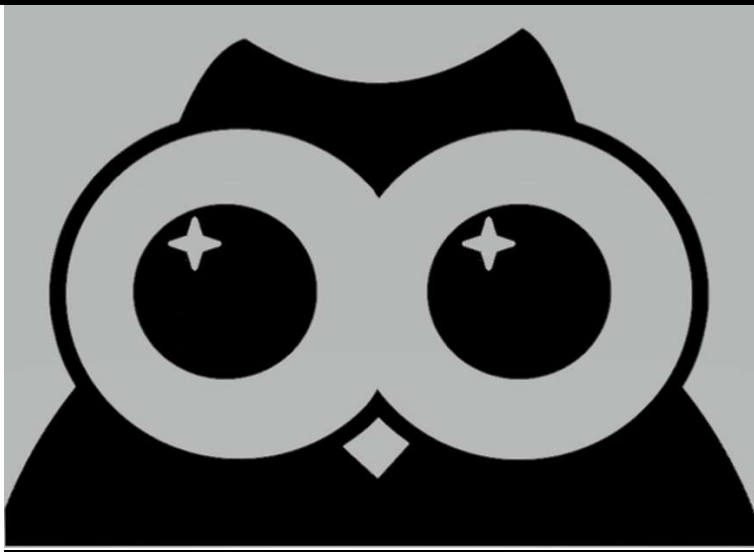


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# AstrowlBox User Guide



The information contained in this document is property of Astrowl Box.  
The information in this document is subject to change without notice.  
Please visit our official website: <http://www.astrowlbox.com>  
for latest version of program

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# 1 Introduction

The Astrowl box is an ultra-portable "all-in-one" system based on an ultra-sensitive sensor that will allow you to view objects in the night sky and capture details inaccessible to the naked eye, because they are too dim or blurred in turbulence.

It will therefore be possible for you with the Astrowl box, even in an urban area heavily polluted by light, to visualize the details of nebulae, galaxies, star clusters, to access colors otherwise inaccessible. The planets, the moon also reveal details that are difficult to perceive with turbulence. The satellites of some planets become visible when they are almost impossible to see, even with a large diameter telescope.

Astrowl has been designed to provide you with the main features of digital astronomy in an ultra-portable box. No need for a camera, a computer, cables, ... all of this is already integrated into the box. The housing is equipped with a camera with the Sony IMX462 sensor, known for its high sensitivity over a wide spectrum of light (even beyond human vision) and particularly well suited for use in astronomy.

The back of the case features a 4" touch screen, offering a good compromise between reduced size and good image visibility.

Finally, the inside of the case incorporates a mini-computer: the Raspberry Pi, particularly reliable and extremely widespread in the world, present in many products and projects.

The set is driven by proprietary software integrating the essential functionalities in digital astronomy, with several parameters at your fingertips if you wish to customize certain settings. This software is accessible from any device (smartphone, tablet, computer, ... on IOS, Android, Windows, ...) equipped with a web browser (Chrome, Edge, Firefox, Safari, ...).

Adjustments and settings have been limited and designed to be quick and easy to access, so you can focus on your observing session and not have to read a tedious user manual and learn complex features, reserved for expert astrophotographers.

The box implements complex and real-time image processing, but you won't have to worry about the details of this processing. Some can be activated on your initiative, but they are limited and you will quickly learn their impact on the quality of the image, depending on the objects observed.

# 2 Description of the Astrowl box

The Astrowl box is equipped with:

- On its rear side, a 4" touch screen, on which the images captured by the camera are displayed (it is also possible to display the images captured by the camera on the user interface - See features below) .
- On its front side, the Sony IMX462 sensor, as well as a Canon EOS format adapter, on which it is possible to install a Canon EOS > T2 ring (see photo below. From the T2 format, you can install most astronomical extensions and accessories (31.75mm (1"25) or 51mm (2") adapter, filter, projection for eyepieces, etc.).



