

NATIONAL RADIO ASTRONOMY OBSERVATORY

VLA SCIENTIFIC MEMORANDUM # 7

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SOME RESULTS ON THE VLA PERFORMANCE WITH LESS THAN 36 ELEMENTS

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This report summarizes the performance of the VLA for the following two cases:

- (i) Single observation performance of the VLA with 36, 33, 30 and 27 elements for three different configurations.
- (ii) Single observation performance of a 36-element VLA in the supplemented Wye configuration when one element is inoperative.

In the first study, three configurations have been tried: (a) The supplemented Wye in which the first three elements are located at one-third the unit spacing, (b) a configuration in which the first two elements are located at one-half the unit spacing and (c) a configuration with uniform spacing between all adjacent elements. Tables I, II, and III give the results for these three configurations for 36, 33, 30 and 27 elements. A comparison of the three configurations is made in Table IV for 36 and 27 elements. The following points are brought out clearly by these results.

- (i) The percentage of holes is not a good measure of the performance. Table IV shows that the percentage of holes goes down considerably for configurations (b) and (c) compared to (a). However, this does not necessarily lead to a reduction of sidelobes.
- (ii) The best configuration depends both upon the number of elements and the declination. It is clear that for sources north of the equator, supplemented Wye is the best configuration. But for sources at and below the equator, uniform spacing leads to a

better beam than the supplemented Wye configuration.

- (iii) If -14db is taken as the upper limit for any side lobe within the field of view, then 33 elements are sufficient. The maximum sidelobes with 33 elements are within one db of the maximum sidelobes with 36 elements.

With the exception of the equator, the goal of an upper limit of -14db on sidelobes can be achieved even with 30 elements. When 30 elements are arranged in the supplemented Wye configuration, the maximum sidelobes at 30° and -15° declinations are -18.4 and -18.9 dbs respectively. However, at 0° declination, there is a -11.1 db sidelobe near the edge of the field of view. The RMS sidelobes are nowhere greater than -23db. The deficiency at 0° declination can be overcome by the use of complementary arrays technique. It appears, therefore, that a 30-element VLA will meet the -14db sidelobe limit with a single observation for sources everywhere except close to and on the equator where complementary arrays technique will have to be used.

The results of the second part of the study, viz., the effect of removing one element on the VLA performance, are summarized in Table V. Since the deterioration in performance depends upon the baselines lost, a complete study should consider the effect of removing each of the 36 elements, one at a time, at various declinations. However, due to the formidable magnitude of such a study, only a few sample elements have been chosen. Specifically, six cases have been considered which include the effect of removing an element close to the center of the Wye and an element far from the center for each of the three arms. In each case the basic configuration is the standard 36-element supplemented Wye with one arm rotated 5° east of the North-South line. Three source declinations, 30° , 0° and -15° have been considered. The element removed is designated by the arm and the number, for example, SW-11 means the 11th element from the center on the South-West arm.

It is clear from Table V that the sidelobe levels go up, in general, when an element is removed. However, nowhere is the increase in sidelobe level more than 2 db. In most cases the increase is less than 1db. Thus the performance does not deteriorate to an unacceptable level when one out of the 36 elements becomes inoperative.

