COC home

SAPPHIRE HOMOGENEITY

Following are homogeneity phase maps of the first 25 x 10 cm sapphire substrate measured at Caltech. These maps show the central 150 mm of the first 250 mm sample. Uncertainty is ~5nm due to turbulence.

If low order terms (Seidels) are subtracted (a compensating polish scenario) the following are the residual Peak to Valley and rms.

Terms Analysis:

Terms removed	PV(nm)	RMS(nm)	
Tilt	444	66	
Tilt, Power	453	59	PSD
T,P, Astigmatism	431	55	
T,P,A, Coma	449	53	
T,P,A,C, Spherical abberation	409	51	PSD

A note about PSDs...
Shown are X and Y average PSDs, we can compare initial LIGO fused silica with Sapphire using the same software... whether this software gives the correct absolute amplitude values is still under investigation.
12-27-00

FUSED SILICA HOMOGENEITY COMPARISON

2ITM04 Homogeneity PV=77 nm, rms=10 nm 2ITM04 PSD (both are -Tilt and Power)
Taken at CSIRO, this map shows the central 150 mm of the full aperture phase map

Other LIGO 1 Fused Silica
CSIRO measurements of 15cm sapphire

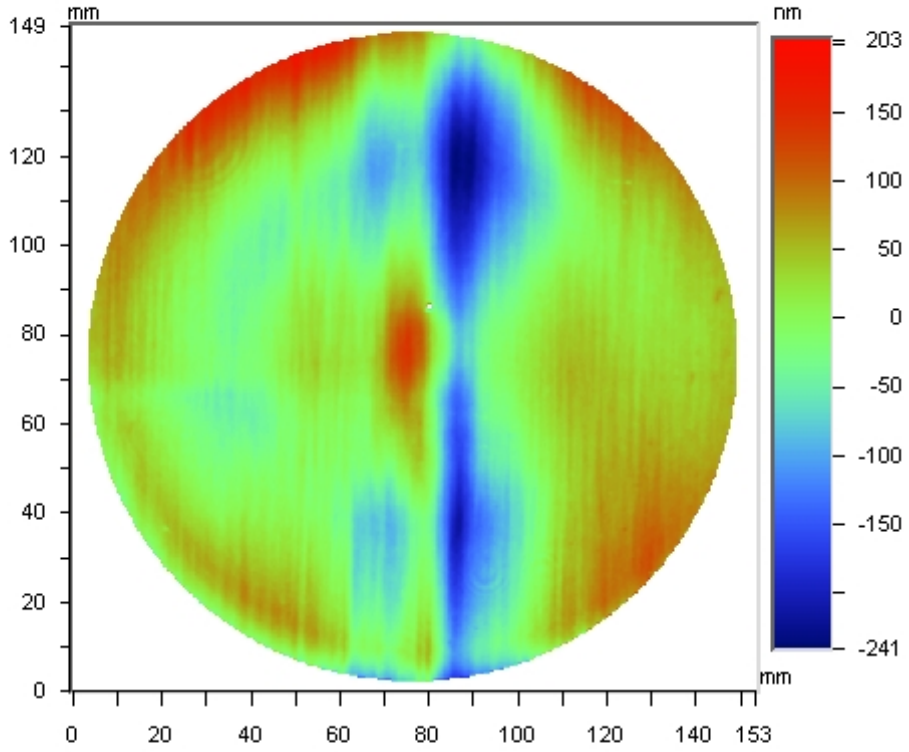
CSIRO sapphire homogeneity measurement

Two sapphire samples, A and B, provided by Caltech were measured on CSIRO's Large Aperture Digital Interferometer (LADI) to determine optical homogeneity of the material in two orthogonal directions. The samples, which appear to have an *m*- or *a*-axis crystal orientation, have a nominal diameter of 150 mm, a thickness of 80 mm and a wedge of around 1° on one face. The *c*-axis of the crystal structure appears to be oriented nominally parallel to the wedge direction. This was verified in a white light strain viewer where the sample is viewed between crossed polarisers. Both sides of the samples, as supplied, were polished to a surface figure better than a fringe.

CSIRO measurement report and analysis(.pdf)

.JPG images of the data. Color scales are autoscaled to each data set
Contact GariLynn for more information x 2184

	Filename	Comments		rms (nm)	Δn (ppm)	rms –T,P (nm)	rms -ATR (nm)
1.	saphah0a	⊥,	S2(sup)	30.2	0.38	25.4	20.7
2.	saphah0b	⊥,	S1(sup)	28.9	0.36	24.2	20.4
3.	saphah9a	//,	S2(sup)	24.7	0.31	20.1	17.2
4.	saphah9b	//,	S1(sup)	23.3	0.29	18.6	17.1
5.	saphah9c	//,	S1(sup)	24.1	0.30	20.0	17.2
6.	saphbh0a	⊥,	S1(sup)	58.4	0.73	48.7	33.6
7.	saphbh0b	⊥,	S2(sup)	57.6	0.72	47.5	33.9
8.	saphbh9a	//,	S1(sup)	41.4	0.52	27.1	15.5
9.	saphbh9b	//,	S2(sup)	41.1	0.51	26.4	15.8
10.	saphbh9c	//,	S1(sup)	42.3	0.53	27.9	15.5
11.	saphbt0a						



