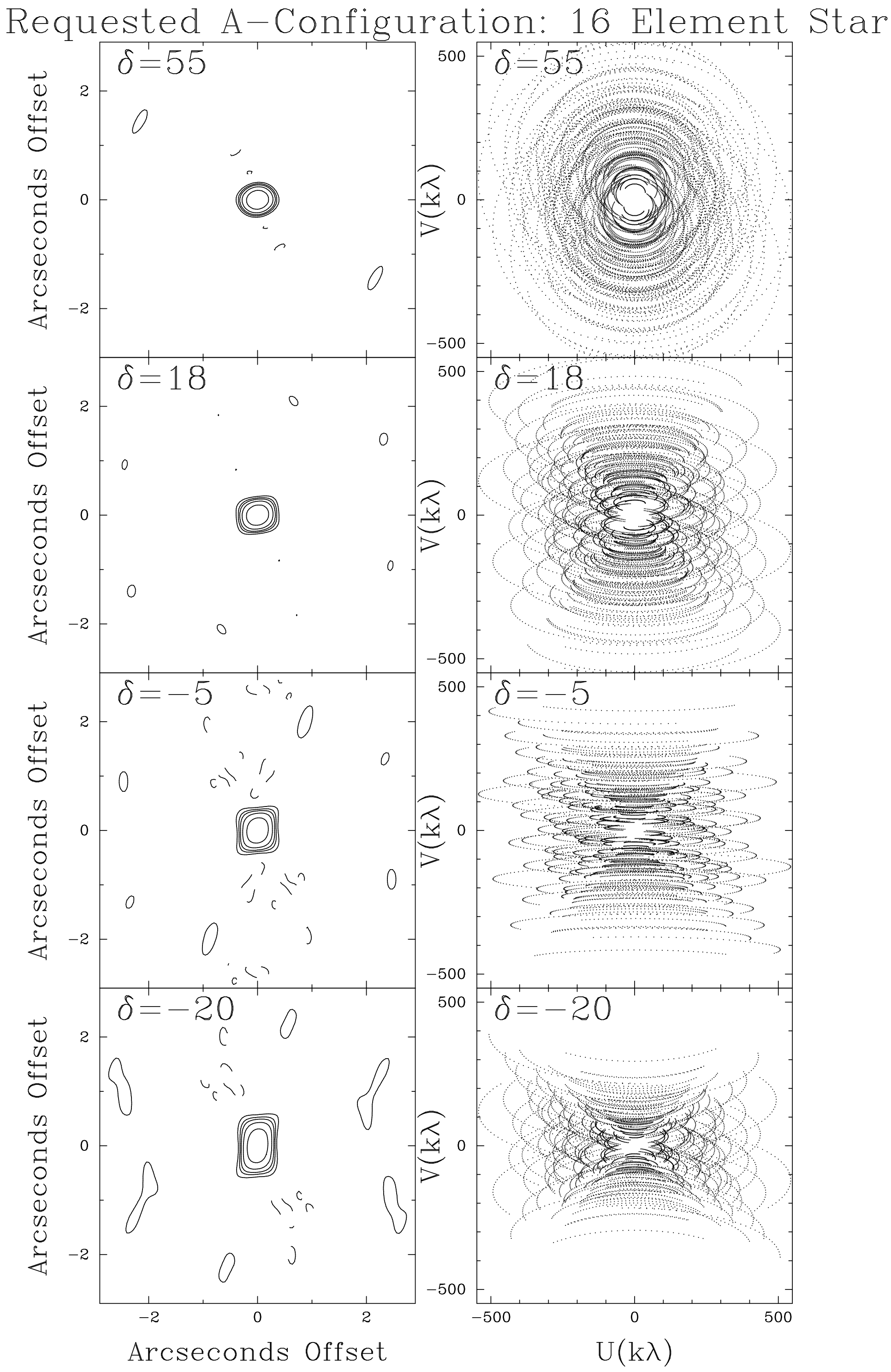

Fig. 2.— Plots of the beams and uv coverages for the requested pad locations with uv coverage ±5 hours from transit. The contour levels in the beam panels are -20, -15, -10, -7.5, -5, 5, 7.5, 10, 15, 20, 30, and 50 percent of the peak. The source declinations for each panel is given in the upper-left corner.

