CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

35276

Project Title

How Does the Shape of a Telescope's Mirror Affect the Size of Image Produced?

Abstract

Objectives/Goals

This study determines how the Coefficient of Deformation of a telescope's mirror affects the size of image produced (Transverse Aberration). Coefficient of Deformation is a number that describes the shape of the mirror, and size of image produced (Transverse Aberration) is a measure of the sharpness of the image. For a reflecting telescope mirror, the goal is a parabola with a Coefficient of Deformation -1. My hypothesis was that at a Coefficient of Deformation -1 the size of image produced would be zero, meaning that once the mirror was parabolic, the best image quality would be achieved. Throughout this project, the mirror was polished using specific techniques in order to test different mirror shapes.

Methods/Materials

In order to test my hypothesis, I ground and polished a 6-inch telescope mirror. Once it was reflective, it was tested for performance with the Foucault test. Foucault testing is finding the shape of a mirror by measuring its Radius of Curvature in each part, or zone. The mirror was placed on the test stand with a screen to isolate four zones, which were each tested separately. The Foucault tester was positioned so that its light source illuminated the full mirror. By moving the knife-edge across the return image, the focus of each zone could be determined, and the position of the knife-edge would be recorded. Each zone's measurements were then compared to each other. Using this information, the polishing stroke would be adjusted to correct the shape of the mirror. Each set of measurements, followed by corrective polishing, constituted one data point.

Results

At a Coefficient of Deformation -1, the size of image produced was 0.0145 mm, not zero as predicted.

Conclusions/Discussion

The results show that Coefficient of Deformation is an incomplete way of describing the shape of the mirror because it does not take into account surface defects. The shape of the mirror within each zone is also a large factor in the resulting size of image produced (Transverse Aberration).

Summary Statement

I built a telescope and investigated the image-forming properties of its mirror during fabrication.

Help Received

Mom documented the entire process (photos and videos), and Dad helped with the use of power tools and provided support through the mirror figuring process.