BRESSER

NEBULA

GOTO SYSTEM

by

STARS ASTRONOMY

USER MANUAL

Version 1.2.0, November 2024

WARNING

- The system must be powered on with the RA DEC motors cable connected to the motors plug.

1. Introduction

Nebula Go To System is a Raspberry Pi 4 micro-computer that allows the control of the setup (mount, camera) without requiring any other external device.

The philosophy behind the **Nebula Go To System** is providing the user with a control system independent from normal PC, remote controllable in all its functions using a smart device such as a smartphone or a tablet, not excluding, however, the traditional use of computers of all types and brands, wired or wireless connected to system. Being based on Raspberry PI, the Nebula Go To System is natively provided of all Linux based applications necessary to perform full astrophotography functions. The presence of INDI environment allows to control almost all the devices (cameras, filter wheels, rotator, etc. including even observatory domes) which are necessary to perform locally or remotely controlled astrophotography sessions.

It allows also an extreme flexibility for those users that prefer to make use of the traditional computer client applications such as Cart du Ciel (Star Chart), TheSkyX, SkySafari, Stellarium and other planetarium programs, and SGP, Nina, CCD Ciel, and other astrophotography tools. This full compatibility is assured by the adoption of **Alpaca** communication protocol that allows the use of traditional ASCOM platform drivers for native INDI devices.

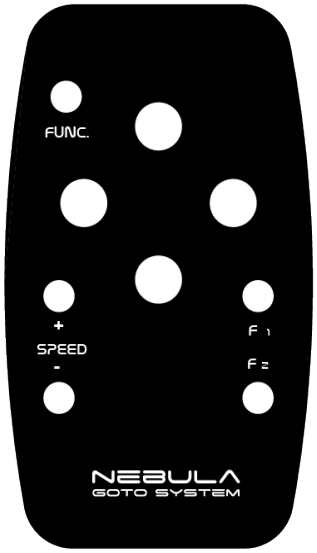
2. Product hardware description

The Nebula Go To System controller is constituted by an aluminum box with compact dimensions,

The box is provided of all the input/output connectors for communicate by wire with the mount motors. Furthermore, the Nebula Go To System is also provided of the Raspberry PI typical Ethernet and USB I/Os. Figure 1 shows the Nebula GoTo System 2 schematic.

NEBULA INPUT/OUTPUT SCHEMATIC

2.1. Use of the Nebula Go To System Handcontroller



The full control of the setup is made through the Nebula Go To System WebApp used together with the Raspberry internal kStar or with external astrophotographic softwares, as explained above.

However the controller comes provided with a Handcontroller that allow basic and some advanced features.

It will be possible, for example, just using the Handcontroller, to switch from the WiFi interface from the managed mode to the hotspot mode or triggering the Sync Home Position.

Those feature can be really helpful to have an intuitive and advanced control of the setup, allowing to easily establish a connection with a pc or smart device to obtain a full controf the setup.

Below the full list of hancontrol keys functions and combinations:

Up OR Down OR Left OR Right:
Slews Up (North) or Down (South) or Left (East) or Right (West) at the setted speed in Alt-Az mode (in equatorial mode) since any of these ends with telescope at tracking speed it could be used as a handy way of nearly stopping any other motion (for istance PC controlled ones)

Speed- OR Speed+: Changes slew speed from Guide/Center/Find/Max (Speed+) and back (Speed-)

Focus- OR Focus+: Moves focus if available in hardware

Speed- AND Speed+ for 5 seconds: Set WiFi interface to managed mode (connect to the last used Access Point)

Focus- AND Focus+ for 5 seconds: Set WiFi interface to hotspot mode

Up AND Down for at least 2 seconds: Stop current motion
Left AND Right for at least 2 seconds: Stop current motion

Up AND Down AND Left AND Right for at least 5 seconds: Controller shutdown

Func AND Speed- OR Speed+: Changes any slew speed of handcontrol movements from 100% to 50% in steps of 10% (Speed-) and back (Speed+)

Func AND Left OR Right: Changes Max speed of handcontrol movements from 100% to 50% in steps of 10% (Left) and back (Right)

Func AND Up OR Down: Changes tracking speed from Terrestrial(None)/Sidereal/Lunar/Solar (Up) and back (Down)

Func AND Focus+: In display equipped controllers increases display brightness
Instead in no display controllers, if pressed for at least 5 seconds, triggers "**Sync to Home Position**"
Func AND Focus-:
In display equipped controllers decreases display brightness
Instead in no display controllers, if pressed for at least 5 seconds, triggers "**Park**" if unparked or "**Unpark**" if parked

3. Quick Start and first access to the WebApp

3.1 Quick WiFi direct access

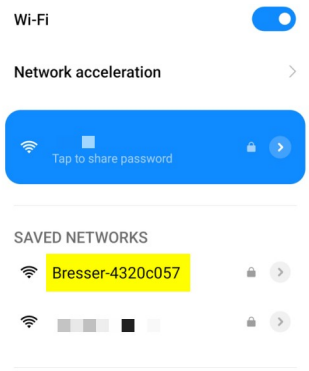
The Nebula Go To System is a Raspberry Pi based controller that allows quick WiFi direct connections for Visual Observing use as well as more reliable cabled based connections suggested for Advanced Astrophotographic session. In this first step it will be shown the quickest way, the direct connection with the Nebula WiFi network. This can be considered the first step to access to the WebApp for check and adjust the system basic settings. This connection can be accomplished via smart device (smartphone or tablet) or via PC.

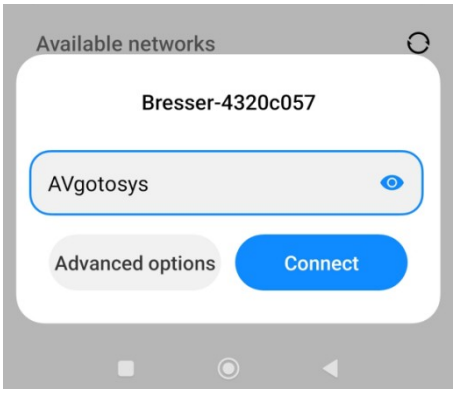
Method 1: Through Smart Device

This method is the faster and smarter connection way, therefore is suggested as a first step to set up the basic system value as: I.P. address, mount configuration file, location coordinates input etc.

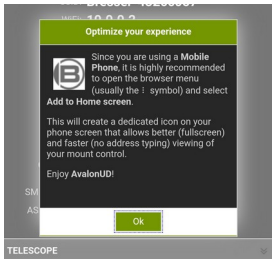
This connection method procedure is described below:

1. Power on the Nebula Go To System by connecting the provided Power Supply to the Power 12V. Port
2. Wait few seconds until the **Status Led** begin to blink
3. Search the Nebula HotSpot network. The SSID WiFi name is divided in two parts: the first is common for every device and is "**Bresser-**", the second is a 8 digits alpha-numeric code. So the SSID WiFi name will be something like "Bresser-xxxxxxxx". In our sample the SSID is "**Bresser-4320c057**". The default password is: "**AVgotosys**"

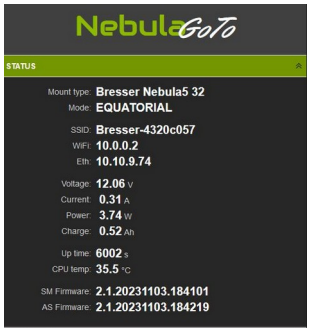




4. After the connection will be established, tap on the Access to WiFi network pop up windows and the WeApp will displaay a Welcome message.



5. By clicking on the OK button the message will be closed and the Webapp wil be available.

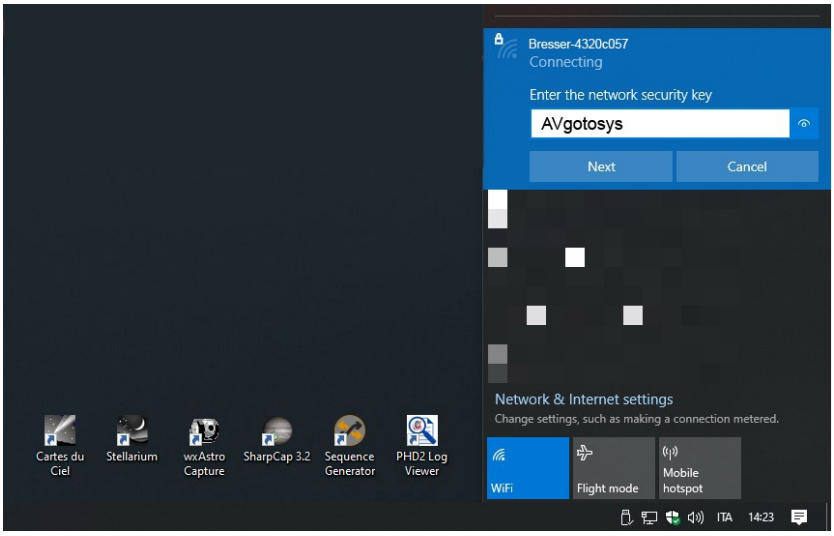


Method 2: Throug PC

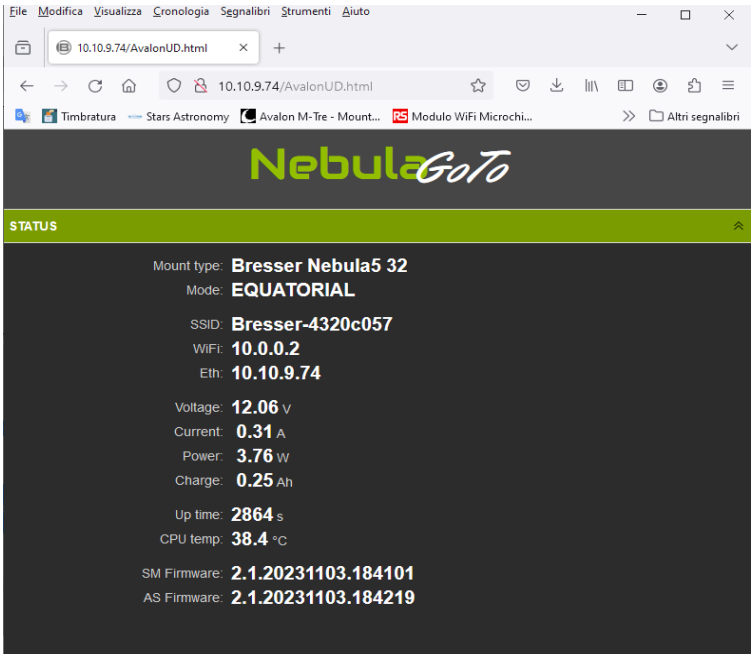
The PC access requires to know the Nebula Go To System IP address.

For a quick connection it will be possible to directly connect to the Nebula Go To System. In this case the procedure will be similar to the smart device aforementioned, below is described step by step:

1. Search the Nebula Go To System HotSpot network and connect using the default password: **AVgotosys**



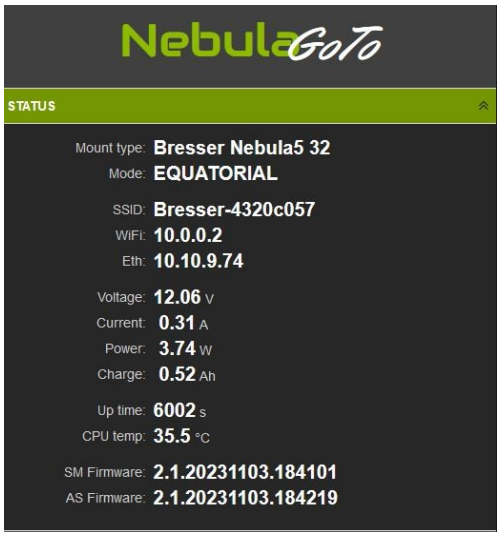
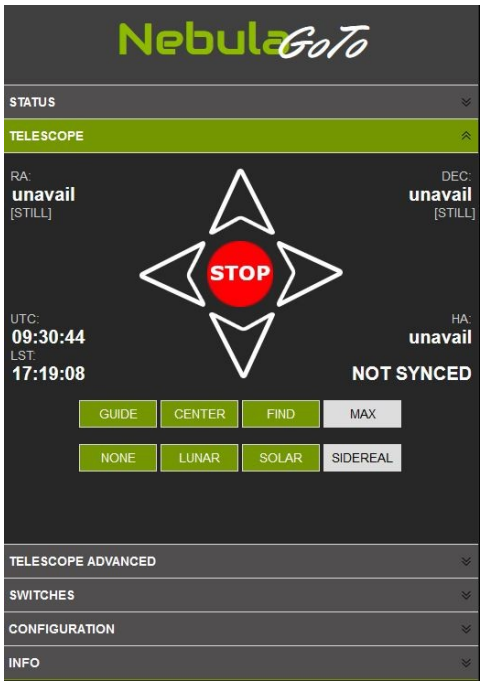
2. Soon after the connection will be required to open any kind of web browser installed on the pc and type on the url string the default Nebula Go To System WiFi IP: 10.0.0.2



3.2 Use of the Nebula Go To System WebApp (SGWA)

Once the connection has been established it will be possible to access to the Nebula Go To System WebApp (SGWA), that comes with a very simple and user-friendly display. It is an internet page (called in the following pages “WEB Application”) subdivided in several panels each accessible by clicking on his name. The SGWA automatically resizes itself to the most used device screen sizes and resolution. The following figures report all the open panels. Their explanation will be given below.

NOTE: The WebApp is accessible with any browser but has been optimized for Google Chrome

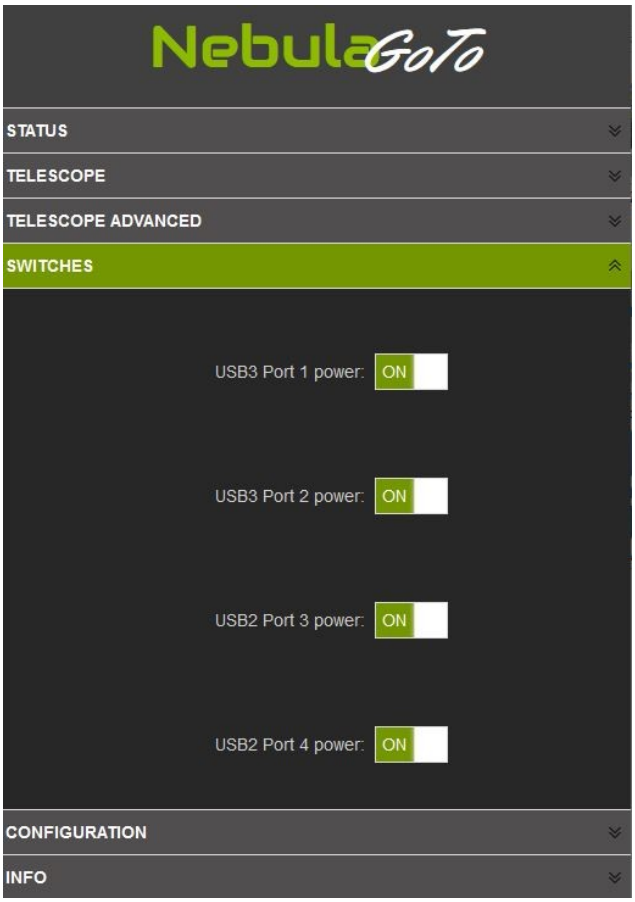
The **STATUS** panel (Figure 2.6a) provides a list of parameter values to keep under control during the telescope operations.	
The **TELESCOPE** Panel (Figure 2.6b) contains the Nebula Go To System virtual keypad with which we can duplicate all operations performed with the hardware keypad with the addition of other information: • Move the telescope in the four directions • Stop the telescope movement • Report the Telescope actual position (RA, DEC) • Choose the speed at which the telescope moves. • Select the tracking speed (Terrestrial, Lunar, Solar, Sidereal) • Report the Time information (UTC, LST)	

Through the **TELESCOPE ADVANCED** panel (Figure 2.6c) is possible to perform the operations for defining a correct position the telescope when parked and the Home position, usually matching the Counter Weight Down position (CDW - North Pole pointing) before to start the GOTO actions.

The **SWITCHES** panel (Figure 2.7b) contains the controls of the power supply and the USB signals. In particular, the first two (OUT) will switches on/off the 12 V DC fixed voltage supply to devices such as CCD, Filter Wheels, Rotators, etc. The third switch (PWM) regulate the voltage from 0 to 12 VDC, essentially for the anti-dewing band.

The four USB switches turn on/off the access to the correspondent ports of the Raspberry PI in the Nebula Go To System, used to control peripheral devices, like those cited above.

The sixth panel INFO (Figure 2.7c) report a summary of the Nebula Go To System features to put allow the new user to get the most important characteristics of this new control system.



The **CONFIGURATION** is the last panel to be illustrated. It is quite long, containing most of the Nebula Go To System settings.

The setup items in this panel are the following:

1. **PREFERENCES** section allows:
   - to regulate the Display Brightness, very important to not disturb during observation.
   - to set the mount speed rates for Guide, Center, Find and Slew.
   - to activate or exclude the Mount Meridian Flip function.
2. In the **MOUNT LIMITS** section it is possible to fix the grace distance from Moon and SUN to avoid dazzlement by the full Moon or, worst, eyes damages by the Sun. Here it is also possible to set the limits for the telescope to avoid mechanical interferences from optical tube, mount and tripod.
3. The **MAIN OFFSET BACKUP** allow to save the main pointing offset to be restored in case of accidental resync. It is of exclusive use of mount provided with encoders.
4. The **GEOGRAPHIC LOCATION** of the observation site is entered in this section of the panel. It is required in degrees in decimal format.
5. The **DEVICES** section allows to set the type of used mount and the optional INDI drivers for the other device eventually connected to the Nebula Go To System.
6. The settings in the **NETWORKING** section are exactly those reported and before described.
7. In the **MANAGEMENT** section it is possible to perform all the needed operation regarding the Nebula Go To System hardware / software. In particular:
   - Update the software with the provided file.
   - Export and Import the SW configuration.
   - Installing optional SW.
   - Shutdown / Reboot the system.

3.3 Starting a session

The following procedure intend to describe the operations required to start a basic session with the Nebula Go To System controller as the first connection from the device that the user wish to use for the first time (PC, Tablet or smartphone), Polar Alignment, mount movement and setup of the basical options.

1. Point the mount toward the North (or South) pole. This is the starting position and coincides with the Counterweight Down (CWD) position.
2. Make a precise alignment to the Pole using the most suitable method for your mount, using a polar scope or similar means.
3. Insert the 12 VDC power supply connector into the Nebula Go To System plug and wait about 20 seconds to have the Nebula Go To System on and ready to operate.
4. Run the Nebula Go To System WebApp (see point 1.1 Nebula Go To System First Web App access methods)
5. In the TELESCOPE ADVANCED tab click on the SYNC HOME POSITION button.
6. Start GOTOs actions and your session.

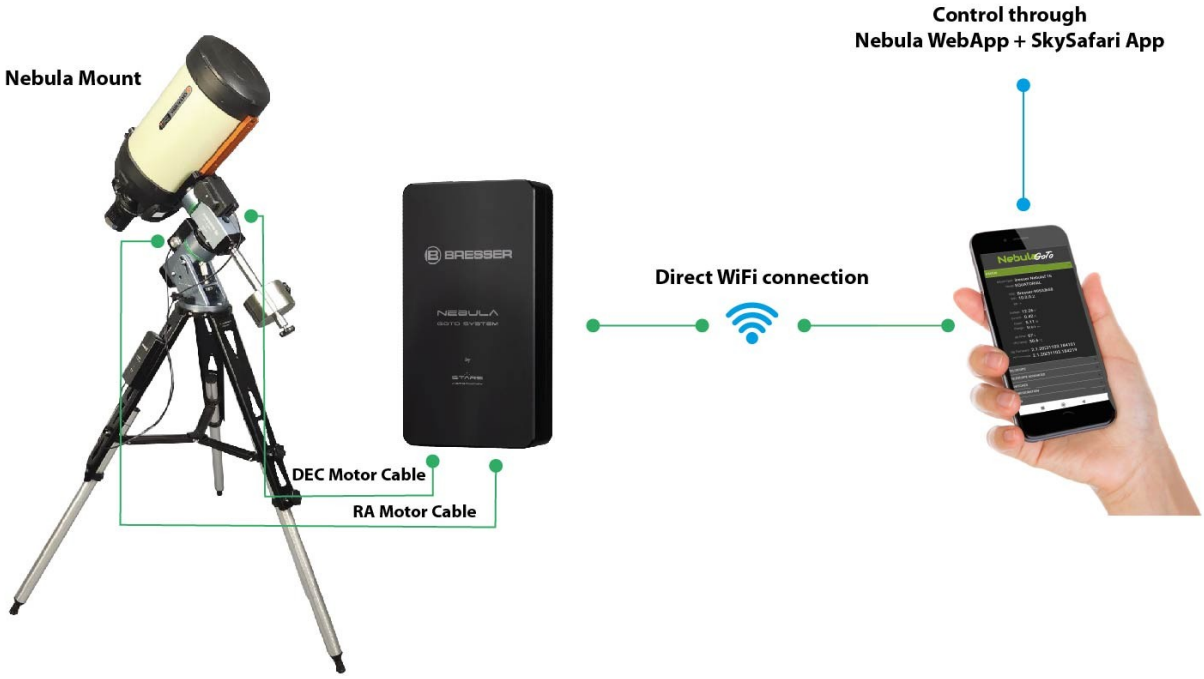
4. APPROACHING THE NEBULA GOTO SYSTEM

There are several ways on how touse the Nebula GoTo system that depend on the user final purpose and it's own equipment setup.

Below it will be explained three main approaches.

1. **VISUAL USE: SMART DEVICE ONLY (suggested connection: WiFi)**

   Using only a smart device (smartphone or tablet) connected via WiFi to the Nebula Hotspot (**AVgotosys** is the password). In this mode just by using the WebApp and SkySafari it is possible to have the full control of the whole sytem.



2. **ADVANCED CONTROL: Nebula as Stand Alone System (suggested connection: cabled)**

In this case the Nebula controller will be used as a stand alone astronomical system, using an external PC (or even a Tablet with large display) for the remote controlling via **VNCserver**.
After the connection it will be possible to use all the pre-installed astro-photographic suite and softwares as (CCDciel, Kstars, Carte du ciel, PHD2 etc.)

NOTE: for this kind of use a cabled connection is suggested but it is still possible to use the WiFi connection because in case of accidentally connection loss, once the session is planned, the setup will keep executing the session without problems.

The instructions on how to establish a Remote Desktop Connection via VNC are available on the paragraph 3.2.1

3. ADVANCED CONTROL: PC Remote Operations (Nebula used as a GoTo System only)

This method must be used in case the user prefer to use Software available only on Windows or other Operative Systems. In this case all the devices (main camera, CCD camera, focuser etc..) must be connected to the external pc.
This approach is mainly suggested for the operator that prefer to continue using the habitual software such as Sequence Generator Pro, NINA, etc, which are not available in the Raspberry environment.
In this case everything is managed by the external PC and the Nebula is used as a GoTo system only. The tablet or smartphone can still be used but only with the WebApp or SkySafari (via WiFi).
The infographics below shows two main connection method for this advanced control:

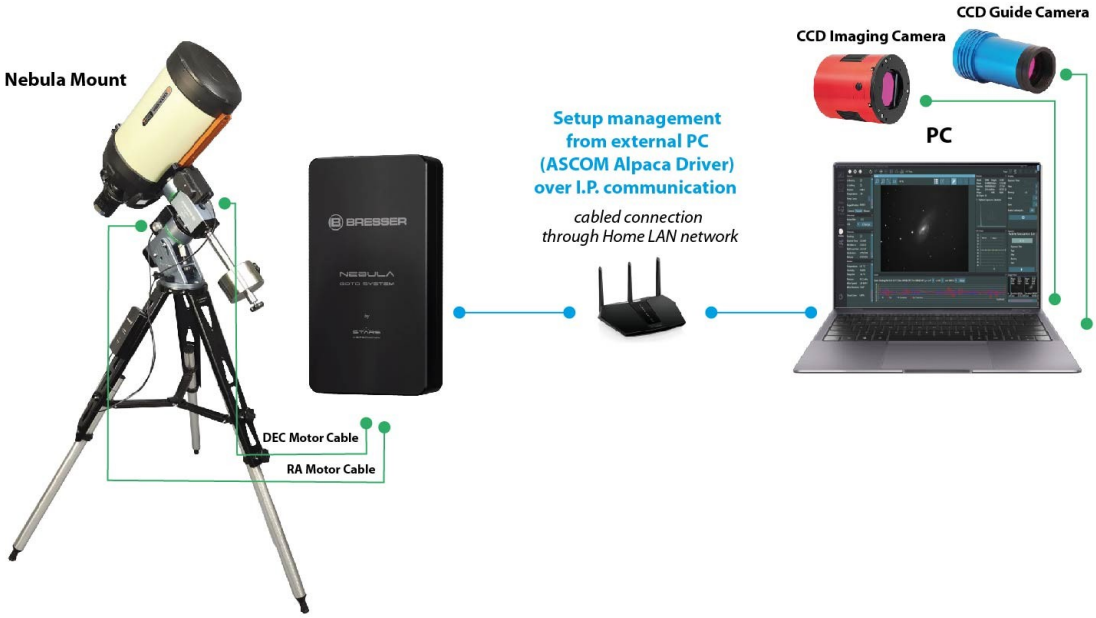
1 - USB ethernet adapter connection

NOTE: for this kind of use the most suggested and simple connection is the cabled via USB ethernet adapter method, in this way all the commands (GoTo, Pulse guiding, Axis movements etc..) are sent through the cables in a more reliable way compared to the WiFi communication protocol.