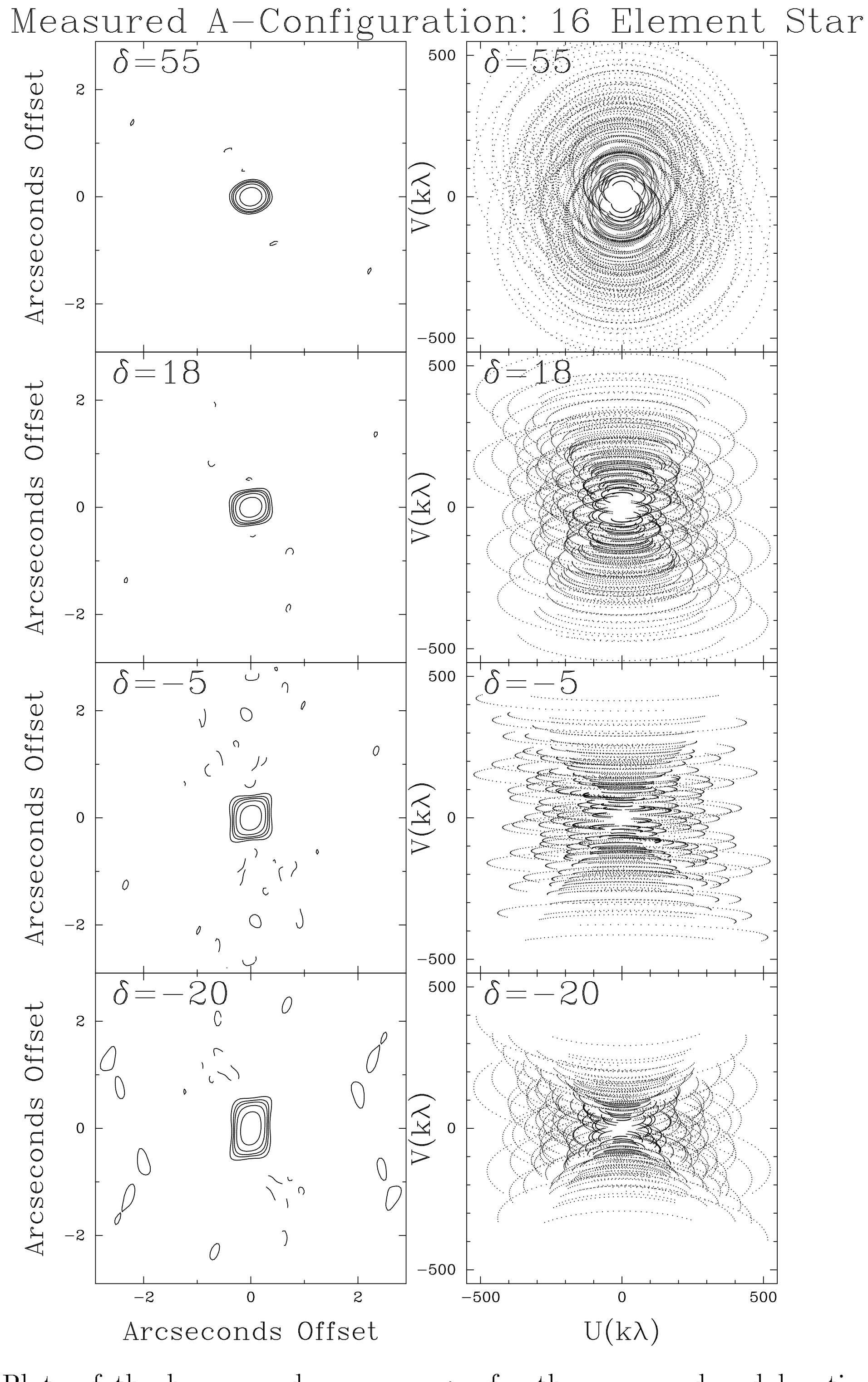

Fig. 3.— Plots of the beams and uv coverages for the measured pad locations with uv coverage ±5 hours from transit. The contour levels in the beam panels are -20, -15, -10, -7.5, -5, 5, 7.5, 10, 15, 20, 30, and 50 percent of the peak. The source declinations for each panel is given in the upper-left corner.

