Figure 1: *The Argelander Institute for Astronomy 0.5m Cassegrain telescope.*

AIfA 50cm Telescope
Users Manual

March 15, 2013

1 Special AIfA telescope rules

- Only persons who have the driver's license are allowed to use the telescope. If you do not have a driver's license, you should talk to the Astroclub tutors to obtain it.
- Everyone with a driver's license has to be member of the telescope mailing list.
- Please reserve time for observations in the Google Calender. You will get the account information when getting your driver's license.
- Since the primary use of the telescope is for students' education, every user has to respect the following priorities:
  1. Observations for the Lab Courses
  2. Astroclub and Bonner Sternhimmel (Public Observatory Bonn)
  3. Every other person who has been the first to reserve time in the Google Calender.
- If you make use of the priorities and override someone's subscription in the Google Calender, you will have to inform this person. In case you are a lab course student please tell your tutor to do this.
- Everybody who does CCD observations with the AIfA telescope agrees that the pictures taken by her/him may be used for public outreach purposes for the institute (in printed form or online). Of course, this does not mean that you lose copyright for your images – the name of the person who took the picture will always be given as credit. If you took particularly nice images and want to share them, we'd encourage you to send them to astroclub@astro.uni-bonn.de.

2 Warnings

- NEVER TOUCH ANY OPTICAL SURFACES, e.g. filters, eyepieces, mirrors etc.
- Remember to close the dome when you leave and check for signs of rain/snow during observations.
- Be careful and always make sure that the camera or eyepiece is secured in its place and will not fall.
- Never move the telescope too low, especially not below the horizon, because the primary mirror is placed loosely in the telescope mount and could fall out. If you see that it is going dangerously low (below 10 degrees) immediately stop slewing by clicking on the EMERGENCY STOP button in Autoslew.
- NEVER TRY TO OBSERVE THE SUN WITH THIS TELESCOPE!!

- Warning: If any of your pictures show signs of frost, for example a haze growing from the edges, immediately stop observing. Turn off the cooling of the camera. There is probably water inside the camera and the dessicant needs to be replaced (baked). If there is still one of the responsible persons available, inform him or her as soon as possible. Otherwise, go through all the steps of turning off the telescope detailed in Section 11 if you don't want to observe visually and make your report the next day. Be sure to also write down the incident in both the Observing Diary and the Error Log.

3 Hints for successful observations

Open the dome as early as possible so that the temperature inside and outside the dome get about the same. For informations about the weather, astrophotography and other stuff (like ephemeris for that new comet/incoming asteroid that you want to see/photograph), you can use the links saved in the bookmarks toolbar of the Mozilla Firefox browser and also the following books might prove useful (they can be found in the institute library):

1. *To measure the Sky, An introduction to observational astronomy*, Frederick R. Chromey **12.03.99.35a**
2. *Astronomical Photometry - A guide*, Chr. Sterken, J. Manfroid **12.03.11.19**
3. *Digital Astrophotography*, David Ratledge **12.03.12.23**
4. *Photoshop Astronomy*, R. Scott Ireland **12.03.10.19**

The manual of the camera and of CCDOps are also found on the shelf if you want additional information about using the camera properly. The entrance door to the control room and the one to the telescope should be kept closed at all times to prevent heat coming in from the institute building into the dome. Turn off the lights in the dome and close the door when you are observing. When you start observing, the telescope will usually be out of focus. Instructions on focusing are given in Section 7.

3.1 Visual Observations

When observing visually you should try to minimize your exposure to light – so don't rush back and forth to the eyepiece and monitor/observing diary all the time. Be patient while observing visually, the eye needs about 30 minutes to fully dark-adapt (!!), and in order to see faint details or just to detect them, you will need a lot of time.

3.2 CCD Observations

Before coming to the telescope you should have a clear (even written) plan of what you are going to observe and how. Plan your observations carefully, checking the altitude and relative distance of the objects, trying to optimize their order so that you don't waste observing time moving the dome long distances between consecutive targets.

Take calibration frames (darks/biases/flats) during the day and flats in twilight if possible, otherwise use the dome screen (if you take spectrocopic data, you have to take the flats DIRECTLY after the objectframe before moving the telescope!). To take darks you will need to precisely know long your exposures will be. Keep the temperature constant for the science and calibration frames. Check once every 20 minutes that the dome is still aligned with the telescope and you are not taking pictures of the dome, since it has to be moved manually. Also, check the weather from time to time to make sure that it's not raining in the telescope at the end of your 30 minute exposure!

4 General Information

4.1 The Telescope

- Manufacturer: Astrooptik Ph. Keller
- Type: Cassegrain
- Mounting: Equatorial
- Primary mirror diameter: 50 cm
- Cassegrain focus focal ratio: f/9
- Primary focus ratio: f/3

4.2 The SBIG-STL 6303E CCD Camera

- Manufacturer: SBIG
- CCD size (pixels): 3060 $\times$ 2040 pixel
- Pixel size (μ_m) 9 μm $\times$ 9 μm
- Field of view in the Cassegrain focus: 21' $\times$ 14' (0.4" per pixel)
- Field of view in the primary focus: 63' $\times$ 42' (1.2" per pixel)
- Denominated STL6303 in THELI-GUI; see Figure 35

4.3 Filter sets

- Standard LRGBC (CCD)
- Johnson/Bessel UBVRI (CCD)
- Narrow-band filters: Hα (7 nm), OIII (CCD)
- Neodymium; filters for scattering of bright objects (visual)
- Neutral density filter; darkens bright objects for example the Moon (visual)
- UHC filter; filters for scattering of city light which is useful for faint nebulae (visual)

4.4 Spectrograph

4.4.1 The SBIG ST 402 ME

- Manufacturer: SBIG
- CCD size (pixels): 765 $\times$ 510 pixel
- Pixel size (μ_m) 9 μm $\times$ 9 μm
- Field of view in the primary focus: 5' $\times$ 3'
- This camera is for the DADOS spectrograph. It is permanently connected to the spectrograph and should not be separated from it.

4.4.2 DADOS Spectrograph

- Grid: 200 mm^{-1}, 900 mm^{-1}
- Resolution: R $\approx$ 1500 for the 200 mm^{-1} grating ; R $\approx$ 3000 for the 900 mm^{-1} grating

5 Setting up the telescope

1. *Before* doing anything with the telescope, open the dome, so that possible dirt or water on the dome doesn't hit the unprotected telescope mirrors. Be careful in winter if there is snow or ice on the dome as it might damage the telescope even with the covers on.
2. To open the dome, get the step ladder to the side of the dome opposite the entrance door (south side), where a wheel is placed on the dome. Do not use the wheel, but the smaller device further up. Unlock the catch by the lever which has a ball at its end. Press the crank handle in place so that it clicks, and turn the crank handle to open the dome (Figure 5).
3. Turn on the computer (username "astro", look at the hint for the password).
4. Turn on the telescope motor control box, located on top of the computer (Figure 6).
5. At the computer, start the program Autoslew (linked on the desktop, Figure 7).
6. Make sure that the step ladder and all people are away from the telescope, which will move soon. There are two home positions: zenith (button "1") and maintenance (button "2"). Choose maintenance. The telescope should now move into a horizontal position.
7. Get the step ladder to the telescope and take off *both* lids – on the primary (big) and secondary (small) mirror. First take off the small one and then the big one, so the small one can't fall and hit the primary mirror! DO NOT TOUCH THE MIRRORS! BE (extra) CAREFUL!

8. Activate "Siderial tracking" in Autoslew, so that the telescope follows the motion of the sky (stars). If you want to observe other objects like comets or planets you can choose another customized tracking (from Autoslew/Drive/Tracking).

9. Write down general information (your name, date, weather etc) in the Observing Diary, usually located on the shelf above the computer monitor, even if you just came to take calibration frames or to check/modify something.

You are now ready to use the telescope.

6 How to do the observations

6.1 Visual observations

1. Get the green suitcase if you want to observe visually or to redo the pointing using an eyepiece. The case contains eyepiece and filters (see Figure 3).

2. Open the green suitcase. Take out one of the eyepieces and take off its covers. We have three eyepieces of focal lengths 38mm (2"), 15mm (1.25") and 10mm (1.25") which will give you a magnification and apparent field of view of: 118X - 0.59 degrees(38mm), 300X - 0.22 degrees (20mm) and 450X - 0.15 degrees (15mm).

