

Maxim DL

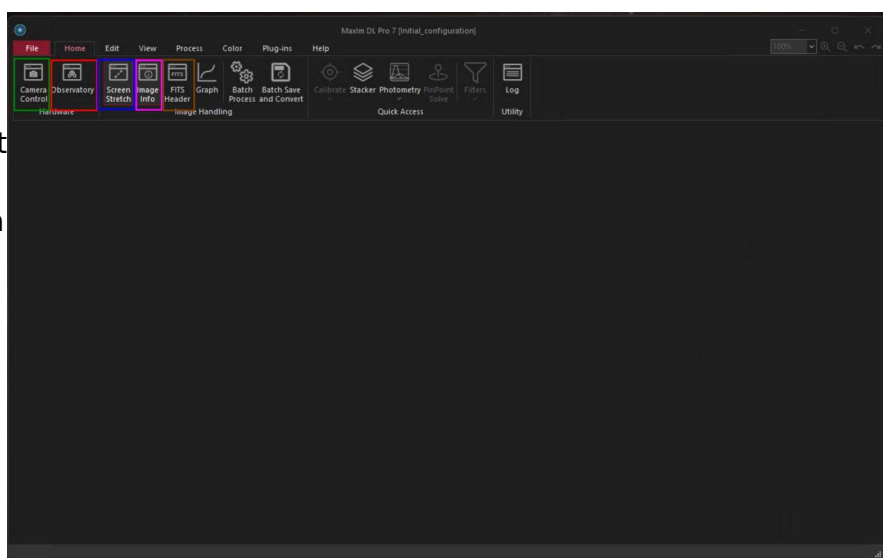
Maxim DL is currently the primary interface used to control the observatory, operate the cameras, and perform observations.

Interface and Basic Operation

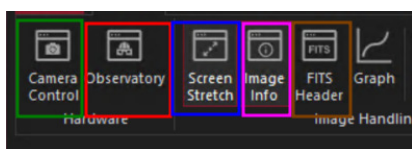
Maxim DL can be started most easily by double-clicking the Maxim DL 6 icon on the desktop or via the taskbar.

Main Window

The toolbar at the bottom provides the main image window of Maxim DL, and displays important features. The toolbar is highlighted. The toolbar is located at the bottom of the main window. The toolbar contains the following icons: Camera Control, Observatory, Screen Stretch, Image Info, FITS Header, Graph, Batch Save, Batch Process and Convert, Calibrate, Stacker, Photometry, Plot, Filters, Log, and Utility. The Camera Control and Observatory icons are highlighted in red. The Screen Stretch icon is highlighted in blue. The Image Info icon is highlighted in purple. The FITS Header icon is highlighted in orange. The Graph icon is highlighted in green.



Main window of Maxim DL



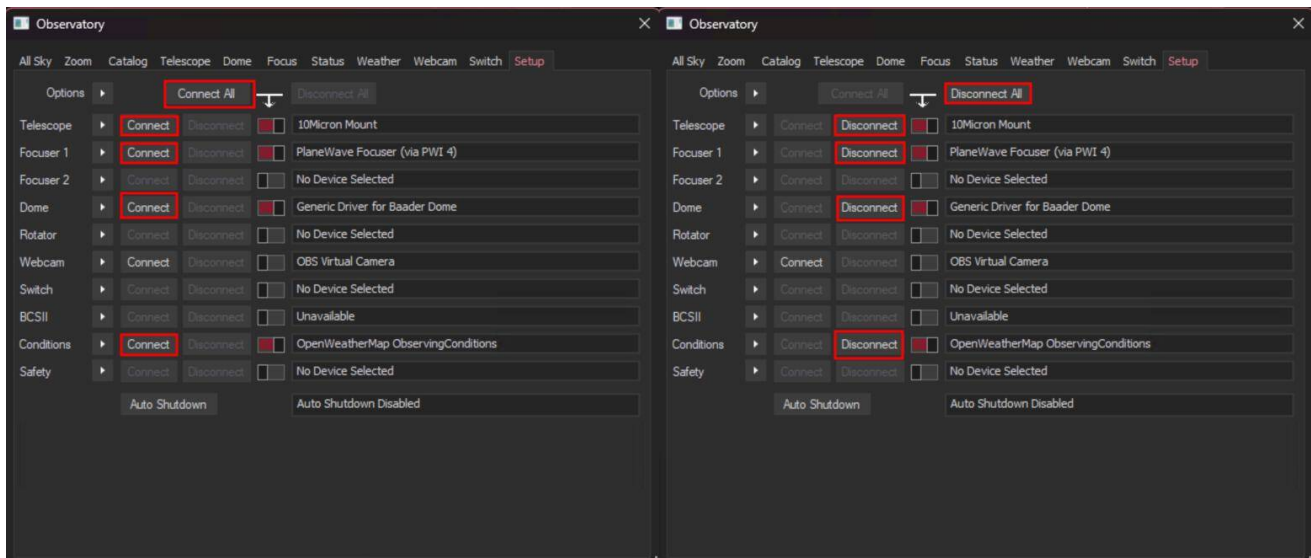
Observatory Panel

The **Observatory** control window contains different tabs used to control the various components of the observatory. Objects can be selected by entering their coordinates, choosing them from a catalog, or marking them on the All-Sky map. The dome can be opened, closed, and manually repositioned if necessary. Furthermore, the telescope can be moved manually via this control window and parked again after the observations are completed.

Setup Tab

The Setup tab is used to establish the connection to the telescope, the dome, and the focuser. Click the respective **Connect** button next to each entry or use **Connect All** to establish connections to all

components simultaneously. Other entries such as **Rotator** are not relevant for our setup.