EOS / T2 ring, with examples of accessories (filters, 51mm (2") adapter

- On the side of the case is the power socket in USB-C format. The power supply must be 5 Volts, available via a simple USB connection or an external battery.



- On the opposite side a small square opening allows you to adjust the brightness of the screen. By inserting a small rod (preferably non-metallic) and by successive presses, you can vary the intensity of the screen.



- Finally, a network socket (RJ45) is also accessible on the side of the case. This socket currently has no function.

### 3 How to install the box on your telescope

The box is installed in the focuser of your telescope or refractor, like an eyepiece. You will need to choose the right adapter depending on your use (T2 adapter > 31.75mm (1.25"), T2 > 51mm (2") or other). If you are using a star diagonal with your eyepieces, insert it before putting on the Astrowl box. Remove any covers and protection from the front of the case to uncover the sensor. Careful, the sensor is not protected, it is preferable to avoid touching it. If dust appears during your observations, use a blower to gently remove it, but never rub the sensor directly.

I strongly suggest you to buy an IR Cut filter to screw on the front of the camera (on the 31.75mm or 51mm output). This filter will protect the sensor and above all it will allow shots with faithful colors. The IMX462 sensor being very sensitive in the infrared, if you make observations without such a filter, the color balance will be difficult to obtain. However, on certain objects such as nebulae, it may be interesting to shoot without the IR Cut filter.



### 4 Start the Astrowl box

Connect the box to a 5 Volt power supply in USB-C format. Once powered, the box will start by itself and display the Astrowl logo after approximately 1 minute.



Finally, the Astrowl logo will disappear and the image captured by the camera will be displayed over the entire surface of the screen with a predefined setting (by default *Starfield* mode). The camera is not equipped with a lens, you will not be able to focus. Your astronomical instrument (telescope or refractor) will serve as the lens and will focus the image.

If your power supply is fixed relative to the movement of your mount, make sure that the power cable from the case is long enough. Otherwise you risk stretching the cable when moving the mount and tearing the Astrowl box from its support.

## 5 Connect to the Astrowl box

To connect to the box, look in the list of wifi access points (from your smartphone, tablet, computer, etc.) for the network called *astrowlxx* (xx being numbers). Select this access point to connect to it.

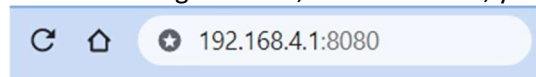
The password is the same as the network name, so *astrowlxx*.

Your smartphone (or others) may possibly display a message telling you that this access point has no connection to the Internet and offers you to cancel the connection or to confirm it. You must confirm the connection and if possible validate this choice for future use.

## 6 Display Astrowl user interface

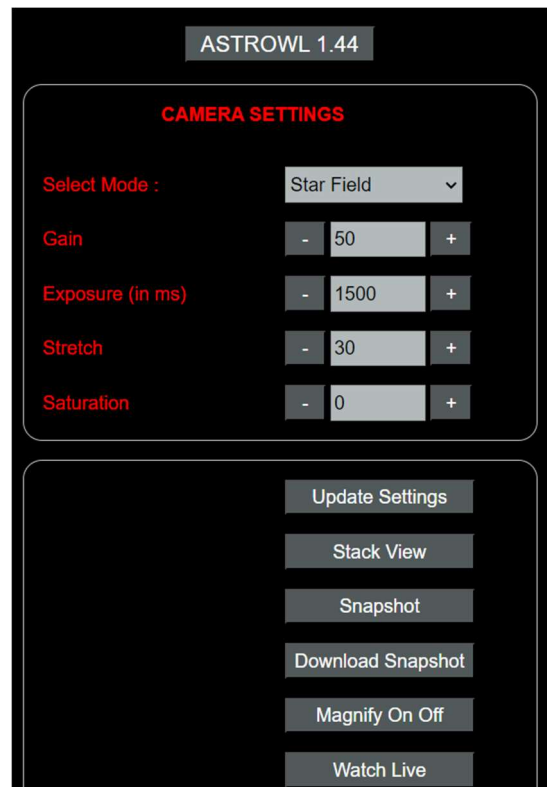
Once connected to the box (see previous steps), you must open a browser (Chrome, Edge or other) from the device you have connected to the Astrowl box.