Title: 250mm Sapphire File name: FliptestResult

Note: bulk homogeneity 150 mm aperture

Zernike Coefficients

	Zernike_15[01]: -0.161653 wv
	Zernike_15[02]: 0.261673 wv
	Zernike_15[03]: 0.044283 wv
	Zernike_15[04]: 0.048069 wv
Zernike_8[1]: -0.16161 wv	Zernike_15[05]: -0.025558 wv
Zernike_8[2]: 0.26168 wv	Zernike_15[06]: 0.002335 wv
Zernike_8[3]: 0.04547 wv	Zernike_15[07]: 0.037198 wv
	Zernike_15[08]: 0.032937 wv
Zernike_8[4]: 0.04974 wv	Zernike_15[09]: 0.036449 wv
Zernike_8[5]: -0.02569 wv	Zernike_15[10]: -0.003820 wv
	Zernike_15[11]: -0.054792 wv
Zernike_8[6]: 0.00244 wv	Zernike_15[12]: -0.000654 wv
Zernike_8[7]: 0.03726 wv	Zernike_15[13]: -0.019281 wv
Zernike_8[8]: 0.03471 wv	Zernike_15[14]: 0.025439 wv
	Zernike_15[15]: -0.032709 wv

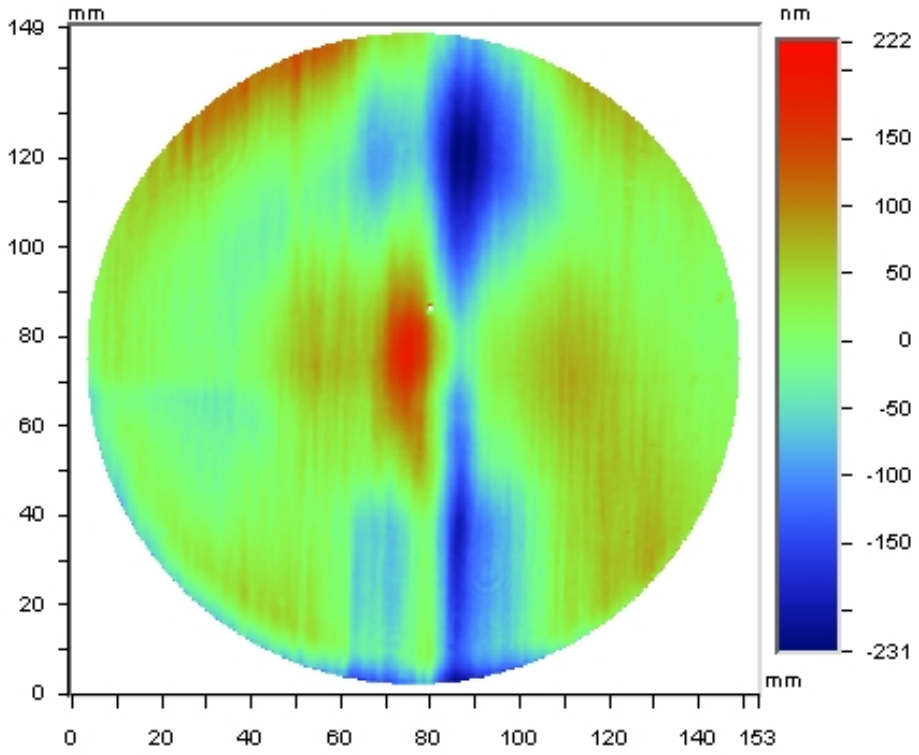
Date: 11/08/2000
Time: 13:14:17
Wavelength: 1.064 um
Pupil: 100.0 %
PV: 444.0355 nm
RMS: 65.7678 nm
Rad of curv: 28.13 km

X Center: 287.00
Y Center: 240.00
Radius: 274.00 pix
Terms: Tilt
Filters: None
Masks: Detector Mask
Ref Sub: No

Averages: 8

Seidel Aberrations (8 Term Fit)

	Coeff (per radius)	Rms	Angle
Tilt	0.2505 wv		131.7 deg
Power	0.0909 wv	0.026 wv	
Focus	-0.1733 wv		
Astig	0.1120 wv	0.028 wv	-13.7 deg
Coma	0.1120 wv	0.040 wv	86.3 deg
Sa3	0.2083 wv	0.062 wv	



Title: File name: FliptestResult

Note:

Zernike Coefficients

	Zernike_15[01]: -0.161653 wv
	Zernike_15[02]: 0.261673 wv
	Zernike_15[03]: 0.044283 wv
	Zernike_15[04]: 0.048069 wv
Zernike_8[1]: -0.16161 wv	Zernike_15[05]: -0.025558 wv
Zernike_8[2]: 0.26168 wv	Zernike_15[06]: 0.002335 wv
Zernike_8[3]: 0.04547 wv	Zernike_15[07]: 0.037198 wv
	Zernike_15[08]: 0.032937 wv
Zernike_8[4]: 0.04974 wv	Zernike_15[09]: 0.036449 wv
Zernike_8[5]: -0.02569 wv	Zernike_15[10]: -0.003820 wv
	Zernike_15[11]: -0.054792 wv
Zernike_8[6]: 0.00244 wv	Zernike_15[12]: -0.000654 wv
Zernike_8[7]: 0.03726 wv	Zernike_15[13]: -0.019281 wv
	Zernike_15[14]: 0.025439 wv
Zernike_8[8]: 0.03471 wv	Zernike_15[15]: -0.032709 wv