TABLE I
VLA PERFORMANCE FOR N = 36, 33, 30, 27

| Model | N | Declination | Tracking Range | Holes (%) | Half-Power Beamwidth | Relative Gain | Maximum Sidelobe Level | | | | | RMS Sidelobe Level | | | | | |
|--|----|-------------|----------------|-----------|----------------------|---------------|------------------------|--------|--------|--------|--------|--------------------|--------|--------|--------|--------|--|
| | | | | | | | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 | |
| CONFIGURATION A: SUPPLEMENTED WYE (FIRST THREE ELEMENTS AT 1/3 UNIT SPACING) | | | | | | | | | | | | | | | | | |
| 3621A611 | 36 | 30° | $\pm 6.0^h$ | 6.08 | 10.0 x 10.4 | 419 | -20.6 | -21.6 | -21.7 | -22.1 | -21.8 | -26.2 | -27.7 | -28.5 | -30.6 | -31.3 | |
| 3321A611 | 33 | 30° | $\pm 6.0^h$ | 8.91 | 10.0 x 10.4 | 379 | -19.6 | -20.7 | -19.7 | -22.2 | -20.3 | -25.1 | -26.9 | -27.7 | -29.5 | -30.5 | |
| 3021A611 | 30 | 30° | $\pm 6.0^h$ | 12.35 | 10.0 x 10.4 | 339 | -18.7 | -20.3 | -18.4 | -18.9 | -19.4 | -24.7 | -25.3 | -27.1 | -28.3 | -29.6 | |
| 2721A611 | 27 | 30° | $\pm 6.0^h$ | 17.52 | 10.0 x 10.5 | 304 | -18.0 | -19.1 | -18.1 | -17.4 | -19.5 | -23.4 | -24.1 | -26.1 | -27.0 | -28.7 | |
| 3621A502 | 36 | 0° | $\pm 5.5^h$ | 18.61 | 9.6 x 11.4 | 395 | -17.6 | -19.8 | -19.1 | -14.2 | -16.6 | -25.7 | -28.7 | -30.4 | -32.4 | -34.5 | |
| 3321A502 | 33 | 0° | $\pm 5.5^h$ | 22.08 | 9.4 x 11.7 | 355 | -16.3 | -19.2 | -17.4 | -17.3 | -14.0 | -24.5 | -28.1 | -29.3 | -31.8 | -33.6 | |
| 3021A502 | 30 | 0° | $\pm 5.5^h$ | 28.09 | 9.3 x 12.3 | 314 | -15.3 | -16.2 | -18.2 | -14.3 | -11.1 | -23.4 | -26.1 | -28.3 | -30.3 | -32.4 | |
| 2721A502 | 27 | 0° | $\pm 5.5^h$ | 37.23 | 9.3 x 13.0 | 272 | -16.3 | -16.0 | -12.7 | -15.0 | -8.4 | -22.3 | -25.7 | -26.2 | -29.2 | -31.1 | |
| 3621A523 | 36 | -15° | $\pm 5.3^h$ | 17.20 | 10.7 x 11.5 | 402 | -20.0 | -25.0 | -20.8 | -21.7 | -21.7 | -27.9 | -31.5 | -31.0 | -32.3 | -33.4 | |
| 3321A523 | 33 | -15° | $\pm 5.3^h$ | 20.52 | 10.8 x 11.6 | 362 | -19.0 | -23.6 | -19.8 | -22.6 | -20.5 | -27.5 | -29.7 | -29.8 | -31.2 | -32.3 | |
| 3021A523 | 30 | -15° | $\pm 5.3^h$ | 24.25 | 11.0 x 11.5 | 322 | -18.9 | -21.4 | -19.0 | -21.6 | -18.9 | -25.8 | -28.7 | -28.3 | -30.2 | -31.4 | |
| 2721A523 | 27 | -15° | $\pm 5.3^h$ | 29.02 | 11.2 x 11.5 | 291 | -17.5 | -19.3 | -17.4 | -19.4 | -17.8 | -24.4 | -26.7 | -27.6 | -29.0 | -30.3 | |