Setup tab - Nothing connected

Setup tab - Telescope, dome, and focuser connected

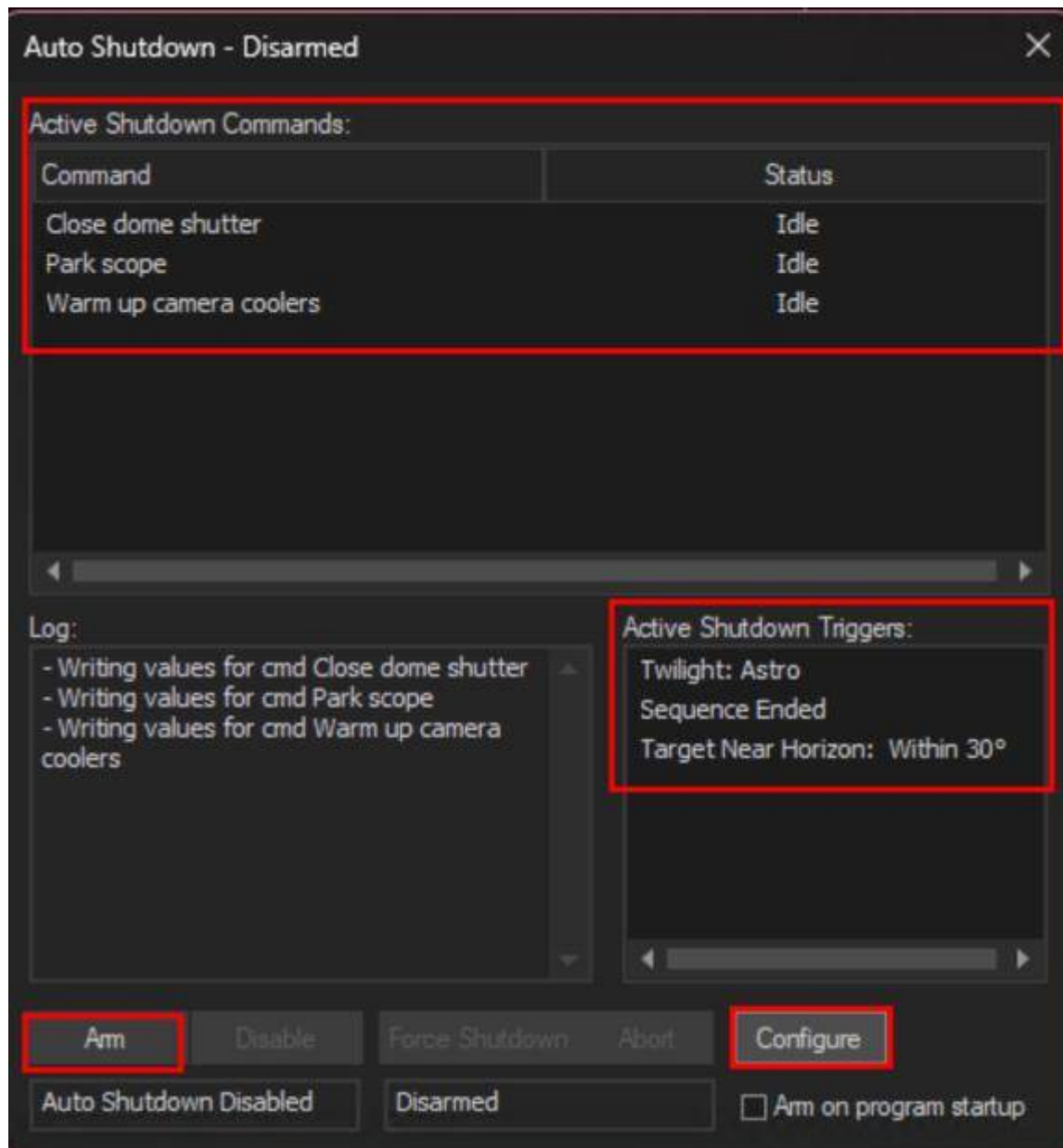
To disconnect the devices after the observations, use the individual **Disconnect** buttons or **Disconnect All**.

When planning an automatic or semi-automatic observation night, you can also activate the automatic shutdown mechanism as an alternative. To do this, click on the **Auto Shutdown** button at the bottom of the Setup tab. The *Active Shutdown Triggers* section in the window that opens (see below) lists the various triggers that can cause an automatic shutdown. In the example below, these are:

1. **Twilight**, which is set to **Astro**. This means that the trigger is activated as soon as astronomical twilight begins.
2. **Sequence Ended**, which activates once the current sequence has finished.
3. **Target near horizon**, which is set to **Within 30°**. The trigger is activated when the altitude of the object above the horizon falls below 30°.

The *Active Shutdown Commands* section lists the actions that occur once the shutdown has been triggered. In our example, the dome closes (**Close dome shutter**), the telescope parks (**Park scope**) and the camera coolers switch off (**Warm up camera coolers**).

All of these options can be configured using the **Configure** button. Once all the settings have been configured, auto shutdown can be activated using the **Arm** button.

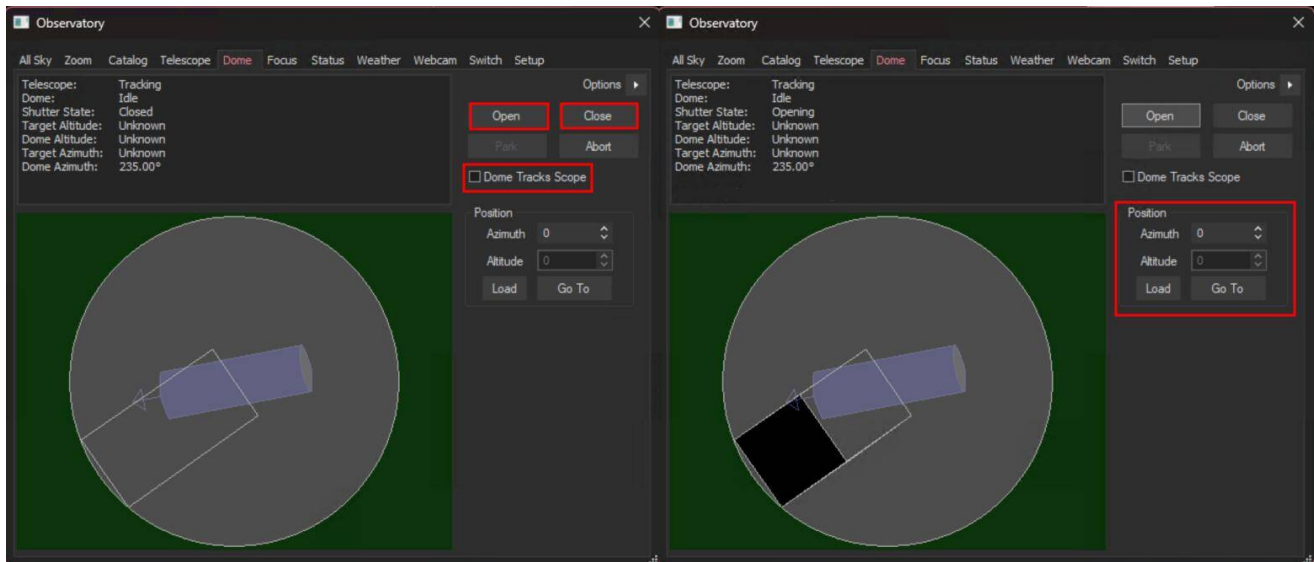


Auto shutdown menu

Dome Tab

The **Open** and **Close** buttons are used to fully open or close the dome. The dome slit and hatch always move into their fully open or fully closed positions.

Ensure that **Slave Dome To Scope** is activated; otherwise, the dome will not follow the telescope. This option is automatically deactivated each time the dome is opened or closed, or when the telescope is parked, and must therefore be reactivated if required.