Date: 11/08/2000
Time: 13:14:17
Wavelength: 1.064 um
Pupil: 100.0 %
PV: 453.1536 nm
RMS: 59.7928 nm
Rad of curv: 28.134 km

X Center: 287.00
Y Center: 240.00
Radius: 274.00 pix
Terms: Tilt Power
Filters: None
Masks: Detector Mask
Ref Sub: No

Averages: 8

Seidel Aberrations (8 Term Fit)

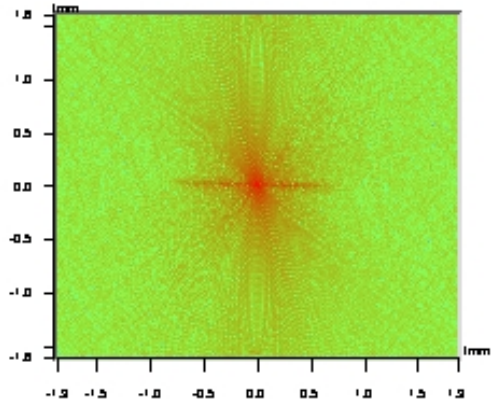
	Coeff (per radius)	Rms	Angle
Tilt	0.2505 wv		131.7 deg
Power	0.0909 wv	0.026 wv	
Focus	-0.1733 wv		
Astig	0.1120 wv	0.028 wv	-13.7 deg
Coma	0.1120 wv	0.040 wv	86.3 deg
Sa3	0.2083 wv	0.062 wv	

