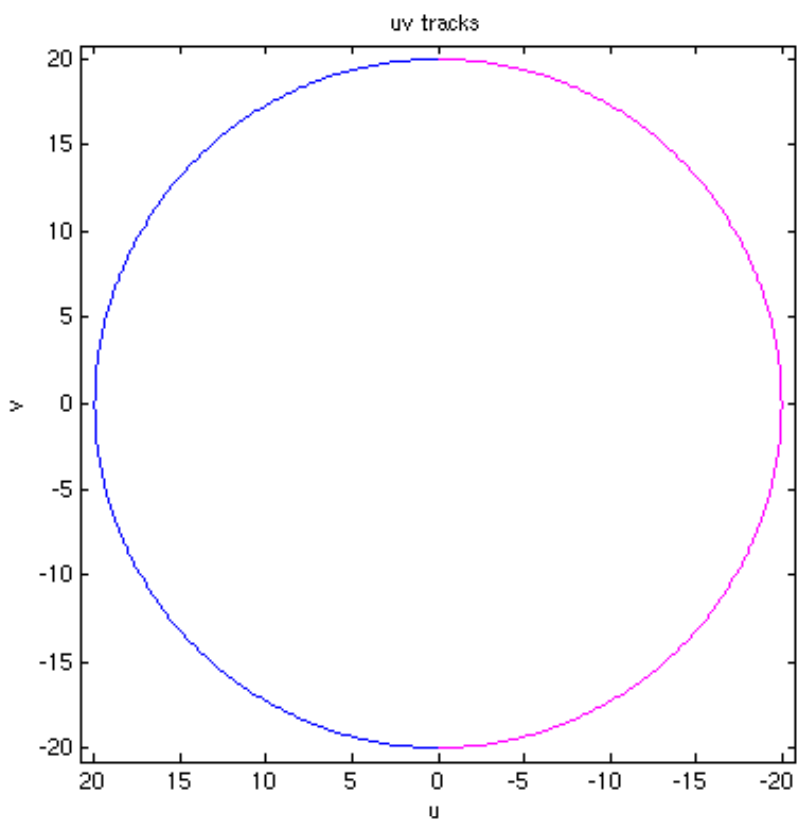
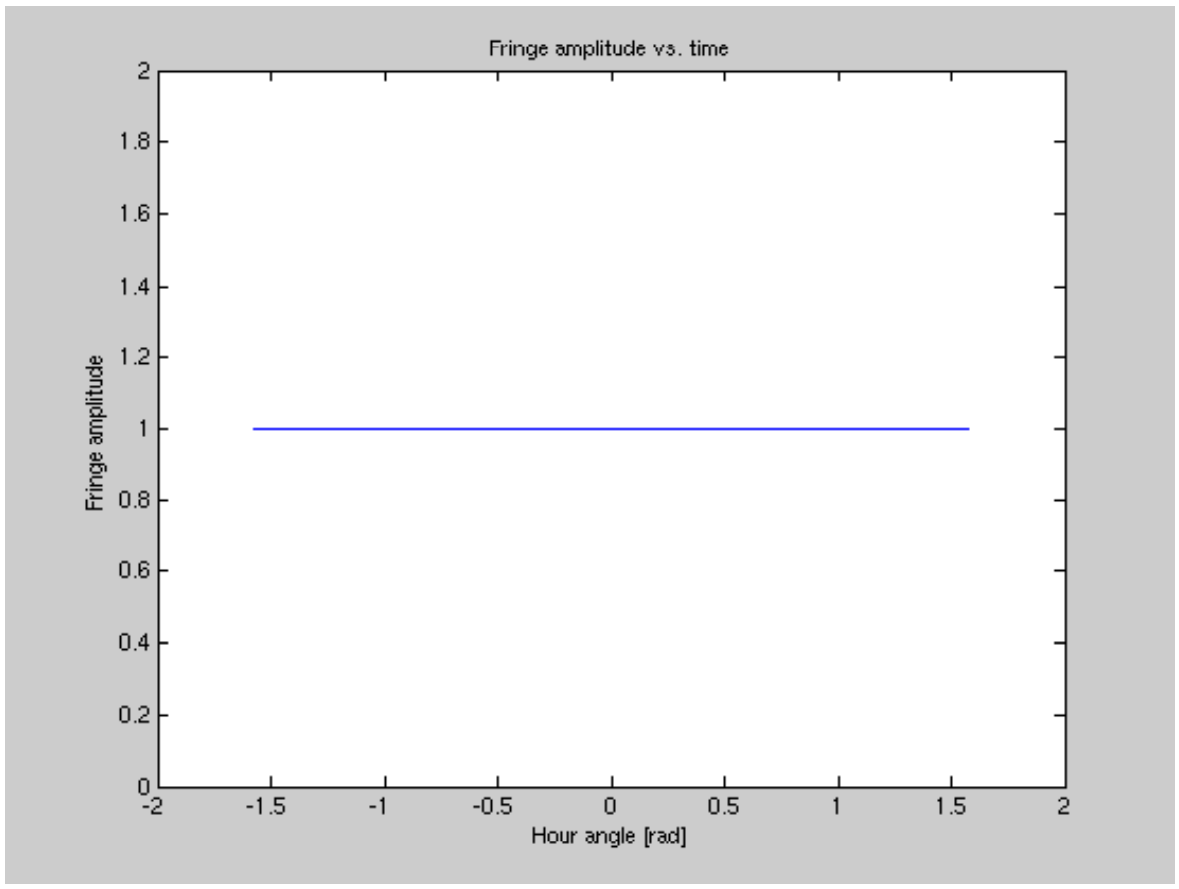
Models of simple arrays
uv tracks, fringes, and beams

For an observatory at latitude 39°N

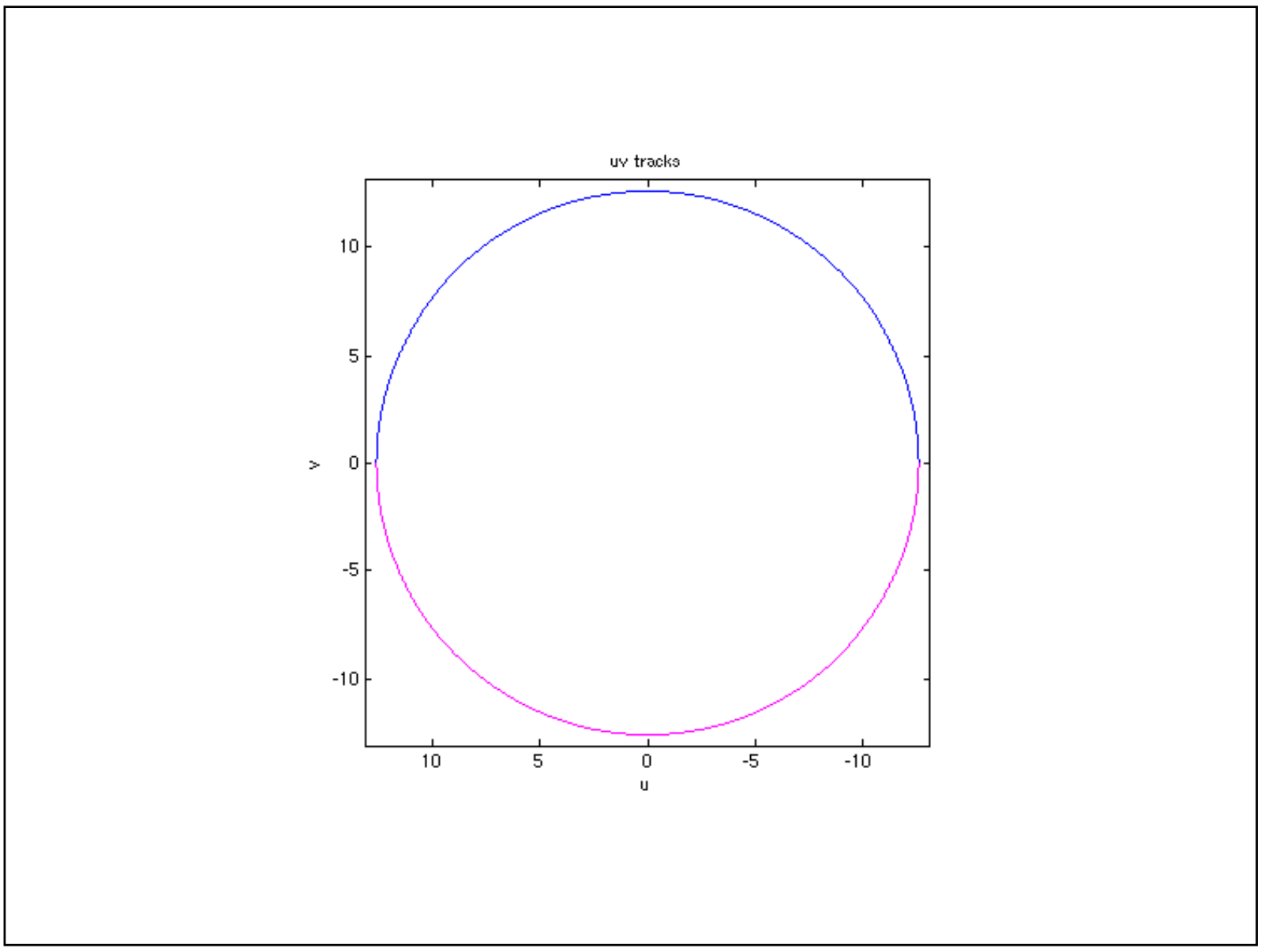
±6 hours from transit

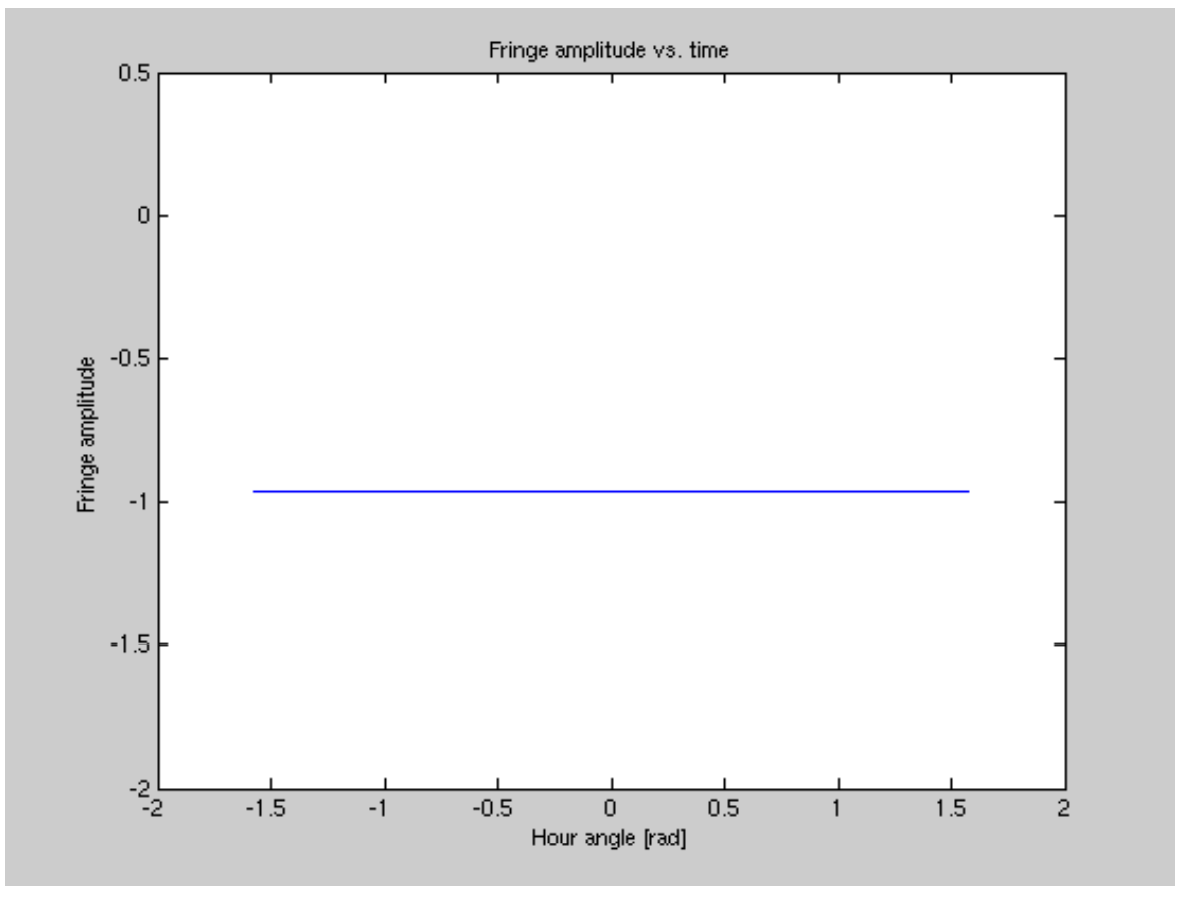
Plotuv1, dec90, EWbl



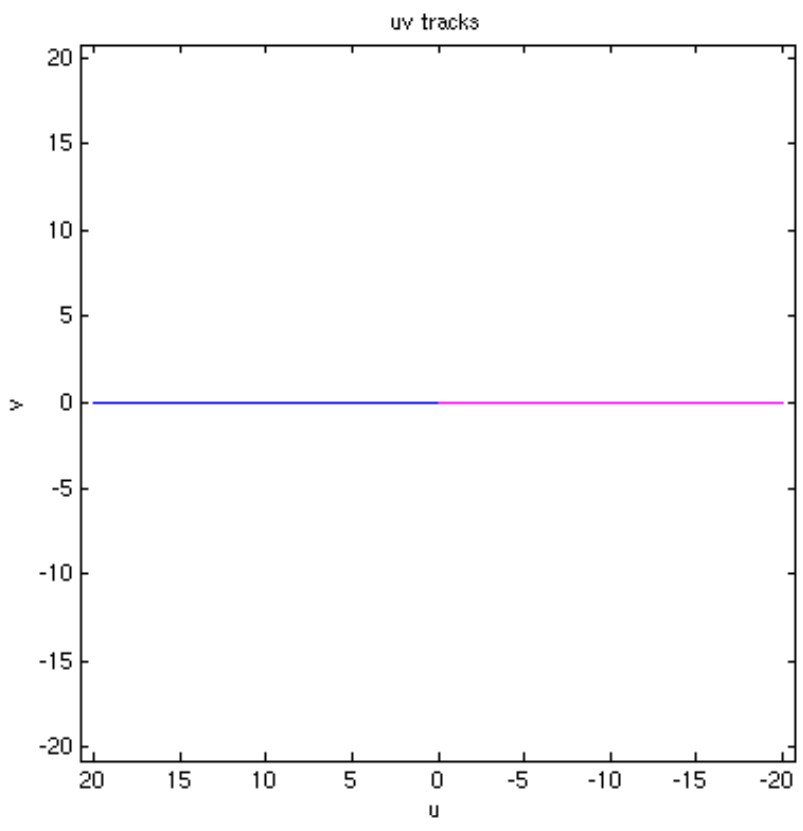


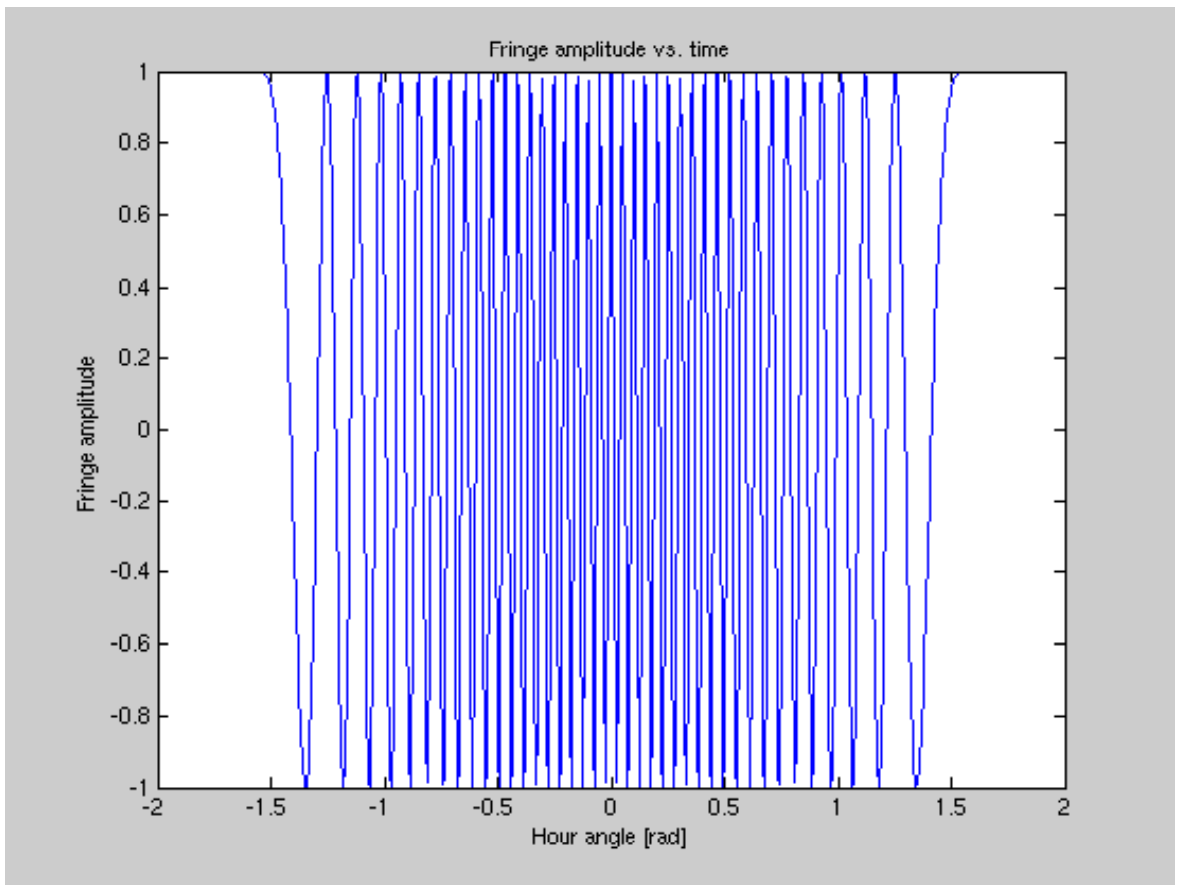
Plotuv1, dec 90, NSbl


uv tracks
10
5
0
-5
-10
v
10
5
0
-5
-10
u

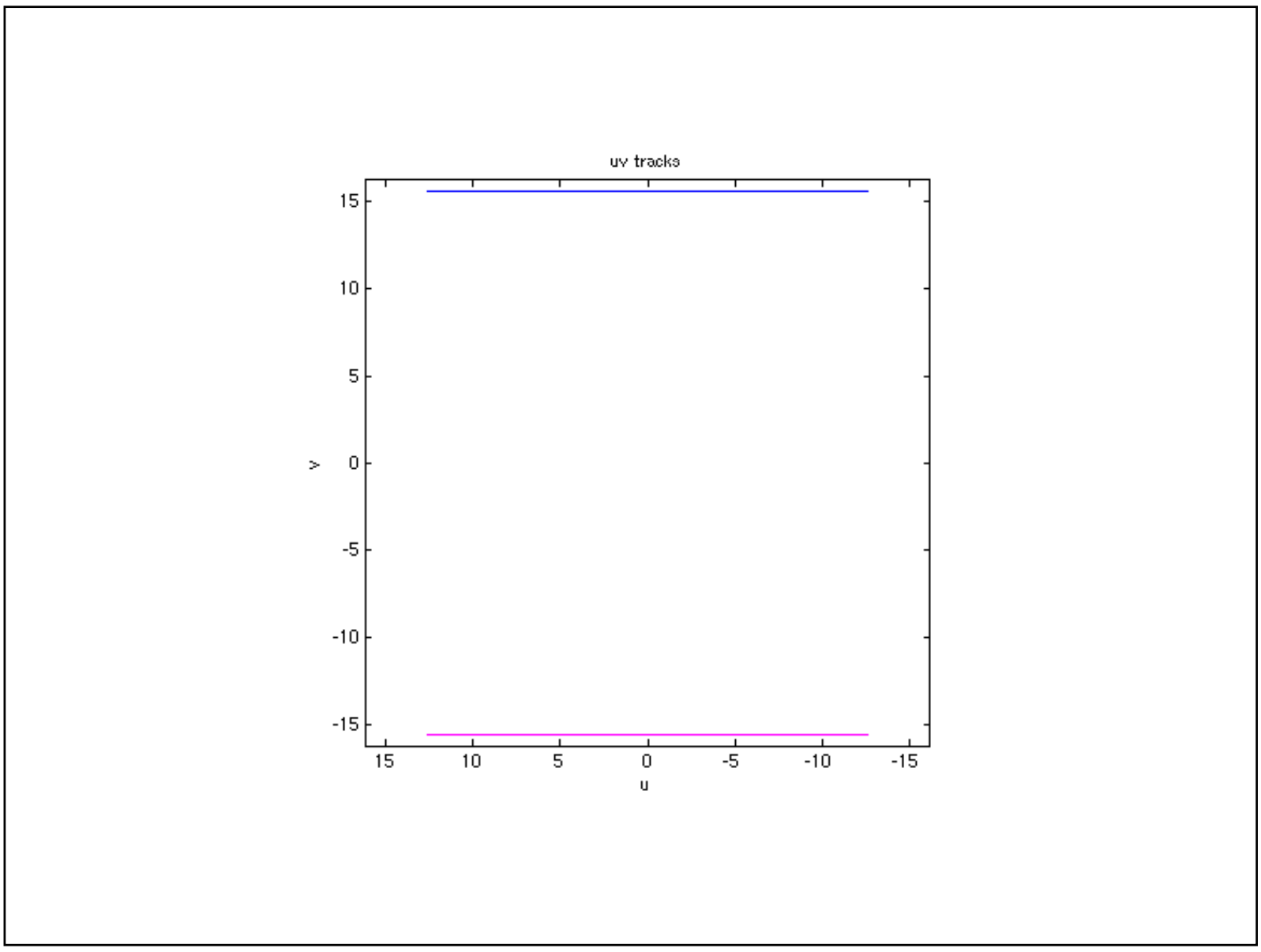

Fringe amplitude vs. time
0.5
0
-0.5
-1
-1.5
-2
Fringe amplitude
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
Hour angle [rad]

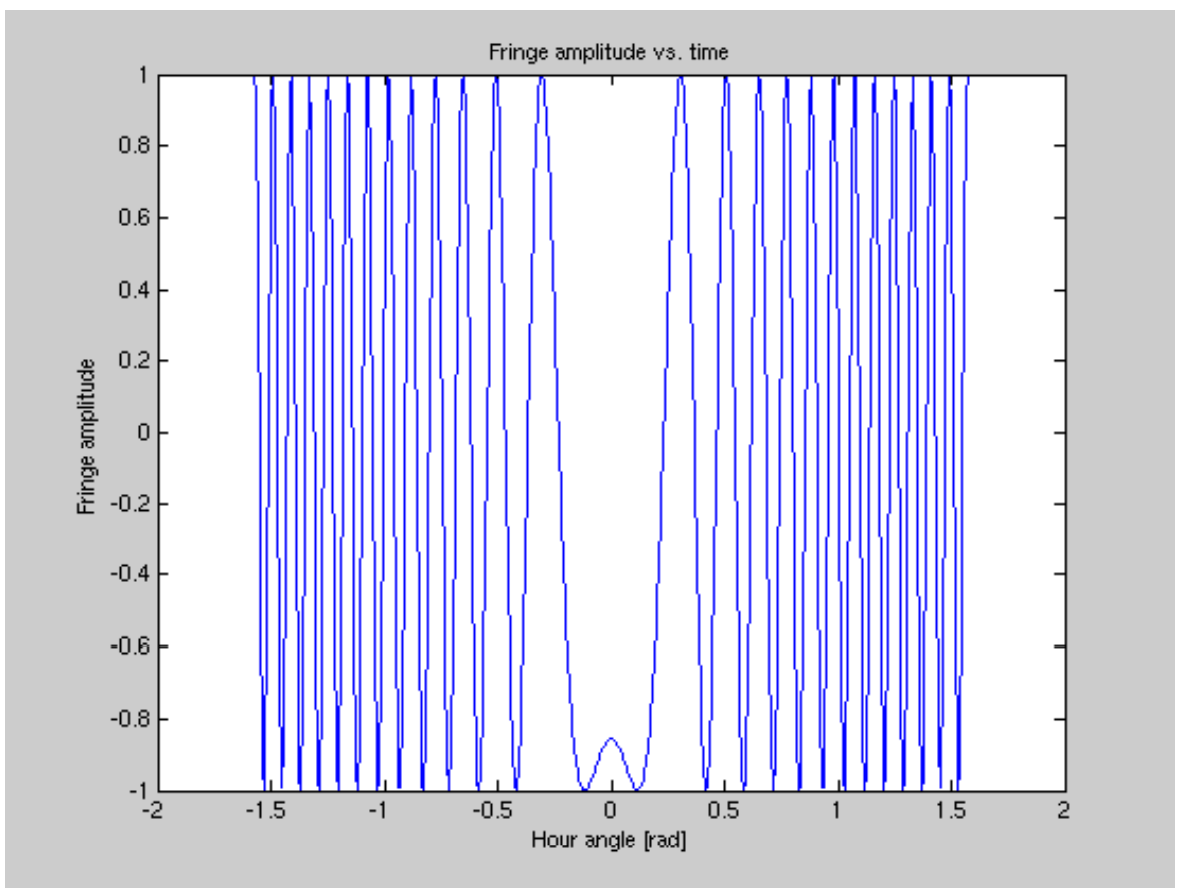
Plotuv1, dec0, EWbl



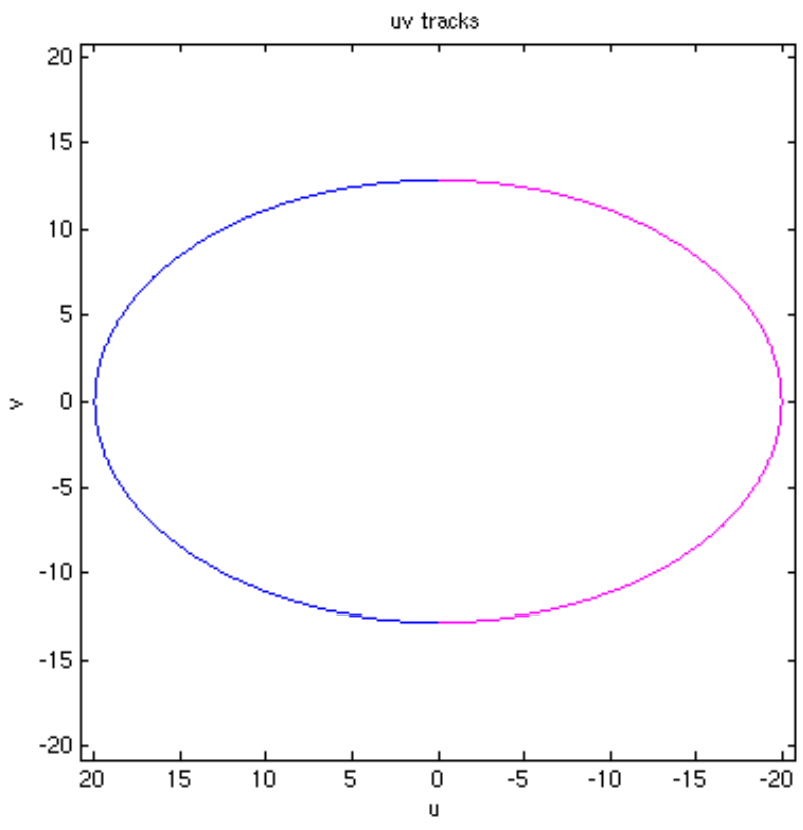


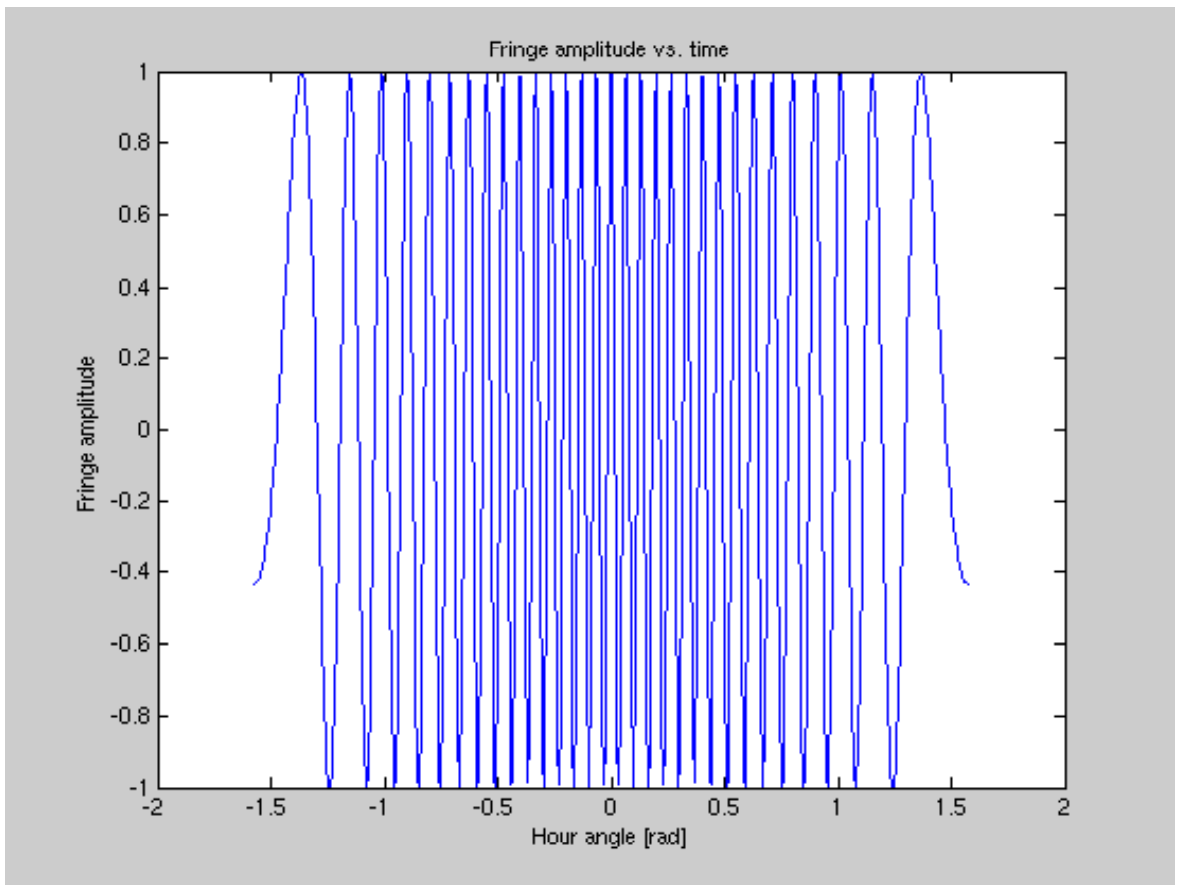
Plotuv1, dec 0, NSbl


uv tracks
15
10
5
0
-5
-10
-15
v
15
10
5
0
-5
-10
-15
u

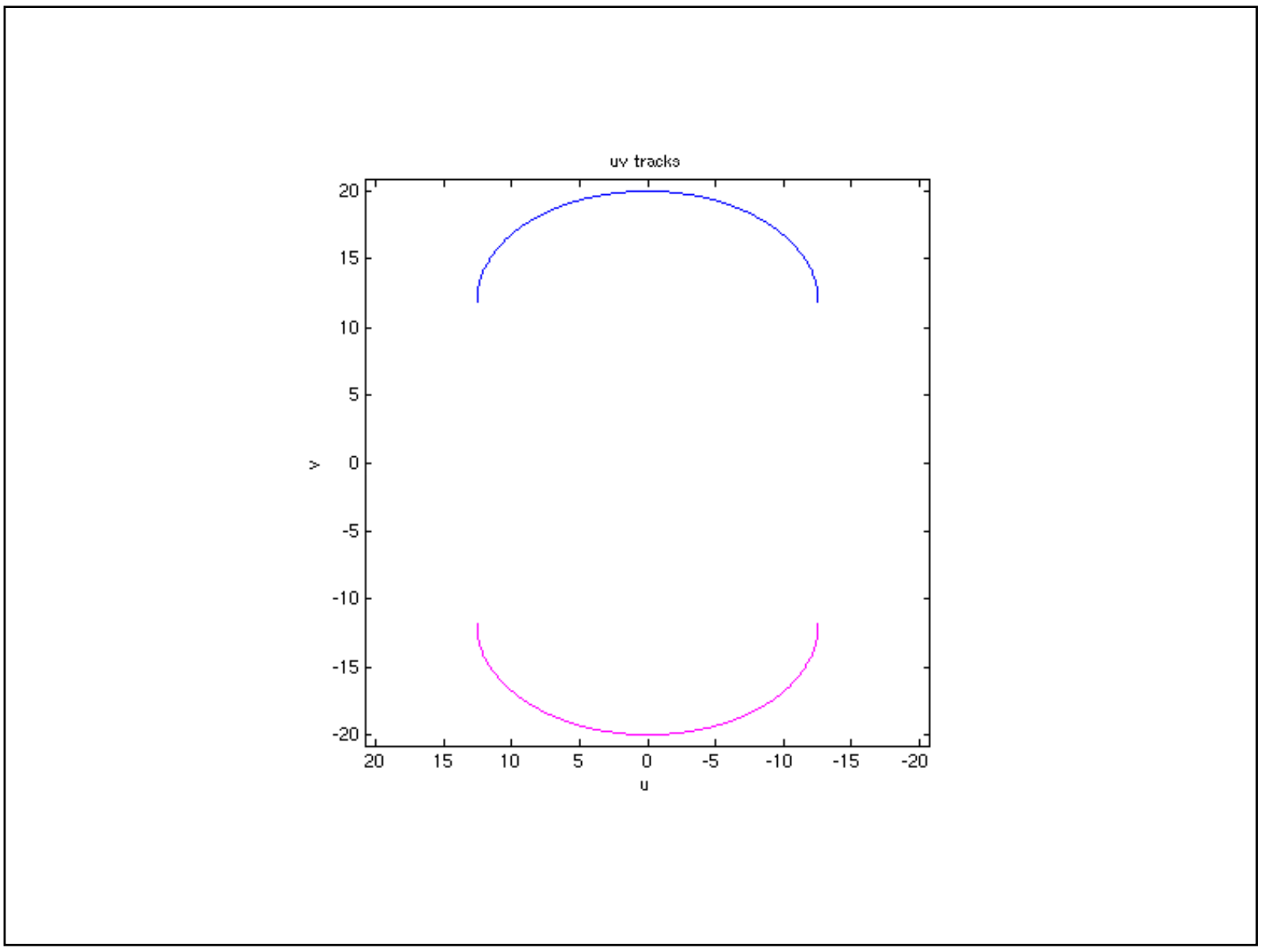

Fringe amplitude vs. time
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
Fringe amplitude
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
Hour angle [rad]

