Declination Drift: An Explanation

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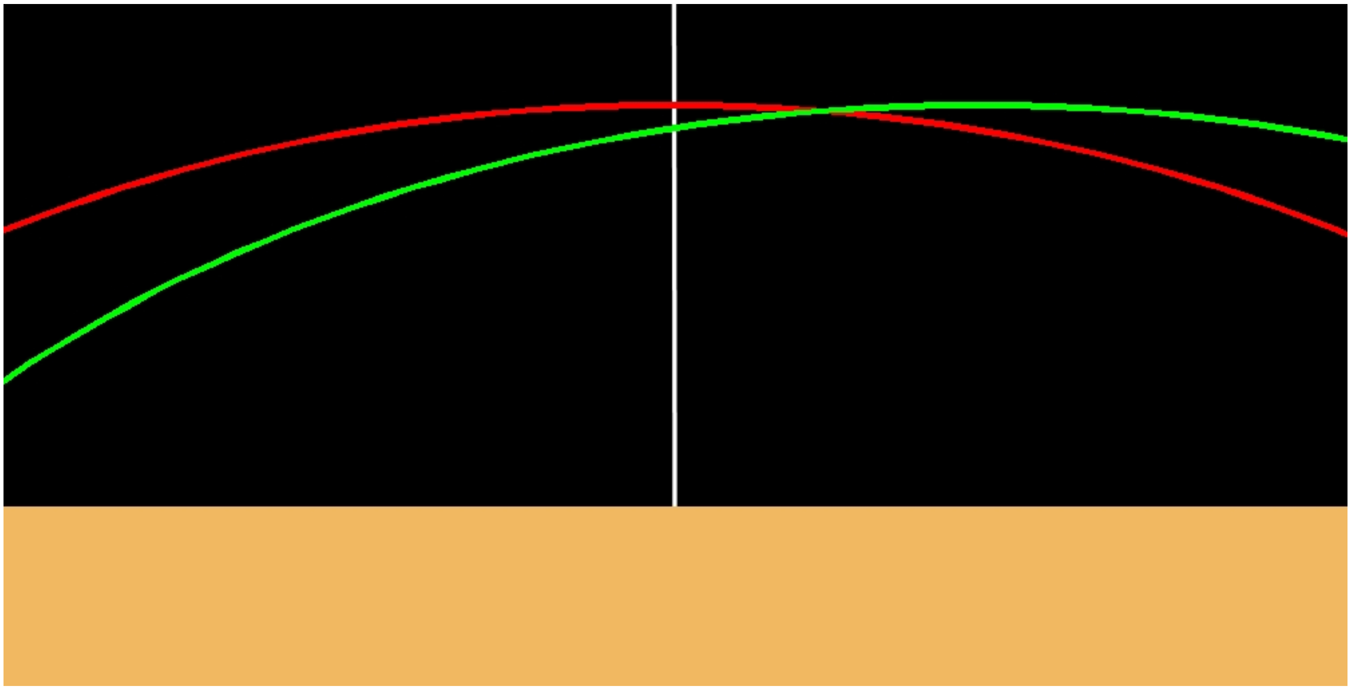
For any true equatorial mount you need to align the polar axis with the earth's rotational axis to track objects. For visual use, simply aligning this axis with Polaris is sufficient for even high magnifications on the planets. Most telescopes aren't capable of magnifications beyond 20x to 30x per inch of aperture due to optical quality and alignment, and most of the time the atmosphere isn't steady enough to allow for higher magnifications.

But for imaging deep sky objects accurate alignment of the polar axis is an absolute necessity, since exposures can last anywhere from a few seconds to many minutes. Even for planetary imaging using web cameras, such accurate alignment gives better quality video for stacking images. For some mounts, a polar alignment scope, usually mounted within the polar axis itself, may provide the necessary accuracy. But the declination drift method gives the highest degree of accuracy. It involves repeating two steps over and over until all drift is eliminated. There are many web sites that give the procedure, the mount is adjusted first in azimuth (east or west) then elevation (pointed higher or lower). It is tedious and time consuming; the first time I tried it I took over 30 minutes. But with practice and experience, I was able to whittle that down to 10 minutes or so. A lot depends on guesstimating just where to point the polar axis initially. The closer you get your initial guess, the faster the drift method can proceed. Hence I usually only do this after adjusting the polar axis using a polar alignment scope.