Veeco

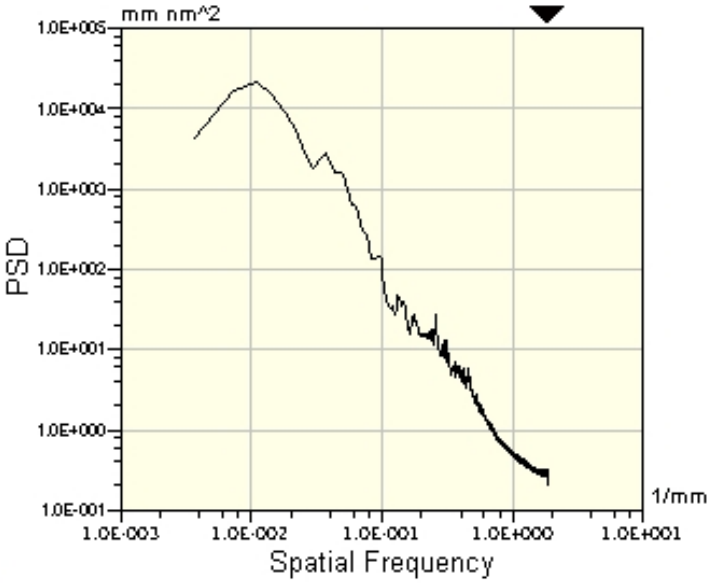
PSD Analysis

Date: 11/08/2000
Time: 13:14:17

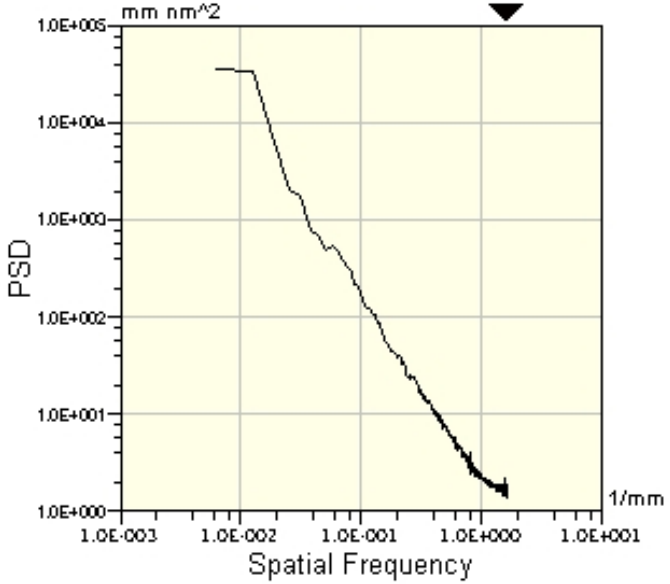
PSD Plot



X Average PSD



Y Average PSD



Analysis Results

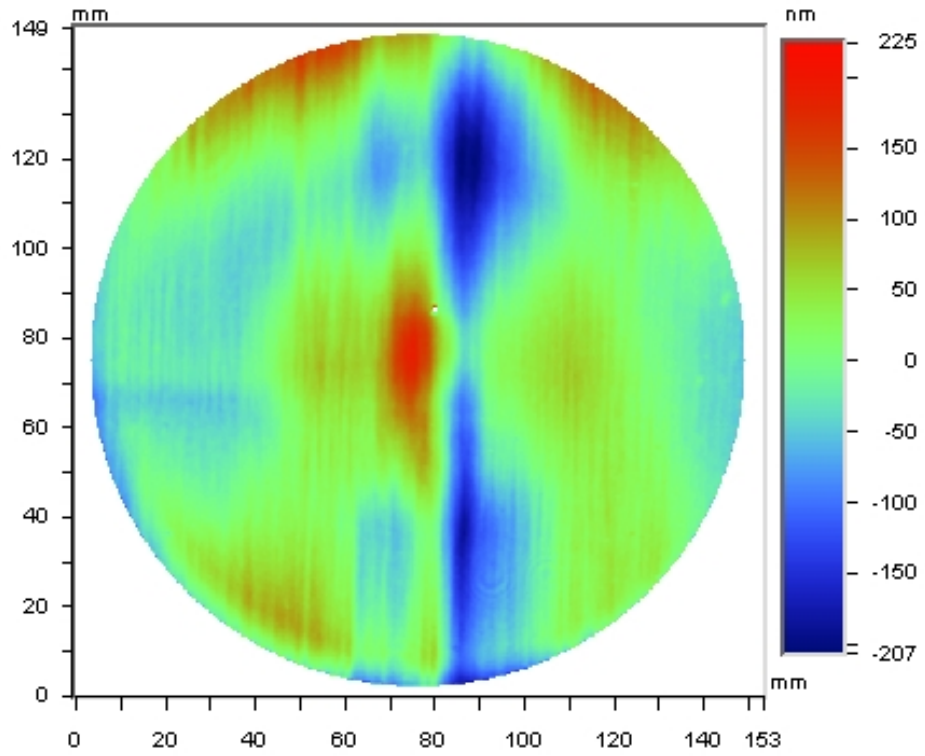
2D Low Cutoff	0.00 /m
2D High Cutoff	10.00 /mm
2D RMS	39.038 nm

X Average PSD Stats:

X Rf	---
X Avg PSD A	---
B	---
X Low Cutoff	0.00 /m
X High Cutoff	0.00 /m
RMS	---

Y Average PSD Stats:

Y Rf	---
Y Avg PSD A	---
B	---
Y Low Cutoff	0.00 /m
Y High Cutoff	0.00 /m
Y Avg PSD RMS	---



Title: File name: FliptestResult

Note:

Zernike Coefficients

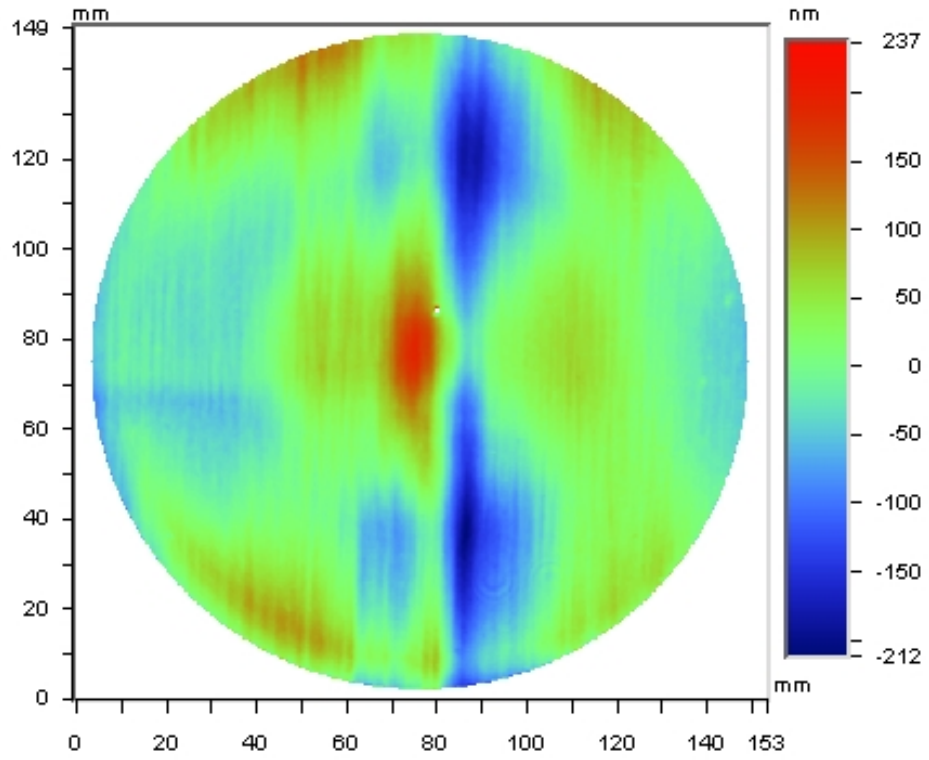
	Zernike_15[01]: -0.161653 wv
	Zernike_15[02]: 0.261673 wv
	Zernike_15[03]: 0.044283 wv
	Zernike_15[04]: 0.048069 wv
Zernike_8[1]: -0.16161 wv	Zernike_15[05]: -0.025558 wv
Zernike_8[2]: 0.26168 wv	Zernike_15[06]: 0.002335 wv
Zernike_8[3]: 0.04547 wv	Zernike_15[07]: 0.037198 wv
	Zernike_15[08]: 0.032937 wv
Zernike_8[4]: 0.04974 wv	Zernike_15[09]: 0.036449 wv
Zernike_8[5]: -0.02569 wv	Zernike_15[10]: -0.003820 wv
	Zernike_15[11]: -0.054792 wv
Zernike_8[6]: 0.00244 wv	Zernike_15[12]: -0.000654 wv
Zernike_8[7]: 0.03726 wv	Zernike_15[13]: -0.019281 wv
Zernike_8[8]: 0.03471 wv	Zernike_15[14]: 0.025439 wv
	Zernike_15[15]: -0.032709 wv