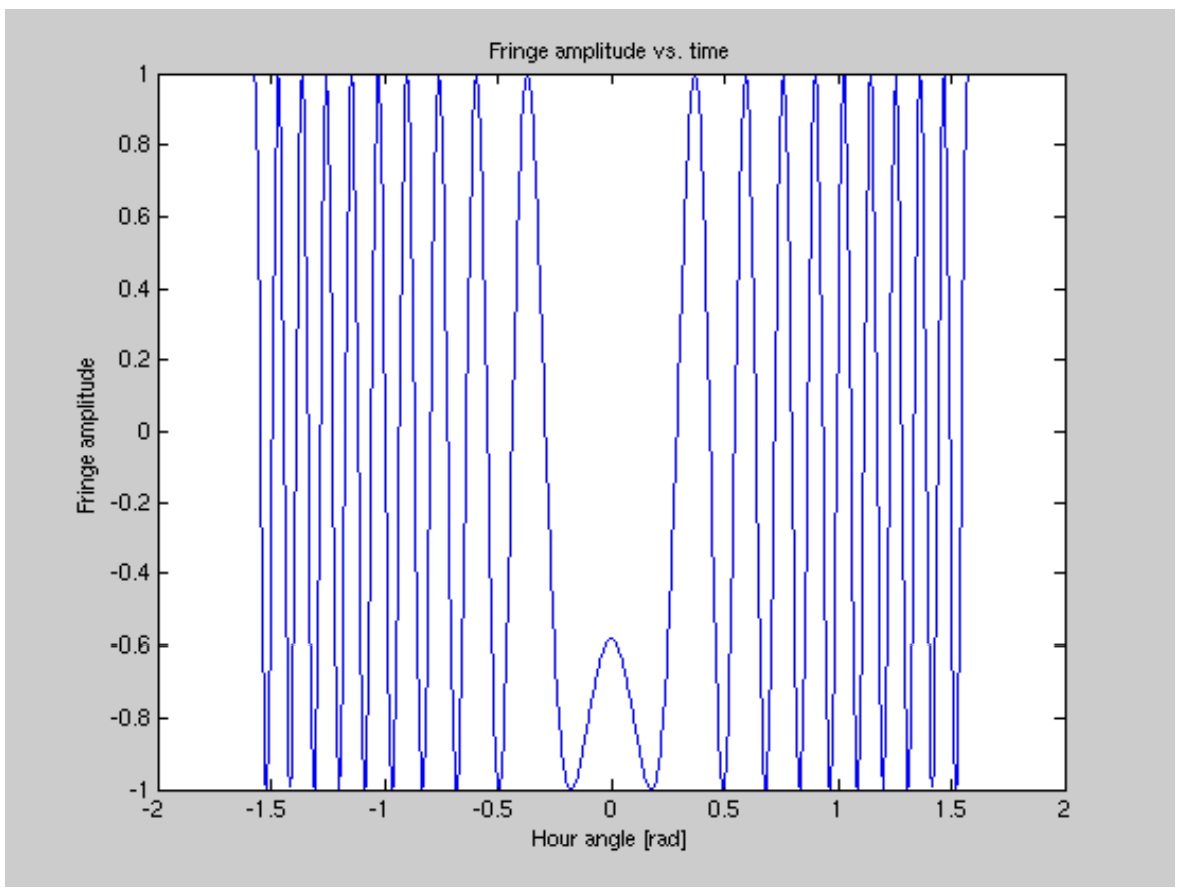
Plotuv1, dec40, EWbl



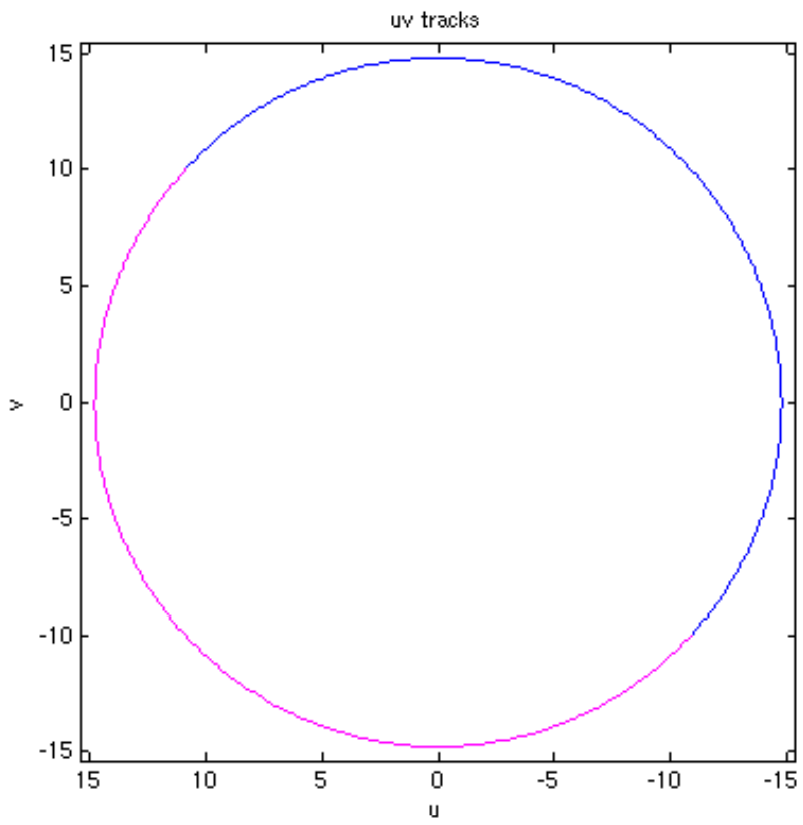


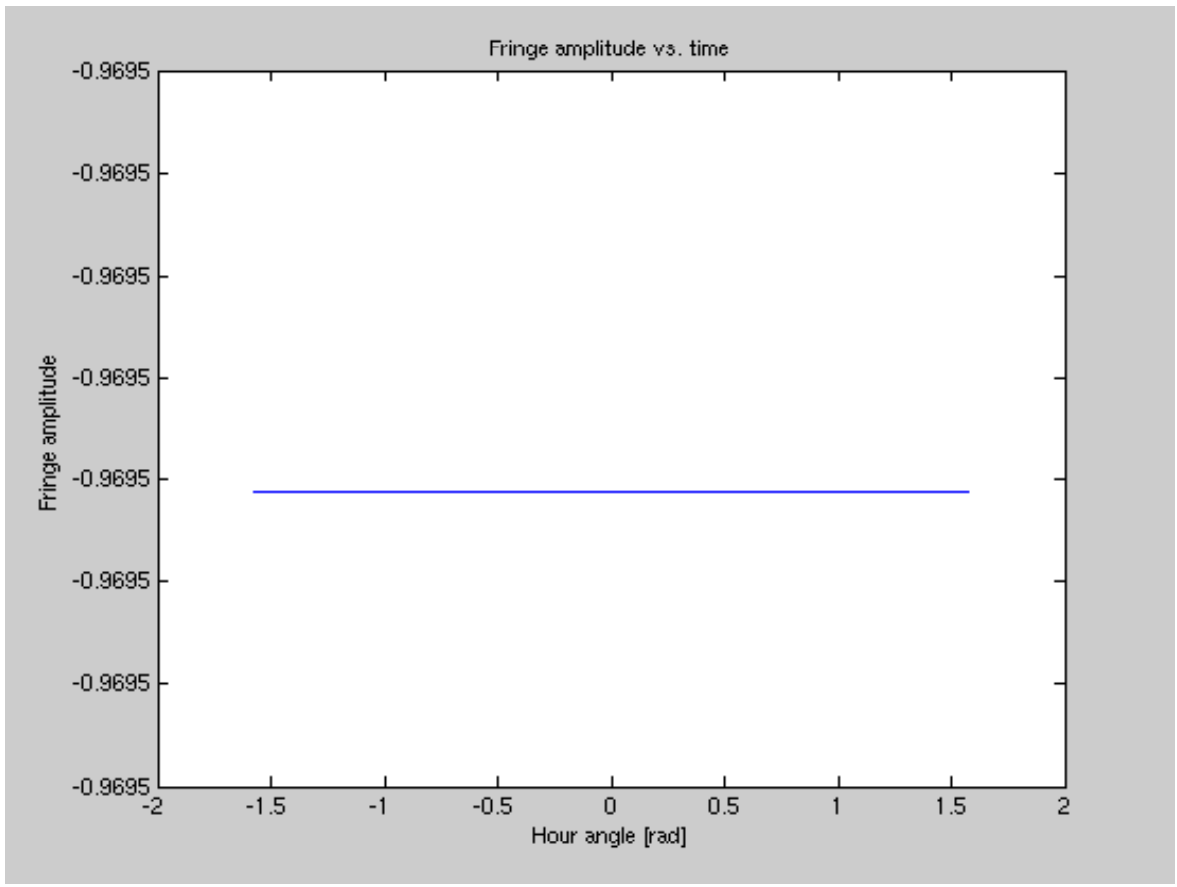
Plotuv1, dec 40, NSbl


uv tracks
v
u
20
15
10
5
0
-5
-10
-15
-20

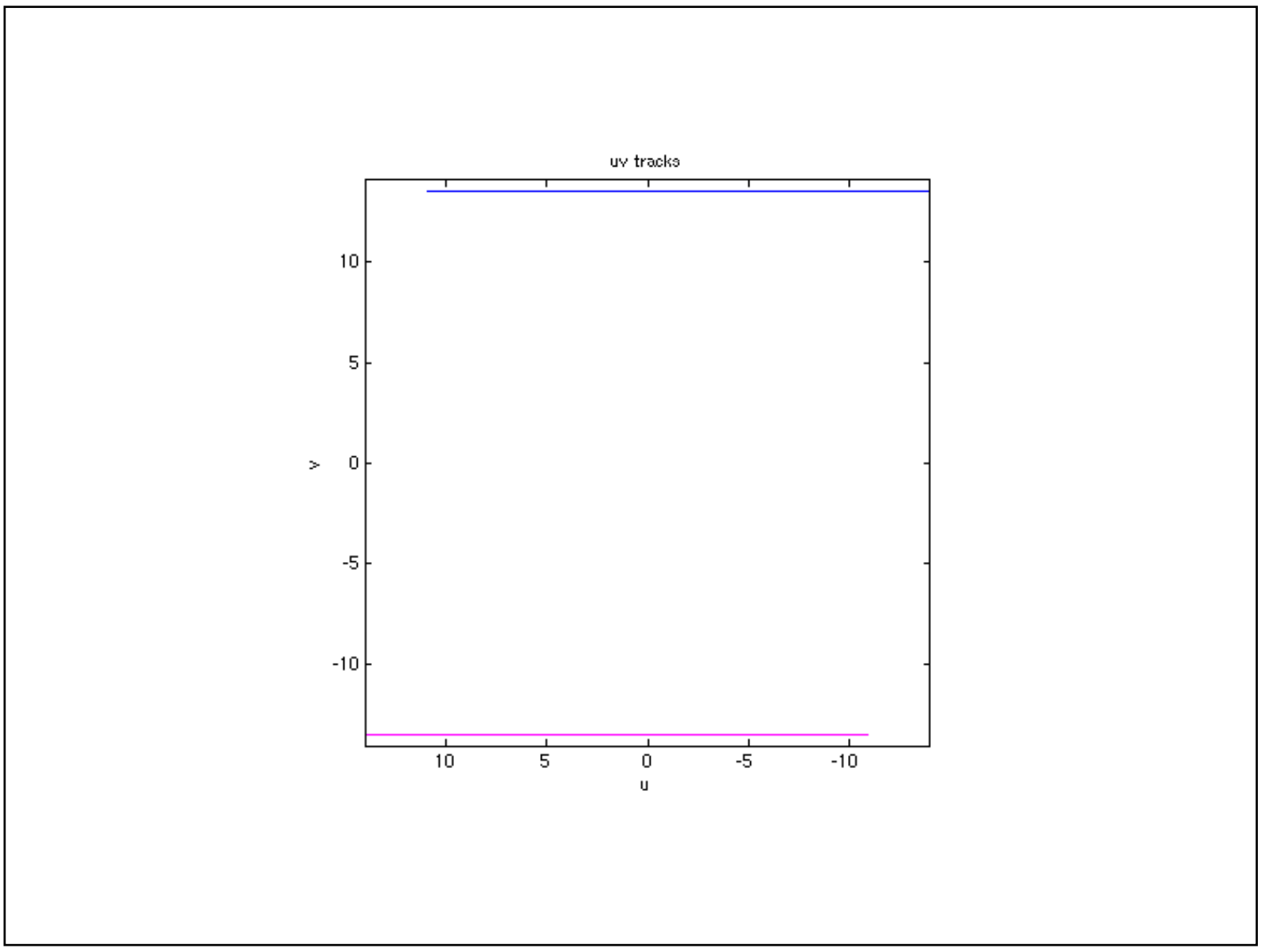

Fringe amplitude vs. time
Fringe amplitude
Hour angle [rad]
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2

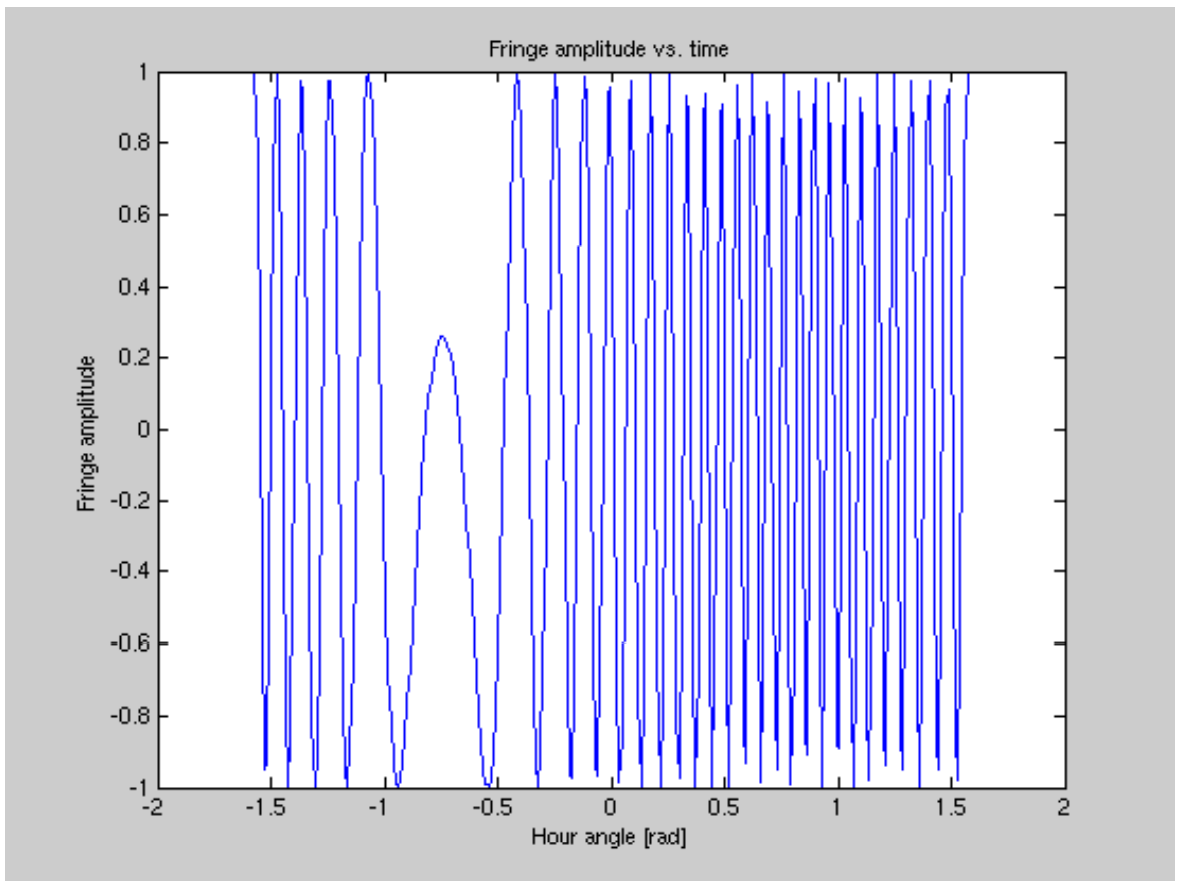
Plotuv1, dec 90, bl -30



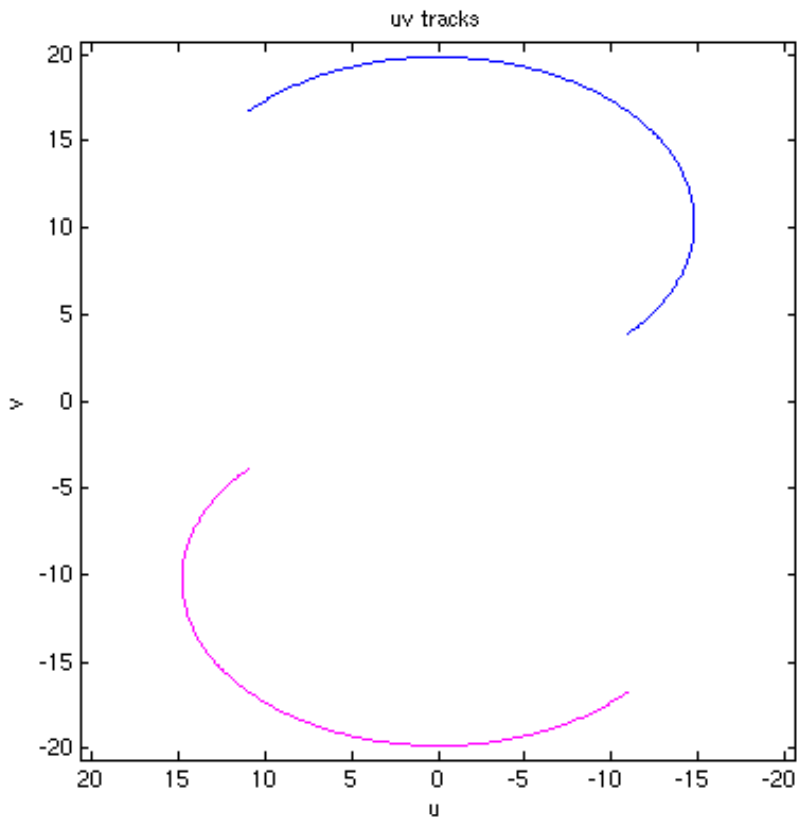


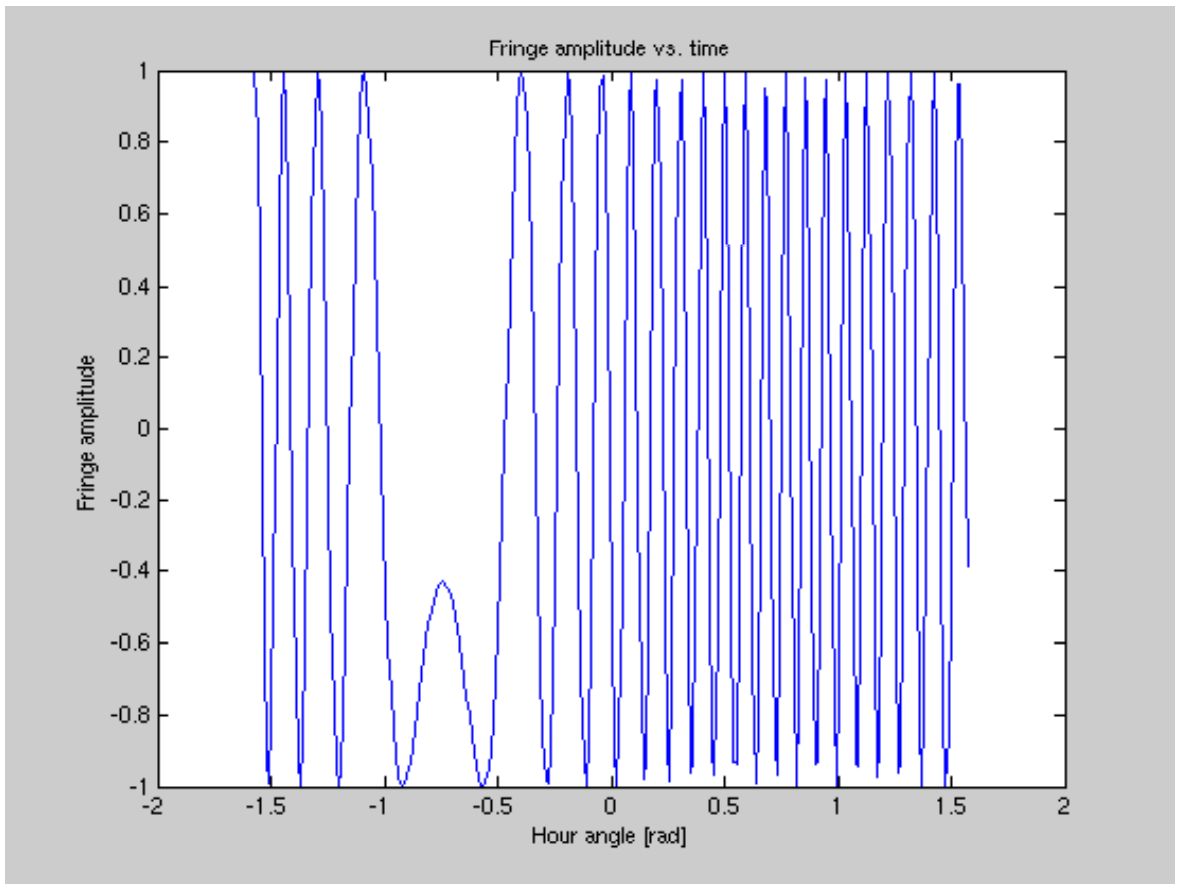
Plotuv1, dec 0, bl -30


uv tracks
10
5
0
-5
-10
v
10
5
0
-5
-10
u

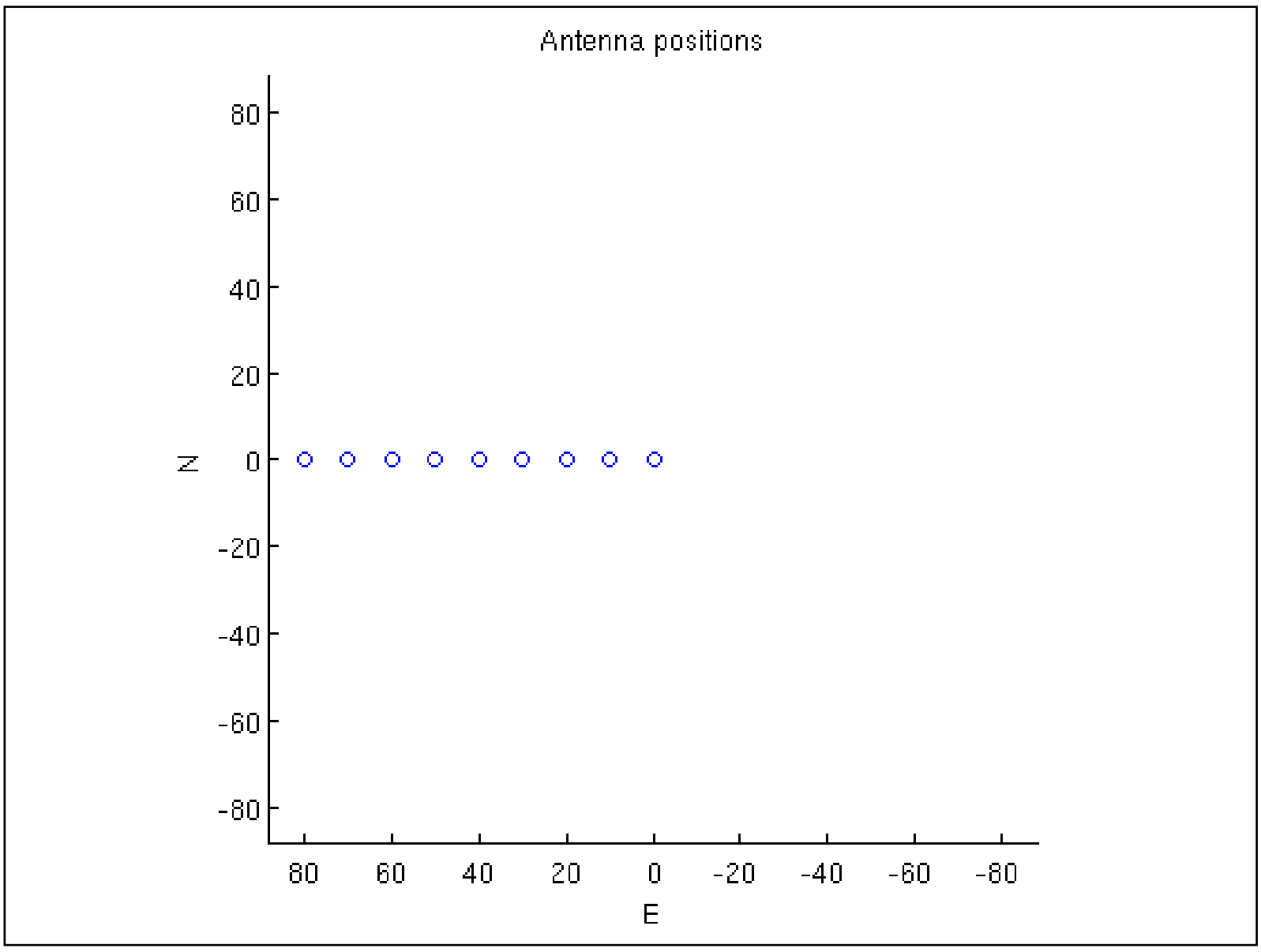

Fringe amplitude vs. time
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
Fringe amplitude
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
Hour angle [rad]