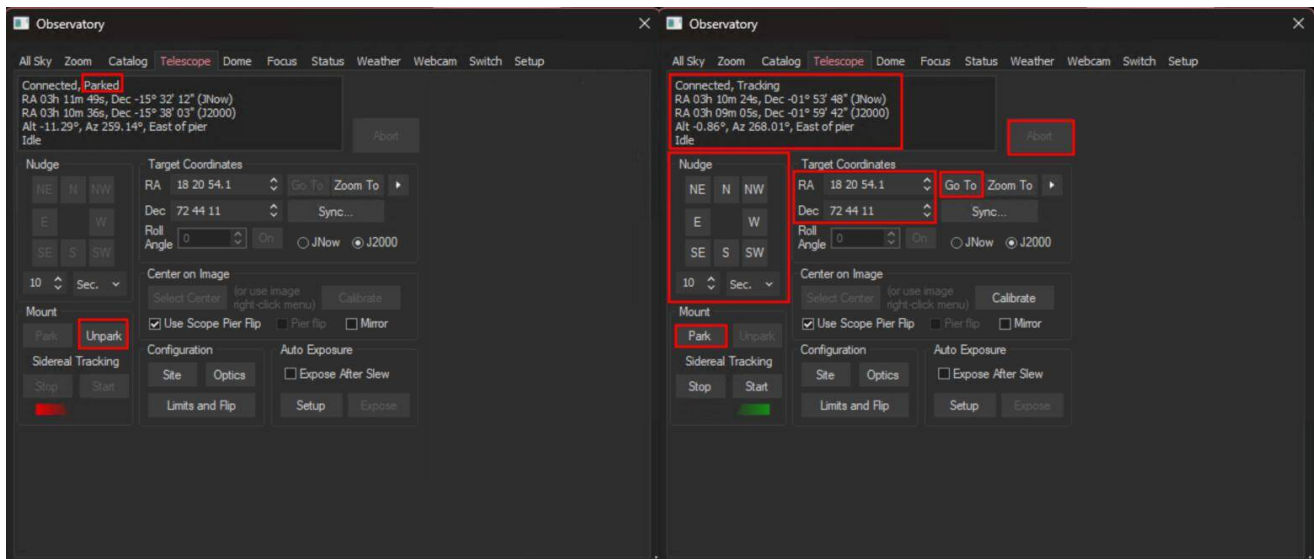
Dome closed

Dome open

The dome can be moved manually via the functions in the **Position** section. This is particularly useful when the telescope and dome slit are not aligned correctly and need to be recalibrated, as shown in the example above.

Telescope Tab

The upper-left section of the Telescope tab shows the current pointing position and status of the telescope. Right ascension and declination are displayed for the current date as well as for the standard epoch J2000. In addition, altitude above the horizon and azimuth are shown. In the examples below, the telescope is parked (left) and tracking (right).



Telescope tab: Telescope parked

Telescope tab: Telescope tracking

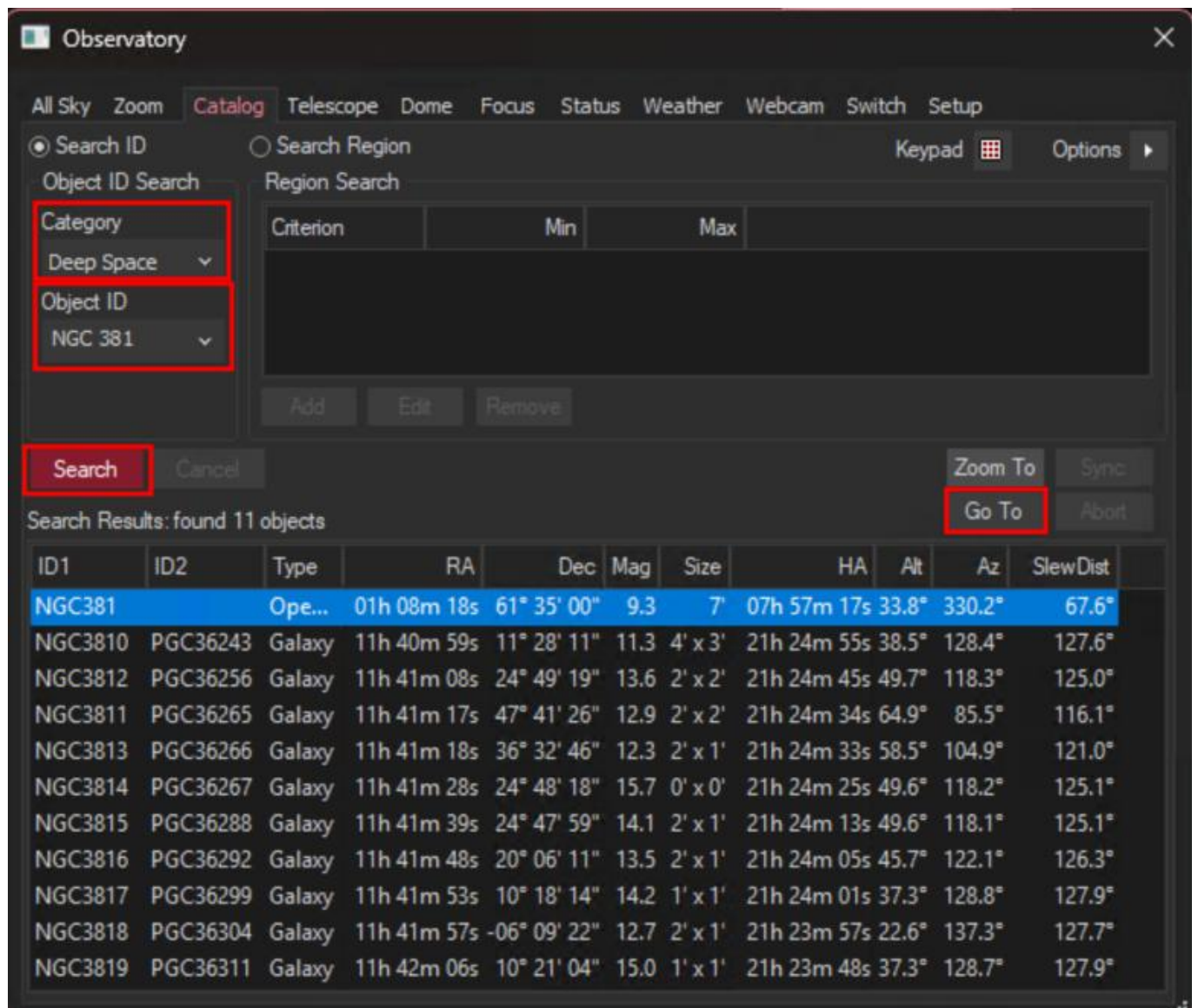
The buttons in the **Nudge** section allow manual movement of the telescope. The step size can be selected via the drop-down menus. Each movement can be aborted using the **Abort** button.

In the **Target Coordinates** section, right ascension and declination can be entered manually and the telescope can be slewed to the selected object using **Go To**. The **Zoom To** button switches to the Zoom tab, which displays a sky map centered on the respective coordinates.

The **Park** button in the **Mount** section parks the telescope after the observations.

