Transfer Function of the LAGEOS-2 Retroreflector Array

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Contents:

1.1 Variation in the range correction.

Ideally the cross section and range correction should be constant. In practice they depend on the incidence angle on the array and the magnitude and direction of the velocity aberration. The diffraction pattern of the array (cross section) tends to be a function primarily of the magnitude of the velocity aberration. A variation with the magnitude of the velocity can be easily corrected during analysis.

1.2 Polarization

With circular polarization the average diffraction pattern of the array has circular symmetry. When linear polarization is used there is an asymmetry that depends on the angle of the transmitted polarization. This causes an asymmetry in the range correction. Correcting for this requires knowing the angle of the transmitted polarization. If this is not known there is no way to correct for the effect and there will be a systematic error.

1.3 Average cross section and centroid matrices

At a single incidence angle the cross section and centroid matrices in the far field are irregular and do not show a well defined symmetry. However when the matrices are

averaged over many incidence angles a well developed symmetry develops. The patterns have circular symmetry for circular polarization. The patterns for linear polarization have a “dumbbell” shape aligned with the polarization vector. In order to determine the average patterns the cross section and centroid matrices in the far field have been computed for linear and circular polarization at 1080 incidence angles from 15 to 90 deg colatitude. The far field matrix is -50 to +50 microradians in each direction in a 51 x 51 matrix with 2 microradians between points. The Longitude is incremented by 5 degrees between points and the colatitude is incremented by .07 deg between points. The incidence angle goes around the satellite once in 72 points. In that time the colatitude increased by .07 x 72 = 5.04 deg. The incidence angle goes around the satellite 15 times as it spirals down to the equator. The cross section and centroid matrices are averaged over the 1080 incidence angles to give the average matrices. This eliminates most of the variations within the pattern at one incidence angle.

1.4 Variation with incidence angle

In order to compute the variation of the cross section and range correction with incidence angle the average cross section and centroid are computed in the velocity aberration annulus between 32 and 40 micoradians for each incidence angle. The average cross section within the annulus is plotted vs incidence angle on the array. In order to reduce the noise and see systematic effects the 1080 points are averages in 72 point bins (one revolution round the sphere) and plotted vs colatitude.

1.5 Geometry of the array

The LAGEOS-2 satellite is a sphere 60 cm in diameter with 426 uncoated circular cube corners 1.5 inches in diameter and 1.096 inches in length. The simulations are done at wavelength 532 nanometers. The index of refraction of the cubes is 1.461 (phase) and 1.484 (group). The phase index is used for the diffraction calculations and the group index is used to compute the optical path length in the cube corner. There is one cube corner at each pole and 9 rings of cubes in each hemisphere. The dihedral angle offset of the cubes is 1.25 arcseconds. Four of the cubes are germanium for infrared ranging. The position and orientation of the cubes are given in Appendix G of the document nasa_tp3400.pdf. Unfortunately, no text version of Appendix G has been located. The PDF file has been converted to text using Adobe Acrobat. There were numerous errors in the conversion that had to be corrected. However, the final copy shows no inconsistencies. In order to avoid anomalies due to loss of internal reflection the orientation angles of the cubes in their mounting have been randomized by rotating each successive cube corner by 26 deg. The rotation angles have been tested by program to check for errors in reading the orientations. Four anomalies have been found. These are known variations in the orientation to accommodate the separation mechanism. They are in cubes 275, 276, 415, and 416. The separation between the rows is not uniform as shown in the Table 1.1. ϕ is the colatitude and θ is the Longitude. All rows begin at Longitude 0 deg, except for rows 3 and 1. These rows begin at half $\Delta\theta$. Row 3 begins at 5.8 deg and row 1 begins at 5.623 deg. The quantities in Table 1.1 are listed at the head of the table.

Spacing of the cubes on LAGEOS-2
In Latitude and longitude

Row A	Previous row
Row B	Current row
ϕA	Colatitude of row A
ϕB	Colatitude of row B
$\phi B - \phi A$	Difference in latitude between rows B and A
$\Delta\theta$	Longitude difference between the cubes in row B
Cubes	Number of cubes in row B

Row A	Row B	ϕA	ϕB	$\phi B - \phi A$	$\Delta\theta$	#Cubes Row B
-	10	-	0.00000	-	-	1
10	9	0.00000	10.12000	10.12000	60.00000	6
9	8	10.12000	19.85000	9.73000	30.00000	12
8	7	19.85000	29.58000	9.73000	20.00000	18
7	6	29.58000	39.31000	9.73000	15.65200	23
6	5	39.31000	49.04000	9.73000	13.33300	27
5	4	49.04000	58.77000	9.73000	11.61300	31
4	3	58.77000	67.01700	8.24700	11.61300	31
3	2	67.01700	76.74700	9.73000	11.25000	32
2	1	76.74700	85.13700	8.39000	11.25000	32
1	1	85.13700	94.86300	9.72600	11.25000	32
1	2	94.86300	103.25300	8.39000	11.25000	32
2	3	103.25300	112.98300	9.73000	11.61300	31
3	4	112.98300	121.23000	8.24700	11.61300	31
4	5	121.23000	130.96000	9.73000	13.33300	27
5	6	130.96000	140.69000	9.73000	15.65200	23
6	7	140.69000	150.42000	9.73000	20.00000	18
7	8	150.42000	160.15000	9.73000	30.00000	12
8	9	160.15000	169.88000	9.73001	60.00000	6
9	10	169.88000	180.00000	10.12000	-	1

Table 1.1. Separation of the cubes in Latitude and Longitude

The rows do not all have the maximum number of cubes that would fit. The table below shows a comparison of the number of cubes that would fit with the actual number.

Maximum and actual number of cubes in each ring

Row	#cubes Maximum	Latitude	#cubes Lageos2	Δ cubes
10	1	90.00000	1	0
9	6	80.52632	6	0
8	12	71.05263	12	0
7	18	61.57895	18	0
6	23	52.10526	23	0
5	27	42.63158	27	0
4	31	33.15789	31	0
3	34	23.68421	31	3
2	36	14.21053	32	4
1	37	4.73684	32	5
1	37	-4.73684	32	5
2	36	-14.21053	32	4
3	34	-23.68421	31	3
4	31	-33.15789	31	0
5	27	-42.63158	27	0
6	23	-52.10526	23	0
7	18	-61.57895	18	0
8	12	-71.05263	12	0
9	6	-80.52632	6	0
10	1	-90.00000	1	0

Table 1.2. Comparison of the actual number of cubes vs the maximum number of cubes that will fit in each row.

2. Cross section vs incidence angle.

Figure 2.1 below plots the average cross section in the 32 to 40 microradians annulus for all 1080 points vs colatitude.

Linear polarization
Cross section vs Colatitude

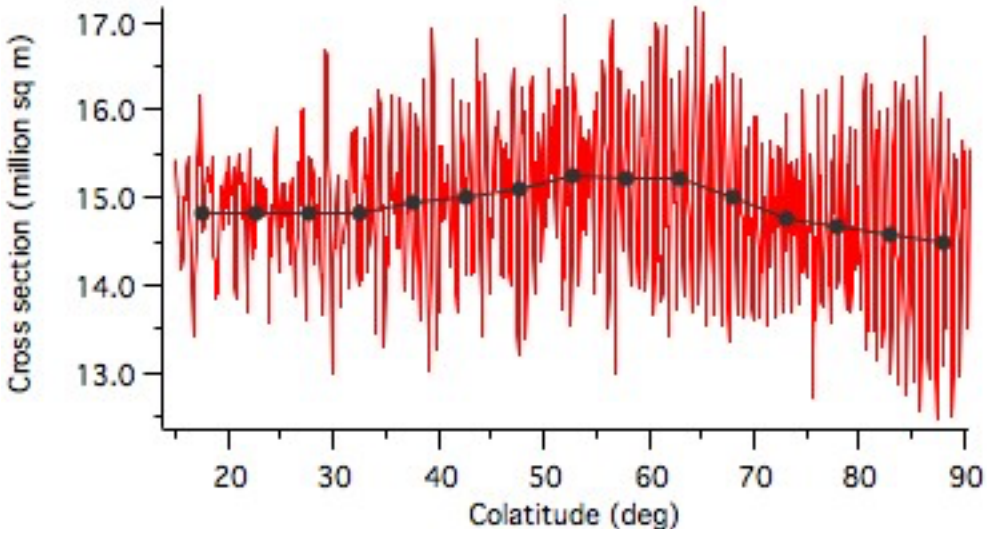


Figure 2.1. Cross section (million sq m) vs colatitude with linear polarization. The black line is the cross section averaged over sets of 72 points. This is one revolution around the satellite with the Colatitude changing by about 5 deg. The averaged data is listed in Table 3.2. There is a small systematic variation with Colatitude that may result from the uneven spacing of rows and/or the number of cubes in the rows.

Cross section (million sq m)

Minimum	Maximum	Max - Min	Average	rms
12.4734	17.1746	4.7012	14.9065	0.8461

Table 2.1. Statistics for Figure 2.1.

Circular polarization
Cross section vs Colatitude

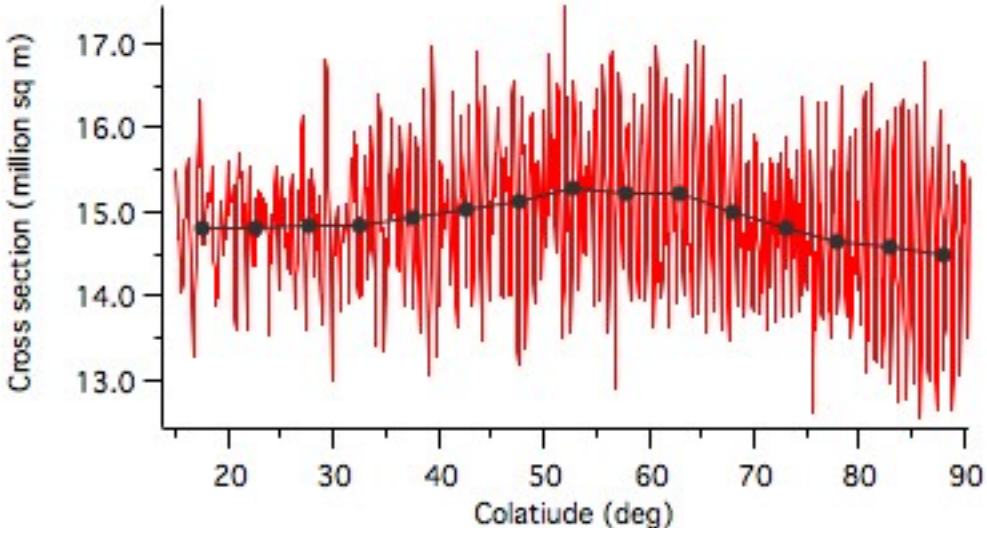


Figure 2.2. Cross section (million sq m) vs colatitude with circular polarization. The black line is the cross section averaged over 5 deg intervals (data is listed in Table 3.4). There is a small systematic variation with Colatitude.

Cross section (million sq m)

Minimum	Maximum	Max - Min	Average	rms
12.5498	17.4459	4.8961	14.9075	0.8563

Table 2.2. Statistics for Figure 2.2.