3. The use of filters is restricted to the 38mm (2") eyepiece, as seen in Figure 8.

4. If you want to use the other 1.25 inch eyepiece you must use an adapter (Figure 9).

5. At the lower end of the telescope, take off the cover. Check that under the focusing unit two tubepieces (labeled Tube 1 and Tube 2) are mounted (unless you are using the star diagonal, in which case only Tube 1 should be used). If you do not use the correct tubes, the focus will be off. Place the eyepiece in the opening and fix it with the screws – tightly, but not with excessive force and again, DON'T TOUCH THE OPTICAL SURFACES.

6. Go to the computer and start the program The Sky. Choose from the menu "Telescope $\rightarrow$ link $\rightarrow$ establish" to connect the program to the telescope (Figure 10) (See Warnings!)

7. In the map of the sky, click on an object to get a dialog box that tells you its name, magnitude and other properties. You can perform a search for a specific object by pressing Ctrl+F, but be careful not to slew to an object that is too low or even below the horizon! With the button "slew", you can move the telescope to this position. *Before* you do this, make sure that nothing is in the way of the moving telescope – the step ladder, cables, people. If anything appears to get in the way during slewing, immediately stop the telescope by clicking on the EMERGENCY STOP button in Autoslew.

8. To move the slit of the dome to where the telescope is pointing, use the “left” and “right” buttons, which are unfortunately located just on that part of the wall where the door goes when it slides open. So close the door and then you can move the dome. There is also a dimmer for the lights at this place, as seen in Figure 11.

9. If you need it, take the gamepad, which should lie in the fork of the telescope mount (Figure 12). With the left stick, you can move the telescope (note the inverted directions). However, the telescope moves very slowly, so that often you may want to use the shoulder buttons (those on the reverse side of the gamepad) as speed boosters – keep one of those pressed while using the stick.

10. When you are not using the gamepad, always put it back into the fork of the mount, so that the cable does not get in the way.

11. Check in the eyepiece whether you can see the selected object. The pointing is not perfect, so you may have to move the telescope manually. Use the gamepad to do this. If it is not activated you can do so with one of the top row buttons in the Autoslew window. If the pointing is off too much (that means that you can’t see the desired object), follow the next procedure to fix the pointing. If you are a lab course student, first ask the tutor to do it!

12. There are other accessories in the green box that you can use, depending on what you want to observe:

    (a) A special 20 mm eyepiece with an imbedded scale (Figure 14) that you can use to measure angular distances and position angles. Very useful for observing double stars.

    (b) Filters:

        i. Two neutral density filters, with ND=0.6 and 0.9 (corresponding to a brightness reduction of 4 and 8 – only 25% and 12.5% of the flux goes through). They are very useful when observing bright objects, like the Moon or some of the planets.

        ii. A neodymium “Moon and skyglow” filter that will improve the contrast a little.

        iii. A “Astronomic UHC” filter, very useful in filtering some of the light pollution (transmission curves for the filters).

        iv. A 1.25" - 2" adapter, so you can use all the eyepieces.

        v. A 90 degree angle prism for a more comfortable viewing position and (it will flip the sky).

6.2 CCD observations

1. Take the big black suitcase (contains SBIG STL-6303E CCD camera and accessories) from the grey locker. In fact, there are two big black suitcases. One is labeled “spectrograph”. Take the other one.

2. Open the suitcase and take out the camera and all its cables (Figure 4).

3. Check which filters are installed before going to the telescope. The filters available are the Jonson/Bessel UBVRI, Baader LRGBC and narrowband H alpha, OIII. If you need a different filter set than currently mounted ask one of the persons in charge to change them for you (ask an Astroclub member for someone who can do that).

4. Check if the fixture (with a circular opening corresponding to the one at the telescope) is correctly attached to the camera. If not, use the hexagon socket key to attach the fixture, which, in this case, should also be in the suitcase. Make sure not to lose any screws.

5. If you have previously used the eyepiece, unscrew it from the telescope (hold it while unscrewing!) and put it back in the green suitcase, covering it with its lid.

6. Both tubepieces (labeled Tube 1 and Tube 2) need to be mounted in order to find the focus. Check if both tubes are mounted before mounting the camera.

7. Hold the camera by its handles (Figure 17), place it on the telescope, and fix it with the screws. Be very careful here as a loose screw can result in total destruction of the camera by falling. Check all the screws (they should be tightly screwed in and after you placed the camera inside try to pull/push it a little and see if it moves easily – it should NOT!).

8. Connect the USB cable coming from the telescope mount to the camera.

9. Connect the power cable (two parts) with the camera and the wall socket. Make sure that the cable is not in the way of your feet or of the telescope when it will be turning. Use the extension cord. The transformer that powers the camera should be placed carefully in the telescope mount (Figure 12).

10. At the computer, start the program CCDSoft.

11. If everything worked fine, the camera should be powered up and the fan should make a noticeable noise. If so, go to Camera Setup and click on Connect (Figure 16). Accept the focus error that will appear.

12. You have to cool the camera down so that the dark current (thermal noise) will be a lot lower. You can do that in the same setup window by clicking the "Temperature" button, setting the desired temperature and clicking "On" and OK. The temperature should be about 35 degrees below the ambient temperature, but be careful not to have the camera working at 100%. You should target for the lowest temperature that you can obtain, while the camera cooling is working at about $70-80\%$. You can see that in the parenthesis near the temperature. As an example, if in the dome you have a temperature of 5 degrees you should set the camera at -35°. For photometry, try even 60% (Figure 32).

13. Wait for the camera to finish cooling, which should take only a few minutes. You can watch the progress in the setup window. If you have just opened the dome, you should also wait some more time for the air to settle down (usually about 30-45 minutes) in order to get better results.

14. Try to find the correct focus. Details described in 7.

15. To take images, go to Setup and then Take image and choose the exposure time, delay between exposures, the number of exposures, binning, windowing, the type of frame you are taking (Light, Dark, Flat, or Bias) and also choose the imaging chip: the main one (imager) or the small one, usually used for autoguiding (Figure 30).

16. Then you can start taking data. Create a subfolder in C:\Data\SBIG-STL6303E\ (if you use the SBIG-STL 6303E camera, otherwise in the other folder you find there, namely SBIG-ST402ME) where you should save all your data, using the following naming convention: the name of your folder should be precisely YYYY.MM.DD. The date should be for the day of the evening of the observing night (so even if you come after 00:00 you should still name your folder after the day before). Go to Setup/Autosave and browse to your folder created in C:\Data\SBIG-STL6303E\ (or C:\Data\SBIG-ST402ME if you use the spectrograph) and always save the files as .fits. The starting number should NOT be changed and you should not add any file name prefix. Create in your subfolder another folder for each object you observe, moving the images there and naming it appropriately (like "M109" if you observed the galaxy M 109 or "R LEO" if you have observed the variable star R LEO.). For the calibration data create a folder named "Calibration frames" where you will save your darks, biases, flats, each in its own subfolder. This whole naming scheme can be summarized as in Figure 15. During the actual observations you should also complete carefully the spreadsheet "Observing log.ods" found in C:\Data\. All observations made with this telescope MUST be saved accordingly to this scheme. They must also not be deleted from the computer, everyone should be able to use the data.

17. The last step is to write in the Observing log found on the table your name, date, time interval, weather, and what you did (calibration frames, objects, visual/ccd observations) and fill the error log if you encountered any problems.

18. Depending on your needs you might want to dither between exposures. To do that you should click in the setup window "Event plugins" and then choose AutoDither Settings, where you can modify the parameters. Dithering a few (3-6) of pixels in a random pattern should be OK for most applications.

6.3 Spectroscopic Observations

1. Get the big black suitcase labeled "Spectrograph". In the suitcase you find the small camera attached to the spectrograph and the two of them already fixed to a tube that can directly be mounted to the telescope (see Figure 18). Take off the

cover of the slitviewer (see Figure 19). Don't touch the optical surface that you are going to uncover.

2. Unmount the tubes, which are normally fixed to the telescope when nobody uses it, and mount the spectrograph the way it is shown in Figure 20.

3. Connect the power and USB cable to the camera and also the power cable of the calibration lamp (Figure 21).

4. The eyepiece at the side (the slitviewer) can also be used to redo the pointing in case it is broken. You do not have to take down the whole spectrograph tube to replace it by the eyepiece.

5. Now you are ready to observe. As explained for the visual observations you have to start the PC and the motor control box, Autoslew, The Sky etc. When the telescope is pointing towards the desired object (let's say a star), you have to look through the slit viewer and center the star on one of the three slits (see Figure 23). To be able to see the slits, turn on the slit viewer lamp (see Figure 22) which is on the backside of the spectrograph if you look onto the eyepiece of the slitviewer.

