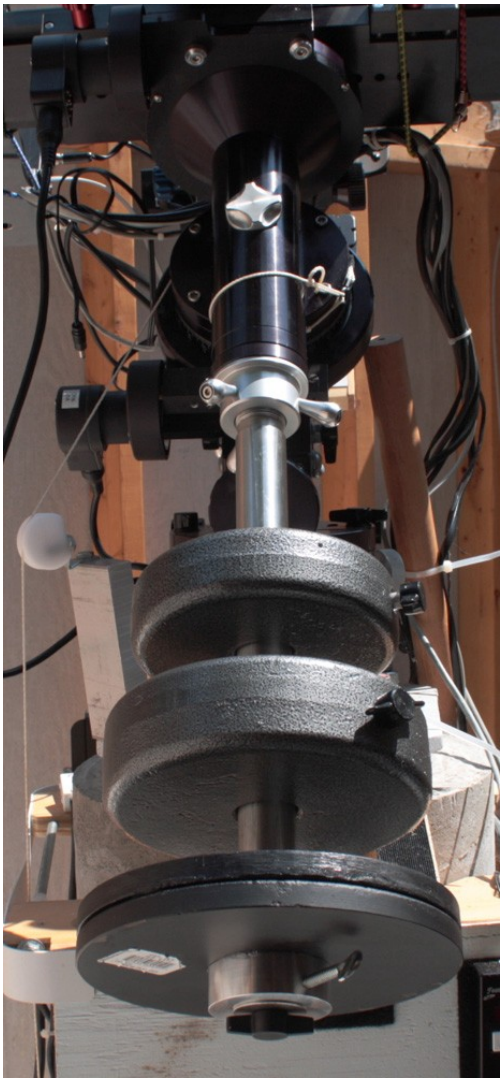
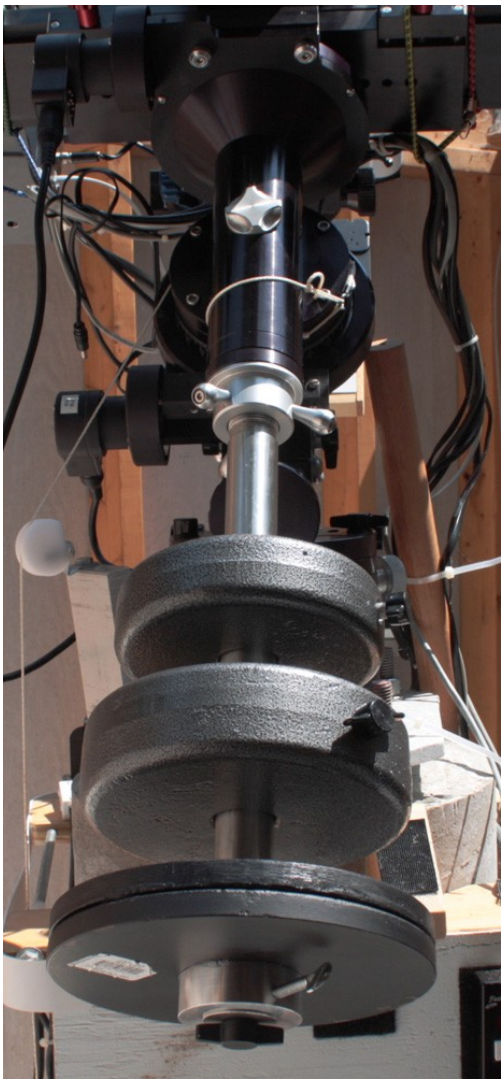
Finding the Losmandy G-11/Gemini's "Magic" CWD Position

by Mike Dodd (mike@mdodd.com), July 22, 2008

The elusive CWD position

Which of these two photos of a Losmandy G-11/Gemini telescope mount shows it in the best counterweight-down (CWD) startup position? In the left photo, the shaft nicely splits the large altitude-adjustment knob behind it, a position you or I might set by eye. But in the right photo, the shaft is offset. Which is best?





Believe it or not,the CWD position in the *right* photo is best on my G-11, even though the counterweight shaft in the left photo is better-centered on the altitude adjustment knob.

This is an important issue because the Gemini control system asks you to put the mount into the CWD position when first starting up (Cold Start, Warm Start), then calculates initial star coordinates relative to this position.

