

## Starstone 8in No. 0001a Tests

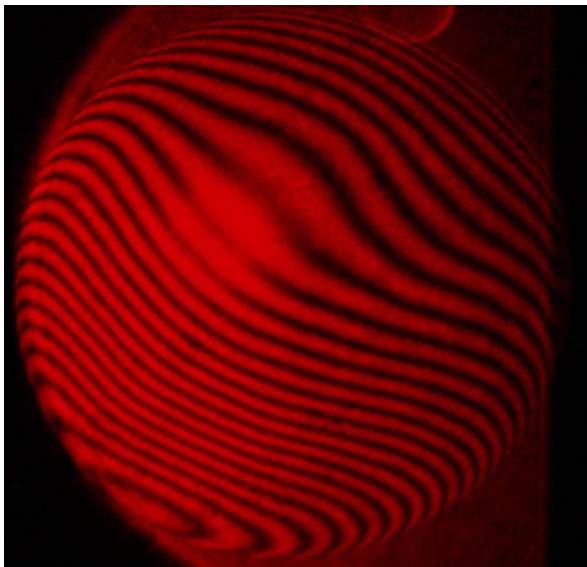
May 8, 2010, Revised May 27, 2010 – BDH \*\*\* PRELIMINARY \*\*\*

Diameter of mirror 8 3/8 inch, thickness 2 inches. f/2.25 Weight 2.5 lbs.

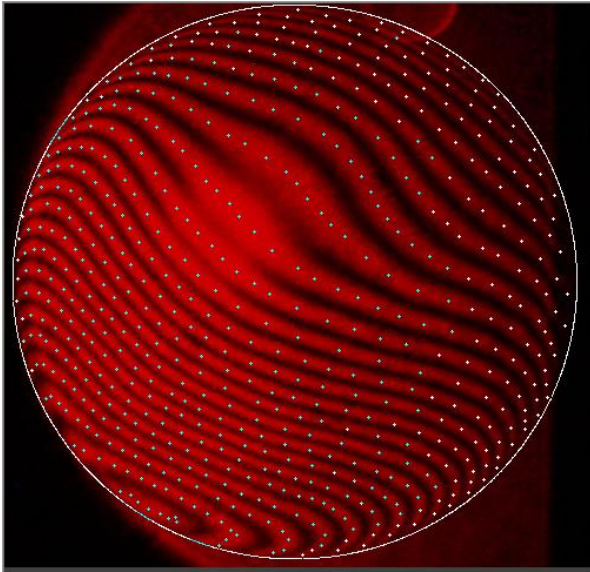
Setup: Bath Interferometer with a HeNe laser. Ambient temperature: 70 deg. Corner mirror about 0.5cm from beam splitter. [My optical table was messy because I reconfigured for the fast f/#].



The interferogram shows a turned down edge and high/low spots in the center of the mirror.



TraceXP fringe points.