Catalog Tab

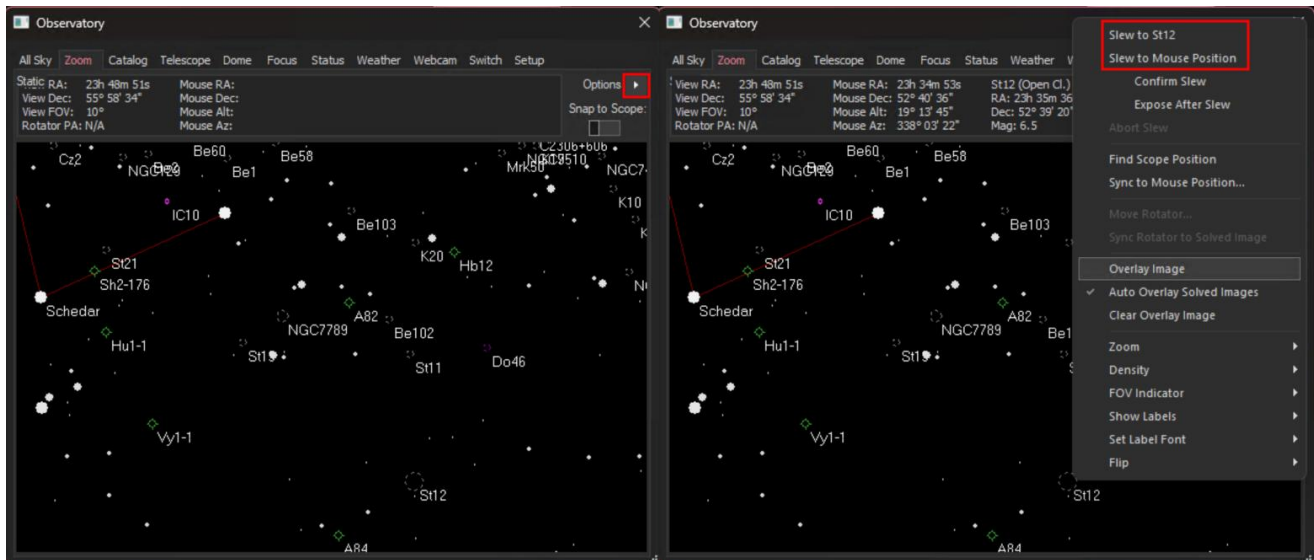
Using the Catalog tab, the built-in catalogs can be searched for objects. First, select a category from the **Category** drop-down menu: Stars, Deep Space, or Solar System. Under **Object ID**, either select the object directly or choose a catalog and enter the catalog number (or part of it). After clicking **Search**, a list of possible matches is displayed. Select the desired object and click **Go To** to slew to it.



Zoom Tab

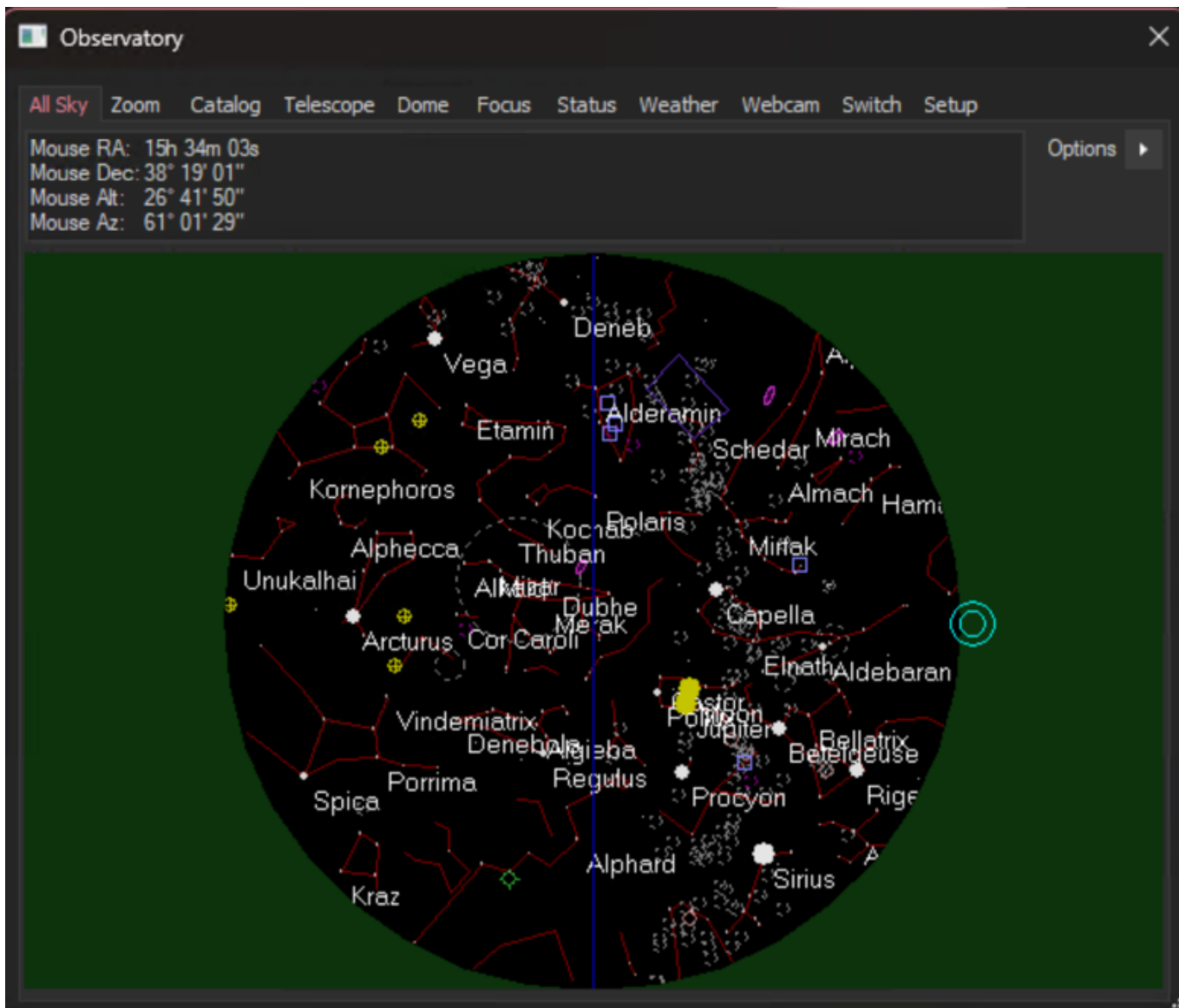
In the Zoom tab, the sky map around the selected object is displayed. Via the options button (arrow) on the right and the context menu, various settings such as zoom level can be accessed.

Right-clicking on any point in the map allows you to slew the telescope to that position via Slew to Mouse Position. If you right-click on an object, it can be selected directly (e.g., Slew to 119 Tau).



All Sky Tab

The All Sky tab shows the current sky. By right-clicking, you can zoom into any area; this automatically switches to the Zoom tab. The options button (arrow) on the right provides access to additional settings.