This is very useful for mobile setup (for example in the backyard or far from home locations, star parties etc.) where no LAN network or router are available but the connection is possible only from the PC where the adapter is connected.

Normally in this condition the Nebula controller has no internet connection

2 - Cabled connection through Home LAN network



This method is the more suggested where a LAN network is available, for example setup close to home or observatory location.

In this way is possible to access to the Nebula from any computer connected to the same network and Nebula can access to the internet, when provided from the router.

4.1 Nebula GoTo System connection procedures

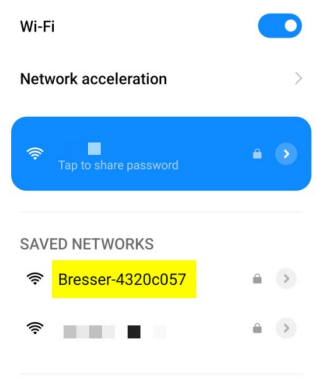
The Nebula GoTo System is a Raspberry Pi based solution that comes with three main connection methods, they are shown in the illustration below and described in the following paragraphs.

The user can choose one the connection method on depending on the approach choosen. For example, for Visual Observing session is suggested the **Direct WiFi connection** + SkySafari App while for Advanced Astro photographic session are suggested the **Home Lan connection** or **Ethernet adapter connection.**

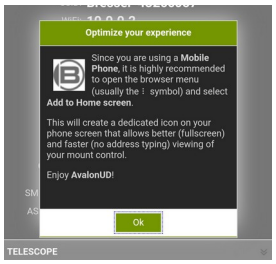
After the connection will be established it will be possible to operate with the Nebula GoTo WebApp and to access to the internal operative system via VNC for the FULL CONTROL: Computer Direct Operations.

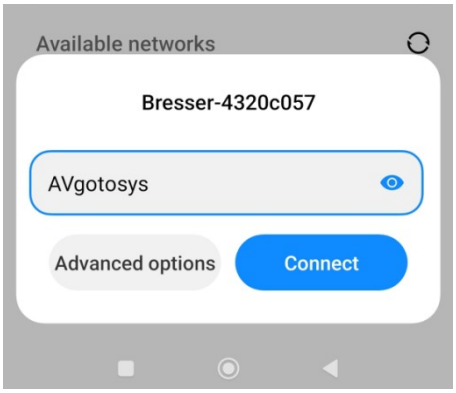
Method 1: HotSpot WiFi connection (IP 10.0.0.2)

Search the Nebula HotSpot network. The SSID WiFi name is divided in two parts: the first is common for every device and is "**Bresser-**", the second is a 8 digits alpha-numeric code. So the SSID WiFi name will be something like "Bresser-xxxxxxxx". In our sample the SSID is "**Bresser-4320c057**". The default password is: "**AVgotosys**"

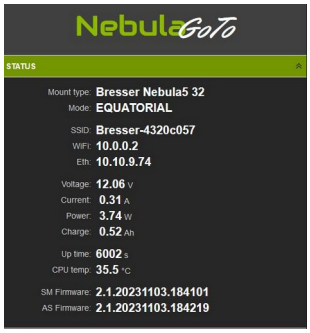


6. After the connection will be established, tap on the Access to WiFi network pop up windows and the WeApp will displaay a Welcome message.





7. By clicking on the OK button the message will be closed and the Webapp wil be available.



Method 2: Ethernet adapter connection (suggested for PC used on the field)

This solution is suggested for setup designed to be used with a PC on the field due to the easy connection way, really similar to the USB direct connection mode.

The Nebula GoTo System automatically set it's IP address as 192.168.1.28 when is not connected to any router.

So, after setting the USB adapter network IP in static mode and choosing an IP address on the same value set (in our example 192.168.1.30), it will be possible to establish the connection by simply connecting the Ethernet cable from the Nebula GoTo System to the USB adapter and typing the 192.168.1.28 on any browser, as shown below:

In order to set up this kind of connection are required the following accessories:

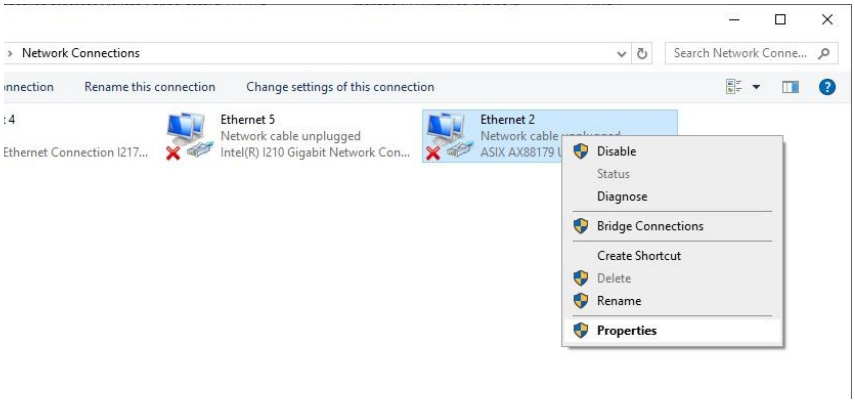
- Ethernet cable (optional)

- USB ethernet adapter (optional)

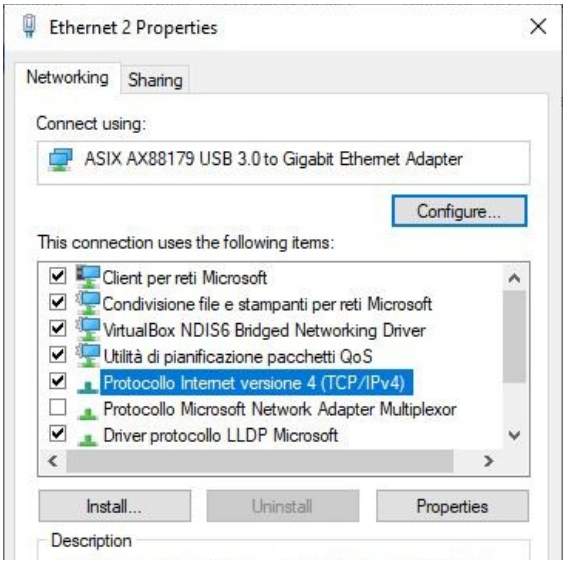
Procedure explanation

- Open the USB ethernet adapter properties

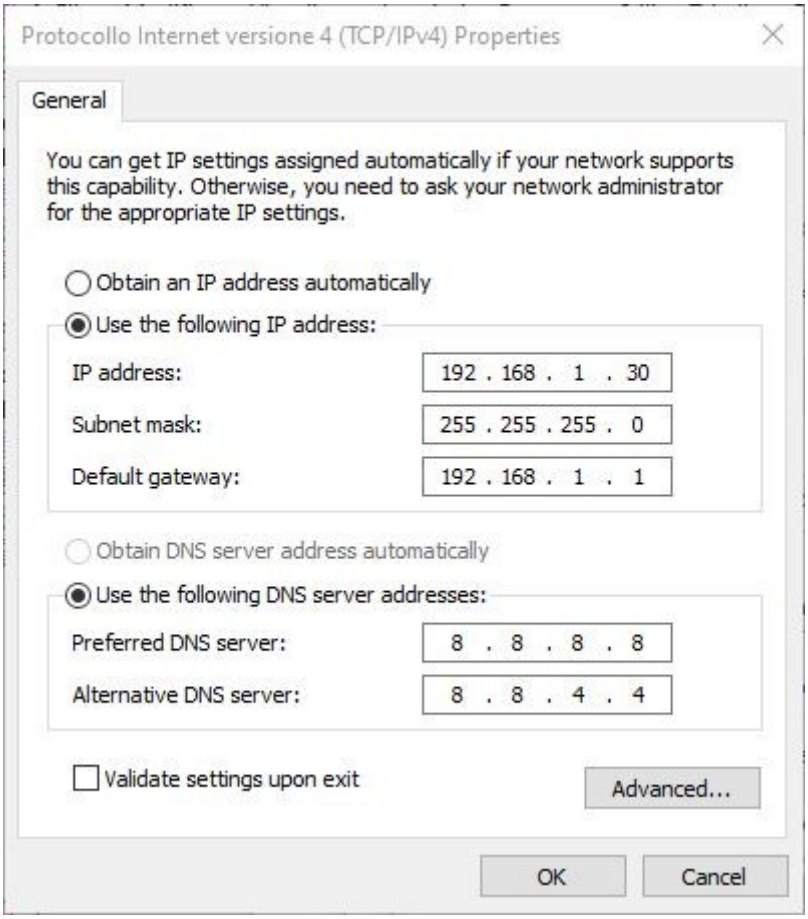
NOTE: In order to understand the correct Ethernet network to configure, check the Network description, it should match with the corresponding USB Ethernet product brand model



- Open the (TCP/IPv4) properties



- Switch the “Use the following IP address: option set the value as shown in the picture below

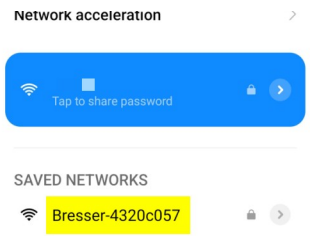
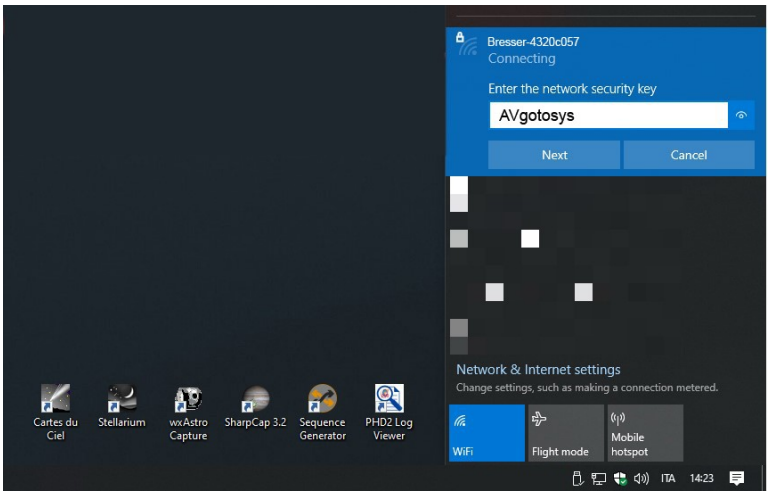
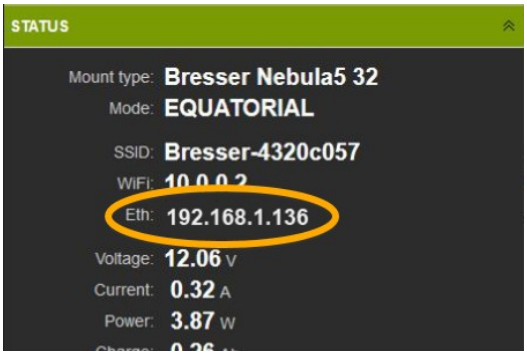


Afterward just typing the **192.168.1.28** I.P. address on a browser it will be possible to connect to the device.

Method 2: Home LAN cabled connection

In this kind of connection the Nebula GoTo System, the PC and all the additional devices (tablet and smartphone) must be connected to the same LAN network. In order to access to the Nebula GoTo System is required to know the I.P. assigned to the Nebula GoTo System.

The fast procedure to discover the ethernet I.P. is the direct connection with the Nebula HotSpot by using a tablet or smartphone and accessing to the Nebula WebApp.

Smart device direct connection with Nebula GoTo System WiFi network	PC / Laptop direct connection with Nebula GoTo System WiFi network
	
Once the connection has been established you will find the Nebula ethernet IP as shown in the screenshot below	
	

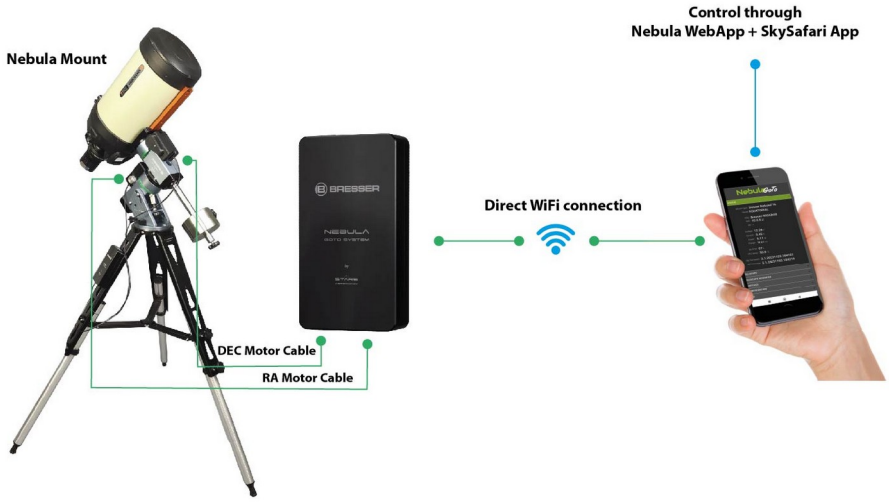
The IP device number is a very important information, it will be required to allow the communication from the software used by the user in the Windows environment or to access from VNC to the internal operative system. With this information it will be possible to access to Nebula from any point of the network.

3. Telescope Operations with the Nebula Go To System

Now that the main connection methods has been explained, the user can choose the preferred method on depending on the approach selected.

3.1 QUICK USE: SMART DEVICE ONLY

This method of telescope control is especially suitable for a light visual use of the telescope. It requires that the Park and Home positions have been set as described in the "ADVANCED TELESCOPE" panel in section 2.3 and that the telescope is synchronized to the Home position and positioned in the CWD position, pointing North.



At the moment of this manual writing the only mobile applications that can manage the Nebula Go To System are Skysafari and kStars lite. The first is available for both iOS and Android, the second only for the latter.

The Skysafari is a very attractive application that can be however used only for simple slewing, goto and sync operations but it doesn't provide other important functions such as parking, homing, etc. It is essentially used for visual management of the mount.

kStar lite is also a planetary app, at the moment available only for android, which is capable of performing almost all necessary operations, including the management of other devices eventually connected to the Nebula GoTo System via its USB ports.

To use the Nebula GoTo System with these mobile application it is sufficient a very simple setup such as that graphically described in the following picture.

3.1.1 Smart Device Direct Operations with SkySafari 6 Pro and 7 Pro.

SkySafari 6 Pro: This app is available in the Apple and Google stores and are available in two version 6 and 7 Pro.

These are the operations to connect the Nebula GoTo System to Skysafari 6:

1. Connect the device to the Nebula GoTo System 2 using the WiFi as explained in section 2.2.3.
2. Launch the Skysafari 6 app on the device and select the icon Setup in the toolbar (Figure 3.1a).

3 In the Setup screen, select Telescope and in the new screen (see figure 3.1b) insert the following:
   - Telescope Type: Meade LX200 Classic
   - Mount Type: Equatorial German GOTO
   - IP address of the Nebula Go To System: take it from the SODD
   - Port # 9624.
   - Leave all other checks unchanged.
   - Press *Done* to return to the main screen.
4 In the Skysafari main screen, click on the Connect button of the telescope controls. After a few seconds the Nebula Go To System will be connected to the application and all other controls will become active (see figure 3.1c). The telescope position indicator will be placed over the North Pole.
5 Select a bright star close to the object you want to visit and press the GOTO button. The telescope will move to the object but probably will non center it.
6 Using the side controls, eventually with the help of a finder-scope, bring the star at the center of the ocular field of view (FOV).
7 Press button *Sync*. Now the telescope is perfectly pointed to the star. The following GOTO to the wanted object will bring the telescope exactly over it.
8 Repeat the operations 5 to 7 on few other stars to improve the GOTO accuracy.

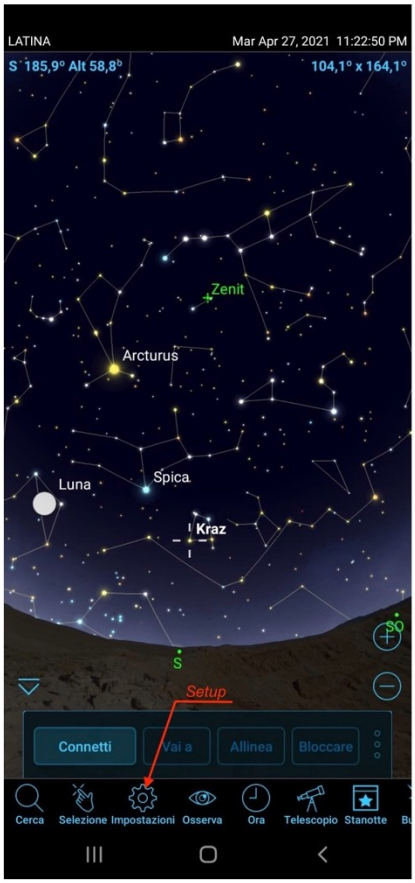


Fig. 3.1.1a

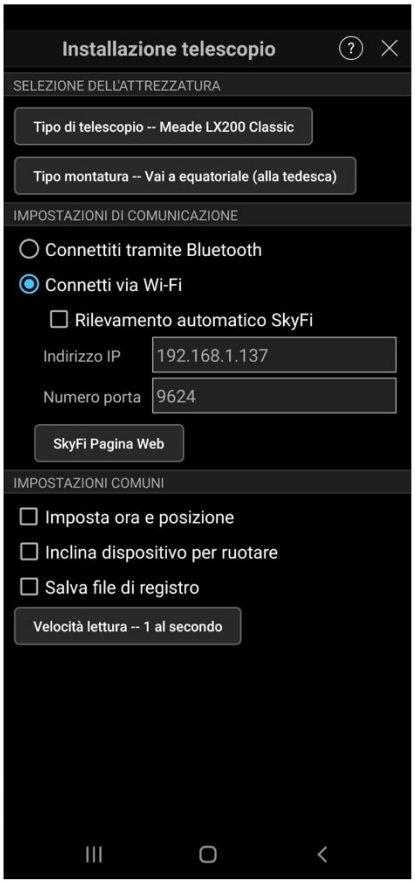


Fig. 3.1.1b

Fig. 3.1.1c

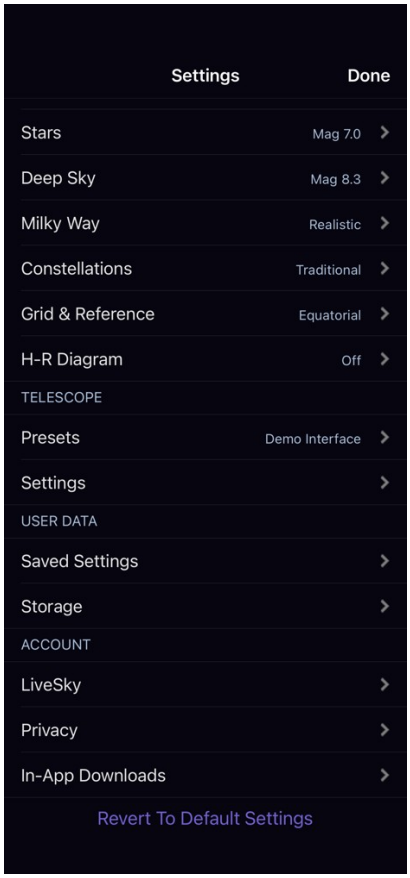
The above images have been taken on a Samsung galaxy Tab 20 smartphone.

Skysafari 7 Pro: This app has been very recently published (November 2021). It has many improvements over the version 6 but the most important for us is that it uses two new modes to connect to the Nebula Go

To System. The new version allow to connect Skysafari using ASCOM Alpaca and INDI driver, in addition to the usual manner using the Meade LX200 classic way.

The operations to connect the Nebula GoTo System to Skysafari 7 using the traditional LX200 method are the same used for the version 6 and therefore are not repeated here. The following are the operazions for the other two modes of connection:

1 Connect the device to the Nebula GoTo System 2 using the WiFi as explained in section 2.2.3.
2 Launch the Skysafari 7 app on the device and click over the *three lines icon* on bottom left.
3 Click *Setting* on the menu (Figure 3.1d). The Settings page will open. Scroll down until the TELESCOPE label appear and then click on the *Presents* label. The Presets page will open (see Figure 3.1e).



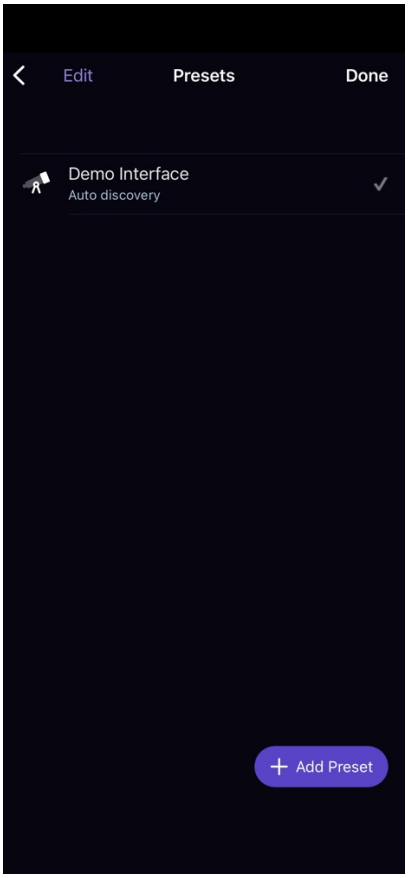


Fig. 3.1.1d *Fig. 3.1.1e* *Fig. 3.1.1f*

4 The first time the app is used the “Demo Interface” is the only presets available for testing. Click on *+ Add Preset* button below (see Figure 3.1f).
5 In the next page (Figure 3.1.1g) four types of connections are proposed. The first two are important for us. The third is relate to the SkyFi hardware and the fourth as been already considered before, which is like the version 6 of Skysafari. These are the way to consider the two interesting modes:

   a. ASCOM Alpaca: Click on this button to open the related page (Figure 3.1.1h). The autodetect function is activated by the default. Press the “*Scan Network For Device*” button to auto detect the Nebula Go To System network. If all is OK the IP Address, the port number and the Scope name will be loaded and shown as in Figure 3.1.1i, together with few other information. If something goes wrong (it can

happen), select the *Manual Configuration* and put in the related fields the needed information, taking into account that the IP number must be taken from the Nebula Go To System SODD and the port number is 11111. At the end press Next to pass to the next page. Here it is possible to set few other secondary parameters. They are common to whatever connection is selected and can be seen in Figure 3.1.1n

