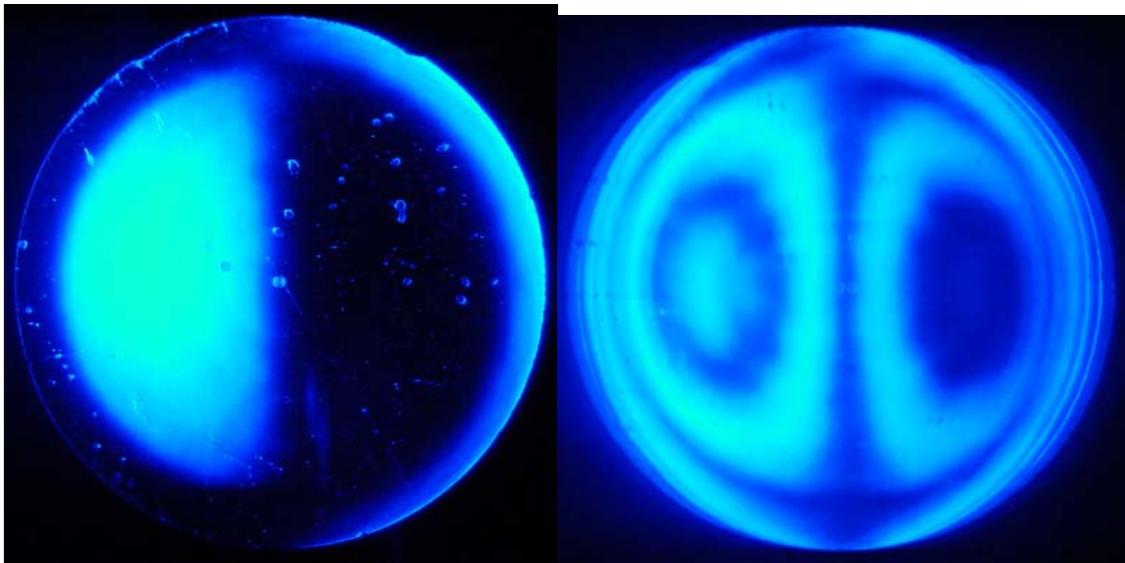


Final Report – 28” F/4.5 primary mirror #0049R, FL=126.5” Refigured for Dan Gray, 12/18/06, by Michael E. Lockwood

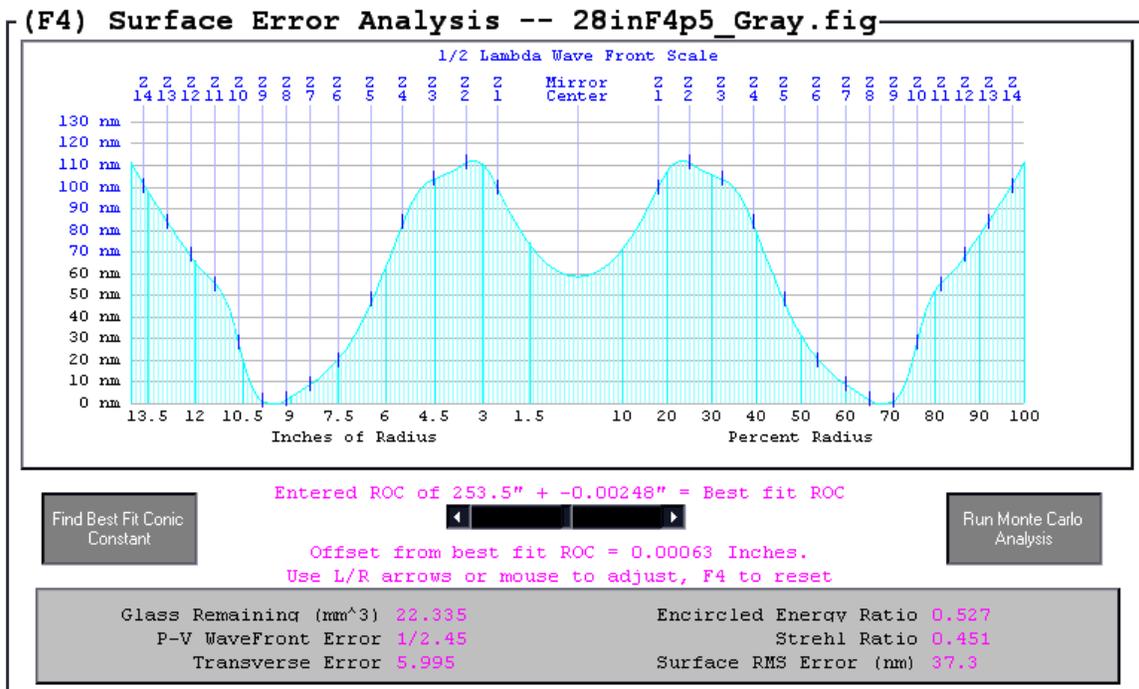
The 28” Pyrex primary mirror arrived in a wooden crate packed in closed cell foam. The blank had nicely ground sides. The optical surface showed some blemishes on the surface and one long fairly light scratch across the center of the mirror that remained after the coating was stripped. The back of the mirror had been partially ground, and was reasonably flat, but still about 1/32” concave. It was deemed to be flat enough.

