ATM Journal 9: Flexing Your Way to a Perfect Paraboloid
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Yes, I know last time I said we'd look at fixing optical problems, but I thought I'd offer a change of pace in this issue and talk about an interesting way to get a perfect paraboloid figure on a mirror without the figuring process – flexing.

To review, a telescope mirror needs (for a Newtonian design anyway) to have a paraboloidal figure to reflect all of the light coming from the sky to a specific focus. Unfortunately, the mirror grinding and polishing process results in (hopefully!) a spherical surface that then has to have its centre deepened during figuring to produce a true paraboloid. But is there a different way to do it? The answer for many ATMs are flex mirrors, where the shape of the mirror is mechanically deflected from a sphere.

In the June 1992 issue of Sky & Telescope Bill Kelley first published a description of the process of pulling the centre of a mirror into a paraboloid. Kelley's method is often referred to as "centre pull" since the mirror is supported at the edge and pulled by a central bolt. Using the right combination of f/ratio, aperture, and thickness, this method has been reported to produce good paraboloids. In November 2000, Alan Adler published a method which uses a wide annular puller to better distribute the flex tension. Adler's method, referred to as "microflexing" produces significantly better results, although it is a little harder to implement.

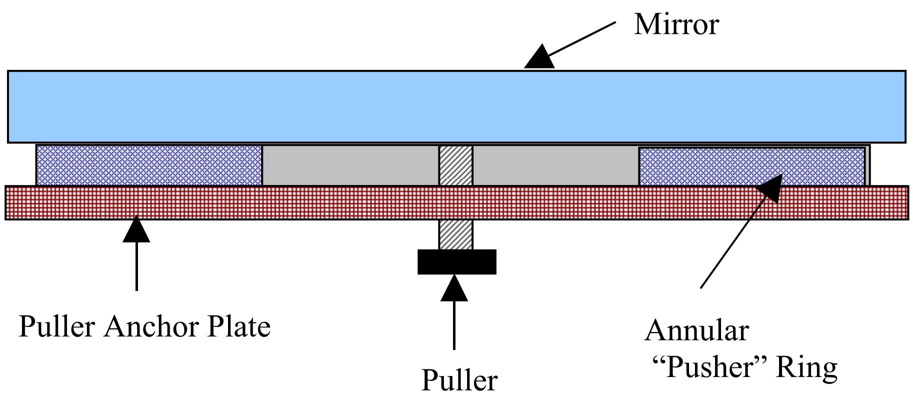

Figure 1 – A simple flex mirror cell ala Kelley

But is flexing a mirror easier than figuring? This is highly dependent on the mirror maker's tendency to produce a perfect sphere, or some other figure. If you're going to end up having to figure your mirror to get it to a sphere it might be just as easy to go ahead and parabolize it!

Drawbacks of using a flex mirror design consist of:

- ✯ You absolutely need to remove wedge from your mirror blank. “Wedge” is a difference in thickness on one side of your blank versus the other side, and will cause astigmatism in a flexed mirror since it will flex differently based on thickness.
- ✯ There's the added technical challenge of building a flex cell, although it's been commented that a flex cell is no more complex to build than a 9 point floatation cell and likely easier.
- ✯ Normal floatation cells are not possible, possibly leading to problems with figures changing based on attitude (however, this has not been raised as a problem by owners of flex mirror systems).
- ✯ Cooling can be impaired by the flexing apparatus not allowing access of air to the mirror.

Once you have a flex mirror there are some definite benefits to using the approach:

1.There's no need to parabolize. This saves a ton of time for most mirror makers, and
2.The Foucault test becomes a null test that you can use to complete your mirror. There is no need for extensive quantitative testing of the figure of the surface because if all points on the mirror don't null at once you know you have some work to do with the common polishing strokes.
3.You now have an adjustable figure mirror – you can adjust the mirror's figure IN THE FIELD to adjust for cooling/rising temperatures, something impossible to do with non-flex mirrors.
4.Chances are you're going to be able to produce a much better mirror than with parabolizing techniques, especially if you're a beginner.

Flexing seems to be a good option, particularly for ATM's experiencing some frustration in parabolizing their mirrors, or even fixing problems with a mirror that is undercorrected. In many cases cheap optics of small apertures and long focal lengths have been figured as spheres because the difference between a sphere and a paraboloid is minimal, but in the case where there is a difference, it's handy to be able to fix the problem.

Next time: Fixing Optical Defects