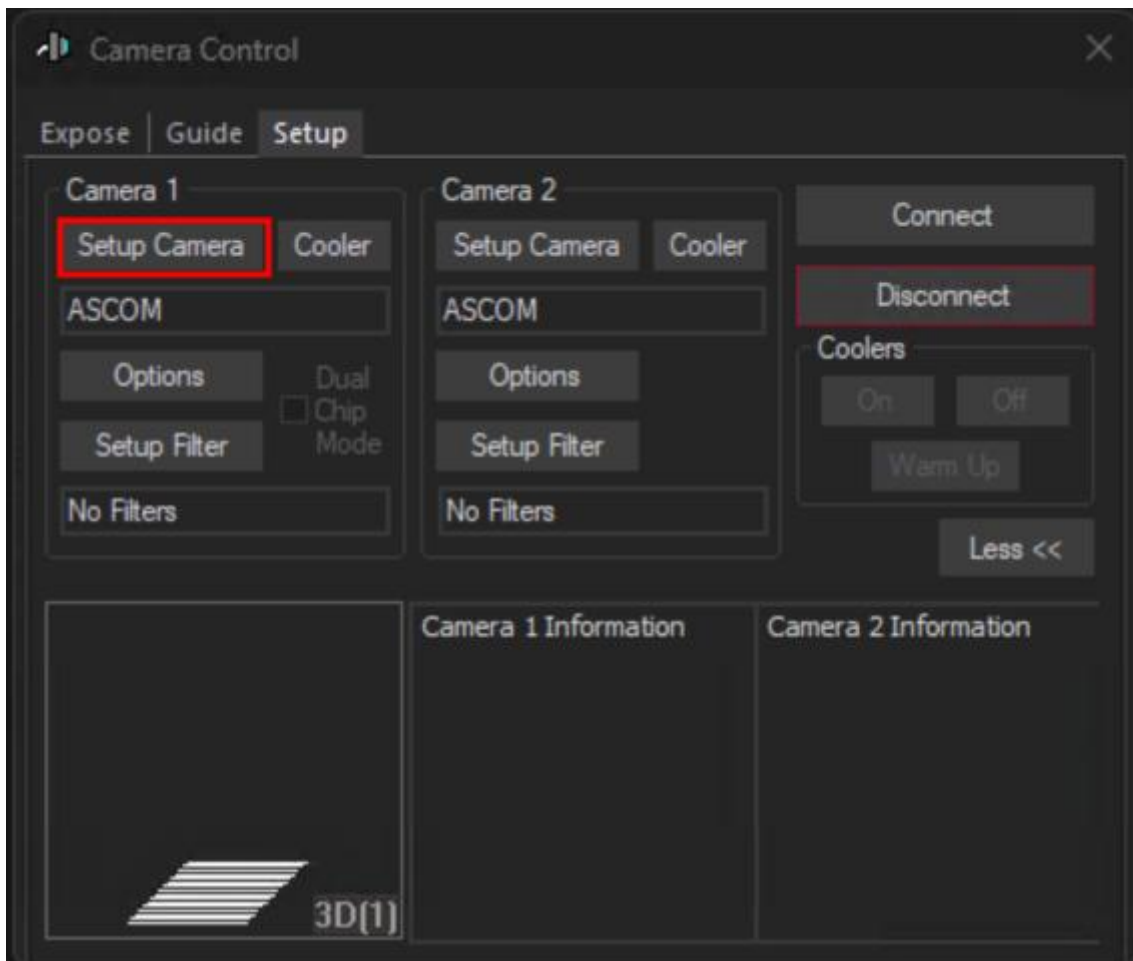
Camera Panel

The **Camera Control** window is used to operate the cameras and acquire images.

Setup Tab

As the name suggests, this tab is used to connect the cameras to Maxim DL. The procedure differs slightly depending on the manufacturer. Here, the setup for QHYCCD cameras is described, as these are the cameras primarily used.

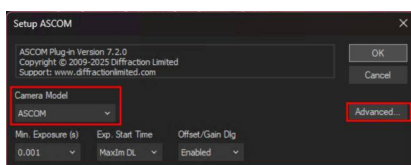
For each camera model, the appropriate driver must be selected. This applies both to the main camera and to the filter wheel. If a guiding camera is used, it must also be connected here. Typically, the main camera is connected as **Camera 1**, while the guiding camera is connected as **Camera 2**.



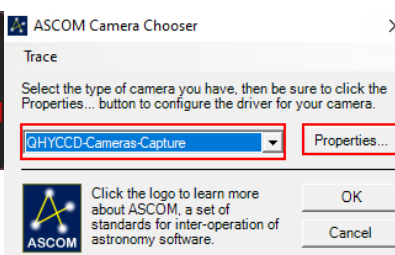
The first step, regardless of the manufacturer, is to click on **Setup Camera**.

Connecting QHYCCD Cameras:

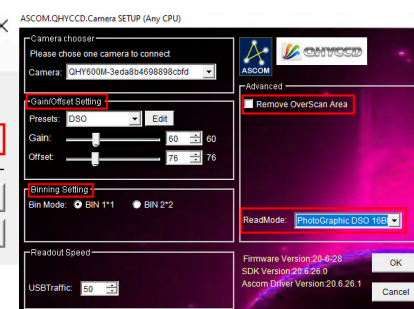
In the window that opens, select **ASCOM** from the **Camera Model** drop-down menu and then click **Advanced...** (Step 1). A second window will open. In this window, select **QHYCCD-Cameras-Capture** from the drop-down menu and click **Properties...** (Step 2). This opens the settings menu for the **ASCOM** driver for the QHYCCD cameras. **ASCOM** serves as the standardized interface through which many of the observatory's hardware components are controlled.



