

AVALON INSTRUMENTS

StarGo Plus



User's Manual

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1. Introduction

The new Avalon's mount control system, the **StarGo Plus**, a Raspberry Pi 4 micro-computer that allows a full control of the setup (mount, camera, focuser, etc...) without requiring any other external device.

The philosophy behind the **StarGo Plus** 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 StarGo Plus 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.

1.1 StarGo Plus First Web App access methods

The StarGo Plus is a Raspberry Pi based controller, in order to set up the basic system settings is required to access to the StarGo Plus WebApp. Below are described the two main connection methods:

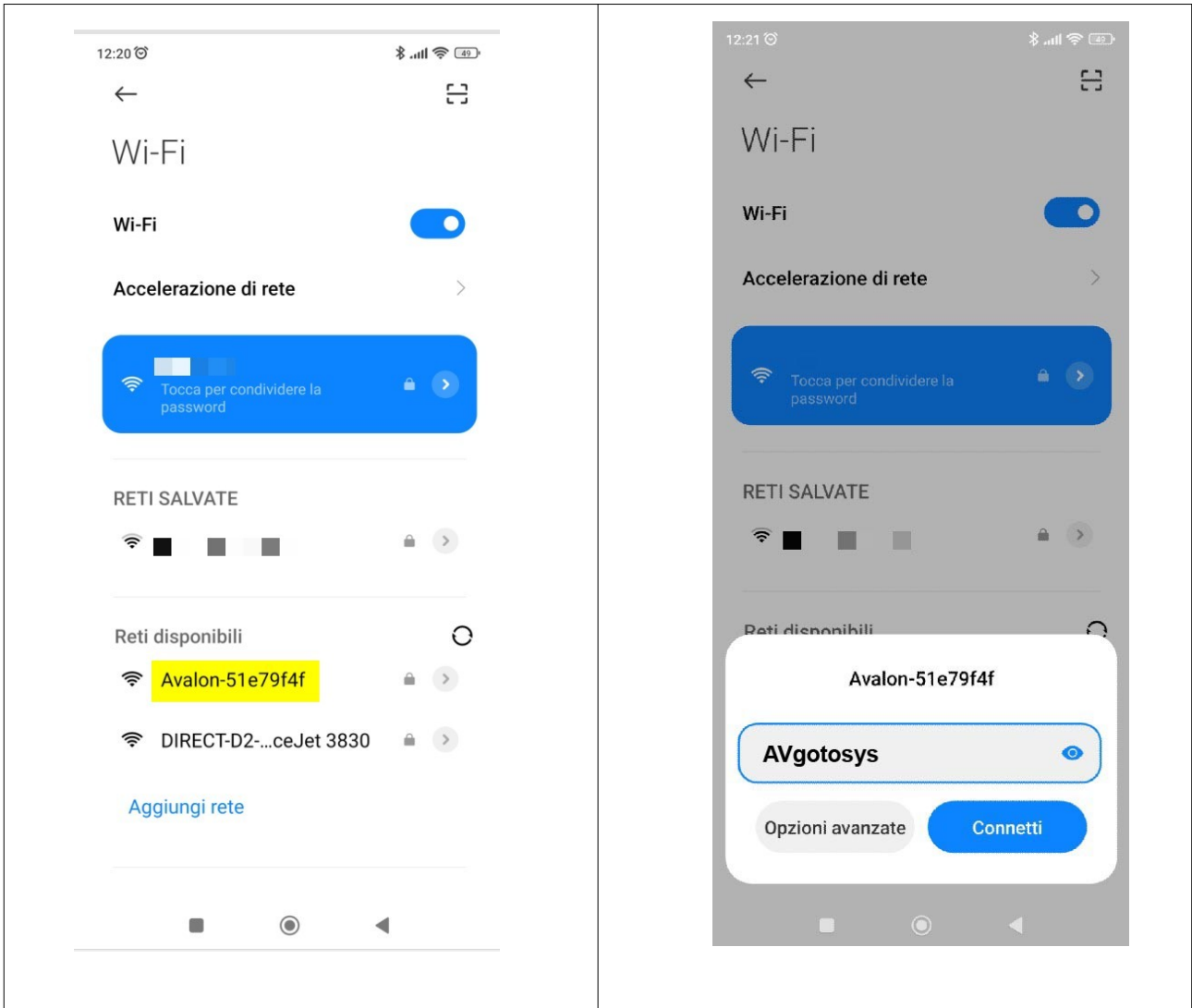
There are two main access methods:

Method 1: Through Smart Device

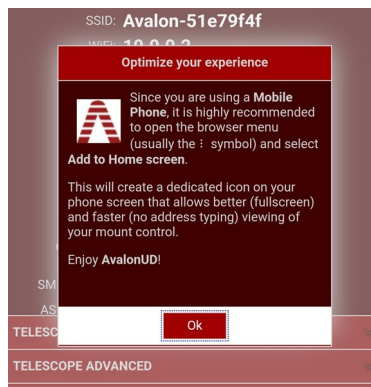
This method is the faster and smarter connection way, therefore is suggested as a first step to set up the basic system value as: I.P. address, mount configuration file, location coordinates input etc.