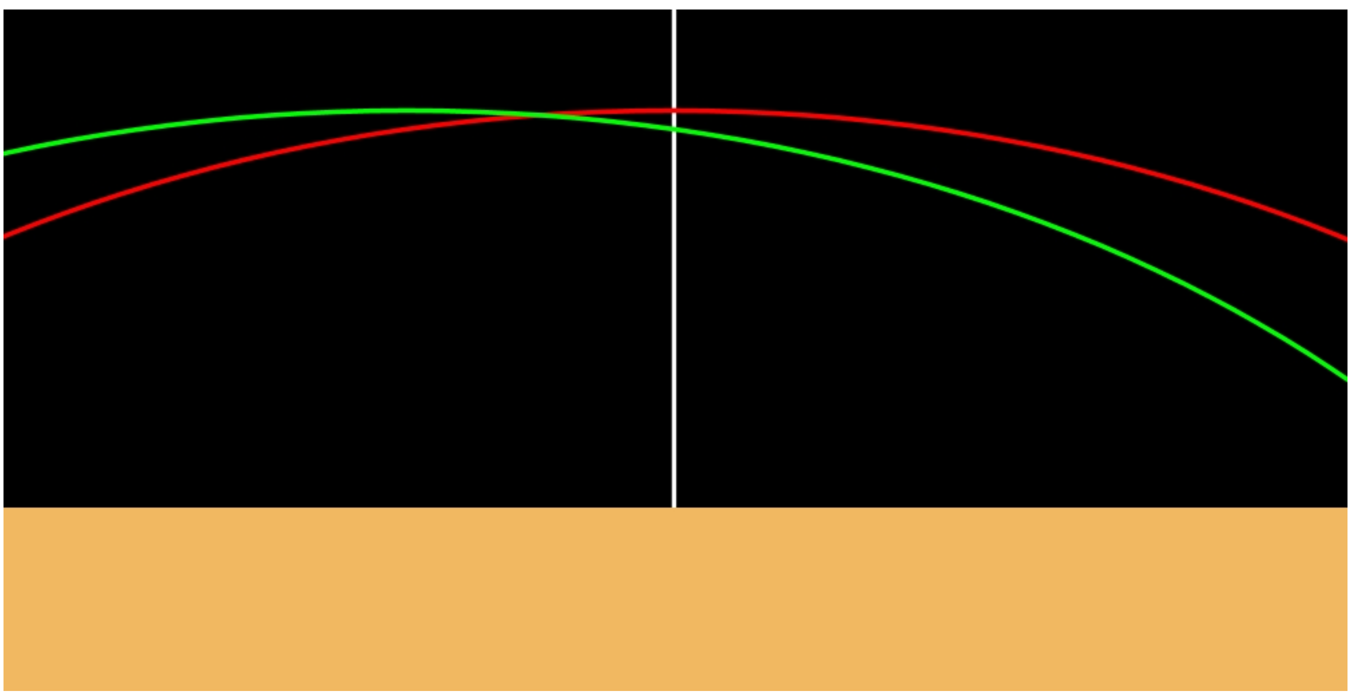
But while there are many websites that explain the procedure, but I've not encountered one that explains WHY it works. So after some thought I convinced myself that what I'm about to describe is the reason why.

The method is called declination drift because it uses ONLY the drift of a star in declination in order to align the polar axis of the mount. East-to-west motion is ignored.

Let's take the first step. This means selecting a relatively bright star within 5 degrees of the meridian, the imaginary line through the sky going directly north-south, and no more than 5 degrees north of the celestial equator.