Decl.	Requested syn beam	Locations sidelobes	Measured syn beam	Locations sidelobes
-20	0.64 x 0.38	-6,8	0.65 x 0.39	-6,8
-5	0.47 x 0.40	-6,10	0.48 x 0.40	-6,15
18	0.41 x 0.36	-5,6	0.42 x 0.36	-5,6
55	0.39 x 0.33	-5,6	0.40 x 0.33	-5,5

Table 2: Beam Characteristics for Requested and Measured Arrays

were to achieve similar resolution to the nominal A-configuration (with N9), with similar sidelobe levels and with the same number of antennas off the main array. Thus, the number of special A-array pads is unchanged.

Table 3 lists the positions of the antennas for the proposed A-configuration. Relative to the nominal A-configuration, pad ERN2 has been moved further north along the road; pad SW9 has been added along the southwest road; pad ERS2 has been moved further south along the road; and, ERS1 has been moved from the ERS1b position to the ERS1c position. There have also been a few small changing in the star pad utilization. The locations of the antenna are displayed in Figure 4 superimposed on the site map.

The beams and uv coverages for this configuration are show in Figure 5. The statistics of the beam are give in Table 4. The sidelobes are nearly identical to those for the nominal A-configuration (with N9); the beam FWHM is actually about 5% smaller in option 1.

Pad Name	Pad East (meters)	Locations North (meters)
N 5	-26.8	177.5
N 7	-67.1	443.8
N 8	-100.	670.0
E 7	286.7	143.6
SE 5	121.6	-123.3
SE 7	303.9	-308.2
SW 7	-213.9	-412.8
W 3	-53.1	8.8
W 7	-332.1	55.0
W 8	-562.	-87.
ERN 1	700.	47.
ERN 2b	975.	630.
SW 8	-197.	-782.
SW 9	-120.	-1100.
ERS 1c	765.	-525.
ERS 3	1290.	-900.

Table 3: A-Array Configuration: Option 1

Decl.	Array syn beam	Option 1 sidelobes	Array syn beam	Option 2 sidelobes
-20	0.61 x 0.37	-5,8	0.80 x 0.44	-5,9
-5	0.45 x 0.39	-6,14	0.59 x 0.47	-6,11
18	0.39 x 0.34	-5,6	0.48 x 0.45	-5,6
55	0.37 x 0.31	-5,6	0.46 x 0.40	-5,5