6. TO DO!!! Additionally to the telescope focus, the spectrograph has its own focus, that should be verified in the beginning of an observation and then stays the same during the whole night. Figure (**??**) shows where to change this focus. There are different marks (one for each grating). Just align these and retighten the locking screw. TO DO!!!

7. With the micrometer screw (Figure 26) you can choose which part of the spectrum (which wavelength) will be displayed on the CCD chip. Please loosen the locking screw BEFORE turning the micrometer screw. You can calculate the mean wavelength displayed with the following equations:

   900 lines grating:
   $$f(x) = -0.083x + 623.78 \tag{1}$$

   200 lines grating:
   $$f(x) = -0.032x + 270 \tag{2}$$

8. The handling of CCDSOFT is the same as for the other camera. In the "Camera Setup" menu you have to choose the SBIG ST 402 Camera. The cooling of this camera is not that good as the one of the big camera. So don't cool it down too far. Always check in the CCDSOFT Menu if the cooling is working below 100%.

9. After EVERY object frame you have to take a calibration frame. Don't move the telescope between object frame and calibration lamp frame. To switch on the calibration lamp, press the little red button (Figure 24) and slew the lamp over the slits with the little handle on the side of the tube (Figure 25). Inside the tube it looks like Figure 27. When you move the handle, the lamp sways over the

opening (Figure 28). Switch off the lamp during observations even when you slew the lamp away from the opening because it is very bright and stray light will disturb your object frames.

10. Figure 29 is a full shot of the spectrograph.

11. The telescope focus for the spectrograph is around 20.36.

7 How to focus

7.1 Visual observations

If you are observing visually it might be useful to use the joystick. Use the upper and lower buttons on the right (ref image). Use the shoulder buttons to accelerate the focusing. If the focus is off completely, check if the correct number of tubes is mounted under the focusing unit (one tube if you are using the star diagonal, two tubes if you only mounted an eyepiece). You can also adjust the focus using autoslew (look at the CCD section if you want to use that).

7.2 CCD observations

For focusing you should go to the setup window at "Focus tools" (Figure 31) in CCD-Soft after you have centered the telescope on a bright star. Take an image of a few seconds and check the focus. The idea is that you want the diffraction spikes to be as narrow as possible (Figure 33, 34). Modify the focus from the Autoslew window while taking pictures. You will find the focusing tool on the right side in Autoslew, accessible through the button "slew". On the right side you can tell the program to move the focal unit in or outwards in user-defined steps. In addition you can tell the focal unit to move to a given position by using the Goto function. You will need to focus again later in the night if you have large thermal variations and also if you change the filter.

In order to make focusing easier (and more accurate), we now have a Bathinov mask – hints on how to use it will be added soon.

8 Correcting the pointing

1. First slew the telescope to Zenith and in Autoslew click on Mount/Home Find. If in the message window it appears that the RA/DEC ALT/AZ were successfully calibrated, proceed to the next step. If not, move the telescope slightly away from zenith and try that again.

2. Find and center in the eyepiece a bright star by using the joystick and then click on it in "The Sky". The Telrad finder (Figure 13) can be used for a coarse centering first. Please remember to turn it off after observing! Then go to Telescope and click on Sync. Repeat the procedure for a few more stars that are far away from each other (tens of degrees) until you find mo more errors in the pointing when you send the telescope to a certain object.

3. In Autoslew, go to Mount and click on “Set new home position” and click “Yes” at the dialogue that will appear.

9 Changing the filters in the Camera

If you want to use a different filter set than mounted in the camera always contact one of the responsible persons. Do not do this on your own. TODO

10 How to mount the camera in the secondary focus

TODO

11 Finishing your observations

1. Close The Sky and all other telescope-related applications except Autoslew and CCDSoft.
2. If you did CCD observations, stop the cooling of the camera in CCDSoft. The camera will take some time for warming up to ambient temperature again, wait for that before unmounting it. After warming up, close CCDSoft. The ST 402 needs less time than the big one to warm up but still give it a few minutes.
3. Move back the telescope dome so that the slit is in the south, opposite the door. The two white signs would be aligned, as in Figure 2.
4. Use Autoslew to bring the telescope into maintenance position.
5. Put the lids of primary and secondary mirror back in, using the step ladder. Be careful with the secondary mirror cover, it should be well fixed in place, otherwise it will fall on the primary cover once you slew to zenith (or later on).
6. Use Autoslew to bring the telescope to zenith position, which is the parking position.
7. Remove the camera or the eyepiece from the telescope, and put back on the cover. HOLD THE CAMERA while unscrewing the bolts!! Put everything back into the correct suitcases, including cables, which should be nicely winded and not randomly thrown back.
8. Turn off Autoslew.
9. Close the dome by the crank handle and fix the catch again.
10. Write down all missing information in the Observing Diary, especially the end time and if there were any errors or incidents. If that was the case, also fill in the Error log and send an e-mail to the telescope mailing list to inform the other telescope users about the problem.

11. Copy your pictures to a USB drive so that you also have a backup of your data. Additionally, there is a easy-to-use backup system via Dropbox: Simply copy the folder containing your data (e.g. 20120920) to C:\Data\Backup\Dropbox\Data\. It will automatically be uploaded to a Dropbox server and the Dropbox client on Dominik's RAID-NAS will automatically download and backup it. It is okay if you don't see older folders, so please don't copy them again!

12. Turn off the computer and the motor control box.

13. Make sure that all parts are back in the suitcases and that those are well closed. Bring them back to the locker and close it.

14. Put the step ladder to the side of the dome where you found it.

15. Turn off the Telrad finder if you have used it.

16. Turn off the lights inside the dome and close the door.

17. Turn off all other lights and lock the room.

18. If there were significant errors or anomalies, report it to the responsible persons on the next day.

12 Frequently Asked Questions

1. The tracking does not work.
   - Make sure that siderial tracking is activated in Autoslew.

2. When I pick an object from "The Sky", it is not visible in the eyepiece / on pictures.
   - Maybe the pointing is off so try first a bright star and if it is really off, try to redo it Maybe the object is too faint, check its magnitude in "The Sky". For extended objects like nebulae and galaxies, the surface brightness is more important.

3. The gamepad does not do anything.
   - Make sure that it is activated in Autoslew ("manual operation"). Use the shoulder buttons to move faster, since the normal mode is barely noticeable.

4. The telescope is not moving anymore, neither after picking an object in "The Sky", nor using the gamepad. Alternatively, it is moving in right ascension / declination direction only.
   - The connection with the motor control box might be lost. Turn it off and on again. Afterwards, in Autoslew, press "Home find" again, and check pointing and tracking. If that doesn't work, restart autoslew.

5. Unable to focus.
   - Check if you mounted the correct Tubes under the focusing unit (Tube 1 and Tube 2 for CCD observations or visual observations *without* the star diagonal, Tube 1 for visual observations *with* the star diagonal, see Section 7).

6. Emergency contact.
   In case something goes completely wrong, you can contact Dominik Klaes or David Mülheims via mobile. You can find their numbers on your driver's license. BUT: If the problem is not too severe, just cancel observations, close the dome, and contact people in charge of the telescope on the next day. Only use the emergency contact in case something goes horribly wrong and has to be sorted out right away – for example, if it starts snowing all of a sudden and the dome cannot be closed due to mechanical failure ;-).

13 Useful links

TODO – check the bookmarks of the Firefox on the computer.