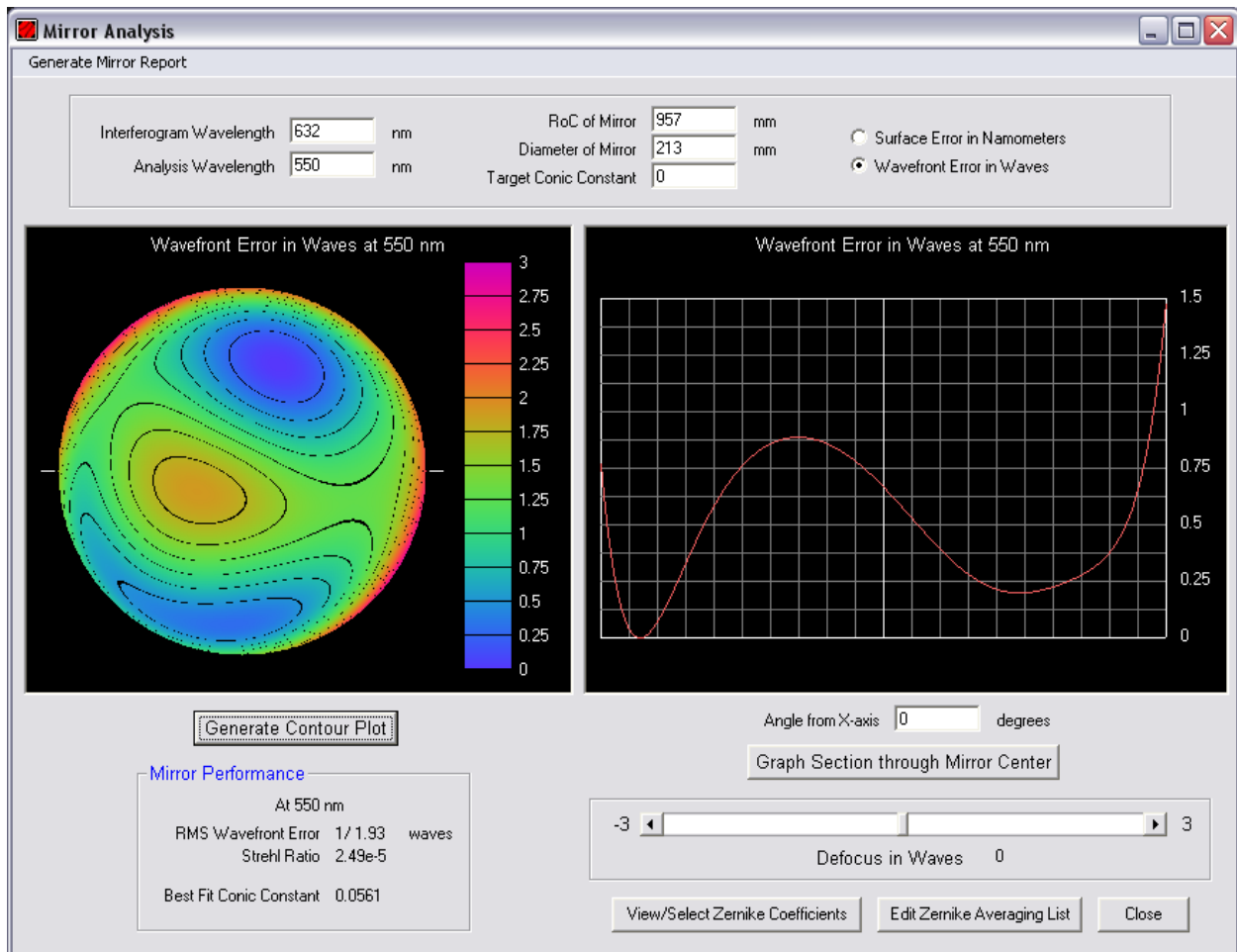


Half a wave of astigmatism, coma, and spherical aberrations are present.

(m, n)	X	Y	Select
Z0 (0, 0)	6.409		<input type="checkbox"/> Piston
Z1 Z2 (1, 1)	3.041	-4.798	<input type="checkbox"/> Tilt
Z3 (1, 0)	-0.4892		<input type="checkbox"/> Defocus (Power)
Z4 Z5 (2, 2)	0.4354	0.3852	<input checked="" type="checkbox"/> Astigmatism
Z6 Z7 (2, 1)	0.4299	-0.5577	<input checked="" type="checkbox"/> Coma
Z8 (2, 0)	0.5424		<input checked="" type="checkbox"/> Principal Spherical
Z9 Z10 (3, 3)	0.1184	0.0147	<input checked="" type="checkbox"/> Trefoil
Z11 Z12 (3, 2)	-0.3661	0.05776	<input checked="" type="checkbox"/> Secondary Astigmatism
Z13 Z14 (3, 1)	-0.1017	0.169	<input checked="" type="checkbox"/> Secondary Coma
Z15 (3, 0)	0.1604		<input checked="" type="checkbox"/> Secondary Spherical
Z16 Z17 (4, 4)	-0.0545	0.0432	<input checked="" type="checkbox"/> Tetrafoil
Z18 Z19 (4, 3)	-0.1249	0.003458	<input checked="" type="checkbox"/> Secondary Trefoil
Z20 Z21 (4, 2)	0.06287	0.1167	<input checked="" type="checkbox"/> Tertiary Astigmatism
Z22 Z23 (4, 1)	-0.009984	-0.001369	<input checked="" type="checkbox"/> Tertiary Coma
Z24 (4, 0)	0.07876		<input checked="" type="checkbox"/> Tertiary Spherical

RMS Fit Error 0.04957 waves

Close



With coma removed from the analysis:

**Mirror Analysis**

Generate Mirror Report

Interferogram Wavelength  nm  
 Analysis Wavelength  nm

RoC of Mirror  mm  
 Diameter of Mirror  mm  
 Target Conic Constant

Surface Error in Nanometers  
 Wavefront Error in Waves

Wavefront Error in Waves at 550 nm

Wavefront Error in Waves at 550 nm

Angle from X-axis  degrees

-3  3

Defocus in Waves

**Mirror Performance**

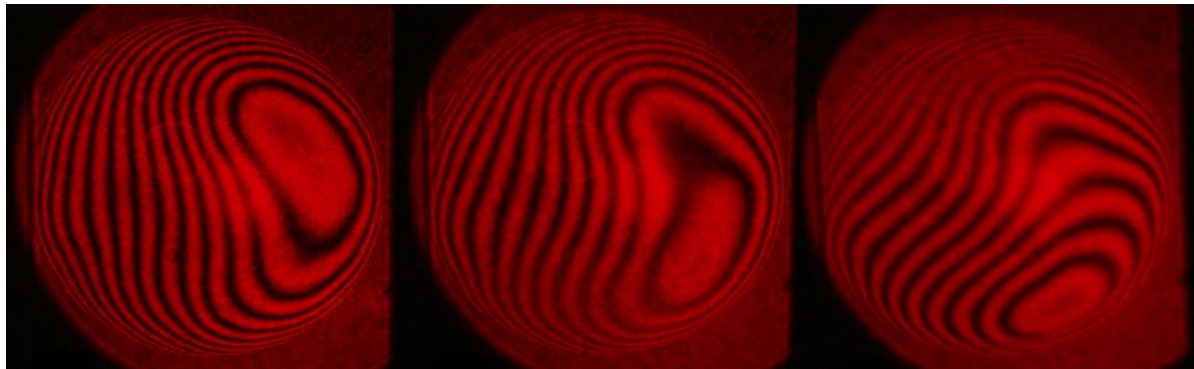
At 550 nm

RMS Wavefront Error  waves  
 Strehl Ratio

Best Fit Conic Constant

## Heat tests

May 10, 2010. A Performance Tools Model W50076 2-speed heat gun was used to warm gently the mirror face from a distance of about 3 feet on low setting. The total heating time was about 45 seconds. During the heat cycle, the interferogram was speckled due to air turbulence. Ambient temperature was about 70 deg. F. The mirror was only slightly heated with the gun, by a few degrees. The following interferograms were made while the mirror cooled.



7:32:26pm

7:32:54pm

7:33:52pm

The high spot on the mirror seems to shift as the mirror cools. It is possible that the heating of the mirror surface was not perfectly uniform. Note that the mirror was not re-mounted in its holder from the earlier tests. Fringes are  $\frac{1}{2}$  wave apart.

### TO DO:

- A. Try warming the temperature in the room and letting the mirror soak, then turning on the air conditioner. I have a temp sensor to use to get precise readings.
- B. Cycle the mirror in the freezer several times.
- C. Tests with spherical correctors
- D. Measure PSF on stars.

## May 27, 2010 Optical bench tests

Hubble Optics 5-star flashlight used for illumination. The apertures are precision holes of 50/100/150/200/250 microns.

See QSBVC color video camera used for images.

Flashlight placed 36 feet away = 11.0m.

The smallest hole in the Hubble flashlight appears to be 0.9 arc seconds in diameter at that distance.

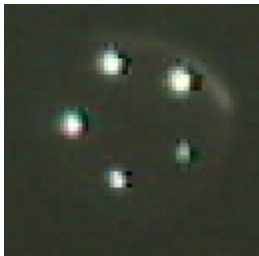
The hole-to-hole separation was measured at 7.7mm (144" or 2.4 arc min) and the diameter of the 5-stars is about 12.5mm (234" or 4 arc minutes).

Best focus without any corrector:



The "stars" are about 180" ( about 3 arc min) in diameter. The picture matches the spherical aberration expected from an f/2 mirror fairly well.

Several different corrector options were tried. The best focus with a SurplusShed Optics 50mm projector lens (no listed parameters on it) is seen below. No vignetting is believed to have happened in this image.



The smallest (0.9") "star" is about 25" (about 0.42 arc min) in diameter. It is likely that better collimation of the test setup would have reduced the spot size further. Also, a custom corrector would be beneficial.