From the navigation bar, in the URL box, you must enter the following text:



Save it in your favorites, it will save you having to retype it each time. If the wifi connection has been correctly made and the Astrowl box works well, the browser displays the following page.

*Live View* settings page .



## 7 Astrowl box control interface

The interface will allow you to control the camera: adjust the shooting parameters (exposure and gain), switch from *Live visualization* to *Stack* visualization , choose between several pre-configured modes ( *Star Field*, *Nebulae*, *Galaxy*, etc. ) depending on the observed target (or Expert Mode to manually change the different parameters), save an image, access the list of saved images and download them.

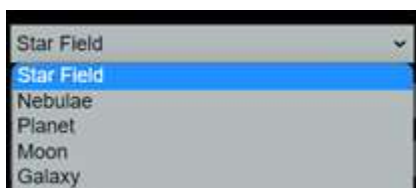
The interface is very simple and consists of only 5 screens:

- **Live View** screen
- **Stack View** screen
- **Captured images** screen ( **Download Snapshot** )
- Display screen of the image captured by the camera ( **Screen View** )
- **Astrowl software update** screen

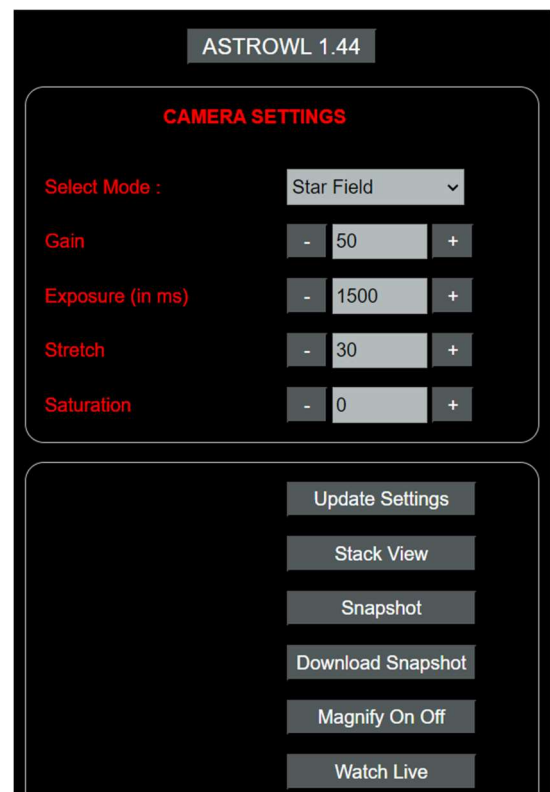
### 7.1 Live View screen

*Live View* screen is displayed the first time you connect to the box. *Live View* is the continuous viewing mode of the images captured by the IMX462 sensor (much like a live video). This screen allows you to change the camera settings.

Under the top *Camera Settings* frame is the **Select Mode** drop-down list . Default is **Star Field** mode which is selected. Clicking on this list displays the different modes available: **Star Field** (for star fields), **Nebulae** , **Planet** , **Moon** , **Galaxy** . Depending on the target to view, choose the most suitable mode and click on the **Update Settings** button.



Depending on the telescope you use, these modes may be more or less suitable. For example, if you are using a telescope with a Focal/Diameter ratio of 10 or greater, **Planet** mode will probably be too dark. You will need to adjust exposure and gain manually.



Modes are just shortcuts for quickly adjusting **Gain**, **Exposure** and **Stretch** settings. But you can also decide not to change the mode and modify the **Gain**, **Exposure** and **Stretch** yourself manually according to the intended target.