Figure 2: *The controls of the dome movement and the alignment marks.*

Figure 3: *The green case content.*

Figure 4: *The black case content.*

Figure 5: *Opening the dome.*

Figure 6: *The motor box, on top of the desktop computer.*

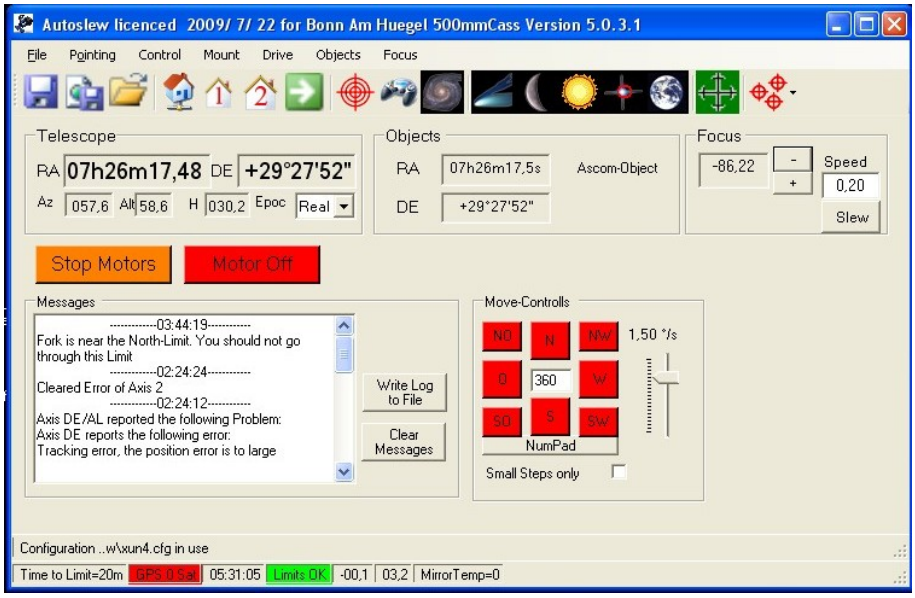

Figure 7: *The Autoslew window.*

Figure 8: *The 2 inch eyepiece and a filter (proper way to use the filter, screwing it into the eyepiece).*