Connecting the QHY600M - Step 1



Connecting the QHY600M - Step 2



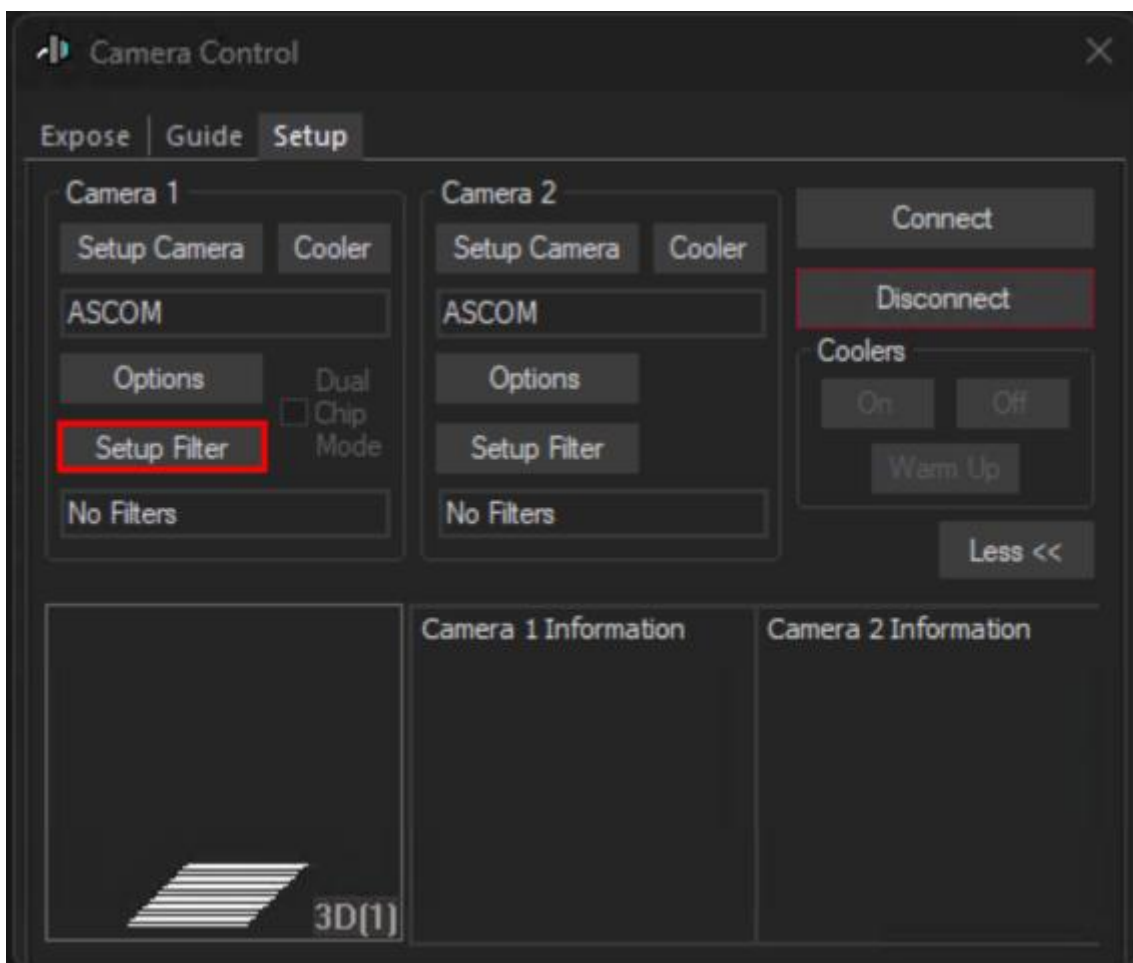
Connecting the QHY600M - Step 3

In the final step (3), all relevant settings for the **ASCOM** driver can be configured. These include the readout mode, selectable via the **ReadMode** drop-down menu. Available options include PhotoGraphic DSO 16bit, High Gain Mode 16bit, Extend Fullwell Mode, and Extend Fullwell 2CMS. Under **Gain/Offset Setting**, the **Gain** and **Offset** can be adjusted. These settings can be saved as **Presets**. For our use case, the **Remove Overscan Area** option should also be

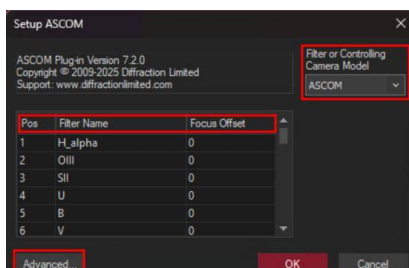
activated. After configuration, close all three windows by clicking **OK**.

Connecting QHYCCD Filter Wheels:

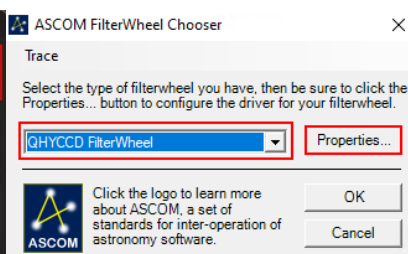
To connect a filter wheel, first click on **Setup Filter**.



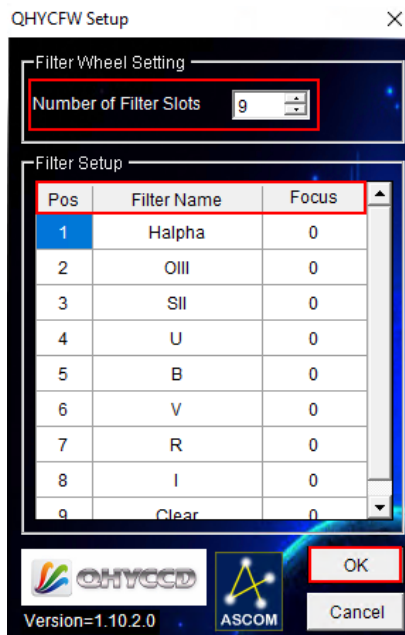
In the first step, select ASCOM from the **Filter or Controlling Camera Model** drop-down menu and click **Advanced...**. In the next window, select QHYCCD FilterWheel and click **Properties...** (Step 2). A driver settings window will open. These settings usually only need to be configured once. Select the **Number of Filter Slots** (in our case 9), define the filter names, and enter any required focus offsets (Step 3). Confirm and close all windows by clicking **OK**.



Connecting the CFW-3 filter wheel - Step 1



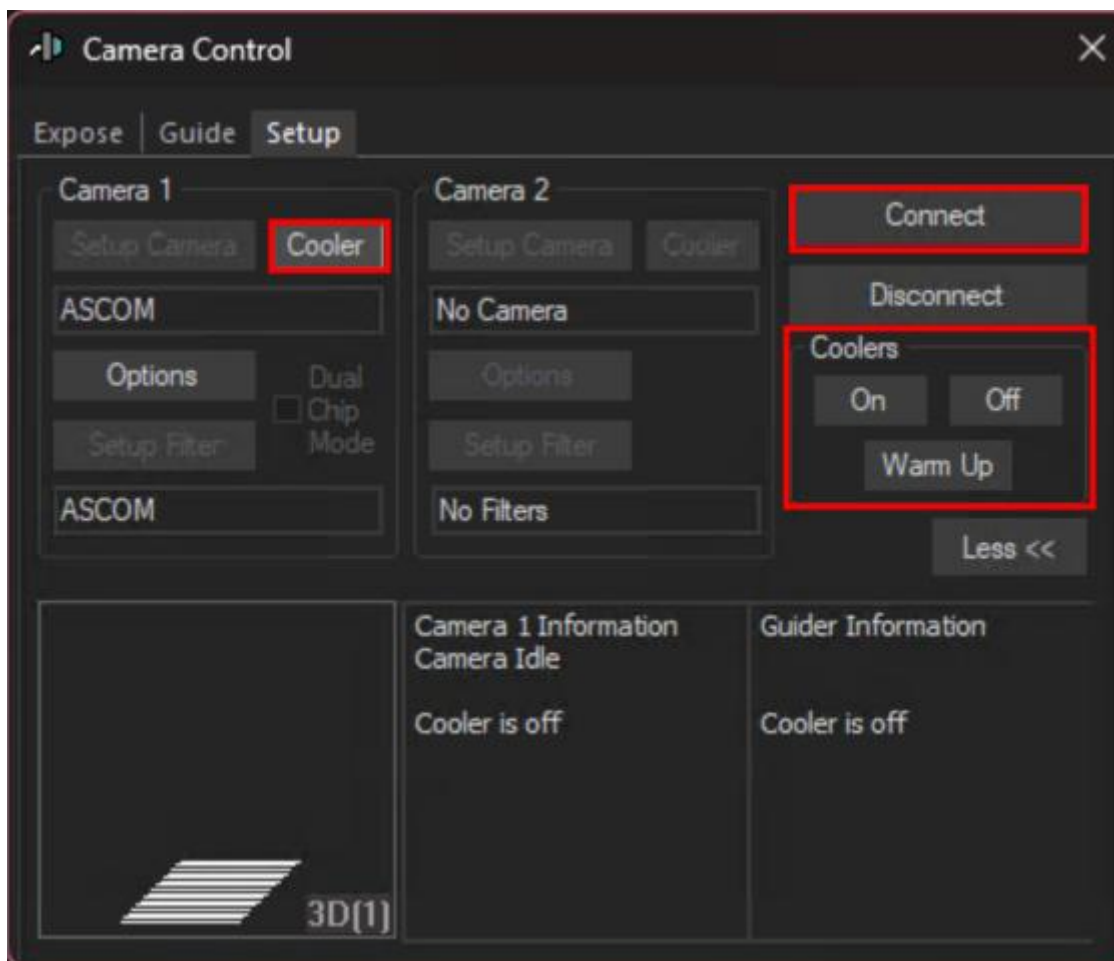
Connecting the CFW-3 filter wheel - Step 2



Connecting the CFW-3 filter wheel - Step 3

Final Step:

Click **Connect**. Under **Coolers**, activate the cooling system and set the target temperature under **Cooler**.



