PlaneWave CDK Collimation Instructions

Collimation and Secondary Spacing Procedure

The CDK optical design has four optical elements shown in figure 1. The primary mirror and the two element lens group are permanently mounted and aligned at PlaneWave Instruments. The secondary mirror is movable to allow fine collimation and to set the spacing between the primary and secondary. To get the best performance out of the CDK optical system, the optics must be collimated and secondary to primary mirror spacing must be set.

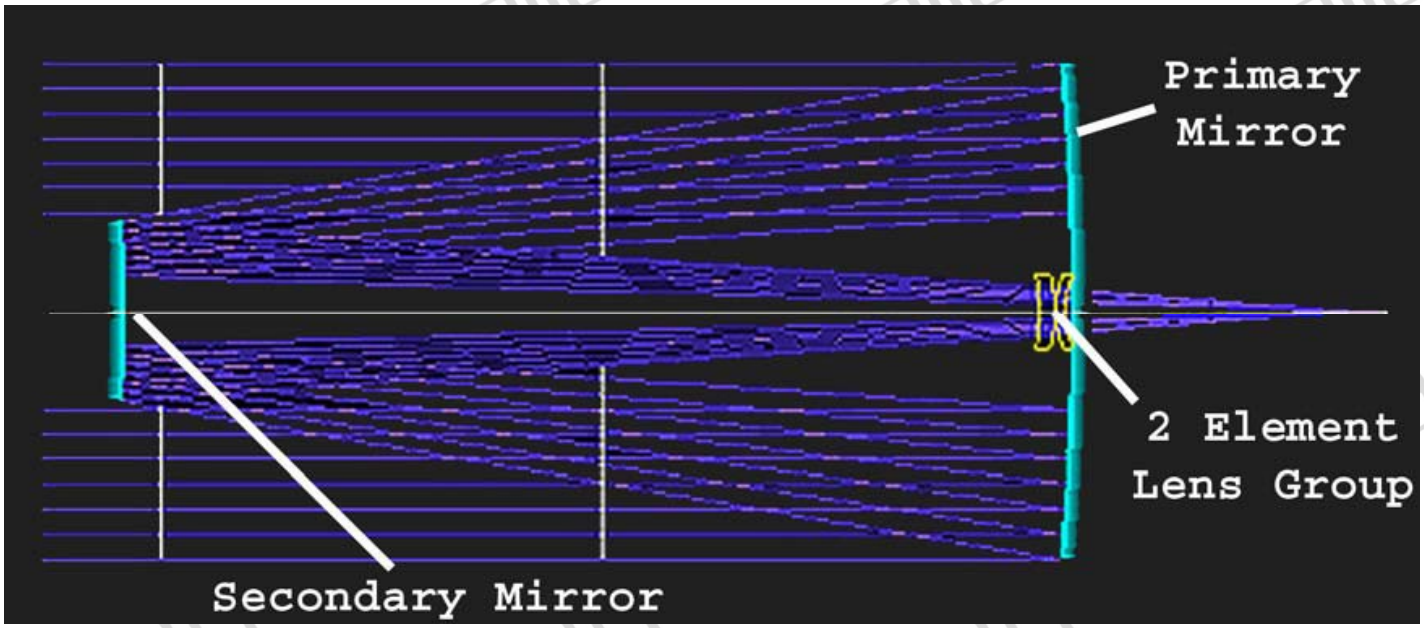

Figure 1: The optical layout of the CDK system. The system contains 4 elements which consist of the primary mirror, the secondary mirror and a 2 element lens group.

Key Components

In alto a sinistra: Secondary Spacer
In alto a destra Ronchi Ocular
In basso a sinistra 2" Adapter for CDK20
In basso a destra 2" Adapter for CDK12.5

Figure 2: Here are the standard accessories used for collimation and setting the primary to secondary distance for the CDK12.5 and CDK20.

Figure 3: On the left is the 2" adapter for the CDK12.5 attached to the Secondary Spacer and the Ronchi Ocular. On the right is the 2" adapter for the CDK20 attached to the Secondary Spacer and the Ronchi Ocular.