Figure 9: *A 1.25 inch eyepiece and the adapter to 2 inch.*

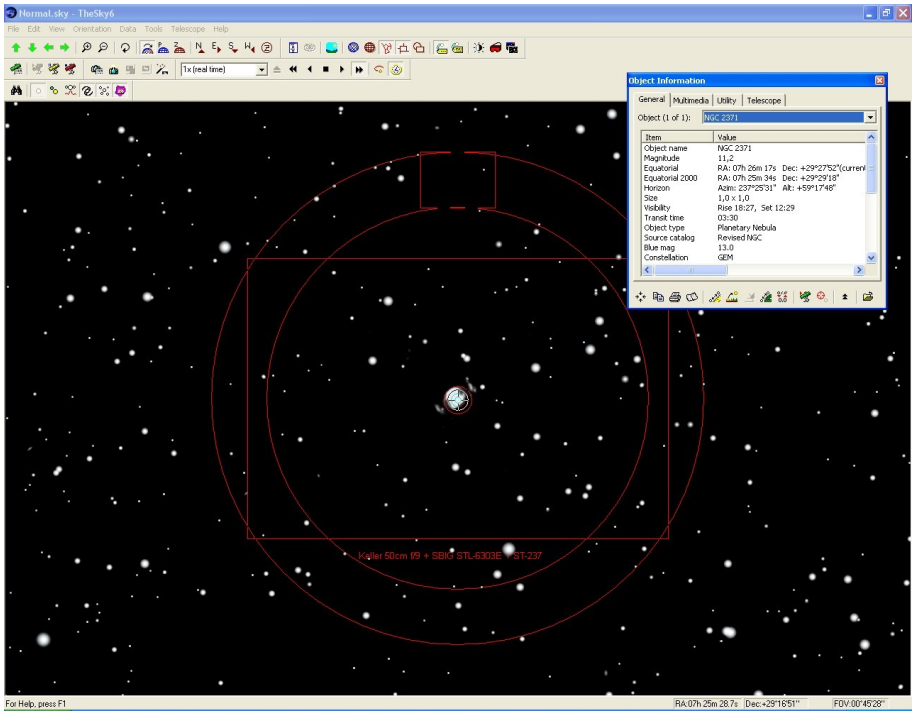

Figure 10: *The Sky 6 window.*

Figure 11: *The door.*

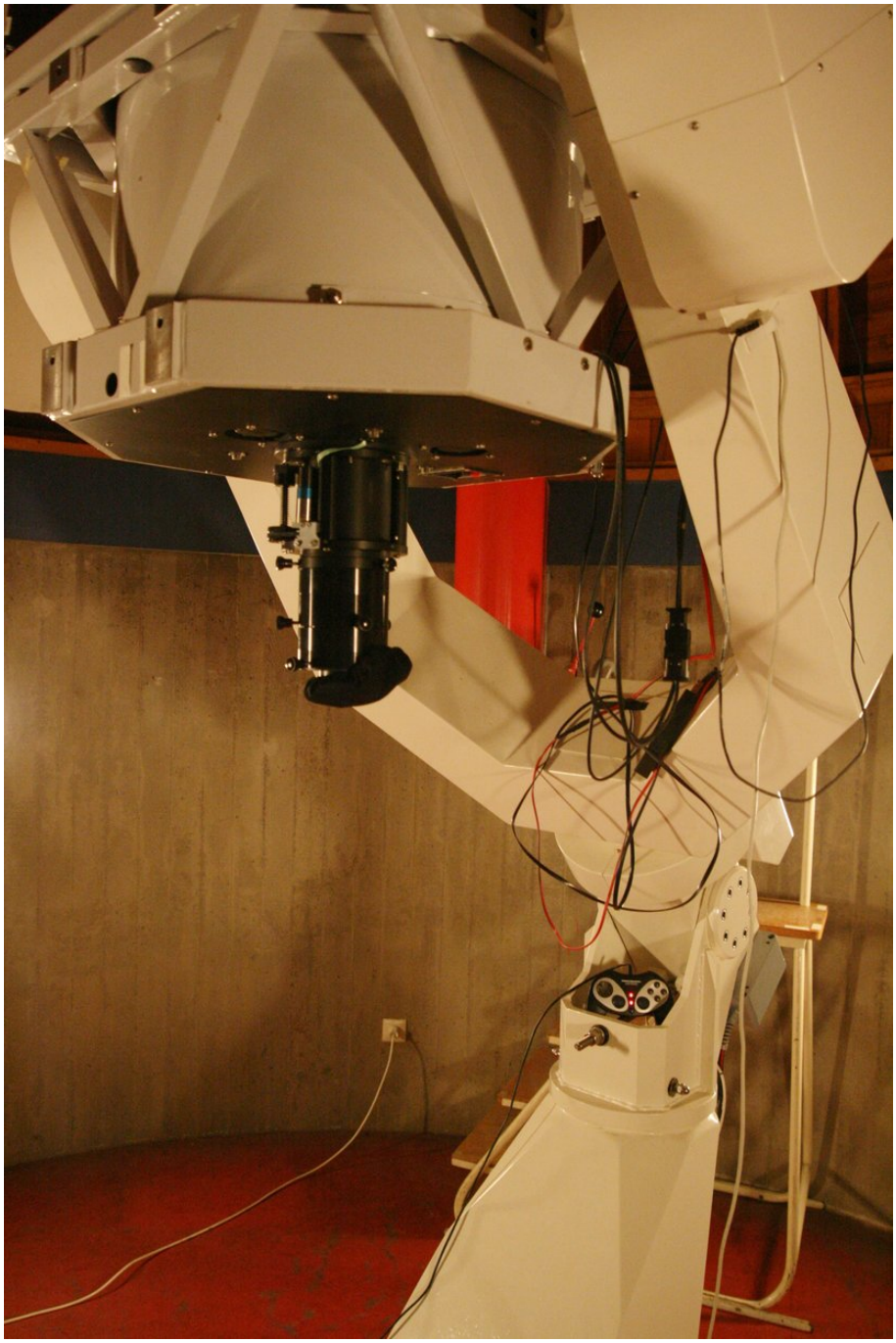

Figure 12: *The joystick is in the middle of the fork mount.*

Figure 13: *The Telrad finder attached to the telescope, turned on.*

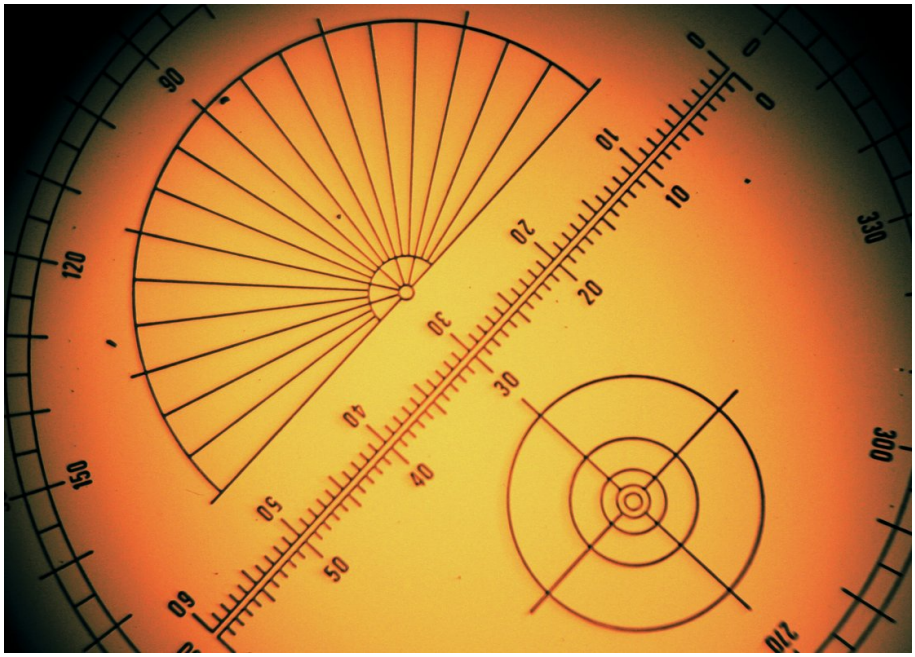

Figure 14: *The 20mm eyepiece scale.*

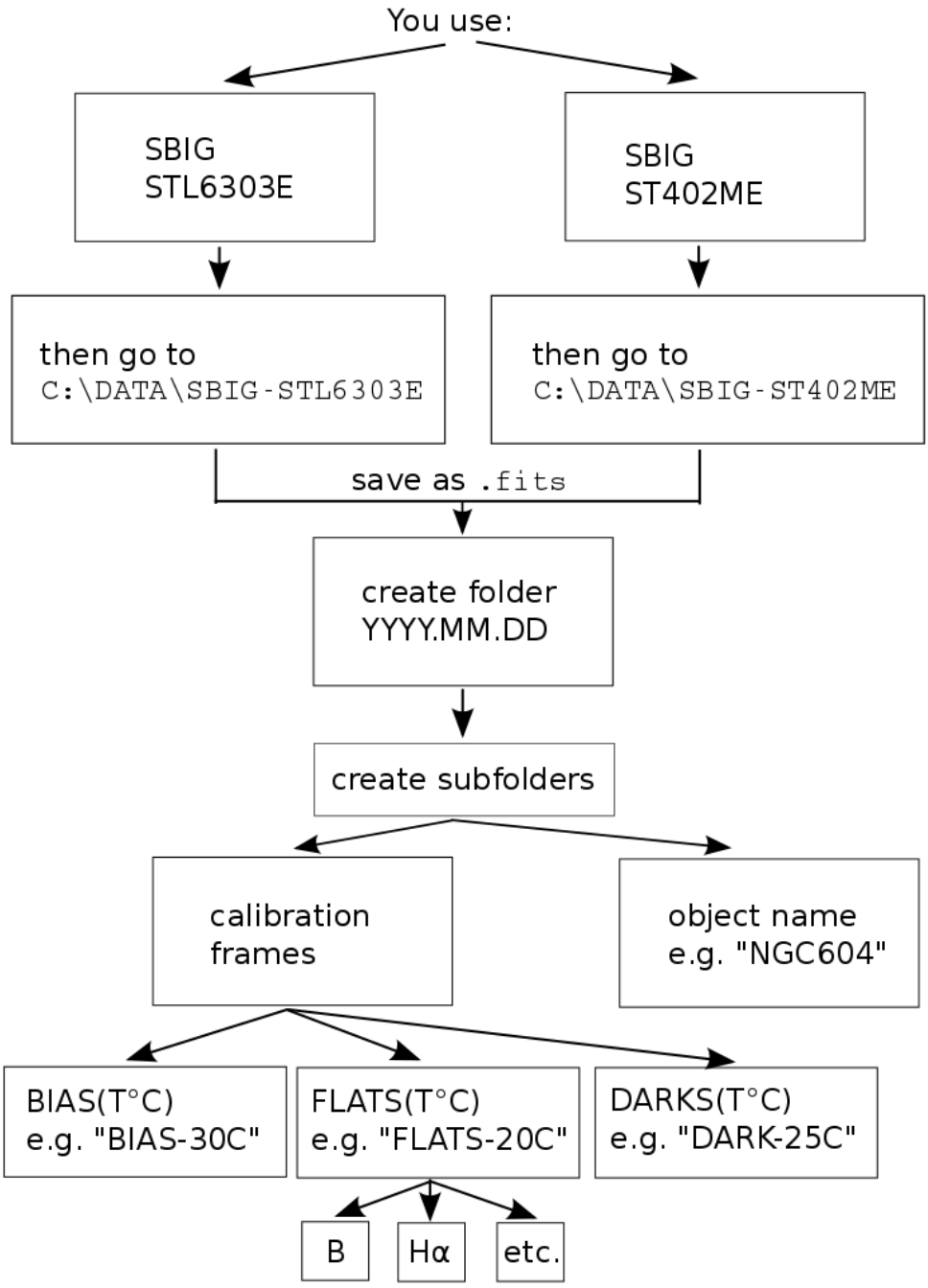

Figure 15: *Naming scheme.*

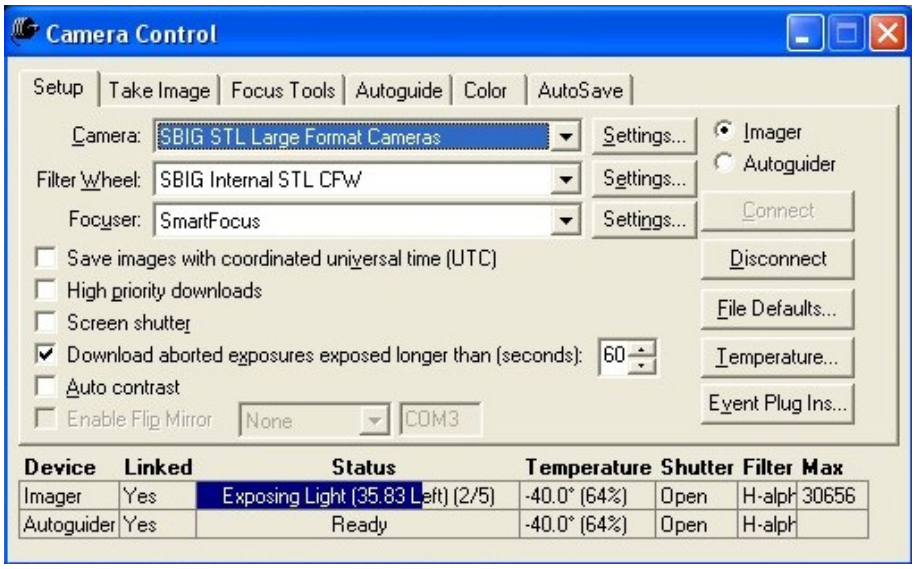

Figure 16: *The setup window of CCDSoft.*

Figure 17: *The SBIG CCD camera.*

Figure 18: *Here you can see how the spectrograph should be restored in the suitcase.*

Figure 19: *The eyepiece of the slitviewer still with its cover on.*

Figure 20: *This is the best way to mount the spectrograph.*

Figure 21: *The blue plug is the power supply for the calibration lamp.*

Figure 22: *When turning this switch, the slit viewer lamp is ON or OFF.*

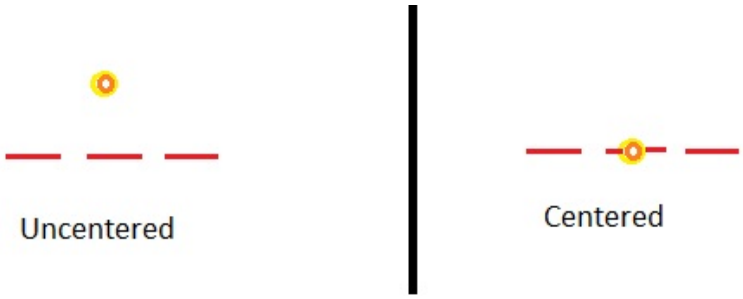

Figure 23: *On the left: Star not centered on slit. On the right: Star centered on slit.*