TABLE II

VLA PERFORMANCE FOR N = 36, 33, 30, 27

| Model | N | Declination | Tracking Range | Holes (%) | Half-Power Beamwidth | Relative Gain | Maximum Sidelobe Level | | | | | RMS Sidelobe Level | | | | | | |
|--|----|-------------|-------------------|-----------|----------------------|---------------|------------------------|--------|--------|--------|--------|--------------------|--------|--------|--------|--------|--|--|
| | | | | | | | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 | | |
| CONFIGURATION B: FIRST TWO ELEMENTS AT ONE-HALF THE UNIT SPACING | | | | | | | | | | | | | | | | | | |
| 3621B611 | 36 | 30° | +6.0 ^h | 5.03 | 10.0 x 10.3 | 409 | -18.7 | -21.7 | -19.4 | -20.9 | -21.2 | -25.3 | -27.0 | -27.8 | -29.6 | -31.1 | | |
| 3321B611 | 33 | 30° | +6.0 ^h | 7.96 | 9.9 x 10.2 | 360 | -16.8 | -19.8 | -17.6 | -18.8 | -22.0 | -24.0 | -26.3 | -27.2 | -28.3 | -30.0 | | |
| 3021B611 | 30 | 30° | +6.0 ^h | 11.52 | 9.8 x 10.2 | 324 | -16.4 | -20.5 | -17.1 | -17.3 | -20.0 | -23.3 | -25.4 | -26.3 | -27.4 | -29.2 | | |
| 2721B611 | 27 | 30° | +6.0 ^h | 16.40 | 9.8 x 10.3 | 288 | -15.7 | -19.7 | -15.8 | -16.4 | -19.1 | -22.2 | -24.4 | -25.5 | -26.6 | -28.3 | | |
| 3621B502 | 36 | 0° | +5.5 ^h | 15.03 | 9.6 x 11.2 | 401 | -21.7 | -20.6 | -20.7 | -17.7 | -18.0 | -27.3 | -29.8 | -31.3 | -33.4 | -35.2 | | |
| 3321B502 | 33 | 0° | +5.5 ^h | 20.25 | 9.5 x 11.5 | 352 | -18.2 | -18.4 | -18.1 | -13.0 | -15.2 | -24.5 | -27.4 | -29.4 | -30.9 | -33.1 | | |
| 3021B502 | 30 | 0° | +5.5 ^h | 25.04 | 9.2 x 12.3 | 305 | -17.4 | -17.3 | -16.1 | -16.2 | -11.7 | -24.8 | -26.9 | -28.2 | -30.2 | -32.2 | | |
| 2721B502 | 27 | 0° | +5.5 ^h | 30.75 | 9.2 x 12.6 | 274 | -15.3 | -17.0 | -16.8 | -13.3 | -9.6 | -22.6 | -25.0 | -27.9 | -29.0 | -31.4 | | |
| 3621B523 | 36 | -15° | +5.3 ^h | 15.50 | 10.6 x 11.8 | 404 | -21.4 | -24.6 | -22.4 | -21.8 | -23.6 | -28.7 | -31.6 | -32.0 | -32.6 | -33.9 | | |
| 3321B523 | 33 | -15° | +5.3 ^h | 18.07 | 10.7 x 11.5 | 358 | -20.7 | -25.4 | -20.0 | -20.7 | -21.1 | -27.7 | -31.2 | -30.8 | -31.8 | -32.9 | | |
| 3021B523 | 30 | -15° | +5.3 ^h | 21.68 | 10.9 x 11.4 | 318 | -20.3 | -23.4 | -19.0 | -21.8 | -19.7 | -27.7 | -29.4 | -29.4 | -30.8 | -31.9 | | |
| 2721B523 | 27 | -15° | +5.3 ^h | 26.28 | 11.1 x 11.4 | 282 | -18.2 | -21.0 | -17.6 | -19.5 | -17.7 | -25.8 | -27.8 | -27.6 | -29.3 | -30.5 | | |