3. Centroid vs incidence angle on the array.

Linear polarization

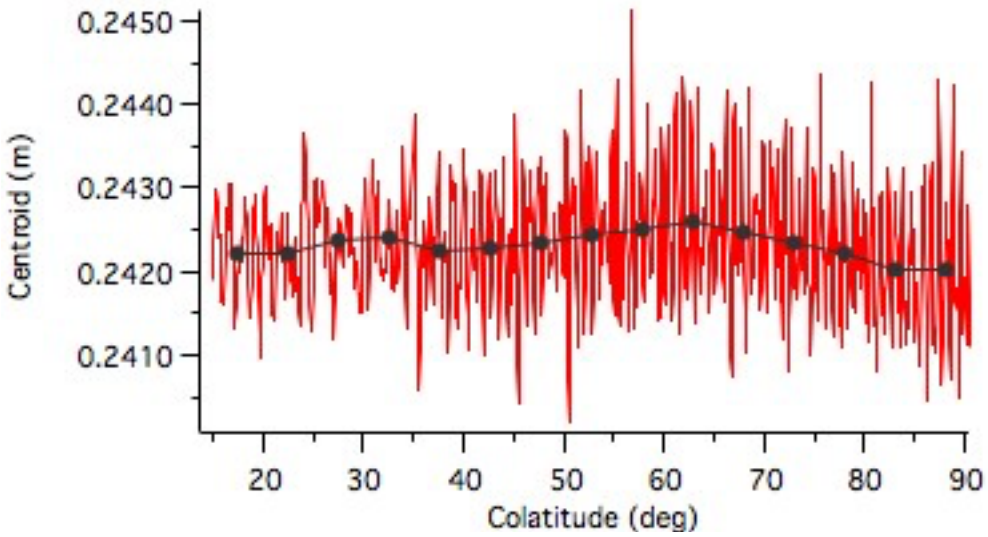


Figure 3.1. Centroid (m) vs colatitude (deg) for linear polarization. The black line is the average over 5 deg intervals (see data in Table 3.2).

Minimum	Maximum	Max - Min	Average	rms
0.2402	0.2451	0.0049	0.2423	0.0007

Table 3.1. Statistics for Figure 3.1.

Data averaged over 5 deg colatitude bins. Linear polarization

Colatitude (deg)	Centroid (m)	Cross section
17.485	0.242206	14.822880
22.525	0.242198	14.830550
27.565	0.242357	14.829441
32.605	0.242413	14.836330
37.645	0.242242	14.931862
42.685	0.242265	15.010650
47.725	0.242329	15.107971
52.765	0.242422	15.258680
57.805	0.242504	15.220080
62.845	0.242600	15.235780
67.885	0.242470	15.000390
72.925	0.242354	14.771533
77.965	0.242207	14.665040
83.005	0.242033	14.587513
88.045	0.242018	14.488712

Table 3.2. Centroid and cross section vs Colatitude. The change in centroid between 62 and 88 deg is .6 mm. This is well within the accuracy requirements.

Circular polarization

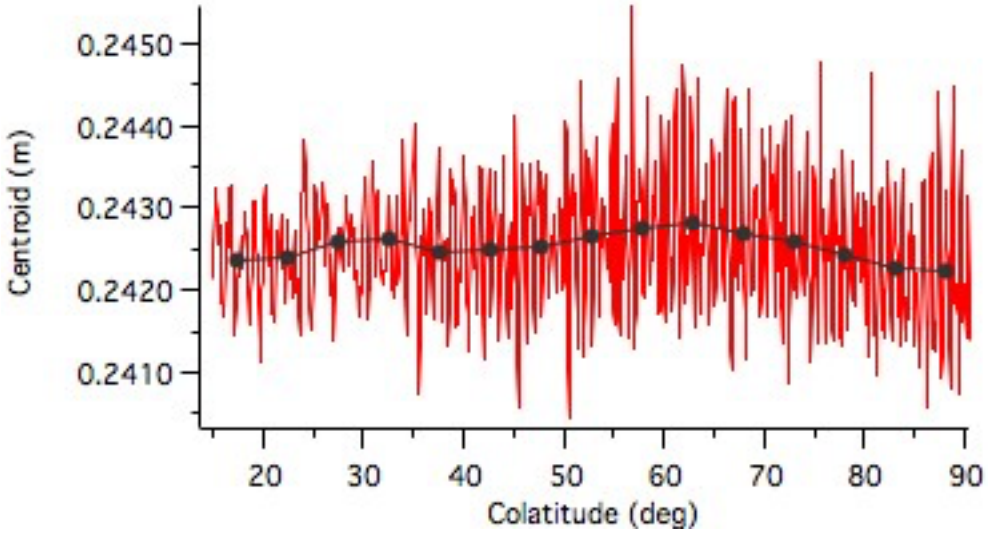


Figure 3.2. Centroid vs colatitude for circular polarization. The black line is the average over 5 deg intervals (see data in table 3.4).

Minimum	Maximum	Max - Min	Average	rms
0.2404	0.2454	0.0050	0.2425	0.0007

Table 3.3. Statistics for Figure 3.2.

Data averaged over 5 deg colatitude bins. Circular polarization

Colatitude (deg)	Centroid (m)	Cross section
17.485	0.242372	14.816582
22.525	0.242408	14.817140
27.565	0.242574	14.825460
32.605	0.242616	14.843044
37.645	0.242469	14.933510
42.685	0.242478	15.024034
47.725	0.242535	15.126020
52.765	0.242657	15.285630
57.805	0.242743	15.204870
62.845	0.242806	15.222863
67.885	0.242685	14.996952
72.925	0.242577	14.796310
77.965	0.242429	14.656312
83.005	0.242267	14.574364
88.045	0.242247	14.489284

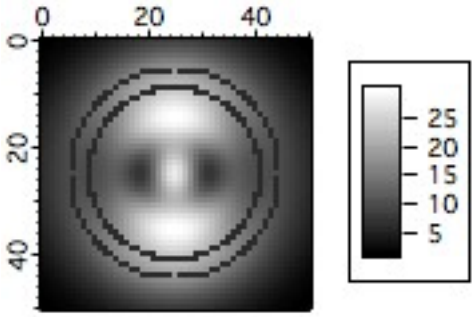
Table 3.4. Centroid and cross section vs Colatitude. The change in centroid between 62 and 88 deg is .6 mm. This is well within the accuracy requirements.

4. Cross section and centroid matrices

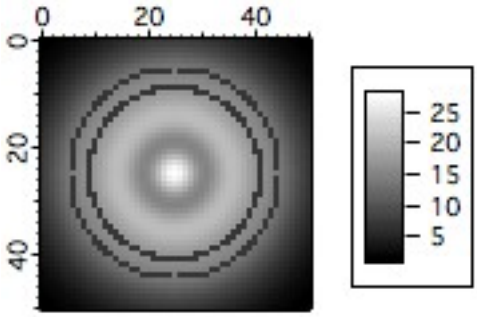
4.1 Images

The figures below plot the average cross section (million sq m) and centroid (m) matrices in the far field. The circles are at velocity aberration 32 -39 microradians that is the velocity aberration range at the LAGEOS altitude. The position of the receiver in the far field is determined by the magnitude and direction of the velocity aberration.

Cross section (million sq m)

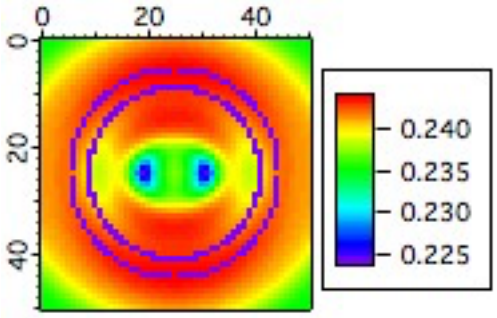


Linear polarization
Fig. 4.1

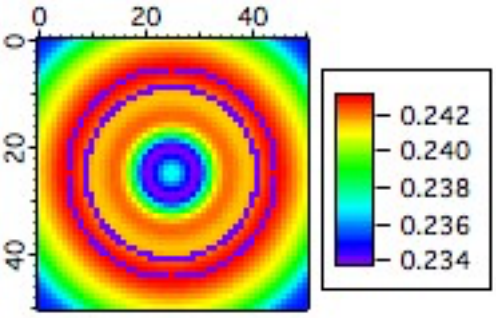


Circular polarization
Fig 4.2

Centroid (m)



Linear polarization
Fig. 4.3



Circular polarization
Fig. 4.4

The dimensions of the plots are from -50 to +50 microradians in each direction. The circles are at 32 and 39 microradians. Figures 4.1 and 4.3 show the asymmetry due to using linear polarization. Figure 4.3 shows that there is a bias in the centroid depending on the direction of the velocity aberration. Figures 4.2 and 4.4 have good circular symmetry.

Figures 4.5 and 4.6 show plots of the range correction around circles in the far field patterns shown in Fig. 4.3 and 4.4. The plots begin on the + x axis and go around the pattern counterclockwise.

4.2 Asymmetry

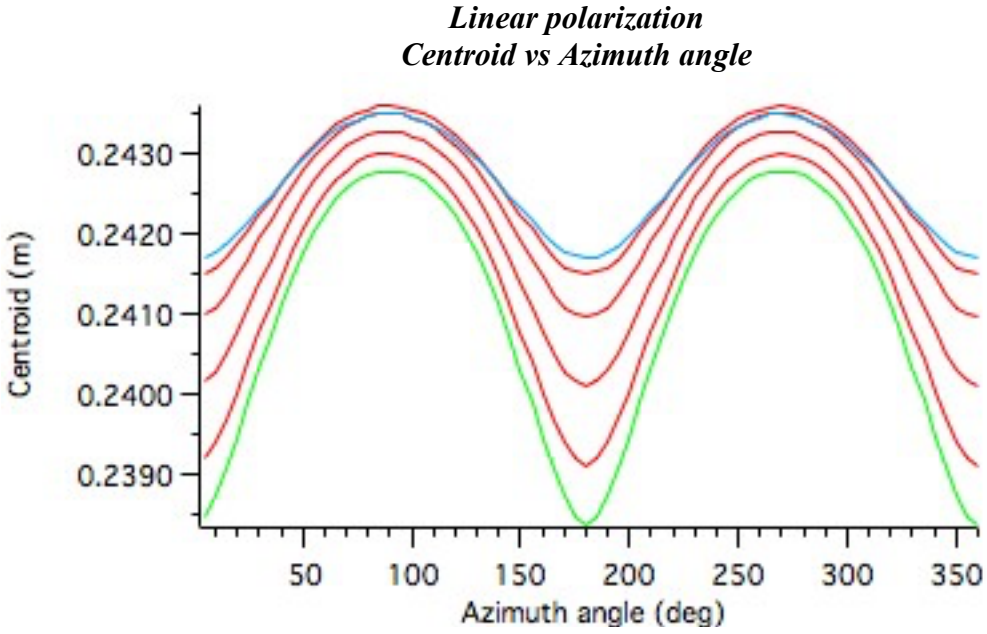


Figure 4.5. Centroid vs azimuth angle for linear polarization at 30,32,34,36,38, & 40 microradians. Green is at radius 30 microradians and blue is at 40 microradians. The azimuth is measured counterclockwise from the + x axis. The average centroid increases with velocity aberration as plotted in Fig. 6.2.

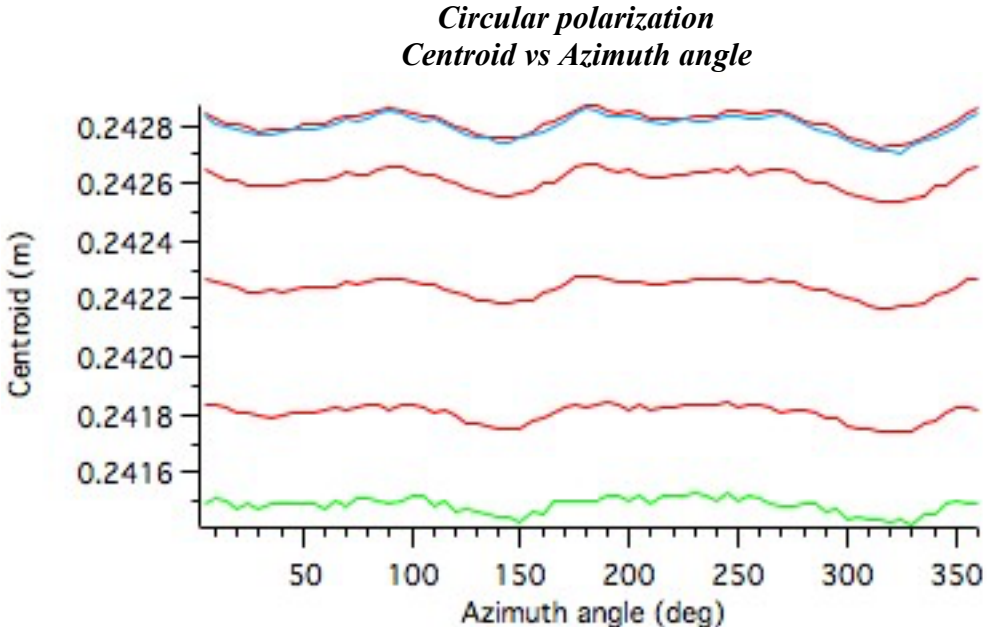


Figure 4.6. Centroid vs azimuth angle for circular polarization at 30,32,34,36,38, & 40 microradians. Green is at radius 30 microradians and blue is at 40 microradians. Fig 4.4 shows the centroid matrix. The azimuth is measured counterclockwise from the + x axis. The average centroid increases with velocity aberration as plotted in Fig. 7.2.