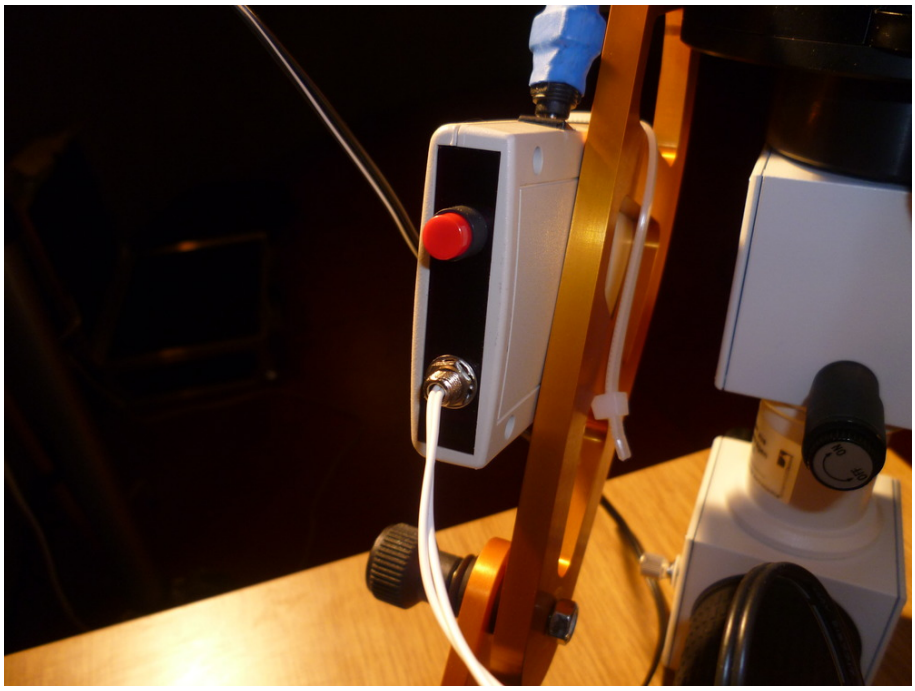

Figure 24: *The red button turns on the calibration lamp.*

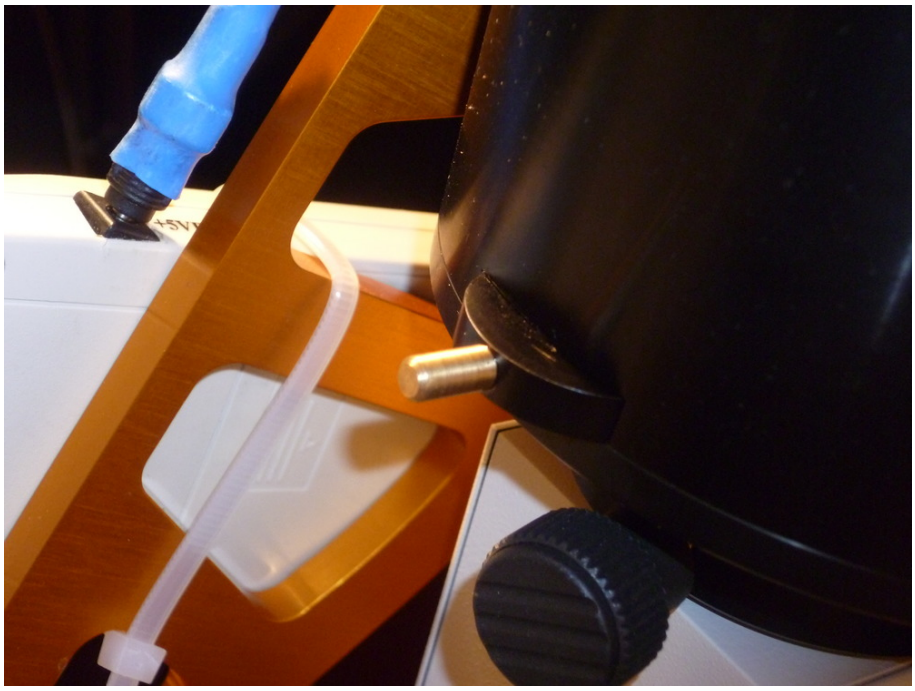

Figure 25: *Pull this handle and the calibration lamp will sway over the slits.*

Figure 26: *This is the micrometerscrew to change the wavelength range displayed on the CCD chip. The silver screw is the locking screw of the grating. Loosen it before turning the micrometer screw.*

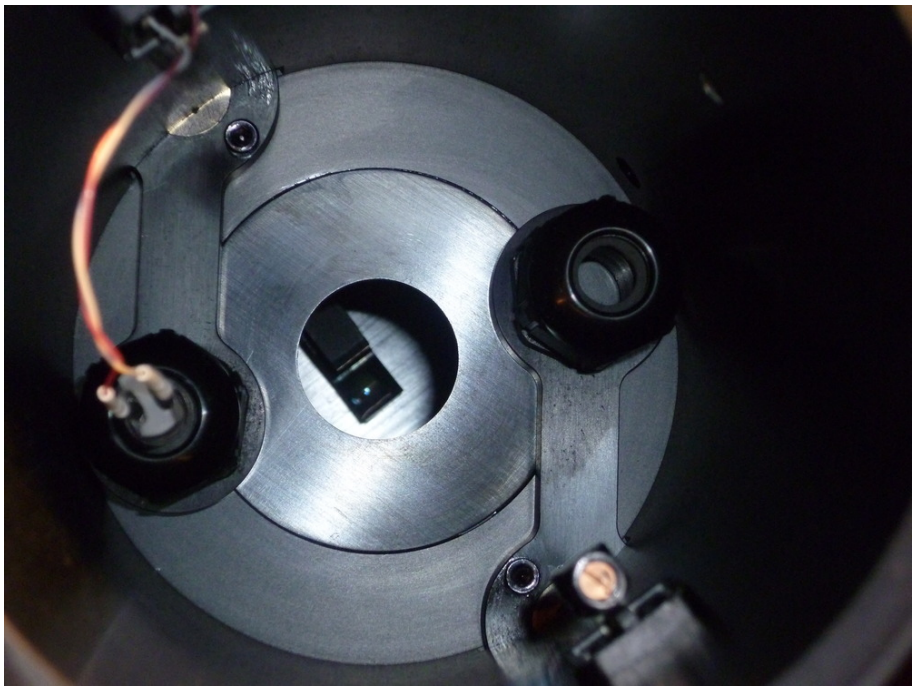

Figure 27: *The calibration lamp is aside so starlight can fall on the slits of the spectrograph.*

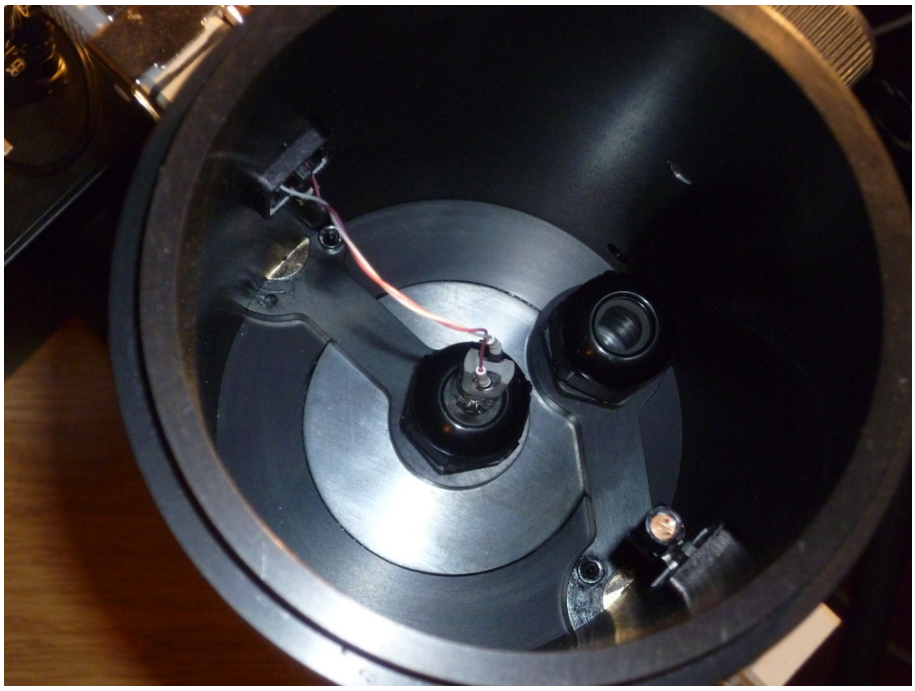

Figure 28: *The calibration lamp is moved over the opening to illuminate the slits.*