Gain	-	50	+
Exposure (in ms)	-	1500	+
Stretch	-	30	+
Saturation	-	0	+

Any modification must be validated by pressing the **Update Settings button** to be taken into account by the Astrowl box.

There may be a delay in taking the new settings into account depending on the activity of the unit which may be busy with other processing.

The **Exposure** parameter is expressed in milliseconds and can take a value from 0 to 15000 ms (15 sec). Pressing the (+) or(−) buttons increases or decreases the value in steps of 50 ms. It is also possible to enter a custom value directly in the text field. This parameter defines the exposure time per shot. The higher the time, the more photons will be accumulated per shot and therefore more low light detail. The counterpart is that the background of the sky also becomes more luminous and noisy.

The **Gain** parameter can take a value from 0 to 100. It is used to adjust the amplification of the signal captured by the camera. The higher it is, the more the sensor amplifies the captured photons and therefore is sensitive. The counterpart is that the noise also increases.

The **Stretch** parameter can take a value from 0 to 100. It allows you to normalize the image by extending its histogram. In summary, this allows you to increase the brightness of weak details, on a nebula for example.

The **Saturation** parameter, as its name suggests, allows you to adjust the saturation of colors and increase the coloring of the visualized targets (for example bringing out the famous red spot of Jupiter, accentuating the coloring of the nebulae, etc.). This setting should be used sparingly, as it can quickly distort the colors of the objects viewed.

The **Update Settings** button must be pressed systematically to take into account changes to the parameters entered above (*Mode*, *Gain*, *Exposure*).

The **Stack View button** allows you to switch to the *Stack View screen* (image stacking, see explanations on this screen below).

The **Snapshot button** is used to save the image displayed on the unit's screen in PNG format. A window will open asking you to rename the file before saving it. If you use an existing file name, the previous file will be overwritten.

Snapshot name :

Y2023M5D6\_111212

OKAnnuler



The **Download Snapshot button** is used to access the list of images taken, to download them and to delete them (see section *Download Snapshot screen* below)

The **Magnify On Off button** allows you to activate and deactivate a magnifying glass x3 on the screen of the Astrowl Box. By touching the screen you can move the magnifying glass to the desired area. Clicking the **Magnify On Off** button again you turn off the magnification window.

**Watch Live** button allows you to view on your device connected to the Astrowl box, the image displayed on the built-in screen of the Astrowl Box. (see **Watch Live screen** below).

## 7.2 [Stack View Screen](#)

The *Stack View screen* allows settings for shooting stacked images. Unlike *Live View*, which displays only one image at a time, *Stack View* mode will add several shots to bring out details and eliminate artifacts. In astrophotography it is considered that the addition, for example, of 5 shots of 1 second is equivalent to a single shot of 5 seconds.

By switching to the *Stack View* the stacking of images will start automatically with the settings (**Camera Settings**) defined from the *Live View* screen .

The settings specific to *Stack View* are located in the **Stack Settings** frame, they are kept each time you switch from *Live View* to *Stack View* .

**Align Method** field allows you to define the method used by the program to align the frames. The program automatically takes care of aligning the new frames with the previous ones before adding it to the final stacked image. This alignment is used to correct shifts between each shot, resulting from the imperfect tracking of your mount.

There are two alignment methods: **KUB** and **DSO** .

The **KUB** method performs best on planets, moon, and works quite well on deep sky objects. In most cases it should work fine.

**DSO** method is rather dedicated to deep sky objects and is more accurate than the KUB method. For this method to be effective, several stars must be present in the field. Otherwise, the alignment will not work.

If the shift between frames is very large, a black band may appear around the final stacked image. This band corresponds to the zone which existed on the initial frame, but which is no longer present on the new shifted frames.