5. Cross section vs velocity aberration.

Linear polarization

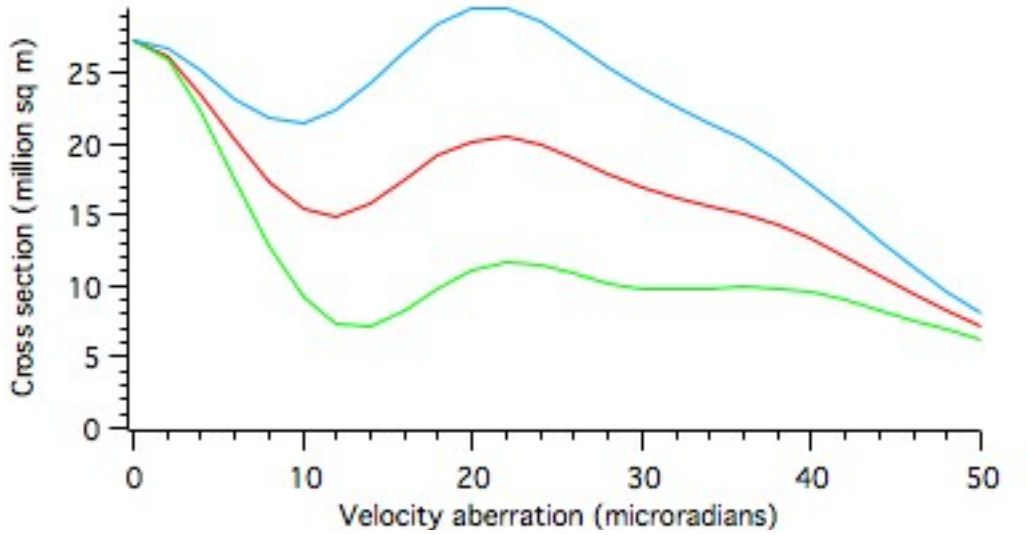


Figure 5.1 Minimum (green), average (red), and maximum (blue), linear polarization

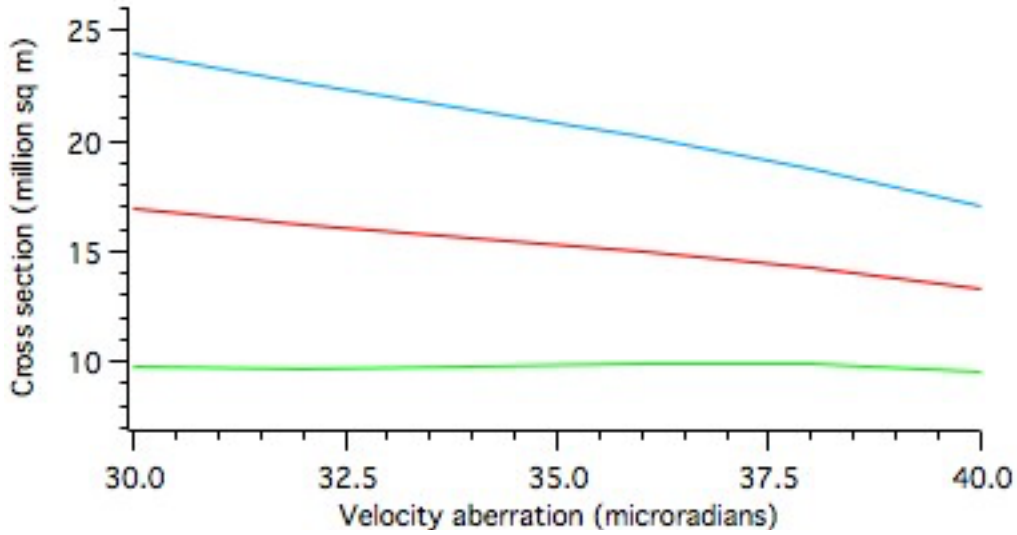


Figure 5.2. Expanded version of fig 5.1

Vel. Aberration	Minimum	Average	Maximum
30.0	9.8105600	16.8826289	23.9311830
32.0	9.7132310	16.1820324	22.6413420
34.0	9.8139840	15.6291844	21.4592230
36.0	9.9196720	15.0417732	20.2107410
38.0	9.8546390	14.2715693	18.7538710
40.0	9.5352890	13.2612326	17.0459380

Table 5.1. Data for Fig 5.2

Circular polarization

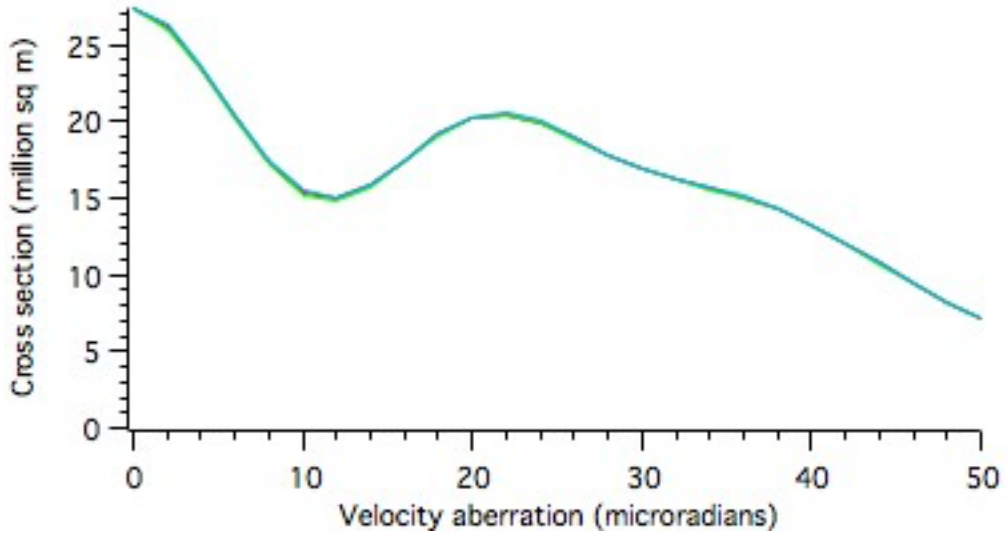


Figure 5.3. Green (minimum), red (average), blue (maximum)

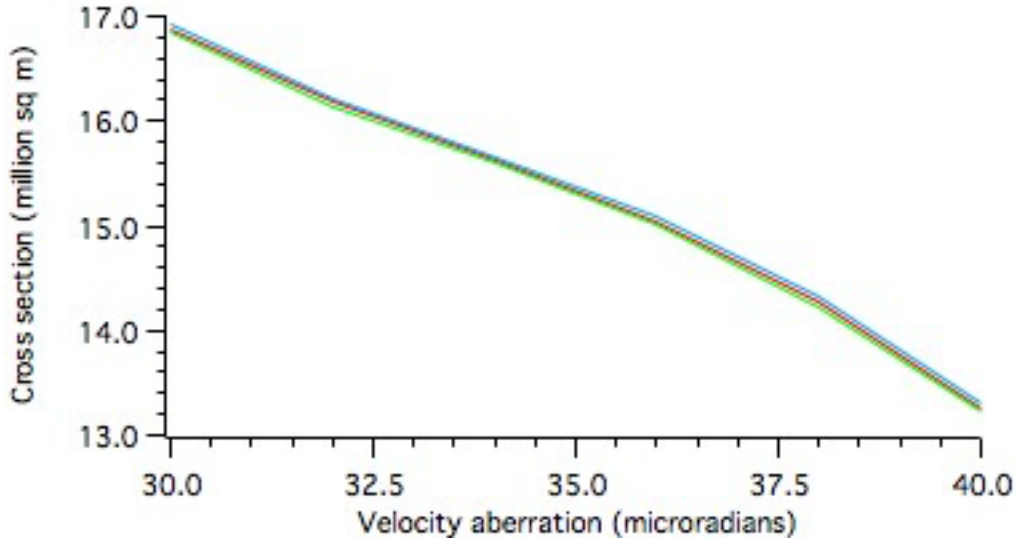


Figure 5.4. Expanded version of Fig. 5.3

Vel. Aberration	Minimum	Average	Maximum
30.0	16.8370504	16.8829313	16.9132633
32.0	16.1451291	16.1824647	16.2110761
34.0	15.5950179	15.6298535	15.6622710
36.0	15.0078128	15.0426896	15.0884200
38.0	14.2325581	14.2727022	14.3236070
40.0	13.2279678	13.2625051	13.3068470

Table 5.1. Data for Fig 5.4.