Unfortunately, we are expected to eyeball this position. The mount has no positive indication to tell us when the right ascension (RA) and declination axes are correctly positioned.

Why do we care?

Why is there a "best" position? Doesn't Gemini build and adjust its pointing model relative to whatever CWD position you set (within reason)?

Yes, but Gemini calculates a target's coordinates *based on* the CWD position. If the CWD position you set by eye exactly matches the position Gemini *expects*, initial pointing (and pointing without a model) will be fairly accurate. If it doesn't match, initial and unmodeled pointing will be less accurate.

For me, it's a matter of convenience. Whenever I need to start Gemini in the CWD position (Cold Start or Warm Start) and slew to an initial sync star, I'd like that star to appear very close to the finder scope crosshairs. If there are several bright stars in the area, I don't want to guess which is the correct one.

There is another factor as well. I use automation software for imaging, and it plate-solves after slewing to a target. With such a feature, building a pointing model in Gemini is not necessary. But plate-solving works best if the mount points to targets fairly accurately. If Gemini has no pointing model, starting it from a good CWD position yields best pointing.

The magic CWD position

I call this Gemini's"magic" CWD position because if we get it right, Gemini performs better. But how are we to figure out the exact RA and declination positions that Gemini expects? I've developed a simple method to do this.

The key is discovering the magnitude and direction of the error between an eyeball CWD position and Gemini's "magic" position. Once you discover this, you can slew the mount the correct distance and turn off the power. Your mount then is in the magic CWD position. The next time you power-up, Gemini accepts and remembers this startup position, and will accurately slew to the initial alignment star. If you mark this magic position with tape or a permanent marker, you will be able to set it correctly in the future.

The procedure

Perform these steps to discover your mount's magic CWD position.

1. Set the RA and declination axes to your best eyeball CWD position.
2. Power-up Gemini and do a Cold Start.
3. Choose an initial alignment star from the Bright Stars list, and let Gemini slew to it. Hopefully the star will appear in the finder scope's FOV.
4. If the star is exactly centered in the finder scope, you're done! Skip to step 10.
5. If the star is *not* exactly centered, hold down the Gemini Menu key until Visual Mode appears on the display, then release the key. This switches to the visual mode, which causes Gemini to slew at a reasonably-fast rate when you press the hand control direction keys.
6. Hold down a direction key to move the star toward one of the finder scope crosshair axes (it doesn't matter which one), and measure how many seconds it takes by using a watch or by counting ("one-thousand-one, one-thousand-two," etc.). **Remember this time and the direction key you pressed to reach the crosshair axis.** Repeat for the other axis. Once the star is centered on the finder scope crosshairs, you should have in mind two direction keys and how long you pressed each of them.
7. Hold down the Gemini Menu key until Park Mount appears in the display. Select Park @ CWD Position to tell Gemini to park the mount there.
8. **Now the key step!** Once parked at the CWD position, hold down the two direction keys for the same length of time you held them to center the star in the finder scope. In other words, if you held down the Right key for 10 seconds, hold it down now for 10 seconds. Repeat for the other key and time period. Pressing these keys moves the RA and declination axes the same direction and distance that was needed to center the bright star in the finder scope.
9. Leave the mount in this modified CWD position and turn off the Gemini power. Wait a few seconds, then go back to step 2 and power-up Gemini with a Cold Start. After you perform steps 3 and 4, the alignment star should be close to the finder scope crosshairs. If it is not centered to your satisfaction, continue with step 5 and the following steps. Each time through the procedure, the length of time you must hold down the direction keys should decrease, and eventually you will zero-in on the magic CWD position, where the initial star is accurately centered in the finder scope.
10. **Mark the magic CWD position in some way so you can easily return to it in the future.** A high-tech scheme would be to affix a micro switch and small cam to each axis, along with an LED that would light up at the correct position. I chose a lower-tech approach, applying small triangles of metal tape, as seen in the photo on the next page.

Why it works

The cool thing about this procedure is, it tricks Gemini into telling us what we need to do to discover its magic CWD position. On startup, Gemini *assumes* the mount is polar-aligned and in the CWD position, then calculates its target coordinates based on this assumption. If the CWD position is wrong,Gemini's target slews will be wrong. By timing how long it takes to center the target, we learn exactly how long and in which direction to move the axes to match Gemini's expected CWD position. The next time Gemini is powered-on, the mount is in this magic CWD position, and all subsequent coordinates will be calculated correctly from it.