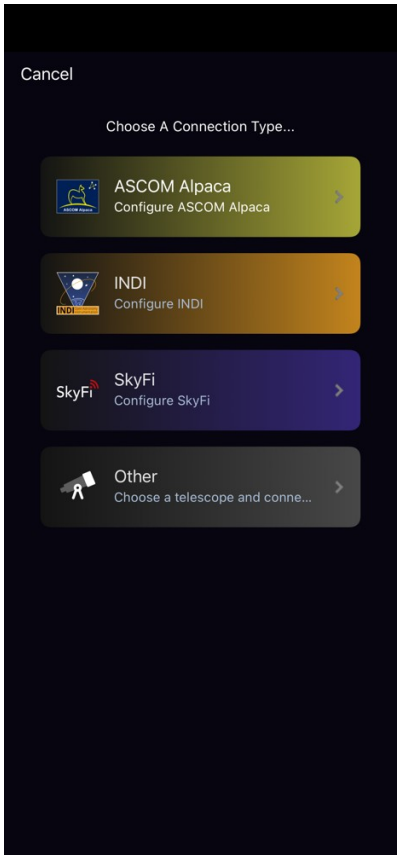


Fig. 3.1.1g

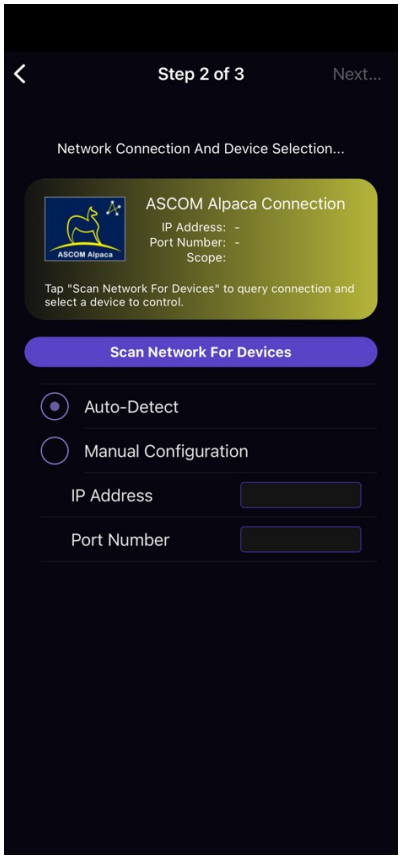


Fig. 3.1.1h

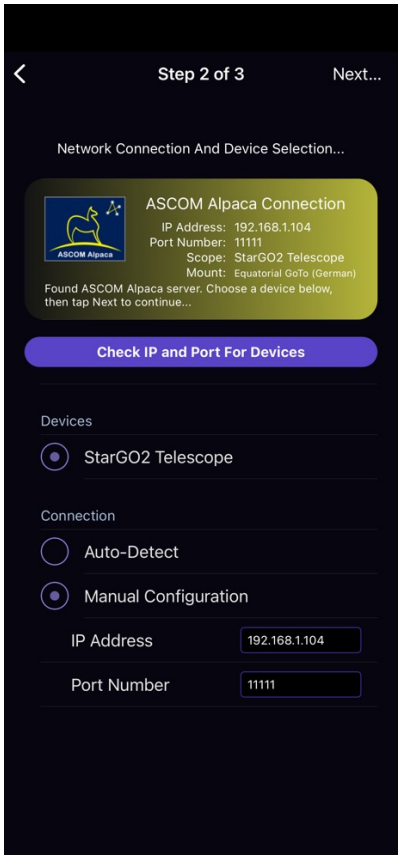


Fig. 3.1.1i

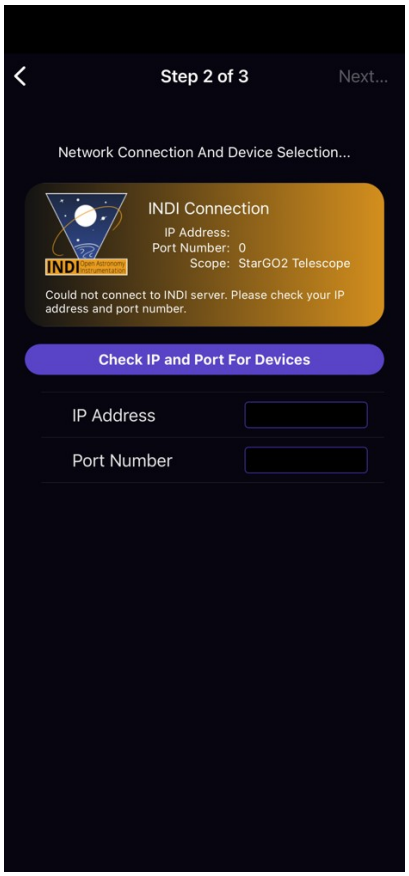


Fig. 3.1.1l

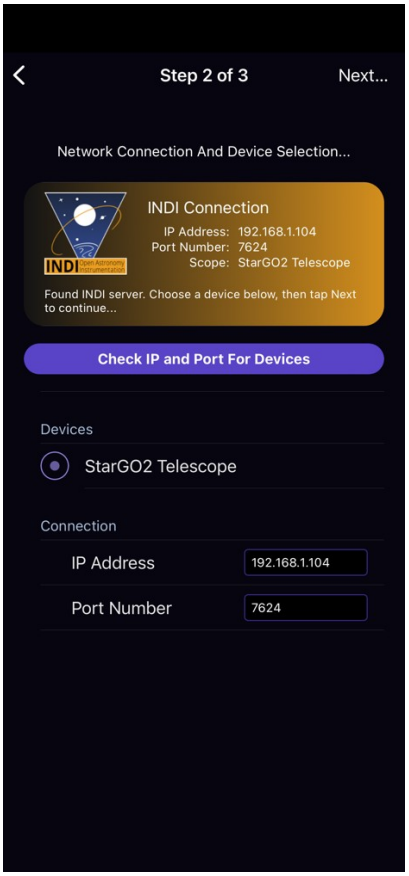


Fig. 3.1.1m

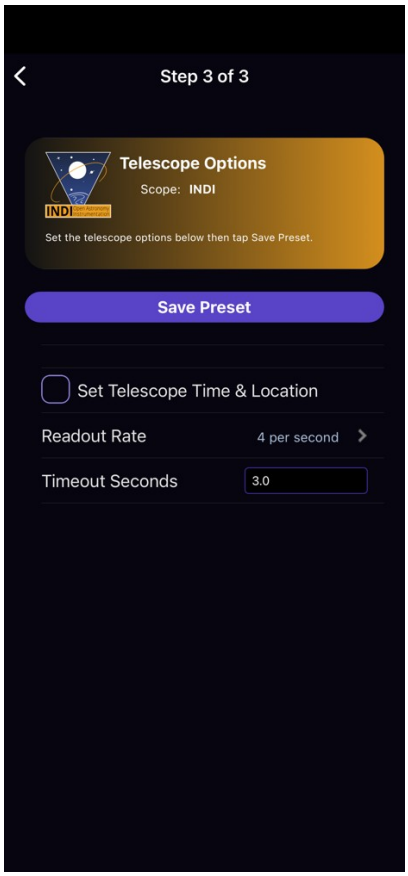


Fig. 3.1.1n

b. INDI: The procedure for INDI is like that for Alpaca. However, some parameters are different and therefore we prefer to repeat here all the procedure so that the INDI user will have a specific mini guide. Start choosing INDI clicking on the INDI button (See figure 3.1.1g) to get the *Network Connection and Device Selection* page and here (Figure 3.1.1i) press the *Check IP and Port for Devices button*. If the operation is successful, the next page (Figure 3.1.1m) will appear with all need parameters ready for checking. If all is correct, go to the next page otherwise put manually your parameters. The IP is taken from the SODD and the port is 7624. Then go to the next page where to set few other parameters.

6 The parameters of Telescope Option page are in Figure 3.1.1n, common to all types of connections. The first is for forcing the Nebula Go To System to synchronize with Time and Location of the device. The second is the refresh rate of the application planetary which doesn't affect the Nebula Go To System in any way.

7 Once the connection parameters have been set go to the Skysafari main screen and click on the Connect button of the telescope controls. After a few seconds the Nebula Go To System will be connected to the application and all other controls will become active (see figure 3.1.1o). The telescope position indicator will be placed over the North Pole.

8 Select a bright star close to the object you want to visit and press the GOTO button. The telescope will move to the object but probably will non center it.

9 Using the side controls, eventually with the help of a finder-scope, bring the star at the center of the ocular field of view (FOV).

10 Press button *Sync*. Now the telescope is perfectly pointed to the star. The following GOTO to the wanted object will bring the telescope exactly over it.
11 Repeat the operations 5 to 7 on few other stars to improve the GOTO accuracy.

3.1.2 Smart Device Direct Operations with kStars lite.

kStar lite is a free application available only for Android smart devices. It is a sister app of the homonymous application available on all types of PCs, including Raspberry.

The operations to connect and operate the Nebula Go To System are the following:

1. Start The application. At the first starting it will propose a short tutorial on the use of the interface. It is convenient to follow it to familiarize with the app.
2. The main screen is very simple and can be populated with more information using the button available by clicking the ∨ symbol on the top screen border. A set of different icons will be presented (see figure 3.1.2a). The active ones are related to the active features. Press them to activate or press the deactivated (greyed) ones to active them again. Choose the set of features which are more suitable to your needs and taste.

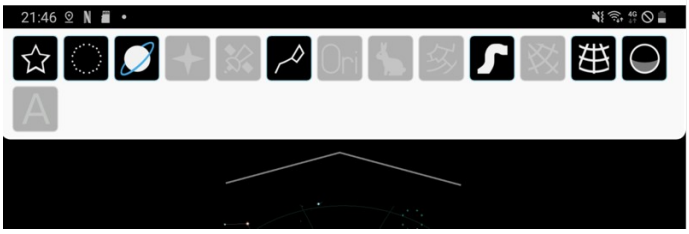


Fig. 3.1.2a

3. For connecting the device to the Nebula GoTo System swipe the left screen border. A side panel will appear with a menu (see figure 3.1.2b). Choose “INDI Control Panel. In the new page (see figure 3.1.2c) insert the IP address of the Nebula GoTo System as given in the SODD and don’t change the default ports. Press CONNECT button and press the back arrow to return to the main screen.

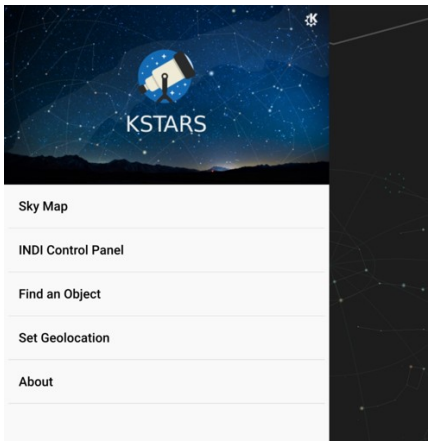


Fig. 3.1.2b

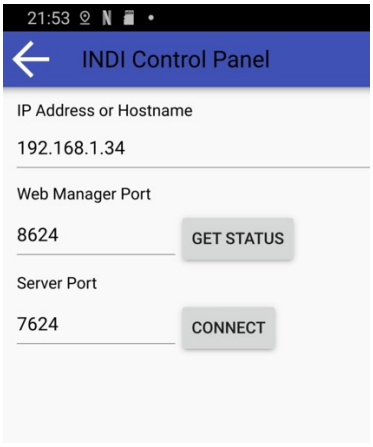


Fig.3.1.2c

4. The device is now connected and can operate the telescope. For example, press an object (star, planet, etc.) on the map and a small panel will appear with the name of the object (see figure 3.1.2d). The possible actions are obvious: for example, for slewing press Slew under Nebula Go To System Telescope section.
5. For manually move the telescope, press the ∧ symbol on the bottom screen border. A small panel will open showing some small icons for time regulation in the center and for small arrows on the sides. This are the four arrows to move the telescope (see figure 3.1.2e).

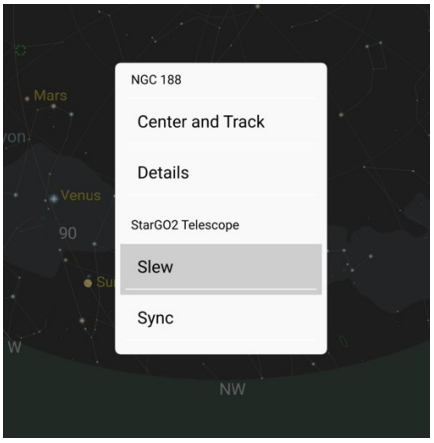


Fig. 3.1.2d

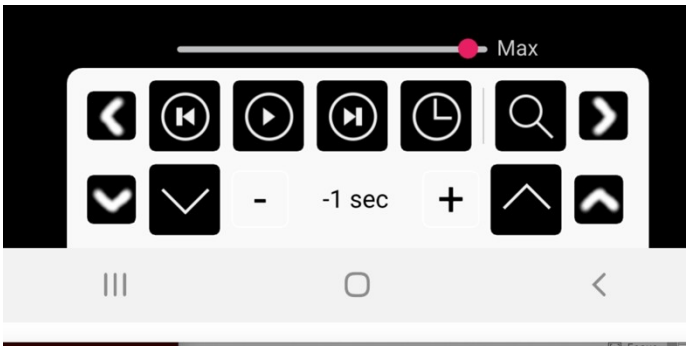


Fig. 3.1.2e

6. To perform more advanced operations, not available in Skysafari, repeat the action 3 up to the point where the INDI Control Panel is pressed. This time, because the Nebula Go To System is already connected to the device, a different page will appear. In this page click “Nebula Go To System Telescope” label: The INDI control panel will appear. Here you can perform all the needed operation. In particular you may Park, Unpark the telescope, define the track modes and rates, etc.
7. Swiping this page right several times and back different pages can be reached allowing us to perform even more advanced actions (figure 3.1.2f and g are two example of these pages).

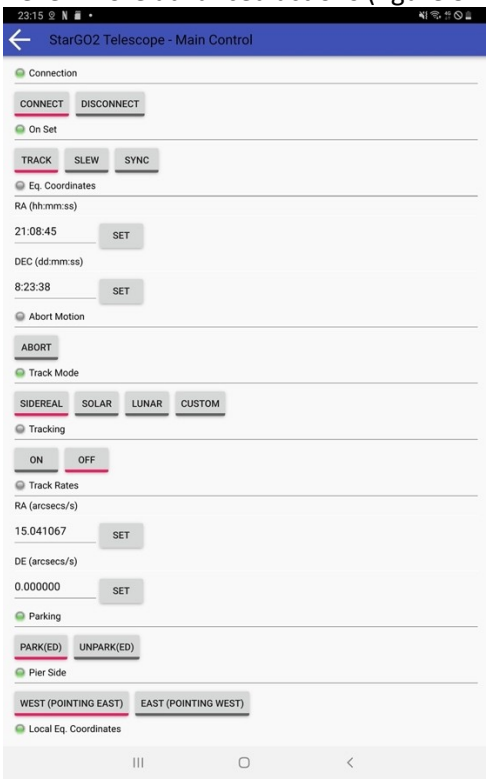


Fig 3.1.2f

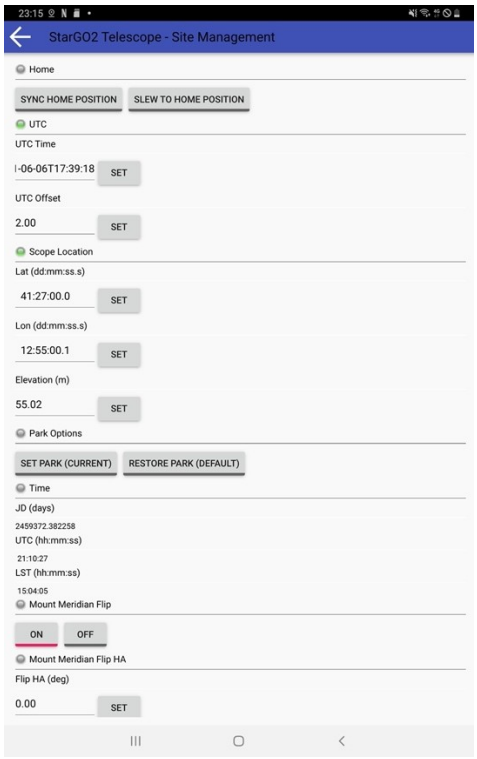


Fig 3.1.2g

On the page reached by pressing the INDI control Panel menu item, you will note that there are other menu items which are related to the other devices eventually connected to the Nebula GoTo System via the USB ports (CDD, guide CCD, Focuser, etc). Pressing these it is possible to enter in the related pages to shoot picture, starting autoguiding, focusing picture, etc. However, these actions are not described here being them out of the scope of this manual.

3.1. Computer Direct Operations (CDO)

This method of Nebula GoTo System management is oriented to provide a full control of the setup without using external device (regardless the PC used as a mere GUI interface control).

The internal Raspberry is used as a remote computer performing all telescope and other device operations (polar alignment, pointing, centering using plate solve, guiding, focusing, rotating CCD, sequencing and shooting pictures).

The internal Raspberry comes with two Astrophotographic setup already pre-installed: Kstars and CCD Ciel, the user can choose the preferred one for the setup management.

The Nebula controller is connected directly with the mount RA and DEC motors, the CCD cameras for imaging and guiding are directly connected to the controller.

NOTE: Considering that this approach is more oriented to advanced astrophotographic sessions, the suggested connection method is the most complete and reliable: the **Home LAN connection**.

The logic schematic of the system is given in the following figure.

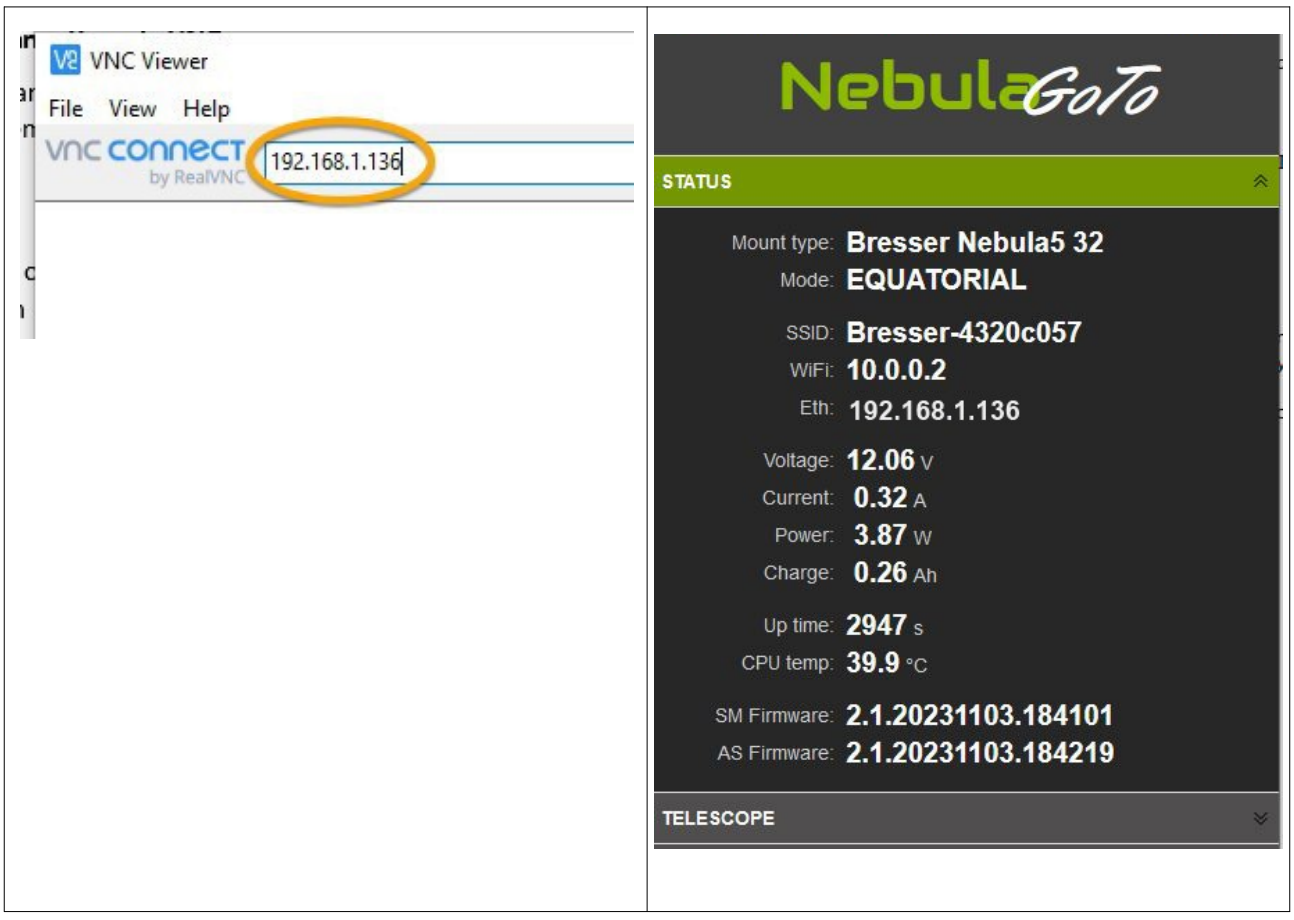
The next paragraph will explain how to establish a connection via VNC viewer from the external PC to the internal Nebula Raspberry.

3.1.1. How to establish a Remote desktop connection via VNC

To run VNC perform a double click of the corresponding icon.

A window asking the I.P. address required for the connection will pop up. In order to establish the connection, both the device must be connected on the same network.

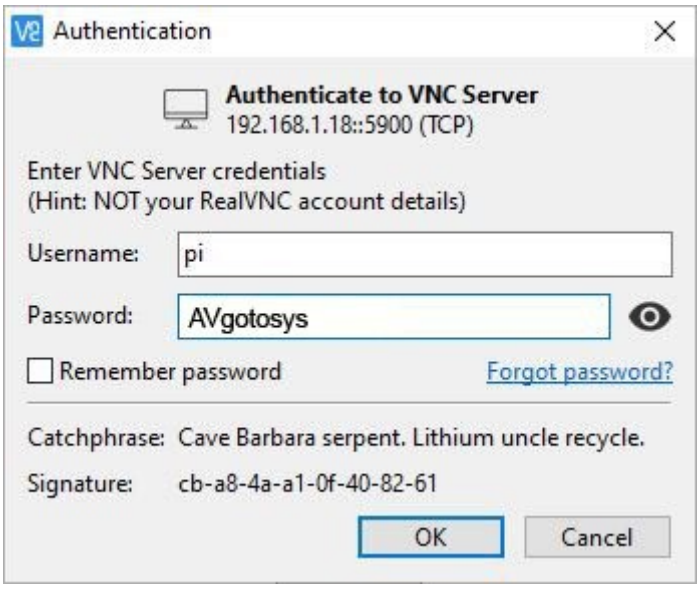
In the corresponding field, write the I.P. (in our sample is 192.168.1.136, as shown in the pictures below) and press Enter.



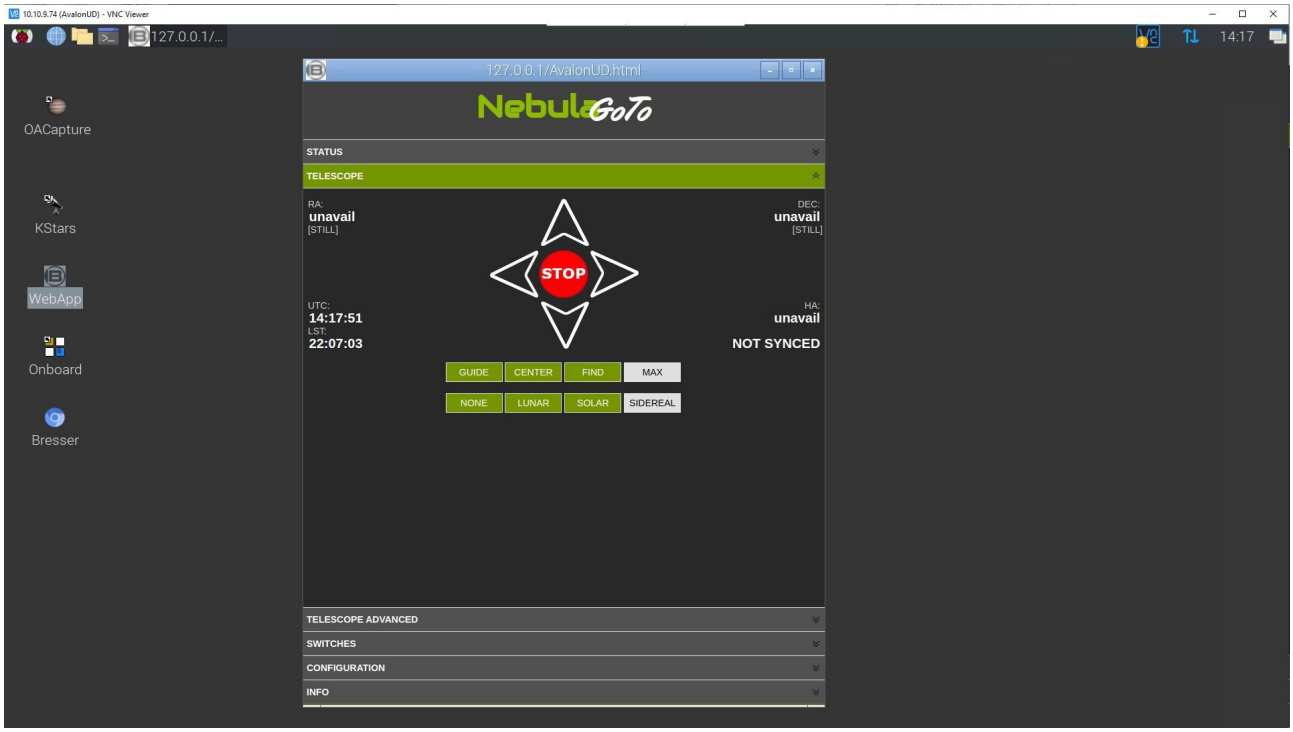
Now a new window will pop up asking Username and Password, the credentials for the log in are the following:

Username: pi

Password: AVgotosys



After pressing the OK button it will be possible to get inside the Nebula Go To System Operative System.



After the access to the internal Raspberry desktop it will be possible to choose among one of the pre-installed software for the setup management. Their configuration it will be described in the next paragraphs.

CCDciel

The first application we will take into consideration for using the Nebula Go To System with this method is CCDciel. It is an integral part of the INDI environment inside the LINUX and MAC operation systems, which is the correspondent of ASCOM for Windows OS.

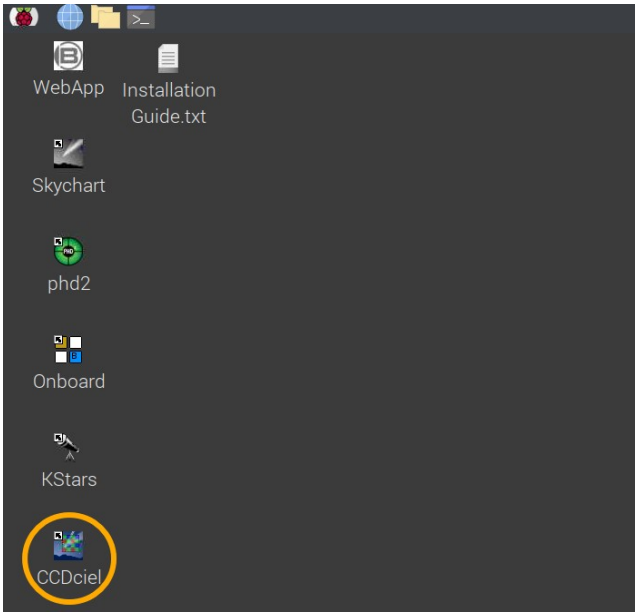
The emphasis of INDI environment is toward the management of astronomical instrumentation, especially for astro-photography. The system manager of INDI environment is a tool called EKOS, which provides, in addition to an efficient mount management, almost all the functions of pieces of software very well-known and used by the astro-photographers, such as SGP, N.I.N.A., Voyager, etc.