ASTROWL 1.44

**STACK SETTINGS**

Align Method : KUB

**POST STACK FILTER**

Contrast Enhance ☐

Details Enhance (RL) ☐

Details Enhance (WI) ☐

Wavelet Sharpen ☐

Balance Background ☐

Frame Rejection - 0 +

Total frames : 9

Total exposure : 13500 ms

Update Settings

Live View

Snapshot

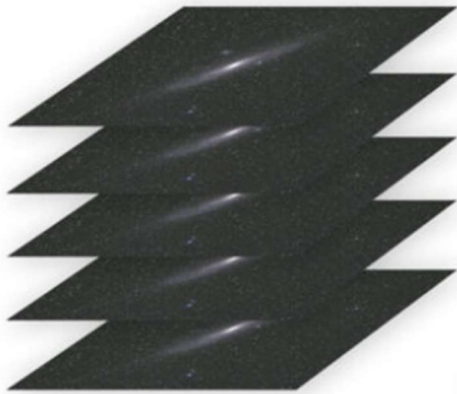
Download Snapshot

Magnify On Off

Watch Live

### How does stacking frames and creating the final image work?

The camera takes pictures (frame) continuously based on the settings you have defined. These images are then added and averaged to create a final image (stacked image displayed on the screen), which makes it possible to remove noise and random artefacts, bring out weakly luminous objects, improve details, ...



Frames added to the stack



Final image = addition of the frames from the stack

### Filters applicable to the final image

There are 3 filters that can be applied on the final stacked image. This means that it is not necessary to activate them throughout the processing, but rather after having already stacked several images. These filters consume computation time and it is therefore preferable not to leave them activated continuously. You can cumulate several filters to increase details and contrast, but keep in mind that each filter will add computing times.

Filter name	Functioning
<b>Contrast Enhance</b>	This filter will enhance the contrast of the image and can help to reveal new details and make them more obvious.
<b>Details Enhance (RL)</b>	Applies a Richardson Lucy Deconvolution to the final stacked image. This filter restores details that turbulence makes diffuse (particularly used in planetary images). You will find abundant documentation on the Internet on this filter
<b>Details Enhance (WI)</b>	Applies a Wiener Deconvolution to the final stacked image. This filter restores details that turbulence makes diffuse (particularly used in planetary images). There is plenty of documentation on the Internet about this filter.
<b>Wavelet Sharpen</b>	This filter will sharpen details.
<b>Balance Background</b> (in testing mode)	This filter makes it possible to balance the background of the sky by removing the effects of light pollution on the image ( <b><u>filter under test</u></b> )

### Filters applicable on each frame before stacking on final image

The **Frame Rejection** filter allows you to sort the frames and exclude the worst (the least detailed), in order to keep only the frames showing the most details and so that stacking increases the details of the final image. By defining a level of 60 for example, you will exclude the worst 60% of frames and therefore only keep the most detailed 40%.

Under the filters you can track the number of stacked frames (**Total frames**) and the cumulative time (**Total exposure**), equal to the number of stacked frames X the exposure time of each frame). This data updates every time you reload the page or every 10 seconds.

**Any modification of parameters, filters, etc. must be validated by pressing the **Update Settings** button.**

The **Live View** button toggles to *Live View*. Again, the switch may take a few seconds while the frames being processed are popped.

The **Snapshot** button allows you to take a picture of the image displayed on the Astrowl box screen.

The **Download Snapshot** button is used to access the list of images taken, to download them and to delete them (see *Download Snapshot screen* below)

The **Magnify On Off** button enables and disables a x3 magnification window on the Astrowl Box screen. By touching the screen you can move the window to the area you want to zoom in on. Clicking the **Magnify On Off** button again turn off the magnification window.

**Watch Live** button allows you to display in your browser the image visible on the integrated screen of your Astrowl Box. (See *Watch Live* screen below)

## 7.3 Download Snapshot Screen

From this screen you can download and delete the snapshots you have taken in Live View or Stack View modes.

The filenames of the shots appear on the left. Just click on the name and the image will be downloaded to your device.

To the right of the name of each shot appears the **[Delete]** link. By clicking on this link you will permanently delete the shot stored on the Astrowl Box (be careful, no confirmation window is displayed to validate the deletion).

