

## *Howie Glatter's tuBlug Instructions*

The tuBlug is used together with a regular single beam laser collimator to adjust the angular alignment of the primary mirror of a Newtonian telescope. First however, the angular alignment of the secondary mirror is adjusted with the laser collimator alone. As usual, adjust the secondary so that the laser beam strikes the center of the primary mirror. The laser collimator is then removed, and the tuBlug is inserted in the focuser and clamped. The tuBlug should be inserted with the side cut-out opening facing the back of the scope, so that the shadow screen will be visible from primary adjustment position.

The laser collimator is then inserted in the tuBlug and clamped with the clamping screws. If the collimator has an aperture stop that was installed for the secondary adjustment, remove it first before using the tuBlug. If not, the Barlowed shadow will lack contrast, and you may be confused by diffraction rings on the tuBlug screen. The collimator should only be inserted at most until it touches the tuBlug insert. If you have a long collimator don't try to insert it all the way, but clamp it at the point it touches the insert.

The laser beam is diverged by the lens in the tuBlug, then reflected by the secondary mirror to illuminate the central area of the primary mirror. The diverged beam impact on the primary may be irregular and not centered, but this does not matter. Upon reflection by the paraboloidal primary, the beam becomes collimated into all parallel rays, but where the center of the mirror is covered by the collimation target the reflection is blocked, so the upward-traveling beam now contains the silhouette shadow of the collimation ring or mark within it.

The collimated beam is reflected by the secondary mirror to the screen in the tuBlug, where the shadow of the collimation mark is seen. The shadow's position is an accurate indication of the primary mirror optical axis location. The primary mirror is adjusted so that the shadow is centered on the screen's central aperture. Collimation is now complete.

If you experience difficulty seeing the reflected shadow on the tuBlug screen, it may be because of one of these correctable reasons:

1. the primary adjustment may be so far off, that the collimation mark shadow does not enter the focuser opening. To test for and correct this, hold a piece of paper at the front of the scope and move it around to see if the shadow is missing the secondary and being projected out the front of the scope. If the shadow is not seen there, hold the paper beside the focuser opening inside the telescope tube to see if the shadow is missing the focuser opening. The primary should then be adjusted to move the shadow onto the tuBlug screen.

2. It is possible for the tuBlug insert to become tipped within the side cut-out tube. To check for and correct this, push the small end of the tuBlug insert against the tube wall with a clean finger, insuring that it is flush against the tube wall.