The primary was Foucault tested before the coating was stripped. Initial testing revealed a fairly zoney central region. More careful testing showed significant astigmatism in the outer regions of the mirror, enough to significantly distort the ronchi lines. Images of the coated mirror under Foucault and Ronchi testing are shown below. Note the asymmetry of the Foucault shadows (dark shadow bends to the left at the bottom of the image) and the Ronchi lines (circular line does not meet at the top center as it does at the bottom center). These are indicators of significant astigmatism. This confirmed the owner’s description of astigmatism in the images that rotated with the primary mirror.



The primary was strain tested and the results indicated that the blank was very well annealed. No strain was observed with the “crossed polarizer” test, so the astigmatism must have been ground or polished into the 2”-thick blank.

The results of initial Foucault testing are shown below. Ignoring the significant astigmatism, the mirror did not meet the Rayleigh criterion. The P-V wavefront error was 1/2.45 waves, the Strehl ratio was 0.451, and the transverse error was 6.0. These indicate significant errors of slope and on the wavefront. As it was, even neglecting the astigmatism this mirror would not perform to my standards, and an improved figure would result in circular, much tighter star images and greatly improved planetary images and performance at high power.



Units are in Inches, Light source is Moving,
Mirror Diameter = 28 Best fit Radius of Curvature = 253.498 Desired deformation = -1

Refiguring was accomplished with pitch laps from 22" to 6" in diameter. Extensive rotational polishing was performed to bring the mirror back to a near-sphere of very true figure of revolution. Figuring was started only after no astigmatism could be detected in the nearly spherical mirror, and great care was used to minimize the chance of astigmatism being reintroduced into the mirror. A fine figuring compound was used for the final stages of work. The surface became quite smooth over most of the surface of the mirror, with the exception of some very slight roughness where a high zone was worked down. Its effect will be nearly undetectable, and it is of no consequence.

The figure of the mirror turned out quite well, as shown in the next figure. According to the final Foucault test results, the Strehl ratio was 0.98, the peak-to-valley wavefront error was 1/13.5 waves corresponding to a surface accuracy of ~1/27 wave, and the transverse error has been reduced to 2.0, indicating that only reasonably small slope errors are present on the optical surface. Ideally the transverse error could have been a little lower, but the extra work and surface roughness generated would not be justified.

Realistically, because every measurement contains inherent error and uncertainty, I can only claim that this mirror has a Strehl ratio of 0.95 or higher, wavefront error of less than 1/8th wave and a maximum transverse error of 2.0. The only astigmatism seen in final testing was due to the mirror flexing slightly on the test stand (it was the same no matter how the mirror was rotated) so I believe it is a good figure of revolution. These specifications should be sufficient to allow use of the mirror at powers of 50x per inch of aperture (1400x for this mirror) providing it is properly collimated, supported in its cell, equilibrated to air temperature, and used with a good quality secondary mirror.