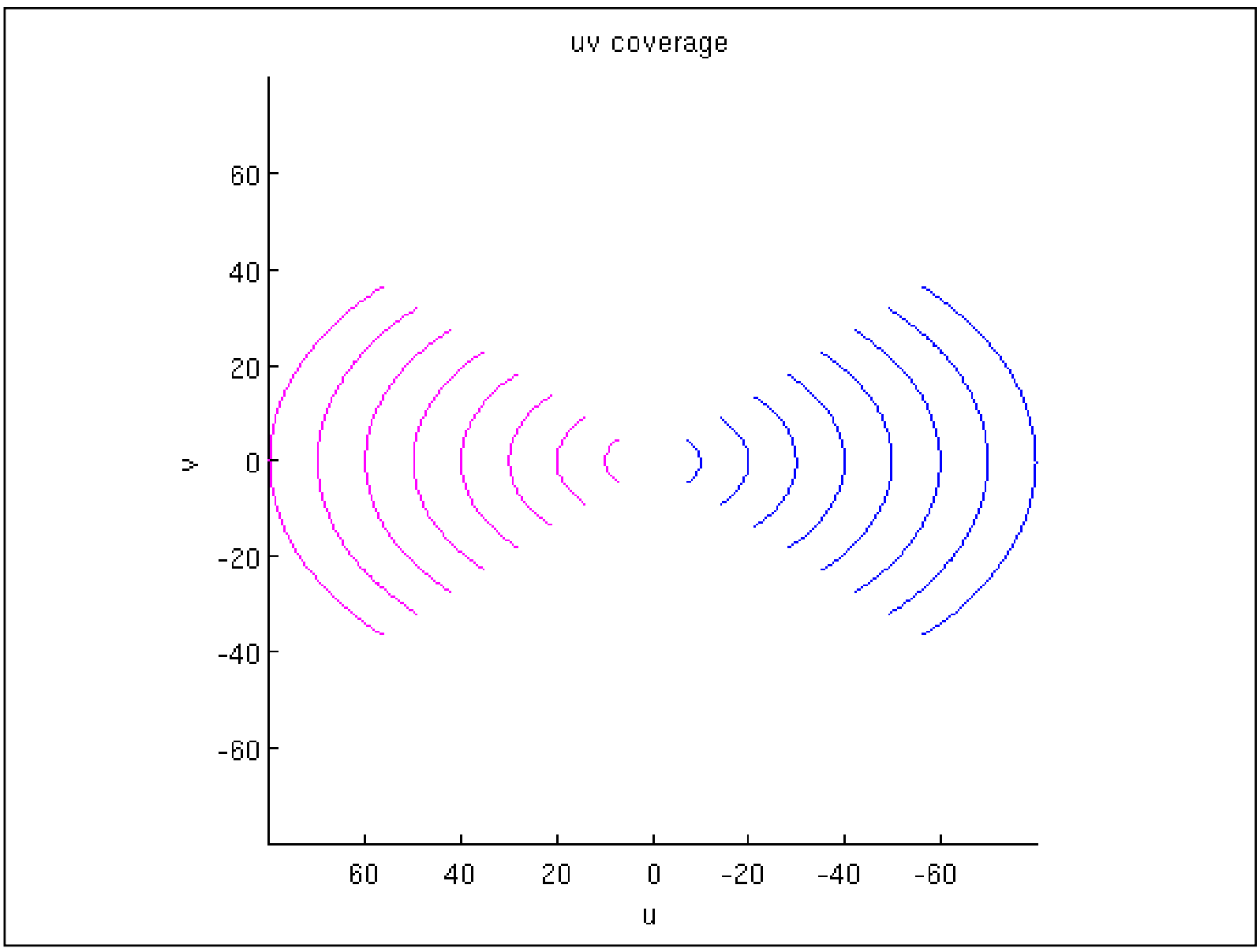
Plotuv1, dec 40, bl -30

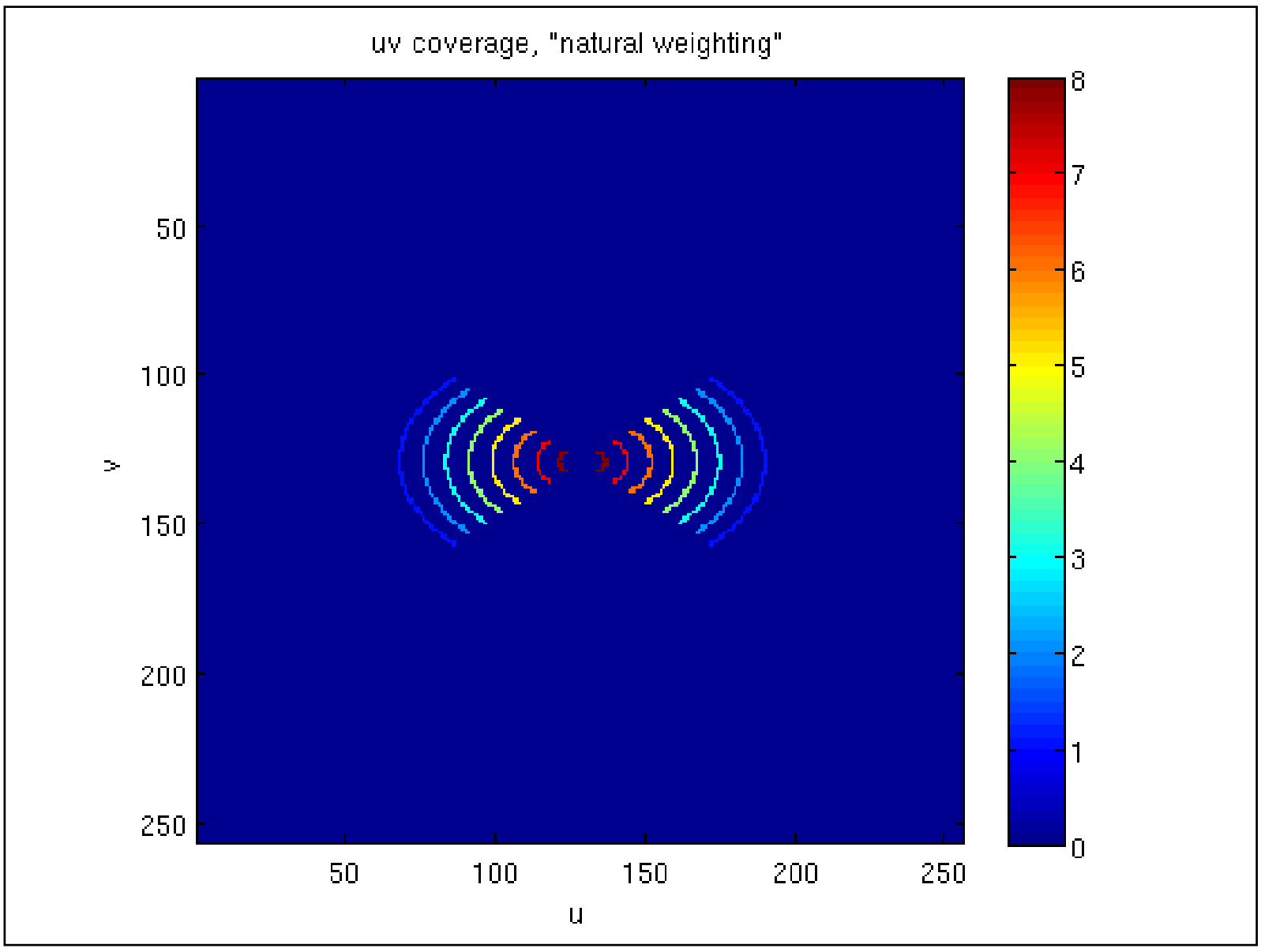


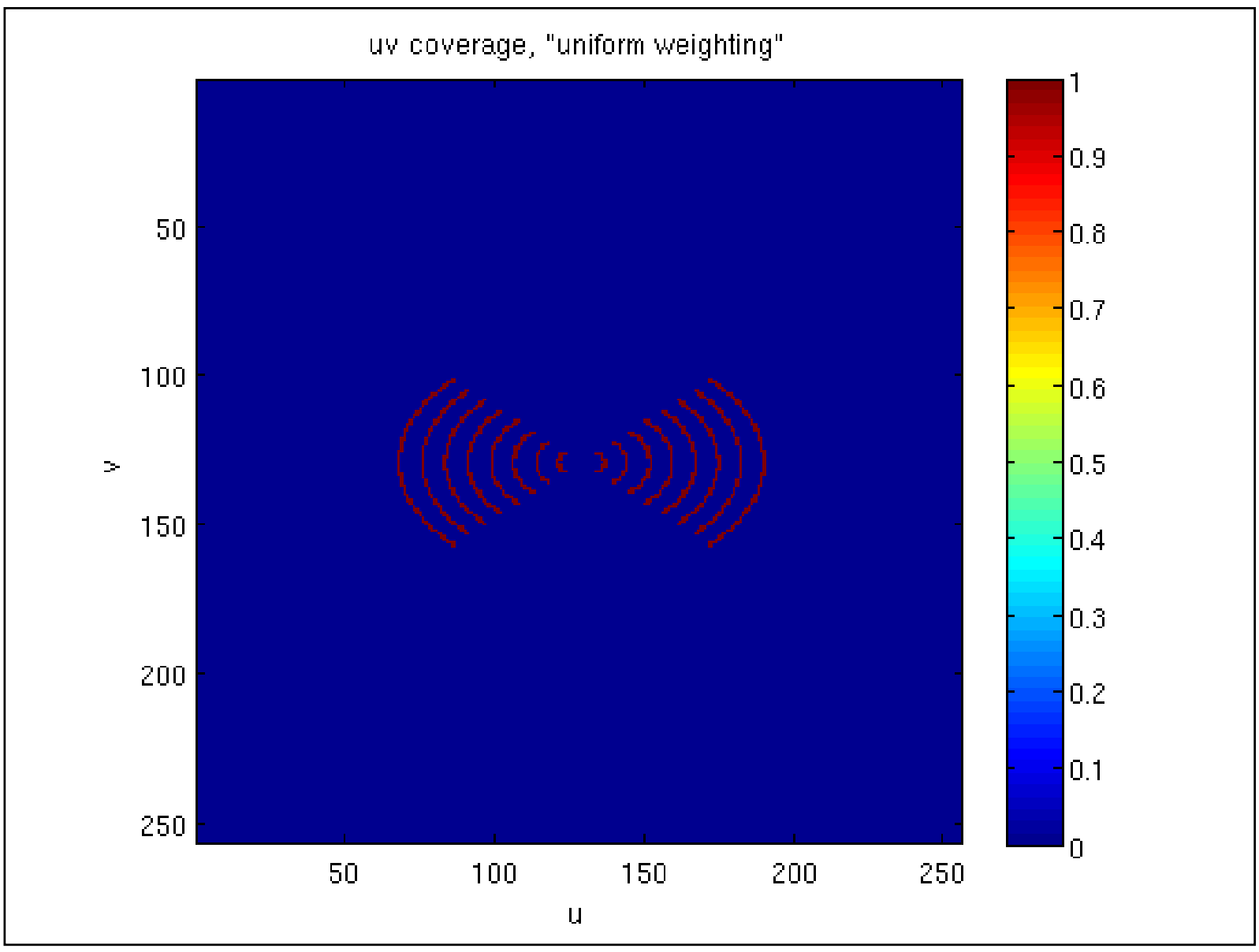


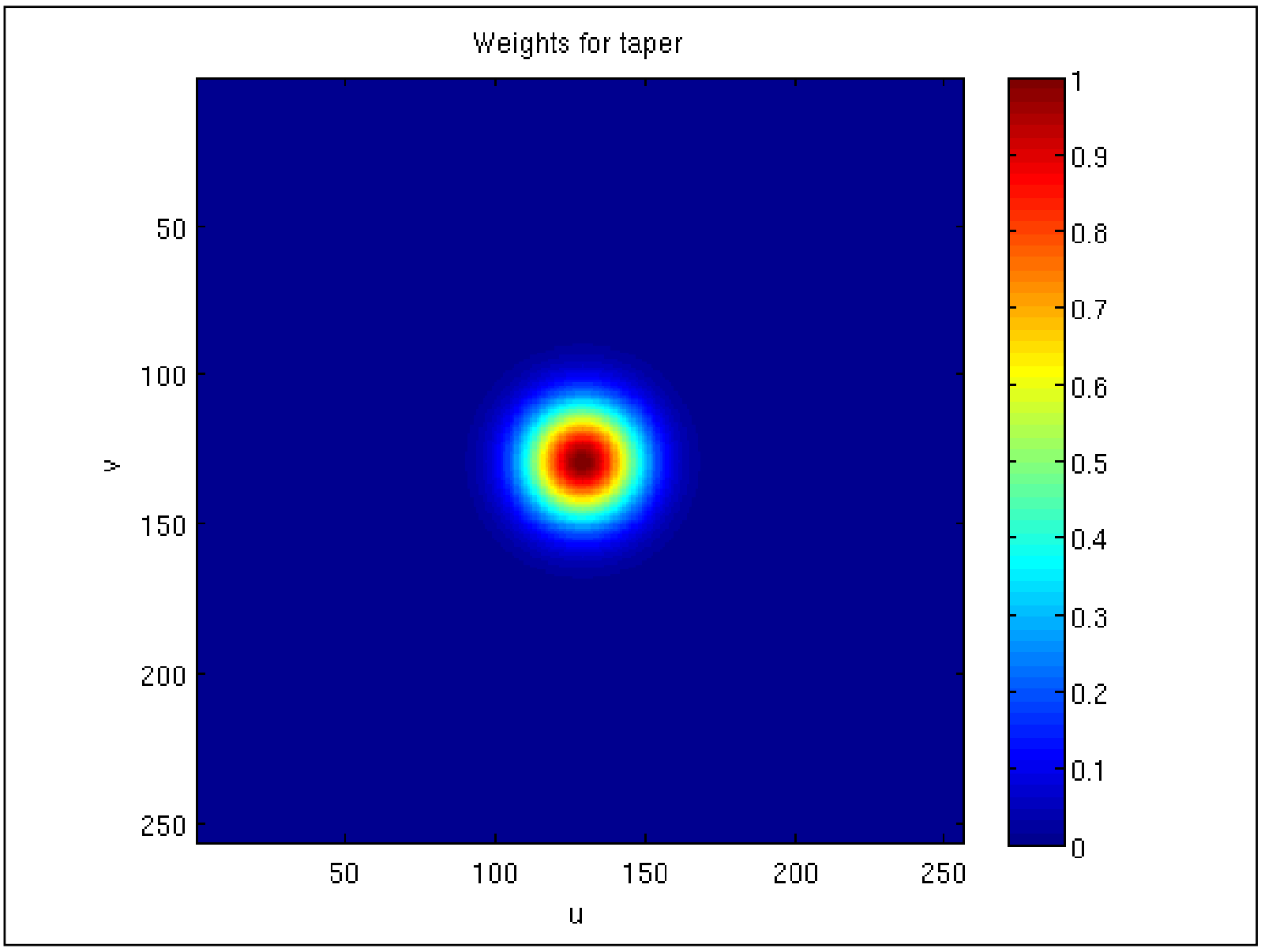
uvAndBeams, EW regular line, dec 40

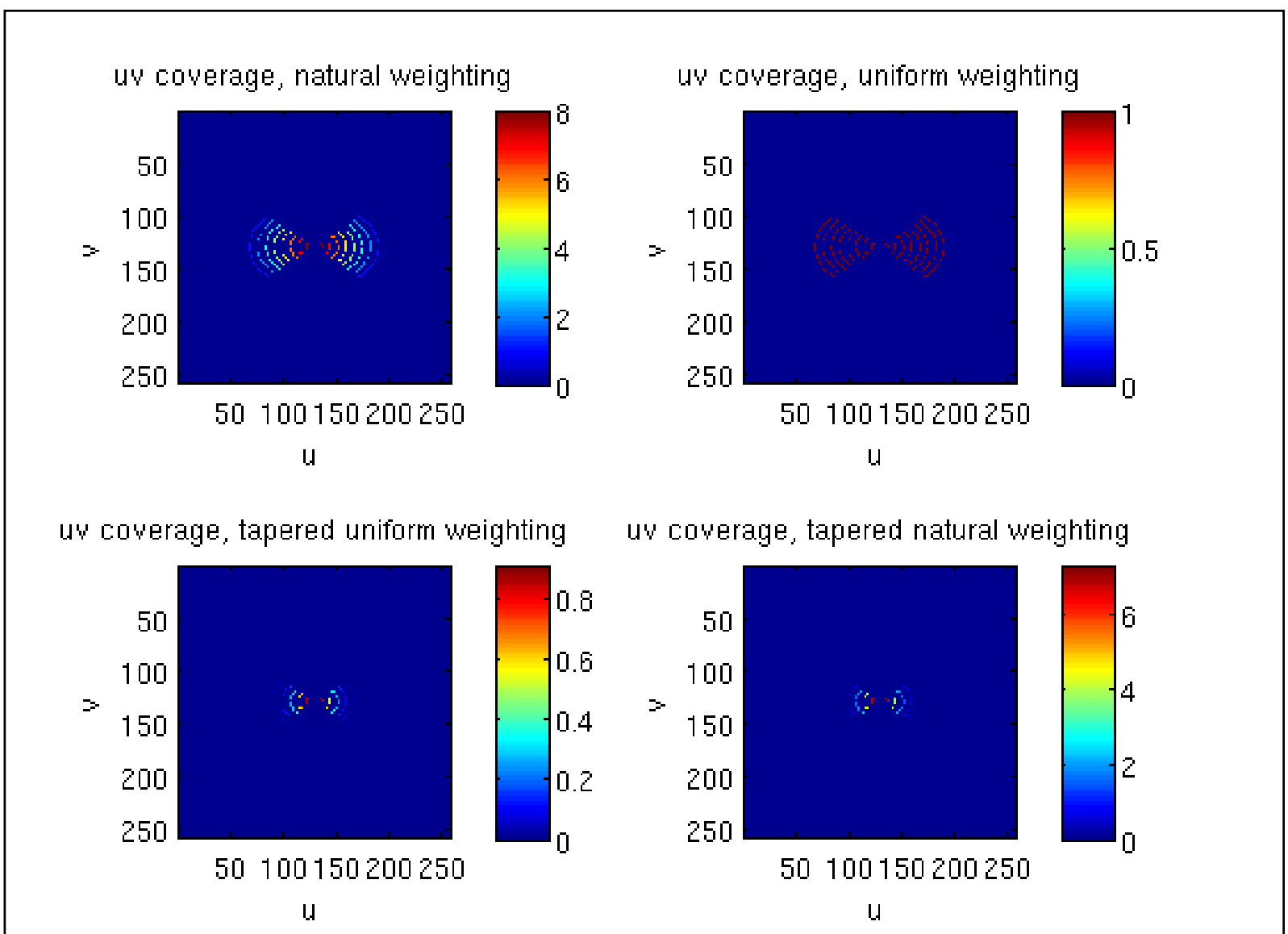

Antenna positions
80
60
40
20
0
-20
-40
-60
-80
N
80
60
40
20
0
-20
-40
-60
-80
E

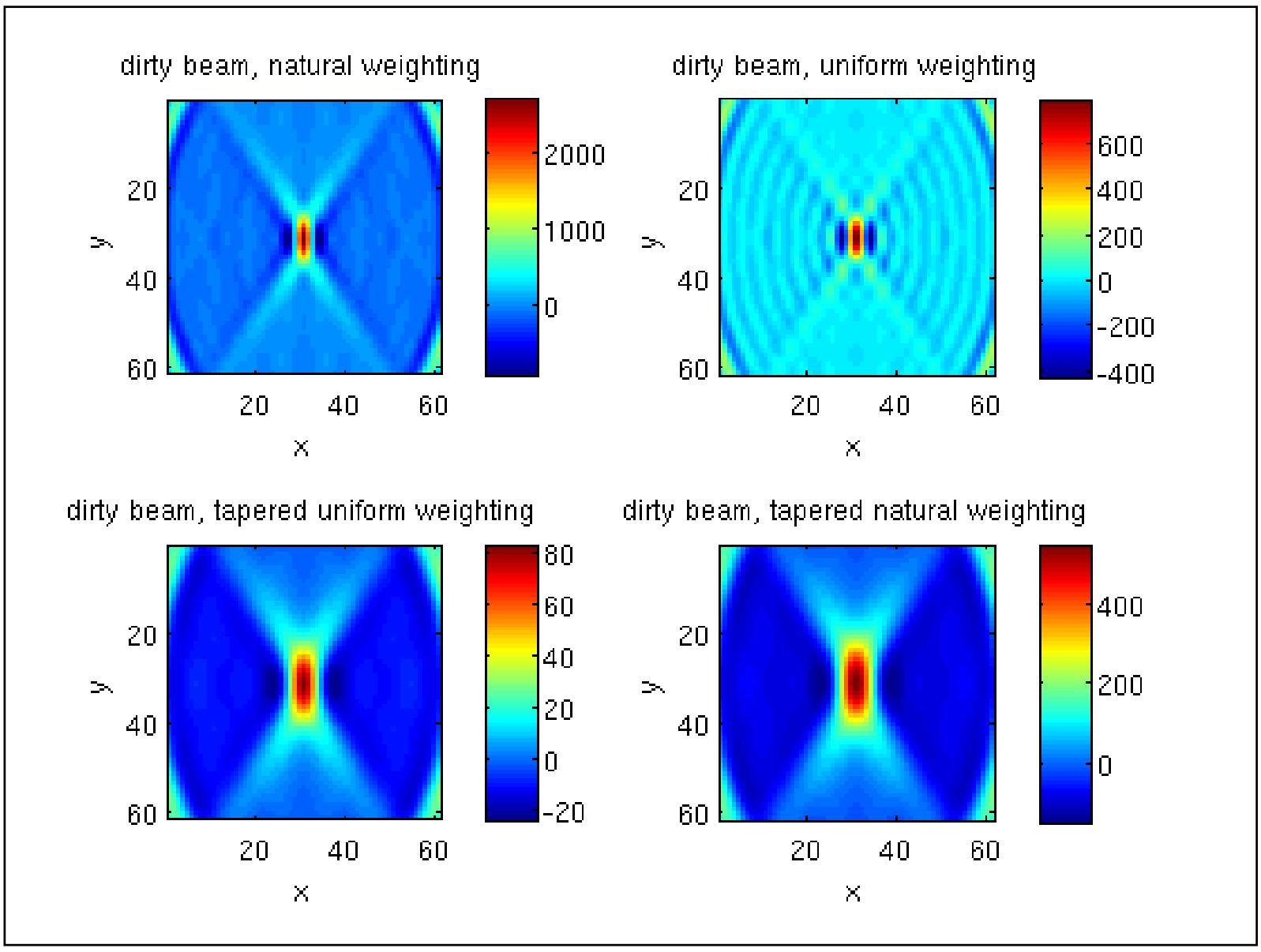

uv coverage
60
40
20
0
-20
-40
-60
v
60
40
20
0
-20
-40
-60
u


uv coverage, "natural weighting"
50
100
150
200
250
v
50
100
150
200
250
u
8
7
6
5
4
3
2
1
0


uv coverage, "uniform weighting"
50
100
150
200
250
v
50
100
150
200
250
u
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0


Weights for taper
v
u
50
100
150
200
250
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0


uv coverage, natural weighting
uv coverage, uniform weighting
uv coverage, tapered uniform weighting
uv coverage, tapered natural weighting
v
u
50
100
150
200
250
8
6
4
2
0
1
0.5
0.8
0.6
0.4
0.2



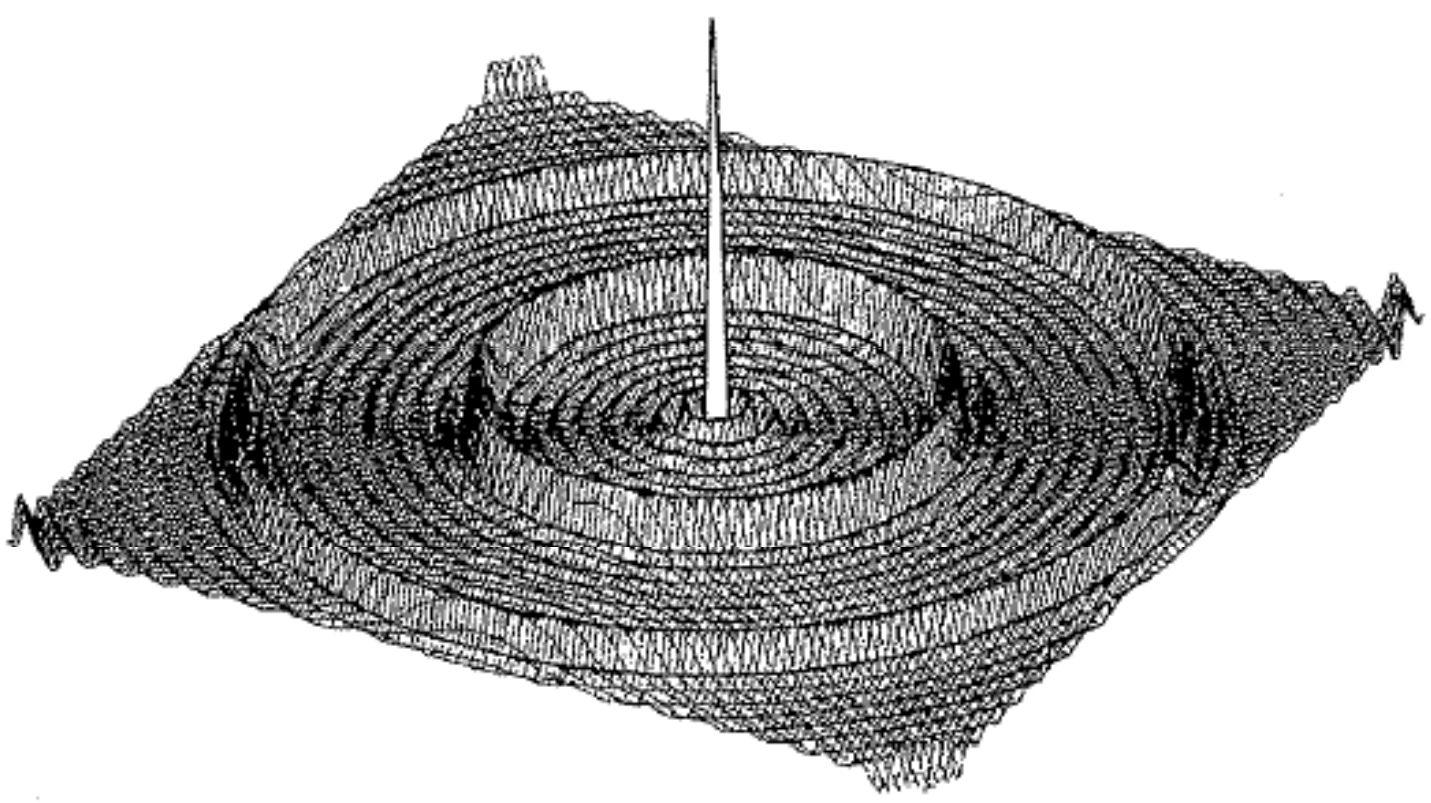
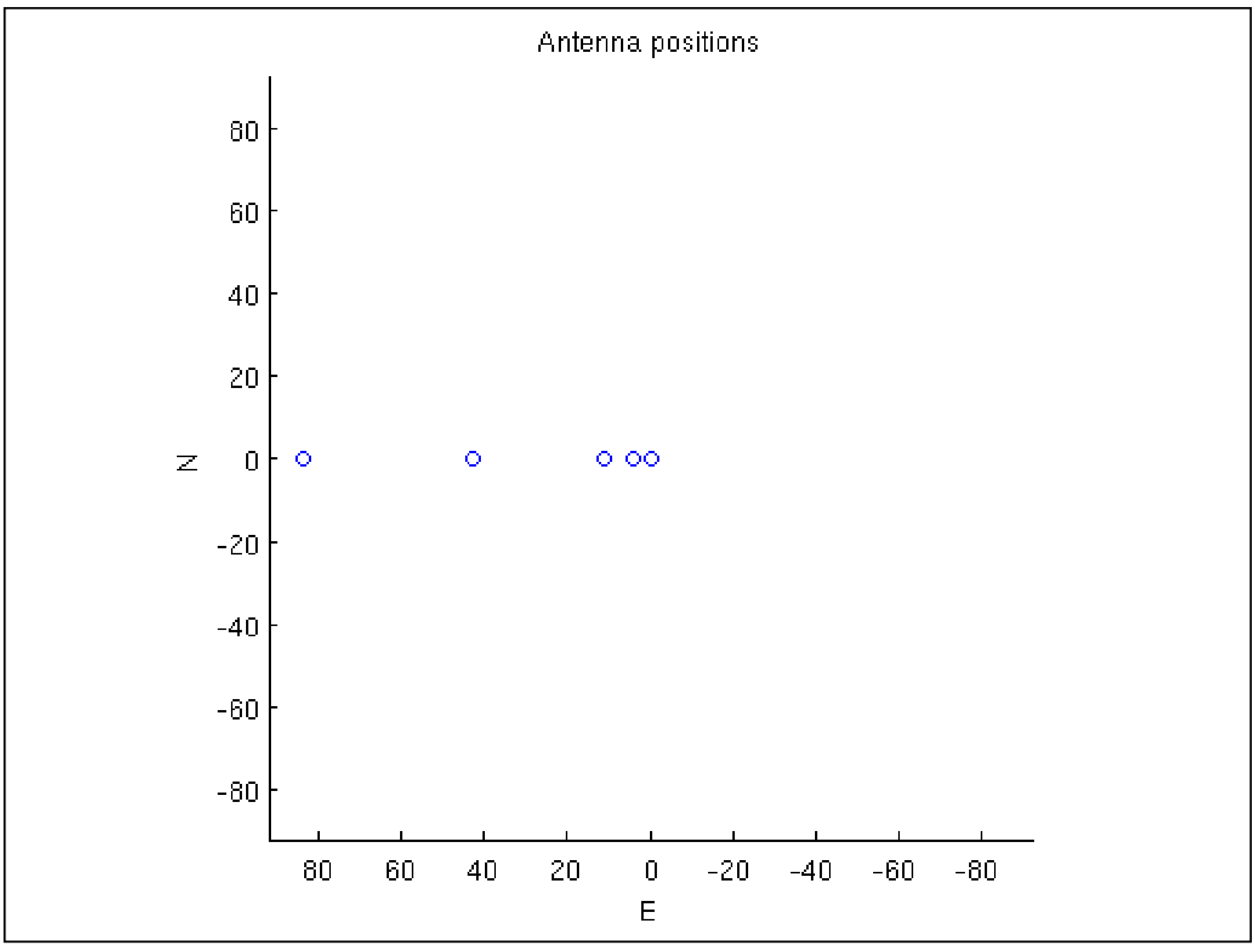
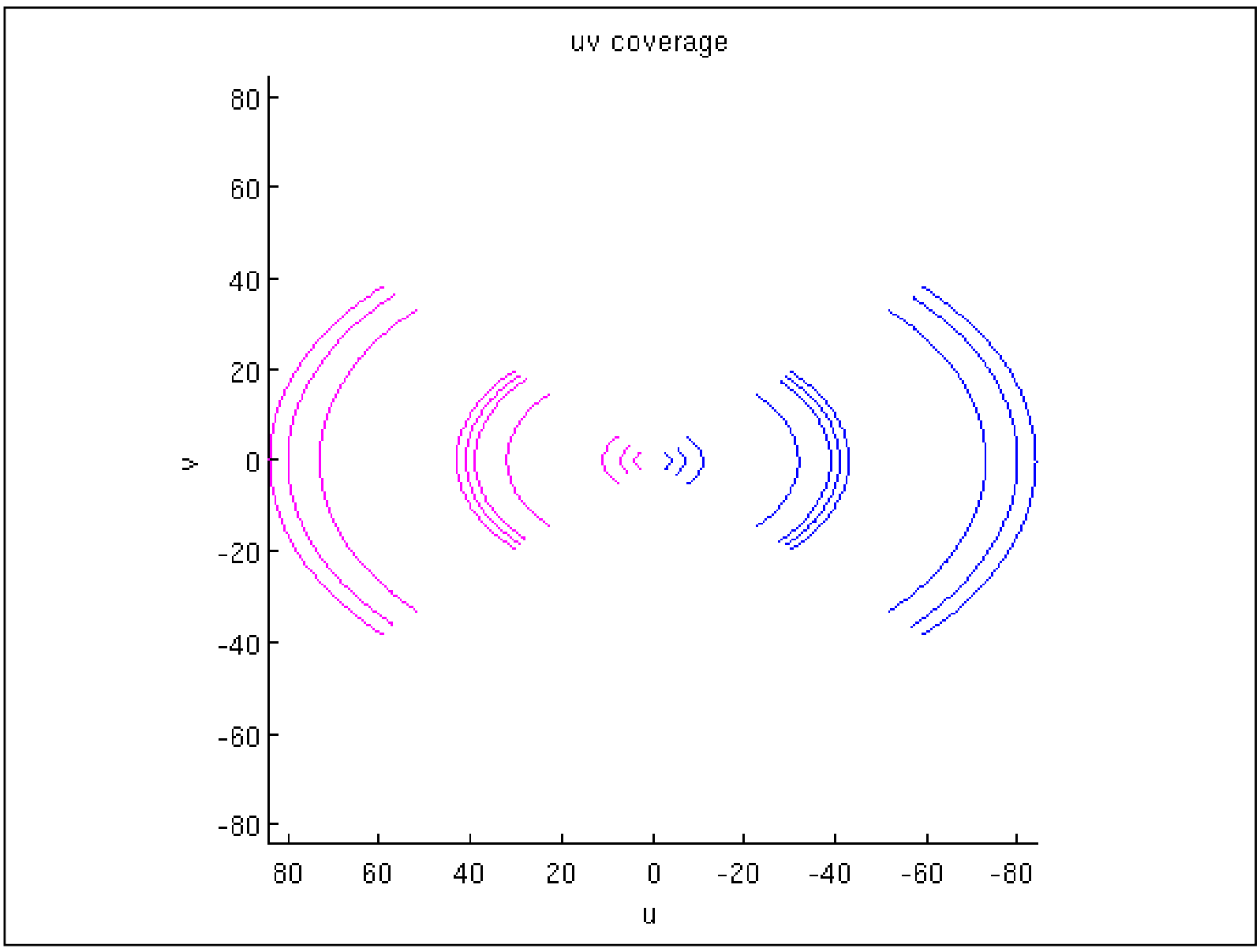


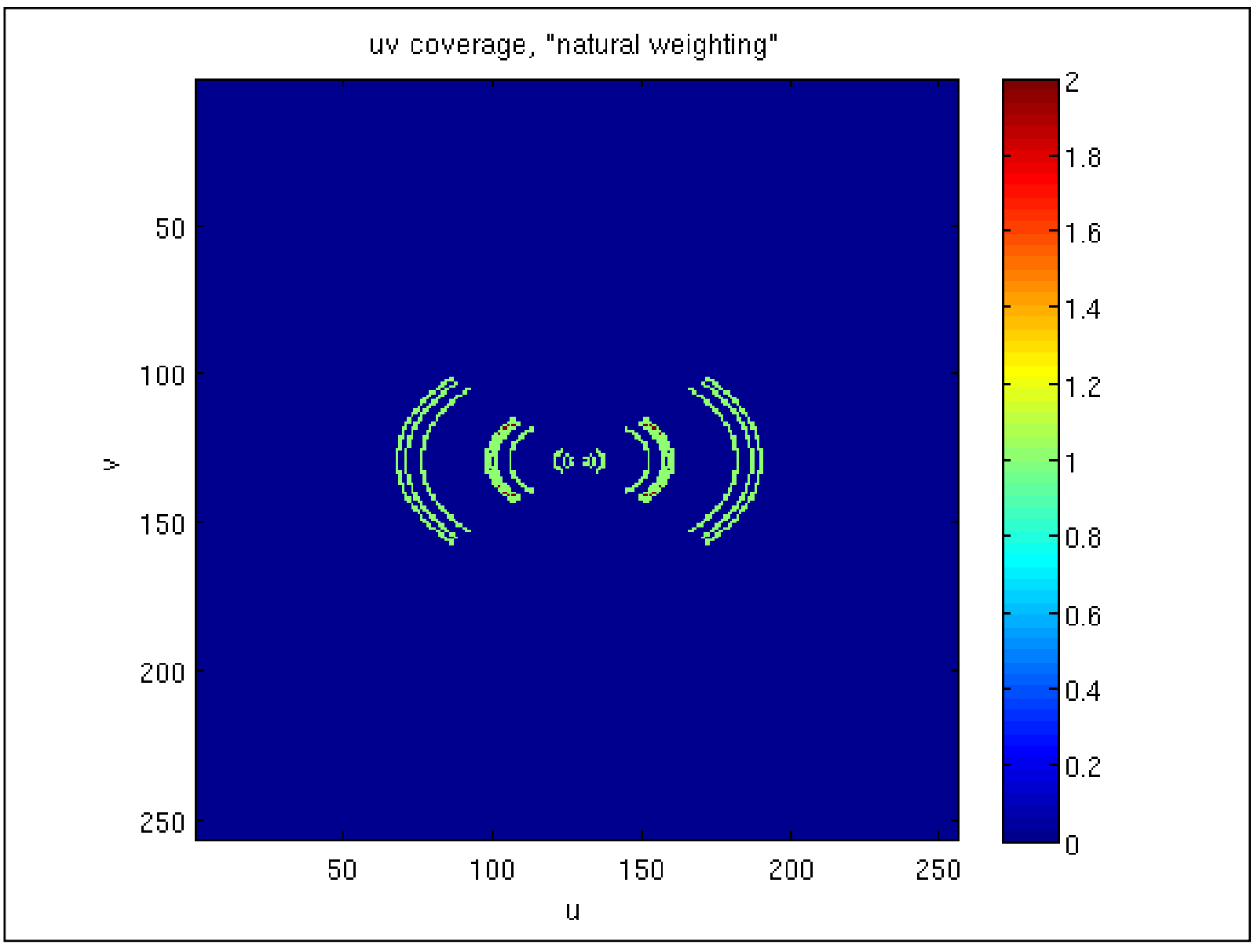
Figure 5.15 Example of ringlobes. The response of an array for which the spatial transfer function is a series of nine circles concentric with the (u, v) origin, resulting, for example, from observations with an east–west linear array with 12 h tracking at a high declination. The radii of these circles are consecutive integral multiples of the unit antenna spacing. The weighting corresponds to the principal response discussed in Section 10.2 under *Weighting of the Visibility Data*. From Bracewell and Thompson (1973).