The advantage of using CCDciel and EKOS is that the commands sent to the telescope are generated directly inside the Nebula Go To System by-passing the external communication so that the maximum speed is obtained. Note that this method is applied using whatever device to communicate with the Nebula Go To System (Windows PC, Mac, Linux PC, iOS and Android devices).

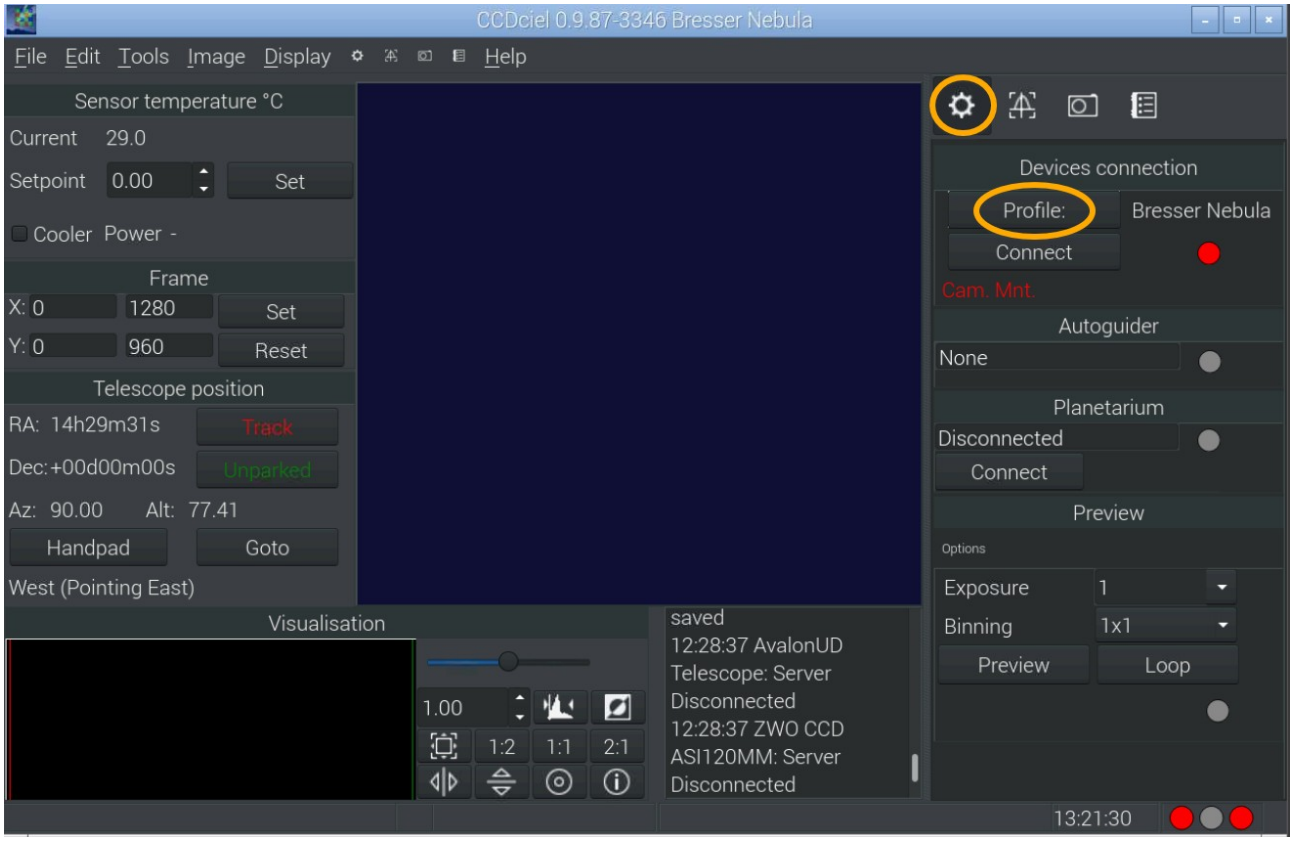
The logical scheme illustrated below shows the hardware / communication / software connection and configuration.

The paragraphs below will describe the setup configuration inside CCDciel:

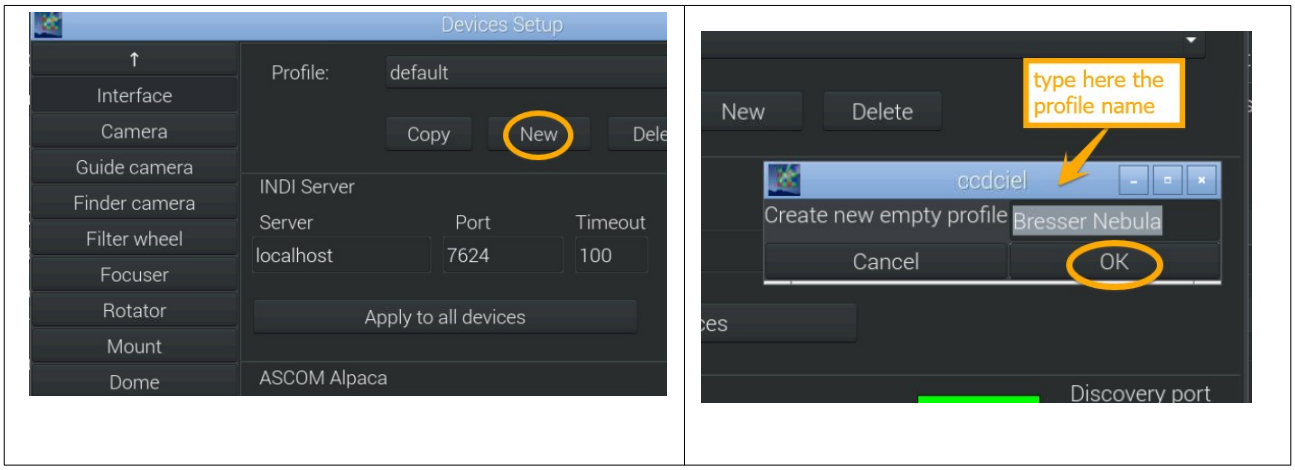
- Run CCDciel by double clicking on it's desktop icon:



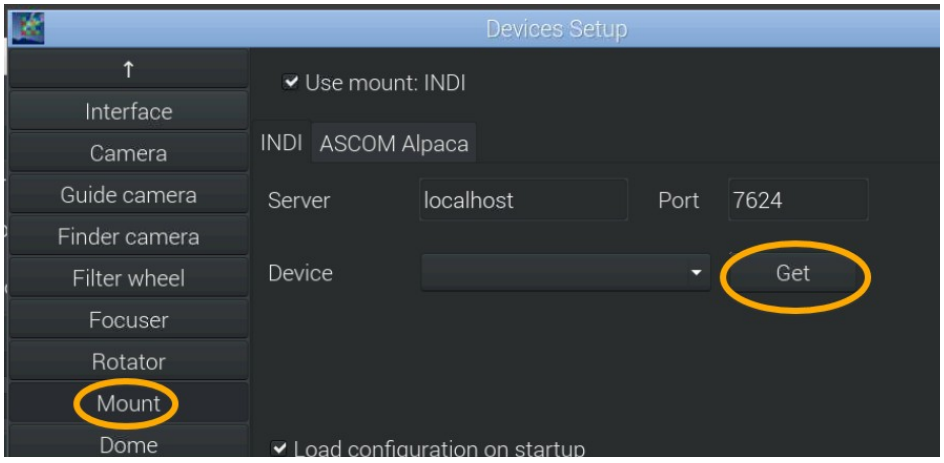
- To set up all the equipment connections and configurations is required to create a new setup profile. This operation is performed in the Devise Setup window. To access this softwate section click on the **Gear icon** on the window top right and then click on the **Profile button**



- In the Device Setup window it will be possible to create a new profile and edit the corresponding name.



- After the profile will be created, type the preferred name and start to configure the devices that are cable connected to Nebula GoTo System. The devices menù is displayed on the left side of the Device Setup window, in order to enable each one click on the corresponding button. When the device menù will be enabled, click on the Get button to make make the software search it on the connected devices.



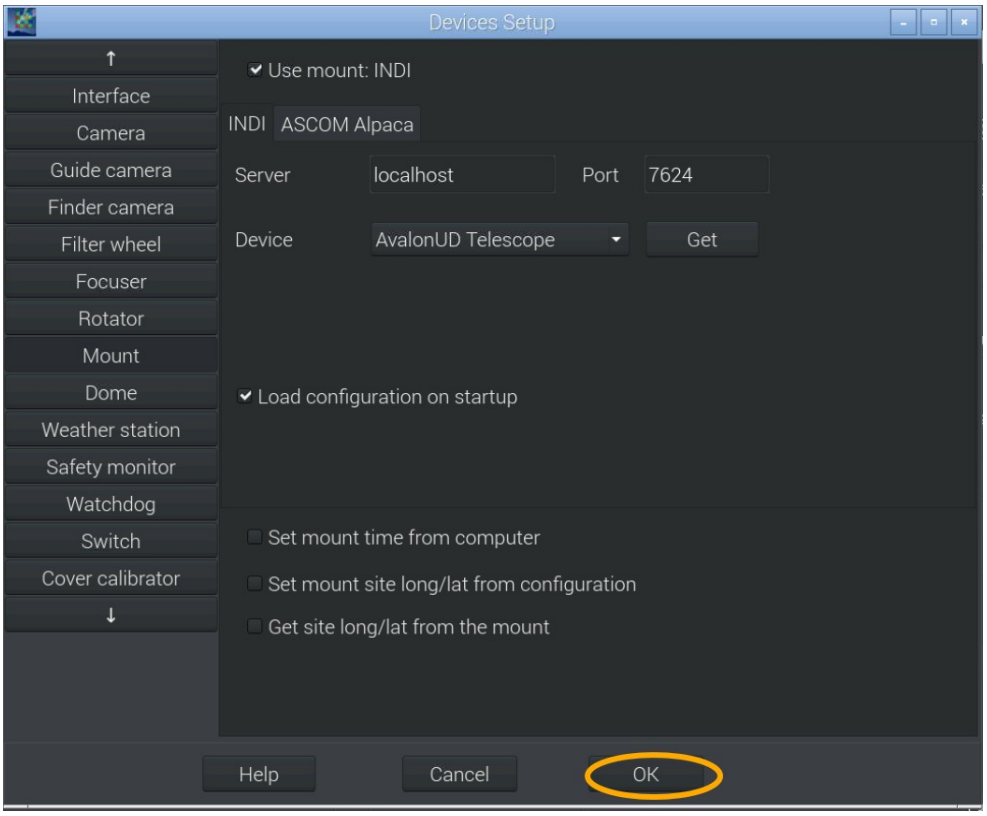
- Then open the drop down menù and select the correct driver, the Nebula mount driver is called AvalonUD.

- In this sample the mount driver has been selected as a first step, afterwards have been configured the main camera and the Guide camera. The devices brand shown in the screenshots below has been selected as a sample to help users easily configure their setup. The user should select his own CCD camera brand driver in the drop down menù. As for the mount driver search, in order to make it appear the CCD connected camera driver in the Device drop down list it is required to click on the Get button

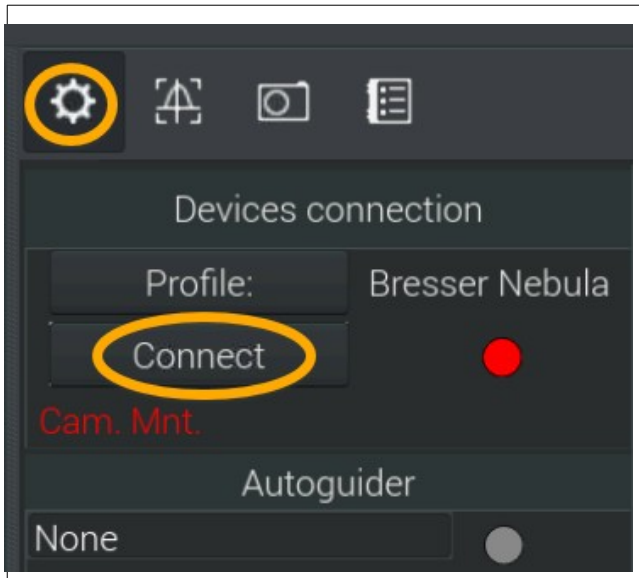
- Afterwards the Camera name model will be available in the list.

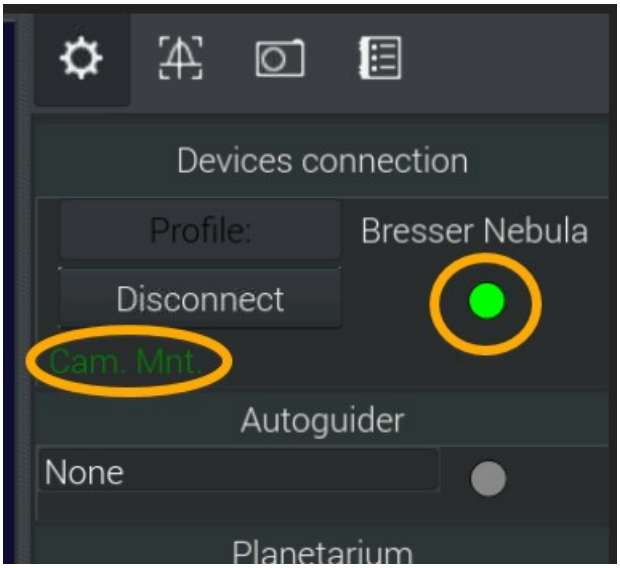
- The same procedure must be followed for the Guide camera

- When all the devices connected to the Nebula controller has been selected in the Device setup, click OK on the window bottom to save the profile configuration.



- Now they are ready to be connected. This operation is accomplished on the main menu right side, the devices connection panel is triggered by the Gear button on the right side button and the connection is established by clicking on the connect button. When the connection will be succesfully established the led on the right will become green as the device name

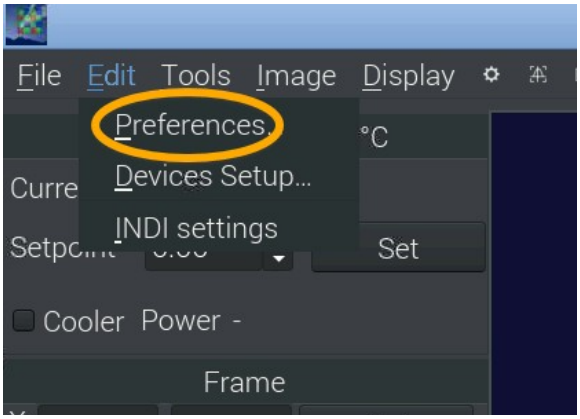




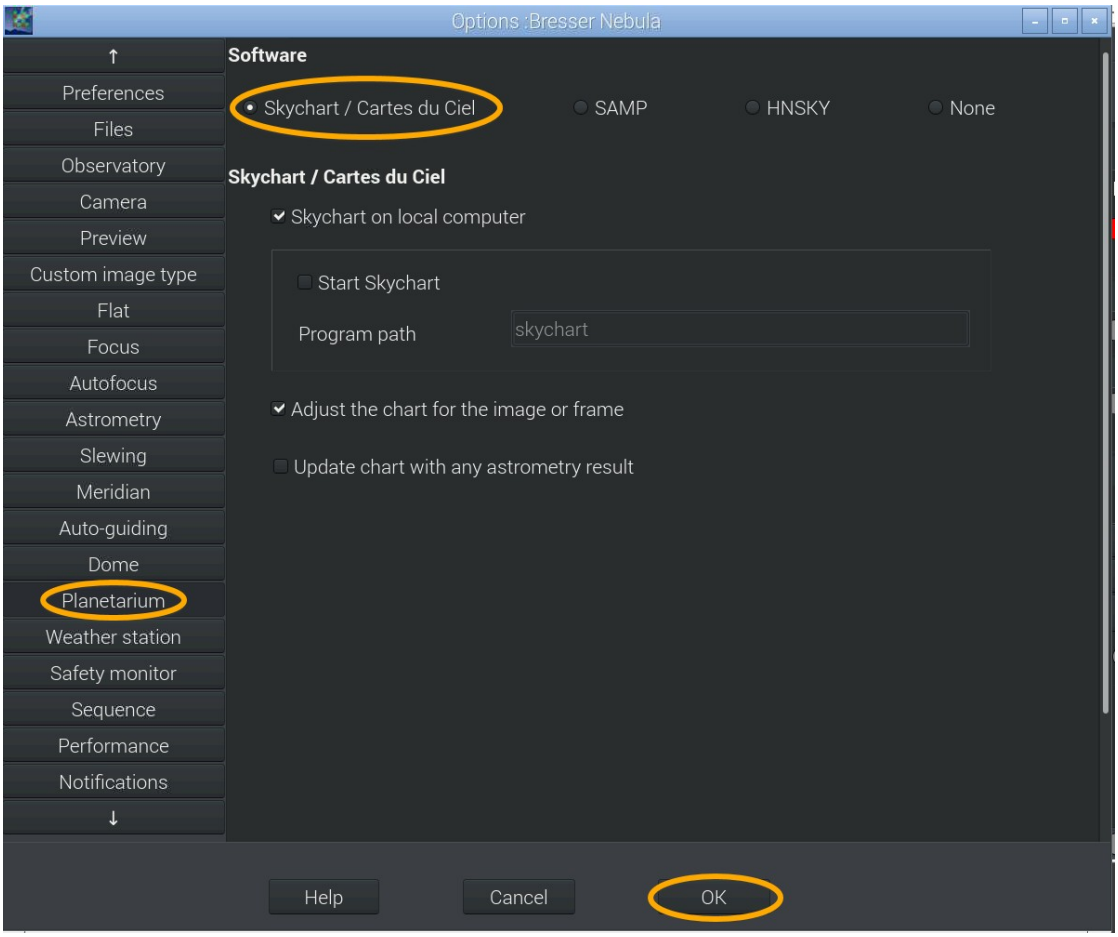
CCDciel Planetary settings setup

CCDciel is an advanced astrophotographic software that allows to program complete sequences. Targets can be added manually by typing the corresponding coordinates, otherwise, it can be used a more user friendly method by linking CCDciel with the pre-installed Carte du Ciel. This procedure is described below:

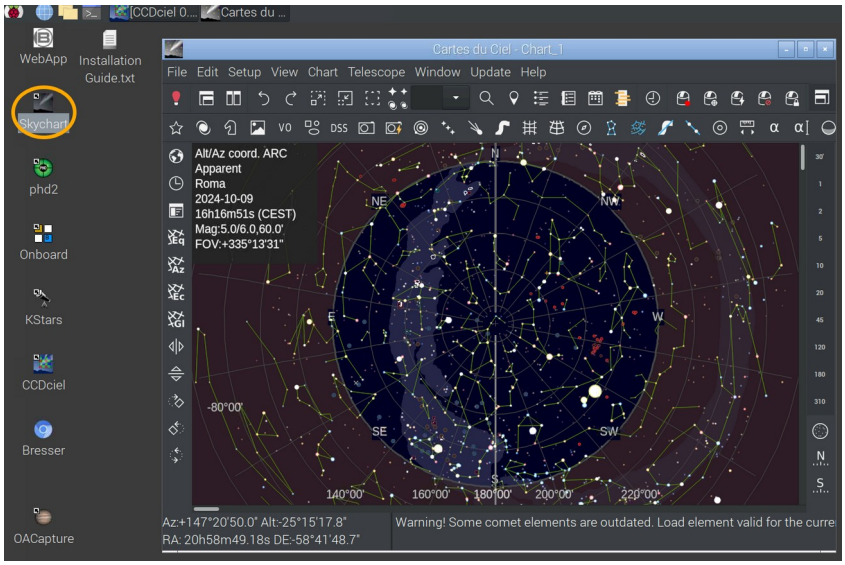
- Open the Edit menu and click on the Preferences button



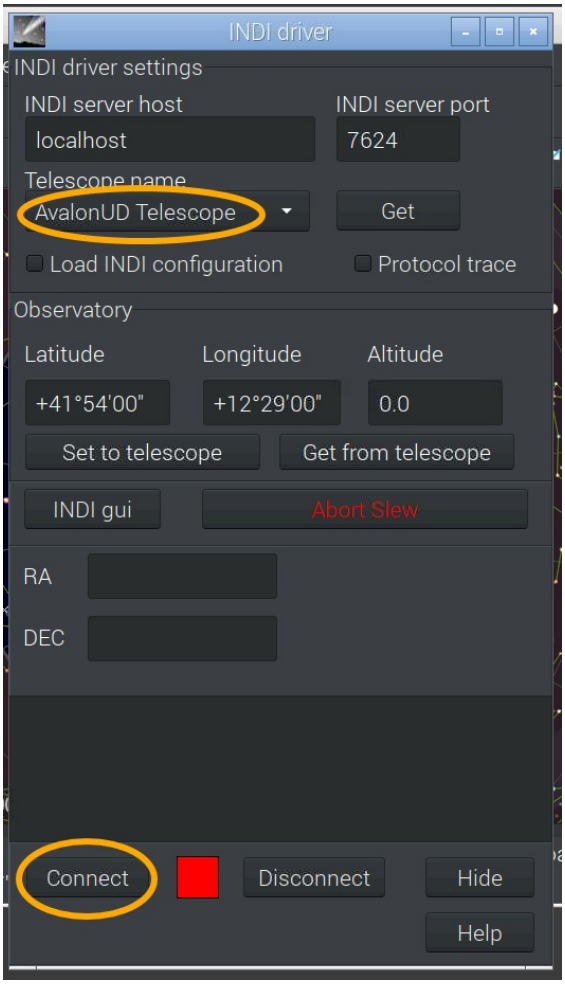
- In this way the window of the previously created profile will pop up. On the left side menu click on the “Planetarium” voice and select Skychart / Carte du Ciel as preferred Planetarium software. Then click OK on the bottom to save the selection.

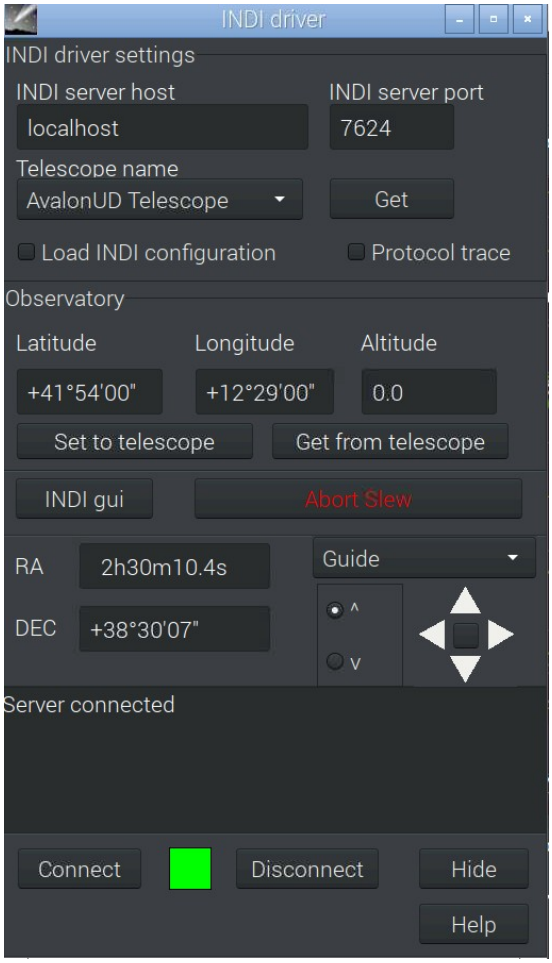


- At this point it is required to connect Carte du Ciel with the mount driver. So, double click on the software icon available in the desktop.