This connection method procedure is described below:

1. Power on the StarGo Plus 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 StarGo Plus HotSpot network. The SSID WiFi name is divided in two parts: the first is common for every device and is "Avalon-", the second is a 8 digits alpha-numeric code. So the SSID WiFi name will be something like "Avalon-xxxxxxx". In our sample the SSID is "**Avalon-51e79f4f**". 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 be opened by the device default browser.



Method 1: Throug PC

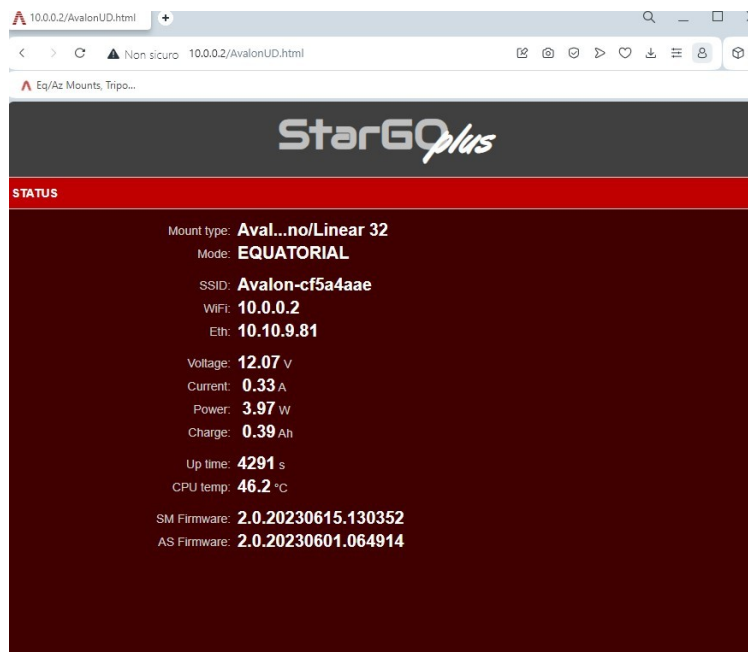
The PC access requires to know the StarGo Plus IP address.

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

1. Search the StarGo Plus HotSpot network and connect using the default password:
AVgotosys

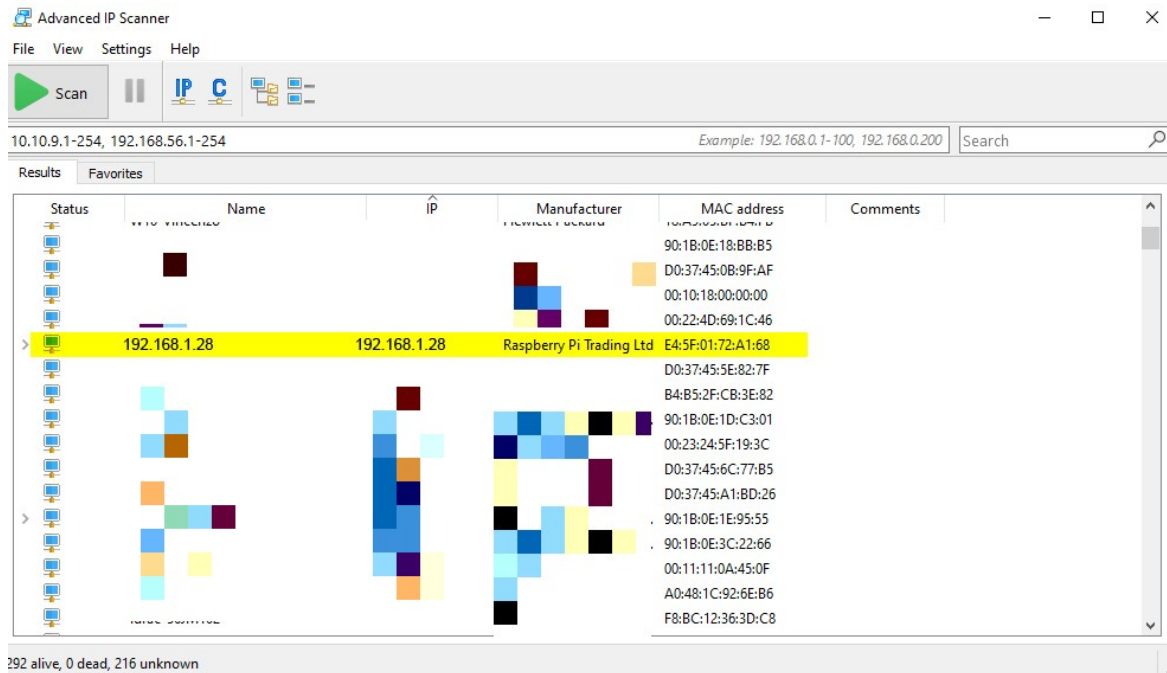


2. Soon after the connection will be required to open any kind of web browser installed on the pc and type on the url string the default StarGo Plus WiFi IP: 10.0.0.2



This method is suggested as a quick connection with the PC but in order to have a reliable connection with the StarGo Plus, for an Astrophotographic session and a complete control of the setup, is suggested the Ethernet cable connection, connecting the StarGo Plus to the router.