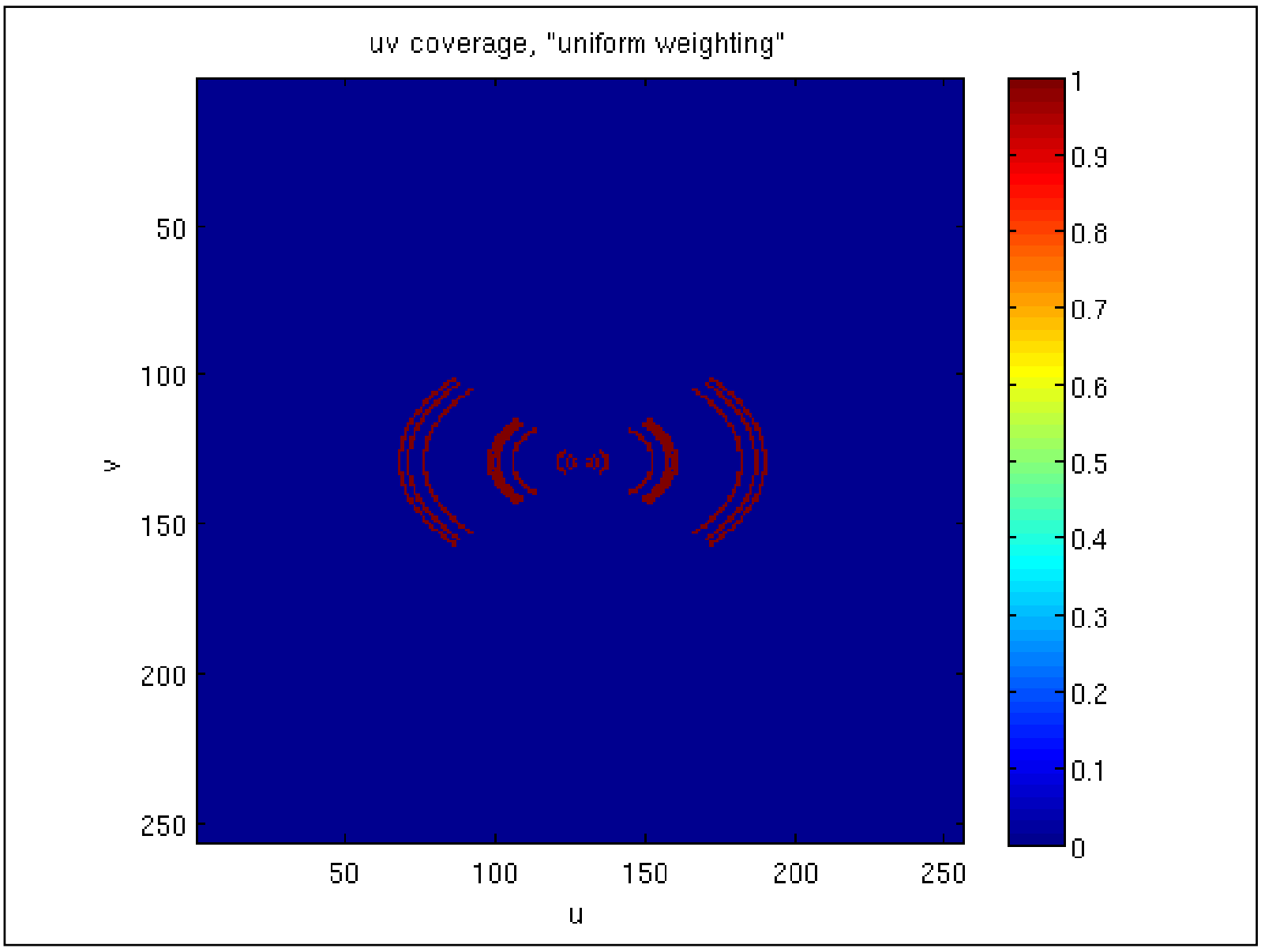
Thomson, Moran & Swenson 2001

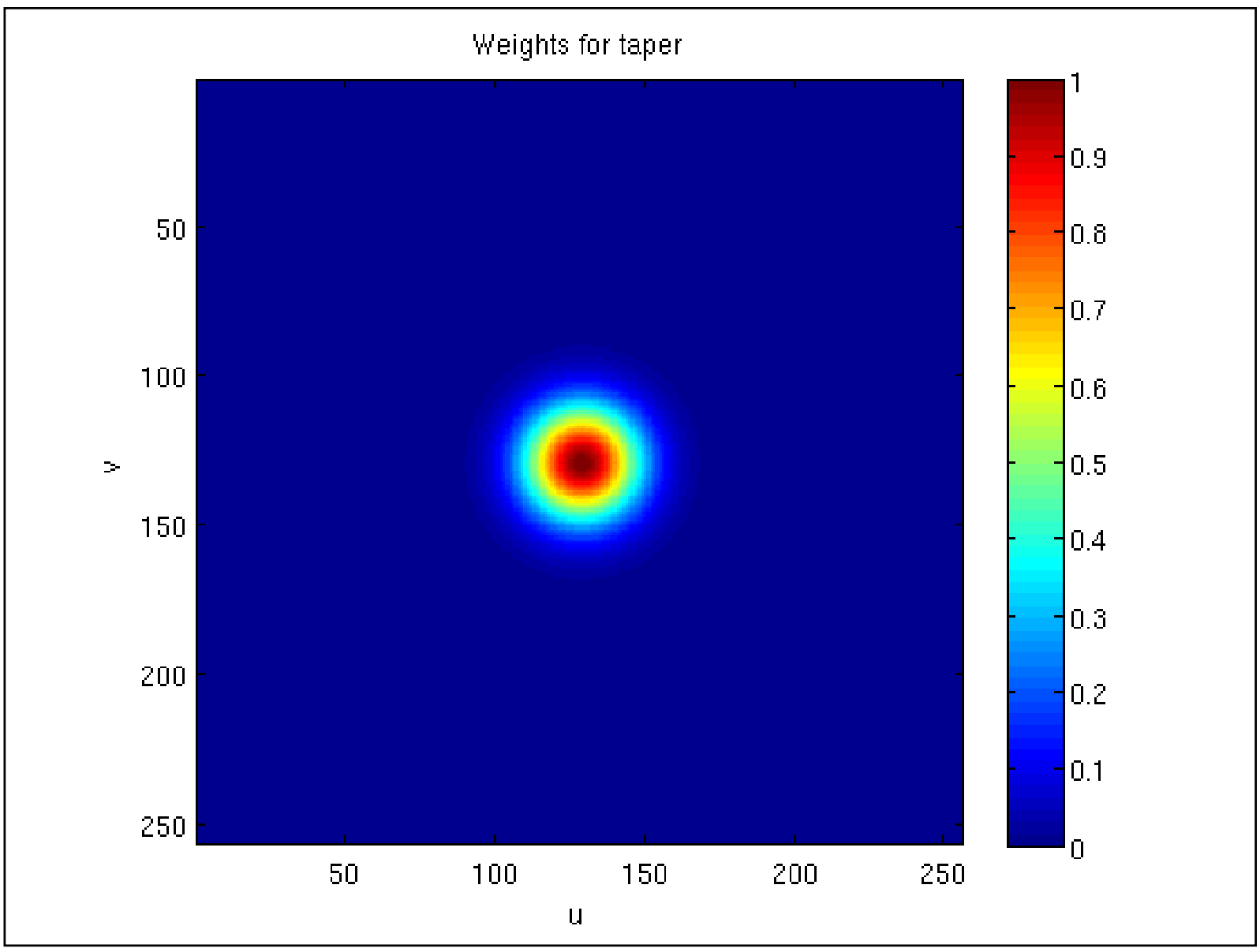
uvAndBeams, EWline, dec 40

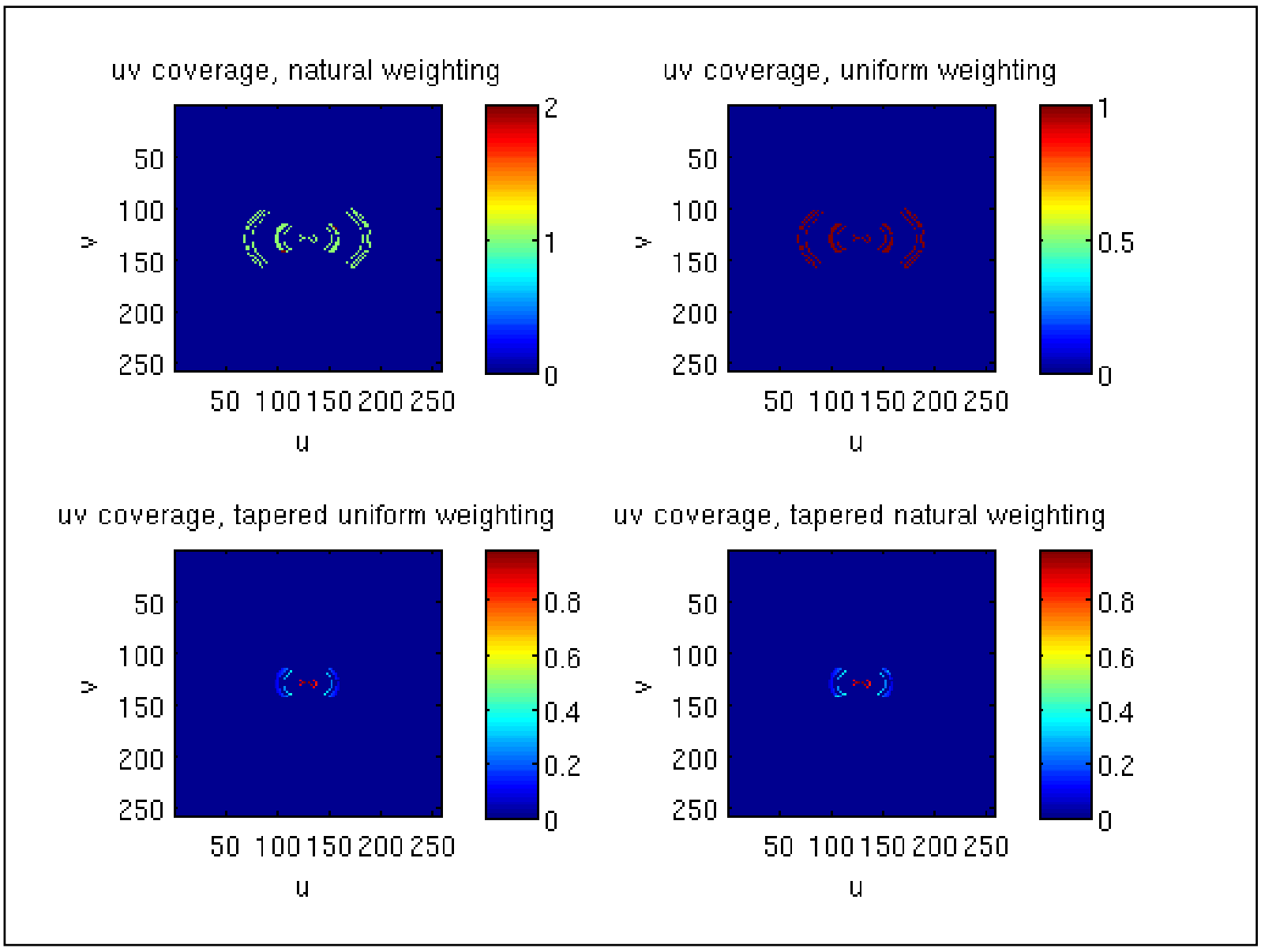


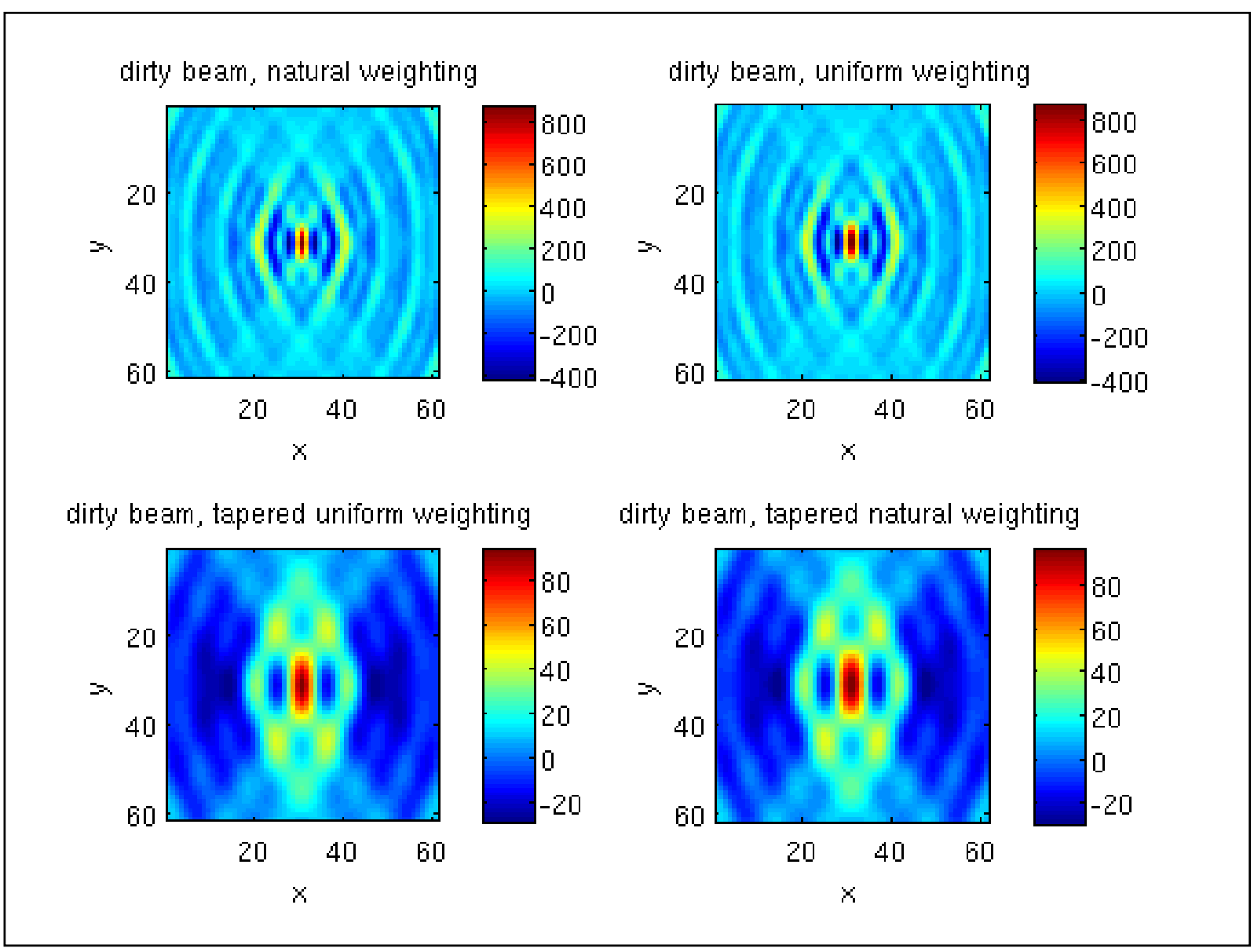

uv coverage
80
60
40
20
0
-20
-40
-60
-80
v
80
60
40
20
0
-20
-40
-60
-80
u

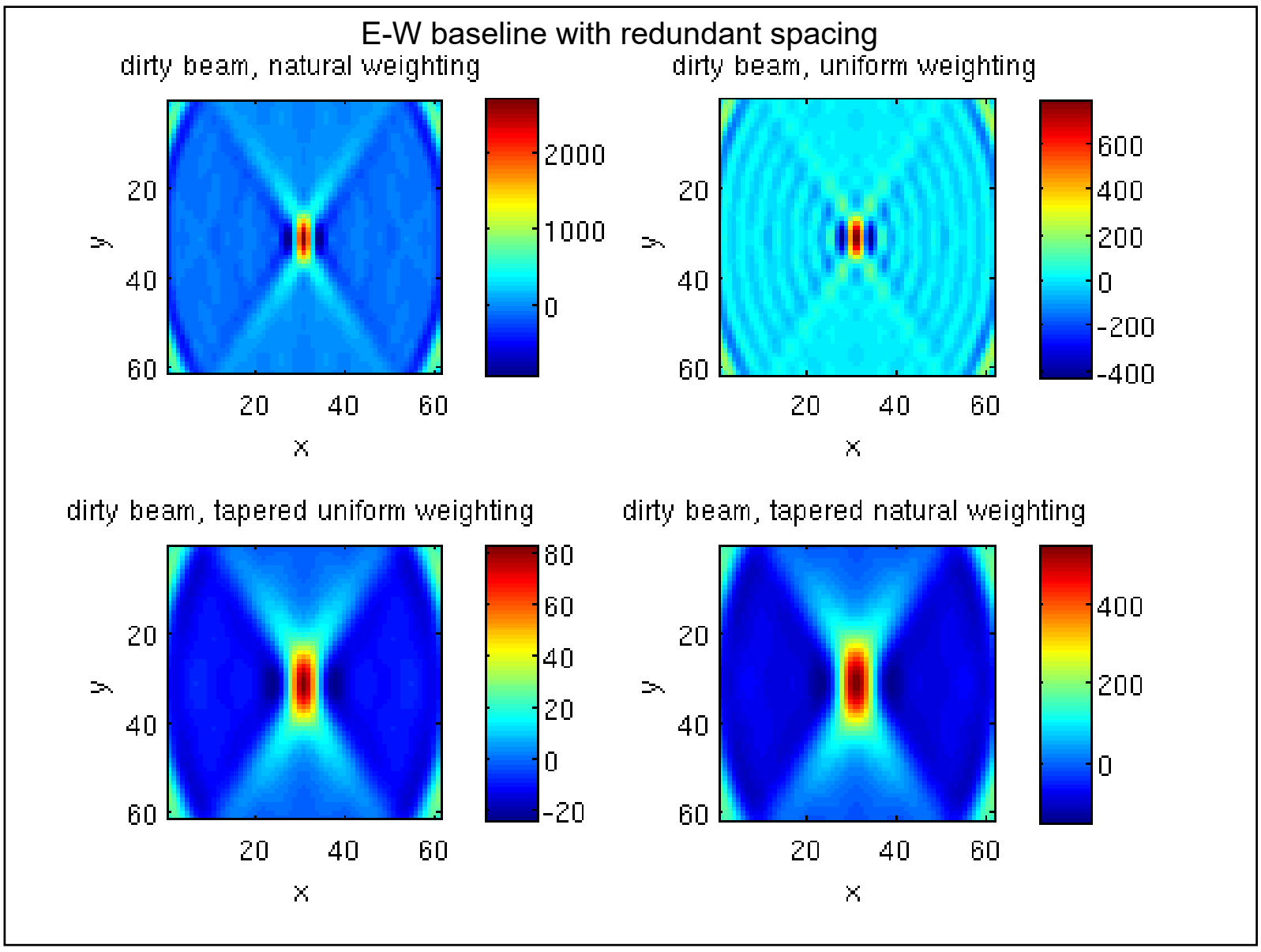

uv coverage, "natural weighting"
50
100
150
200
250
v
50
100
150
200
250
u
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0

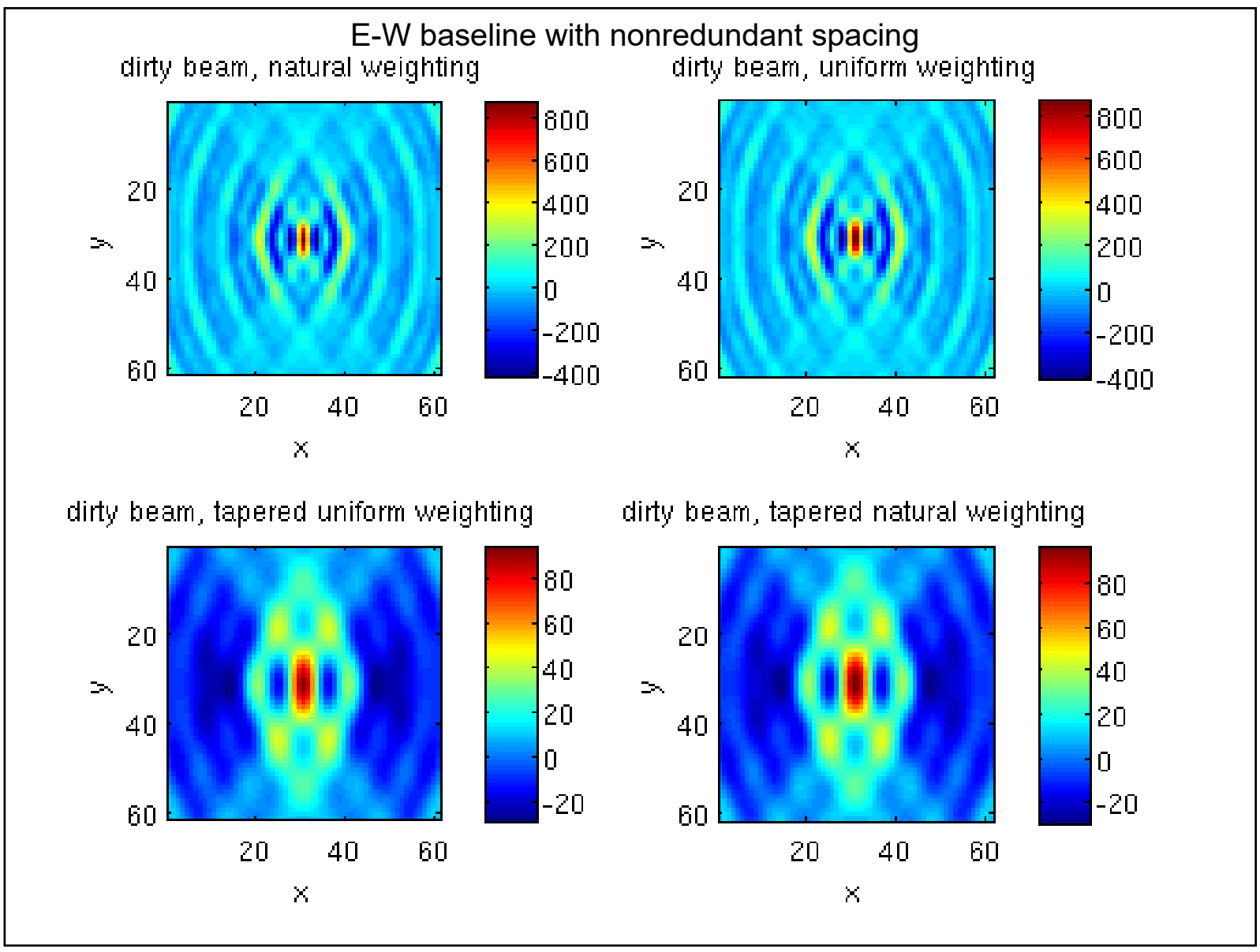

uv coverage, "uniform weighting"
50
100
150
200
250
v
50
100
150
200
250
u
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0


Weights for taper
50
100
150
200
250
v
50
100
150
200
250
u
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

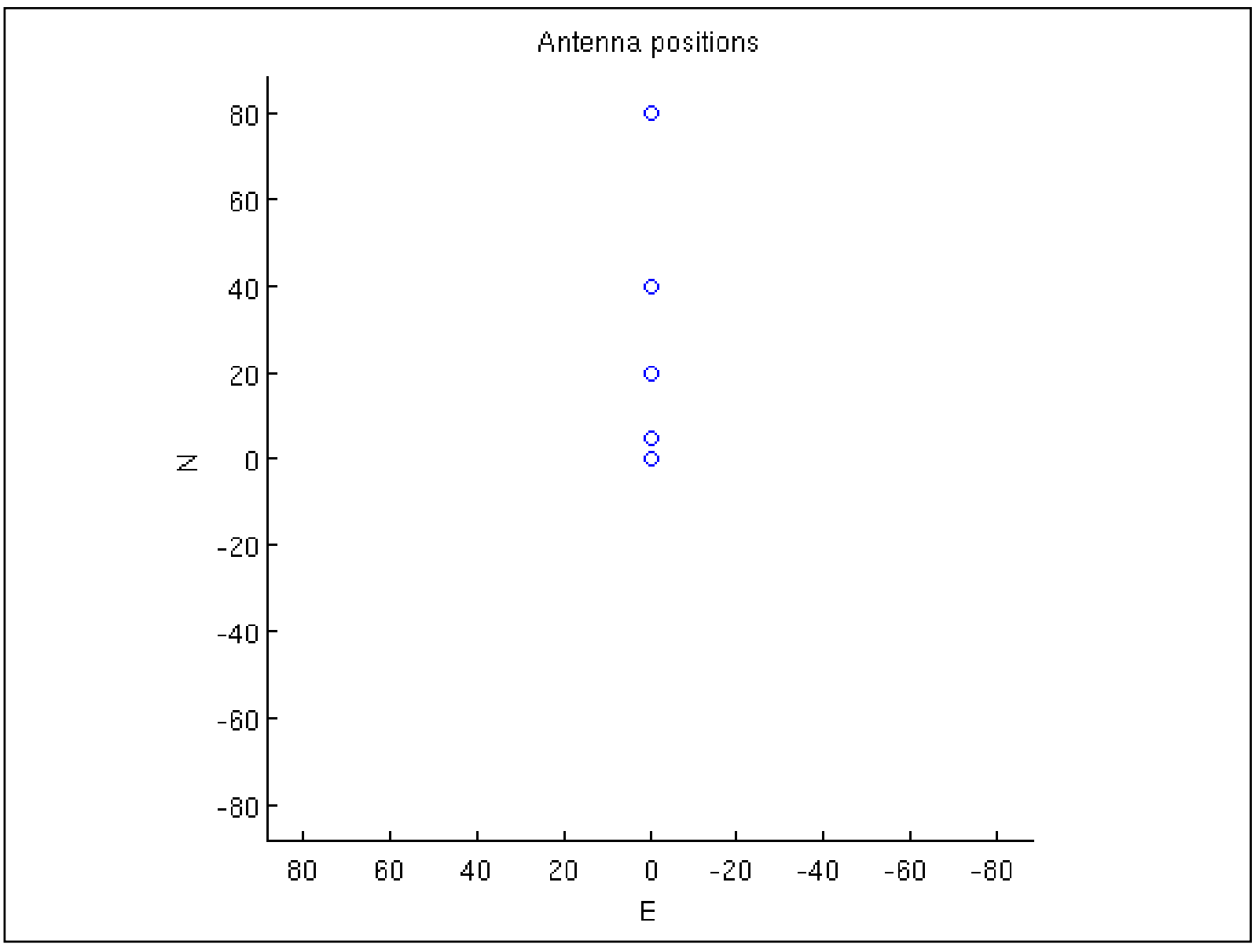

uv coverage, natural weighting
v
u
50 100 150 200 250
2
1
0
uv coverage, uniform weighting
1
0.5
0
uv coverage, tapered uniform weighting
0.8
0.6
0.4
0.2
uv coverage, tapered natural weighting

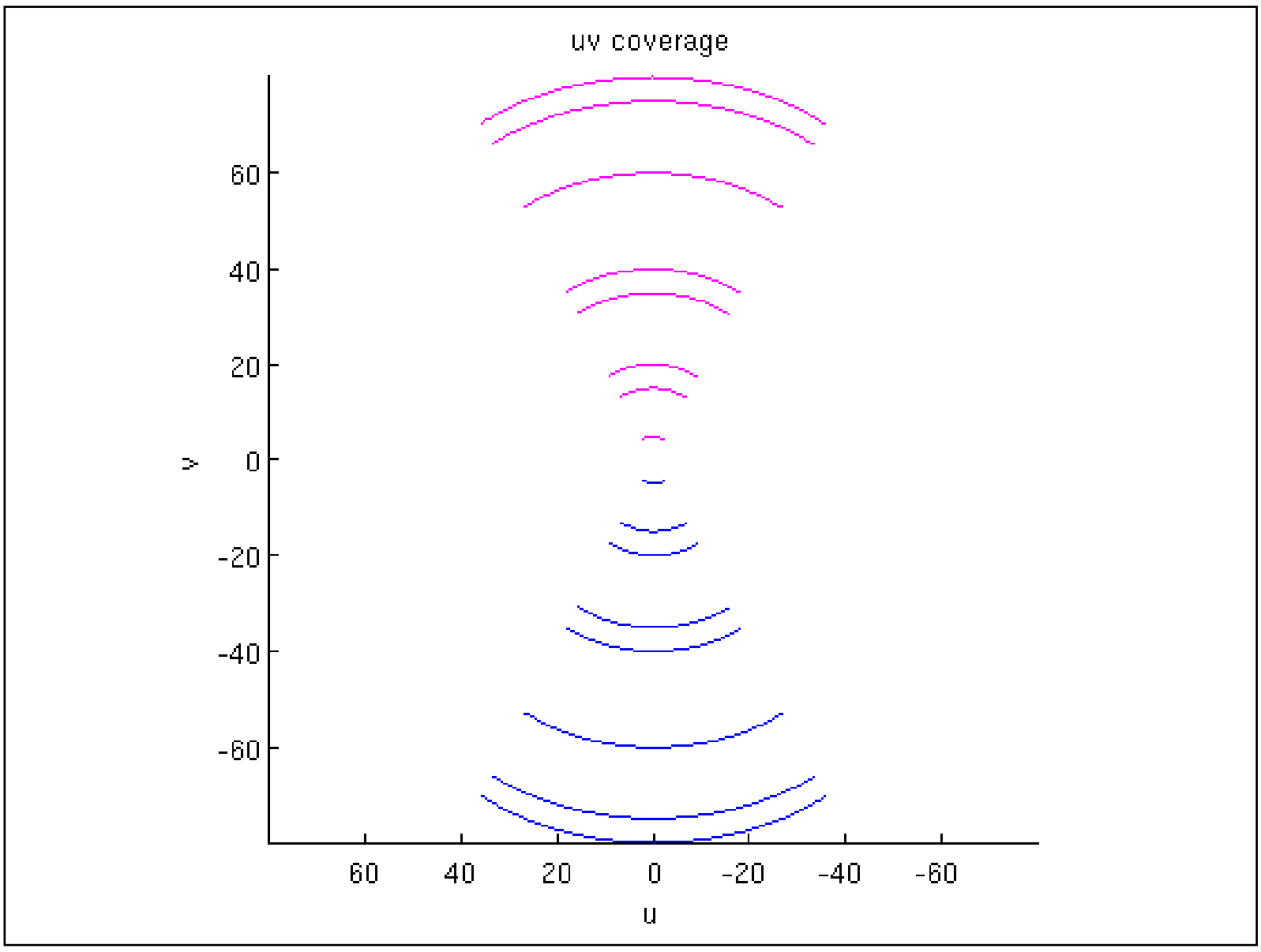

dirty beam, natural weighting
y
x
20 40 60
800
600
400
200
0
-200
-400
dirty beam, uniform weighting
dirty beam, tapered uniform weighting
80
60
40
20
-20
dirty beam, tapered natural weighting

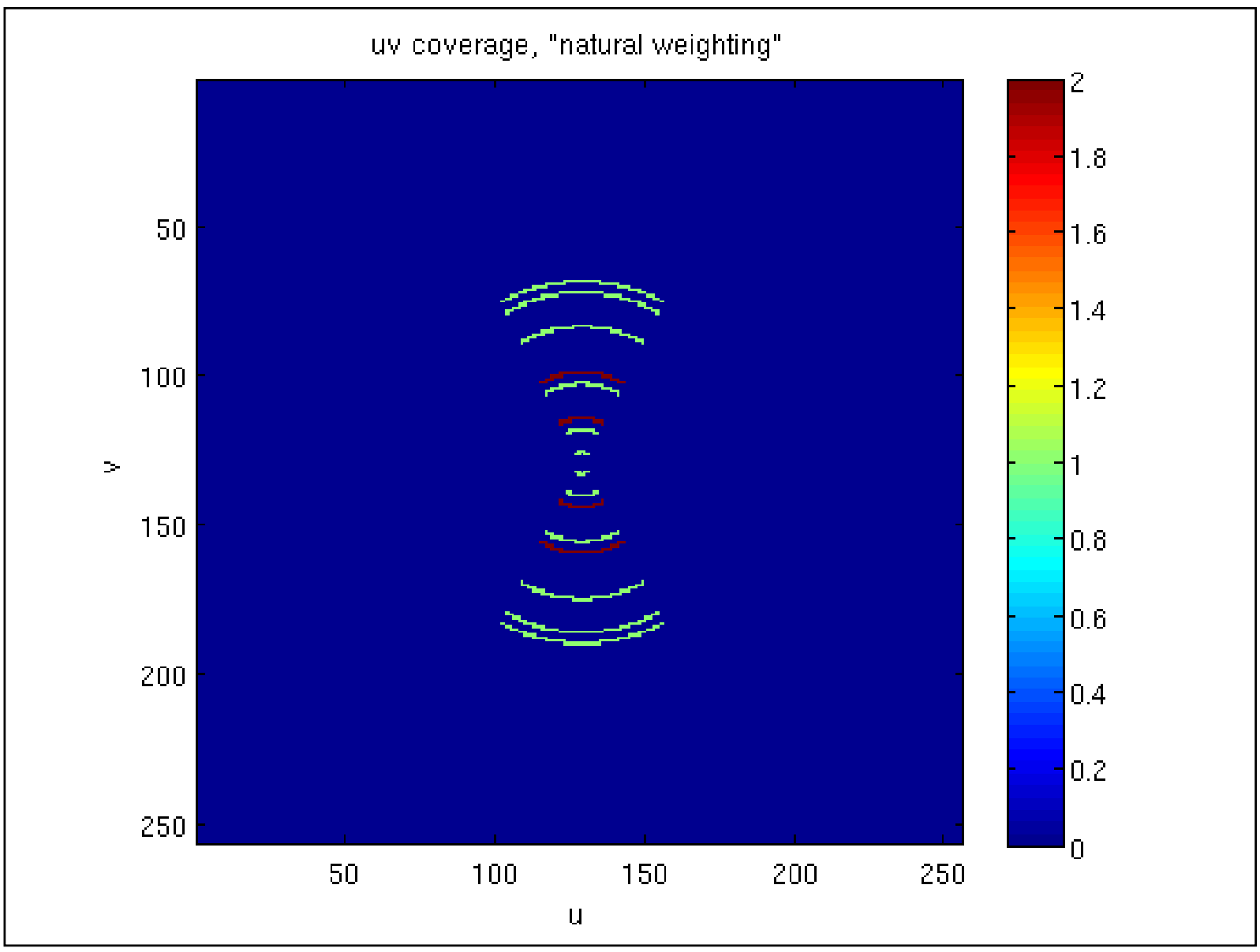

E-W baseline with redundant spacing
dirty beam, natural weighting
dirty beam, uniform weighting
dirty beam, tapered uniform weighting
dirty beam, tapered natural weighting
y
x
20
40
60
2000
1000
0
600
400
200
-200
-400
80
-20

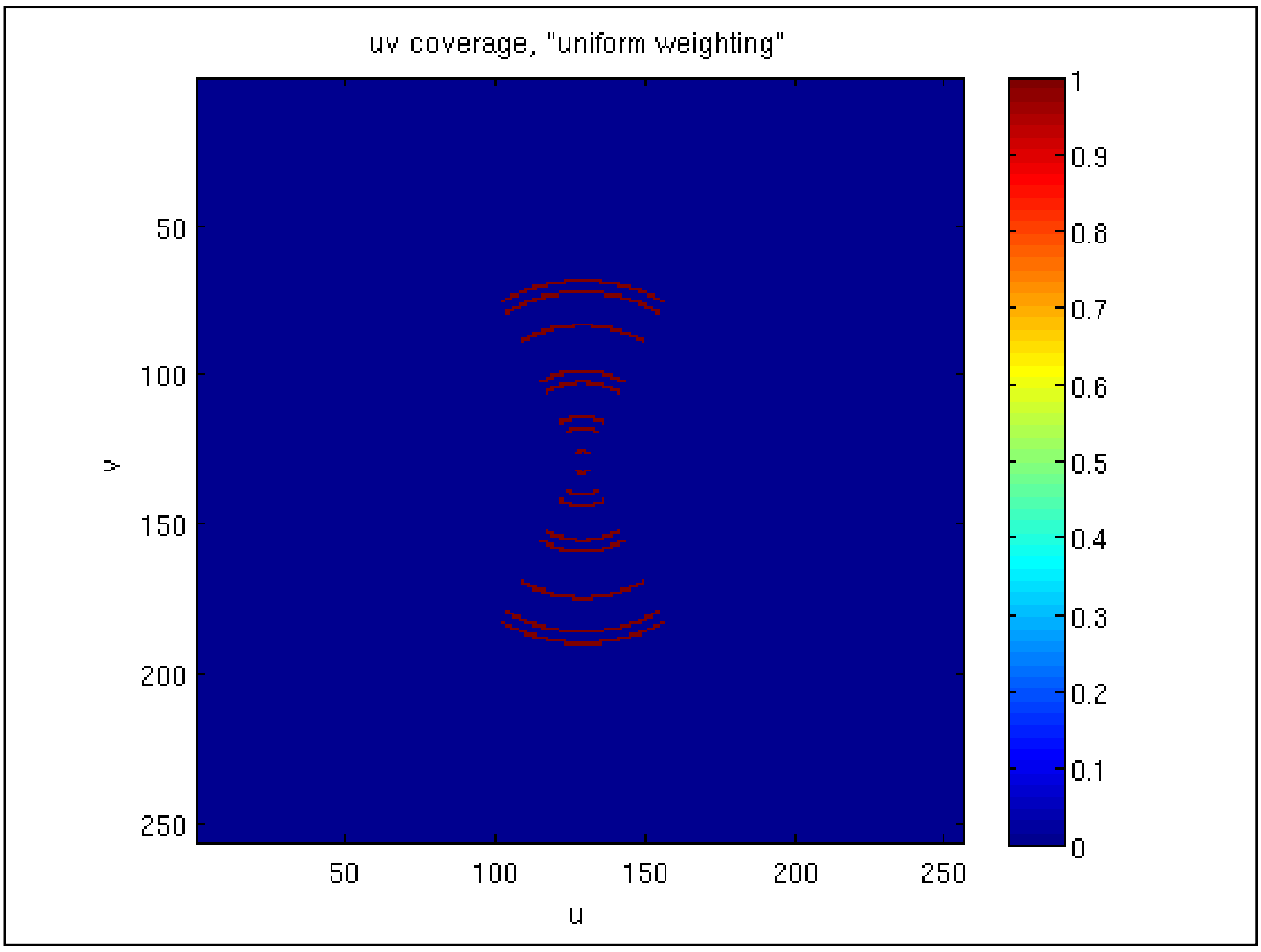

E-W baseline with nonredundant spacing
dirty beam, natural weighting
dirty beam, uniform weighting
dirty beam, tapered uniform weighting
dirty beam, tapered natural weighting
y
x
20
40
60
800
600
400
200
0
-200
-400
80
-20