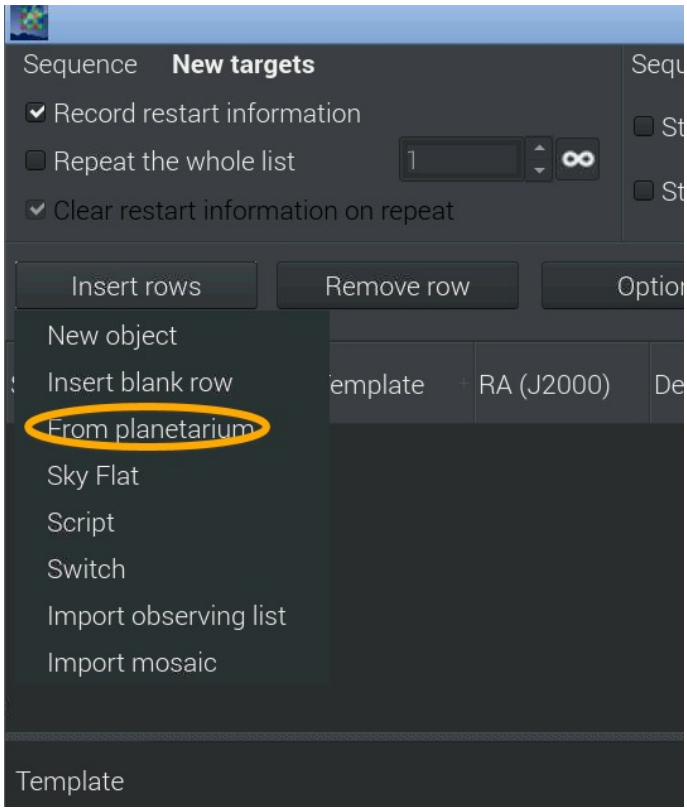


- Then click on the connect telescope button to open the INDI driver settings panel. Here select AvalonUD telescope driver and click Connect.

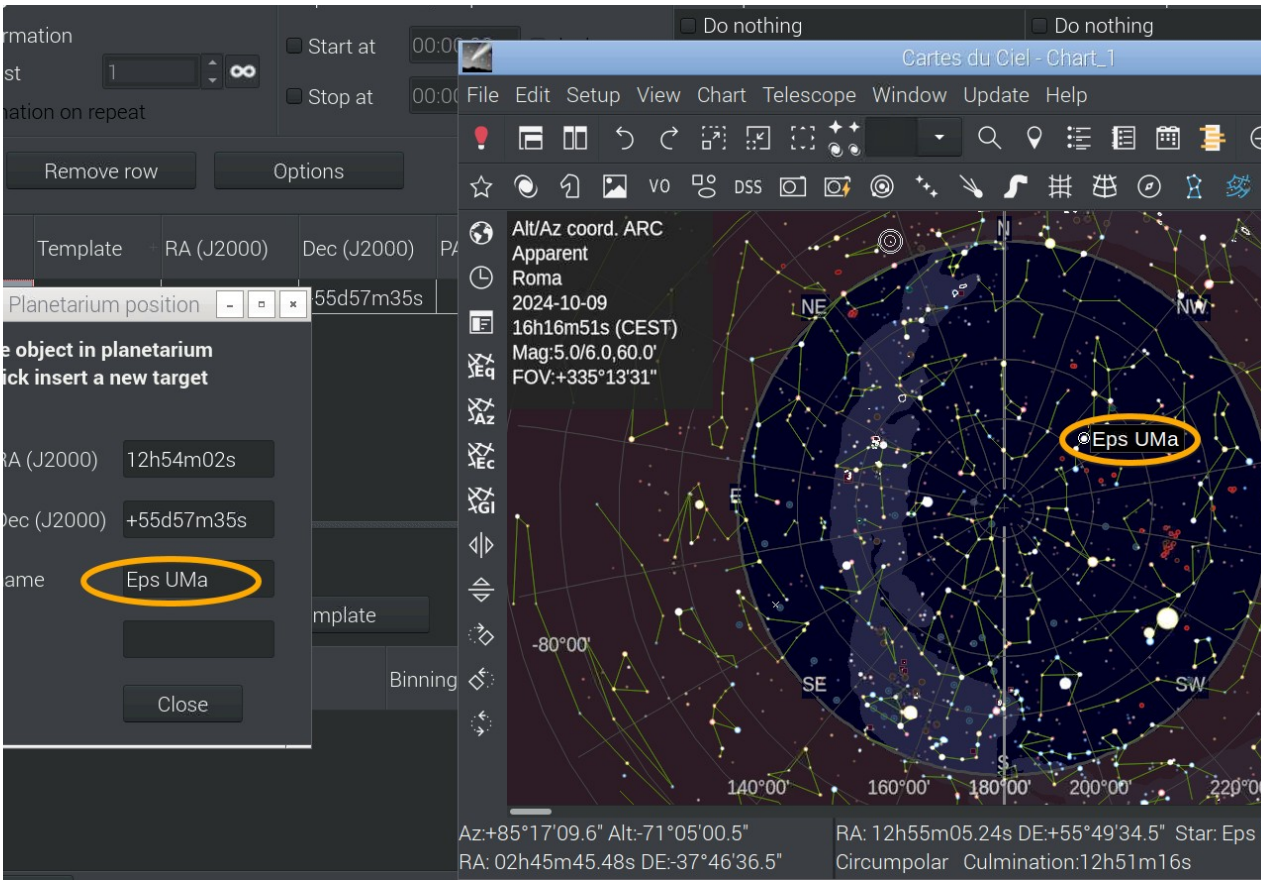




- After this connection it will be possible to add a target to a sequence by simply clicking on an object directly in the Carte du Ciel planetarium.



-



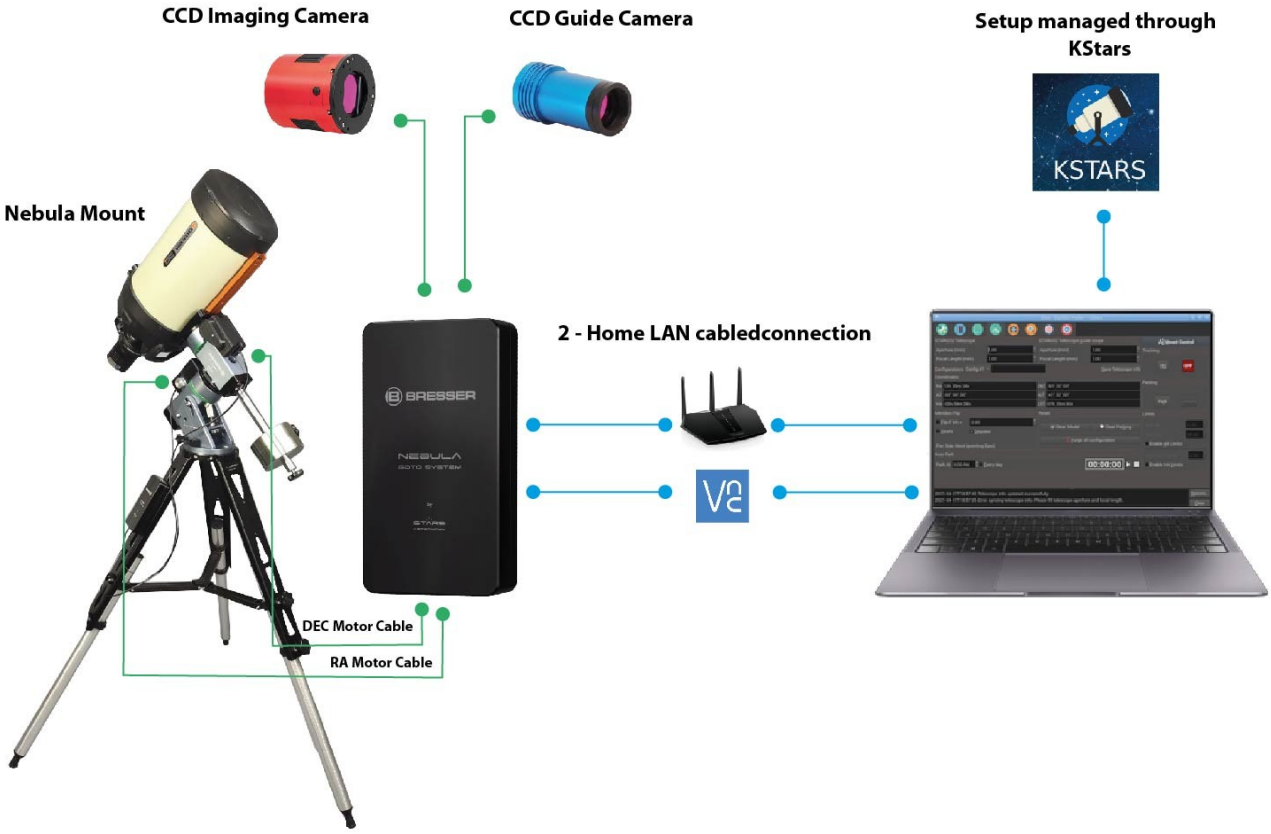
3.1.2. KStars, EKOS

The first planetarium application we will take into consideration for using the Nebula Go To System with this method is KStars. It is an integral part of the INDI environment inside the LINUX and MAC operation systems, which is the correspondent of ASCOM for Windows OS.

The emphasis of INDI environment is toward the management of astronomical instrumentation, especially for astro-photography. The system manager of INDI environment is a tool called EKOS, which provides, in addition to an efficient mount management, almost all the functions of pieces of software very well-known and used by the astro-photographers, such as SGP, N.I.N.A., Voyager, etc.

The advantage of using KStar and EKOS is that the commands sent to the telescope are generated directly inside the Nebula Go To System by-passing the external communication so that the maximum speed is obtained. Note that this method is applied using whatever device to communicate with the Nebula Go To System (Windows PC, Mac, Linux PC, iOS and Android devices).

The next paragraph will provide the required instructions for the first Kstars configuration.



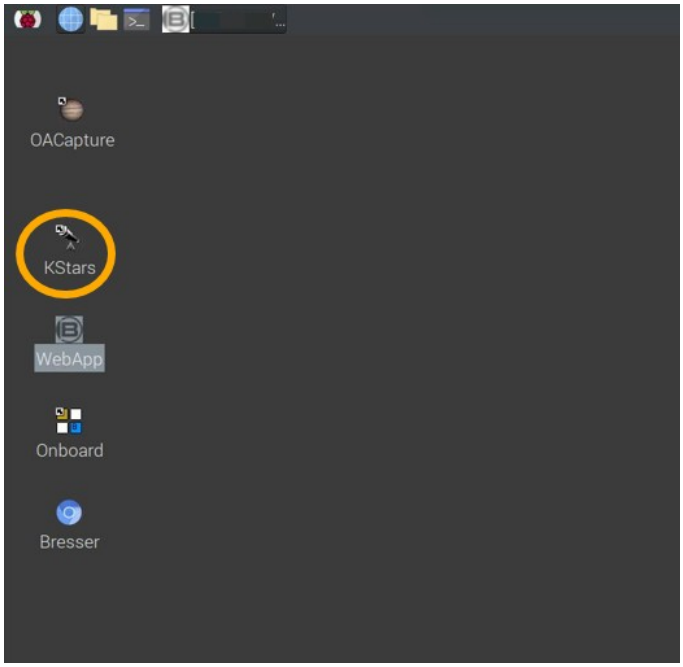
Telescope Setup with KStars

Before to start the step-by-step procedure, it is necessary to access to the Raspberry desktop (Figure 3.2) as described in the 3.2.1 paragraph. After the connection the VNC viewer will show the Raspberry Desktop.

Figure 3.2 – Raspberry Desktop

Below is described the step by step procedure:

1) **SETUP A NEW PROFILE:** Run KStars



2) In the main menu (see Figure 3.2) click on "**Toggle EKOS**" icon in the main toolbar. The EKOS - KStar window will pop up (see Figure 3.4).

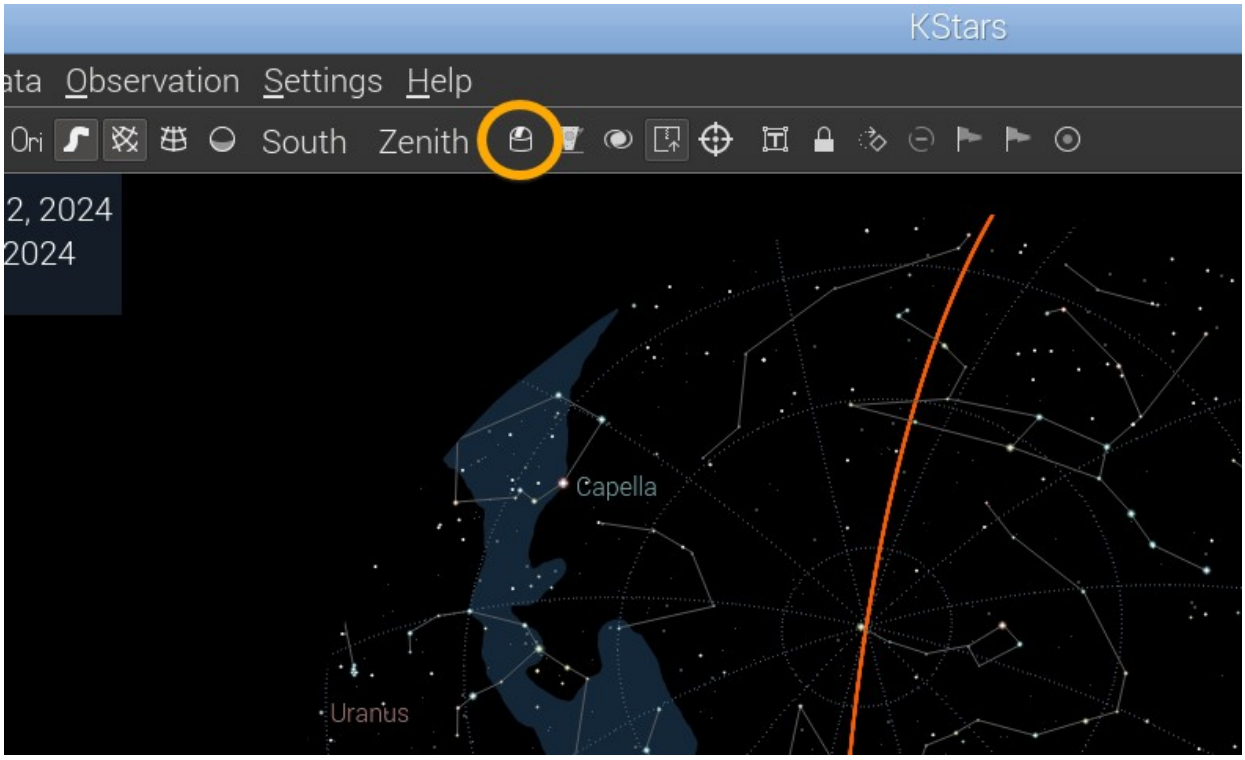
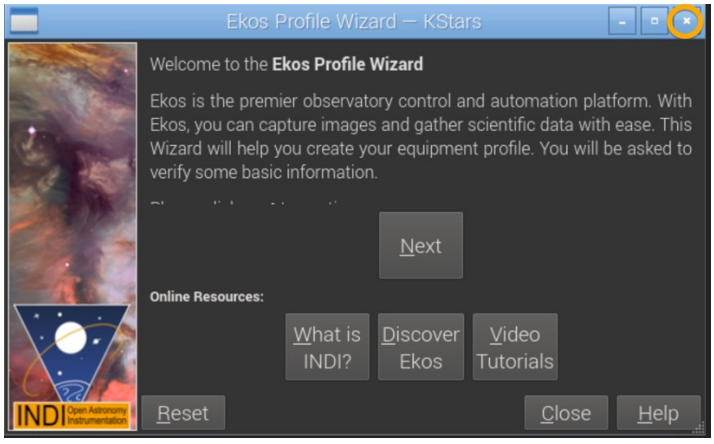


Figure 3.2 – KStar main window

3) If a wizard window appear, close it.



4) After the Profile Wizard Window closing the Ekos / Kstars main setup window will pop up, in order to connect the setup devices, a new profile must added by clicking on the + button.

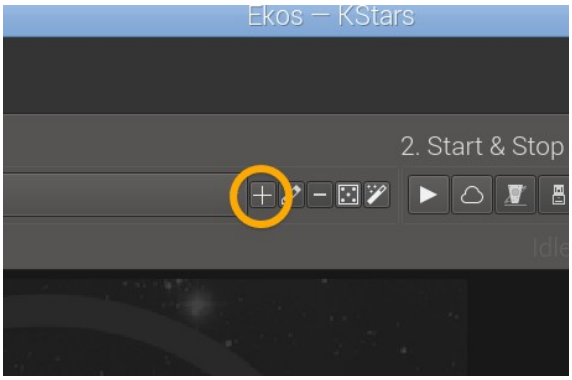


Figure 3.4 – EKOS – KStar window

5) Now the Profile Editor Window will show up, here must be selected all the driver of the devices available in the setup.
   a) Select "**AvalonUD**" telescope in the mount dropdown menù
   b) **Select your own CCD driver on depending on the CCD model used.**
   What is very important in setting up the profile is selecting the **Local Mode** of communication and leave the default in the HOST field, for both the Mode and Guiding lines. It is at this point that one must decide what kind of guiding software he want to use during his astrophotography session. The available alternatives are Internal, PHD2 and LinGuider. Since the algorithms used in the Internal and PHD2 guiding modes are the same, the choice is only related to the fact that PHD2 has more tools to tweak the guiding operations. LinGuider has not been tested with Nebula Go To System.

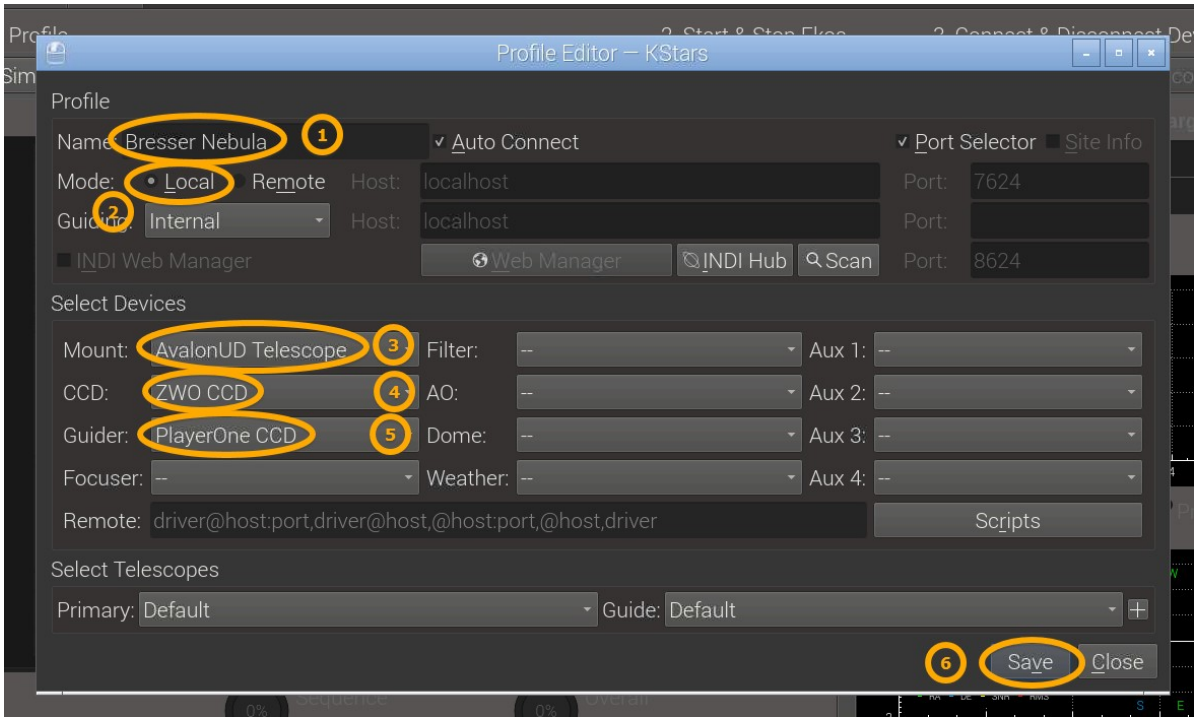
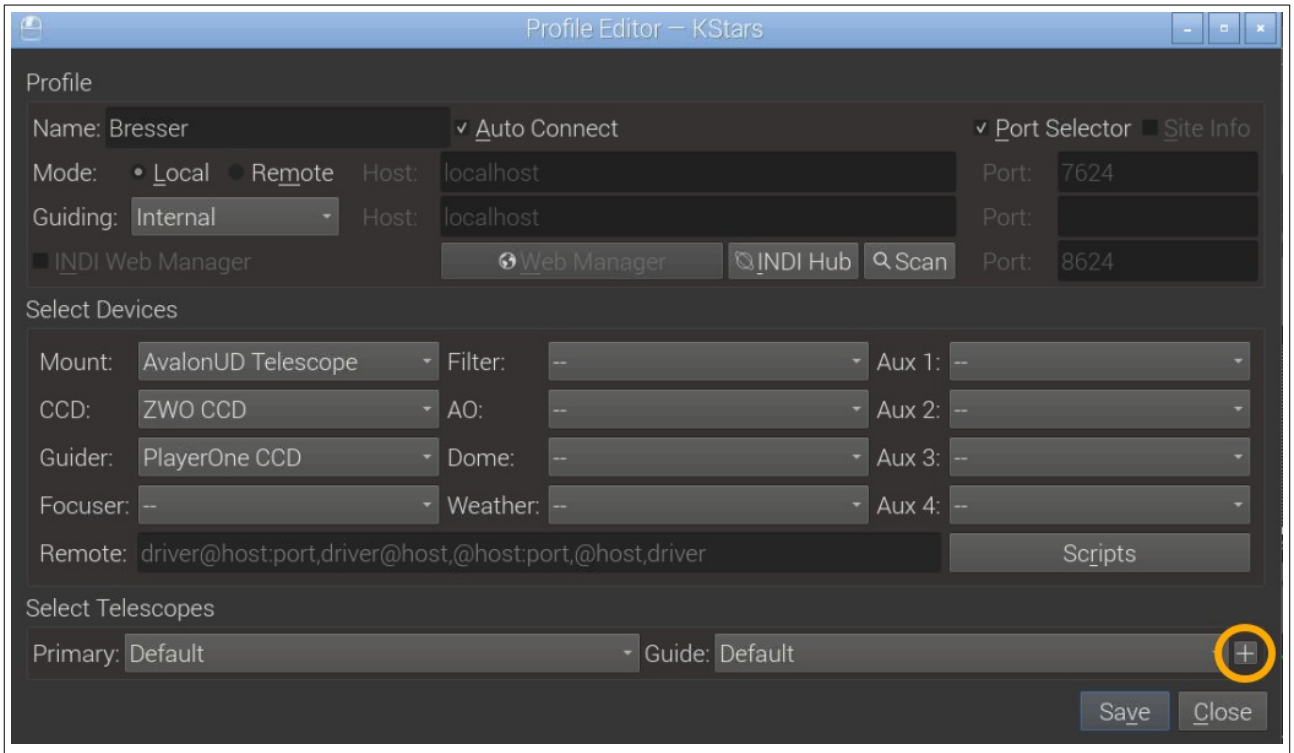
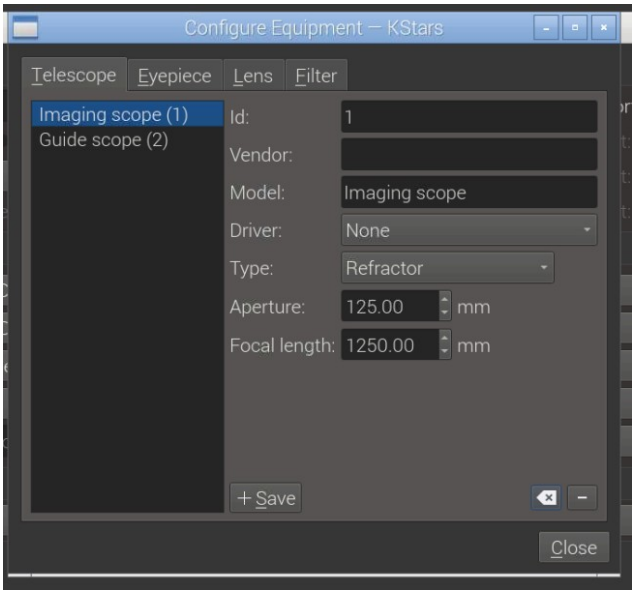