Table 4: Beam Characteristics for Options 1 and 2

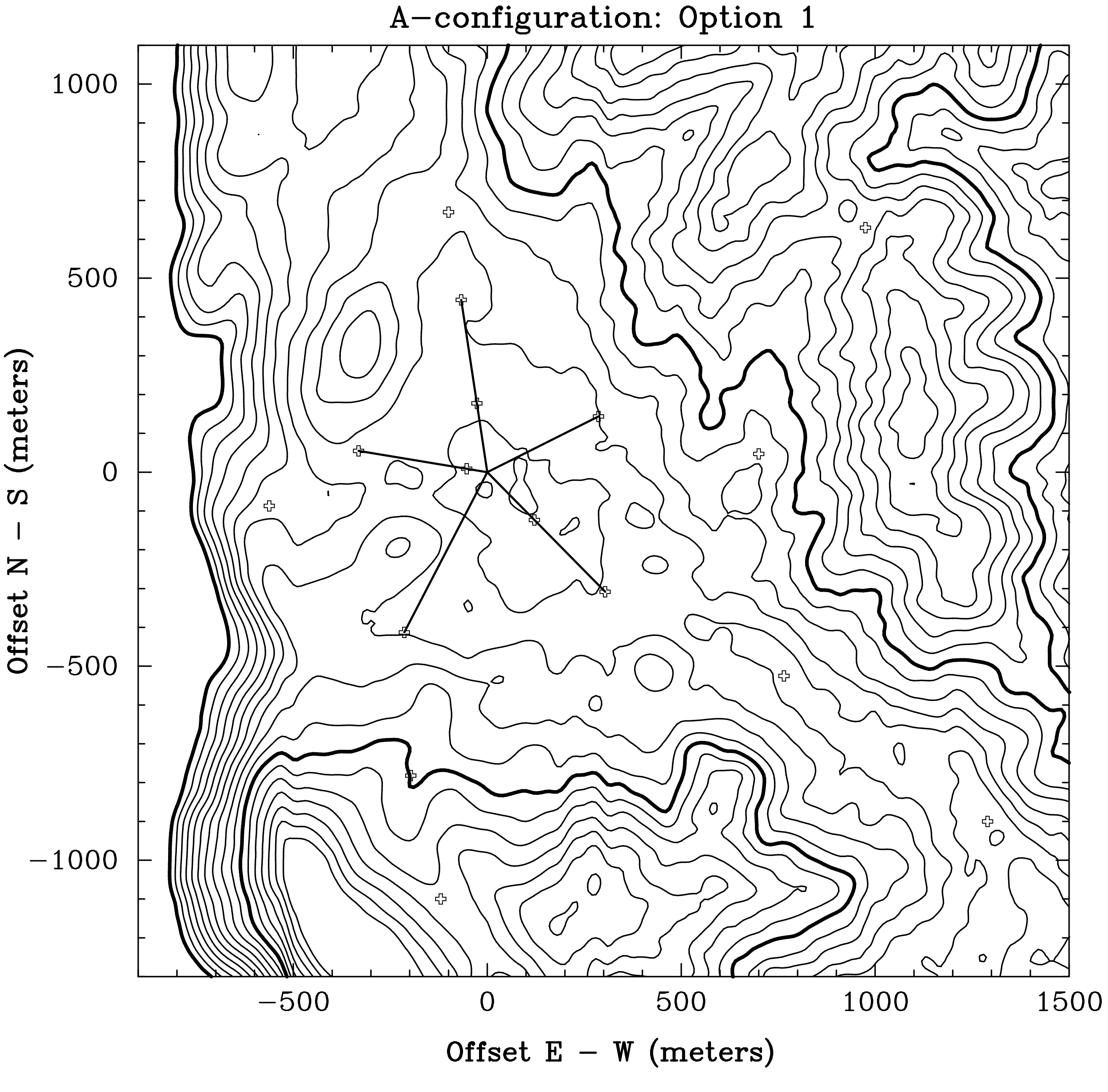

Fig. 4.— Antenna locations for Option 1 overlayed on a contour plot of site elevations. The thin contours run from 2610 to 2760 meters in steps of 10 meters. The thick contours are at levels of 2600 and 2700 meters. The filled dots mark the locations of antennas. The stick-figure star represents of location of the primary star layout for the D, C, and B configurations.

In option 2, we present the best configuration which only modestly extends pad locations along the road, and which seeks to achieve low sidelobe levels. Relative to the nominal A-configuration, pad locations ERS1, ERN2, and SW8 are altered. In each case the change is modest and along the direction of the road. The locations of the pads are shown in Figure 6 and listed in Table 5.

The beams and uv coverages for option 2 are displayed in Figure 7. The statistics of the beams are summarized in Table 4. The beams for option 2 are a little cleaner than for option 1, especially for source declination of -5 degrees. The beam sizes for option 2 are 25% bigger than for option 1.

Pad Name	Pad Locations East (meters)	North (meters)
N 5	-26.8	177.5
N 7	-67.1	443.8
E 5	114.7	57.4
E 7	286.7	143.6
SE 5	121.6	-123.3
SE 7	303.9	-308.2
SW 5	-85.6	-165.1
SW 7	-213.9	-412.8
W 5	-132.9	22.0
W 7	-332.1	55.0
N 8	-100.	670.0
ERN 1	700.	47.
ERS 1c	765.	-525.
W 8	-562.	-87.
ERN 2c	935.	638.8
SW 8b	-215.	-900.