Date: 11/08/2000
Time: 13:14:17
Wavelength: 1.064 um
Pupil: 100.0 %
PV: 431.4746 nm
RMS: 55.0497 nm
Rad of curv: 28.134 km

X Center: 287.00
Y Center: 240.00
Radius: 274.00 pix
Terms: Tilt Power Astig
Filters: None
Masks: Detector Mask
Ref Sub: No
Averages: 8

Seidel Aberrations (8 Term Fit)

	Coeff (per radius)	Rms	Angle
Tilt	0.2505 wv		131.7 deg
Power	0.0909 wv	0.026 wv	
Focus	-0.1733 wv		
Astig	0.1120 wv	0.028 wv	-13.7 deg
Coma	0.1120 wv	0.040 wv	86.3 deg
Sa3	0.2083 wv	0.062 wv	



Title: File name: FliptestResult

Note:

Zernike Coefficients

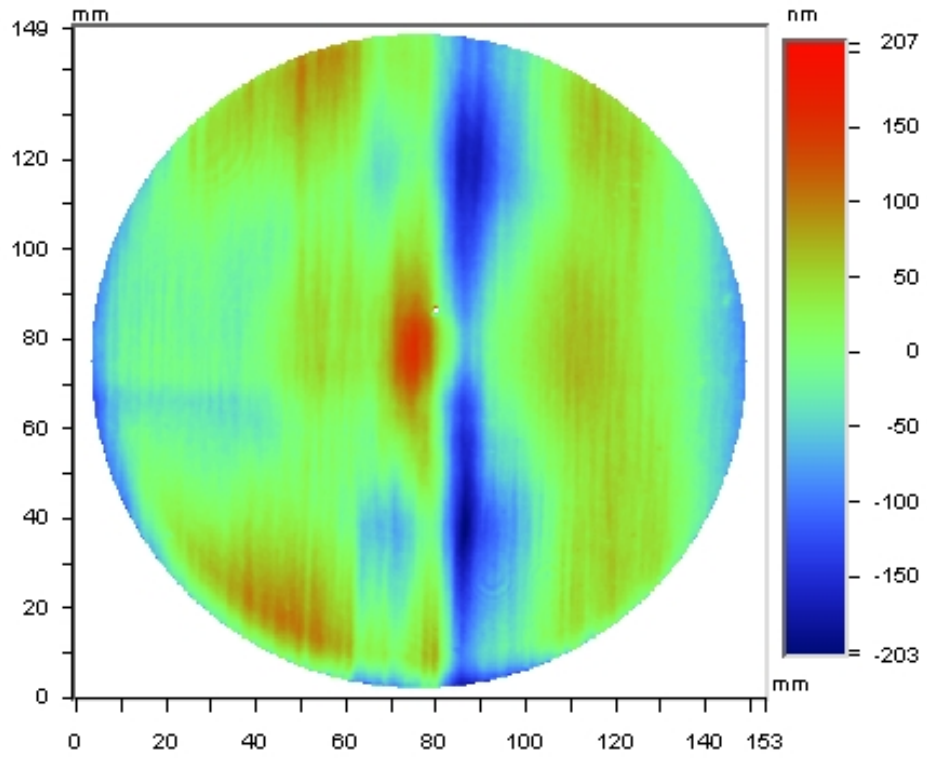
	Zernike_15[01]: -0.161653 wv
	Zernike_15[02]: 0.261673 wv
	Zernike_15[03]: 0.044283 wv
	Zernike_15[04]: 0.048069 wv
Zernike_8[1]: -0.16161 wv	Zernike_15[05]: -0.025558 wv
Zernike_8[2]: 0.26168 wv	Zernike_15[06]: 0.002335 wv
Zernike_8[3]: 0.04547 wv	Zernike_15[07]: 0.037198 wv
	Zernike_15[08]: 0.032937 wv
Zernike_8[4]: 0.04974 wv	Zernike_15[09]: 0.036449 wv
Zernike_8[5]: -0.02569 wv	Zernike_15[10]: -0.003820 wv
	Zernike_15[11]: -0.054792 wv
Zernike_8[6]: 0.00244 wv	Zernike_15[12]: -0.000654 wv
Zernike_8[7]: 0.03726 wv	Zernike_15[13]: -0.019281 wv
Zernike_8[8]: 0.03471 wv	Zernike_15[14]: 0.025439 wv
	Zernike_15[15]: -0.032709 wv