Step 1, Rough Collimation:

Put the Secondary Spacer into the 2" adapter. The CDK12.5 2" adapter has thumb screws and the CDK20 2" Adapter has two 8-32 set screws which requires a 3/32 Allen wrench. Place the 2" adapter into the telescope focuser. Now place a low power 1-1/4 ocular into the secondary spacer (25mm to 40mm). Point the telescope at a bright star. Defocus the star until it becomes a donut looking ring. If the donut hole looks centered (in the center of the donut), proceed to Step 2. If the donut hole is not centered, adjust the collimating screws on the back of the secondary mirror so that the defocused star moves in the direction of the fat side of the donut as shown in figure 4. Re-center the star and repeat this process until the donut hole looks centered as shown in figure 5.

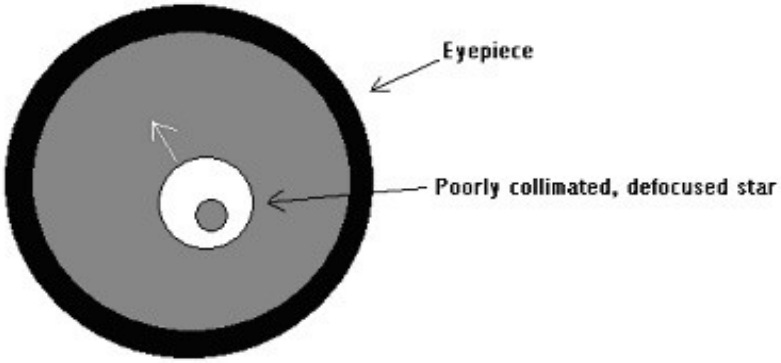

Figure 4: This is an example of what you would see in a low power eyepiece that is out of focus for an out of collimation telescope. To collimate this telescope you will want to adjust the secondary collimating screws so the out of focus stars moves in the direction of the arrow.

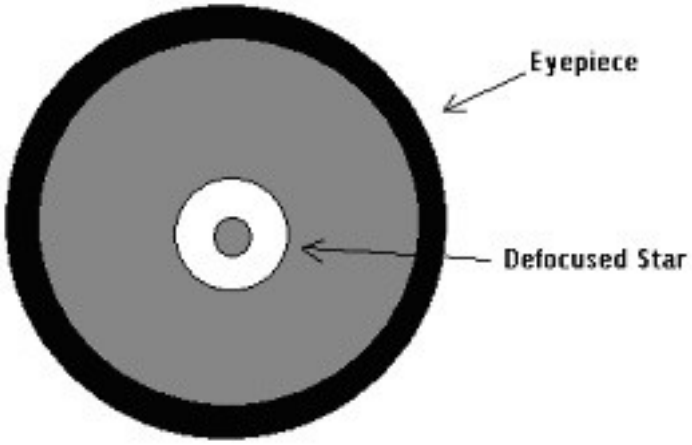

Figure 5: This is an example of an approximately collimated defocused star.

There are three collimating screws on the CDK20 and they are ¼-20 socket head cap screws that require a 3/16 Allen wrench shown in figure 6. The CDK12.5 has four knobs that can be adjusted by hand shown in figure 7. For the CDK12.5 it is easiest if you make adjustment with two knobs at once diagonal to each other. Rotate one knob clockwise and one knob counter-clockwise in order to keep the tension between all the knobs. Always finish a move and with all the secondary preloaded securely with the knobs. Collimating is a two-person job (One person at the eyepiece while one person adjusts the collimating screws). Attempting to do this alone can be quite difficult and frustrating.

Figure 6: CDK20 secondary housing. There are three collimating screws and a central knob. The secondary is spring loaded pulling the secondary into the three collimating screws.