Table 5: A-Array Configuration: Option 2

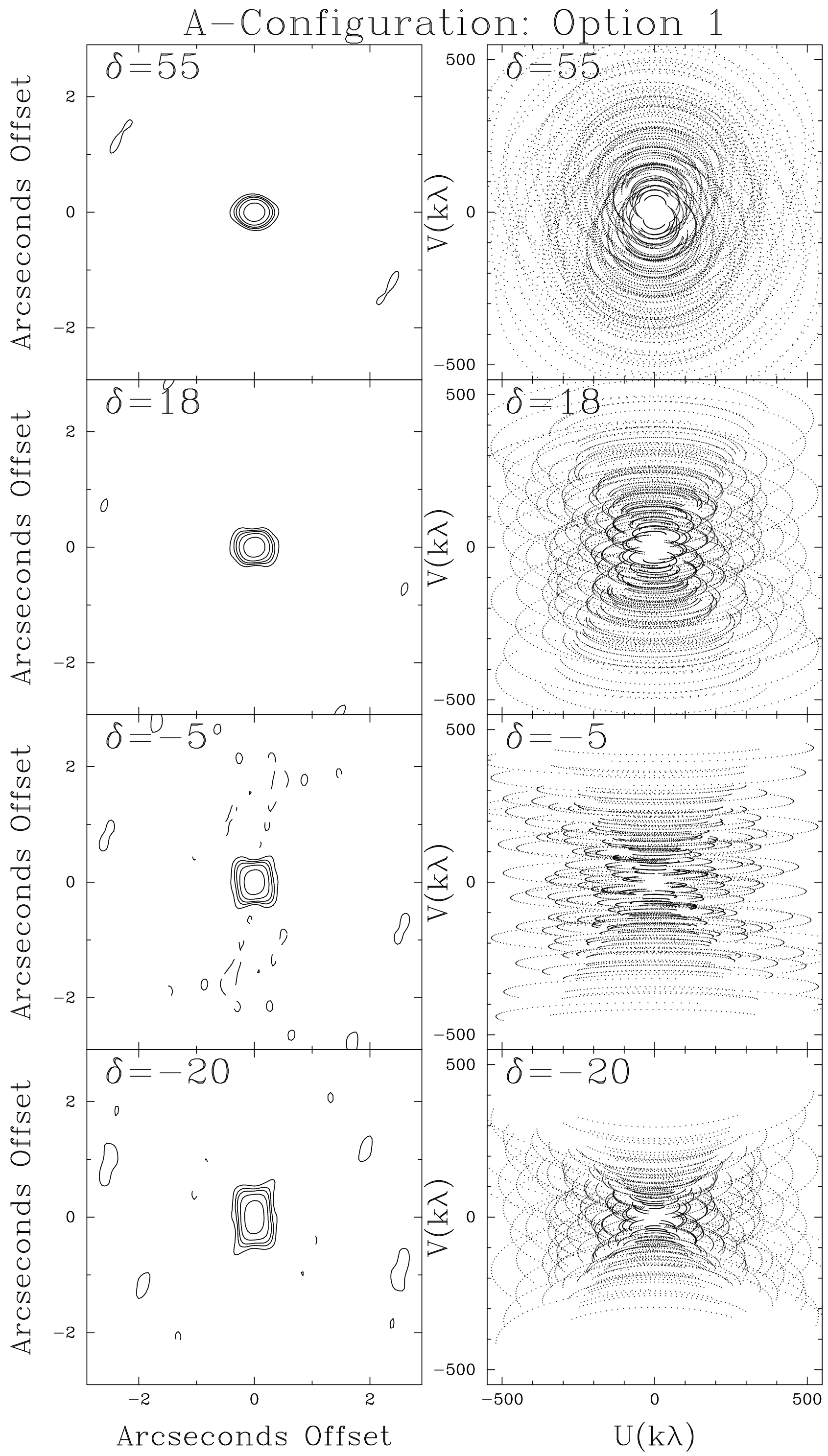

Fig. 5.— Plots of the beams and uv coverages for the proposed option 1 A-configuration for ±5 hours from transit. The contour levels in the beam panels are -20, -15, -10, -7.5, -5, 5, 7.5, 10, 15, 20, 30, and 50 percent of the peak. The source declinations for each panel is given in the upper-left corner.

Conclusions

Options 1 and 2 are both viable alternative A-configurations if N9 pad has to be dropped from the nominal A-array. We prefer option 1 because it maintains the maximum resolution of the array, at some additional cost over option 2. It is possible that option 1 would actually be cheaper than the nominal A-configuration: it is a question of extending along roads in three directions compared to building 300 meters of new antenna-runway to the north.