Date: 11/08/2000
Time: 13:14:17
Wavelength: 1.064 um
Pupil: 100.0 %
PV: 449.5732 nm
RMS: 53.3076 nm
Rad of curv: 28.134 km

X Center: 287.00
Y Center: 240.00
Radius: 274.00 pix
Terms: Tilt Power Astig Coma
Filters: None
Masks: Detector Mask
Ref Sub: No
Averages: 8

Seidel Aberrations (8 Term Fit)

	Coeff (per radius)	Rms	Angle
Tilt	0.2505 wv		131.7 deg
Power	0.0909 wv	0.026 wv	
Focus	-0.1733 wv		
Astig	0.1120 wv	0.028 wv	-13.7 deg
Coma	0.1120 wv	0.040 wv	86.3 deg
Sa3	0.2083 wv	0.062 wv	



Title: File name: FliptestResult

Note:

Zernike Coefficients

	Zernike_15[01]: -0.161653 wv
	Zernike_15[02]: 0.261673 wv
	Zernike_15[03]: 0.044283 wv
	Zernike_15[04]: 0.048069 wv
Zernike_8[1]: -0.16161 wv	Zernike_15[05]: -0.025558 wv
Zernike_8[2]: 0.26168 wv	Zernike_15[06]: 0.002335 wv
Zernike_8[3]: 0.04547 wv	Zernike_15[07]: 0.037198 wv
	Zernike_15[08]: 0.032937 wv
Zernike_8[4]: 0.04974 wv	Zernike_15[09]: 0.036449 wv
Zernike_8[5]: -0.02569 wv	Zernike_15[10]: -0.003820 wv
	Zernike_15[11]: -0.054792 wv
Zernike_8[6]: 0.00244 wv	Zernike_15[12]: -0.000654 wv
Zernike_8[7]: 0.03726 wv	Zernike_15[13]: -0.019281 wv
Zernike_8[8]: 0.03471 wv	Zernike_15[14]: 0.025439 wv
	Zernike_15[15]: -0.032709 wv

Date: 11/08/2000
Time: 13:14:17
Wavelength: 1.064 um
Pupil: 100.0 %
PV: 409.3110 nm
RMS: 50.7372 nm
Rad of curv: 28.134 km

X Center: 287.00
Y Center: 240.00
Radius: 274.00 pix
Terms: Tilt Power Astig Coma Sa3
Filters: None
Masks: Detector Mask
Ref Sub: No
Averages: 8

Seidel Aberrations (8 Term Fit)

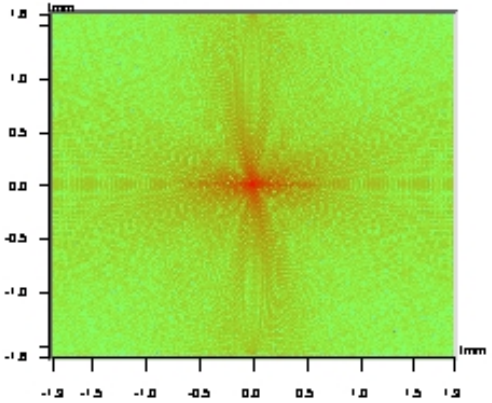
	Coeff (per radius)	Rms	Angle
Tilt	0.2505 wv		131.7 deg
Power	0.0909 wv	0.026 wv	
Focus	-0.1733 wv		
Astig	0.1120 wv	0.028 wv	-13.7 deg
Coma	0.1120 wv	0.040 wv	86.3 deg
Sa3	0.2083 wv	0.062 wv	

