# Collimating a Newtonian telescope

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Telescopes that are hauled across the landscape to observing sites away from home get out of alignment, or collimation. Getting things back in order is part of the job of observing. Some telescopes such as Maksutov-Cassegrains with a silvered secondary and refractors tend to keep collimation almost forever (unless mistreated). Other types need to be checked and adjusted sometimes every time that they are used. This little paper will discusss Newtonian type reflectors.

So what IS collimation. There are several parts to your basic Newt that all have to be aligned both mechanically and optically in order for the telescope to deliver all that it can for you. Collimation starts from the eyepiece and works its way out so the first thing that must be looked at is the focuser. Is it square to the tube and perpendicular to the optical path? Unless you're building your own or changing a focuser you probably don't want to pull your telescope apart so we'll assume that your focuser has been properly installed.

Next the secondary mirror has to be properly positioned in the optical tube to pass the maximum amount of light from the primary mirror up the focuser and adjusted to be reflect a beam from the centre of the focuser to the centre of the primary mirror.

Lastly the primary mirror has to be adjusted to reflect that beam from the centre of the focuser back on itself to coincide perfectly with the outgoing beam. All sound complicated? Well...it's quite simple if you have the right tools. What we'll be using are:

**A collimating cap**

This can be as simple as a 35mm film can with a small hole drilled in the centre of one end that you can put in the focuser and look through. Better is a 1.25” cap with a hole in it put onto a 1.25” eyepiece barrel.

**A sight tube with cross-hairs (Cheshire or not)**

You want one that is metal and well-made. The Celestron is nice. If the sight tube is short enough this can double as the above-mentioned collimating cap. Mine (the Celestron) is too long.

**A barlow lens**

Any old barlow will do... single-element, achromatic or multi-element. Stick with a barlow though, I don't know how this will work with a Meade or TeleVue unit. They're technically not barlows.

**A laser collimator**

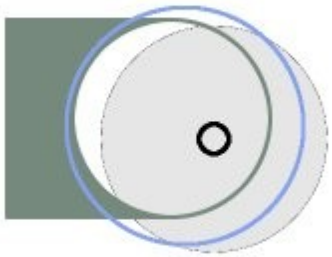
Doesn't need to be collimated itself, you just want light to come out of it.

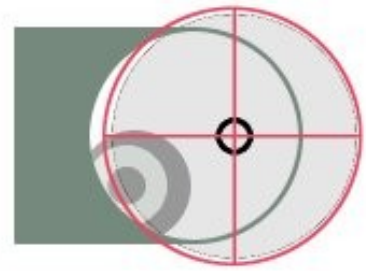
Another tool that is extremely useful but not necessary unless you are bound and determined to achieve the absolute best collimation that you can is an auto-collimator. This is a small plug that fits in the focuser with a centre hole. Inside is a plane, polished reflector. It all works like those mirrors in old barber shops where you see multiple reflections. Between the collimator and the primary mirror you get multiple reflections and if there is any mis-alignment this can be corrected by adjusting the primary mirror until all the reflections coincide. I don't use one and as collimation changes slightly with temperature change it's probably not just a bit to picky..

The process I use, and which I find most effective is the 'barlowed laser' method. This method not only removes from play any mis-collimation of your laser device but any 'slop' in your focuser. This process will be described below with illustrations.

We'll be assuming that the focuser is in the right place on the tube and that the primary mirror has a centre spot. If you have no spot you'll have to remove the primary mirror IN ITS CELL, measure it to find the exact centre and place one of those glued paper rings dead centre then replace the whole assembly back in the tube. Don't worry about this, it won't have any detrimental effect on the image (it's hidden by the secondary) and you can leave it it place.

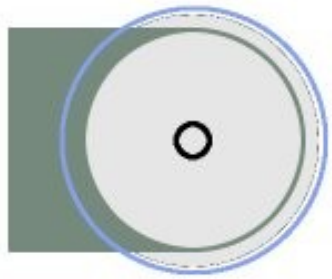
If you put the collimating cap in and look through it you might see something like the first illustration. Nothing is aligned and that's where most people start. As you can see, the primary mirror is in grey with the centre spot visible. The secondary and holder are in green and the collimating cap's field of view is in blue. Normally, of course you won't see that is outside the cap's field, but this is only for illustration.

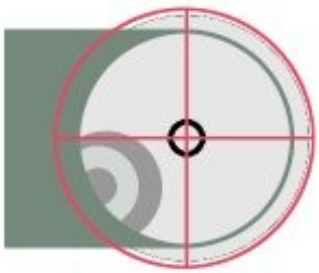




Now place your Cheshire sight tube in the focuser (red). If you are using a 2” to 1.25” adaptor then orient the adaptor so that its tensioning thumbscrew is opposite the one that is holding it in the focuser. Look into the tube and adjust the three (or four) collimating screws on the secondary so as to put the cross-hairs on the primary mirror's centre spot. The grey circle is the shadow of the secondary and Chesire.

Next properly centre the secondary mirror under the focuser. Use your collimating cap for that. Adjust the centre screw of the secondary holder to move the secondary forward and back and the spider adjustments to move it left/right until it's centred (you might have to loosen the three collimating screws first).





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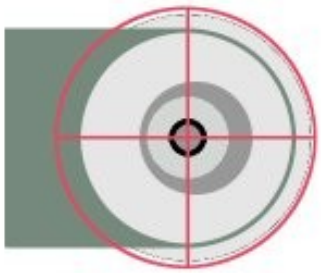
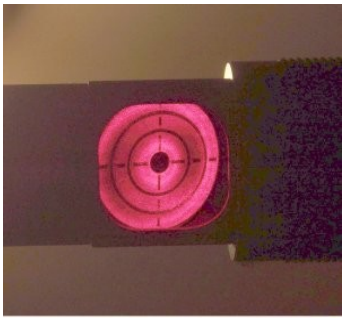
The next step is to put your sight tube back in the focuser and re-adjust the secondary to put the cross-hairs back on the centre spot (things may have shifted when you centred the secondary). Illustration 4.

With the Cheshire in place adjust the primary mirror's adjustment screws or knobs until the shadow of the secondary and Cheshire are under the cross-hair. Don't worry if the shadow of the secondary is off centre. It is supposed to be.





Now put your laser into your barlow and place it into the focuser and turn it on. You'll see the shadow of the primary mirror's centre spot in the cutout of the laser collimator. Adjust the primary cell until the shadow of the centre spot is centred around the hole that the laser is coming out of and then lock the rear cell. You're done. The good thing about this step is that you can do it easily in the field.

The last picture are our tools (except for the collimating cap) lined up on the shelf and ready to go. If you follow these simple steps getting your Newt's optics all in a row is simple.