Expose Tab

This tab contains the most important settings for image acquisition. Predefined configuration sets can be selected under **Exposure Preset**, and new presets can also be created.

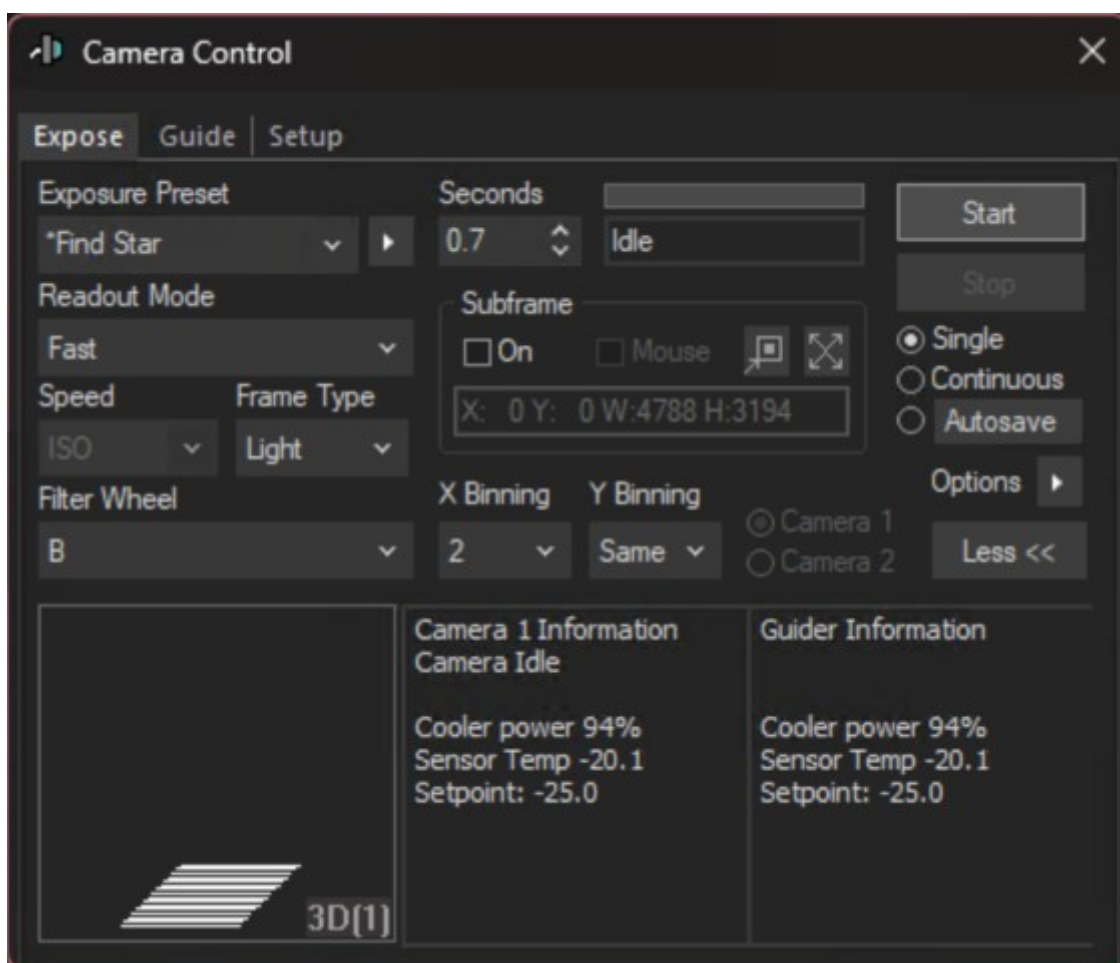
The most important parameter is the exposure time (**Seconds**). To the right, the status line indicates the current camera activity. In the example shown below, the camera is idle.

The selected filters are displayed under **Filter Wheel**. Binning options are accessible via the **X Binning** and **Y Binning** drop-down menus. In some cases, it is also possible to select the **Readout Mode**.

The basic operating modes are:

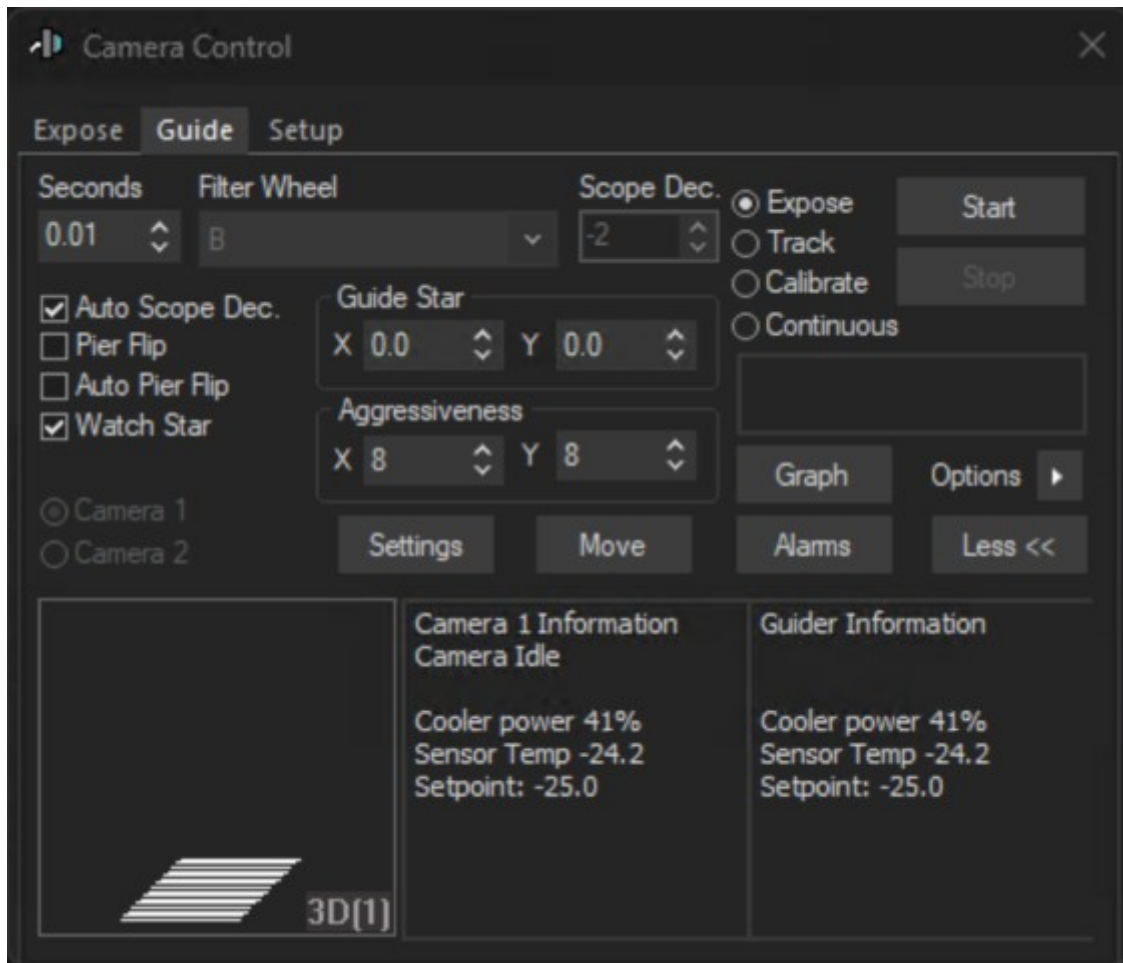
- **Single** - one exposure
- **Continuous** - consecutive exposures displayed sequentially (suitable for focusing)
- **Autosave** - automated exposure series