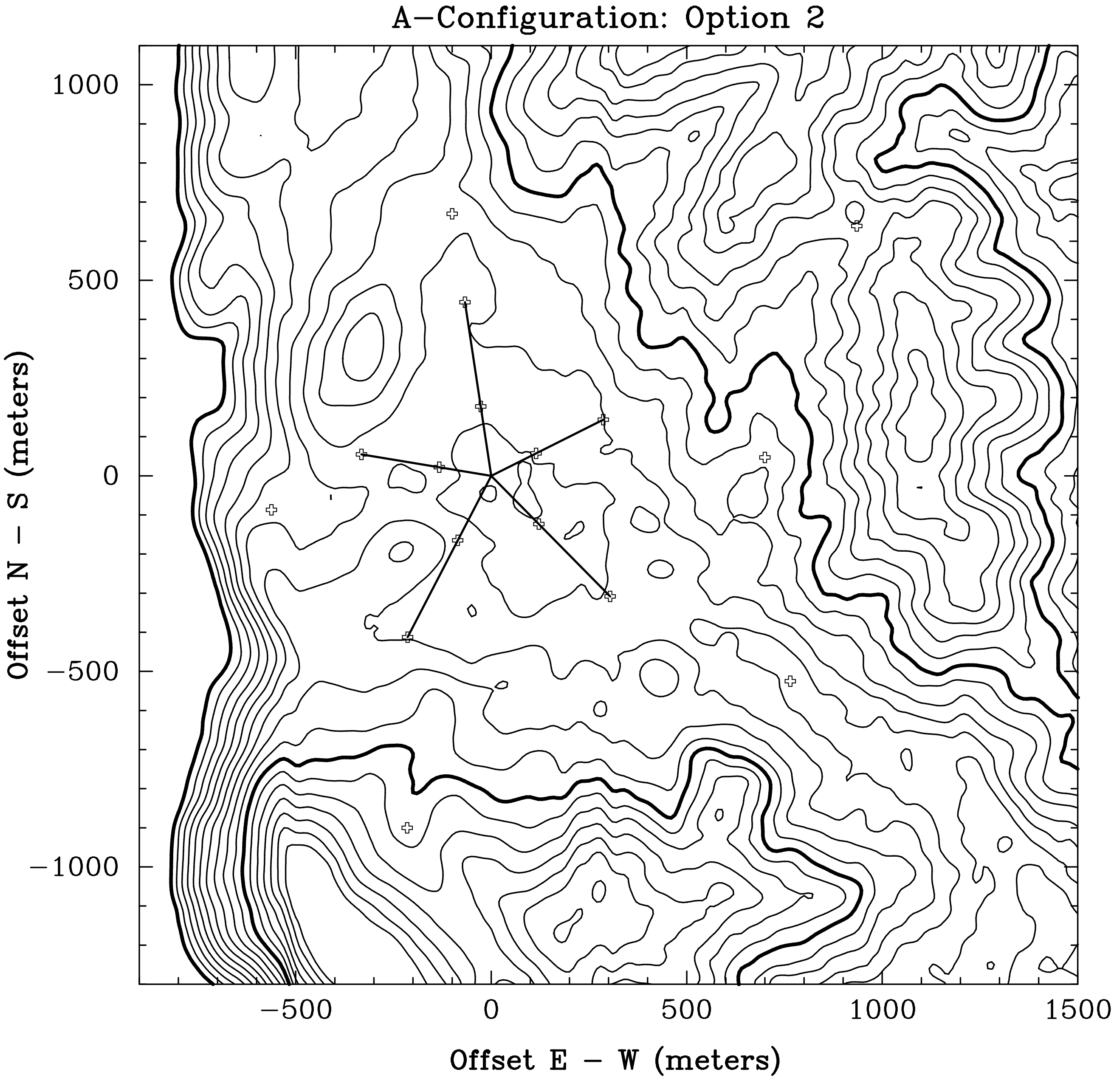

Fig. 6.— Antenna locations for Option 2 overlayed on a contour plot of site elevations. The thin contours run from 2610 to 2760 meters in steps of 10 meters. The thick contours are at levels of 2600 and 2700 meters. The filled dots mark the locations of antennas. The stick-figure star represents of location of the primary star layout for the D, C, and B configurations.