TABLE III
VLA PERFORMANCE FOR N = 36, 33, 30, 27

| Model | N | Declination | Tracking Range | Holes (%) | Half-Power Beamwidth | Relative Gain | Maximum Sidelobe Level | | | | | RMS Sidelobe Level | | | | | | |
|------------------|----|-----------------|----------------|-----------|----------------------|---------------|------------------------|--------|--------|--------|--------|--------------------|--------|--------|--------|--------|--|--|
| | | | | | | | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 | | |
| CONFIGURATION U: | | UNIFORM SPACING | | | | | | | | | | | | | | | | |
| 3621U611 | 36 | 30° | $\pm 6.0^h$ | 5.04 | 9.7 x 10.0 | 365 | -14.6 | -17.7 | -15.9 | -15.6 | -19.7 | -22.1 | -27.1 | -27.6 | -28.6 | -30.2 | | |
| 3321U611 | 33 | 30° | $\pm 6.0^h$ | 7.59 | 9.6 x 10.0 | 332 | -14.1 | -17.5 | -14.9 | -15.4 | -19.5 | -21.8 | -26.9 | -26.6 | -28.1 | -29.3 | | |
| 3021U611 | 30 | 30° | $\pm 6.0^h$ | 11.53 | 9.5 x 9.9 | 295 | -13.7 | -17.7 | -14.2 | -17.8 | -18.7 | -21.9 | -26.2 | -25.5 | -27.4 | -28.5 | | |
| 2721U611 | 27 | 30° | $\pm 6.0^h$ | 16.75 | 9.4 x 9.8 | 266 | -13.5 | -18.2 | -12.8 | -16.8 | -17.2 | -21.7 | -25.5 | -24.7 | -26.6 | -27.7 | | |
| 3621U502 | 36 | 0° | $\pm 5.5^h$ | 12.88 | 9.6 x 11.0 | 386 | -19.5 | -21.1 | -19.3 | -20.0 | -19.7 | -24.5 | -26.9 | -30.9 | -32.8 | -34.5 | | |
| 3321U502 | 33 | 0° | $\pm 5.5^h$ | 17.25 | 9.5 x 11.3 | 345 | -18.3 | -19.7 | -18.2 | -15.4 | -15.5 | -24.1 | -27.1 | -29.7 | -31.5 | -33.7 | | |
| 3021U502 | 30 | 0° | $\pm 5.5^h$ | 22.75 | 9.3 x 11.7 | 294 | -18.2 | -17.3 | -17.6 | -11.8 | -14.2 | -22.3 | -25.7 | -28.3 | -30.1 | -32.2 | | |
| 2721U502 | 27 | 0° | $\pm 5.5^h$ | 27.96 | 9.0 x 12.2 | 251 | -15.1 | -18.0 | -15.5 | -16.3 | -10.2 | -21.1 | -26.2 | -27.5 | -29.7 | -31.4 | | |
| 3621U523 | 36 | -15° | $\pm 5.3^h$ | 13.78 | 10.6 x 11.6 | 387 | -21.7 | -26.0 | -25.4 | -22.1 | -24.1 | -29.2 | -33.5 | -33.7 | -33.3 | -34.3 | | |
| 3321U523 | 33 | -15° | $\pm 5.3^h$ | 16.54 | 10.7 x 11.6 | 343 | -21.3 | -24.9 | -21.6 | -19.9 | -22.4 | -28.1 | -30.7 | -31.2 | -31.7 | -33.1 | | |
| 3021U523 | 30 | -15° | $\pm 5.3^h$ | 19.45 | 10.8 x 11.3 | 302 | -21.1 | -24.5 | -18.6 | -18.8 | -20.4 | -27.5 | -30.9 | -29.7 | -31.0 | -32.2 | | |
| 2721U523 | 27 | -15° | $\pm 5.3^h$ | 23.79 | 11.0 x 11.2 | 262 | -19.7 | -22.2 | -17.5 | -21.1 | -18.1 | -27.5 | -28.3 | -28.1 | -29.6 | -30.7 | | |