6. Centroid vs velocity aberration, linear polarization.

6.1 Centroid vs velocity aberration

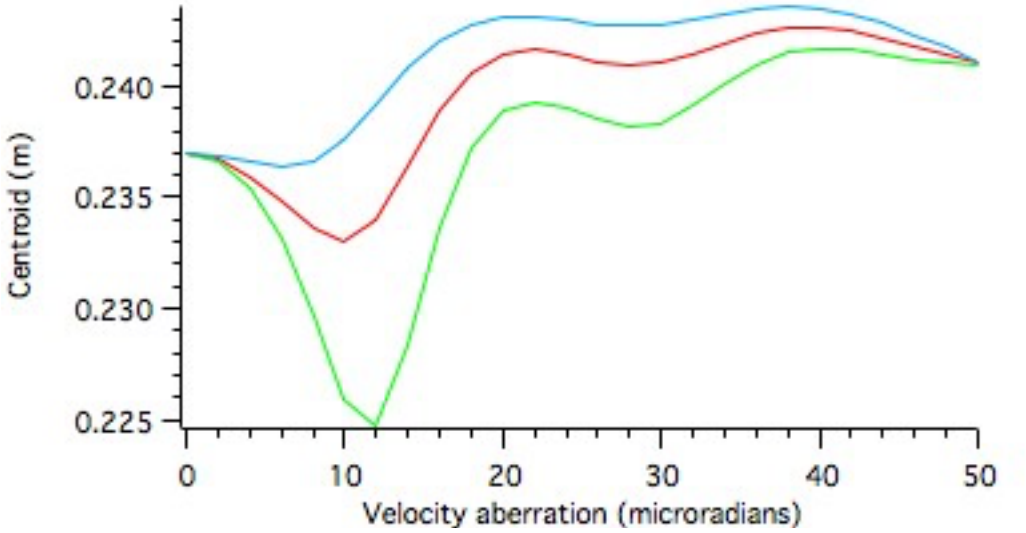


Figure 6.1. Green (minimum), red (average), blue (maximum), linear polarization

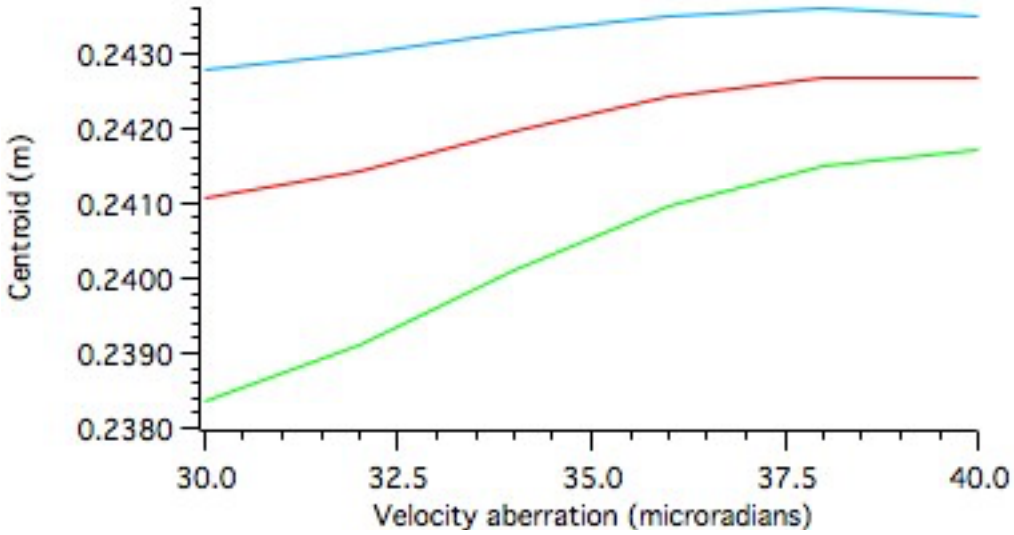


Figure 6.2. Expanded plot of Fig. 6.1, linear polarization

Vel. Aberration	Minimum	Average	Maximum	Max - Min
30.0	0.2383600	0.2410509	0.2427700	0.0044100
32.0	0.2391100	0.2414399	0.2429900	0.0038800
34.0	0.2400900	0.2419594	0.2432800	0.0031900
36.0	0.2409500	0.2424075	0.2435100	0.0025600
38.0	0.2415000	0.2426602	0.2436000	0.0021000
40.0	0.2417000	0.2426808	0.2435100	0.0018100

Table 6.1 Data for Fig 6.2. Centroid (m) vs velocity aberration

The average varies by 1.2 mm from .2414 m at 32 to .2426 m at 40 microradians. The asymmetry of the centroid matrix (Max – Min) varies from 1.8 to 3.9 mm.

6.2 Asymmetry vs Velocity aberration

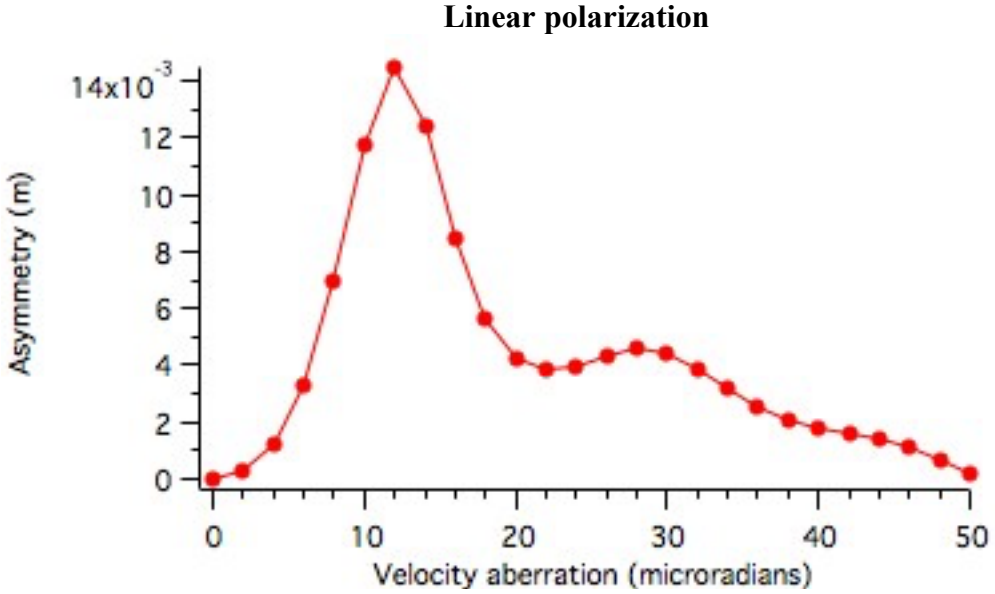


Figure 6.3. Asymmetry of the centroid vs velocity aberration, linear polarization. The data is listed in Table 6.1, column 5

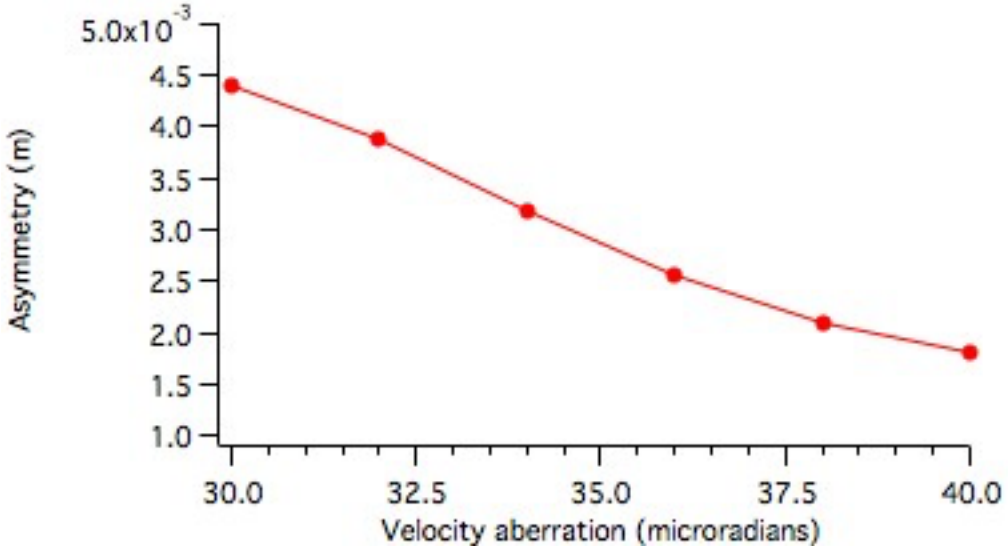


Figure 6.4. Expanded version of Fig. 6.3. Linear polarization.

Complete data for Figures 6.1, 6.2, 6.3, 6.4

Vel. Aberration	Minimum	Average	Maximum	Max - Min
0.0	0.2370200	0.2370200	0.2370200	0.0000000
2.0	0.2366050	0.2366892	0.2368900	0.0002850
4.0	0.2353655	0.2359379	0.2366000	0.0012345
6.0	0.2330800	0.2348010	0.2363800	0.0033000
8.0	0.2296300	0.2336049	0.2366200	0.0069900
10.0	0.2258500	0.2330533	0.2376100	0.0117600
12.0	0.2247000	0.2340087	0.2391700	0.0144700
14.0	0.2283600	0.2364228	0.2407900	0.0124300
16.0	0.2335700	0.2389466	0.2420400	0.0084700
18.0	0.2371600	0.2406435	0.2428000	0.0056400
20.0	0.2388600	0.2414545	0.2431300	0.0042700
22.0	0.2393000	0.2416259	0.2431500	0.0038500
24.0	0.2390200	0.2414303	0.2429900	0.0039700
26.0	0.2384900	0.2411233	0.2428100	0.0043200
28.0	0.2381500	0.2409415	0.2427100	0.0045600
30.0	0.2383600	0.2410509	0.2427700	0.0044100
32.0	0.2391100	0.2414399	0.2429900	0.0038800
34.0	0.2400900	0.2419594	0.2432800	0.0031900
36.0	0.2409500	0.2424075	0.2435100	0.0025600
38.0	0.2415000	0.2426602	0.2436000	0.0021000
40.0	0.2417000	0.2426808	0.2435100	0.0018100
42.0	0.2416400	0.2424951	0.2432400	0.0016000
44.0	0.2414400	0.2421684	0.2428300	0.0013900
46.0	0.2412292	0.2417794	0.2423100	0.0010808
48.0	0.2410810	0.2413912	0.2417400	0.0006590
50.0	0.2409151	0.2410155	0.2411200	0.0002049

Table 6.2. Column 1 is the magnitude of the velocity aberration, columns 2,3,4 are the minimum, average, and maximum values around a circle in the far field with radius equal to the magnitude of the velocity aberration. Column 5 is the asymmetry.

32 to 40 μradians	Minimum	Maximum	max-min
Average (col. 3)	0.2414399	0.2426808	0.0012409
Asymmetry (col. 5)	0.0018100	0.0038800	

Table 6.3. Statistics for Fig 6. The variation with the magnitude of the velocity aberration is 1.24 mm. The asymmetry due to the linear polarization varies from 1.8 to 3.88 mm. This will cause a systematic error as the direction of the velocity aberration changes during a pass.

7. Centroid vs velocity aberration, circular polarization.

7.1 Centroid vs velocity aberration

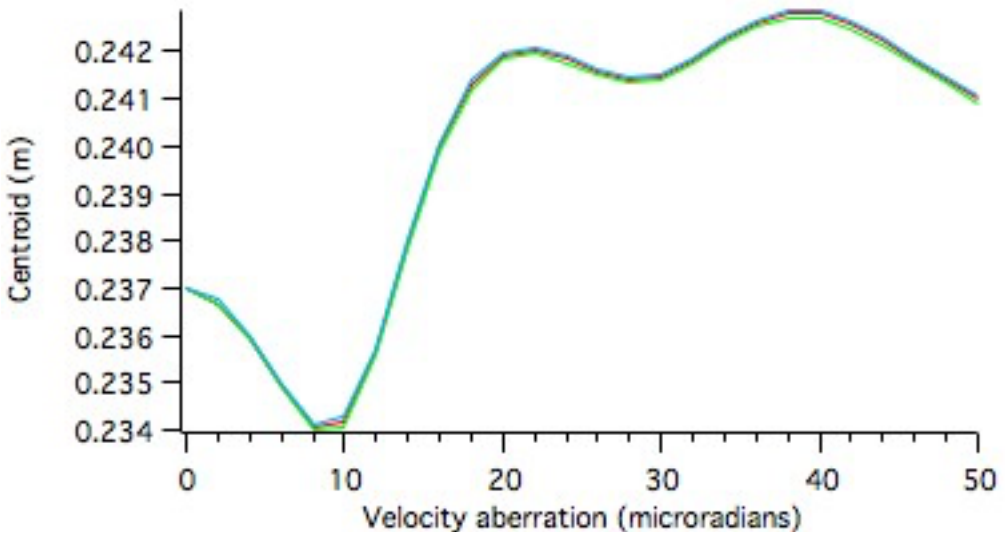


Table 7.1. Minimum (green), average (red), and maximum (blue). Circular polarization

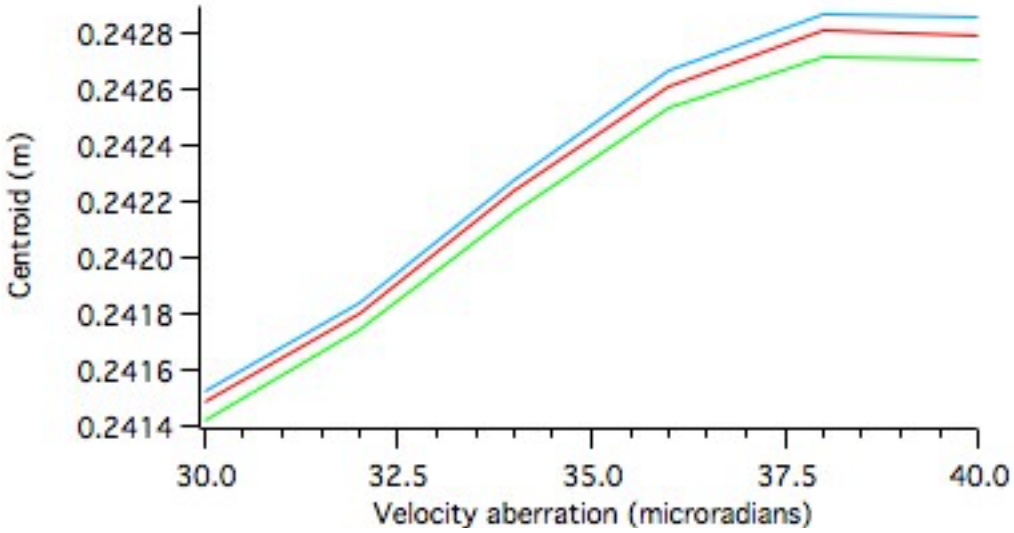


Table 7.2. Expanded plot of Fig 7.1.