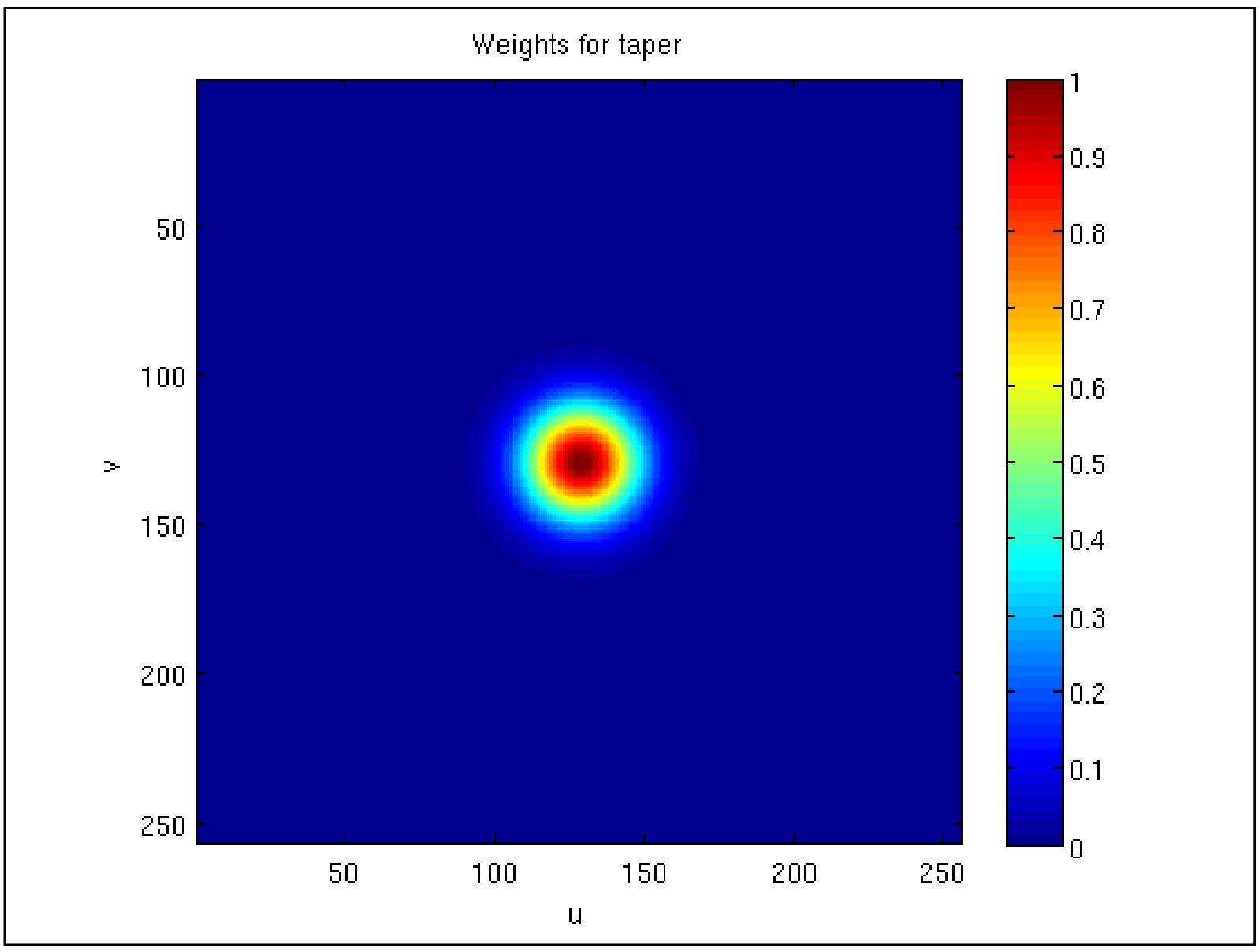
uvAndBeams, NSline, dec 40

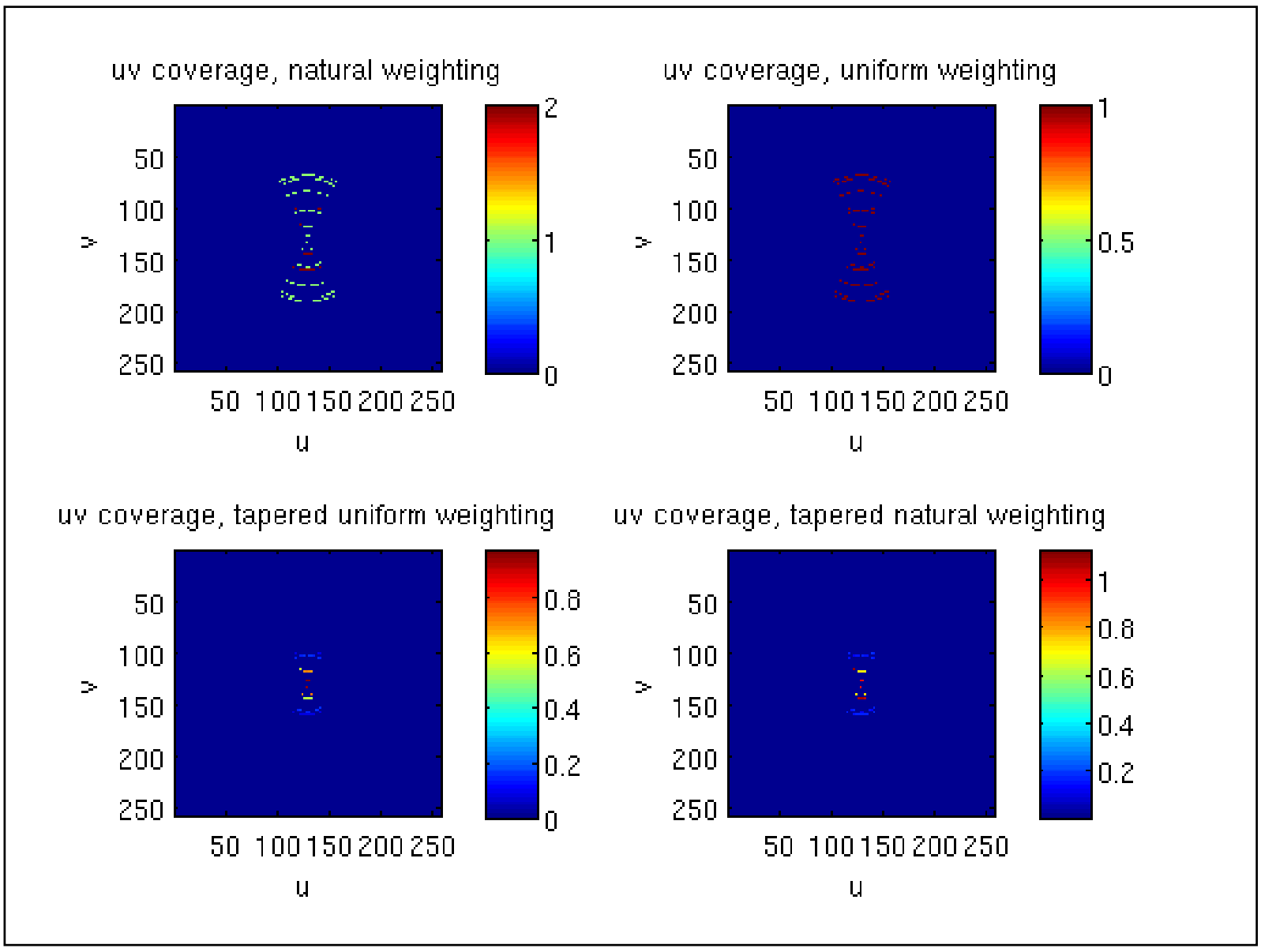


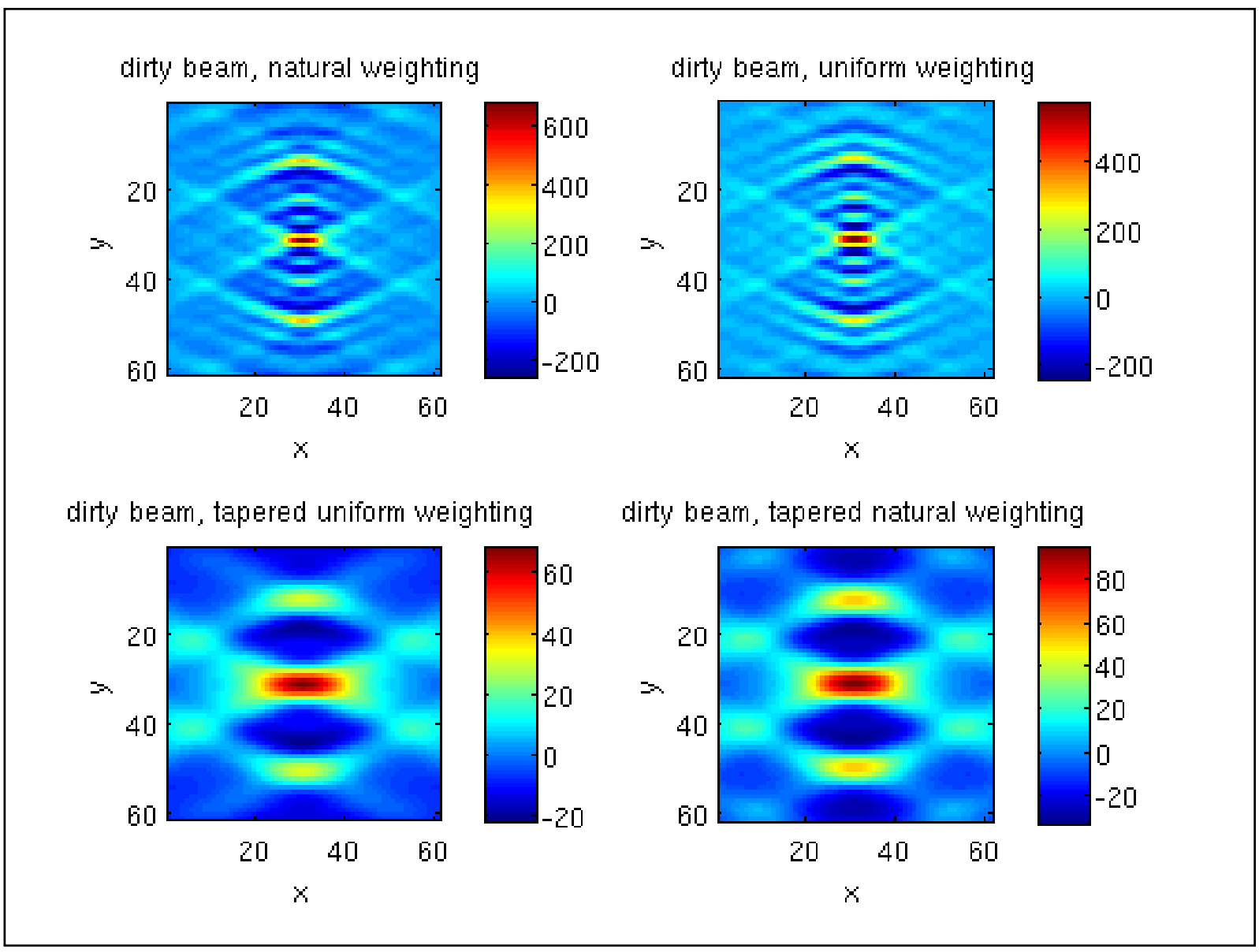

uv coverage
60
40
20
0
-20
-40
-60
v
60
40
20
0
-20
-40
-60
u


uv coverage, "natural weighting"
50
100
150
200
250
v
50
100
150
200
250
u
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0

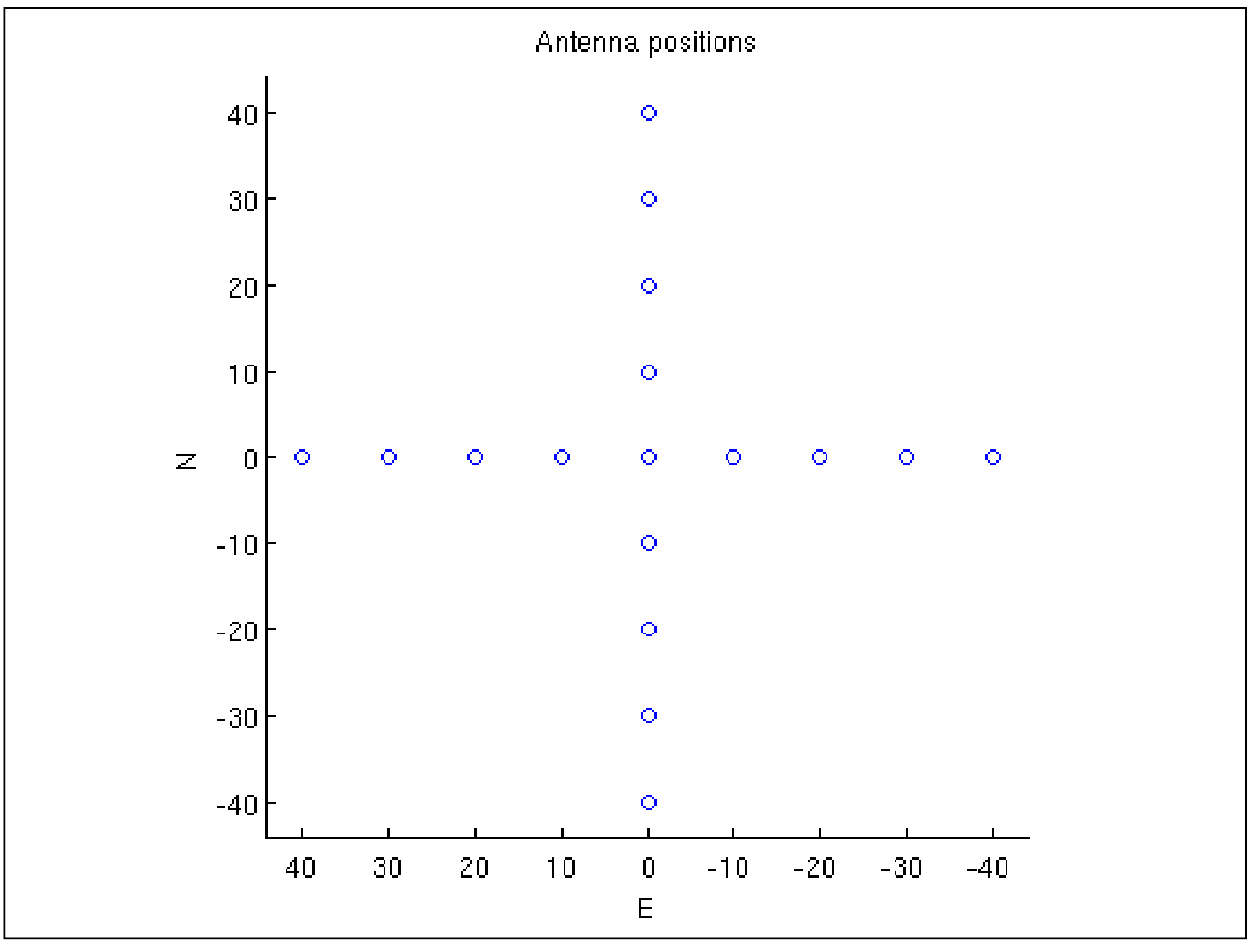

uv coverage, "uniform weighting"
v
u
50
100
150
200
250
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

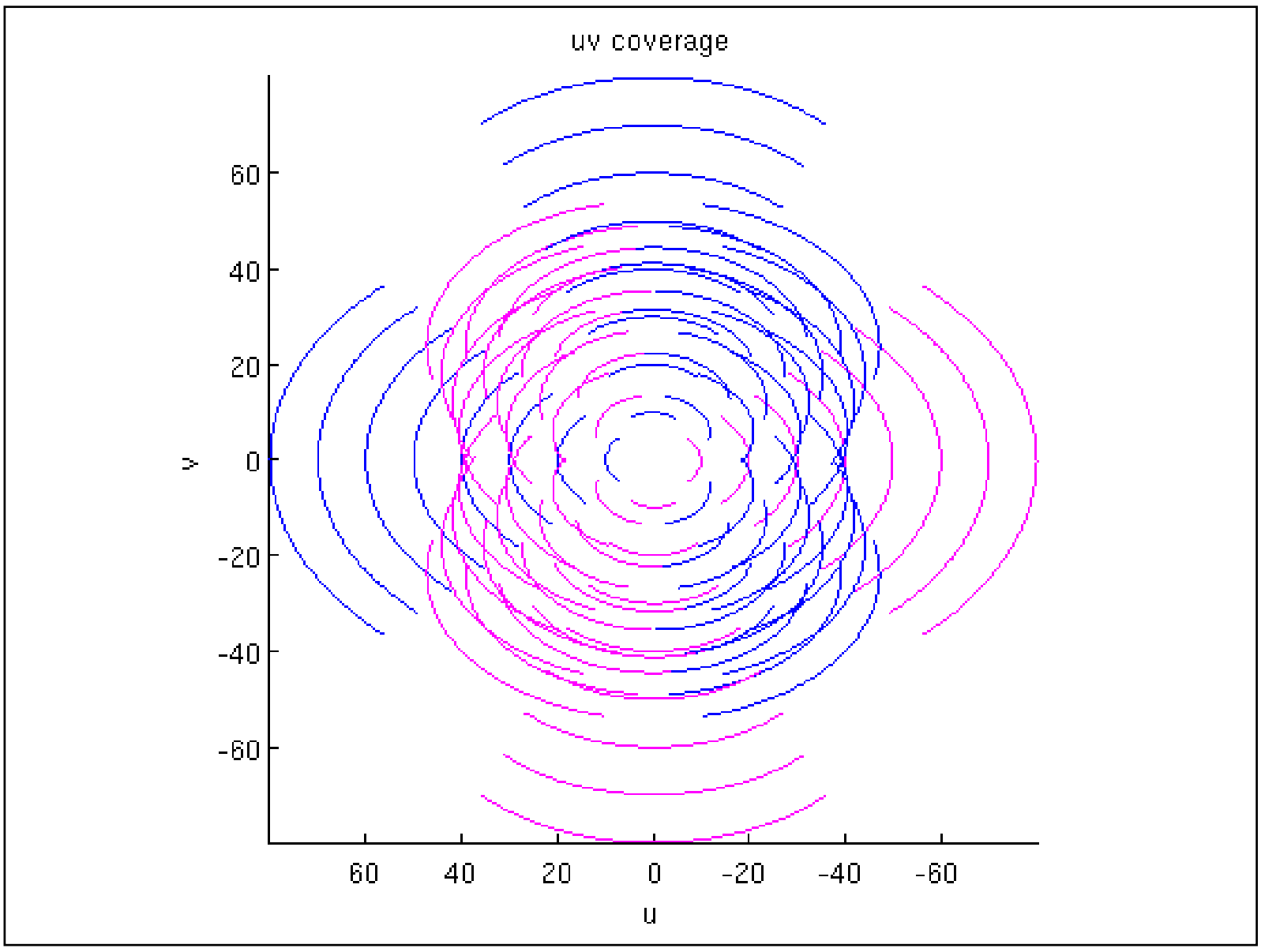

Weights for taper
v
u
50
100
150
200
250
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

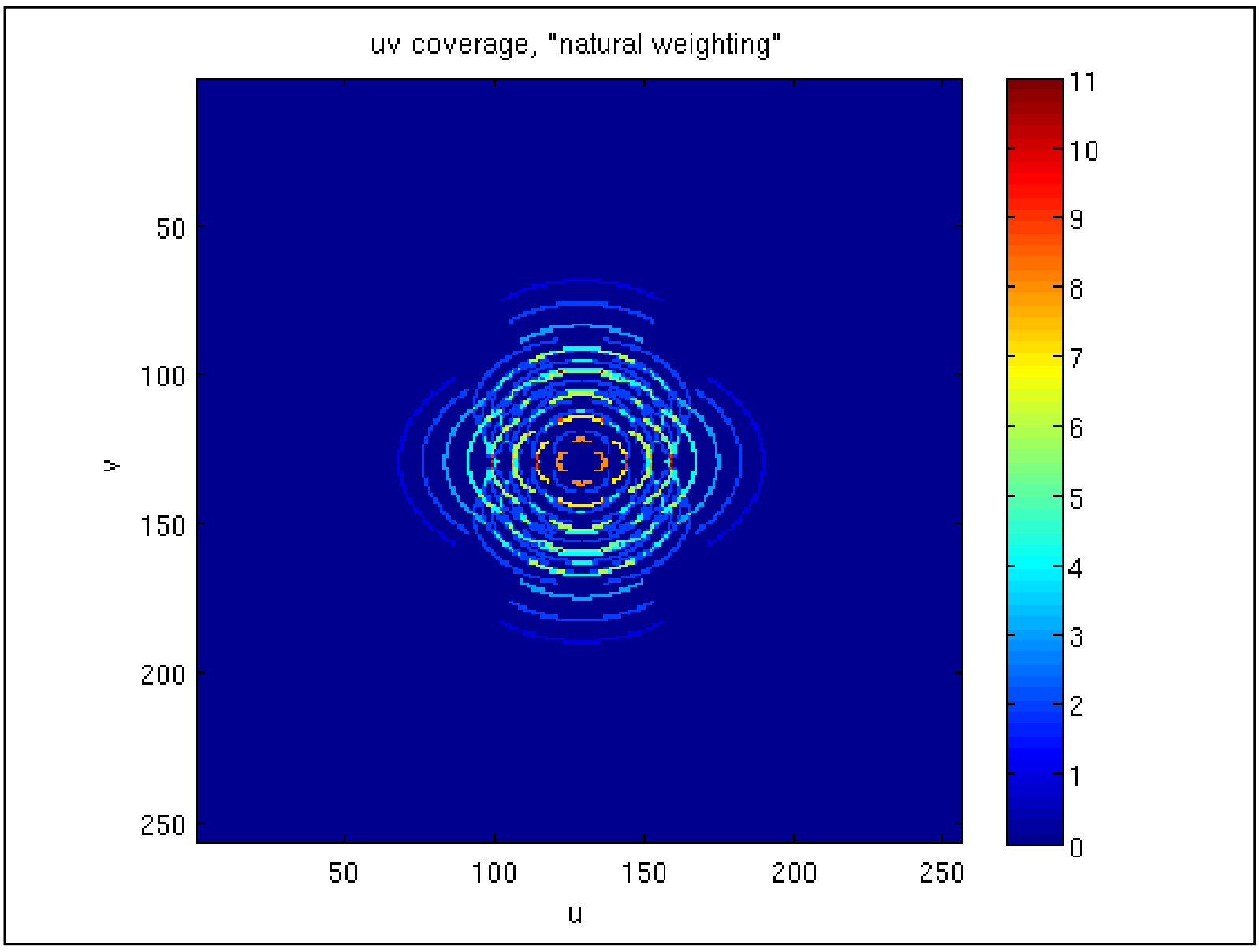

uv coverage, natural weighting
v
u
50 100 150 200 250
2
1
0
uv coverage, uniform weighting
1
0.5
0
uv coverage, tapered uniform weighting
0.8
0.6
0.4
0.2
uv coverage, tapered natural weighting
1
0.8
0.6
0.4
0.2

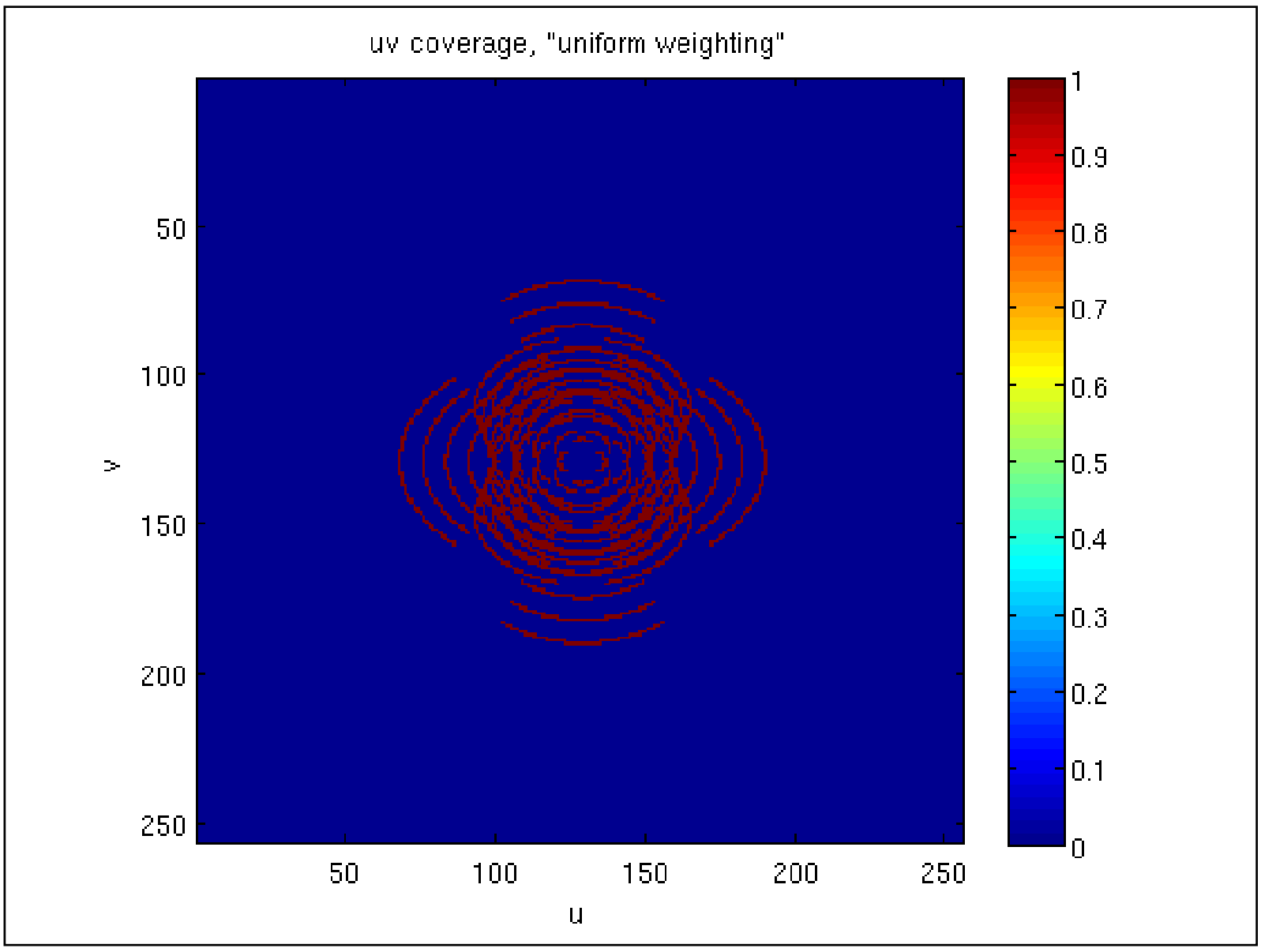

dirty beam, natural weighting
y
x
20 40 60
600
400
200
0
-200
dirty beam, uniform weighting
400
200
0
-200
dirty beam, tapered uniform weighting
60
40
20
0
-20
dirty beam, tapered natural weighting
80
60
40
20
0
-20

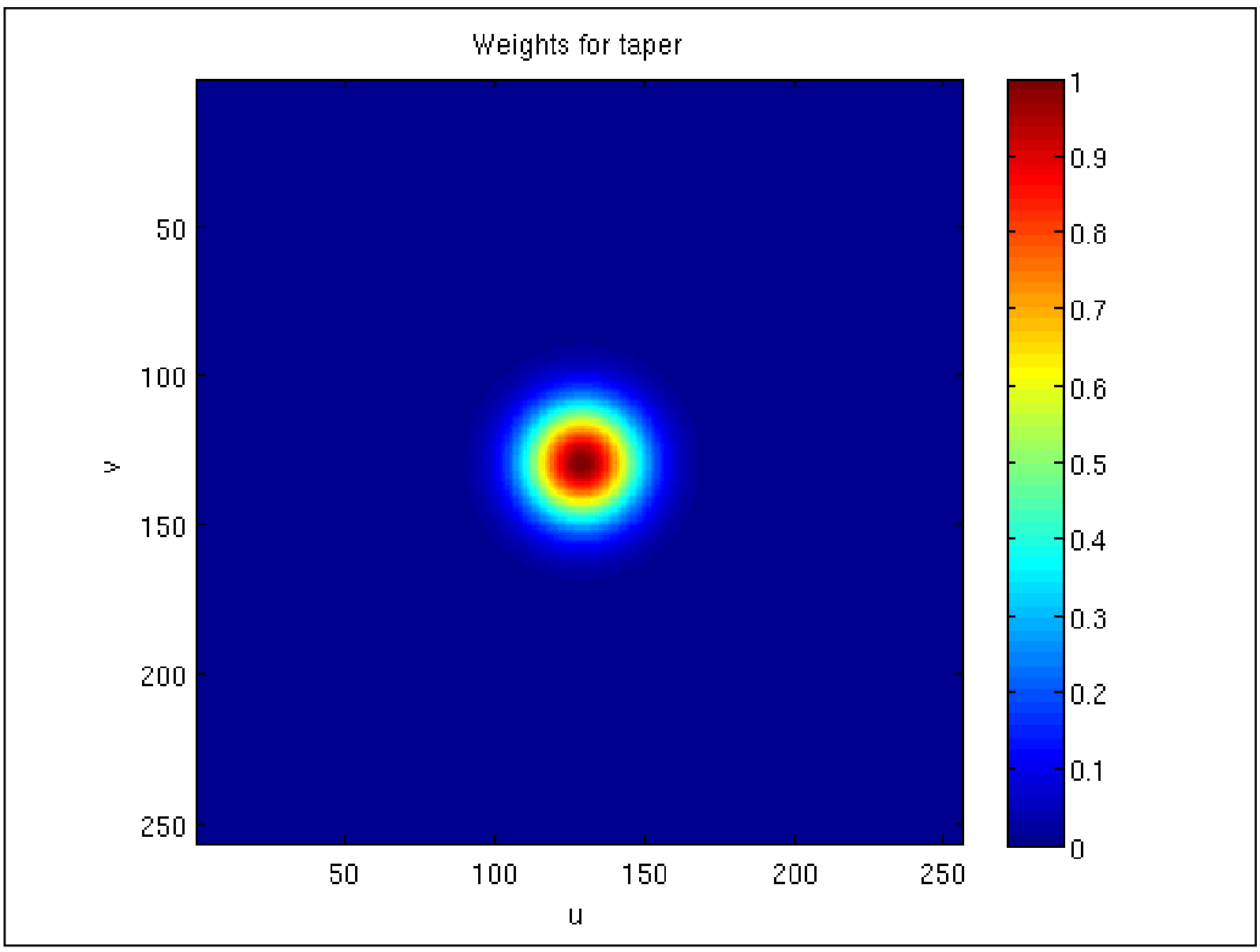
uvAndBeams, Cross, dec 40

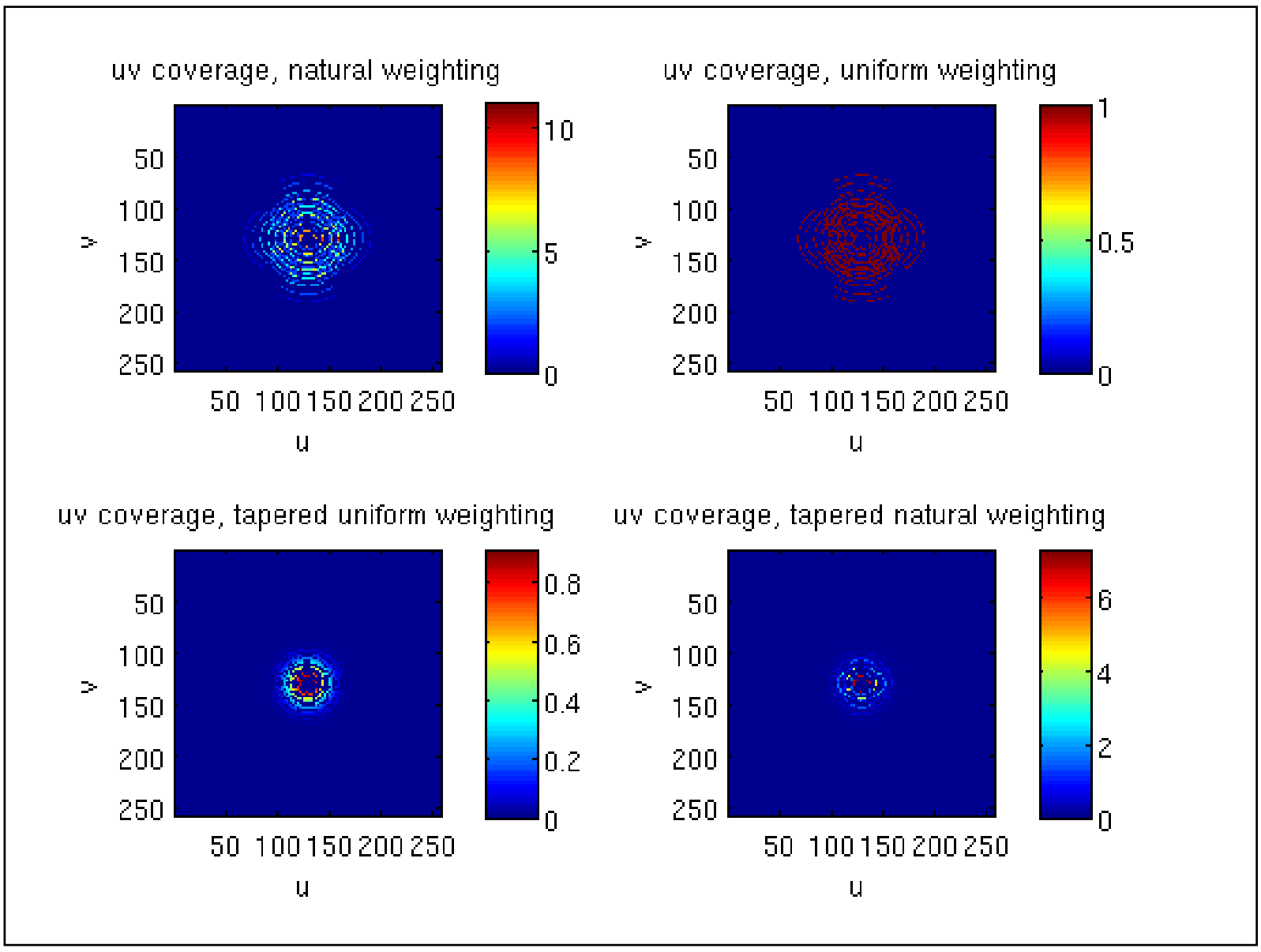


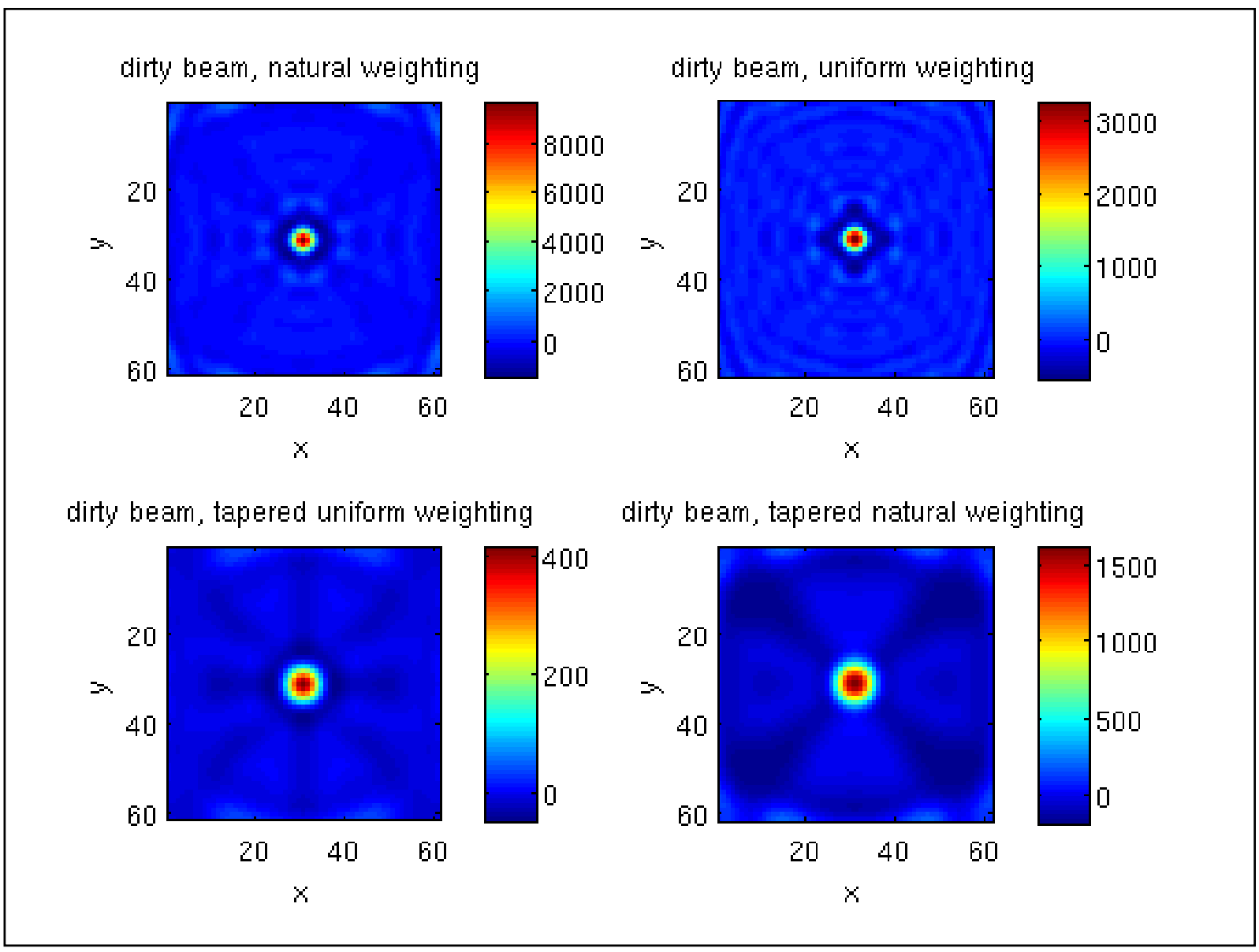

uv coverage
60
40
20
0
-20
-40
-60
v
60
40
20
0
-20
-40
-60
u


uv coverage, "natural weighting"
50
100
150
200
250
v
50
100
150
200
250
u
11
10
9
8
7
6
5
4
3
2
1
0

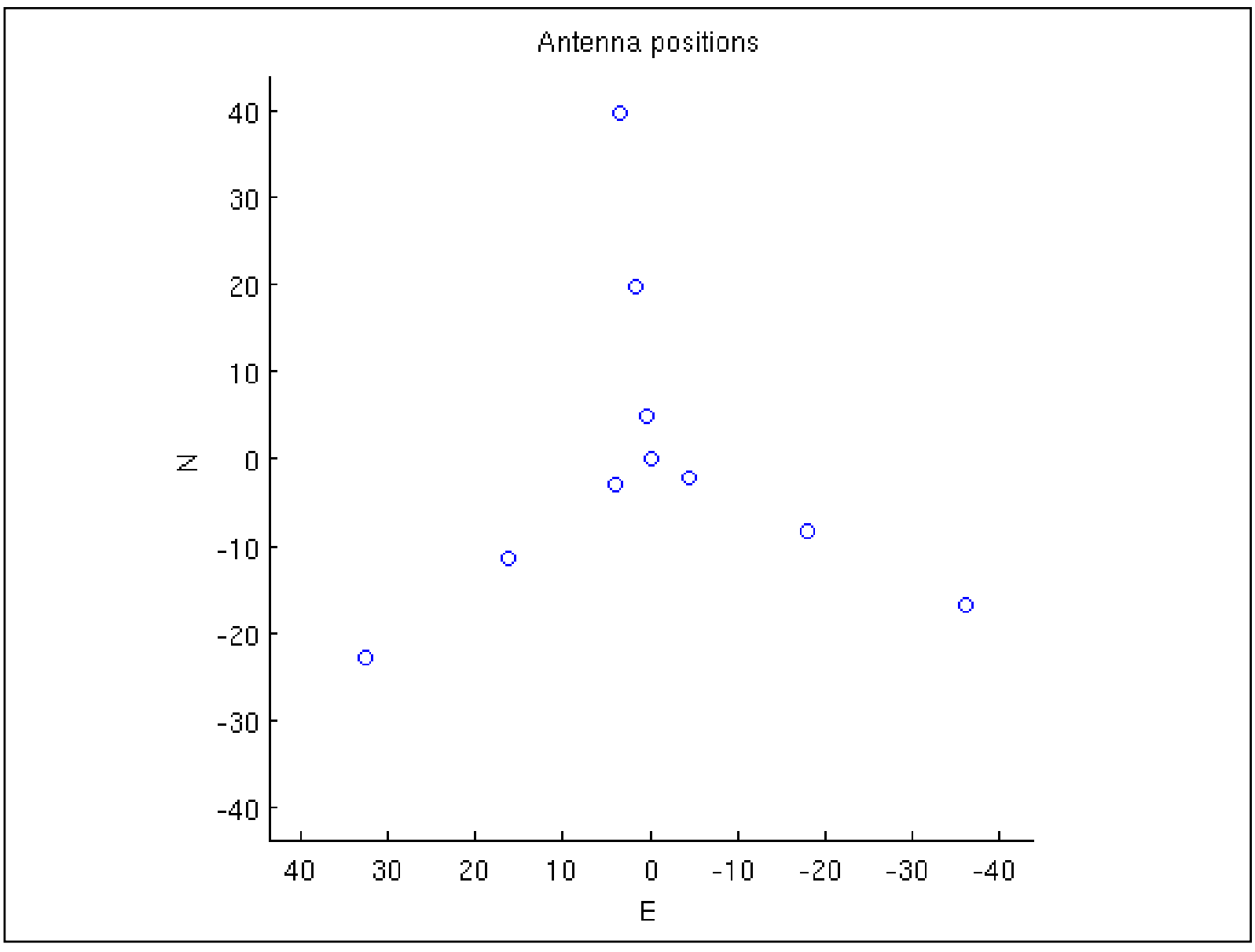

uv coverage, "uniform weighting"
50
100
150
200
250
v
50
100
150
200
250
u
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

