

Alignment of OAP with a Large Auto-collimating Flat Mirror, but no LUPI Interferometer

These instructions assume that the OAP and flat mirror are held by mounts equipped with tip/tilt adjusters.

1. Place a pinhole target at the approximate focal point of the OAP, making sure to be at the same height as the center-line of the OAP. The pinhole target should be approximately .010" in diameter, and the material around the pinhole should ideally be white colored on the side facing toward the OAP.
2. Illuminate the pinhole from behind with a focused He-Ne laser or bright white light source. This creates a point source which illuminates the OAP.
3. Adjust the angle of the auto-collimating flat mirror until a return image is seen on the white side of the pinhole target. Observe the return image with a lens, eye loupe, or a low-power microscope.
4. The alignment objective is to make the return image as small and sharp as possible, and as close as possible to the outgoing pinhole, by adjusting the following*:
 - a) The tip/tilt angles of the OAP
 - b) The tip/tilt angles of the auto-collimating flat mirror
 - c) The focus position of the pinhole
5. The size and shape of the return image tell you what errors to correct.
 - a) a large diameter spot = focus error
 - b) Straight-line images = off-axis distance error and/or clocking error.
6. After locating the pinhole at approximately the nominal focus position, you will usually find sharp, straight-line images before and after the optical focus. The first goal is to make adjustments so that the straight line images (indicating astigmatism) are oriented vertically on one side of focus and horizontally on the other side of focus. They should not be oriented at a 45 degree angle (worst case) to the mounting surface/optical bench, which would indicate a rotation error of the OAP.

If the straight line images are **oriented vertically and horizontally**, skip to step 8. If they are oriented at some other angles, proceed with step 7.

7. Adjust the vertical-tip adjustment knobs on the mounts of the OAP and the flat to make the line images appear horizontal & vertical. Start by adjusting one vertically (tipping the mirror mount) and then follow with the other to move the return image back to the pinhole. An adjustment in the correct direction will cause the line image to be smaller in length and be oriented at an angle closer to 0 or 90 degrees to the mounting surface.

Continue adjusting in this manner until the line images are oriented at 0 and 90 degrees on either side of focus.

8. The next step is to make the line images inside and outside of focus contract to a single point image by horizontal-tilt adjustments of the OAP and flat mirror. Adjust one mirror, then follow with the other (as above). Adjustments in the correct direction will cause the line image to grow shorter in length at its sharpest position. Continue adjustment until both line images converge to the same point.
9. When you have the return image as small as possible and as close to the pinhole as possible, the mirror is aligned. A number of iterations of steps 7 and 8 may be necessary to achieve this condition.

*To make an alignment adjustment, any two of the three components in the system (pinhole/point source location, OAP, and flat mirror) need to be adjusted. If your system does not allow for a change in the angle of the collimated beam portion of the setup (between the OAP and the flat mirror), then instead adjusting the flat mirror in the alignment exercise above, you could adjust the tip/tilt of the OAP and the x-y location of the pinhole.

Possible adjustment pairs:

- OAP and flat mirror tip/tilt (described above)
- OAP tip/tilt and pinhole x-y location
- Flat mirror tip/tilt and pinhole x-y location

If you do not have the freedom in your setup to adjust two components, the clocking error described in step 7 can be removed in the following way:

1. Put on some latex gloves
2. Carefully rotate the mirror in its mount by the smallest amount you can (<1 degree). TAKE CARE NOT TO TOUCH THE OPTICAL SURFACE. This slight rotation will move the return spot vertically.
3. Use the tip/tilt adjusters on the OAP mount to drive the return spot back toward the pinhole.
4. Note the effect of the rotation on your focused spot. A rotation of the mirror in the correct direction will cause the line image to be smaller in length at its sharpest point and be oriented at an angle closer to 0 or 90 degrees to the mounting surface or optical bench. Continue until line images are oriented at 0 and 90 degrees on either side of focus. Proceed with step 8 above.