Vel. Aberration	Minimum	Average	Maximum	Max - Min
30.0	0.2414192	0.2414871	0.2415270	0.0001078
32.0	0.2417397	0.2418058	0.2418437	0.0001040
34.0	0.2421668	0.2422388	0.2422802	0.0001133
36.0	0.2425335	0.2426122	0.2426700	0.0001365
38.0	0.2427230	0.2428112	0.2428700	0.0001470
40.0	0.2427081	0.2427971	0.2428600	0.0001519

Table 7.1. Data for Fig 7.2.

The average varies by 1.0 mm from 32 to 38 microradians. The asymmetry (Max – Min) varies from 0.1 to to 0.15 mm.

7.2 Asymmetry vs velocity aberration.

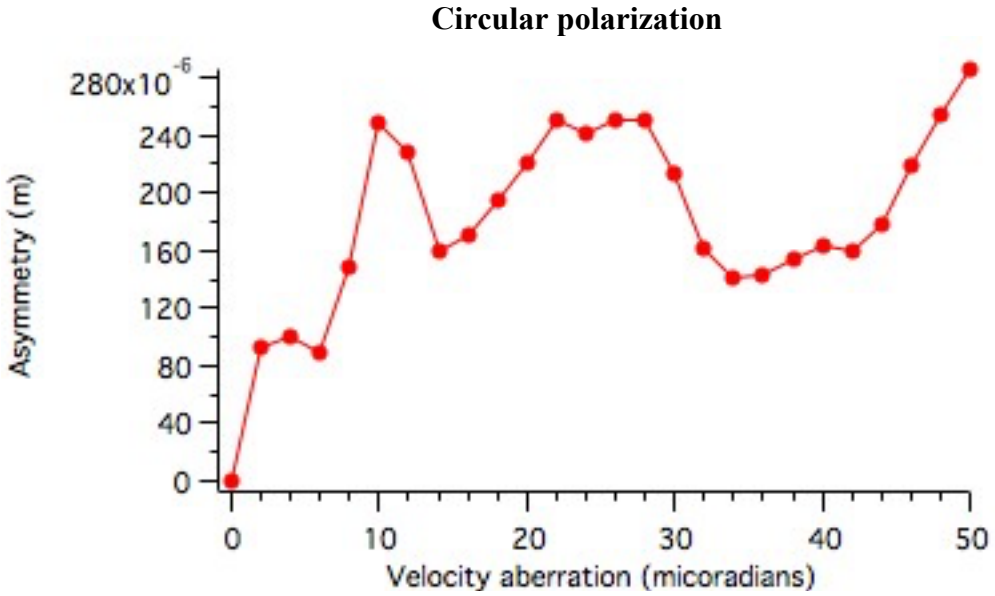


Figure 7.3. Asymmetry of the centroid vs velocity aberration. Circular polarization. The data is listed in column 5 of Table 7.2.

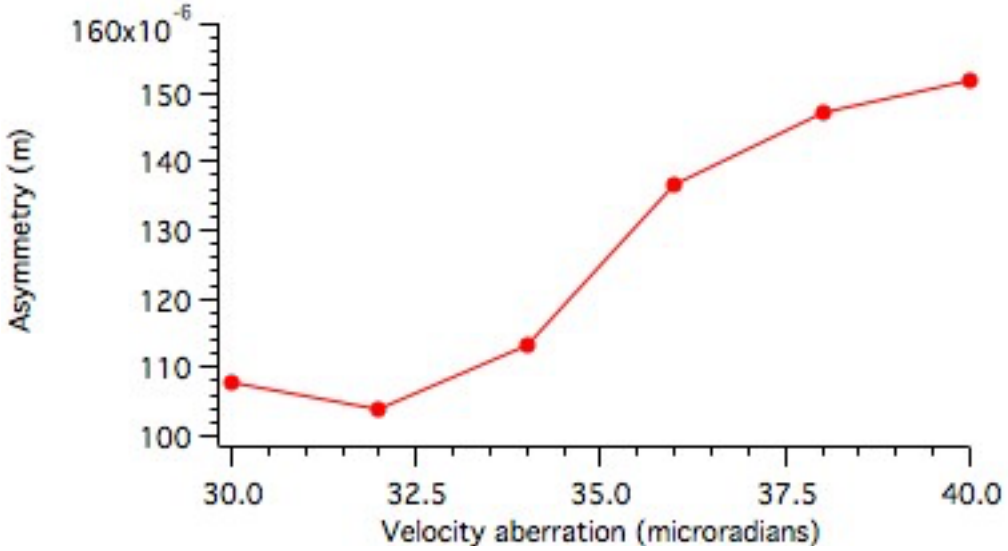


Figure 7.4. Expanded version of Fig 7.3.

Complete data for Figure 7.1, 7.2, 7.3, 7.4

Vel. Aberration	Minimum	Average	Maximum	Max - Min
0.0	0.2370100	0.2370100	0.2370100	0.0000000
2.0	0.2366473	0.2366839	0.2367600	0.0001127
4.0	0.2359107	0.2359494	0.2360100	0.0000993
6.0	0.2348936	0.2349181	0.2349500	0.0000564
8.0	0.2340090	0.2340701	0.2341237	0.0001147
10.0	0.2340600	0.2341852	0.2342664	0.0002064
12.0	0.2355800	0.2356665	0.2357276	0.0001476
14.0	0.2378709	0.2379274	0.2380013	0.0001304
16.0	0.2398873	0.2399672	0.2400643	0.0001770
18.0	0.2412002	0.2412936	0.2413800	0.0001798
20.0	0.2418289	0.2419206	0.2419900	0.0001611
22.0	0.2419546	0.2420316	0.2420900	0.0001354
24.0	0.2417679	0.2418416	0.2418827	0.0001147
26.0	0.2415015	0.2415661	0.2416110	0.0001094
28.0	0.2413321	0.2414018	0.2414443	0.0001122
30.0	0.2414192	0.2414871	0.2415270	0.0001078
32.0	0.2417397	0.2418058	0.2418437	0.0001040
34.0	0.2421668	0.2422388	0.2422802	0.0001133
36.0	0.2425335	0.2426122	0.2426700	0.0001365
38.0	0.2427230	0.2428112	0.2428700	0.0001470
40.0	0.2427081	0.2427971	0.2428600	0.0001519
42.0	0.2425027	0.2425871	0.2426416	0.0001390
44.0	0.2421536	0.2422369	0.2422900	0.0001364
46.0	0.2417451	0.2418226	0.2418757	0.0001306
48.0	0.2413227	0.2414065	0.2414600	0.0001373
50.0	0.2409139	0.2410039	0.2410599	0.0001460

Table 7.2. Column 1 is the magnitude of the velocity aberration, columns 2,3,4 are the minimum, average, and maximum values around a circle in the far field with radius equal to the magnitude of the velocity aberration. Column 5 is a measure of the asymmetry.

32 to 40 μradians	minimum	maximum	max-min
Average (col. 3)	0.2418058	0.2428112	0.001
Asymmetry (col. 5)	0.0001040	0.0001519	

Table 7.3. Statistics for Fig 7.1, 7.2, 7.3, 7.4. The variation with the magnitude of the velocity aberration 1.0 mm. The asymmetry due to the circular polarization varies from .10 to .15 mm. This is well below the accuracy requirements.

8. Summary

Polarization	Cross section Million sq m	Centroid (m)	ΔR Inc. ang.	Rms Inc. ang.	Asymmetry (mm)	ΔR Vel. Aber.
Linear	14.9065	0.2423	0.0049	.7mm	1.8 to 3.88	1.2 mm
Circular	14.9075	0.2425	0.0050	.7mm	.10 to .15	1.0 mm

Table 8.1. Summary of cross section, centroid, and the variation of the centroid with incidence angle, azimuth, and the magnitude of the velocity aberration.

The peak to peak variation of the centroid with incidence angle on the satellite is 5 mm. The rms is .7 mm. This is due to the spacing between cube corners and random loss of total internal reflection in the uncoated cube corners. The average range correction over the whole satellite probably has an accuracy of +/- one millimeter.

There is a systematic error of up to 4 mm due to asymmetry of the pattern with linear polarization. There may be no way to correct for this since the direction of the polarization is not known and may be elliptical in some cases. A better approach would be to use circular polarization. The systematic error due to asymmetry is virtually zero with circular polarization.

The variation of the centroid with the magnitude of the velocity aberration is 1.2 mm for linear and 1.0 mm for circular polarization. This is within the accuracy requirements. A correction could be applied during analysis.

There is a small systematic variation of the centroid with Latitude. This may be due to the fact that the spacing between rows is not completely uniform and/or the rows do not have the maximum number of cubes that could fit in the row. The peak to peak variation of the centroid with Latitude is about .5 mm. This is within the accuracy requirements.

9. Appendix: Coordinates of the cube corners

X,Y,Z in meters, θ, ϕ, α in degrees.

Cap	Row	Cube	X	Y	Z	θ	ϕ	α
1	10	1	0.00000	0.00000	0.29814	0.0000	0.0000	5.0
1	9	1	0.05239	0.00000	0.29350	0.0000	10.1200	89.0
1	9	2	0.02619	0.04537	0.29350	60.0000	10.1200	115.0
1	9	3	-0.02619	0.04537	0.29350	120.0000	10.1200	21.0
1	9	4	-0.05239	0.00000	0.29350	180.0000	10.1200	47.0
1	9	5	-0.02619	-0.04537	0.29350	240.0000	10.1200	73.0
1	9	6	0.02619	-0.04537	0.29350	300.0000	10.1200	99.0
1	8	1	0.10124	0.00000	0.28042	0.0000	19.8500	17.0
1	8	2	0.08767	0.05062	0.28042	30.0000	19.8500	43.0
1	8	3	0.05062	0.08767	0.28042	60.0000	19.8500	69.0
1	8	4	0.00000	0.10124	0.28042	90.0000	19.8500	95.0