Free space disk is displayed above file names.



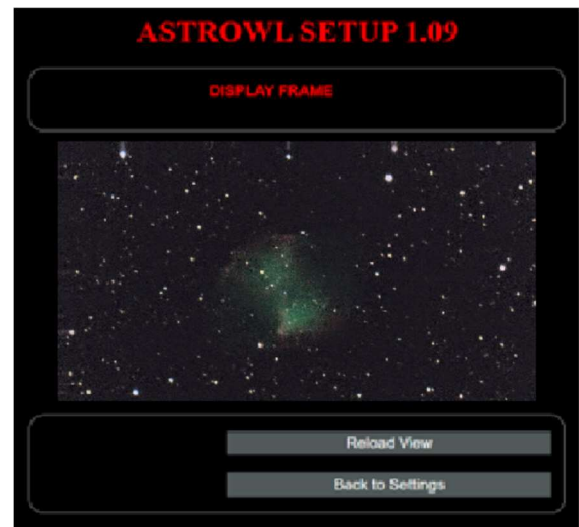
## 7.4 Watch Live screen

From this screen you can display in your browser (from a smartphone, tablet, computer, etc.) the image which is also displayed on the screen of the Astrowl box. The image size automatically adapts to the screen size of your device.

The image is updated every 10 seconds.

If you want to force the image update, click the **Reload View button**.

The **Back to Settings button** allows you to return to the box settings screen.

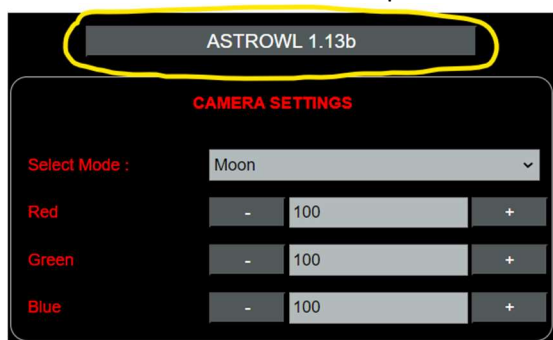


## 8 Astrowl software update

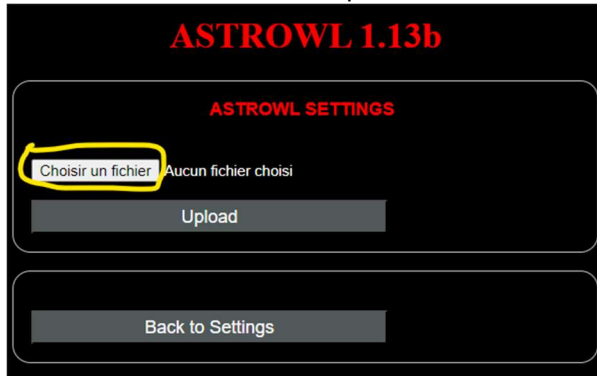
The Astrowl software running on the box is regularly updated to add features, correct bugs, etc. These updates will be available via the Astrowl site (under construction) or via a link sent by email.

To update, follow the steps below (from version 1.13b):

- Download from a computer the new version of the Astrowl software and save it in a directory. It is best not to use a smartphone or tablet for this update.
- Start the Astrowl box,
- Connect via wifi to the Astrowl box from the computer on which you saved the new version of the software. Look for the wifi network starting with *astrowl*,
- Open a browser (Chrome, Edge or other) from your computer and launch the Astrowl interface by typing in the address bar: <http://192.168.4.1:8080>
- *LiveView* interface should appear in your browser,
- Click the version name at the top of the screen:



- You arrive on the software update screen. Click *Choose File* :



- An explorer screen is displayed to search the new version of the Astrowl software that you have previously saved on your computer. Go to the directory containing the Astrowl software and validate your selection.
- Click the **Upload button**. The transfer of the new software to the box will start.
- This download may take several minutes, do not turn off the box and do not refresh the page on the browser until the operation is complete.
- Keep an eye on the Astrowl Box screen, and when box will restart automatically after installation is finished. You will need to reconnect to the box, as wifi was interrupted during restart

## 9 Informations displayed on Astrowl Box screen

The Astrowl Box screen, in addition to displaying the image of the object observed and visualizing the effects of the defined settings, provides you with some informations. This informations appear in red letters at the top left of the Astrowl Box screen.