Veeco

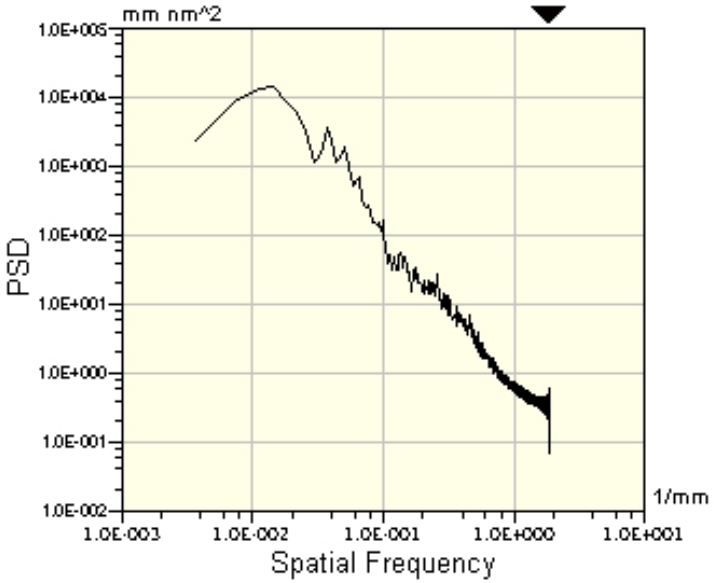
PSD Analysis

Date: 11/08/2000
Time: 13:14:17

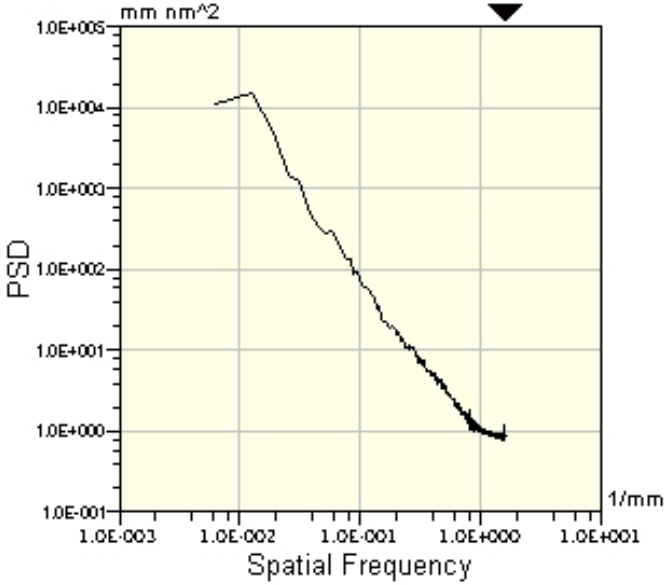
PSD Plot



X Average PSD



Y Average PSD



Analysis Results

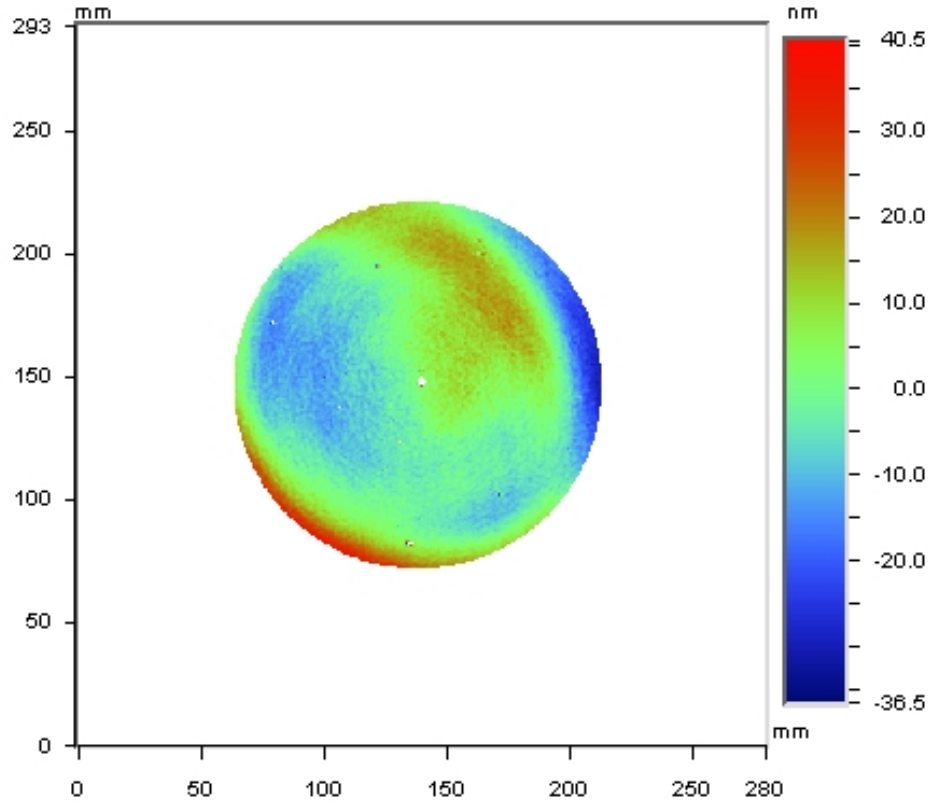
2D Low Cutoff	0.00 /m
2D High Cutoff	10.00 /mm
2D RMS	33.126 nm

X Average PSD Stats:

X Rf	---
X Avg PSD A	---
B	---
X Low Cutoff	0.00 /m
X High Cutoff	0.00 /m
RMS	---

Y Average PSD Stats:

Y Rf	---
Y Avg PSD A	---
B	---
Y Low Cutoff	0.00 /m
Y High Cutoff	0.00 /m
Y Avg PSD RMS	---



Title: 2ITM04 Homogeneity File name: 2ITM4TA

Note: Measured at CSIRO

Zernike Coefficients

	Zernike_15[01]: 0.042057 wv
	Zernike_15[02]: 0.032221 wv
	Zernike_15[03]: -0.441916 wv
	Zernike_15[04]: -0.018963 wv
Zernike_8[1]: 0.04240 wv	Zernike_15[05]: 0.007790 wv
Zernike_8[2]: 0.03286 wv	Zernike_15[06]: -0.025892 wv
Zernike_8[3]: -0.44189 wv	Zernike_15[07]: -0.018335 wv
	Zernike_15[08]: 0.003773 wv
Zernike_8[4]: -0.01861 wv	Zernike_15[09]: 0.002781 wv
Zernike_8[5]: 0.00884 wv	Zernike_15[10]: -0.009820 wv
	Zernike_15[11]: -0.004069 wv
Zernike_8[6]: -0.02523 wv	Zernike_15[12]: -0.008181 wv
Zernike_8[7]: -0.01712 wv	Zernike_15[13]: -0.003732 wv
	Zernike_15[14]: -0.006994 wv
Zernike_8[8]: 0.00381 wv	Zernike_15[15]: 0.001724 wv