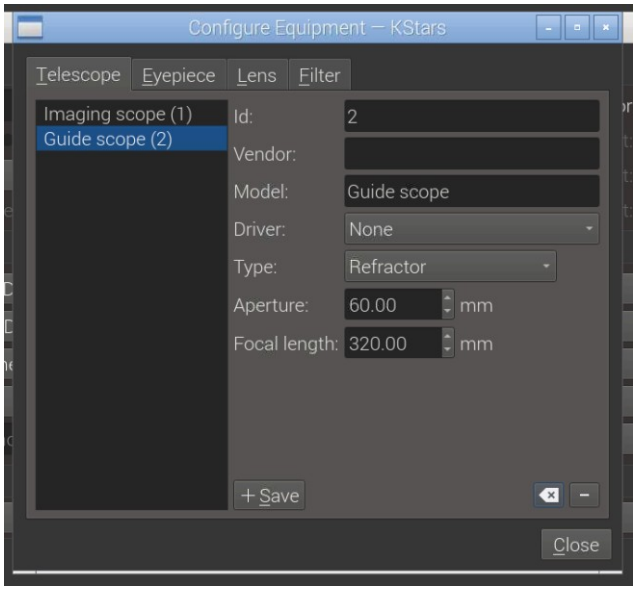
Figure 3.5 - Profile Editor

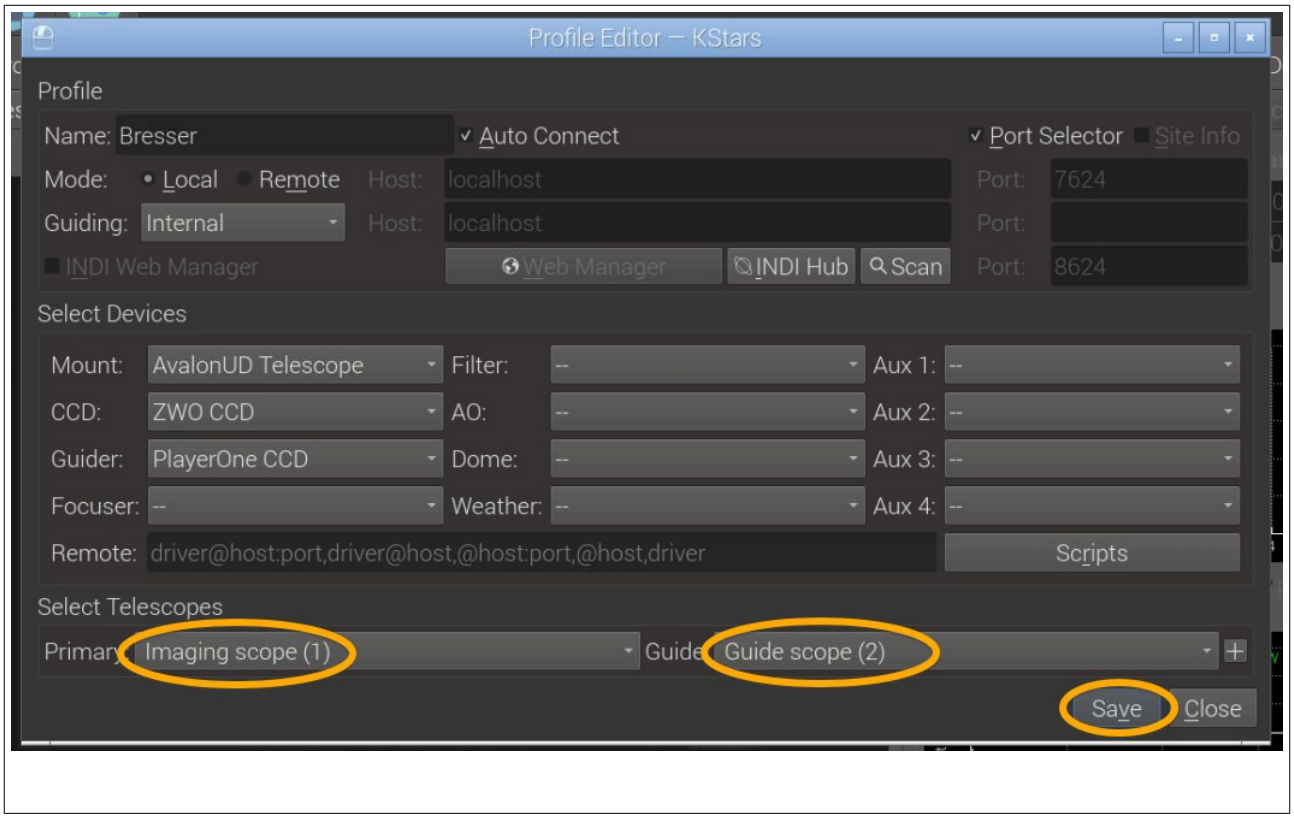
Telescopes configurationf for solving operations

NOTE: *It is also convenient to fill the* ***Primary*** *and* ***Guide Telescope*** *types by clicking the bottom right + icon and filling the next windows with the needed information. These parameters are important because they are used during plate solving operations that can be done during the pointing of the telescope and for the guiding operations. Once the profile is completed, save it and close the window.*

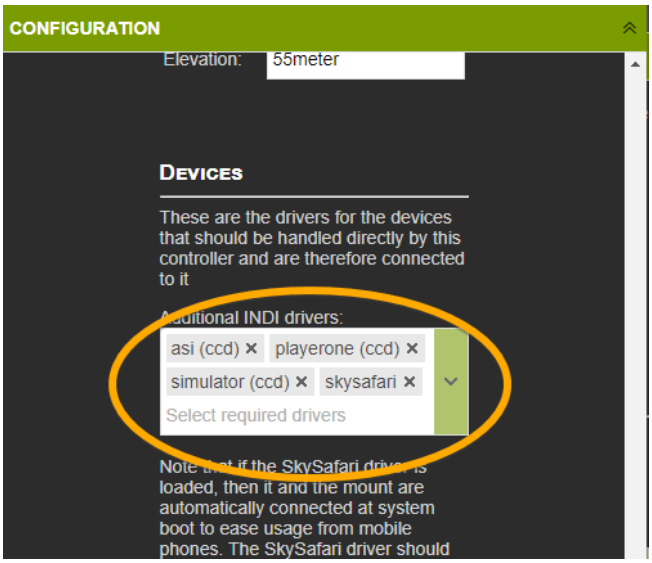




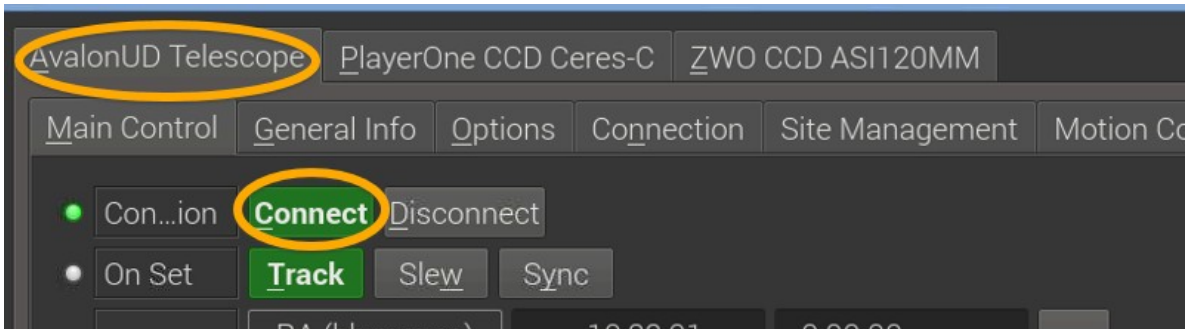




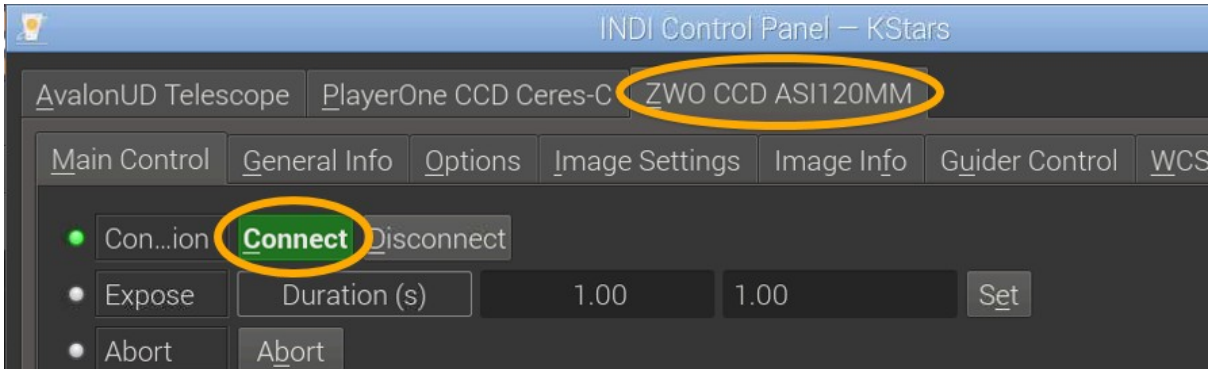
NOTE: When the CCD cameras are directly connected to the Nebula GoTo System, the corresponding camera driver must be loaded on the WebApp. **They will be available in the Kstar driver list after a system reboot.**



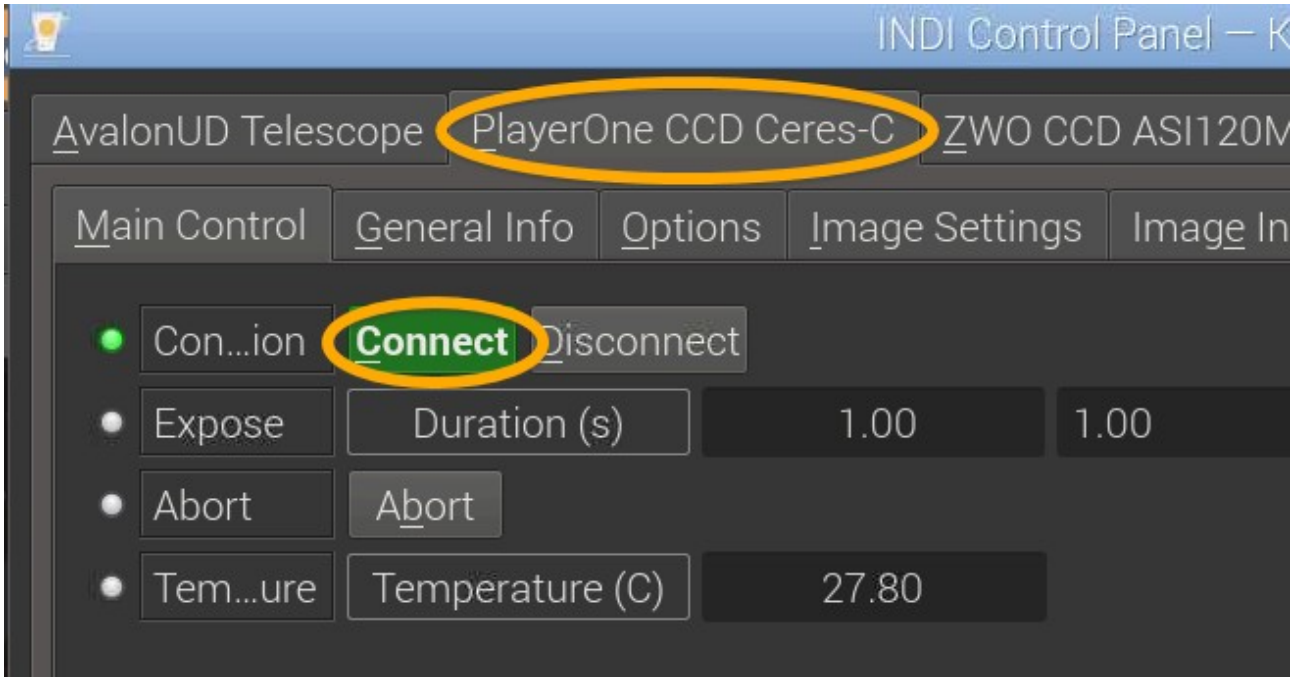
6) After the profile has been created and the correct drivers has been selected, they must be connected selecting one by one each tab.
   a) So click in the **AvalonUD Telescope** tab and click on the **Connect** button.



   b) Click on your own Imaging camera tab and then click on the connect button



   c) Click on your own Guide camera tab and then click on the connect button



After the mount and CCD cameras are connected is possible to check all the mount driver parameters.

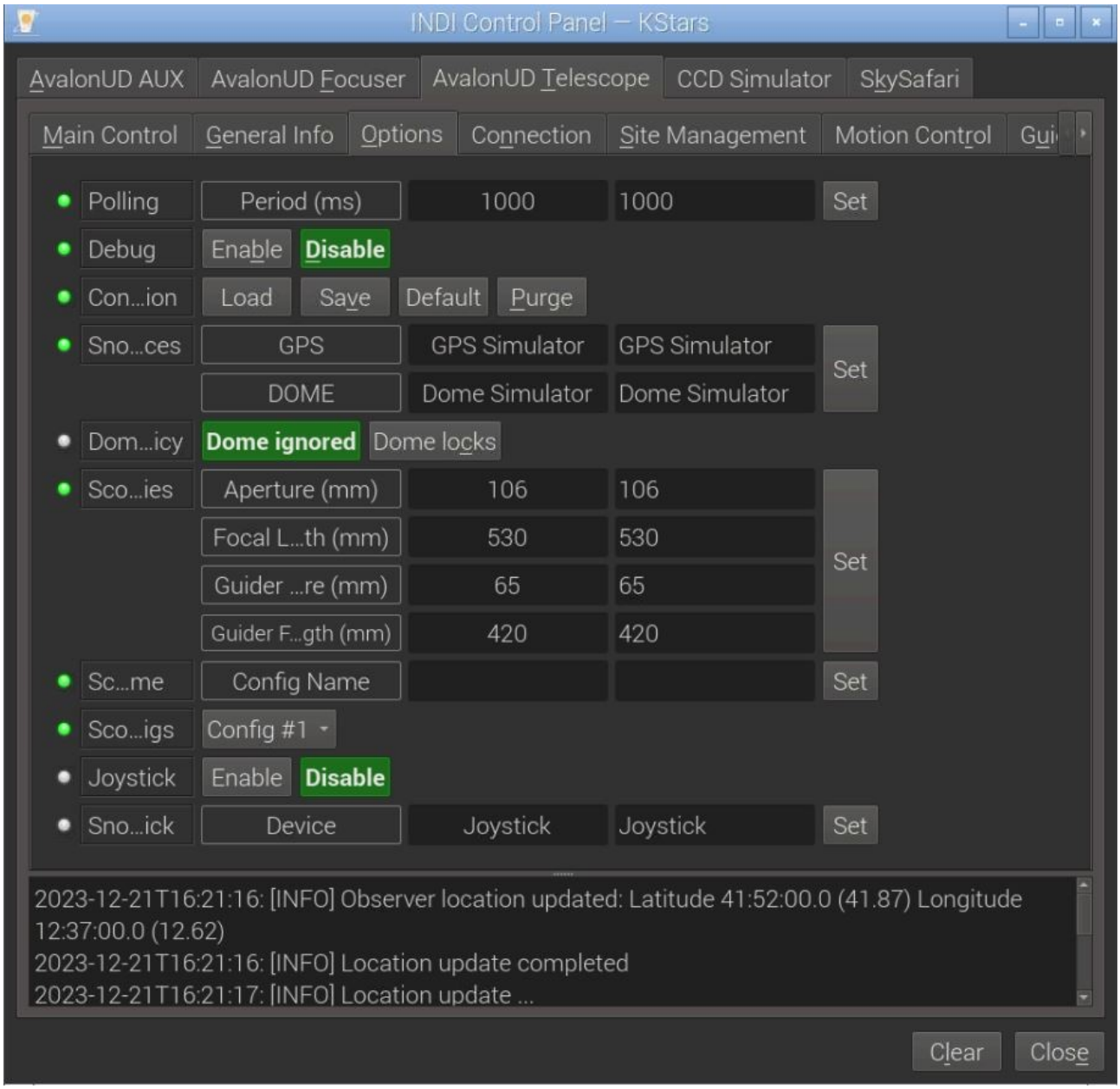


Figure 3.6c – Nebula GoTo System Option Tab

7) Once we are satisfied with our controls and sets, we can close the INDI Control Panel. We will note that now, the EKOS – KStars Panel has been renamed EKOS – Nebula GoTo System Plusfile – KStars and its top is now populated with a long raw of colorful icons, each related to the tabs necessary to operate the single pieces of equipment in our profile (se figure 3.7).

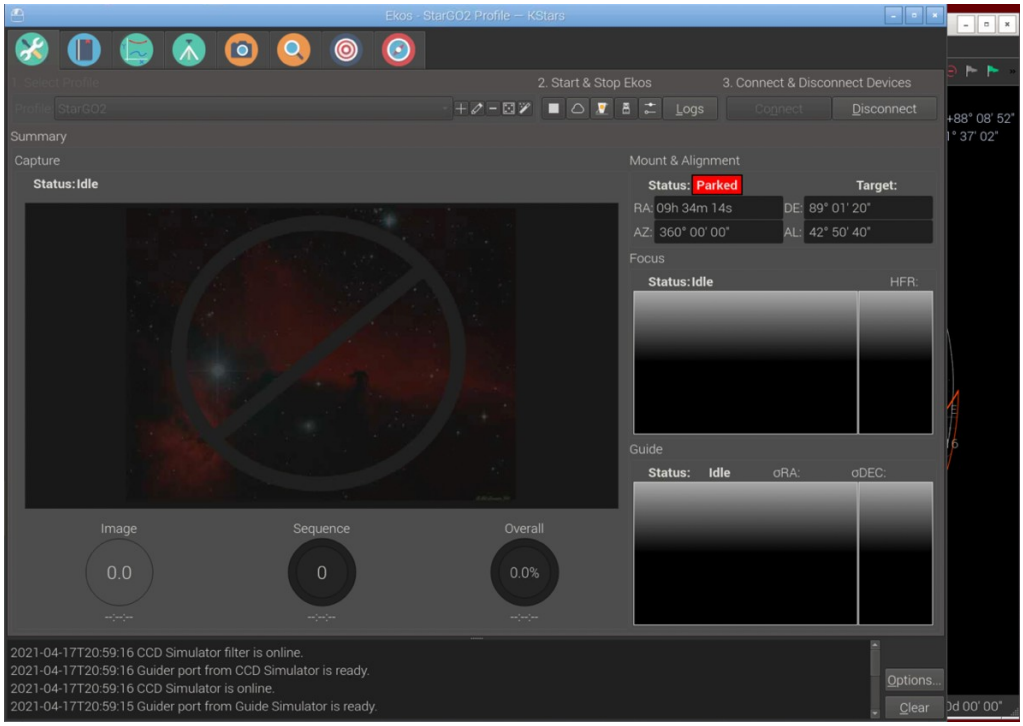


Figure 3.7 – EKOS – Nebula GoTo System Plusfile – KStars window

8) The important Tab for the purpose of managing the mount is that with a green one, with a tripod inside: it allows to open the mount Tab window containing the most important selection of parameters and commands (Figure 3.8). This is also auto-explaining.

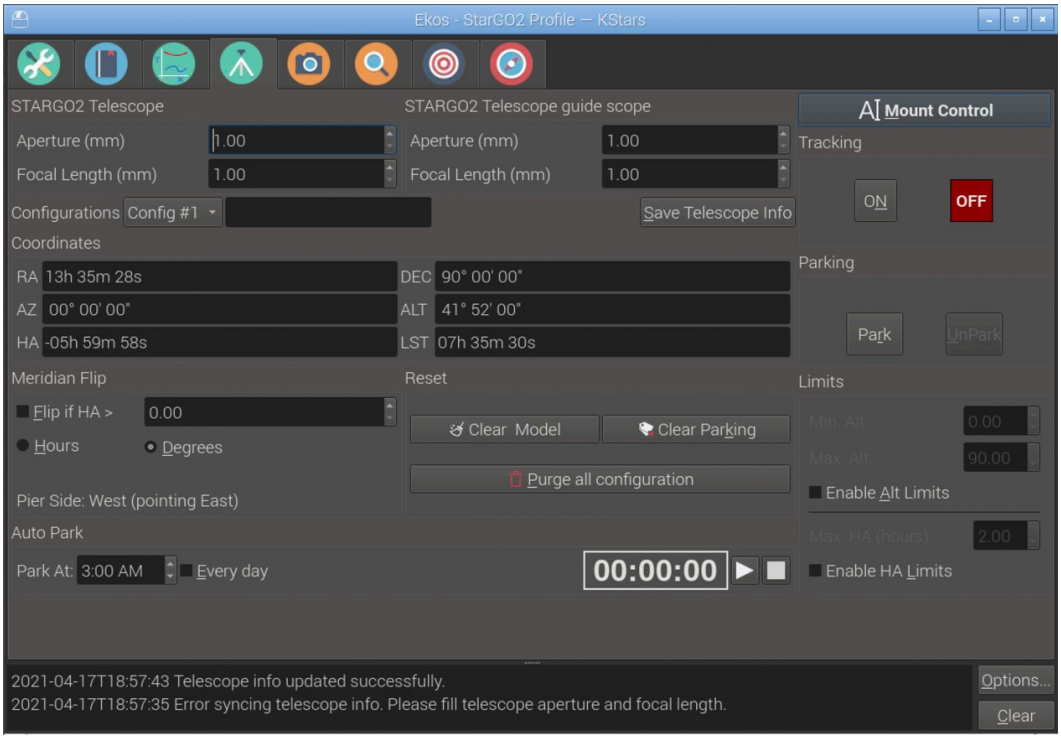
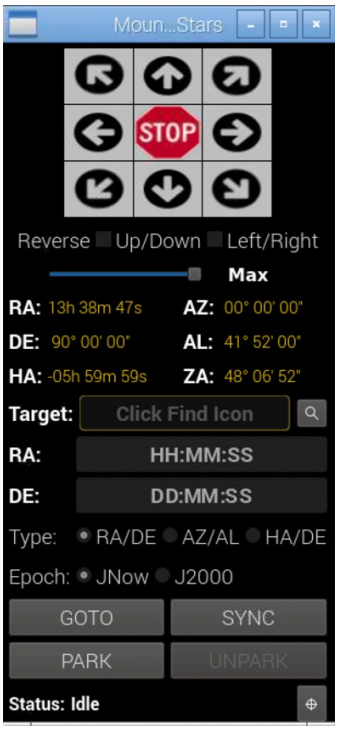


Figure 3.8 – Mount Control window

9) Finally, an important function for the mount movement is the Virtual Keypad that is activated by clicking the button on the upper right corner of the window (Figure 3.9 – Mount Virtual Keypad).



It must be noted that many of the routine operations with the mount, such as gotos, parking/unparking, slew, etc., may be carried out using few icons in the toolbar of KStars:

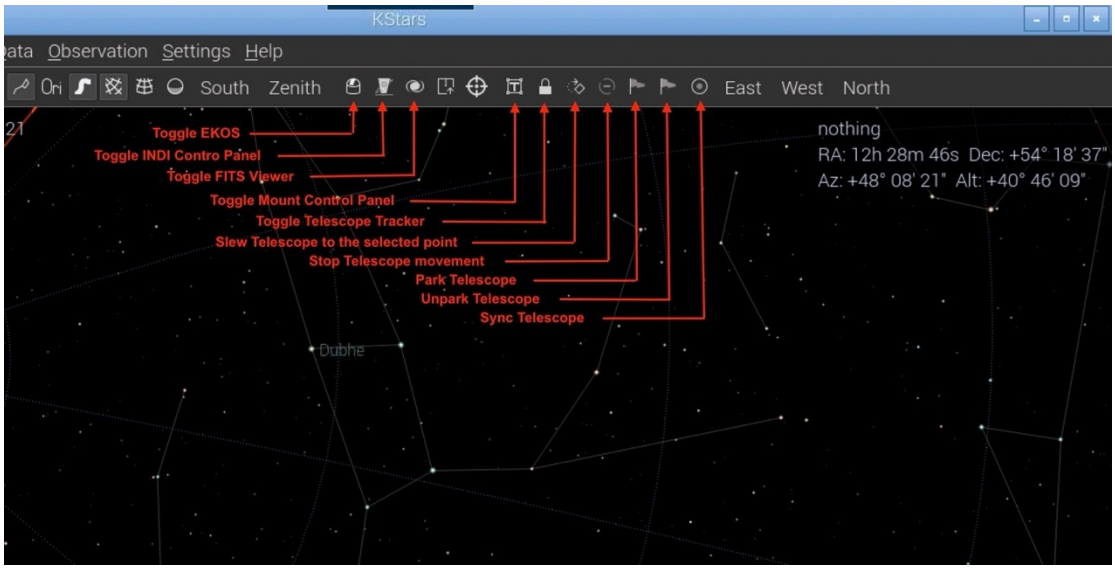


Figure 3.10 – Alternate method of mount control

3.1.3. Telescope Operation

To operate the telescope, press again the telescope icon already used at point 1 of the previous section. This time a Slew Telescope window will pop up allowing to move the telescope using the RA/DEC cross keys, to slew the telescope to a chosen position and to Sync the telescope in that position.

The following is a detailed description of the Slew telescope window fields:

- Right Ascension and Declination: manually insert the desired values in the format shown in the figure or automatically provided from the Stellarium sky map.
- Current Object: It allows to insert in the RA, DEC above the values related the actual object selected in the sky map. This simplifies a lot the insertion of the correct celestial coordinates.
- Centre of the Screen: To insert in the RA, DEC fields the coordinates of the screen center.
- Nebula Go To System (or whatever other telescope name available) makes possible the choice among several telescope settings.
- Slew: This big button primes the telescope movement toward the chosen object the coordinates of which are in the RA, DEC fields.
- Sync: After the telescope has reached the destination and is perfectly centered on it, the press of this button synchronizes the telescope with the object coordinates, to improve the pointing accuracy.
- Cross keys: Allow the telescope movement in the related directions at the speed selected in the side cursor (Min – Max).

For more detailed information on Stellarium use, please consult the site: http://stellarium.org

3.2. Computer Remote Operations.

The method described above involves, as said at the beginning, the use of a tablet or a computer but only as a way to access to the Raspberry desktop, to perform all the described operations with kStars, EKOS and all other applications directly on the Raspberry. This connection may be realized with WIFI, for smartphone and tablet, and WiFi or Ethernet for PCs.

The method described in this section differs only by the fact that the applications used to control the mount and to perform all the astro-photographic operations, reside on a remote computer, once again connected to the Nebula Go To System wireless through WIFI or wired via Ethernet cable, being the second preferred due to higher speed and reliability. The software programs proven with the Nebula Go To System with this method are the same already described.