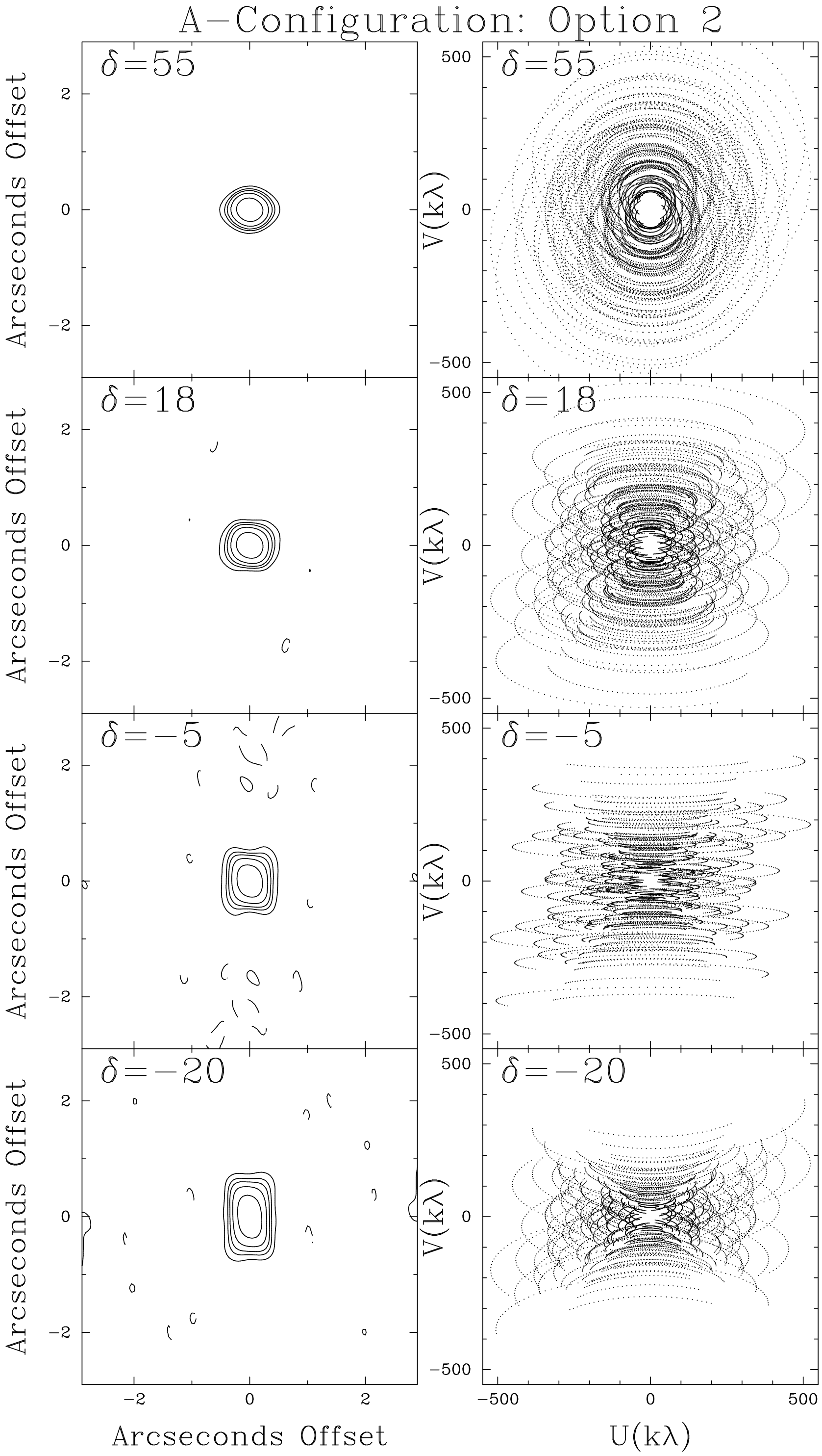

Fig. 7.— Plots of the beams and uv coverages for the proposed option 1 A-configuration for ±5 hours from transit. The contour levels in the beam panels are -20, -15, -10, -7.5, -5, 5, 7.5, 10, 15, 20, 30, and 50 percent of the peak. The source declinations for each panel is given in the upper-left corner.