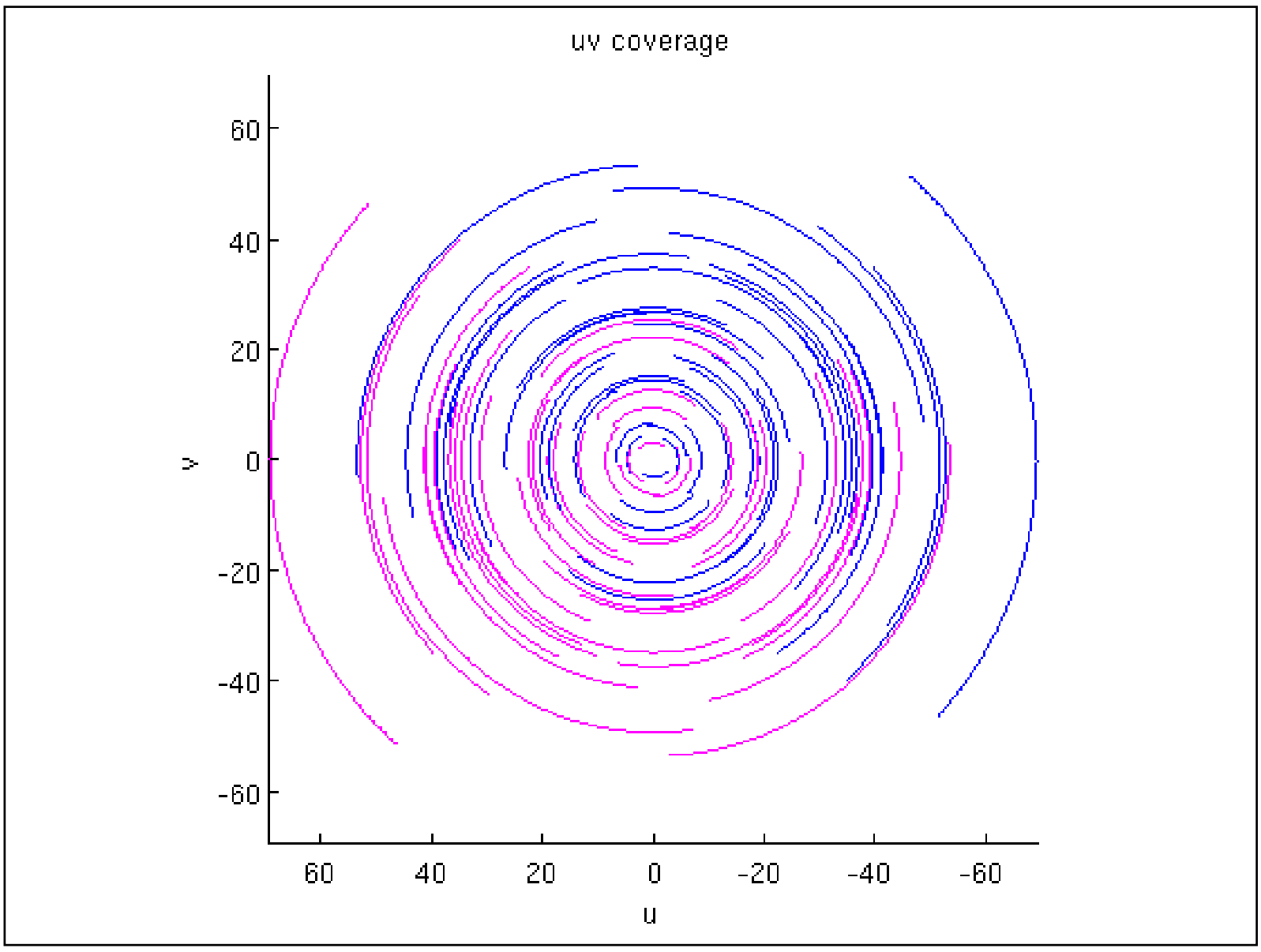

Weights for taper
50
100
150
200
250
v
50
100
150
200
250
u
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0


uv coverage, natural weighting
uv coverage, uniform weighting
uv coverage, tapered uniform weighting
uv coverage, tapered natural weighting
v
u
50
100
150
200
250
10
5
0
1
0.5
0.8
0.6
0.4
0.2
6
4
2


dirty beam, natural weighting
dirty beam, uniform weighting
dirty beam, tapered uniform weighting
dirty beam, tapered natural weighting
y
x
20
40
60
8000
6000
4000
2000
0
3000
1000
400
200
1500
1000
500

uvAndBeams, Wye, dec 90




uv coverage
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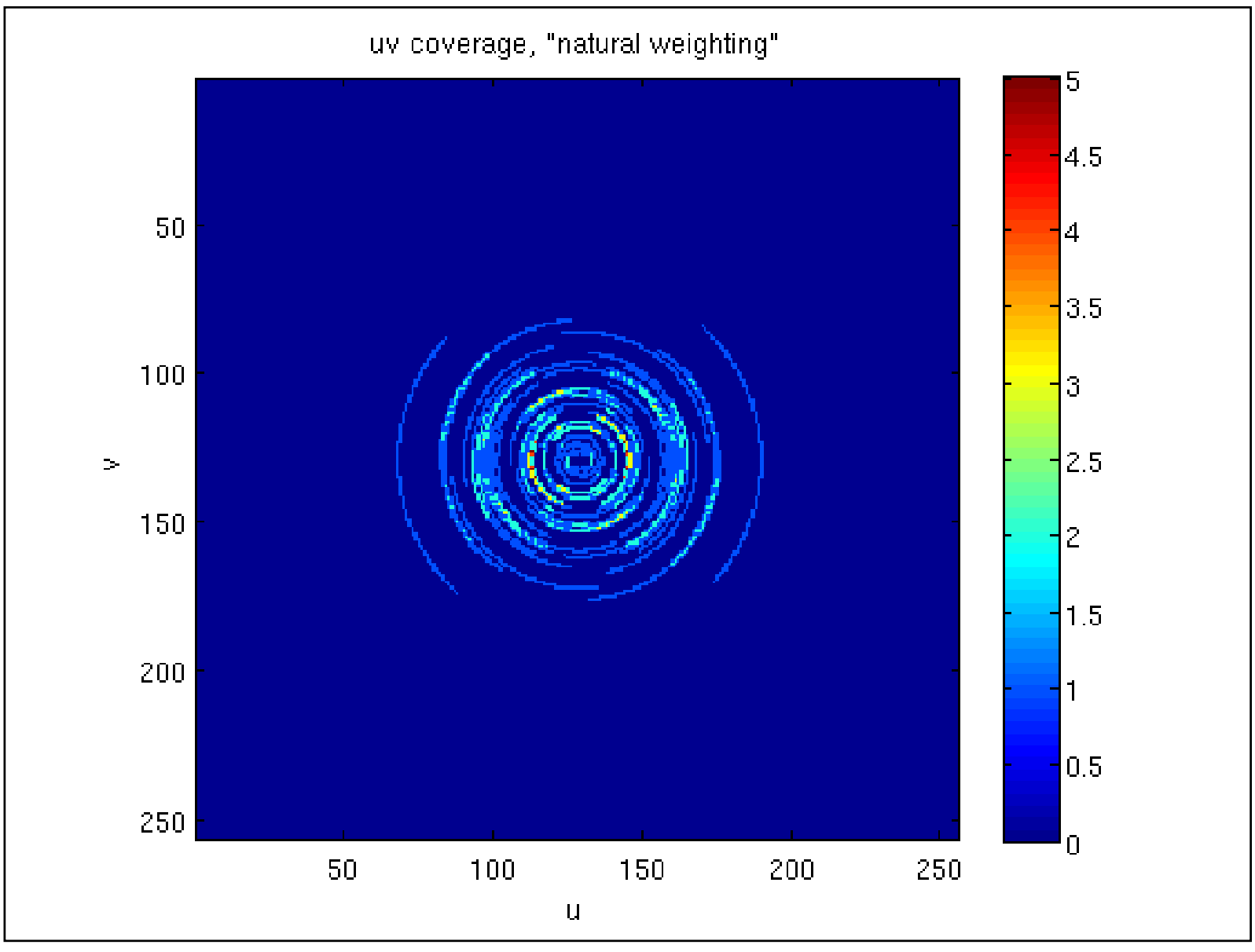
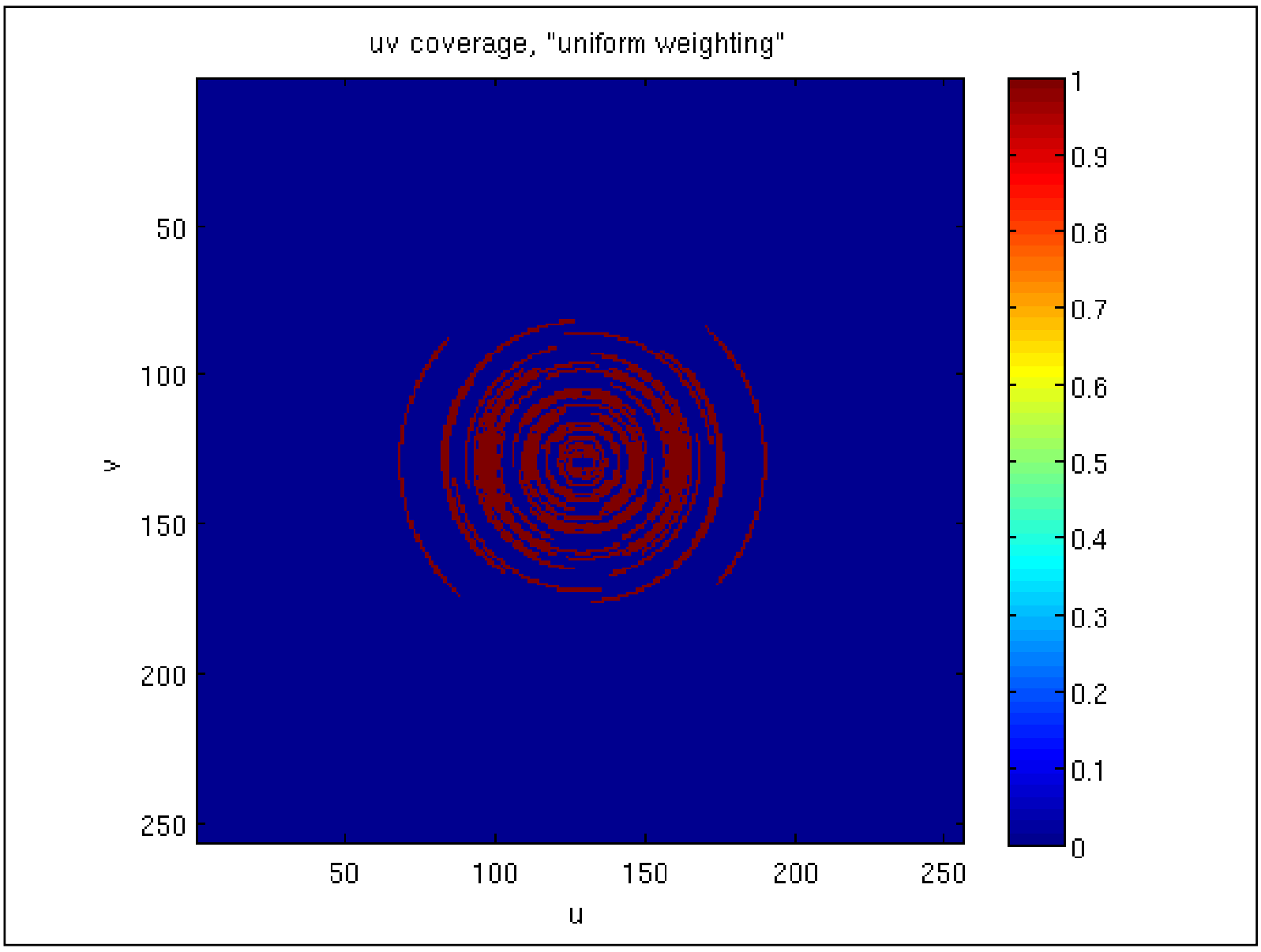
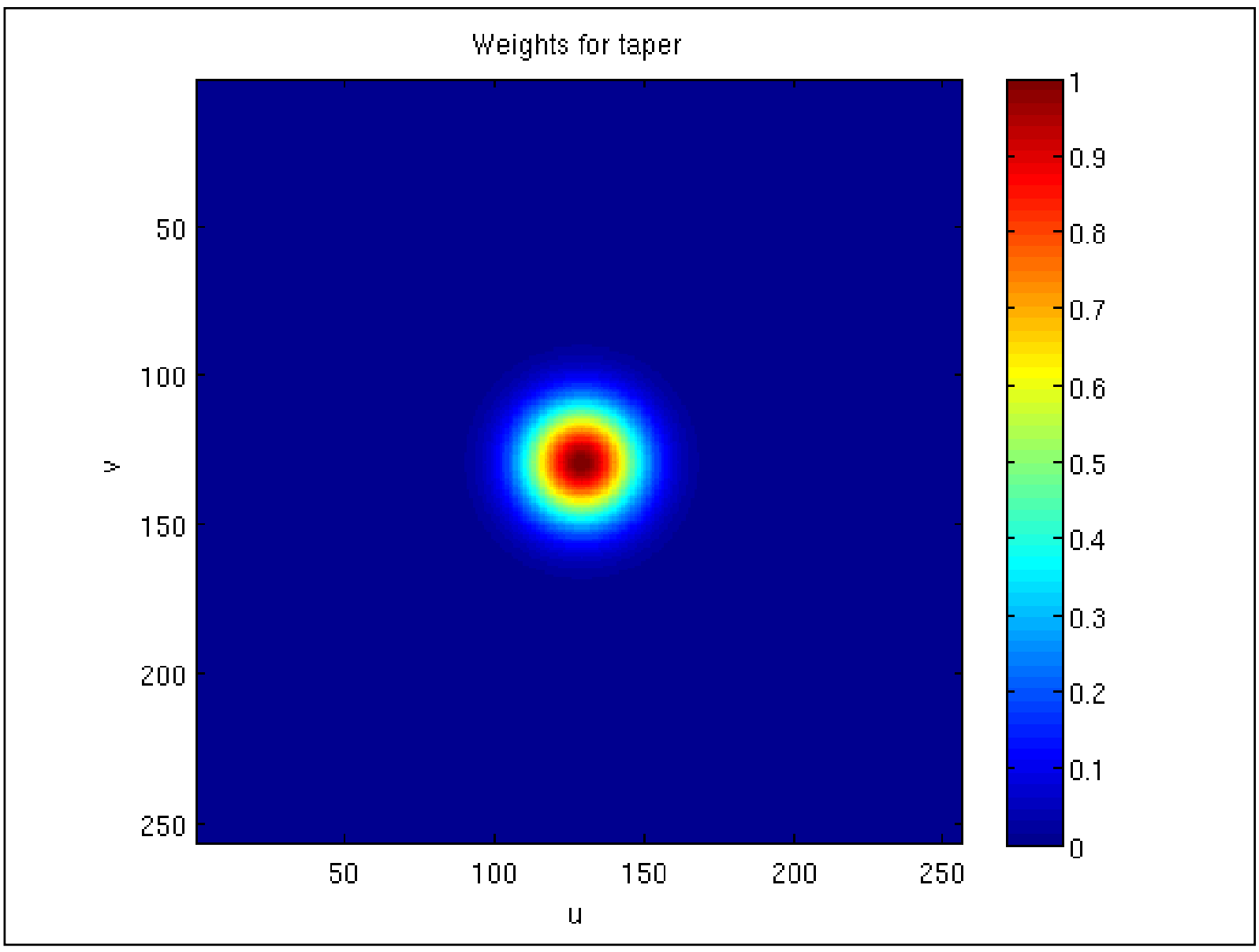
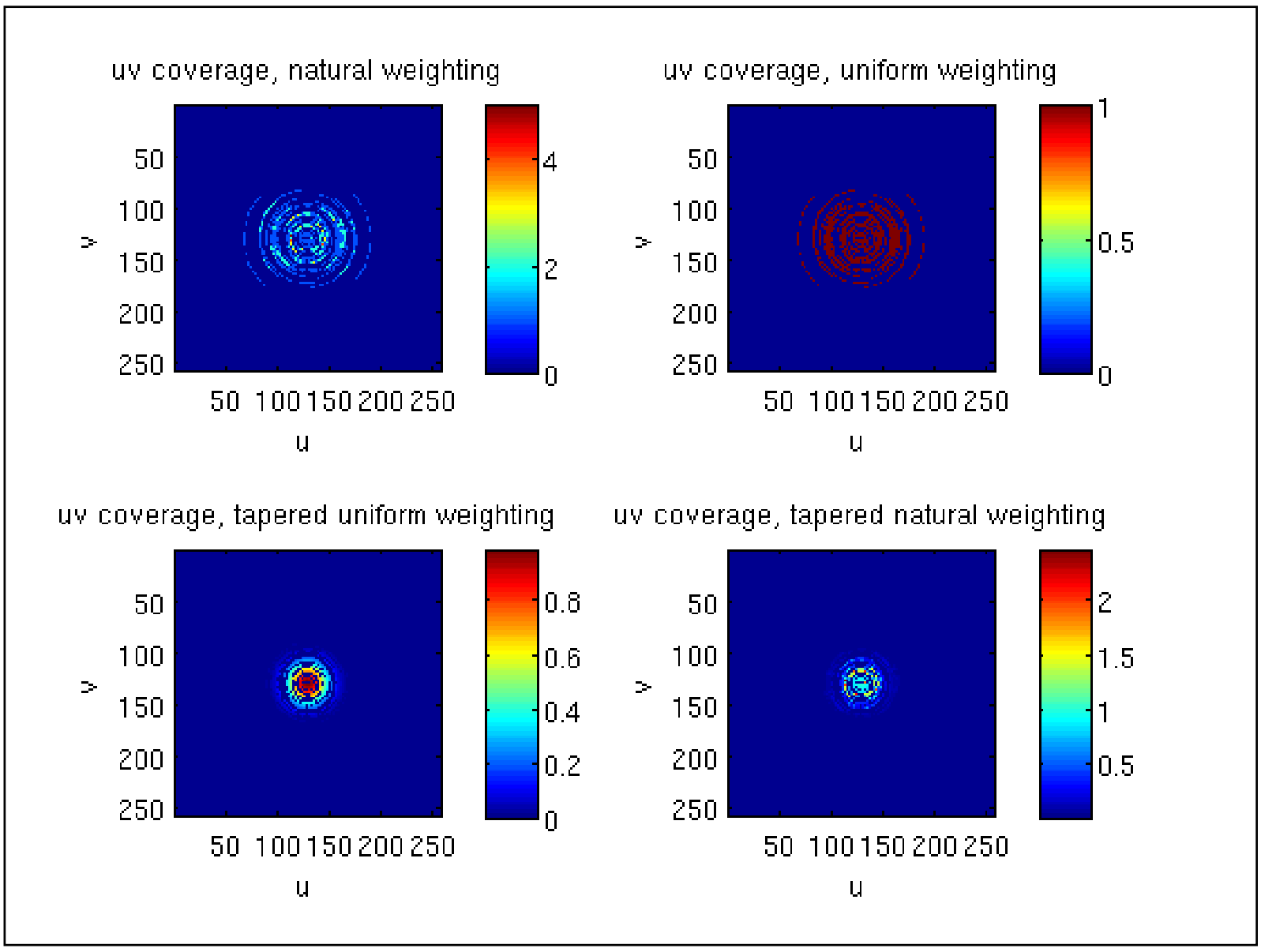
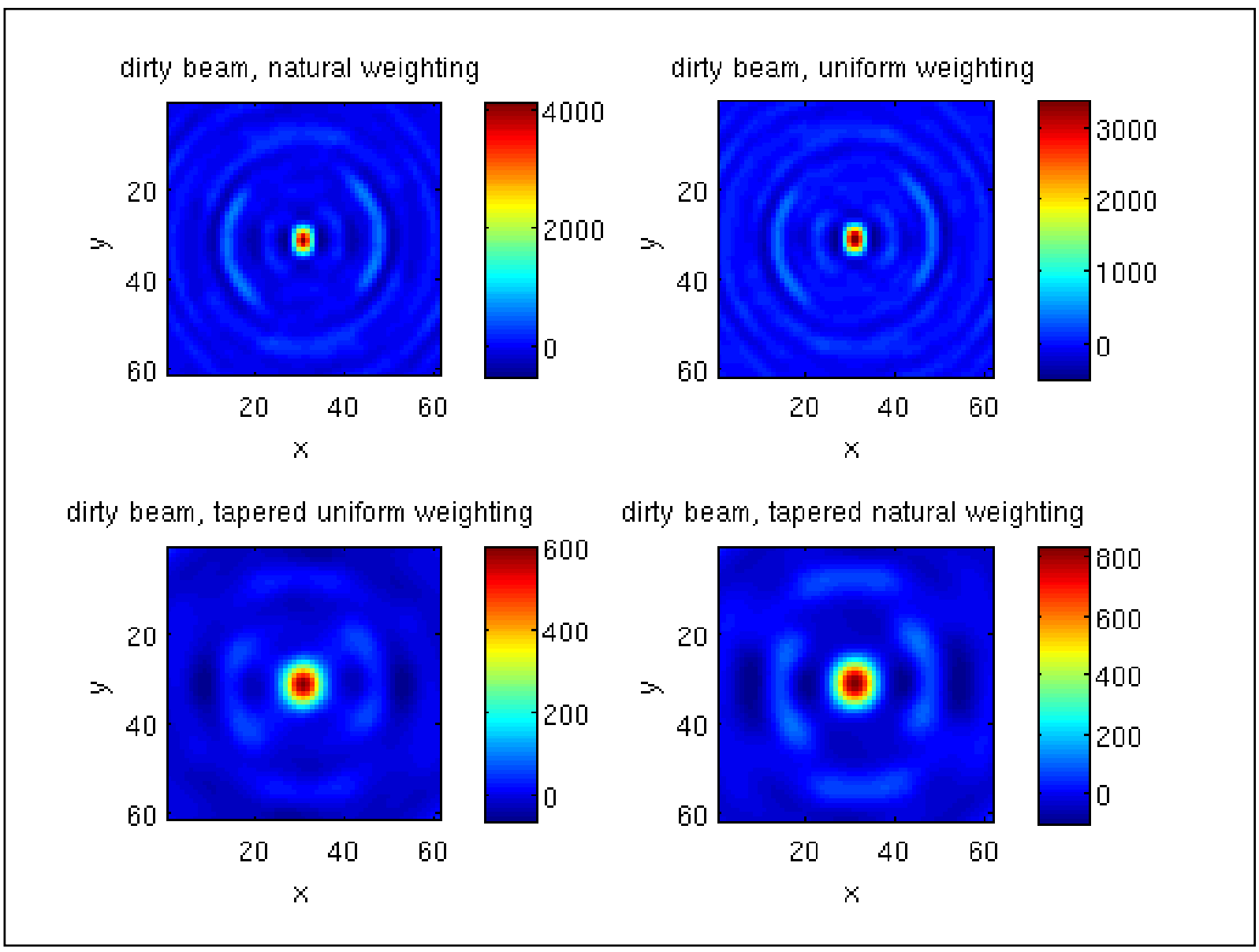
40
20
0
-20
-40
-60
v
60
40
20
0
-20
-40
-60
u


uv coverage, "natural weighting"
50
100
150
200
250
v
50
100
150
200
250
u
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0

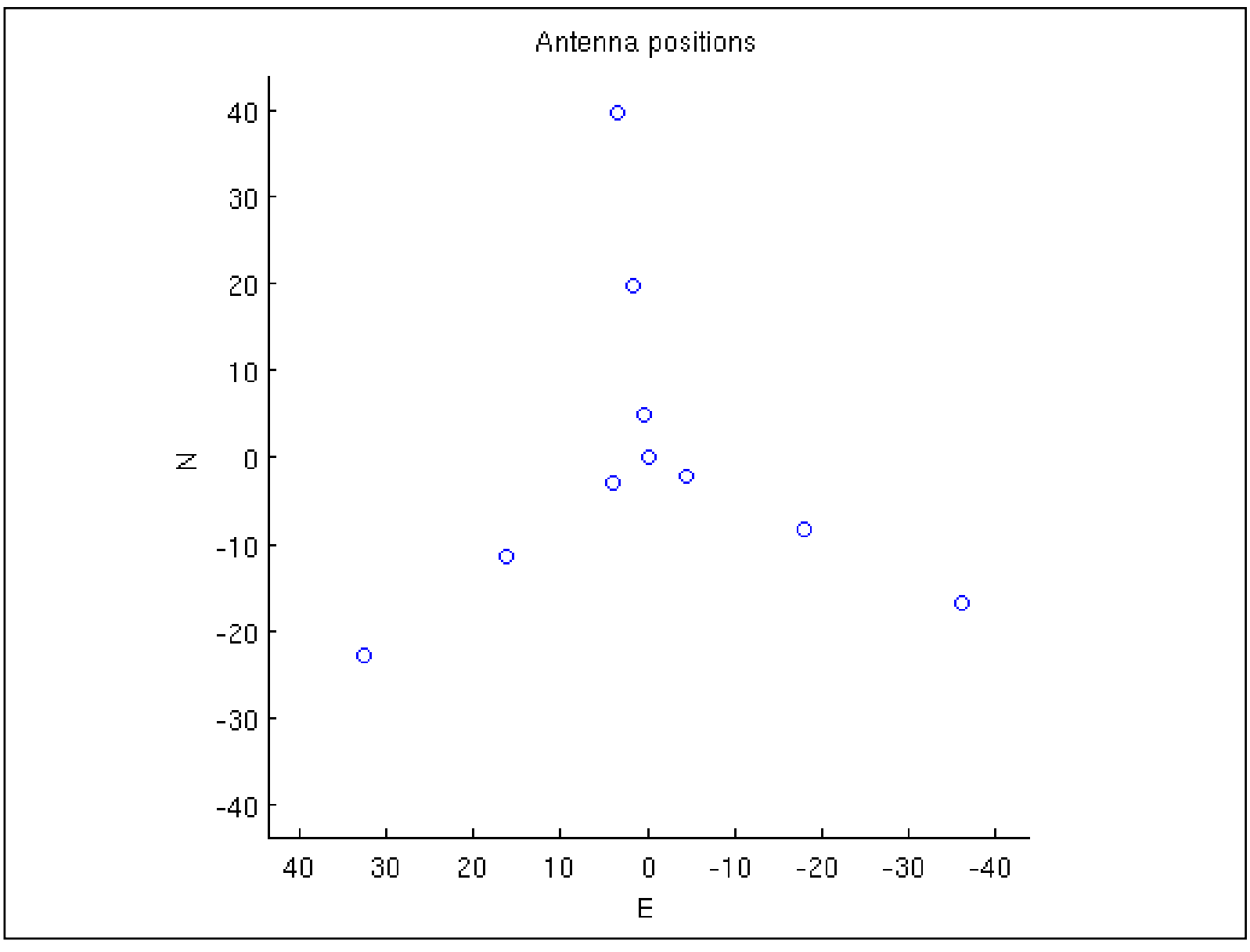

uv coverage, "uniform weighting"
v
u
50
100
150
200
250
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

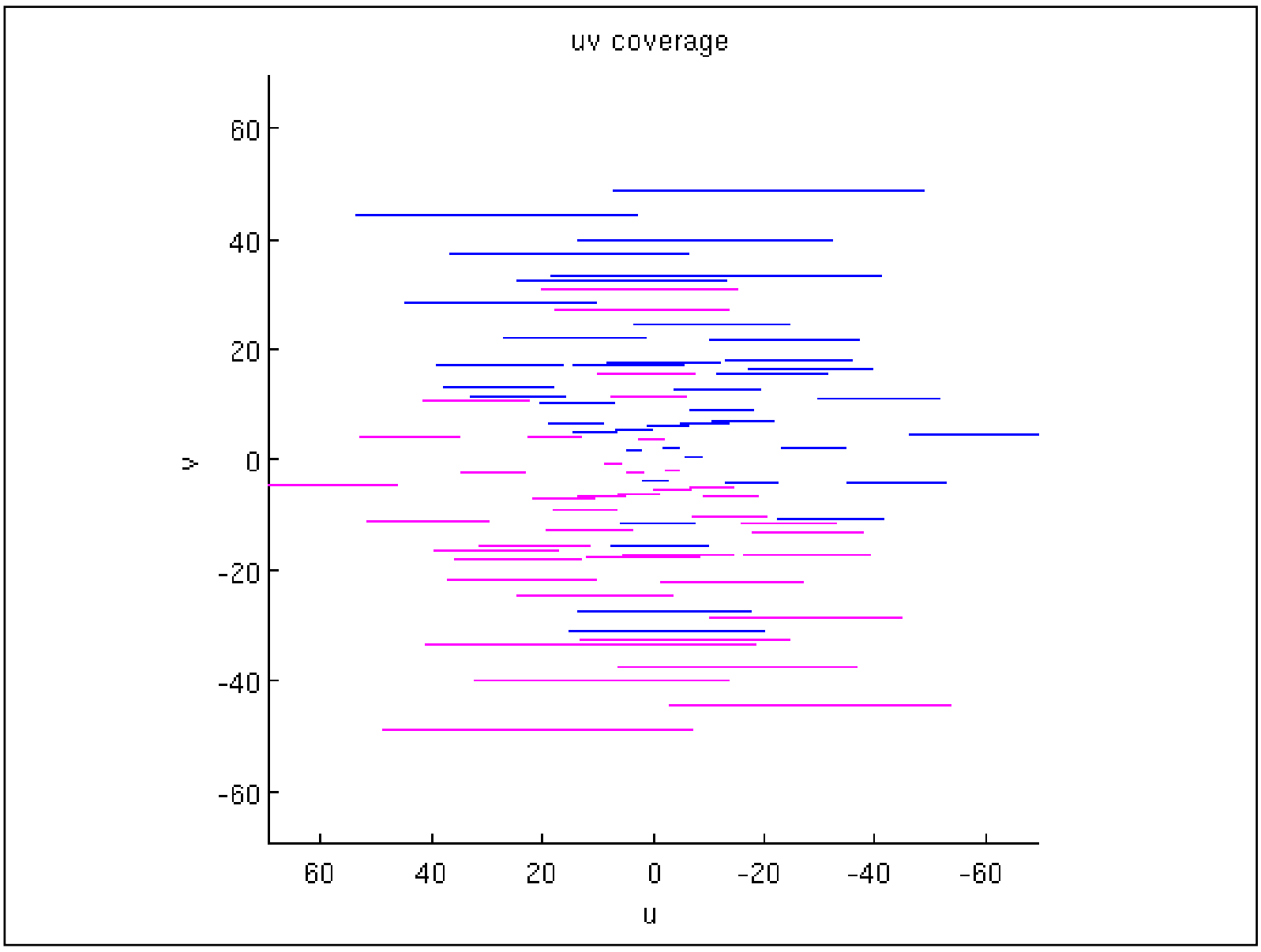

Weights for taper
v
u
50
100
150
200
250
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

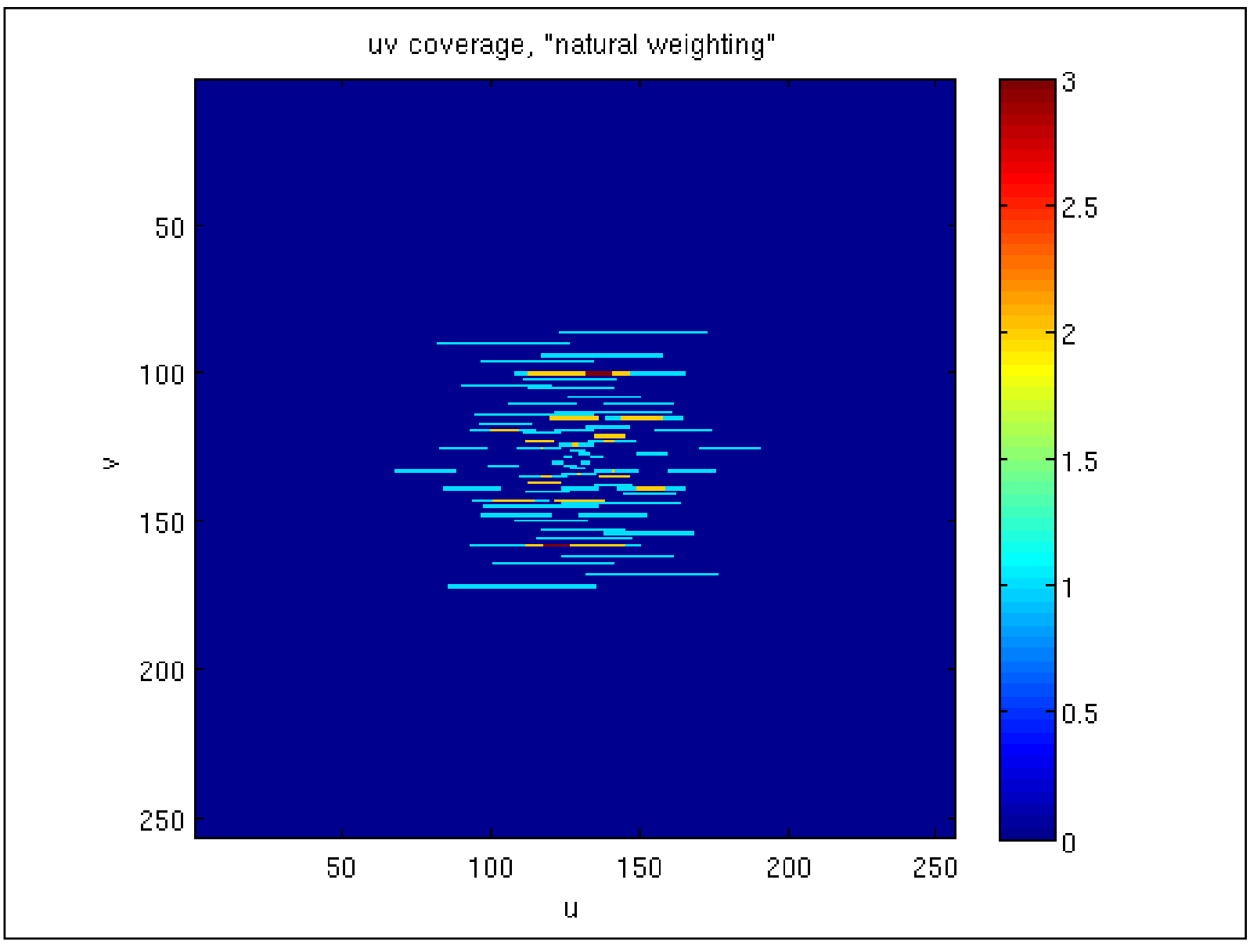

uv coverage, natural weighting
v
u
50 100 150 200 250
0 2 4
uv coverage, uniform weighting
0 0.5 1
uv coverage, tapered uniform weighting
0 0.2 0.4 0.6 0.8
uv coverage, tapered natural weighting
0 0.5 1 1.5 2