The advantage of this method for the Windows PC users is that they can still use their ASCOM based applications as they did with other conventional control systems. A further advantage is that the PC may be based, as well as on Windows, also on Mac or Linux operating systems. For this two OS, however, still remains the limitation of the availability of some applications available only for Windows OS.

3.3.1 Use of CDC from a computers

CDC is one of the most used planetary application used by the astrophotographers to the gross control of the telescope. It is available also for Apple Macintosh computers and for Linux based PCs. The procedure to connect the Nebula Go To System to CdC is the following:

1. After the launch of CdC in the remote, in the main menu click on Setup and, in the dropdown list choose General. The General window will pop up. Select the Telescope panel (see Figure 3.11 of section 3.2).
2. In this window select the ASCOM item (even if we are well aware that ASCOM environment does not exist for Macs and Linux computers). The click Apply and OK to exit the window.
3. Now open the “ASCOM telescope interface” window by clicking on the Connect Telescope icon (the small dome with the red dot – see Figure 3.12 od section 3.2)
4. Fill all the fields with the needed information windows that appears that will be similar for all three operating systems (see Figures 3.24a, b, c). Note that the information required is the same. The only difference is that the Mac panel lacks the virtual keypad to manually operate the telescope. In case of need use the connected keypad for this purpose.
   The IP address to be used is retrieved from the Nebula Go To System on the Device Display (ODD) and the other pieces of information are the default (IP Port 11111, Remote Device Number 0)

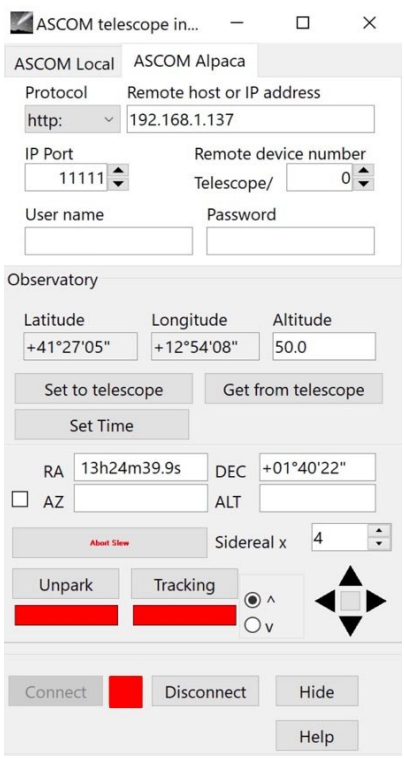


Figure 3.24a - Windows

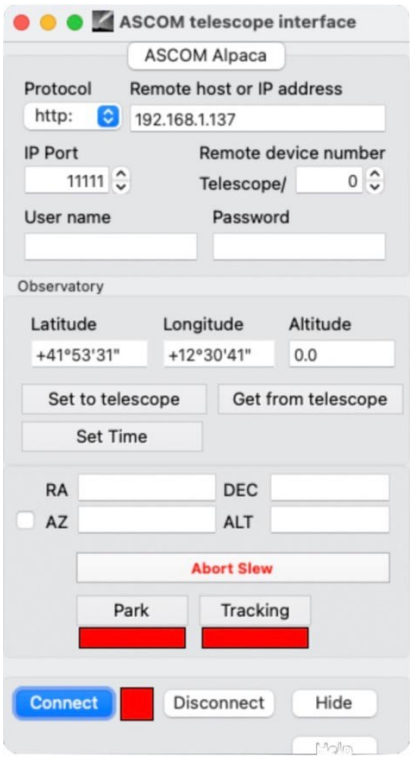


Figure 3.24b - Mac

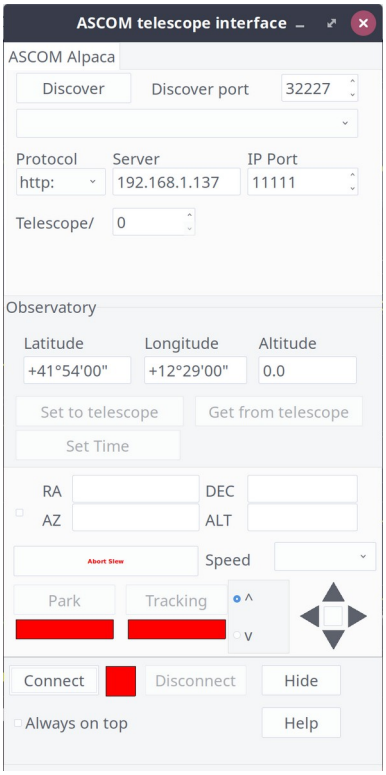


Figure 3.24a - Linux

The telescope coordinate values (RA, DEC, AZ and ALT) are also retrieved from the Nebula Go To System after the connection. Even the Park and Tracking will become active after the telescope has been connected.

5. To perform the connection, it is sufficient to click on the Connect button. After the connection, if the telescope is parked the Park button will show red and the telescope cannot be moved. Clicking on it will unpark the mount and the button will turn green and the label will become Unparked. Otherwise the mount will appear already unparked. This button can be used to park / Unpark the telescope as needed during operations. The same is applicable to the Tracking button. It is red if the telescope is tracking the sky or green if it is tracking. Pressing the button will stop or start the tracking.
6. Once connected the Goto operations may be performed in two manners: the first consists on clicking with the right mouse button on the celestial object we want to point to and then choosing, under the Telescope menu the Slew to…. function. The telescope will move to the object. The second way is by using the dome icons placed on the right of the tool bar as described in Figure 3.16 of section 3.2. In addition, the other two operating systems (Window and Linux) have the small cross keys in the ASCOM telescope Interface panel to move the telescope (See Figures 3.25a, b, c).

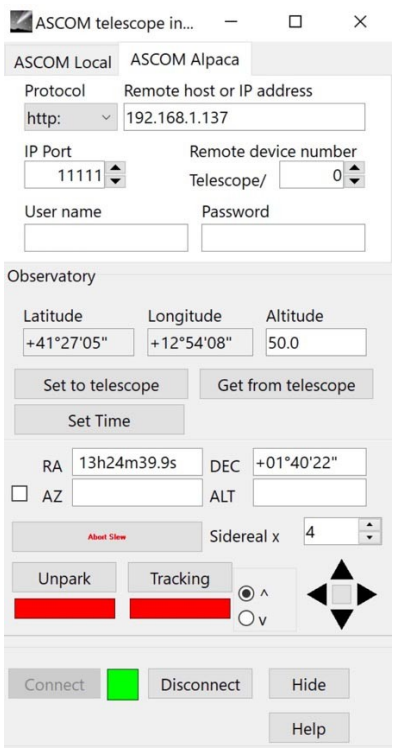


Figure 3.25a - Windows

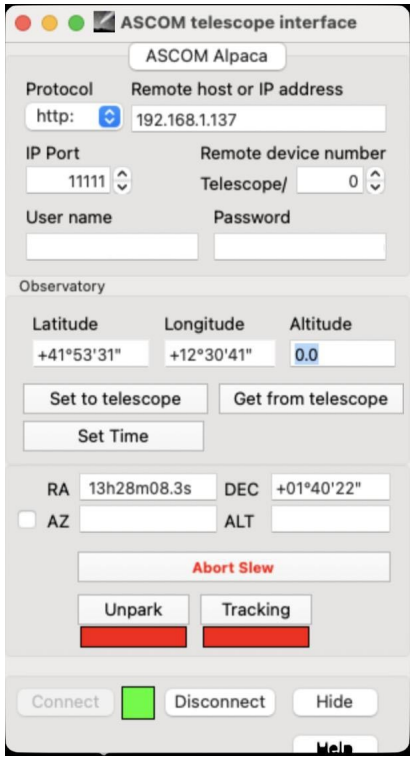


Figure 3.25b - Mac

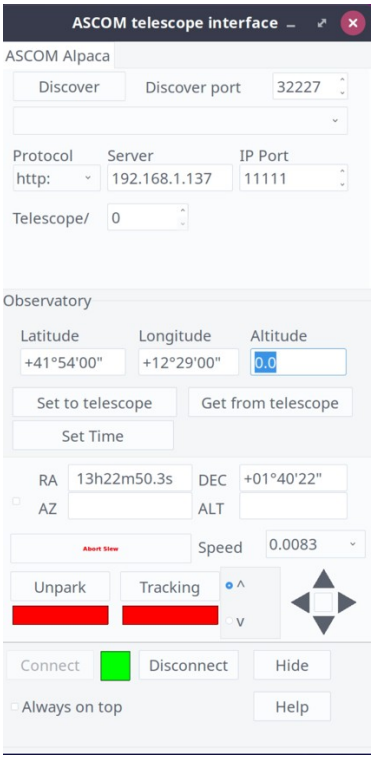


Figure 3.25a - Linux

3.3.2 Connection to Nebula Go To System of Stellarium residing on an external computer

The procedure to connect the Nebula Go To System to Stellarium for Mac is similar to that shown in section 3.2.3. Here below, we will summarize the needed steps which refer to the points and figures reported on that section:

1. Launch of the telescope function in the bottom icon menu.
2. The “Slew Telescope” window will popup but showing no telescope available (only at the first-time launch).
3. Click on the “Configure Telescope” bar. An additional empty window will appear, named “Telescopes”.
4. Press the + icon to add the telescope. This will make to appear another window named “Add New Telescope” in which all the information related to our Nebula Go To System will be inserted.
5. Enter the information as shown in the figure but using the actual IP address as shown in the Nebula Go To System Main Display and inserting in the last line the diameter in degrees of the desired telescope indication circles, separated by a comma. At the end press OK. All the inserted set information is memorized in Stellarium to be loaded at the next restarting.

Even the indications to operate the scope are those listed in the mentioned section 3.2.3.

3.3.3 Connection of Skysafari for Mac residing on an external computer.

Skysafari is a well known and appreciated planetarium application normally available on iOS and Android smart devices. It is, however, available also for Mac computers and, especially for visual sessions can be nice to use this program to control the Nebula Go To System mount. In this section the instructions to connect the Skysafari running on Mac to the Nebula GoTo System are provided.

1. Once launched the app on the Mac click the Setup item under the Telescope main menu (Figure 3.26).

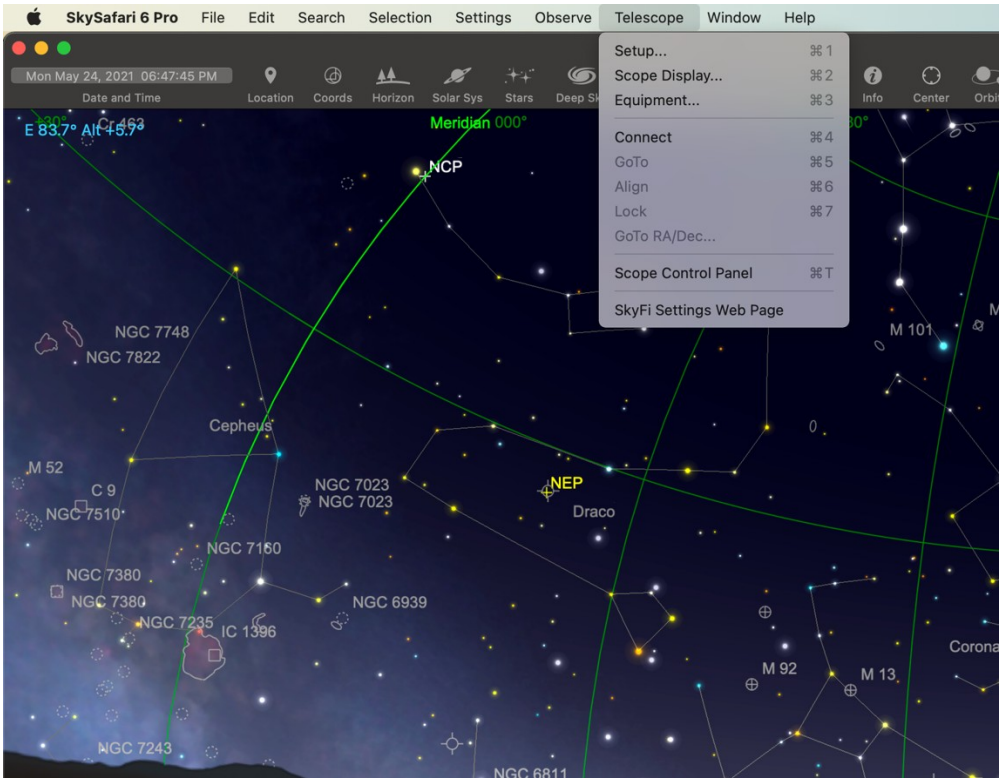


Figure 3.26

2. The Setup panel will open on the top left of the main window. Fill all the fields with the information provided in Figure 3.27, with the only exception of the IP address that will be taken from the main ODD (see Figure 2.5 of section 2).

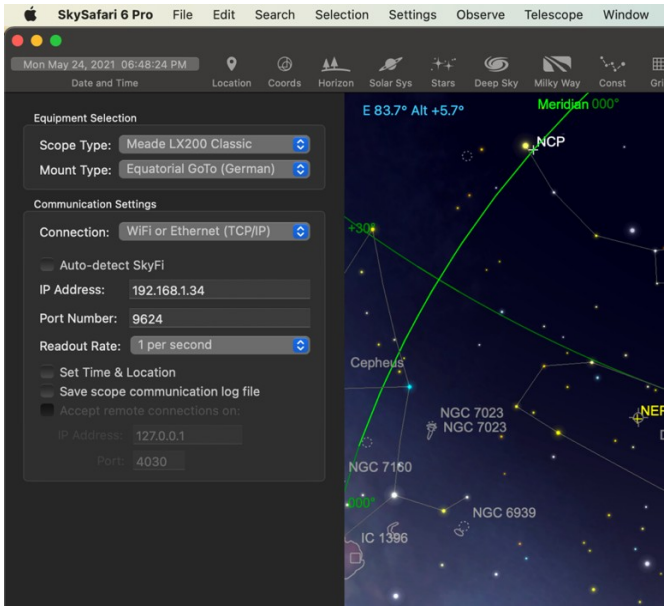


Figure 3.27

3. After the insertion of the required parameters, the connection can be established pressing Connect key in the bottom of the panel. This will close the Setup panel and will open the floating Scope Control one (Figure 3.28).

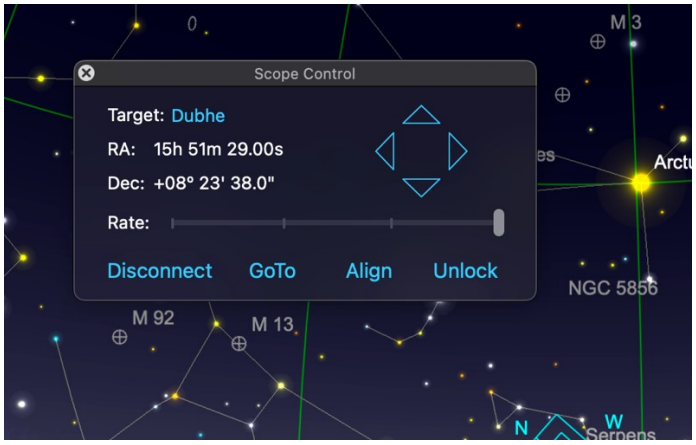


Figure 3.28

4. Use the directional keys to move around the telescope, the GoTo to slew the telescope to the selected object and the Align button to synchronize the telescope to the object centered in the eyepiece to increase the pointing precision.

3.4 Connecting the Nebula GoTo System to external astrophotography software.

To shoot astrophotography it is necessary to use specialized software (i.e. Sequence Generator Pro -SGP, N.I.N.A., CCD Ciel, etc) that performs all the operations needed to exactly frame to object of the shooting and, obviously, performs all the photographic actions required by the CCD or DSLR cameras.

The Nebula Go To System has the advantage to provide a direct connection of the photographic equipment to the internal Raspberry that can take charge of all those operations. This is done using the INDI/EKOS that, even if it constitutes a complete suite of reliable astrophotography tools, could not be the preferred by many of the users.

For this reason, in this section we will show how to use with Nebula Go To System several software suites which may be more familiar to users, making it a very flexible mount control system.

It is useful to repeat that in the next paragraphs, we assume that the PC (essentially Window but also MAC/Linux when the tools are available) is wireless or wired connected to the Nebula Go To System, following the instructions given in the previous sections.

It is also obvious that the next sections will be essentially aimed at the operations needed to allow the astrophotography tools to speak to the Nebula Go To System and not to the use of such tools, especially as regards the connection and use of other hardware devices other than the Nebula Go To System.

The key point in connecting the software to the Nebula Go To System is to access to the ASCOM chooser which allow, first of all to access to ALPACA, which is the essential environment for managing equipment connected to non-Windows computer, using ASCOM compatible applications, such as the ones mentioned at the beginning of this chapter.

What is different for each application is the way the ASCOM Chooser is accessed. Once we are in from of this panel, the way to follows for connection the Nebula Go To System is identical. In section 3.4.1 we will show how the ASCOM chooser is invoked by each application and in section 3.4.2 the common procedure for all application is shortly described.

3.4.1 Accessing the ASCOM Chooser from several applications

Sequence Generator Pro

One of the most popular sequencer applications for astrophotography is SGP.

The connection of SGP to the mount is performed using the “Equipment” section of the Sequence window that can be accessed by the Main Menu (See figure 3.4.1a).

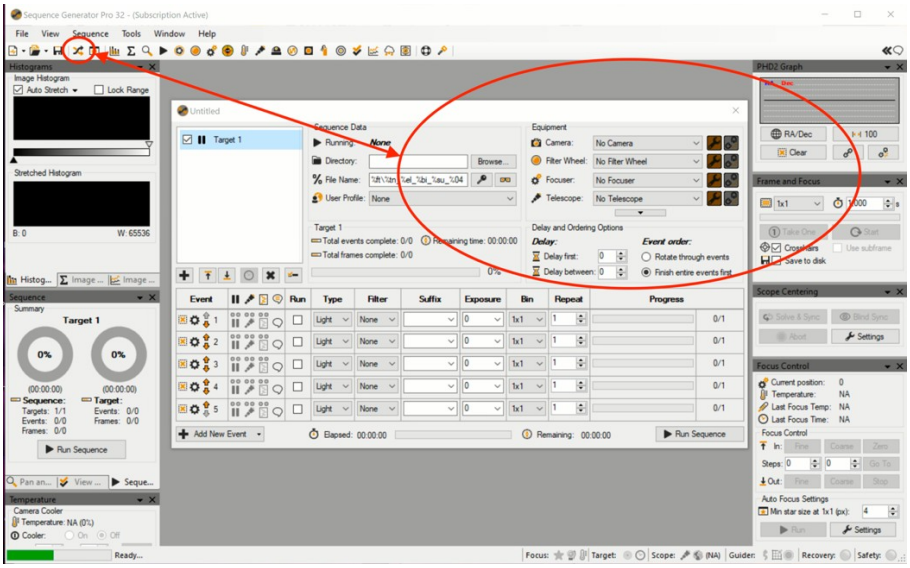


Figure 3.4.1a

In this window select ASCOM in the “Telescope” dropdown menu: the ASCOM chooser will be proposed for selecting the Nebula Go To System telescope.

TheSkyX

On the TheSkyX main screen, under the Telescope menu choose Telescope Setup… to open the “Imaging System Setup – Imaging Window” Fig.3.4.1b.

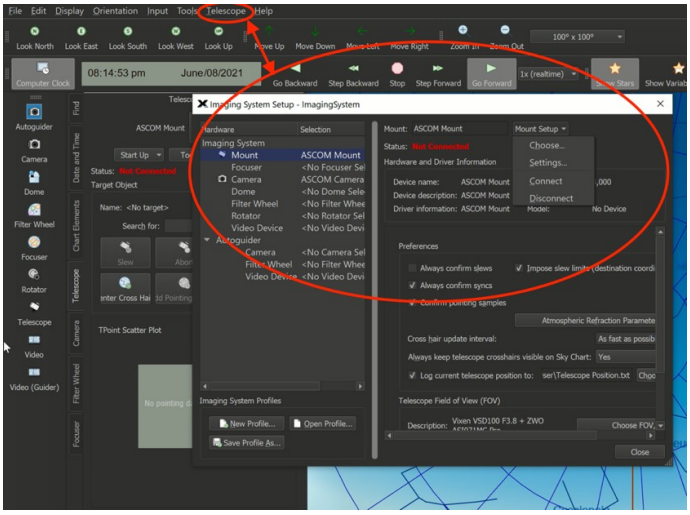


Figure 3.4.1b

Here, under Mount Setup dropdown menu (Fig. 3.4.1c), select Chooser.... The Choose Menu panel will appear. Here click on “ASCOM Mount” submenu.

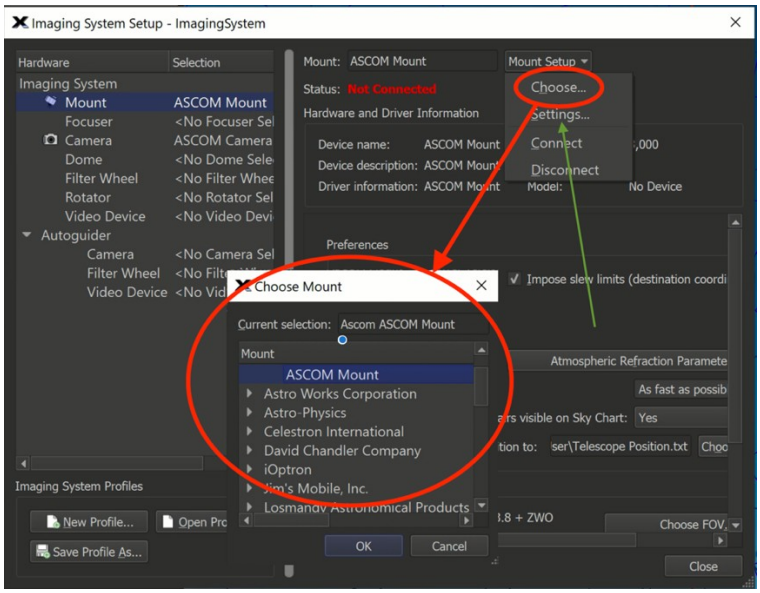


Figure 3.4.1c

Repeat the operation but finally selecting the Setting… sub-menu in Fig. 3.4.1c, (green arrow). The ASCOM Telescope Chooser panel will open as needed.

Voyager

Voyager is a very good shareware program, with a nice, unusual graphical interface that can be intimidating at the beginning but with the use it shows to be a very powerful and complete application for astrophotography. For accessing the ASCOM Telescope Chooser, press the Profile icon in the top menu (See Figure 3.4.1d).

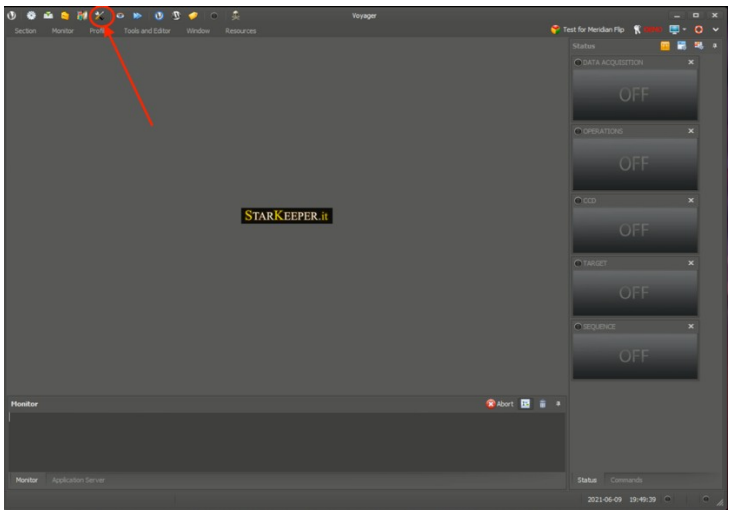


Figure 3.4.1d

A new window named “SetupForm” will open. Select the “Mount” tab to enter in the mount setup (Figure 3.4.1.e). In this form, on the top Mount line select “ASCOM Mount” in the dropdown menu (oval 1) and then click ASCOM button on the right side (oval 2). This will pop up the ASCOM Chooser Panel as needed.