Date: 08/12/1998
Time: 14:40:02
Wavelength: 690.700 nm
Pupil: 100.0 %
PV: 77.0458 nm
RMS: 10.1658 nm
Rad of curv: -4.745 km

X Center: 279.00
Y Center: 279.00
Radius: 152.00 pix
Terms: Tilt Power
Filters: None
Masks: Analysis Mask
Ref Sub:
Averages:

Seidel Aberrations (8 Term Fit)

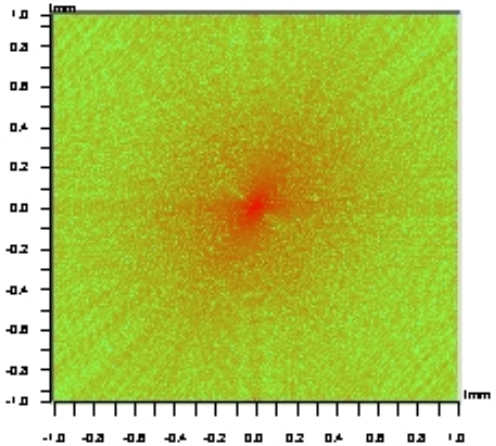
	Coeff (per radius)	Rms	Angle
Tilt	0.1146 wv		35.8 deg
Power	-0.8838 wv	0.255 wv	
Focus	-0.8861 wv		
Astig	-0.0412 wv	0.010 wv	-12.7 deg
Coma	0.0915 wv	0.032 wv	-145.8 deg
Sa3	0.0229 wv	0.007 wv	

Veeco

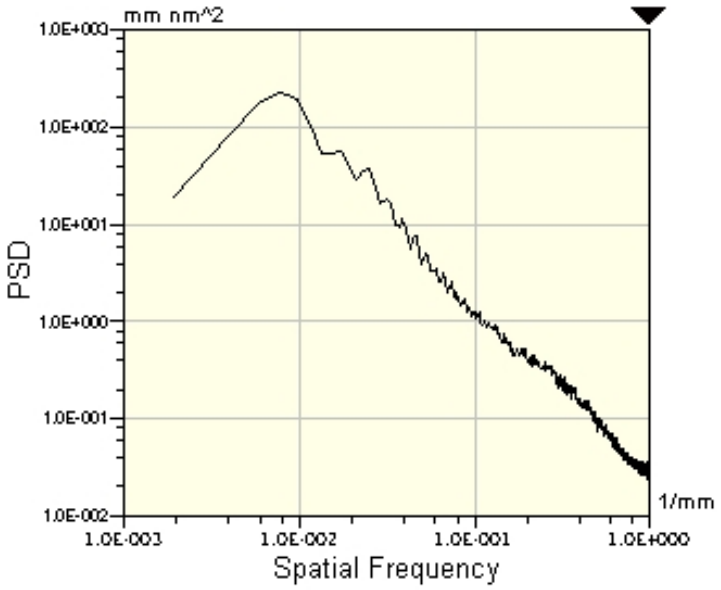
PSD Analysis

Date: 08/12/1998
Time: 14:40:02

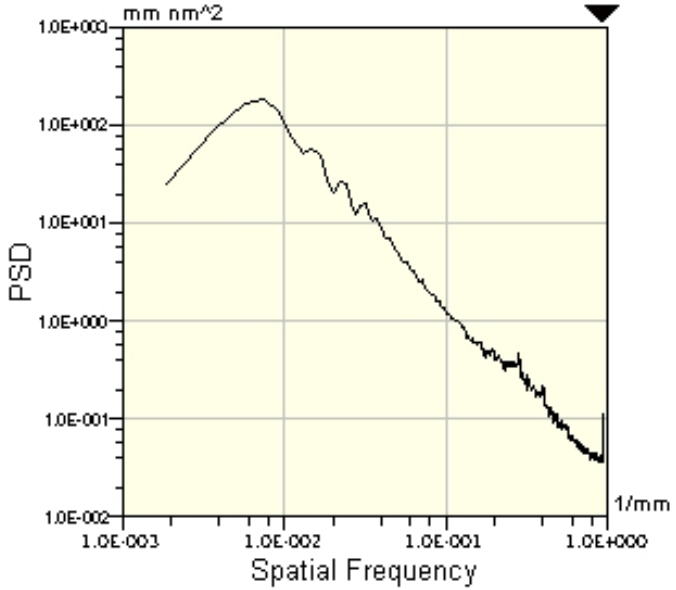
PSD Plot



X Average PSD



Y Average PSD



Analysis Results

2D Low Cutoff	0.00 /m
2D High Cutoff	10.00 /mm
2D RMS	4.817 nm

X Average PSD Stats:

X Rf	---
X Avg PSD A	---
B	---
X Low Cutoff	0.00 /m
X High Cutoff	0.00 /m
RMS	---

Y Average PSD Stats:

Y Rf	---
Y Avg PSD A	---
B	---
Y Low Cutoff	0.00 /m
Y High Cutoff	0.00 /m
Y Avg PSD RMS	---

Title: 2ITM04 Homogeneity

Note: Measured at CSIRO