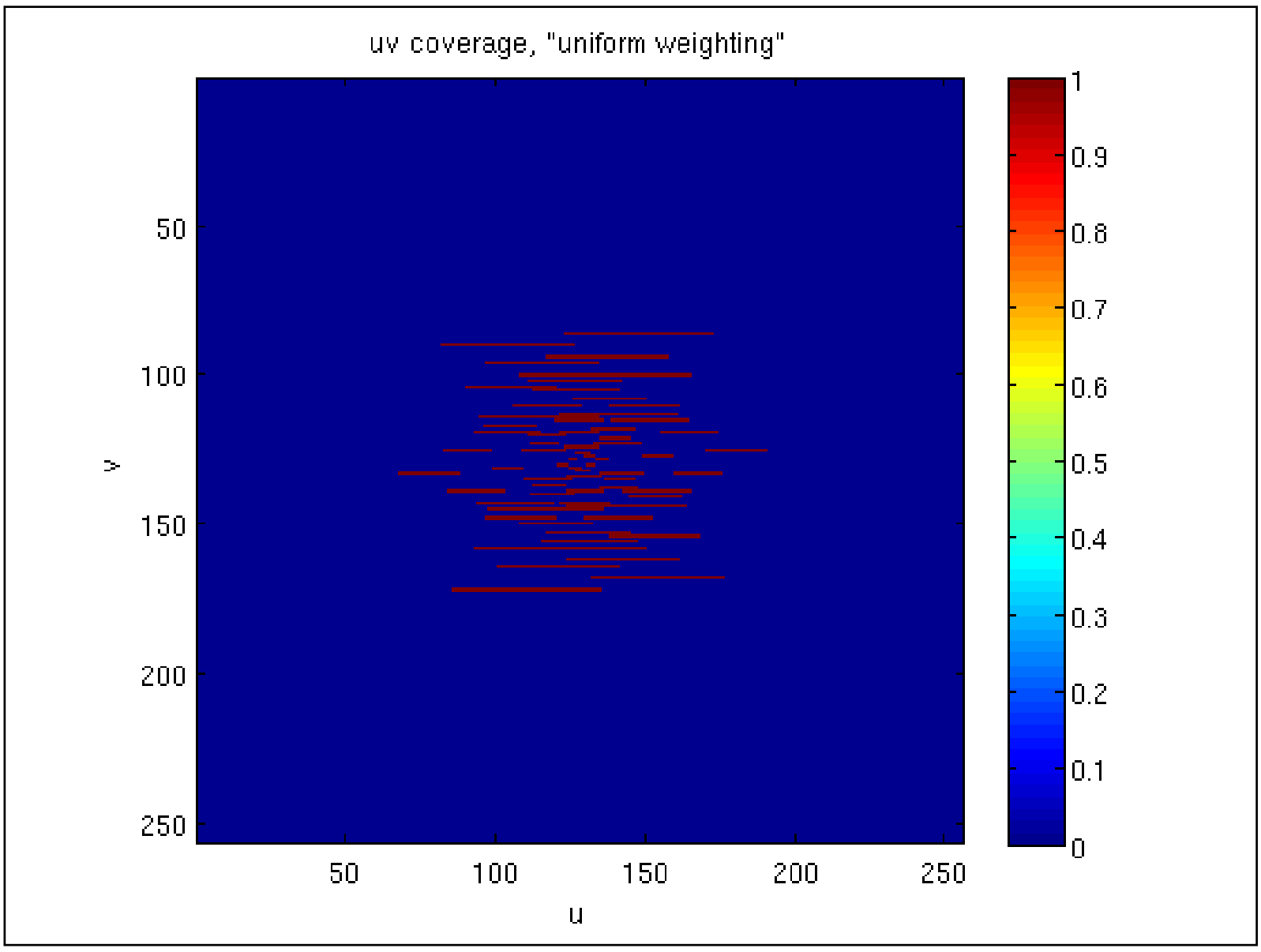

dirty beam, natural weighting
y
x
20 40 60
0 2000 4000
dirty beam, uniform weighting
0 1000 2000 3000
dirty beam, tapered uniform weighting
0 200 400 600
dirty beam, tapered natural weighting
0 200 400 600 800

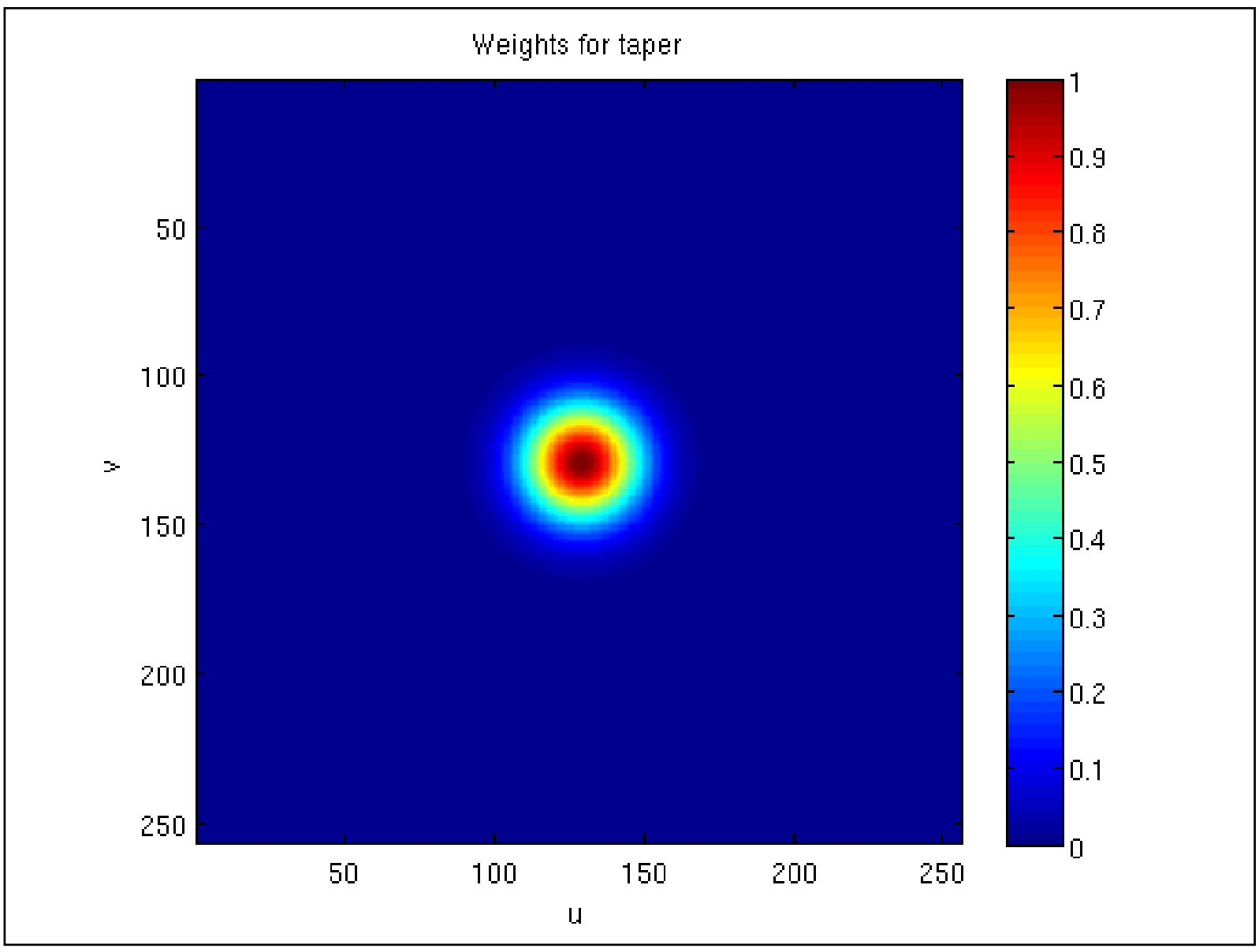
uvAndBeams, Wye, dec 0

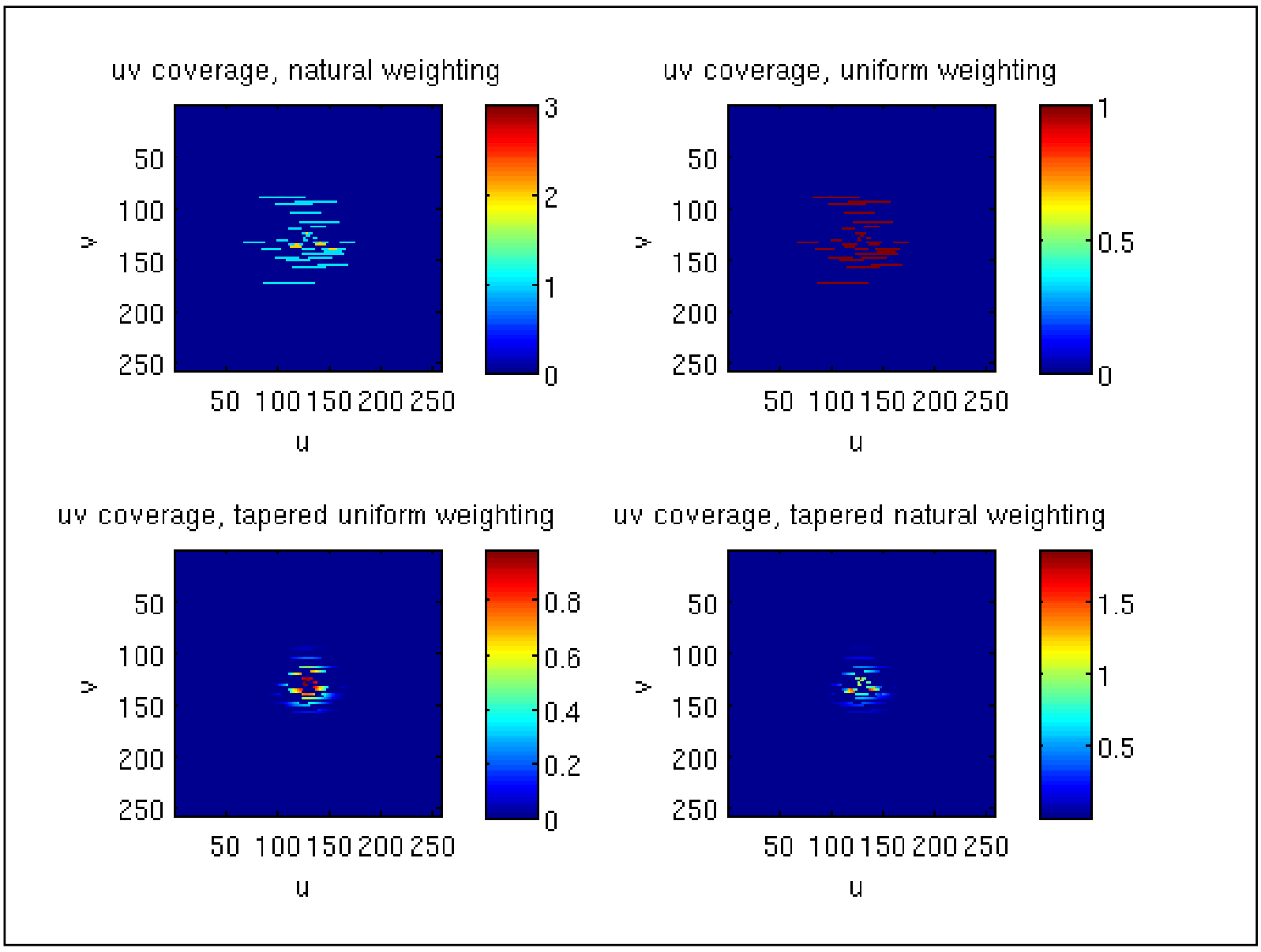


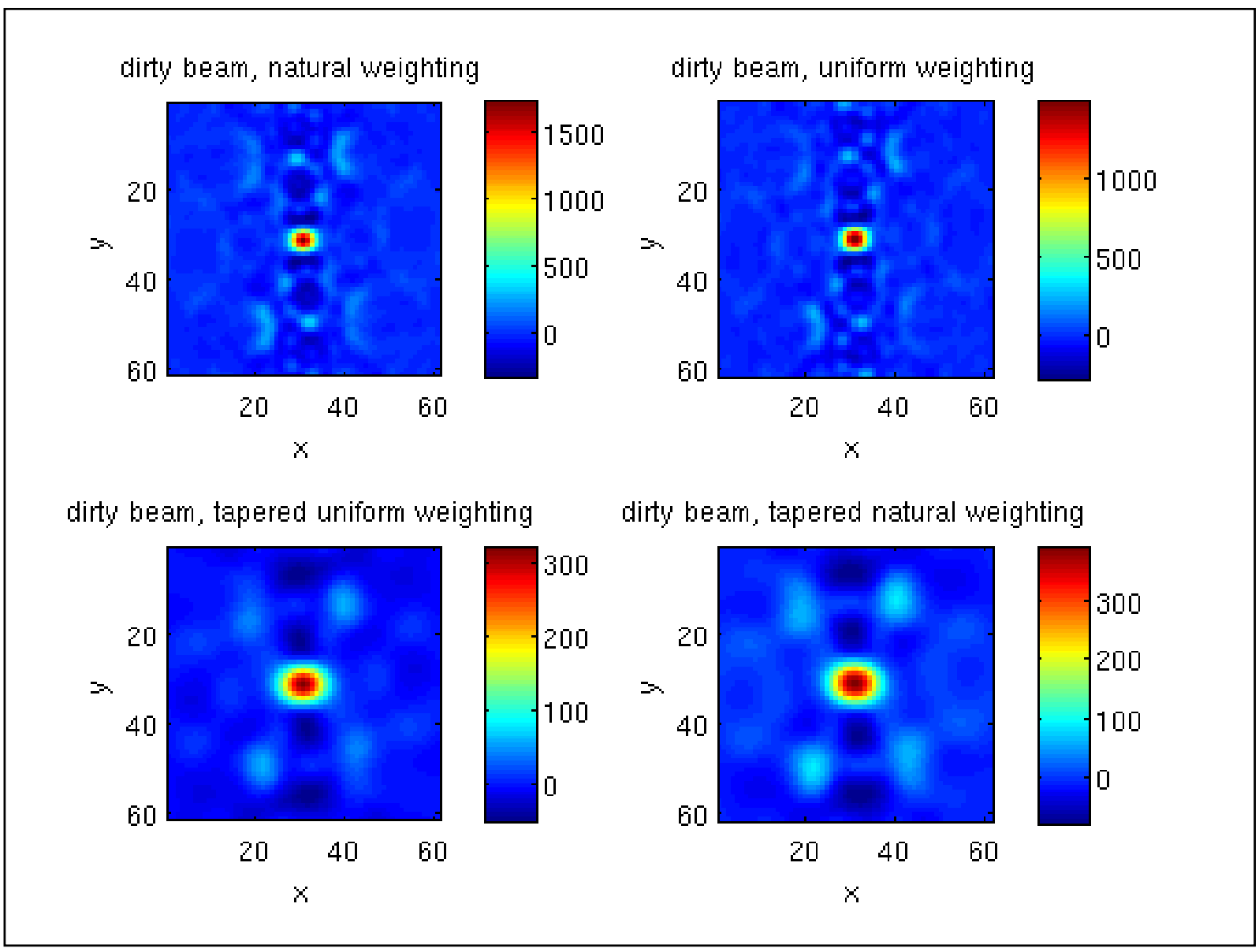

uv coverage
60
40
20
0
-20
-40
-60
v
60
40
20
0
-20
-40
-60
u


uv coverage, "natural weighting"
50
100
150
200
250
v
50
100
150
200
250
u
3
2.5
2
1.5
1
0.5
0

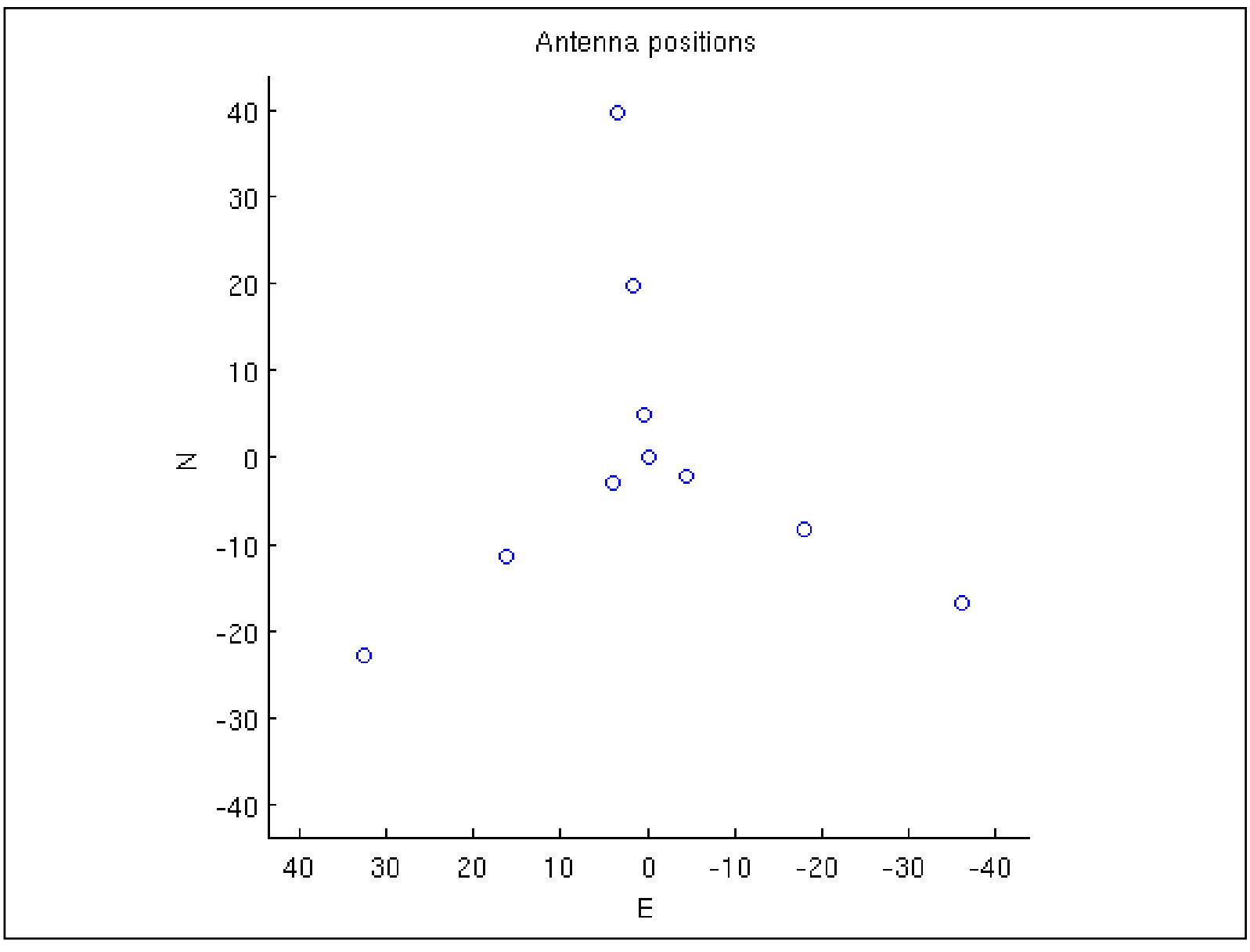

uv coverage, "uniform weighting"
v
u
50
100
150
200
250
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

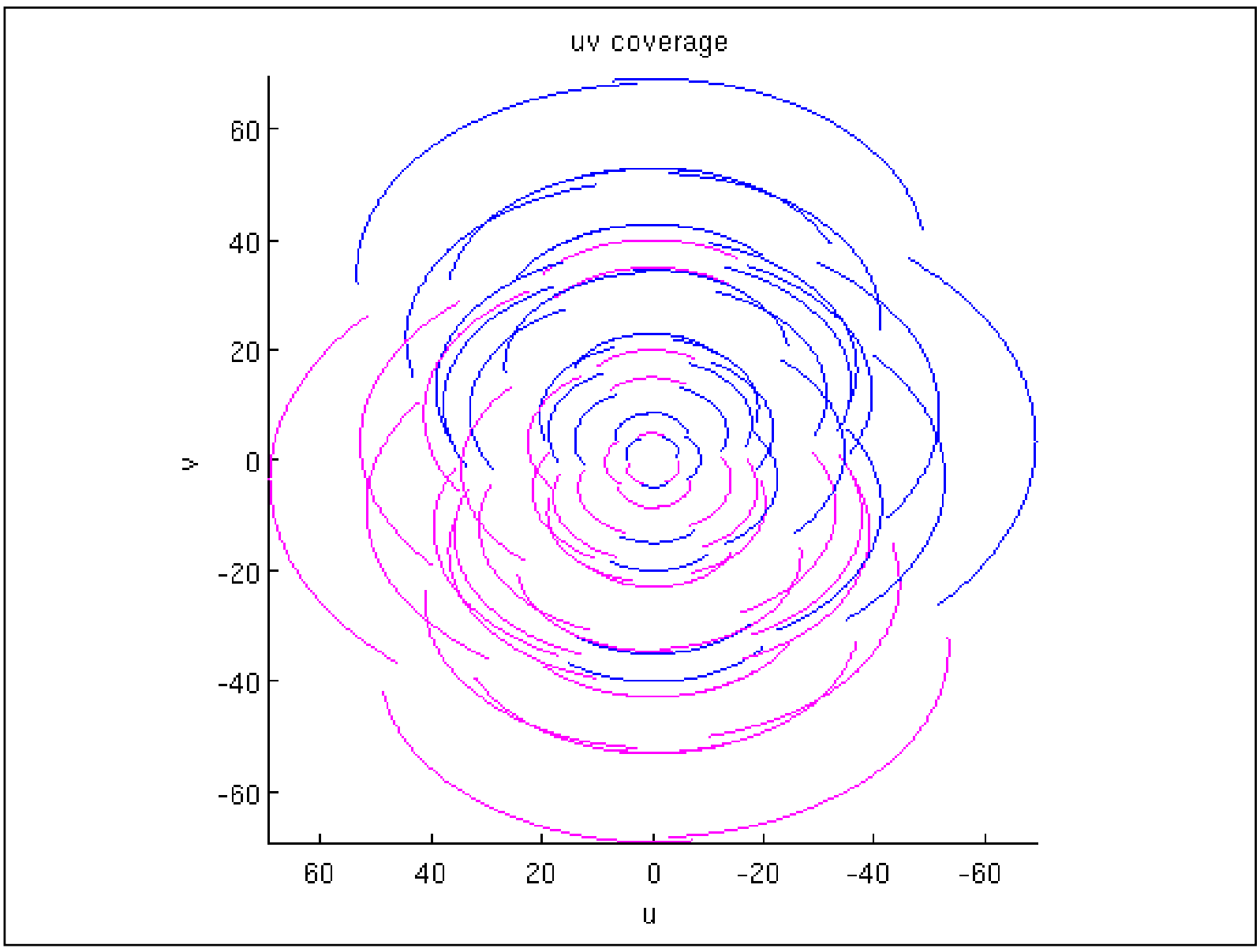

Weights for taper
v
u
50
100
150
200
250
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

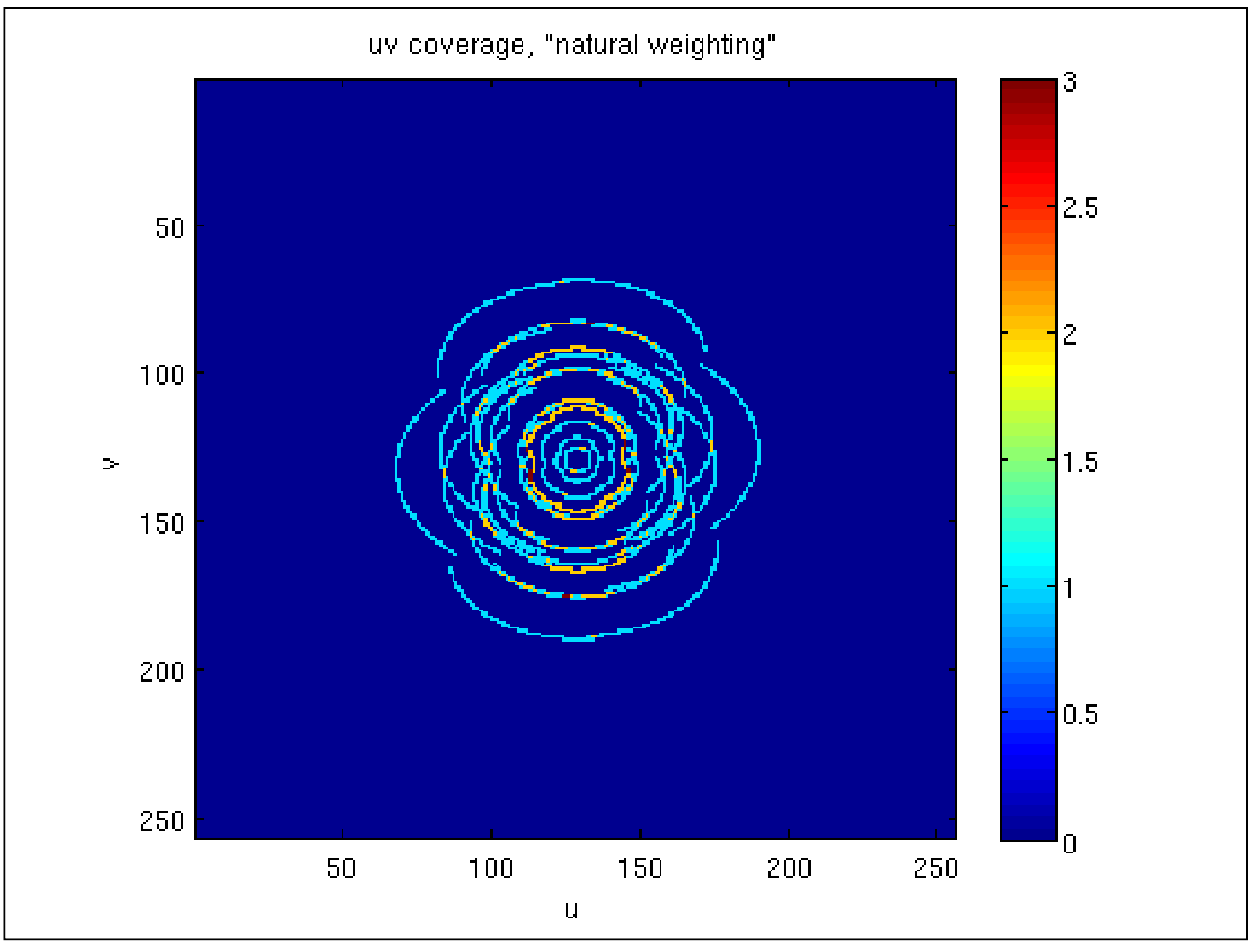

uv coverage, natural weighting
v
u
50 100 150 200 250
3 2 1 0
uv coverage, uniform weighting
1 0.5 0
uv coverage, tapered uniform weighting
0.8 0.6 0.4 0.2 0
uv coverage, tapered natural weighting
1.5 1 0.5

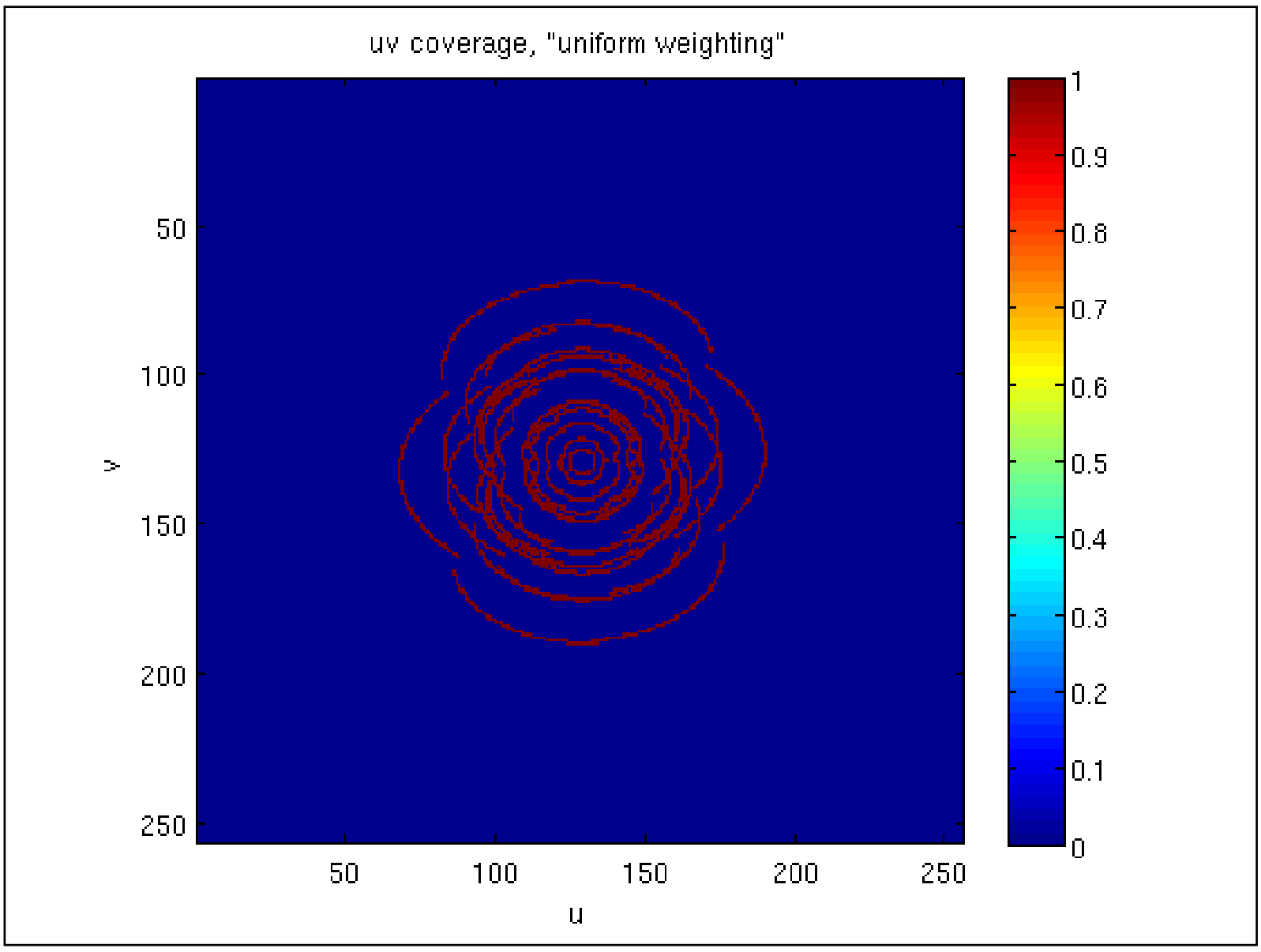

dirty beam, natural weighting
y
x
20 40 60
1500 1000 500 0
dirty beam, uniform weighting
1000 500 0
dirty beam, tapered uniform weighting
300 200 100 0
dirty beam, tapered natural weighting