TABLE IV
VLA PERFORMANCE FOR VARIOUS CONFIGURATIONS

| A. Supplemented Wye | | | B. First Two Elements at Half Unit Spacing | | | | U. Uniform Spacing | | | | | | | | | |
|---------------------|----|-------------|--|-----------|----------------------|---------------|------------------------|--------|--------|--------|--------|--------------------|--------|--------|--------|--------|
| Model | N | Declination | Tracking Range | Holes (%) | Half-Power Beamwidth | Relative Gain | Maximum Sidelobe Level | | | | | RMS Sidelobe Level | | | | |
| | | | | | | | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 |
| 3621A611 | 36 | 30° | +6.0 ^h | 6.08 | 10.0 x 10.4 | 419 | -20.6 | -21.6 | -21.7 | -22.1 | -21.8 | -26.2 | -27.7 | -28.5 | -30.6 | -31.3 |
| 3621B611 | 36 | 30° | +6.0 ^h | 5.03 | 10.0 x 10.3 | 409 | -18.7 | -21.7 | -19.4 | -20.9 | -21.2 | -25.3 | -27.0 | -27.8 | -29.6 | -31.3 |
| 3621U611 | 36 | 30° | +6.0 ^h | 5.04 | 9.7 x 10.0 | 365 | -14.6 | -17.7 | -15.9 | -15.6 | -19.7 | -22.1 | -27.1 | -27.6 | -28.6 | -31.1 |
| 3621A502 | 36 | 0° | +5.5 ^h | 18.61 | 9.6 x 11.4 | 395 | -17.6 | -19.8 | -19.1 | -14.2 | -16.6 | -25.7 | -28.7 | -30.4 | -32.4 | -34.5 |
| 3621B502 | 36 | 0° | +5.5 ^h | 15.03 | 9.6 x 11.2 | 401 | -21.7 | -20.6 | -20.7 | -17.7 | -18.0 | -27.3 | -29.8 | -31.3 | -33.4 | -35.2 |
| 3621U502 | 36 | 0° | +5.5 ^h | 12.88 | 9.6 x 11.0 | 386 | -19.5 | -21.1 | -19.3 | -20.0 | -19.7 | -24.5 | -26.9 | -30.9 | -32.8 | -34.5 |
| 3621A523 | 36 | -15° | +5.3 ^h | 17.20 | 10.7 x 11.5 | 402 | -20.0 | -25.0 | -20.8 | -21.7 | -21.7 | -27.9 | -31.5 | -31.0 | -32.3 | -33.4 |
| 3621B523 | 36 | -15° | +5.3 ^h | 15.50 | 10.6 x 11.8 | 404 | -21.4 | -24.6 | -22.4 | -21.8 | -23.6 | -28.7 | -31.6 | -32.0 | -32.6 | -33.9 |
| 3621U523 | 36 | -15° | +5.3 ^h | 13.78 | 10.6 x 11.6 | 387 | -19.5 | -21.1 | -25.4 | -22.1 | -24.1 | -29.2 | -33.5 | -33.7 | -33.3 | -34.3 |
| 2721A611 | 27 | 30° | +6.0 ^h | 17.52 | 10.0 x 10.5 | 304 | -18.0 | -19.1 | -18.1 | -17.4 | -19.5 | -23.4 | -24.1 | -26.1 | -27.0 | -28.7 |
| 2721B611 | 27 | 30° | +6.0 ^h | 16.40 | 9.8 x 10.3 | 288 | -15.7 | -19.7 | -15.8 | -16.4 | -19.1 | -22.2 | -24.4 | -25.5 | -26.6 | -28.3 |
| 2721U611 | 27 | 30° | +6.0 ^h | 16.75 | 9.4 x 9.8 | 266 | -13.5 | -18.2 | -12.8 | -16.8 | -17.2 | -21.7 | -25.5 | -24.7 | -26.6 | -27.7 |
| 2721A502 | 27 | 0° | +5.5 ^h | 37.23 | 9.3 x 13.0 | 272 | -16.3 | -16.0 | -12.7 | -15.0 | - 8.4 | -22.3 | -25.7 | -26.2 | -29.2 | -31.1 |
| 2721B502 | 27 | 0° | +5.5 ^h | 30.75 | 9.2 x 12.6 | 274 | -15.3 | -17.0 | -16.8 | -13.3 | - 9.6 | -22.6 | -25.0 | -27.9 | -29.0 | -31.4 |
| 2721U502 | 27 | 0° | +5.5 ^h | 27.96 | 9.0 x 12.2 | 251 | -15.1 | -18.0 | -15.5 | -16.3 | -10.2 | -21.1 | -26.2 | -27.5 | -29.7 | -31.4 |
| 2721A523 | 27 | -15° | +5.3 ^h | 29.02 | 11.2 x 11.5 | 291 | -17.5 | -19.3 | -17.4 | -19.4 | -17.8 | -24.4 | -26.7 | -27.6 | -29.0 | -30.3 |
| 2721B523 | 27 | -15° | +5.3 ^h | 26.28 | 11.1 x 11.4 | 282 | -18.2 | -21.0 | -17.6 | -19.5 | -17.7 | -25.8 | -27.8 | -27.6 | -29.3 | -30.5 |
| 2721U523 | 27 | -15° | +5.3 ^h | 23.79 | 11.0 x 11.2 | 262 | -19.7 | -22.2 | -17.5 | -21.1 | -18.1 | -27.5 | -28.3 | -28.1 | -29.6 | -30.7 |