1	8	5	-0.05062	0.08767	0.28042	120.0000	19.8500	1.0
1	8	6	-0.08767	0.05062	0.28042	150.0000	19.8500	27.0
1	8	7	-0.10124	0.00000	0.28042	180.0000	19.8500	53.0
1	8	8	-0.08767	-0.05062	0.28042	210.0000	19.8500	79.0
1	8	9	-0.05062	-0.08767	0.28042	240.0000	19.8500	105.0
1	8	10	0.00000	-0.10124	0.28042	270.0000	19.8500	11.0
1	8	11	0.05062	-0.08767	0.28042	300.0000	19.8500	37.0
1	8	12	0.08767	-0.05062	0.28042	330.0000	19.8500	63.0
1	7	1	0.14717	0.00000	0.25928	0.0000	29.5800	29.0
1	7	2	0.13830	0.05034	0.25928	20.0000	29.5800	55.0
1	7	3	0.11274	0.09460	0.25928	40.0000	29.5800	81.0
1	7	4	0.07359	0.12746	0.25928	60.0000	29.5800	107.0
1	7	5	0.02556	0.14494	0.25928	80.0000	29.5800	13.0
1	7	6	-0.02556	0.14494	0.25928	100.0000	29.5800	39.0
1	7	7	-0.07359	0.12746	0.25928	120.0000	29.5800	65.0
1	7	8	-0.11274	0.09460	0.25928	140.0000	29.5800	91.0
1	7	9	-0.13830	0.05034	0.25928	160.0000	29.5800	117.0
1	7	10	-0.14717	0.00000	0.25928	180.0000	29.5800	23.0
1	7	11	-0.13830	-0.05034	0.25928	200.0000	29.5800	49.0
1	7	12	-0.11274	-0.09460	0.25928	220.0000	29.5800	75.0
1	7	13	-0.07359	-0.12746	0.25928	240.0000	29.5800	101.0
1	7	14	-0.02556	-0.14494	0.25928	260.0000	29.5800	7.0
1	7	15	0.02556	-0.14494	0.25928	280.0000	29.5800	33.0
1	7	16	0.07359	-0.12746	0.25928	300.0000	29.5800	59.0
1	7	17	0.11274	-0.09460	0.25928	320.0000	29.5800	85.0
1	7	18	0.13830	-0.05034	0.25928	340.0000	29.5800	111.0
1	6	1	0.18888	0.00000	0.23068	0.0000	39.3100	31.0
1	6	2	0.18187	0.05096	0.23068	15.6520	39.3100	57.0
1	6	3	0.16138	0.09814	0.23068	31.3040	39.3100	83.0
1	6	4	0.12892	0.13804	0.23068	46.9570	39.3100	109.0
1	6	5	0.08689	0.16770	0.23068	62.6090	39.3100	15.0
1	6	6	0.03843	0.18493	0.23068	78.2610	39.3100	41.0
1	6	7	-0.01289	0.18844	0.23068	93.9130	39.3100	67.0
1	6	8	-0.06325	0.17797	0.23068	109.5650	39.3100	93.0
1	6	9	-0.10892	0.15431	0.23068	125.2170	39.3100	119.0
1	6	10	-0.14651	0.11920	0.23068	140.8700	39.3100	25.0
1	6	11	-0.17324	0.07525	0.23068	156.5220	39.3100	51.0
1	6	12	-0.18712	0.02572	0.23068	172.1740	39.3100	77.0
1	6	13	-0.18712	-0.02572	0.23068	187.8260	39.3100	103.0
1	6	14	-0.17324	-0.07525	0.23068	203.4780	39.3100	9.0
1	6	15	-0.14651	-0.11920	0.23068	219.1300	39.3100	35.0
1	6	16	-0.10892	-0.15431	0.23068	234.7830	39.3100	61.0
1	6	17	-0.06325	-0.17797	0.23068	250.4350	39.3100	87.0
1	6	18	-0.01289	-0.18844	0.23068	266.0870	39.3100	113.0
1	6	19	0.03843	-0.18493	0.23068	281.7390	39.3100	19.0

1	6	20	0.08689	-0.16770	0.23068	297.3910	39.3100	45.0
1	6	21	0.12892	-0.13804	0.23068	313.0430	39.3100	71.0
1	6	22	0.16138	-0.09814	0.23068	328.6960	39.3100	97.0
1	6	23	0.18187	-0.05096	0.23068	344.3480	39.3100	3.0
1	5	1	0.22514	0.00000	0.19544	0.0000	49.0400	49.0
1	5	2	0.21908	0.05192	0.19544	13.3330	49.0400	75.0
1	5	3	0.20120	0.10105	0.19544	26.6670	49.0400	101.0
1	5	4	0.17247	0.14472	0.19544	40.0000	49.0400	7.0
1	5	5	0.13445	0.18059	0.19544	53.3330	49.0400	33.0
1	5	6	0.08917	0.20673	0.19544	66.6670	49.0400	59.0
1	5	7	0.03910	0.22172	0.19544	80.0000	49.0400	85.0
1	5	8	-0.01309	0.22476	0.19544	93.3330	49.0400	111.0
1	5	9	-0.06457	0.21569	0.19544	106.6670	49.0400	17.0
1	5	10	-0.11257	0.19498	0.19544	120.0000	49.0400	43.0
1	5	11	-0.15450	0.16377	0.19544	133.3330	49.0400	69.0
1	5	12	-0.18811	0.12372	0.19544	146.6670	49.0400	95.0
1	5	13	-0.21157	0.07700	0.19544	160.0000	49.0400	1.0
1	5	14	-0.22362	0.02614	0.19544	173.3330	49.0400	27.0
1	5	15	-0.22362	-0.02614	0.19544	186.6670	49.0400	53.0
1	5	16	-0.21157	-0.07700	0.19544	200.0000	49.0400	79.0
1	5	17	-0.18811	-0.12372	0.19544	213.3330	49.0400	105.0
1	5	18	-0.15450	-0.16377	0.19544	226.6670	49.0400	11.0
1	5	19	-0.11257	-0.19498	0.19544	240.0000	49.0400	37.0
1	5	20	-0.06457	-0.21569	0.19544	253.3330	49.0400	63.0
1	5	21	-0.01309	-0.22476	0.19544	266.6670	49.0400	89.0
1	5	22	0.03910	-0.22172	0.19544	280.0000	49.0400	115.0
1	5	23	0.08917	-0.20673	0.19544	293.3330	49.0400	21.0
1	5	24	0.13445	-0.18059	0.19544	306.6670	49.0400	47.0
1	5	25	0.17247	-0.14472	0.19544	320.0000	49.0400	73.0
1	5	26	0.20120	-0.10105	0.19544	333.3330	49.0400	99.0
1	5	27	0.21908	-0.05192	0.19544	346.6670	49.0400	5.0
1	4	1	0.25494	0.00000	0.15458	0.0000	58.7700	83.0
1	4	2	0.24972	0.05132	0.15458	11.6130	58.7700	109.0
1	4	3	0.23428	0.10054	0.15458	23.2260	58.7700	15.0
1	4	4	0.20924	0.14564	0.15458	34.8390	58.7700	41.0
1	4	5	0.17564	0.18478	0.15458	46.4520	58.7700	67.0
1	4	6	0.13485	0.21635	0.15458	58.0650	58.7700	93.0
1	4	7	0.08854	0.23907	0.15458	69.6770	58.7700	119.0
1	4	8	0.03861	0.25200	0.15458	81.2900	58.7700	25.0
1	4	9	-0.01291	0.25461	0.15458	92.9030	58.7700	51.0
1	4	10	-0.06390	0.24680	0.15458	104.5160	58.7700	77.0
1	4	11	-0.11227	0.22888	0.15458	116.1290	58.7700	103.0
1	4	12	-0.15605	0.20160	0.15458	127.7420	58.7700	9.0
1	4	13	-0.19344	0.16606	0.15458	139.3550	58.7700	35.0
1	4	14	-0.22290	0.12372	0.15458	150.9680	58.7700	61.0

1	4	15	-0.24324	0.07632	0.15458	162.5810	58.7700	87.0
1	4	16	-0.25363	0.02579	0.15458	174.1940	58.7700	113.0
1	4	17	-0.25363	-0.02579	0.15458	185.8060	58.7700	19.0
1	4	18	-0.24324	-0.07632	0.15458	197.4190	58.7700	45.0
1	4	19	-0.22290	-0.12372	0.15458	209.0320	58.7700	71.0
1	4	20	-0.19344	-0.16606	0.15458	220.6450	58.7700	97.0
1	4	21	-0.15605	-0.20160	0.15458	232.2580	58.7700	3.0
1	4	22	-0.11227	-0.22888	0.15458	243.8710	58.7700	29.0
1	4	23	-0.06390	-0.24680	0.15458	255.4840	58.7700	55.0
1	4	24	-0.01291	-0.25461	0.15458	267.0970	58.7700	81.0
1	4	25	0.03861	-0.25200	0.15458	278.7100	58.7700	107.0
1	4	26	0.08854	-0.23907	0.15458	290.3230	58.7700	13.0
1	4	27	0.13485	-0.21635	0.15458	301.9350	58.7700	39.0
1	4	28	0.17564	-0.18478	0.15458	313.5480	58.7700	65.0
1	4	29	0.20924	-0.14564	0.15458	325.1610	58.7700	91.0
1	4	30	0.23428	-0.10054	0.15458	336.7740	58.7700	117.0
1	4	31	0.24972	-0.05132	0.15458	348.3870	58.7700	23.0
1	3	1	0.27307	0.02774	0.11641	5.8000	67.0170	117.0
1	3	2	0.26189	0.08214	0.11641	17.4130	67.0170	23.0
1	3	3	0.24000	0.13318	0.11641	29.0260	67.0170	49.0
1	3	4	0.20828	0.17876	0.11641	40.6390	67.0170	75.0
1	3	5	0.16803	0.21703	0.11641	52.2520	67.0170	101.0
1	3	6	0.12090	0.24641	0.11641	63.8650	67.0170	7.0
1	3	7	0.06883	0.26570	0.11641	75.4770	67.0170	33.0
1	3	8	0.01393	0.27412	0.11641	87.0900	67.0170	59.0
1	3	9	-0.04153	0.27131	0.11641	98.7030	67.0170	85.0
1	3	10	-0.09530	0.25740	0.11641	110.3160	67.0170	111.0
1	3	11	-0.14516	0.23295	0.11641	121.9290	67.0170	17.0
1	3	12	-0.18908	0.19896	0.11641	133.5420	67.0170	43.0
1	3	13	-0.22526	0.15682	0.11641	145.1550	67.0170	69.0
1	3	14	-0.25222	0.10827	0.11641	156.7680	67.0170	95.0
1	3	15	-0.26885	0.05528	0.11641	168.3810	67.0170	1.0
1	3	16	-0.27447	0.00003	0.11641	179.9940	67.0170	27.0
1	3	17	-0.26886	-0.05522	0.11641	191.6060	67.0170	53.0
1	3	18	-0.25224	-0.10821	0.11641	203.2190	67.0170	79.0
1	3	19	-0.22530	-0.15677	0.11641	214.8320	67.0170	105.0
1	3	20	-0.18913	-0.19891	0.11641	226.4450	67.0170	11.0
1	3	21	-0.14521	-0.23291	0.11641	238.0580	67.0170	37.0
1	3	22	-0.09535	-0.25738	0.11641	249.6710	67.0170	63.0
1	3	23	-0.04159	-0.27130	0.11641	261.2840	67.0170	89.0
1	3	24	0.01387	-0.27412	0.11641	272.8970	67.0170	115.0
1	3	25	0.06877	-0.26572	0.11641	284.5100	67.0170	21.0
1	3	26	0.12085	-0.24644	0.11641	296.1230	67.0170	47.0
1	3	27	0.16798	-0.21707	0.11641	307.7350	67.0170	73.0
1	3	28	0.20824	-0.17881	0.11641	319.3480	67.0170	99.0