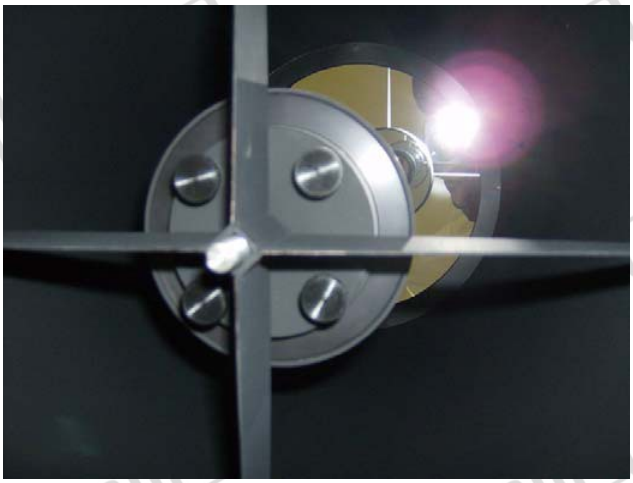

Figure 7: The CDK12.5 collimation screws and the central secondary spacing bolt.

Step 2, Setting the Primary to Secondary Spacing:

For your CDK optical system to perform as well as it should, the spacing between the primary mirror and secondary mirror should be set to an accuracy of +/- 1mm! Fortunately, you won't have to measure this spacing. When the primary to secondary spacing is set correctly, the focal plane will land at an exact known distance behind the

fully racked in focuser. The secondary spacer places the Ronchi screen of the Ronchi Ocular at the place where the focal plane is supposed to be. In order to set the primary to secondary distance, you will be moving the secondary mirror. And by adjusting secondary mirror distance, you will be moving the focal plane relative to that Ronchi screen. The job here is to move the secondary mirror such that the focal plane coincides with the Ronchi screen on the Ronchi Ocular. When you have done this, you have accurately set the primary to secondary spacing.

With reasonable effort, the primary to secondary spacing can be set to well within its 1mm tolerance. Now that the collimation is at least close and a bright star is centered, replace the low power eyepiece with the provided Ronchi Ocular. Rack the focuser all the way in, as far in as it goes, and make sure the 2" adapter is seated all the way into the focuser and the Secondary Spacer is seated flush in to the 2" adapter. If the Ronchi is nulled (you can see no lines, or one ronchi line covers the entire aperture), see figure 8. This means that your spacing is already set so you can proceed to Step 3. This is not uncommon because the primary to secondary spacing is set at PlaneWave and you most likely will not have to adjust it. If you see two or more lines you should move the secondary toward or away from the

primary. The mechanics for moving the CDK12.5 and the CDK20 secondary mirrors are a little different.

Adjusting the Secondary Spacing on the CDK12.5

The CDK12.5 secondary mirror is not spring loaded so you must always keep tension in the collimating screws and the central bolt. To move the secondary toward the primary mirror:

1. Loosen the four collimation knobs. Loosen them in equal amounts to maintain your collimation.
2. Hold the secondary housing with one hand. This is to keep the housing from rotating. (*The four screws sit in shallow detents and we would like them to go back in the detents when the procedure is complete)*.
3. Take a flat head screw driver and place the tip in the central bolt of the secondary assembly. Rotate the central bolt in a clockwise direction. **For reference, rotating ¼ turn moves the secondary .4mm and that moves the focus 3mm.**
4. Take the four collimation knobs and rotate them in equal amounts until the assembly is tight again.
5. Check the Ronchi screen and repeat process as necessary until you get a null.

To move the secondary away from the primary:

1. Loosen the four collimation knobs. Loosen them in equal amounts to maintain your collimation.
2. Hold the secondary housing with one hand. This is to keep the housing from rotating. (*The four screws sit in shallow detents and we would like them to go back in the detents when the procedure is complete)*.
3. Take a flat head screw driver and place the tip in the central bolt of the secondary assembly. Rotate the central bolt in a counter-clockwise direction. **For reference, rotating ¼ turn moves the secondary .4mm and that moves the focus 3mm.**
4. Take the four collimation knobs and rotate them in equal amounts until the assembly is tight again.
5. Check the Ronchi screen and repeat process as necessary until you get a null. **Determining the Direction to Move the Secondary (CDK12.5)** To determine which way to move the secondary, gently slide the Ronchi Ocular out of the spacing tube. If as you do this, the Ronchi reaches null, the focal plane is too far back and you need to move the secondary mirror away from the primary. If as you slide the Ronchi out of the spacing tube, the number of lines grows, the focal plane is too far forward and you need to move the secondary toward the primary.