TABLE V

Effect of Removing One Element from a 36-Element VLA

| Model | Element Removed | Declination | Tracking Range | Holes (%) | Half-Power Beamwidth | Relative Gain | Maximum Sidelobe Level | | | | | RMS Sidelobe Level | | | | |
|----------|-----------------|-------------|----------------|-----------|----------------------|---------------|------------------------|--------|--------|--------|--------|--------------------|--------|--------|--------|--------|
| | | | | | | | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 |
| 3621A611 | None | 30° | <u>+6.0</u> | 6.08 | 10.0 x 10.4 | 419 | -20.6 | -21.6 | -21.7 | -22.1 | -21.8 | -26.2 | -27.7 | -28.5 | -30.6 | -31.3 |
| 3521C611 | N-3 | 30° | <u>+6.0</u> | 6.59 | 10.0 x 10.3 | 399 | -20.0 | -21.0 | -20.9 | -21.8 | -20.8 | -25.5 | -27.1 | -27.8 | -29.8 | -30.8 |
| 36216112 | N-12 | 30° | <u>+6.0</u> | 6.78 | 10.1 x 10.4 | 417 | -20.6 | -21.5 | -21.7 | -22.1 | -21.7 | -26.2 | -27.7 | -28.5 | -30.5 | -31.3 |
| 36216115 | SE-3 | 30° | <u>+6.0</u> | 6.46 | 10.0 x 10.4 | 403 | -20.8 | -20.9 | -21.2 | -21.9 | -21.5 | -26.5 | -27.4 | -28.4 | -30.2 | -31.0 |
| 3521D611 | SE-11 | 30° | <u>+6.0</u> | 7.17 | 10.0 x 10.4 | 411 | -20.3 | -21.4 | -21.2 | -22.0 | -21.5 | -26.1 | -27.7 | -28.4 | -30.4 | -31.2 |
| 36216127 | SW-3 | 30° | <u>+6.0</u> | 6.63 | 10.0 x 10.3 | 406 | -19.8 | -20.6 | -21.2 | -22.9 | -21.3 | -24.3 | -26.2 | -28.2 | -29.9 | -30.8 |
| 36216135 | SW-11 | 30° | <u>+6.0</u> | 7.23 | 9.9 x 10.4 | 411 | -20.9 | -21.7 | -21.6 | -21.8 | -21.6 | -26.1 | -27.7 | -28.4 | -30.4 | -31.1 |
| 3621A502 | None | 0° | <u>+5.5</u> | 18.61 | 9.6 x 11.4 | 395 | -17.6 | -19.8 | -19.1 | -14.2 | -16.6 | -25.7 | -28.7 | -30.4 | -32.4 | -34.5 |
| 3521C502 | N-3 | 0° | <u>+5.5</u> | 19.78 | 9.6 x 11.5 | 381 | -17.2 | -18.0 | -18.9 | -14.8 | -16.6 | -24.9 | -28.4 | -30.2 | -32.0 | -34.2 |