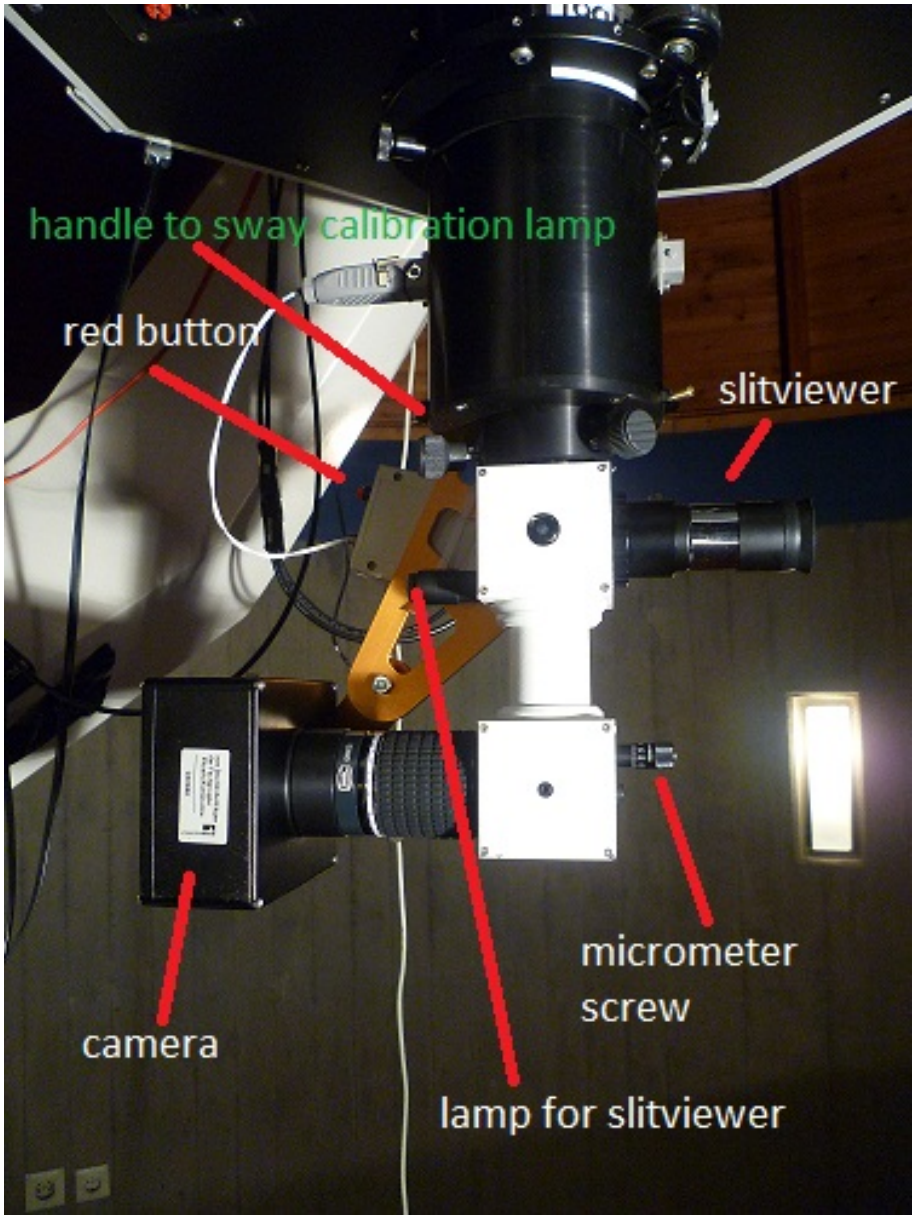

Figure 29: *This picture shows all buttons and switches to get an overview where they are located.*