In **Continuous** mode, images are taken and displayed one after another using the defined exposure time. Further details on the lower three panels can be found in the [focusing instructions](#). Additional options are available via the **Options** button (arrow).



Guide Tab

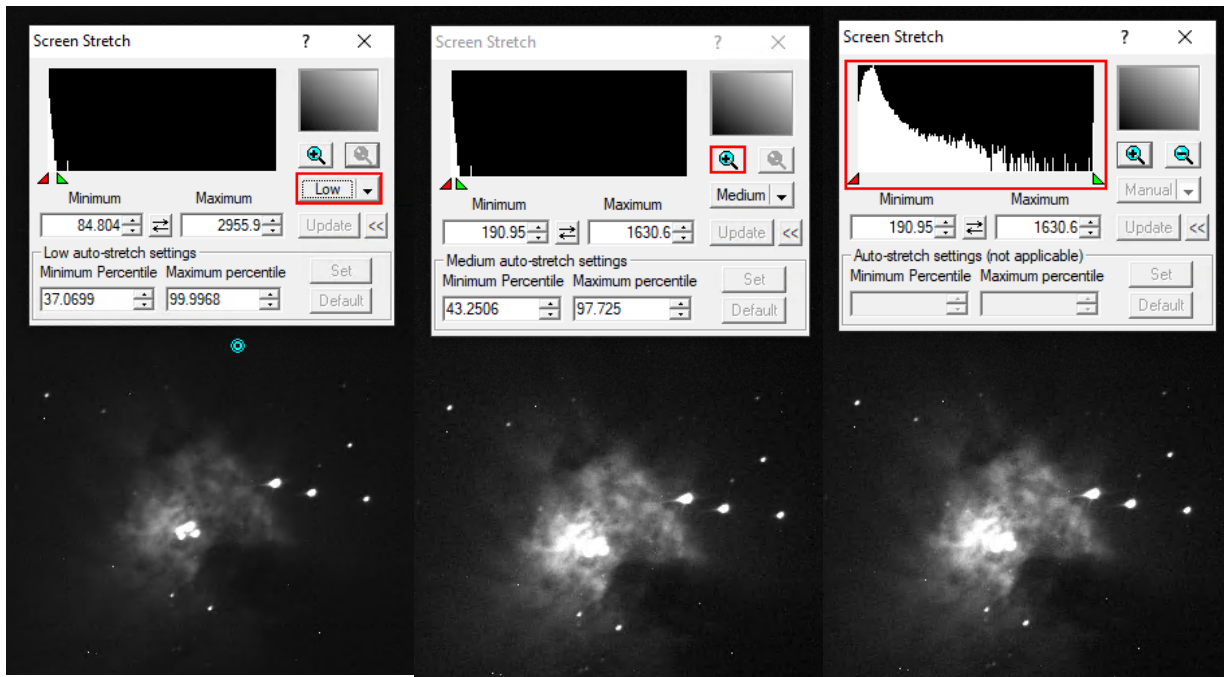
The Guide tab contains the primary settings required for telescope guiding. Detailed instructions are provided in the corresponding [guiding how-to](#).



Screen Stretch Panel

The **Screen Stretch Panel** allows adjustment of the image display scaling. These settings affect only the visualization of the image and do not modify the underlying data.

In the first example below (showing M42), the scaling is set to Low. Increasing the scaling to Medium reveals significantly more detail. Additional predefined scaling options are available from the drop-down menu.



Screen Stretch - Low scaling

Screen Stretch - Medium
scalingScreen Stretch - Histogram
zoom

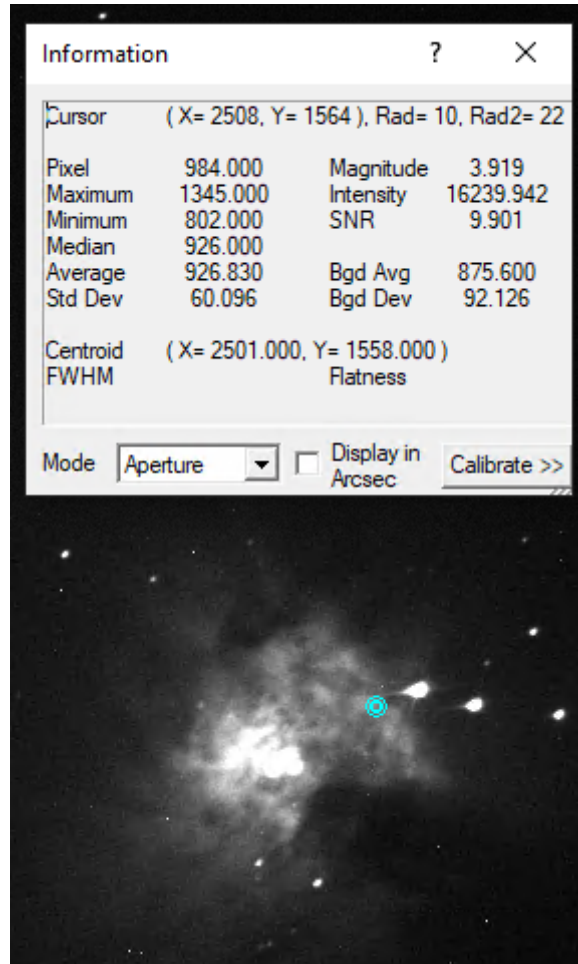
Clicking the plus symbol in the upper right section zooms into the histogram displayed in the upper left. This allows fine adjustment of the scaling using the red and green triangles, where the red triangle defines the black level and the green triangle defines the white level. The same adjustment can be performed using the **Minimum** and **Maximum** fields.

Information Panel

The **Information Panel** is particularly useful for checking whether an image is overexposed and identifying which stars may be saturated.

Of particular interest are the **Pixel** and **Maximum** values. In the default Aperture mode, the information is derived from the cyan aperture shown on the image, which can be moved, for example, onto a bright star.

When evaluating stellar image quality, the signal-to-noise ratio (**SNR**) and the full-width at half-maximum (**FWHM**) are also relevant parameters. For our predominantly uncalibrated images, values such as **Magnitude** are generally not meaningful.



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