| 36215012 | N-12 | 0° | <u>+5.5</u> | 20.67 | 9.8 x 11.4 | 391 | -18.1 | -19.7 | -19.1 | -14.1 | -16.1 | -25.7 | -28.6 | -30.3 | -32.3 | -34.4 |
| 36215015 | SE-3 | 0° | <u>+5.5</u> | 19.20 | 9.6 x 11.4 | 376 | -17.8 | -20.1 | -19.1 | -14.4 | -16.6 | -25.6 | -28.3 | -30.1 | -31.7 | -33.9 |
| 3521D502 | SE-11 | 0° | <u>+5.5</u> | 21.47 | 9.5 x 11.7 | 385 | -17.4 | -18.8 | -17.6 | -13.9 | -16.2 | -25.5 | -28.4 | -30.0 | -32.1 | -34.2 |
| 36215027 | SW-3 | 0° | <u>+5.5</u> | 19.13 | 9.6 x 11.4 | 379 | -17.6 | -19.2 | -18.7 | -14.2 | -16.0 | -25.5 | -28.0 | -30.1 | -31.7 | -33.8 |
| 36215035 | SW-11 | 0° | <u>+5.5</u> | 22.29 | 9.3 x 11.8 | 388 | -16.1 | -20.0 | -17.3 | -14.0 | -14.7 | -24.5 | -29.0 | -29.8 | -31.9 | -34.0 |
| 3621A523 | None | -15° | <u>+5.3</u> | 17.20 | 10.7 x 11.3 | 427 | -20.3 | -24.9 | -21.0 | -21.8 | -21.8 | -28.0 | -31.5 | -31.1 | -32.4 | -33.5 |
| 3521C523 | N-3 | -15° | <u>+5.3</u> | 17.63 | 10.7 x 11.5 | 386 | -19.9 | -24.6 | -20.6 | -21.4 | -21.7 | -27.8 | -31.2 | -30.8 | -32.1 | -33.2 |
| 36215212 | N-12 | -15° | <u>+5.3</u> | 21.60 | 10.6 x 10.1 | 392 | -18.6 | -24.7 | -20.4 | -21.5 | -21.6 | -27.3 | -30.9 | -30.7 | -32.1 | -33.0 |
| 36215215 | SE-3 | -15° | <u>+5.3</u> | 17.37 | 10.7 x 11.5 | 383 | -19.6 | -25.0 | -20.7 | -22.1 | -21.4 | -27.8 | -30.9 | -30.6 | -32.0 | -33.1 |
| 3521D523 | SE-11 | -15° | <u>+5.3</u> | 20.02 | 10.7 x 11.7 | 392 | -18.1 | -23.1 | -20.0 | -20.7 | -22.2 | -27.3 | -30.1 | -30.3 | -31.7 | -32.9 |
| 36215227 | SW-3 | -15° | <u>+5.3</u> | 17.54 | 10.7 x 11.5 | 390 | -19.7 | -24.8 | -20.0 | -20.8 | -21.6 | -27.7 | -30.4 | -30.4 | -32.1 | -33.2 |
| 36215235 | SW-11 | -15° | <u>+5.3</u> | 18.81 | 10.8 x 11.2 | 388 | -19.1 | -23.6 | -20.8 | -20.9 | -21.5 | -27.4 | -30.7 | -30.6 | -31.8 | -32.8 |