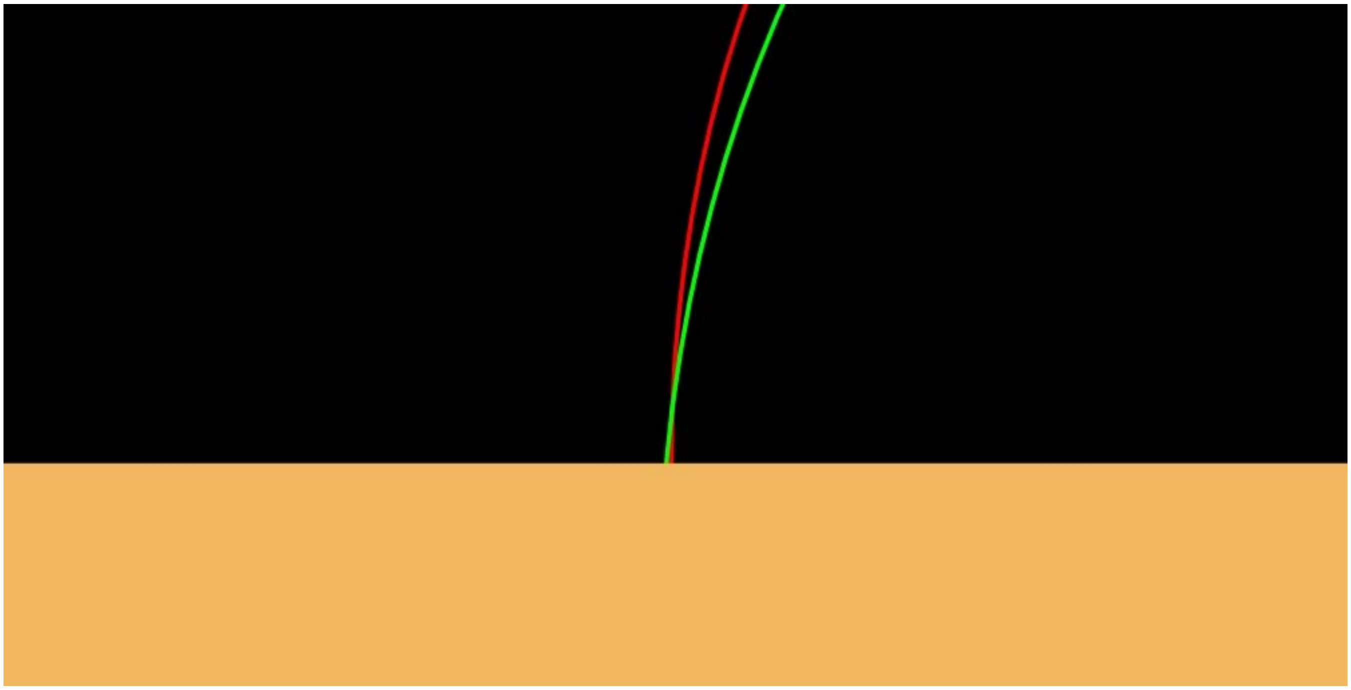
The illustration above is looking due south. The white line is the meridian, and the red line the true celestial equator. The green line is the mount's celestial equator if the mount is pointing a little east of where true north is. In this case, the mount tracks gradually further north of where it should be, and the star drifts south. So to correct this, you need to move the mount's azimuth direction a little to the west. This explains why you only adjust in azimuth at this stage. If the mount is not off in azimuth but is off in elevation, then the green line would be parallel to the red line, and no shift would be seen.



