

Mirror cell, from page 2

proper places, and gently lowered the 11 pound mirror into position. I then patiently waited 48 hours for the cement to set before removing the spacers that held the mirror about 3/32" above the plywood disk. The idea is that the silicon cement dries to form small, resilient pads that support the mirror and isolate it from any deformation of the plywood disk that might occur during collimation or over time. Imagine my horror when I removed the spacers and watched as the mirror slowly compressed the pads of silicon and settled onto the plywood disk!

I stared at the mirror for a long time trying to decide what to do. In the end, I left it securely cemented to the plywood disk. I decided to wait and see if it created a noticeable problem, and to fix the problem if it did. I'm happy to report that I've been very pleased with the performance of my home-made scope, and have never noticed any performance degradation that I could attribute to the improperly mounted mirror.

The mirror remounted

However, this imperfection has nagged at me. Not enough to motivate me to remount the mirror, but I couldn't forget that it was there. Subsequently, other items came to my attention that increased my desire to remount the mirror. First, was the collimation method I employed. It worked well enough, but it could be more stable. And I hadn't considered the fact that the springs will lose tension over time so the eyepiece focal plane will slowly work its way closer to the tube.

Second, was achieving mirror temperature equilibrium with the external environment. This was not considered in Berry's book, but it's a major concern among telescope makers because heat induced air currents within the telescope's tube can significantly degrade image quality. I've discovered I need to let my scope cool down for at least two hours in order to obtain high quality views of Jupiter and Saturn, so I was very interested in improving the mirror cell design to obtain better heat exchange between the mirror and the outside air.

A better design

I'd been contemplating this effort for 18 months or more with the idea of tackling the

project during the summer when it was too hot and hazy to do much observing.

Therefore, I was elated when I received the May issue of *Sky and Telescope* and saw that it featured an article on "How to Build a Better Mirror Cell" by Gary Seronik. Seronik's design is similar in principle to a mirror cell with push-pull adjustment bolts, except the three separate "push" bolts are replaced by a single fixed point behind the center of the mirror. The mirror is free to tilt in any direction about this point, and the three collimation bolts are tightened or loosened to get the tilt just right. I liked this approach even better than one proposed by Bob Bunge which used a central pull bolt and three push ones, so I started planning the job. First off, the late July weather cooperated extremely well. I wasn't even tempted to go out observing. Then I posted a message on the NOVAC email list looking for some help to reduce the diameter of the plywood disk holding the mirror.

Bob L'Hommedieu graciously offered to lend a hand, so I made a date with him and the project was off the ground. Separating the mirror from the plywood disk was a real pain. In the end, I found I could pry it up and the cement would yield; however, it took a lot of elbow grease and a sharp knife to scrape away the silicon residue. Once that was finished the job went smoothly. I popped over to see Bob, and he had the disk cut to the required 10" diameter in about ten minutes. Thanks a lot, Bob! Then all I had to do was cut three 2.5" holes in the pair of plywood disks that form the cell, drill a few additional holes for the collimation screws, slap on some flat black paint, and the job was done.

I did deviate from Gary's design in the *S&T* article. The collimation bolts in Gary's cell are flat head machine screws that pass through the disk with the mirror attached and protrude out the rear of the scope, where wing nuts are used to make the collimation adjustments. I had several concerns with this approach. First, I was concerned that the wing nuts would be easy to bump and the collimation would be disturbed. Second, I place the mirror end of the tube on the ground when I transport the scope. My original cell used flat head bolts that didn't protrude so there weren't any obstructions at

the rear of the scope. I decided to use tee-nuts recessed in the disk with the mirror attached so I could again use flat head bolts. I made sure that the flat head bolts were short enough so they wouldn't protrude and push directly on the mirror.

Get the spacing right

When a mirror cell is modified, the surface of the mirror must return to the same place it was originally or the eyepiece focal plane will move. I put a spacer between the tailpiece and the mirror disk to accomplish this. Doing this reminded me that determining the position of the hole to be cut in the side of the tube for the focuser is tricky. Careful calculation and measurement is required. It occurred to me that the mirror cell could be made to slide in the end of the tube and allow adjustment that would take the worry out of accurately positioning the focuser hole. When the scope was finished there would be a recess at the end of the scope, but I don't think this would be much of a problem. Next time I build a scope I'll keep this in mind.

The modified cell went back into the scope without a problem and my first impressions were very good. I took advantage of the clear skies during the first week of August and spent a couple of hours at Savage. Collimation was easy and there isn't any movement or squeaking when I carry the tube. The only thing that isn't perfect is the spacer. It's about an eighth of an inch thicker than it should have been which seems a lot bigger at the eyepiece than I expected. I'll leave it alone for now, but I expect to disassemble the cell so I can paint the exterior of the tailpiece and take some pictures, so I might reduce the spacer height then.

Now that my upgrade is complete, I'm ready for clear, transparent skies to see if I notice any difference in mirror cooling. There is one thing I'm sure of—I won't be nagged by construction errors. This time I used aquarium cement to attach the mirror to the plywood and it worked perfectly. It made the cutest little buttons! Just like I wanted. ★