OPTI 415L / 515L - Optical Fabrication and Testing Laboratory

Lab #10 Alignment of Aspheres

Purpose:

The purpose of this lab is to perform an alignment of an off-axis parabolic mirror.

Procedure:

I] First Steps

1) Look at OAP from its center of curvature with the PSM. Image will be larger than will fit in objective. Use an iris to illuminate only the central region of the OAP. This is result in a smaller image. Image will look somewhat fish shaped (a combination of astigmatism and coma).
2) The "tail" of the fish points toward the optical axis of the OAP. Rotate the OAP in its mount until the astigmatism is aligned with the plane of the table. This makes subsequent alignment easier.

II] Measure radius of curvature and off-axis distance

1) Measure the distance from sagittal C of C and tangential C of C to OAP.

The radius of curvature of the parent mirror surface ' R_V ' is given by

$$R_V = \sqrt{\frac{R_S^3}{R_T}},$$

and

the off-axis distance ' h ' is given by

$$h^2 = R_S^2 - R_V^2,$$

where

R_S is the sagittal radius of curvature of the OAP and

R_T is the tangential radius of curvature of the OAP.

III] Autocollimator setup

1) Move the OAP toward the PSM to get to the approximate focus. Point the PSM to center the light cone on the OAP aperture.
2) Position the return flat to capture the collimated beam from the OAP. Tilt the flat to return the beam to the OAP. Find the return image near the PSM objective.
3) Adjust the PSM and flat to get the image in the objective. Focus the PSM to get smallest image. It will be largely astigmatic. First align astigmatism with the table.

IV] Final Steps

1) Keep the image centered on the PSM screen and tilt the return flat to see which way makes spot smaller (When badly misaligned it is difficult to tell the right direction). Once the correct direction is found keep tilting to reduce astigmatism as much as possible in one direction.
2) Then work on orthogonal tilt adjustment. Keep the image roughly centered on the screen all the time. The spot will reduce to a roughly symmetrical image. The spot will never look perfectly round and focused. At this point you have aligned to OAP.