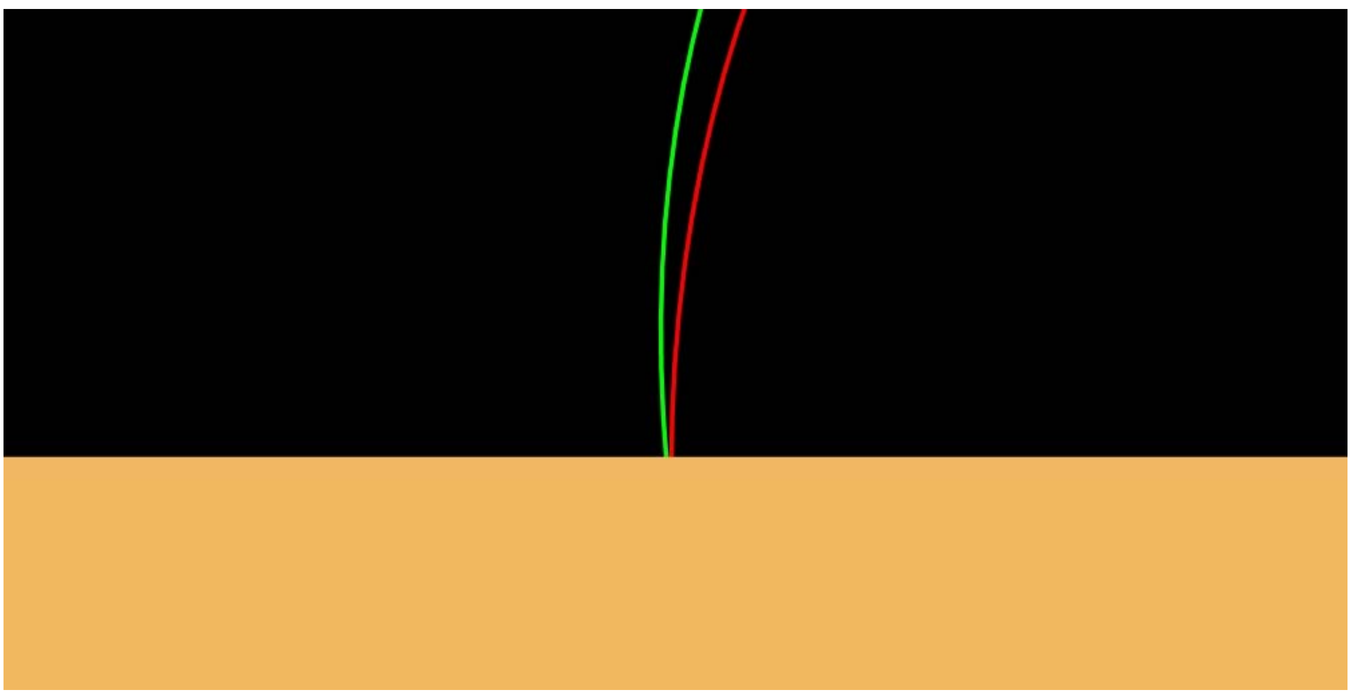
The illustration above shows the opposite situation, with the mount pointed a little to the west of true north. Now the mount will track gradually south of where it should, and the star drifts north. Then the adjustment is to move the mount's azimuth a little to the east.

Remember that, if you've done a good polar alignment before applying the declination drift method, your adjustments are going to be small. Make small corrections and check the star to see how it tracks in the north/south direction.

Once we cancel all north-south drift at the meridian, we select a star as far to the east as we can, and just above the celestial equator. This situation is shown in the illustration below.



If the mount is pointed higher than true north, then the green line is where the mount's celestial equator is. In this case, the mount gradually tracks further south than it should, and the star drifts north, so you have to adjust your polar axis to point lower.



The reverse happens if the mount were pointed too low. Then your mount's celestial equator is tilted higher than it should be, as shown above. Now the star drifts to the south, so you adjust the polar axis a little higher than it is.

These adjustments can affect each other so you have to go back and forth between the two stars until all drift is canceled. However, I've found that I usually had to do this twice on both stars depending on how much accuracy I needed. To gain more accuracy, simply use higher magnifications to see the drift. I've found that a good rule of thumb is to use twice the magnification your camera delivers. Placing a Barlow in front of your camera accomplishes this.