You will be able to see if you are in Live or Stack mode, the preselected mode (starfield, nebulae, moon, etc.), which alignment method is used (KUB or DSO in Stack mode only), possible error messages and the FWHM.



The **FWHM** (Full Width at Half Maximum) is information that is only displayed in Live mode, it allows you to know the spread of the stars and helps you refine the focus. The two values displayed are the horizontal spread and the vertical spread. The higher the numbers, the more the stars are spread out, so the focus can be improved. The two numbers must be close, otherwise you have an asymmetrical star spread. In this case, it is not the focus that needs to be modified, but the problem may come from your instrument (bad collimation for example) or because the automatically chosen star is at the edge of the field. In this case, center the brightest star.



**FWHM** is more difficult to use on the moon or planets or a very bright nebula. In this case, use the magnifying glass instead.

**IMPORTANT:** Before moving your telescope to another target, it is important to switch to *Live View mode*, otherwise you will have completely inconsistent images, since the box will try to stack and align frames from different targets.

## 10 Typical steps of an observation session with the Astrowl Box

### 1- **Setting up your motorized mount**

The first step before using the Astrowl Box is to set up your telescope and the motorized mount on which it is installed. There are a multitude of sites that clearly explain the steps to follow, which are also different depending on whether you are using an equatorial or azimuthal mount. But the idea is that your mount compensates the rotation of the earth as precisely as possible and keeps the objects observed in the field of your eyepiece or the Astrowl Box as long as possible. The more careful you have been with this station setting, the better your observing session will be.

### 2- **Choose a target and center it in an eyepiece**

Once your mount is stationed, you will choose the target you want to observe (during the first uses of the box and in order to familiarize yourself, I strongly advise you to choose a bright star as your target). Do not put the Astrowl Box in the focuser yet, but choose an eyepiece with a wide enough field of view. Accurately center the object in the eyepiece. You can now remove the eyepiece and replace it with the Astrowl Box.

### 3- **Focus the images displayed by the Astrowl Box**

In most cases, the focusing between your eyepiece and the Astrowl Box is not the same, which explains why by putting the Astrowl Box in the eyepiece, you will not see anything appear on the screen of the box or at best blurred spots. It is therefore necessary to make the focus for the Astrowl Box. It is necessary to proceed by turning slowly and step by step the focus knob of your focuser, because the image on the screen of the box can be refreshed less than once per second and you could pass the focus point without realizing it. When you approach the focus, activate the magnifying glass (Magnify On Off button) and place it on the target or on a fairly bright star in the field. You can move the location of the magnifying glass by touching the Astrowl Box touch screen. Once the magnifying glass is positioned on the object, refine the focus. A word of advice, take note of the difference in focus between your eyepiece and the Astrowl box (graduation of the focuser or by counting the turns of the focus knob), which will allow you to switch from one to the other and find focus quickly.

### 4- **Displayed objects are dim or difficult to see**

Deep sky objects are faint and their brightness can vary greatly from one object to another. The Astrowl Box sensor is renowned for its high sensitivity, so if objects on the screen are dim, you need to adjust the gain or exposure. To do this, choose *Expert Mode* from the user interface and manually increase the *Gain* and *Exposure* (see detailed explanations above).

The *Starfield*, *Nebulae* preset modes are nothing more or less than *Gain* and *Exposure* presets. Depending on the Focal / Diameter ratio of your telescope, these presets may be a little too bright or too dark (they were chosen for an average F/D of around 6). In this case, you will have to change the *Gain* and *Exposure* yourself.