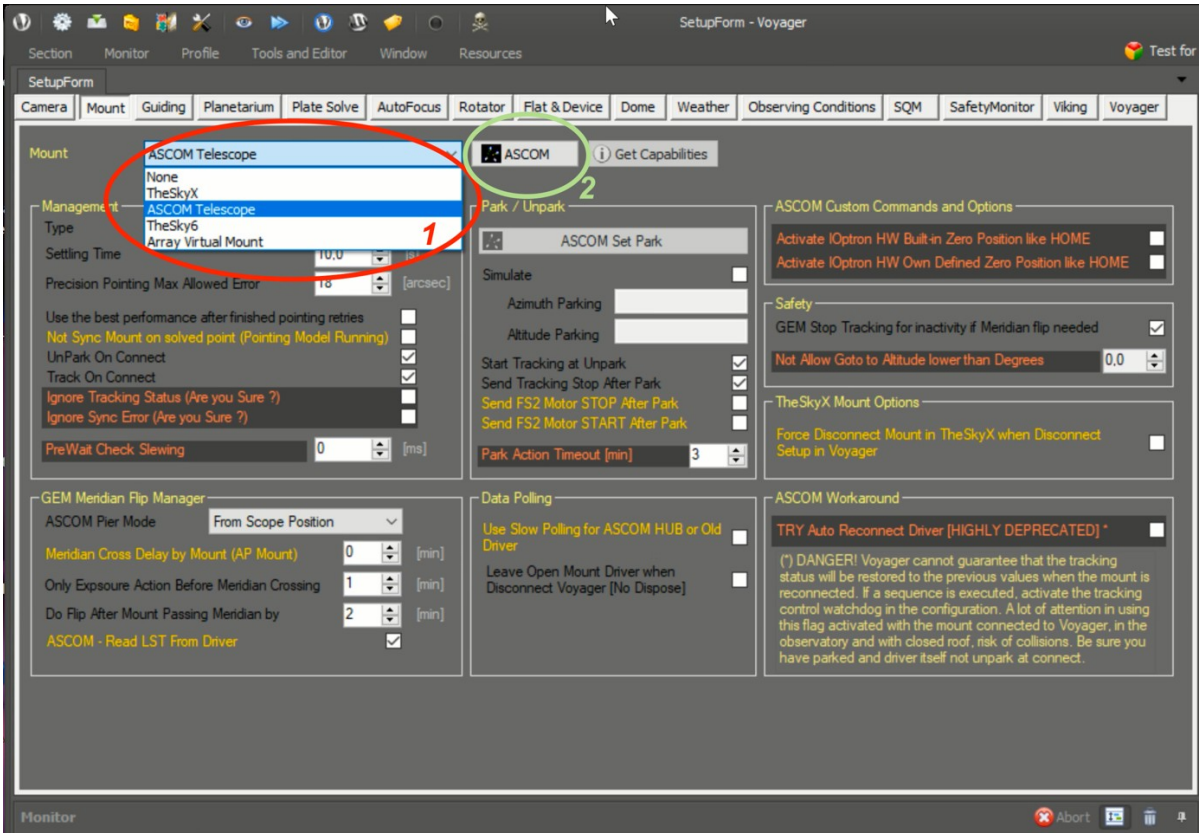


Figure 3.4.1e

Nighttime Imaging 'N' Astronomy (N.I.N.A.)

N.I.N.A. is also a very good application for advance astro photographer. It is very complete, allowing many advanced functions. The program starts with the Chooser Profiler panel opened (see Fig. 3.4.1f). Close it because the profile may be set in a second moment.

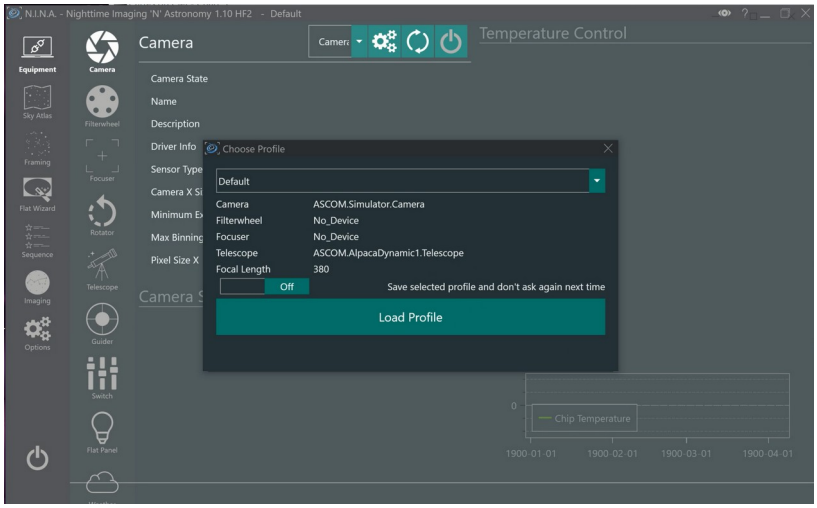


Figure 3.4.1f

Click the Telescope icon on the left of the screen to open the Telescope setup windows and on this open the dropdown menu and choose ASCOM. This will pop up the required ASCOM chooser if this is the first setup. In the subsequent accesses we will find the Nebula Go To System telescope as it has been set during the first access.

This is the companion program of the CartduCiel planetary, written by the same developer. The resemblances between the two are really evident. To access the ASCOM Chooser in this program, after its launch, click the menu items “Edit/Devices Setup…” (figure 3.4.1g) to open the homonymous window.

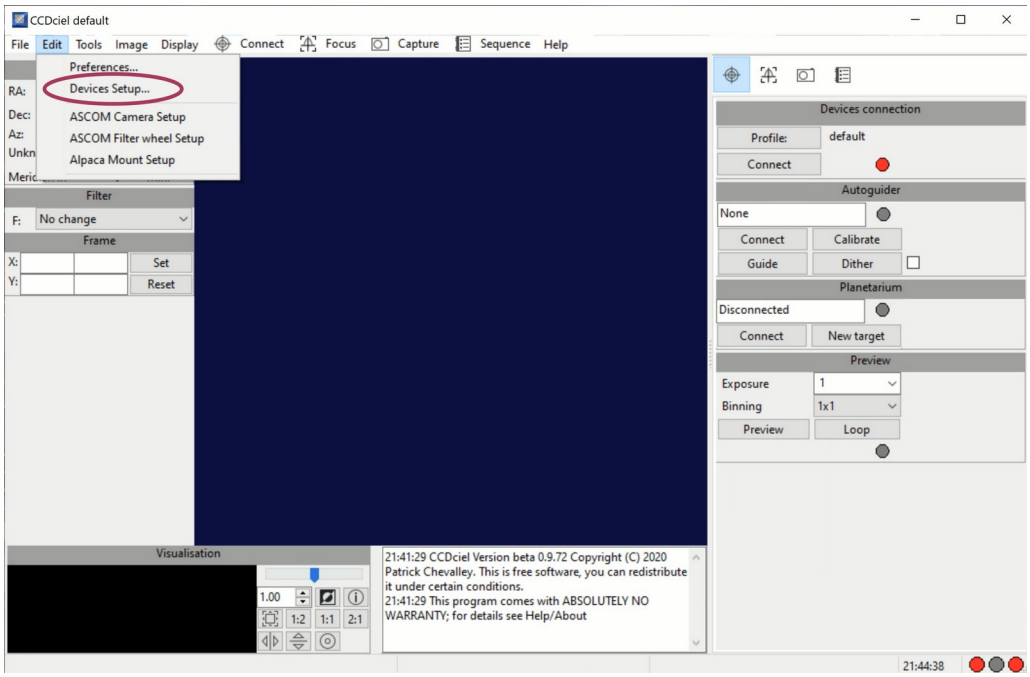


Figure 3.4.1g

Choose Mount device, in the panel select the ASCOM tab and, finally, click on Choose (see Fig. 3.4.1h). The ASCOM Chooser panel will appear.

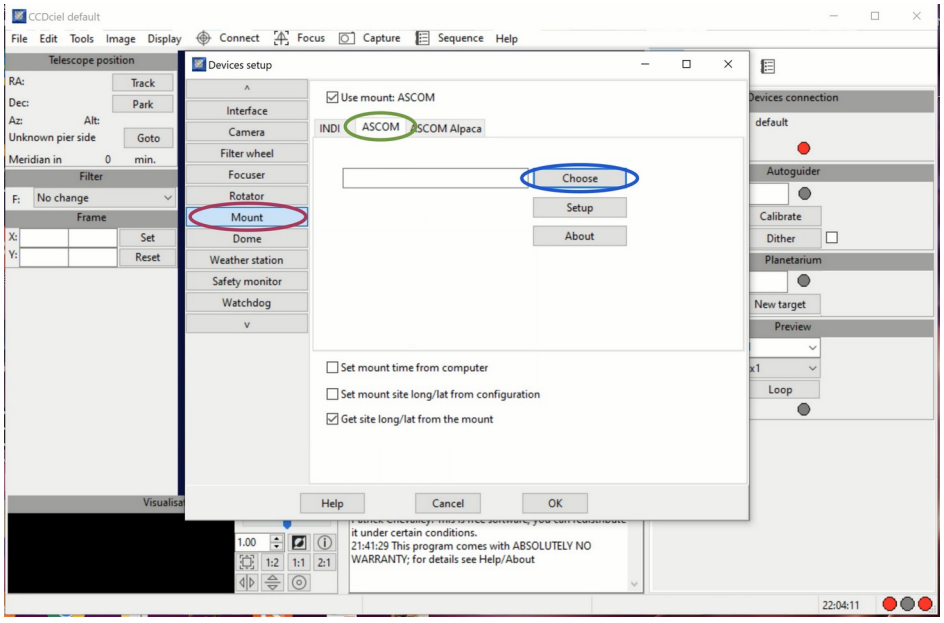


Figure 3.4.1h

3.4.2. Choosing the Nebula Go To System driver

We have seen that any of the analyzed application has a different approach to get the ASCOM Chooser panel. Once this is available, the procedure to connect the application to the mount is the same for each one.

There is a small difference between the first and the subsequent connections. The ASCOM Chooser has this aspect when invoked by the application. If the last version of ASCOM is used, which also includes Alpaca which is essential for our needs, the ASCOM Chooser will have the following aspect:

Very First Access:

The initial ASCOM Chooser use to have the following form (Figure 3.4.2a). Note that there are two unselected tabs. If the color rectangle on the right is red, it means that the discovery function is not enabled.

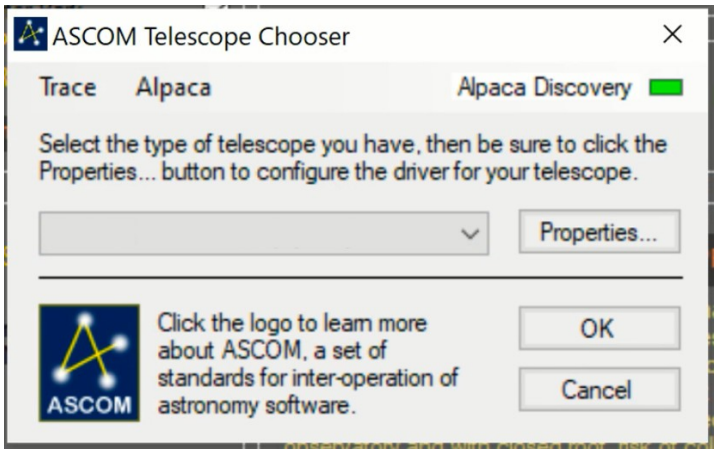


Figure 3.4.2a

Th enable it, click on the Alpaca label, for accessing the Discovery tab. It will have the aspect of Figure 3.4.2b after the Discovery Enabled is selected.

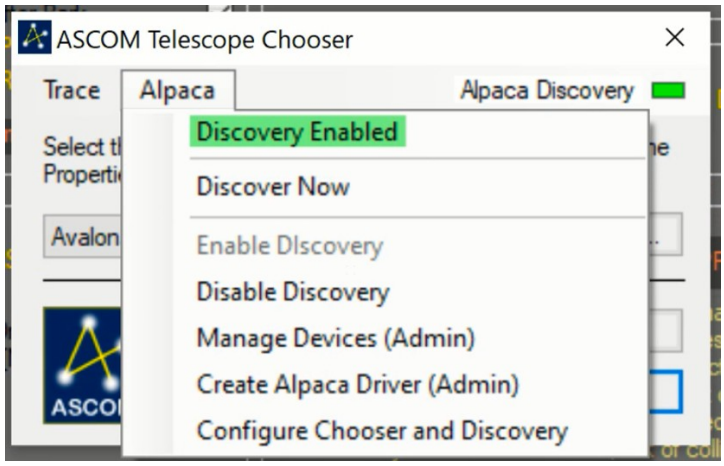


Figure 3.4.2b

From this time on, every time the ASCOM Telescope Chooser is invoked, it will have the Alpaca discovery function enebled.

With the Nebula GoTo System correctly connected to the mount and powered up, open the drop-down menu to get the list of available Alpaca drivers (Fig. 3.4.2c).

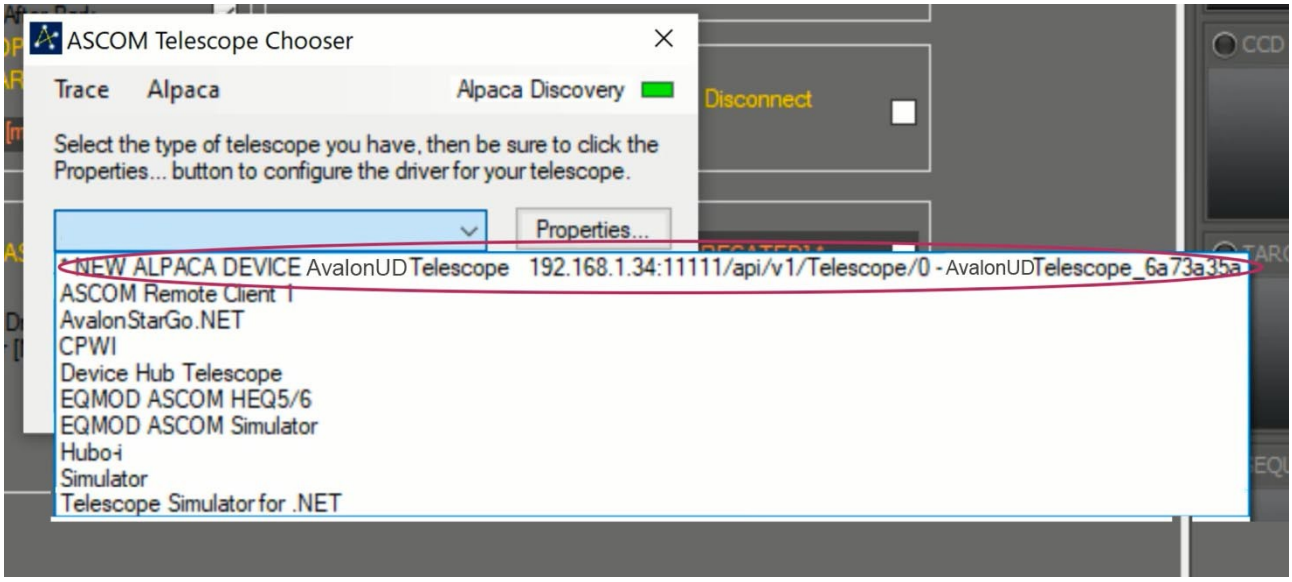


Figure 3.4.2c

In the first raw it is highlighted the new discovered device, which is our Nebula Go To System, with the indication of the related parameters. Click on the line to select and connect the Nebula Go To System telescope to the software in use. Note that the above two figure may be the last time you see them because the next times you will invoke the chooser, it will automatically detect the Nebula Go To System.

Next accessing

Next times you call the ASCOM Chooser, it will have the form of figure 3.4.2a. Opening the drop-down menu, we will get the list of available devices. Among them the Nebula Go To System one (See Figure 3.4.2d).

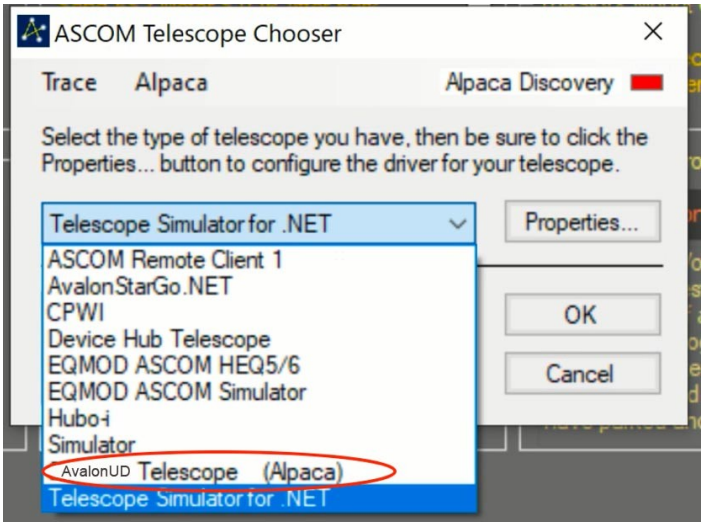


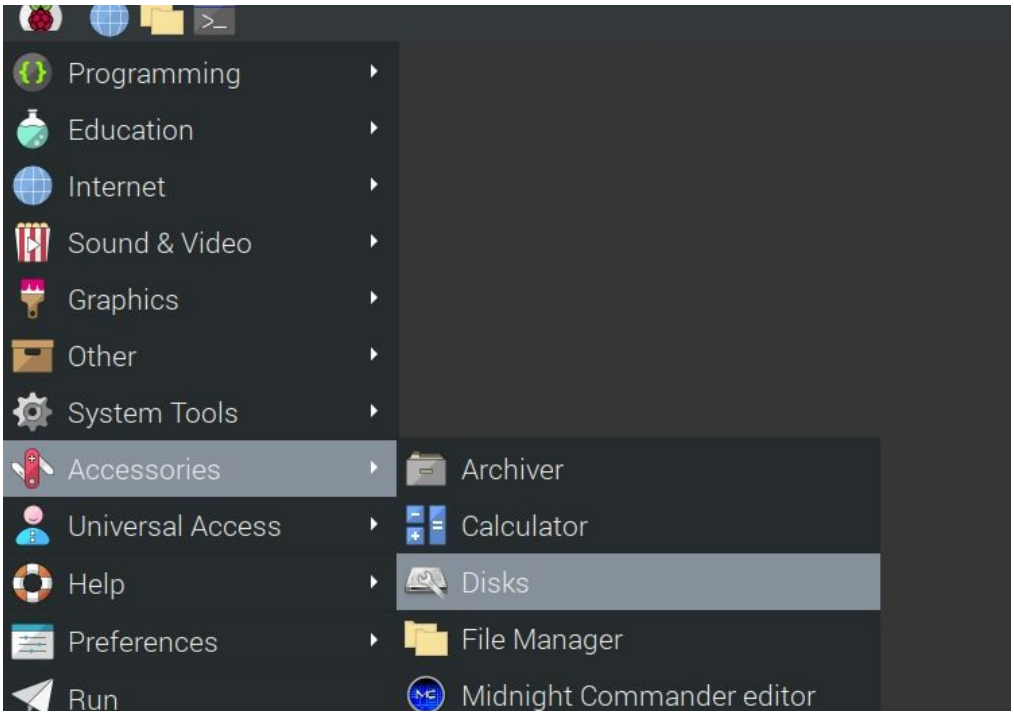
Figure 3.4.2d

Clicking on the highlighted driver will connect the Nebula Go To System telescope to the application.

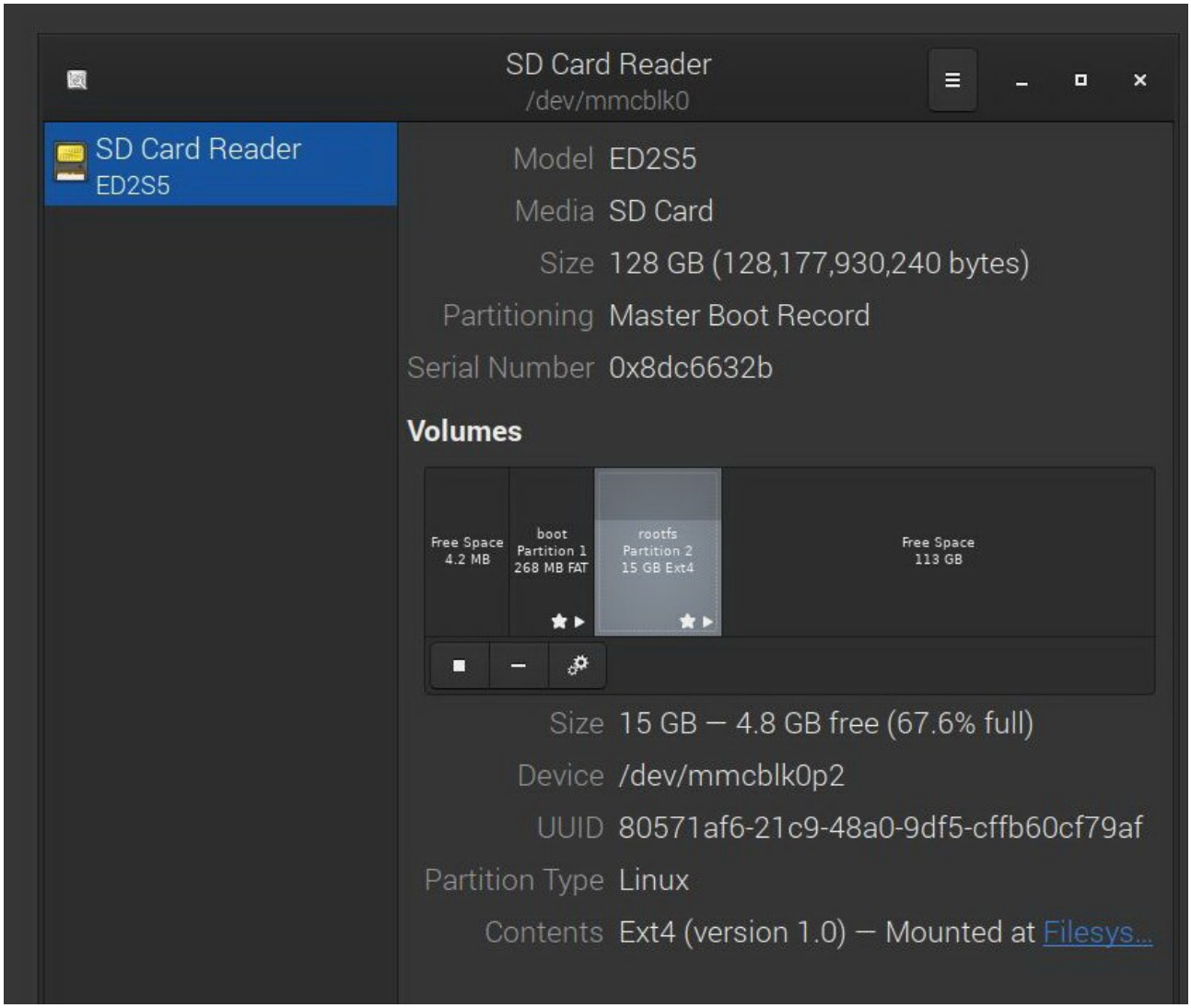
APPENDIX A

How to expand the internal Raspberry SD memory

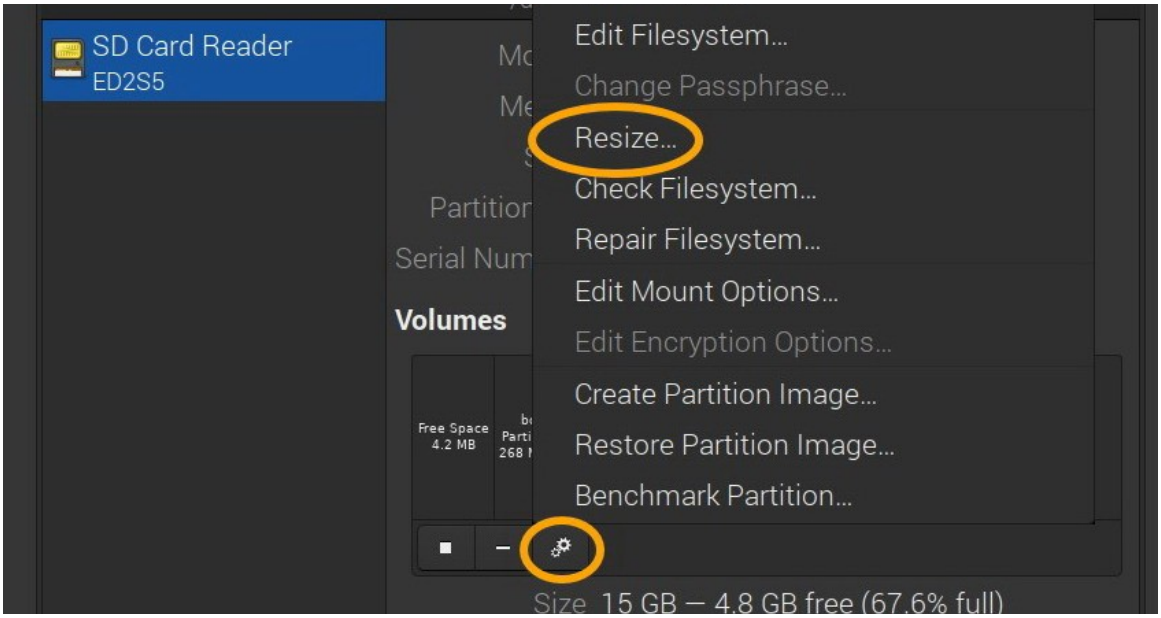
The Raspberry PI free memory can be checked with the "Disks" tool available at the following path: Accessories -> Disks (see screenhot).



With this tool and with the GParted tool (preinstalled in the Raspberry) is also possible to add / create / modify the partitions as explained below. Once the tool will be launched a window will pop up showing the memory available and has has been divided / allocated.



To modify it, click on the gear icon under the partition volume graph.



Then select the dimension required and click on the Reize button on the window top right.