For every one unit the secondary spacing is changed on the CDK12.5, the focal plane moves 7.5 units. You want to keep the error at the focal plane to 5mm or better which equals just under two lines on the Ronchi. And it equals an error in primary to secondary spacing of about +/- .7mm. Figure 8 shows a Ronchi simulation for the CDK20 with the Ronchi screen set at the focal plane and also with the focal plane 10mm away from the Ronchi screen. The image on the left is what

you will see if the primary to secondary spacing is perfect. The image on the right is what you will see if the primary to secondary spacing is off by about 2mm. Remember you want better than 1mm spacing accuracy for the CDK12.5.

Adjusting the Secondary Spacing on the CDK20

Since the CDK20 secondary mirror is spring loaded, small adjustments in spacing can be made by tightening or loosening the collimating screws by equal amounts. For large spacing adjustments, one may need to adjust the center knob shown in figure 6. To move the secondary toward the primary, loosen the center knob and tighten the collimating screws by equal amounts until everything feels snug. To move the secondary away from the primary, loosen the tree collimating screws by equal amounts and tighten the center knob.

Determining the Direction to Move the Secondary (CDK20)

To determine which way to move the secondary, gently slide the Ronchi ocular out of the spacing tube. If as you do this, the Ronchi reaches null, the focal plane is too far back and you need to move the secondary mirror away from the primary. If as you slide the ronchi out of the spacing tube, the number of lines grows, the focal plane is too far forward and you need to move the secondary toward the primary. For every one unit the secondary spacing is changed, the focal plane moves five units. Or, if the focal plane is within 5mm (about two ronchi lines), the secondary spacing is within its 1mm tolerance. Figure 8 shows a Ronchi simulation of the CDK20 with the Ronchi screen set at the focal plane and also with the focal plane 10mm away from the Ronchi screen. The image on the left is what you will see if the primary to secondary spacing is perfect. The image on the right is what you will see if the primary to secondary spacing is about 2mm off.

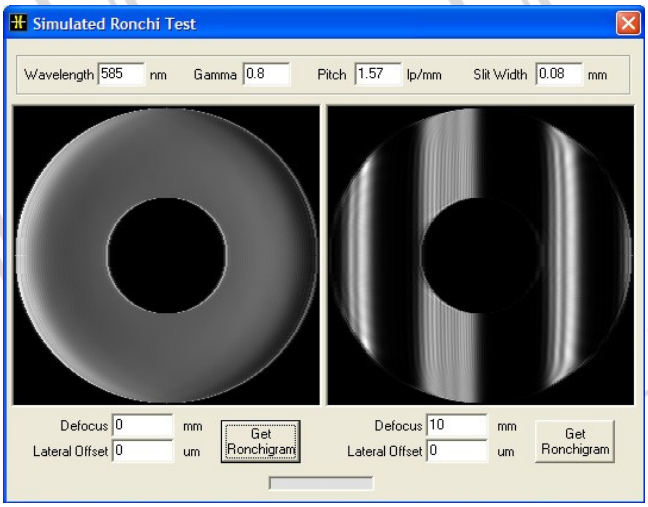

Figure 8: The left image is a simulation of what a null looks like through a Ronchi screen. The right image is a simulation of what an out of focus view looks like through a Ronchi screen. The right image shows 2 full lines. The more lines you see, the farther the ronci screen is from the focal plane.

After you are satisfied that the secondary spacing is correct, replace the Ronchi ocular with the low power eyepiece and repeat step 1 to verify that the collimation is still close. If re-collimation adjustments are necessary, make them and repeat step 2.

Step 3, Fine Collimation:

Use a high power eyepiece (5mm or less) and follow the same procedure described in Step 1 (adjust the secondary so that the donut hole is in the center of the donut). You may want to switch to low power when making adjustments and re-centering the star and back to high power to check the collimation. Finally, use the Ronchi eyepiece to recheck the spacing. As long as only small adjustments were made in Step 3, the spacing should still be fine. If it is not, repeat Step 2, and Step 3.