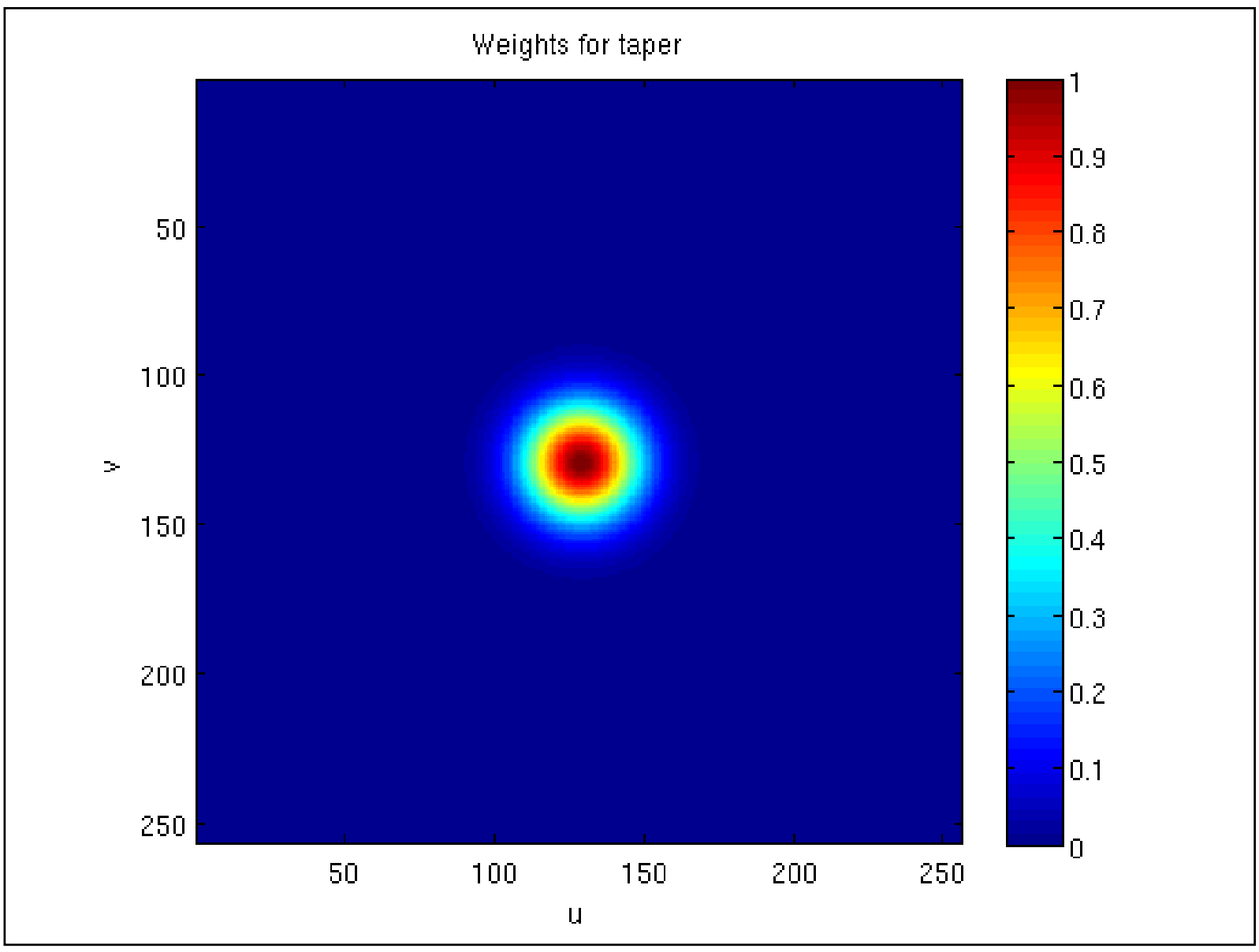
uvAndBeams, Wye, dec 40

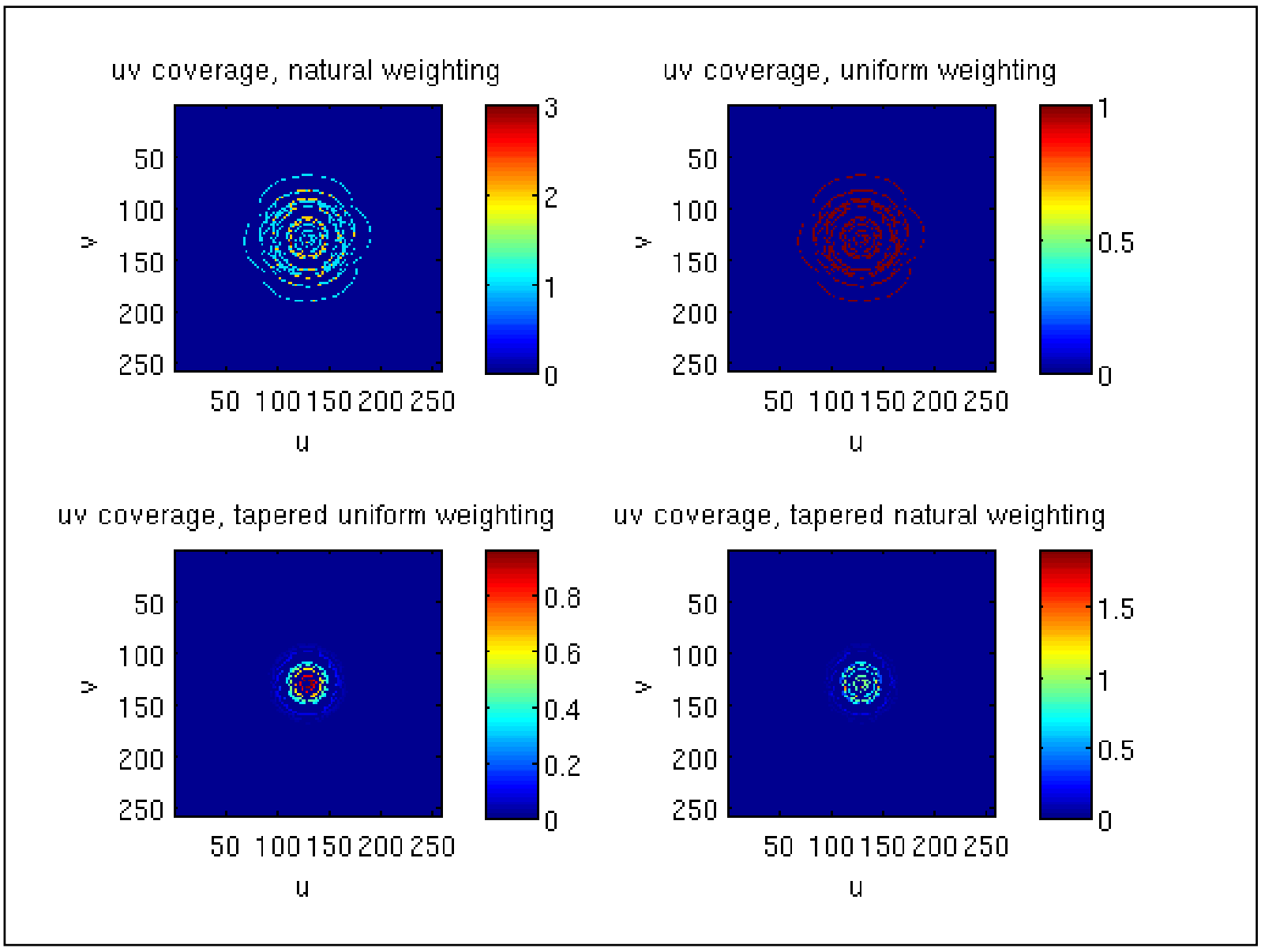


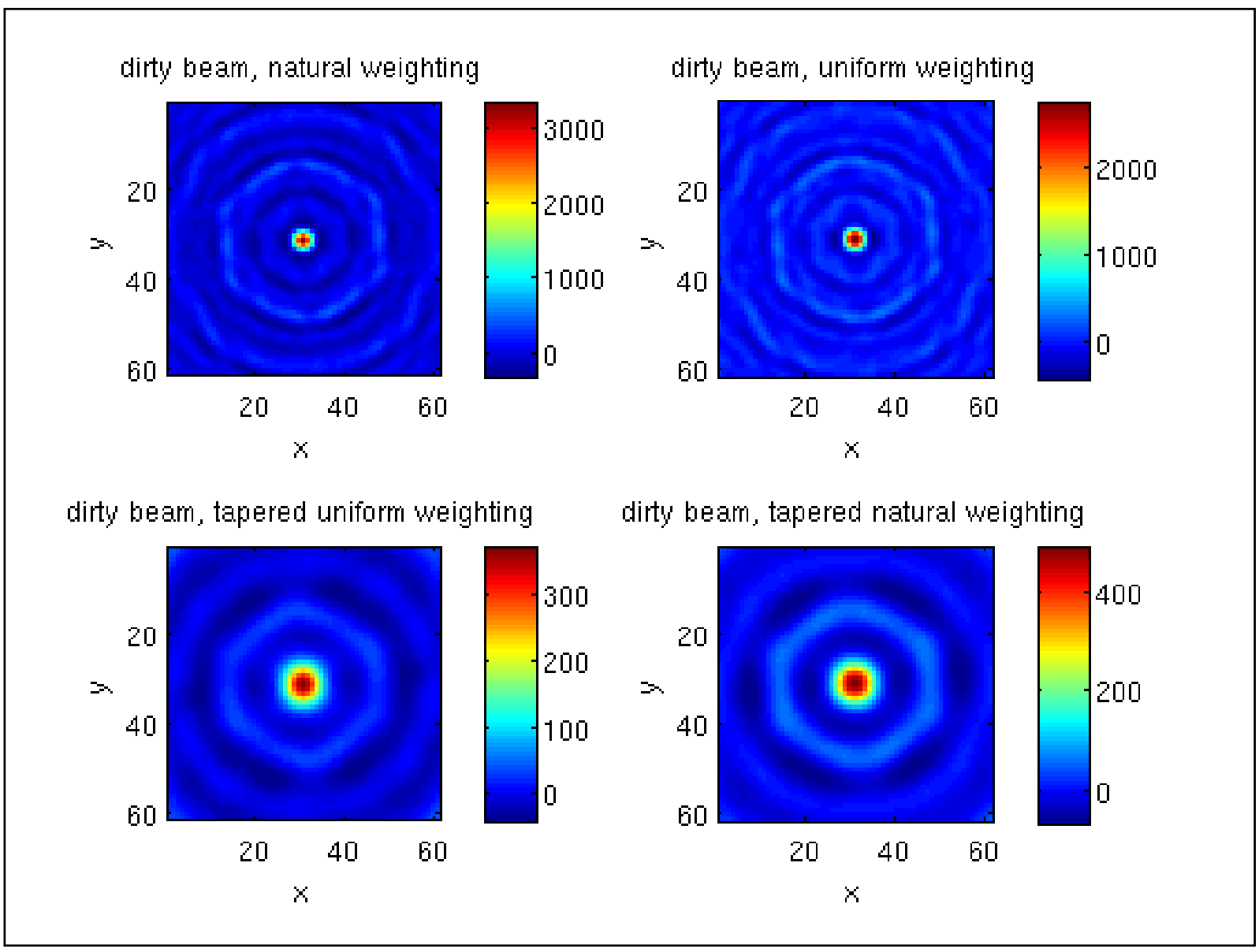

uv coverage
60
40
20
0
-20
-40
-60
v
60
40
20
0
-20
-40
-60
u


uv coverage, "natural weighting"
50
100
150
200
250
v
50
100
150
200
250
u
3
2.5
2
1.5
1
0.5
0


uv coverage, "uniform weighting"
v
u
50
100
150
200
250
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0


Weights for taper
v
u
50
100
150
200
250
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0


uv coverage, natural weighting
v
u
50 100 150 200 250
3
2
1
0
uv coverage, uniform weighting
1
0.5
0
uv coverage, tapered uniform weighting
0.8
0.6
0.4
0.2
uv coverage, tapered natural weighting
1.5


dirty beam, natural weighting
y
x
20 40 60
3000
2000
1000
0
dirty beam, uniform weighting
dirty beam, tapered uniform weighting
300
200
100
dirty beam, tapered natural weighting
400

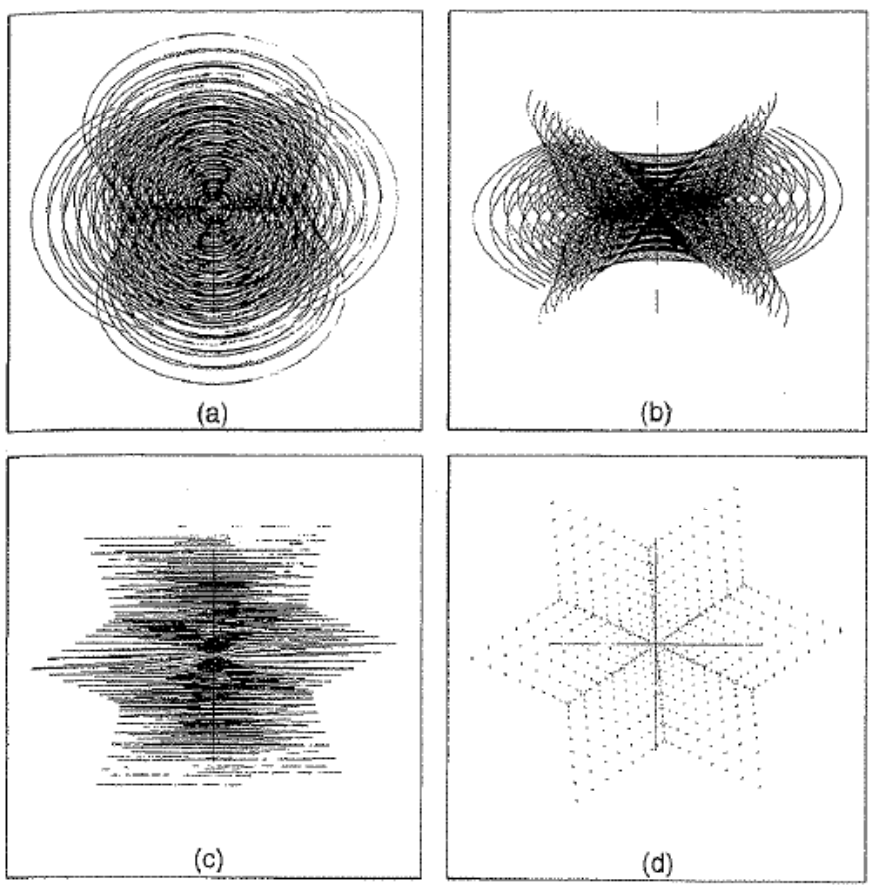
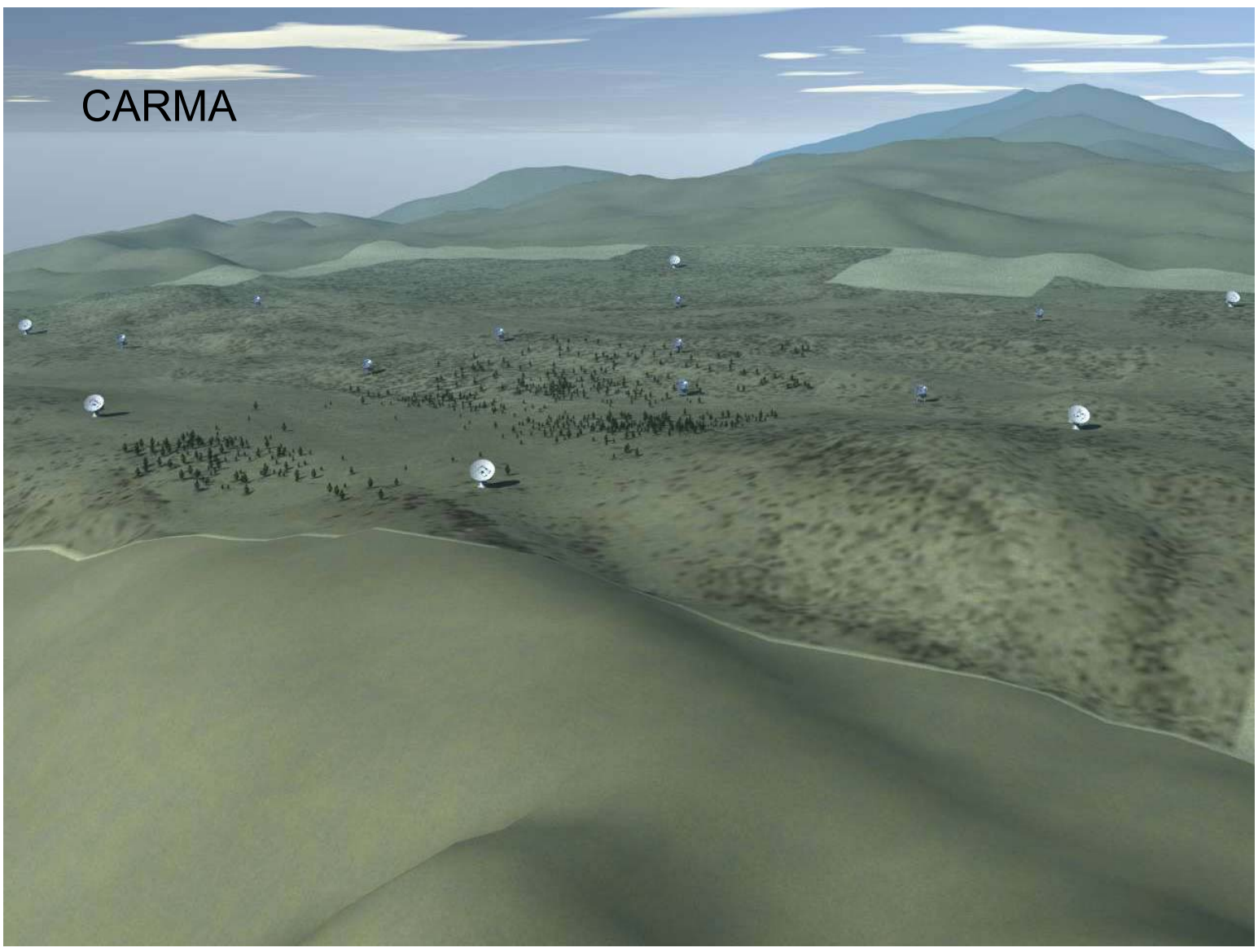
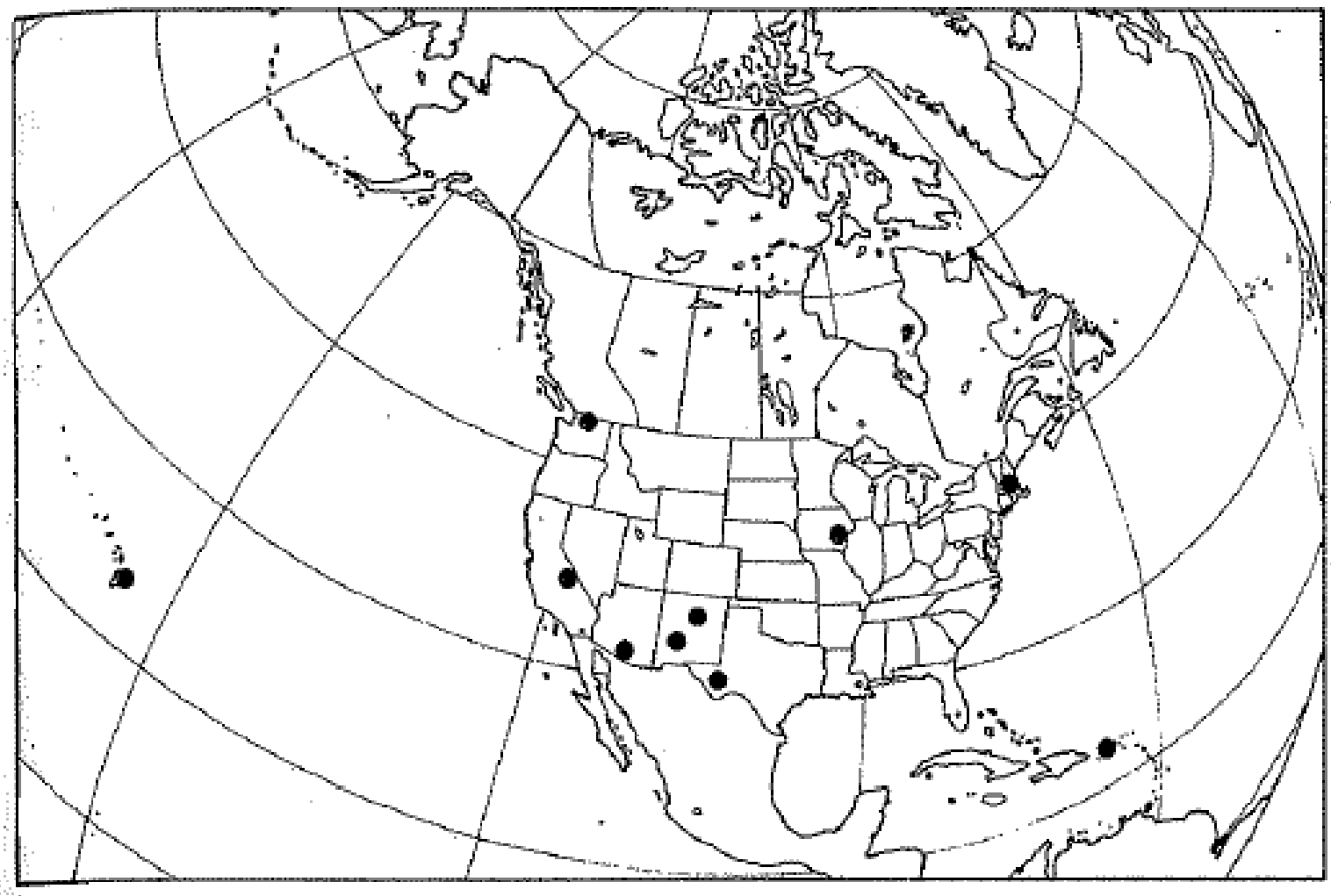


Figure 5.18 Spatial frequency coverage for the VLA with the power-law configuration of Fig. 5.17b: (a) $\delta = 45°$; (b) $\delta = 30°$; (c) $\delta = 0°$; (d) snapshot at zenith. The range of hour angle is ±4 h or as limited by a minimum pointing elevation of 9°, and ±5 min for the snapshot. The lengths of the (u, v) axes from the origin represent the maximum distance of an antenna from the array center, that is, 21 km for the largest configuration. From Napier, Thompson, and Ekers (1983), ©1983 IEEE.

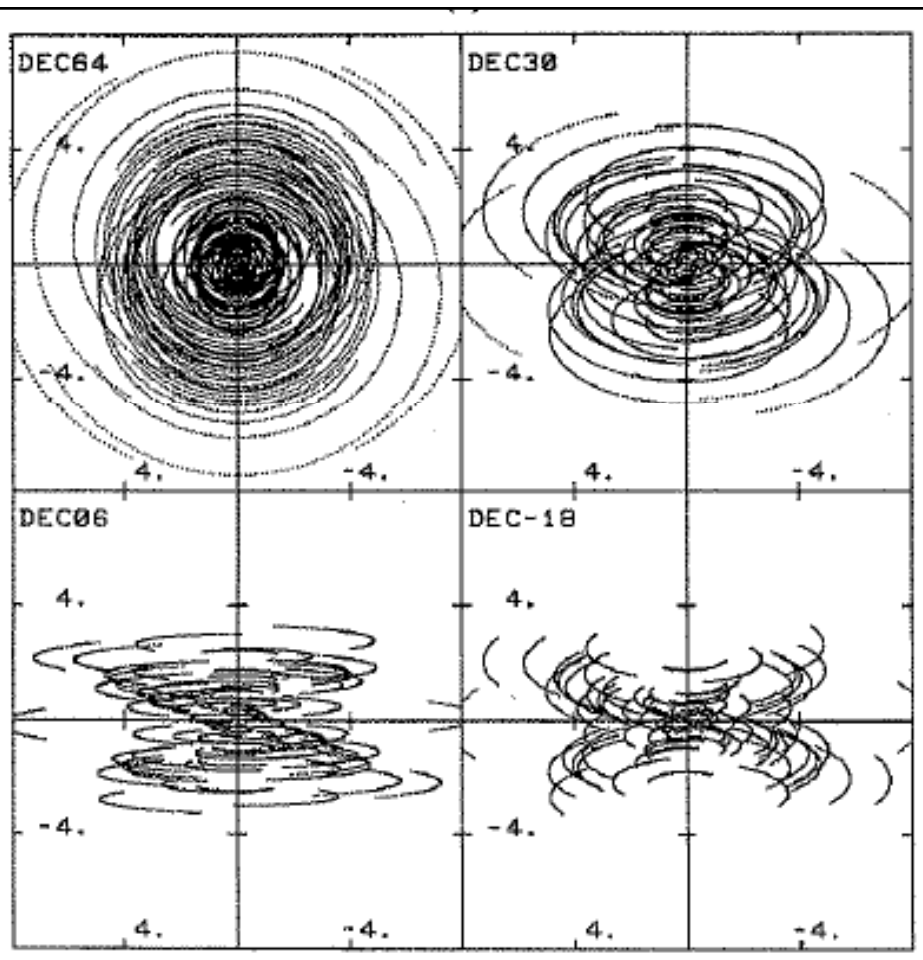
Thomson, Moran & Swenson 2001


CARMA


CARMA



Thomson, Moran & Swenson 2001



(b)

Figure 5.21 Very-Long-Baseline Array in the United States: (a) locations of the 10 antennas, and (b) spatial frequency coverage (spacings in thousands of kilometers) for declinations of 64°, 30°, 6°, and −18°, in which the observing time at each antenna is determined by an elevation limit of 10°. From Walker (1984).

Thomson, Moran & Swenson 2001

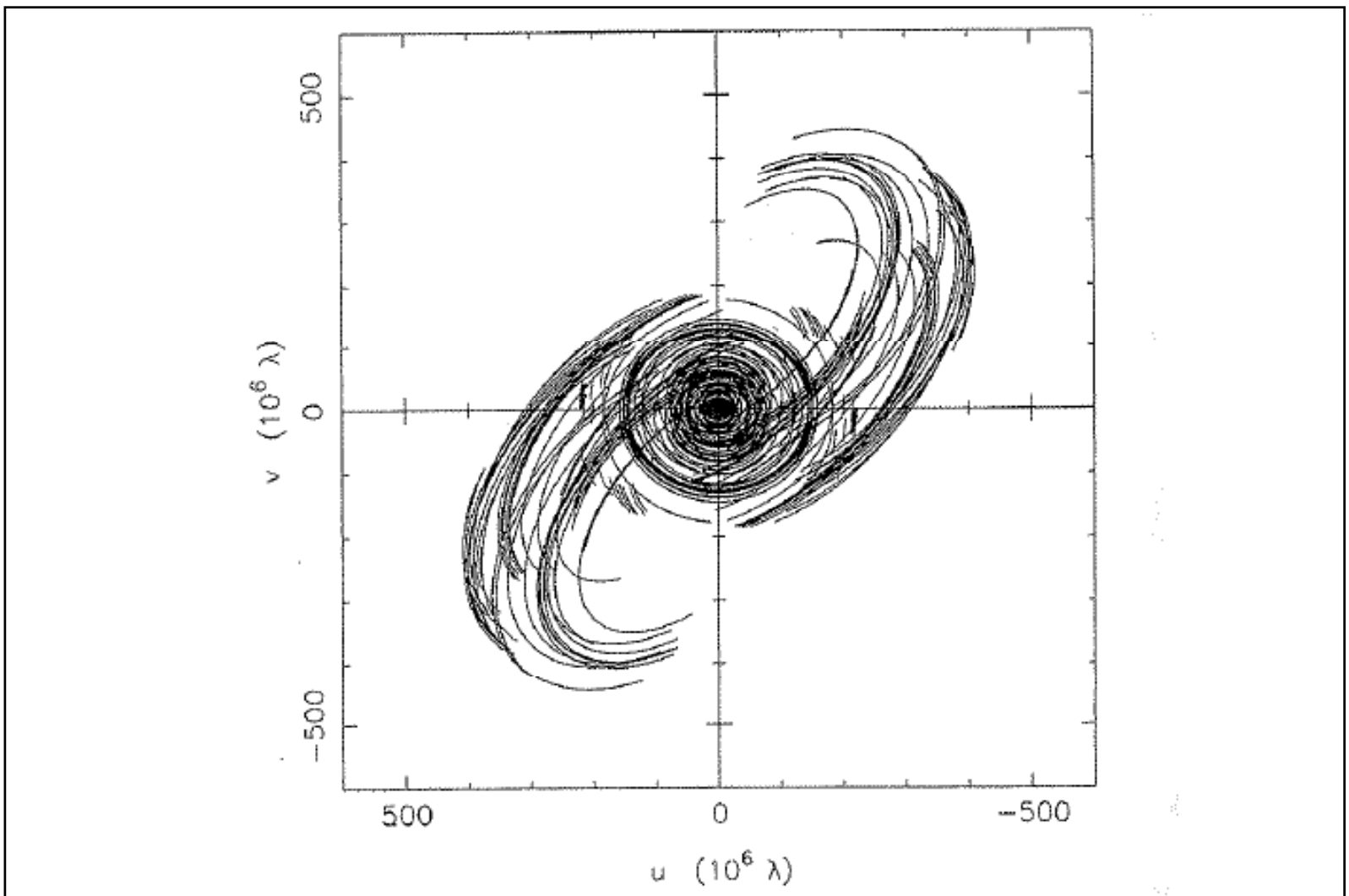
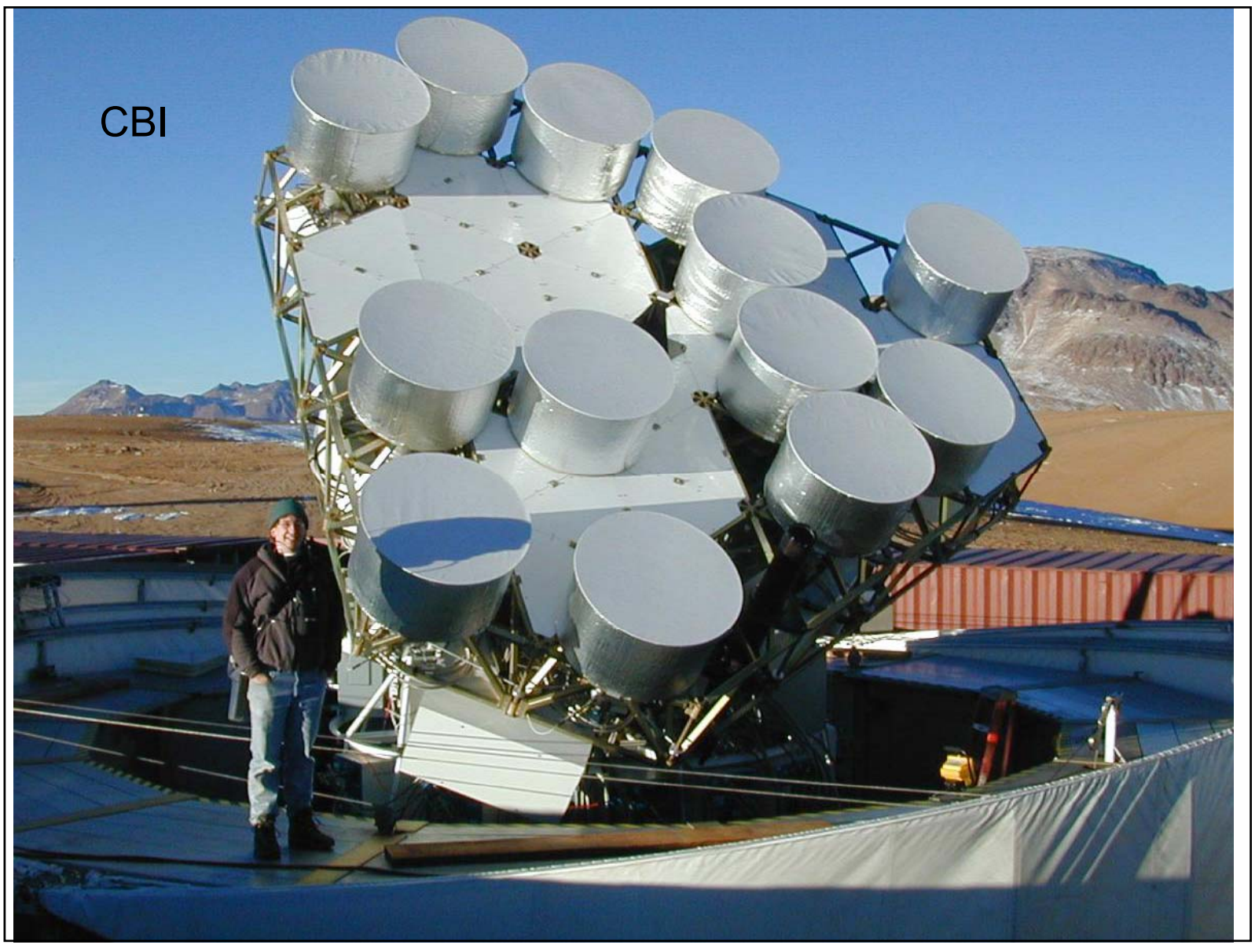


Figure 5.22 An example of spatial frequency coverage for the HALCA satellite with 12 ground-based antennas. This is for an observation of the source 1622 + 633 at 5 GHz frequency. See text for further details.

Thomson, Moran & Swenson 2001



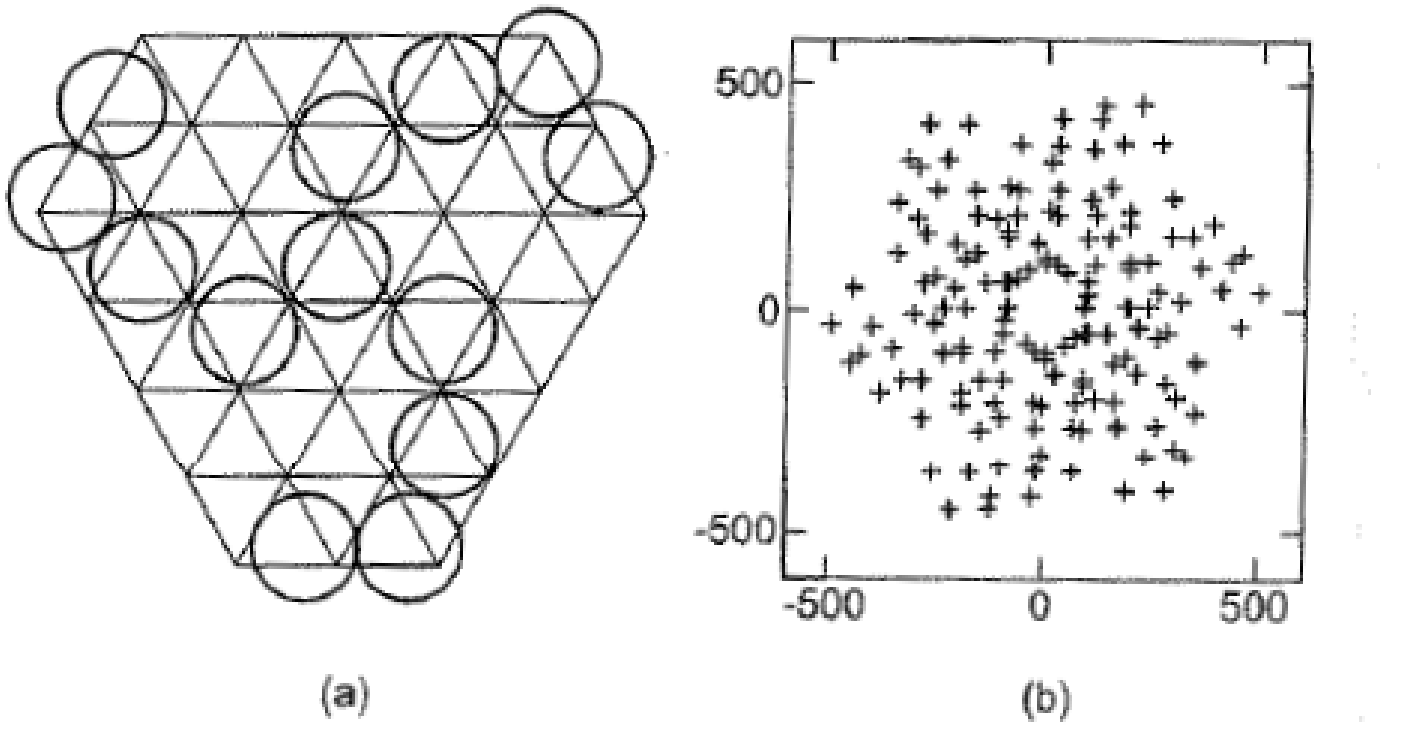
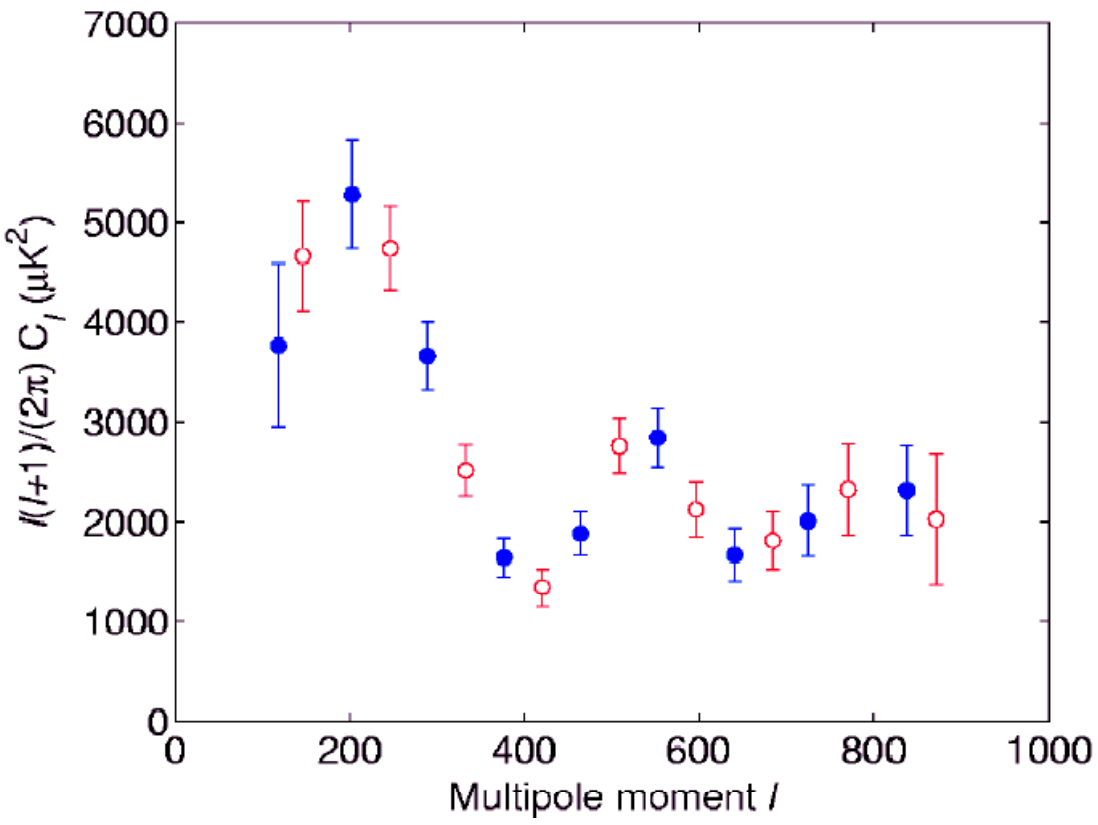


Figure 5.24 (a) Face view of the antenna platform of the Cosmic Background Imager, showing a possible configuration of the 13 antennas. (b) The corresponding antenna spacings in (u, v) coordinates for a wavelength of approximately 1 cm.

Thomson, Moran & Swenson 2001

DASI

Angular power spectrum from the DASI interferometer



Carlstrom et al. 2001