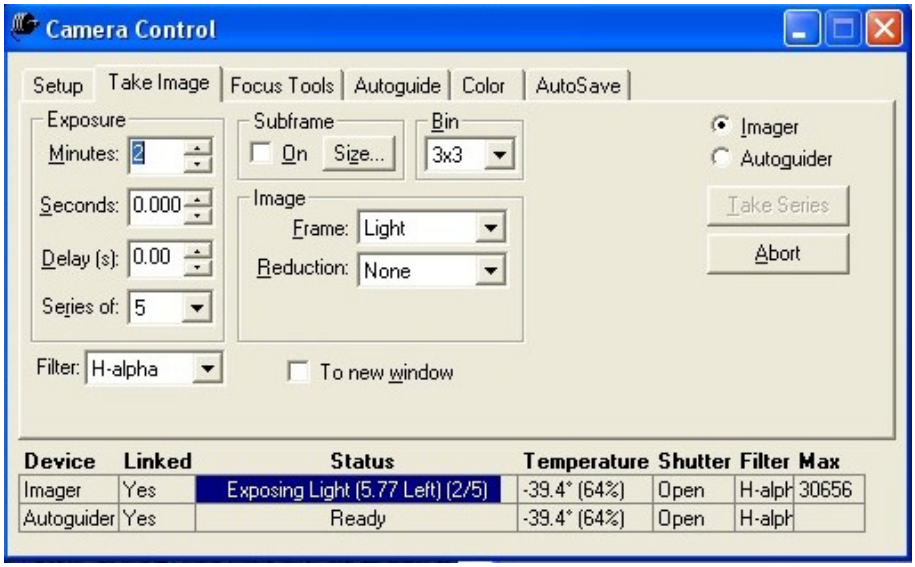

Figure 30: *The setup (take image) window of CCDSoft.*

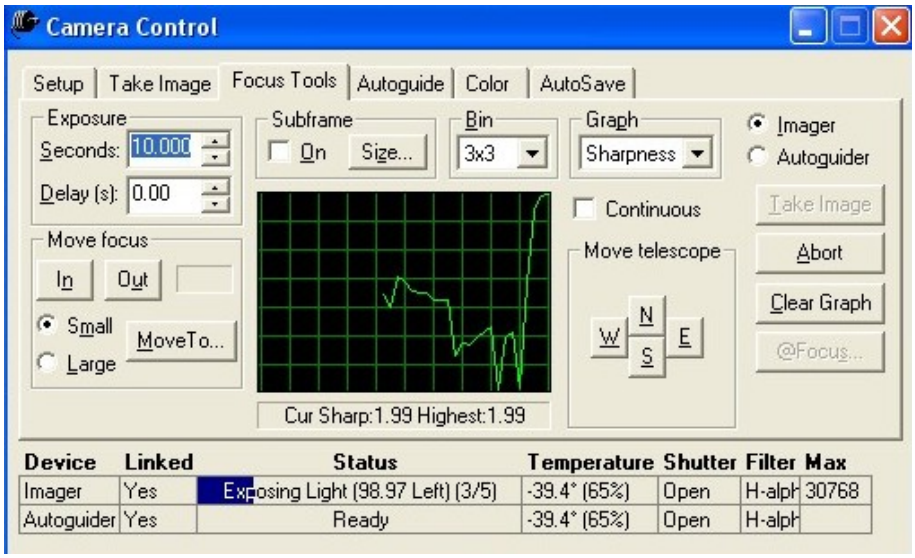

Figure 31: *The setup (focus) window of CCDSoft.*

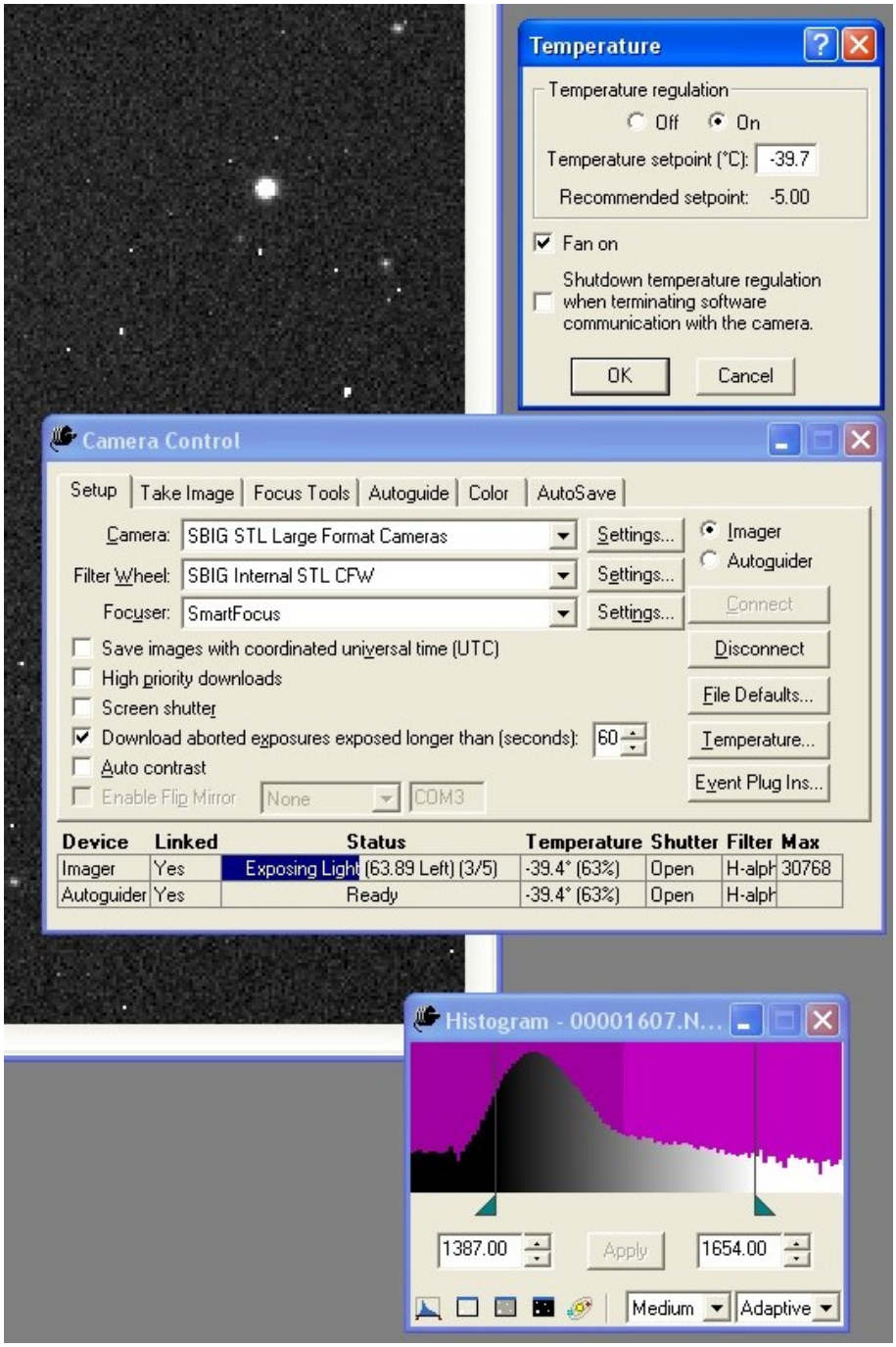

Figure 32: *The setup window of CCDSoft with the temperature setting opened.*

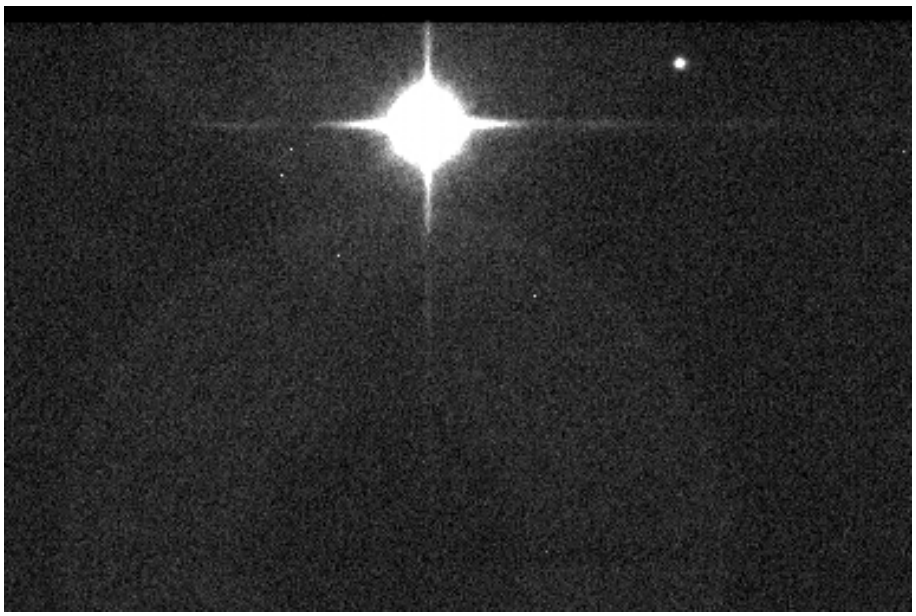

Figure 33: *Well defined diffraction spikes for a focused star.*

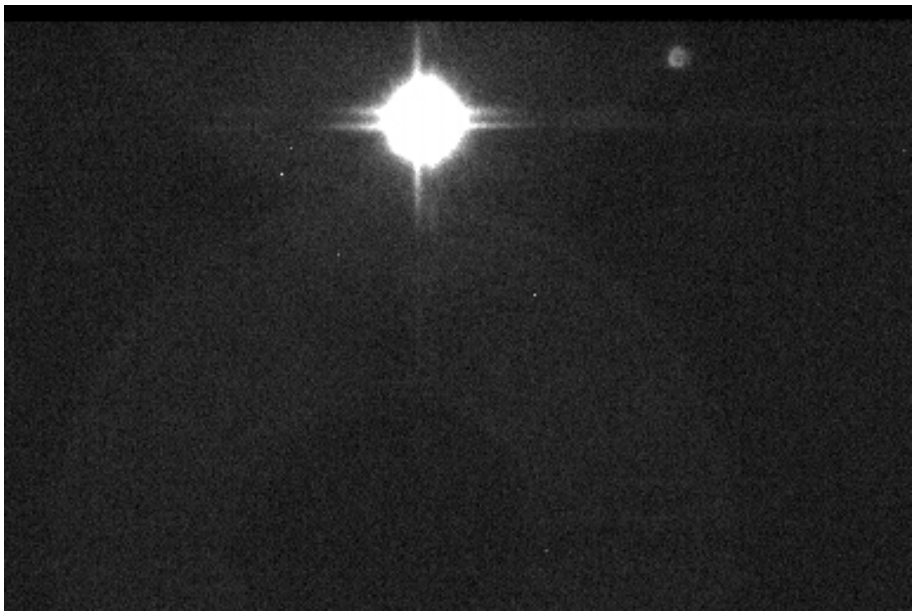

Figure 34: *Blurred diffraction spikes for an out of focus star.*

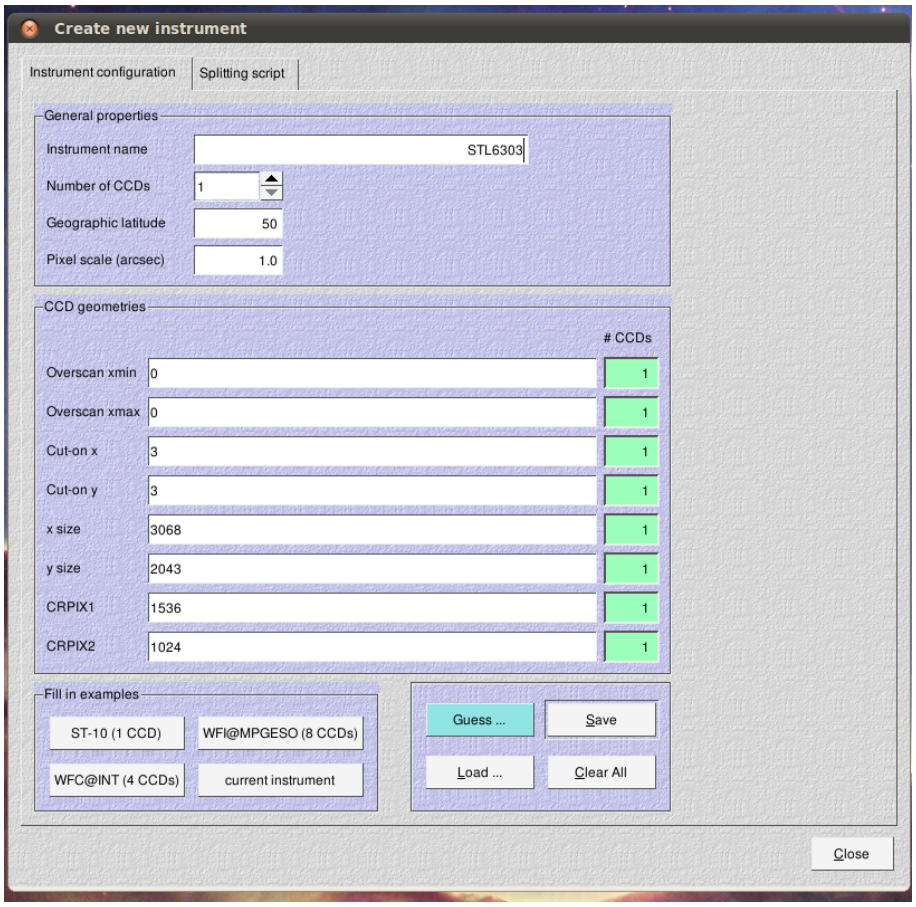

Figure 35: *The Theli configuration window.*