1	3	29	0.23997	-0.13323	0.11641	330.9610	67.0170	5.0
1	3	30	0.26188	-0.08220	0.11641	342.5740	67.0170	31.0
1	3	31	0.27306	-0.02780	0.11641	354.1870	67.0170	57.0
1	2	1	0.29020	0.00000	0.06835	0.0000	76.7470	5.0
1	2	2	0.28462	0.05661	0.06835	11.2500	76.7470	31.0
1	2	3	0.26811	0.11105	0.06835	22.5000	76.7470	57.0
1	2	4	0.24129	0.16123	0.06835	33.7500	76.7470	83.0
1	2	5	0.20520	0.20520	0.06835	45.0000	76.7470	109.0
1	2	6	0.16123	0.24129	0.06835	56.2500	76.7470	15.0
1	2	7	0.11105	0.26811	0.06835	67.5000	76.7470	41.0
1	2	8	0.05661	0.28462	0.06835	78.7500	76.7470	67.0
1	2	9	0.00000	0.29020	0.06835	90.0000	76.7470	93.0
1	2	10	-0.05661	0.28462	0.06835	101.2500	76.7470	119.0
1	2	11	-0.11105	0.26811	0.06835	112.5000	76.7470	25.0
1	2	12	-0.16123	0.24129	0.06835	123.7500	76.7470	51.0
1	2	13	-0.20520	0.20520	0.06835	135.0000	76.7470	77.0
1	2	14	-0.24129	0.16123	0.06835	146.2500	76.7470	103.0
1	2	15	-0.26811	0.11105	0.06835	157.5000	76.7470	9.0
1	2	16	-0.28462	0.05661	0.06835	168.7500	76.7470	35.0
1	2	17	-0.29020	0.00000	0.06835	180.0000	76.7470	61.0
1	2	18	-0.28462	-0.05661	0.06835	191.2500	76.7470	87.0
1	2	19	-0.26811	-0.11105	0.06835	202.5000	76.7470	113.0
1	2	20	-0.24129	-0.16123	0.06835	213.7500	76.7470	19.0
1	2	21	-0.20520	-0.20520	0.06835	225.0000	76.7470	45.0
1	2	22	-0.16123	-0.24129	0.06835	236.2500	76.7470	71.0
1	2	23	-0.11105	-0.26811	0.06835	247.5000	76.7470	97.0
1	2	24	-0.05661	-0.28462	0.06835	258.7500	76.7470	3.0
1	2	25	0.00000	-0.29020	0.06835	270.0000	76.7470	29.0
1	2	26	0.05661	-0.28462	0.06835	281.2500	76.7470	55.0
1	2	27	0.11105	-0.26811	0.06835	292.5000	76.7470	81.0
1	2	28	0.16123	-0.24129	0.06835	303.7500	76.7470	107.0
1	2	29	0.20520	-0.20520	0.06835	315.0000	76.7470	13.0
1	2	30	0.24129	-0.16123	0.06835	326.2500	76.7470	39.0
1	2	31	0.26811	-0.11105	0.06835	337.5000	76.7470	65.0
1	2	32	0.28462	-0.05661	0.06835	348.7500	76.7470	91.0
1	1	1	0.29564	0.02911	0.02527	5.6230	85.1370	13.0
1	1	2	0.28428	0.08622	0.02527	16.8730	85.1370	39.0
1	1	3	0.26199	0.14003	0.02527	28.1230	85.1370	65.0
1	1	4	0.22964	0.18845	0.02527	39.3730	85.1370	91.0
1	1	5	0.18846	0.22963	0.02527	50.6230	85.1370	117.0
1	1	6	0.14004	0.26198	0.02527	61.8730	85.1370	23.0
1	1	7	0.08624	0.28427	0.02527	73.1230	85.1370	49.0
1	1	8	0.02913	0.29563	0.02527	84.3730	85.1370	75.0
1	1	9	-0.02911	0.29564	0.02527	95.6230	85.1370	101.0
1	1	10	-0.08622	0.28428	0.02527	106.8730	85.1370	7.0

1	1	11	-0.14003	0.26199	0.02527	118.1230	85.1370	33.0
1	1	12	-0.18845	0.22964	0.02527	129.3730	85.1370	59.0
1	1	13	-0.22963	0.18846	0.02527	140.6230	85.1370	85.0
1	1	14	-0.26198	0.14004	0.02527	151.8730	85.1370	111.0
1	1	15	-0.28427	0.08624	0.02527	163.1230	85.1370	17.0
1	1	16	-0.29563	0.02913	0.02527	174.3730	85.1370	43.0
1	1	17	-0.29564	-0.02911	0.02527	185.6230	85.1370	69.0
1	1	18	-0.28428	-0.08622	0.02527	196.8730	85.1370	95.0
1	1	19	-0.26199	-0.14003	0.02527	208.1230	85.1370	1.0
1	1	20	-0.22964	-0.18845	0.02527	219.3730	85.1370	27.0
1	1	21	-0.18846	-0.22963	0.02527	230.6230	85.1370	53.0
1	1	22	-0.14004	-0.26198	0.02527	241.8730	85.1370	79.0
1	1	23	-0.08624	-0.28427	0.02527	253.1230	85.1370	105.0
1	1	24	-0.02913	-0.29563	0.02527	264.3730	85.1370	11.0
1	1	25	0.02911	-0.29564	0.02527	275.6230	85.1370	37.0
1	1	26	0.08622	-0.28428	0.02527	286.8730	85.1370	63.0
1	1	27	0.14003	-0.26199	0.02527	298.1230	85.1370	89.0
1	1	28	0.18845	-0.22964	0.02527	309.3730	85.1370	115.0
1	1	29	0.22963	-0.18846	0.02527	320.6230	85.1370	21.0
1	1	30	0.26198	-0.14004	0.02527	331.8730	85.1370	47.0
1	1	31	0.28427	-0.08624	0.02527	343.1230	85.1370	73.0
1	1	32	0.29563	-0.02913	0.02527	354.3730	85.1370	99.0
2	1	1	0.29564	0.02911	-0.02527	5.6230	94.8630	86.0
2	1	2	0.28428	0.08622	-0.02527	16.8730	94.8630	112.0
2	1	3	0.26199	0.14003	-0.02527	28.1230	94.8630	18.0
2	1	4	0.22964	0.18845	-0.02527	39.3730	94.8630	44.0
2	1	5	0.18846	0.22963	-0.02527	50.6230	94.8630	70.0
2	1	6	0.14004	0.26198	-0.02527	61.8730	94.8630	96.0
2	1	7	0.08624	0.28427	-0.02527	73.1230	94.8630	2.0
2	1	8	0.02913	0.29563	-0.02527	84.3730	94.8630	28.0
2	1	9	-0.02911	0.29564	-0.02527	95.6230	94.8630	54.0
2	1	10	-0.08622	0.28428	-0.02527	106.8730	94.8630	80.0
2	1	11	-0.14003	0.26199	-0.02527	118.1230	94.8630	106.0
2	1	12	-0.18845	0.22964	-0.02527	129.3730	94.8630	12.0
2	1	13	-0.22963	0.18846	-0.02527	140.6230	94.8630	38.0
2	1	14	-0.26198	0.14004	-0.02527	151.8730	94.8630	64.0
2	1	15	-0.28427	0.08624	-0.02527	163.1230	94.8630	90.0
2	1	16	-0.29563	0.02913	-0.02527	174.3730	94.8630	116.0
2	1	17	-0.29564	-0.02911	-0.02527	185.6230	94.8630	22.0
2	1	18	-0.28428	-0.08622	-0.02527	196.8730	94.8630	48.0
2	1	19	-0.26199	-0.14003	-0.02527	208.1230	94.8630	74.0
2	1	20	-0.22964	-0.18845	-0.02527	219.3730	94.8630	100.0
2	1	21	-0.18846	-0.22963	-0.02527	230.6230	94.8630	6.0
2	1	22	-0.14004	-0.26198	-0.02527	241.8730	94.8630	32.0
2	1	23	-0.08624	-0.28427	-0.02527	253.1230	94.8630	58.0

2	1	24	-0.02913	-0.29563	-0.02527	264.3730	94.8630	84.0
2	1	25	0.02911	-0.29564	-0.02527	275.6230	94.8630	110.0
2	1	26	0.08622	-0.28428	-0.02527	286.8730	94.8630	16.0
2	1	27	0.14003	-0.26199	-0.02527	298.1230	94.8630	42.0
2	1	28	0.18845	-0.22964	-0.02527	309.3730	94.8630	68.0
2	1	29	0.22963	-0.18846	-0.02527	320.6230	94.8630	94.0
2	1	30	0.26198	-0.14004	-0.02527	331.8730	94.8630	0.0
2	1	31	0.28427	-0.08624	-0.02527	343.1230	94.8630	26.0
2	1	32	0.29563	-0.02913	-0.02527	354.3730	94.8630	52.0
2	2	1	0.29020	0.00000	-0.06835	0.0000	103.2530	78.0
2	2	2	0.28462	0.05661	-0.06835	11.2500	103.2530	104.0
2	2	3	0.26811	0.11105	-0.06835	22.5000	103.2530	10.0
2	2	4	0.24129	0.16123	-0.06835	33.7500	103.2530	36.0
2	2	5	0.20520	0.20520	-0.06835	45.0000	103.2530	62.0
2	2	6	0.16123	0.24129	-0.06835	56.2500	103.2530	88.0
2	2	7	0.11105	0.26811	-0.06835	67.5000	103.2530	114.0
2	2	8	0.05661	0.28462	-0.06835	78.7500	103.2530	20.0
2	2	9	0.00000	0.29020	-0.06835	90.0000	103.2530	46.0
2	2	10	-0.05661	0.28462	-0.06835	101.2500	103.2530	72.0
2	2	11	-0.11105	0.26811	-0.06835	112.5000	103.2530	98.0
2	2	12	-0.16123	0.24129	-0.06835	123.7500	103.2530	4.0
2	2	13	-0.20520	0.20520	-0.06835	135.0000	103.2530	30.0
2	2	14	-0.24129	0.16123	-0.06835	146.2500	103.2530	56.0
2	2	15	-0.26811	0.11105	-0.06835	157.5000	103.2530	82.0
2	2	16	-0.28462	0.05661	-0.06835	168.7500	103.2530	108.0
2	2	17	-0.29020	0.00000	-0.06835	180.0000	103.2530	14.0
2	2	18	-0.28462	-0.05661	-0.06835	191.2500	103.2530	40.0
2	2	19	-0.26811	-0.11105	-0.06835	202.5000	103.2530	66.0
2	2	20	-0.24129	-0.16123	-0.06835	213.7500	103.2530	92.0
2	2	21	-0.20520	-0.20520	-0.06835	225.0000	103.2530	118.0
2	2	22	-0.16123	-0.24129	-0.06835	236.2500	103.2530	24.0
2	2	23	-0.11105	-0.26811	-0.06835	247.5000	103.2530	50.0
2	2	24	-0.05661	-0.28462	-0.06835	258.7500	103.2530	76.0
2	2	25	0.00000	-0.29020	-0.06835	270.0000	103.2530	102.0
2	2	26	0.05661	-0.28462	-0.06835	281.2500	103.2530	8.0
2	2	27	0.11105	-0.26811	-0.06835	292.5000	103.2530	34.0
2	2	28	0.16123	-0.24129	-0.06835	303.7500	103.2530	60.0
2	2	29	0.20520	-0.20520	-0.06835	315.0000	103.2530	86.0
2	2	30	0.24129	-0.16123	-0.06835	326.2500	103.2530	0.0
2	2	31	0.26811	-0.11105	-0.06835	337.5000	103.2530	18.0
2	2	32	0.28462	-0.05661	-0.06835	348.7500	103.2530	44.0
2	3	1	0.27307	0.02774	-0.11641	5.8000	112.9830	70.0
2	3	2	0.26189	0.08214	-0.11641	17.4130	112.9830	96.0
2	3	3	0.24000	0.13318	-0.11641	29.0260	112.9830	2.0
2	3	4	0.20828	0.17876	-0.11641	40.6390	112.9830	28.0

2	3	5	0.16803	0.21703	-0.11641	52.2520	112.9830	54.0
2	3	6	0.12090	0.24641	-0.11641	63.8650	112.9830	80.0
2	3	7	0.06883	0.26570	-0.11641	75.4770	112.9830	106.0
2	3	8	0.01393	0.27412	-0.11641	87.0900	112.9830	12.0
2	3	9	-0.04153	0.27131	-0.11641	98.7030	112.9830	38.0
2	3	10	-0.09530	0.25740	-0.11641	110.3160	112.9830	64.0
2	3	11	-0.14516	0.23295	-0.11641	121.9290	112.9830	90.0
2	3	12	-0.18908	0.19896	-0.11641	133.5420	112.9830	116.0
2	3	13	-0.22526	0.15682	-0.11641	145.1550	112.9830	22.0
2	3	14	-0.25222	0.10827	-0.11641	156.7680	112.9830	48.0
2	3	15	-0.26885	0.05528	-0.11641	168.3810	112.9830	74.0
2	3	16	-0.27447	0.00003	-0.11641	179.9940	112.9830	100.0
2	3	17	-0.26886	-0.05522	-0.11641	191.6060	112.9830	6.0
2	3	18	-0.25224	-0.10821	-0.11641	203.2190	112.9830	32.0
2	3	19	-0.22530	-0.15677	-0.11641	214.8320	112.9830	58.0
2	3	20	-0.18913	-0.19891	-0.11641	226.4450	112.9830	84.0
2	3	21	-0.14521	-0.23291	-0.11641	238.0580	112.9830	110.0
2	3	22	-0.09535	-0.25738	-0.11641	249.6710	112.9830	16.0
2	3	23	-0.04159	-0.27130	-0.11641	261.2840	112.9830	42.0
2	3	24	0.01387	-0.27412	-0.11641	272.8970	112.9830	68.0
2	3	25	0.06877	-0.26572	-0.11641	284.5100	112.9830	94.0
2	3	26	0.12085	-0.24644	-0.11641	296.1230	112.9830	0.0
2	3	27	0.16798	-0.21707	-0.11641	307.7350	112.9830	26.0
2	3	28	0.20824	-0.17881	-0.11641	319.3480	112.9830	52.0
2	3	29	0.23997	-0.13323	-0.11641	330.9610	112.9830	78.0
2	3	30	0.26188	-0.08220	-0.11641	342.5740	112.9830	104.0
2	3	31	0.27306	-0.02780	-0.11641	354.1870	112.9830	10.0
2	4	1	0.25494	0.00000	-0.15458	0.0000	121.2300	36.0
2	4	2	0.24972	0.05132	-0.15458	11.6130	121.2300	62.0
2	4	3	0.23428	0.10054	-0.15458	23.2260	121.2300	88.0
2	4	4	0.20924	0.14564	-0.15458	34.8390	121.2300	114.0
2	4	5	0.17564	0.18478	-0.15458	46.4520	121.2300	20.0
2	4	6	0.13485	0.21635	-0.15458	58.0650	121.2300	46.0
2	4	7	0.08854	0.23907	-0.15458	69.6770	121.2300	72.0
2	4	8	0.03861	0.25200	-0.15458	81.2900	121.2300	98.0
2	4	9	-0.01291	0.25461	-0.15458	92.9030	121.2300	4.0
2	4	10	-0.06390	0.24680	-0.15458	104.5160	121.2300	30.0
2	4	11	-0.11227	0.22888	-0.15458	116.1290	121.2300	56.0
2	4	12	-0.15605	0.20160	-0.15458	127.7420	121.2300	82.0
2	4	13	-0.19344	0.16606	-0.15458	139.3550	121.2300	108.0
2	4	14	-0.22290	0.12372	-0.15458	150.9680	121.2300	14.0
2	4	15	-0.24324	0.07632	-0.15458	162.5810	121.2300	40.0
2	4	16	-0.25363	0.02579	-0.15458	174.1940	121.2300	66.0
2	4	17	-0.25363	-0.02579	-0.15458	185.8060	121.2300	92.0
2	4	18	-0.24324	-0.07632	-0.15458	197.4190	121.2300	118.0

2	4	19	-0.22290	-0.12372	-0.15458	209.0320	121.2300	24.0
2	4	20	-0.19344	-0.16606	-0.15458	220.6450	121.2300	50.0
2	4	21	-0.15605	-0.20160	-0.15458	232.2580	121.2300	76.0
2	4	22	-0.11227	-0.22888	-0.15458	243.8710	121.2300	102.0
2	4	23	-0.06390	-0.24680	-0.15458	255.4840	121.2300	8.0
2	4	24	-0.01291	-0.25461	-0.15458	267.0970	121.2300	34.0
2	4	25	0.03861	-0.25200	-0.15458	278.7100	121.2300	60.0
2	4	26	0.08854	-0.23907	-0.15458	290.3230	121.2300	86.0
2	4	27	0.13485	-0.21635	-0.15458	301.9350	121.2300	112.0
2	4	28	0.17564	-0.18478	-0.15458	313.5480	121.2300	18.0
2	4	29	0.20924	-0.14564	-0.15458	325.1610	121.2300	44.0
2	4	30	0.23428	-0.10054	-0.15458	336.7740	121.2300	70.0
2	4	31	0.24972	-0.05132	-0.15458	348.3870	121.2300	96.0
2	5	1	0.22514	0.00000	-0.19544	0.0000	130.9600	2.0
2	5	2	0.21908	0.05192	-0.19544	13.3330	130.9600	28.0
2	5	3	0.20120	0.10105	-0.19544	26.6670	130.9600	54.0
2	5	4	0.17247	0.14472	-0.19544	40.0000	130.9600	80.0
2	5	5	0.13445	0.18059	-0.19544	53.3330	130.9600	106.0
2	5	6	0.08917	0.20673	-0.19544	66.6670	130.9600	12.0
2	5	7	0.03910	0.22172	-0.19544	80.0000	130.9600	38.0
2	5	8	-0.01309	0.22476	-0.19544	93.3330	130.9600	64.0
2	5	9	-0.06457	0.21569	-0.19544	106.6670	130.9600	90.0
2	5	10	-0.11257	0.19498	-0.19544	120.0000	130.9600	116.0
2	5	11	-0.15450	0.16377	-0.19544	133.3330	130.9600	22.0
2	5	12	-0.18811	0.12372	-0.19544	146.6670	130.9600	48.0
2	5	13	-0.21157	0.07700	-0.19544	160.0000	130.9600	74.0
2	5	14	-0.22362	0.02614	-0.19544	173.3330	130.9600	100.0
2	5	15	-0.22362	-0.02614	-0.19544	186.6670	130.9600	6.0
2	5	16	-0.21157	-0.07700	-0.19544	200.0000	130.9600	32.0
2	5	17	-0.18811	-0.12372	-0.19544	213.3330	130.9600	58.0
2	5	18	-0.15450	-0.16377	-0.19544	226.6670	130.9600	84.0
2	5	19	-0.11257	-0.19498	-0.19544	240.0000	130.9600	110.0
2	5	20	-0.06457	-0.21569	-0.19544	253.3330	130.9600	16.0
2	5	21	-0.01309	-0.22476	-0.19544	266.6670	130.9600	42.0
2	5	22	0.03910	-0.22172	-0.19544	280.0000	130.9600	68.0
2	5	23	0.08917	-0.20673	-0.19544	293.3330	130.9600	94.0
2	5	24	0.13445	-0.18059	-0.19544	306.6670	130.9600	0.0
2	5	25	0.17247	-0.14472	-0.19544	320.0000	130.9600	26.0
2	5	26	0.20120	-0.10105	-0.19544	333.3330	130.9600	52.0
2	5	27	0.21908	-0.05192	-0.19544	346.6670	130.9600	78.0
2	6	1	0.18888	0.00000	-0.23068	0.0000	140.6900	104.0
2	6	2	0.18187	0.05096	-0.23068	15.6520	140.6900	10.0
2	6	3	0.16138	0.09814	-0.23068	31.3040	140.6900	36.0
2	6	4	0.12892	0.13804	-0.23068	46.9570	140.6900	62.0
2	6	5	0.08689	0.16770	-0.23068	62.6090	140.6900	88.0

2	6	6	0.03843	0.18493	-0.23068	78.2610	140.6900	114.0
2	6	7	-0.01289	0.18844	-0.23068	93.9130	140.6900	20.0
2	6	8	-0.06325	0.17797	-0.23068	109.5650	140.6900	46.0
2	6	9	-0.10892	0.15431	-0.23068	125.2170	140.6900	72.0
2	6	10	-0.14651	0.11920	-0.23068	140.8700	140.6900	98.0
2	6	11	-0.17324	0.07525	-0.23068	156.5220	140.6900	4.0
2	6	12	-0.18712	0.02572	-0.23068	172.1740	140.6900	30.0
2	6	13	-0.18712	-0.02572	-0.23068	187.8260	140.6900	56.0
2	6	14	-0.17324	-0.07525	-0.23068	203.4780	140.6900	82.0
2	6	15	-0.14651	-0.11920	-0.23068	219.1300	140.6900	108.0
2	6	16	-0.10892	-0.15431	-0.23068	234.7830	140.6900	14.0
2	6	17	-0.06325	-0.17797	-0.23068	250.4350	140.6900	40.0
2	6	18	-0.01289	-0.18844	-0.23068	266.0870	140.6900	66.0
2	6	19	0.03843	-0.18493	-0.23068	281.7390	140.6900	92.0
2	6	20	0.08689	-0.16770	-0.23068	297.3910	140.6900	118.0
2	6	21	0.12892	-0.13804	-0.23068	313.0430	140.6900	24.0
2	6	22	0.16138	-0.09814	-0.23068	328.6960	140.6900	50.0
2	6	23	0.18187	-0.05096	-0.23068	344.3480	140.6900	76.0
2	7	1	0.14717	0.00000	-0.25928	0.0000	150.4200	102.0
2	7	2	0.13830	0.05034	-0.25928	20.0000	150.4200	8.0
2	7	3	0.11274	0.09460	-0.25928	40.0000	150.4200	34.0
2	7	4	0.07359	0.12746	-0.25928	60.0000	150.4200	60.0
2	7	5	0.02556	0.14494	-0.25928	80.0000	150.4200	86.0
2	7	6	-0.02556	0.14494	-0.25928	100.0000	150.4200	112.0
2	7	7	-0.07359	0.12746	-0.25928	120.0000	150.4200	18.0
2	7	8	-0.11274	0.09460	-0.25928	140.0000	150.4200	44.0
2	7	9	-0.13830	0.05034	-0.25928	160.0000	150.4200	70.0
2	7	10	-0.14717	0.00000	-0.25928	180.0000	150.4200	96.0
2	7	11	-0.13830	-0.05034	-0.25928	200.0000	150.4200	2.0
2	7	12	-0.11274	-0.09460	-0.25928	220.0000	150.4200	28.0
2	7	13	-0.07359	-0.12746	-0.25928	240.0000	150.4200	54.0
2	7	14	-0.02556	-0.14494	-0.25928	260.0000	150.4200	80.0
2	7	15	0.02556	-0.14494	-0.25928	280.0000	150.4200	106.0
2	7	16	0.07359	-0.12746	-0.25928	300.0000	150.4200	12.0
2	7	17	0.11274	-0.09460	-0.25928	320.0000	150.4200	38.0
2	7	18	0.13830	-0.05034	-0.25928	340.0000	150.4200	64.0
2	8	1	0.10124	0.00000	-0.28042	0.0000	160.1500	90.0
2	8	2	0.08767	0.05062	-0.28042	30.0000	160.1500	116.0
2	8	3	0.05062	0.08767	-0.28042	60.0000	160.1500	22.0
2	8	4	0.00000	0.10124	-0.28042	90.0000	160.1500	48.0
2	8	5	-0.05062	0.08767	-0.28042	120.0000	160.1500	74.0
2	8	6	-0.08767	0.05062	-0.28042	150.0000	160.1500	100.0
2	8	7	-0.10124	0.00000	-0.28042	180.0000	160.1500	6.0
2	8	8	-0.08767	-0.05062	-0.28042	210.0000	160.1500	40.0
2	8	9	-0.05062	-0.08767	-0.28042	240.0000	160.1500	58.0

2	8	10	0.00000	-0.10124	-0.28042	270.0000	160.1500	84.0
2	8	11	0.05062	-0.08767	-0.28042	300.0000	160.1500	110.0
2	8	12	0.08767	-0.05062	-0.28042	330.0000	160.1500	16.0
2	9	1	0.05239	0.00000	-0.29350	0.0000	169.8800	42.0
2	9	2	0.02619	0.04537	-0.29350	60.0000	169.8800	68.0
2	9	3	-0.02619	0.04537	-0.29350	120.0000	169.8800	94.0
2	9	4	-0.05239	0.00000	-0.29350	180.0000	169.8800	0.0
2	9	5	-0.02619	-0.04537	-0.29350	240.0000	169.8800	26.0
2	9	6	0.02619	-0.04537	-0.29350	300.0000	169.8800	52.0
2	10	1	0.00000	0.00000	-0.29814	0.0000	180.0000	78.0