In this case will be required to know the IP assigned to the StarGo Plus from the router. This information can be found in two way: accessing to the router or using IP scan software. In the sample below is shown the IP scan software example:



After the correct address has been found, by typing it in any web browser installed on the PC, it will be possible to access the WebApp

1.2 Quick Start

The following procedure intend to describe the operations required to start a basic session with the StarGo Plus 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 StarGo Plus plug and wait about 20 seconds to have the StarGo Plus on and ready to operate.
4. Run the StarGo Plus WebApp (see point 1.1 StarGo Plus 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.

THREE MAIN APPROACHES TO THE StarGo Plus USE

Once all the above mentioned operations for a basic mount use has been performed, on depending on the user preferred setup managing system, the user can choose among three main way of mount control:

1. QUICK USE: SMART DEVICE ONLY (suggested for Visual Observation sessions)

Using only a smart device (smartphone or tablet) connected via WiFi to the StarGo Plus (**AVgotosys** is the password). In this case it is not possible to perform astrophotography and therefore it the most suitable method for visual observations (see section 3.1)

2. FULL CONTROL: Computer Direct Operations

REMOTE DESKTOP CONNECTION VIA VNC

Using an external PC (or even a Tablet with large display) connected to the StarGo Plus via WiFi or Ethernet and provided of VNC server for remote controlling the internal Raspberry. There, the kStars suite is already installed, allowing to command the telescope and to perform all photographic operations, even the most demanding, using the Planetary and the EKOS tools based on the well-known INDI environment (details in section 3.2).

This is the most reliable and suggested mount control method, is around this concept that the StarGo Plus has been designed.

For example, once the session is planned, even in case of temporary accidentally disconnection between the remote pc and the StarGo Plus, the setup will keep executing the session without losing any commands.

NOTE: it is possible to upload many other applications into the Raspberry, such as Cart du Ciel, Stellarium, CCD Ciel and TheSkyX astrophotography managers and even PHD2 guider replacing the internal EKOS tools. **However, this is an approach that can be performed only by expert users and with many cautions to avoid possible interference with the StarGo Plus operating system. In any case it is necessary to consult Avalon Instruments before trying this way. Avalon is not responsible of possible software faults due to this approach.**

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

3. FULL CONTROL: Computer Remote Operations

SETUP MANAGING SOFTWARE RESIDING IN EXTERNAL PC. StarGo Plus AS A MERE COMMANDS EXECUTOR (for N.I.N.A., SGP habitual users)

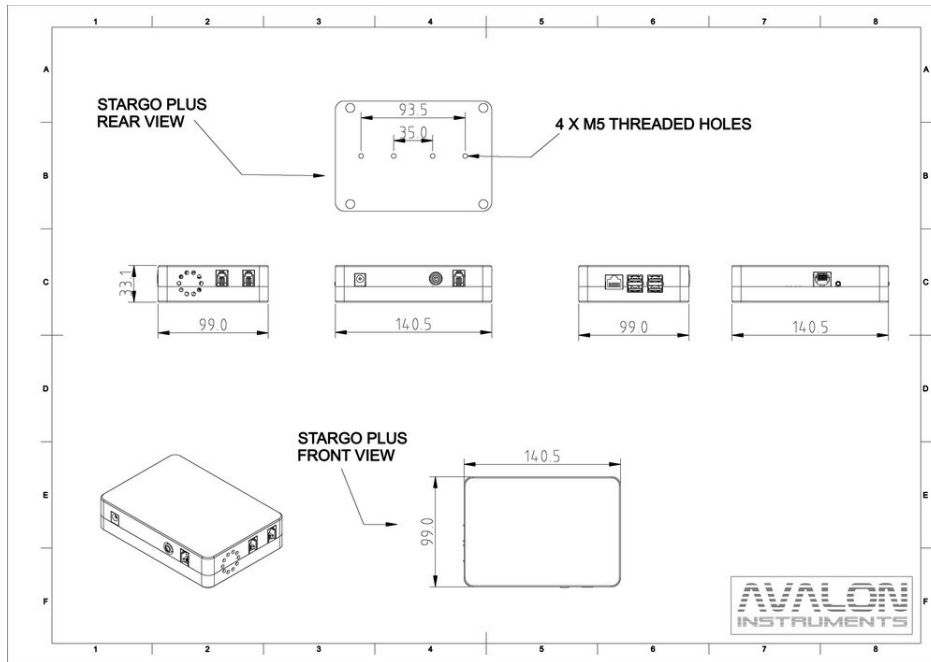
The third method is similar to the previous one as regards the equipment involved and the connection method to the StarGo Plus. The basic difference is that this time the managing software for both telescope control and astrophotography actions are residing in the remote computer and not in the internal Raspberry. In this case the StarGo Plus loses its smart capability and becomes a simple executor of commands generated outside of it. The advantage of this approach is that the operator can continue to use the habitual software such as Sequence Generator Pro, NINA, etc, which are not available in the Raspberry environment, but the disadvantages are that one loses the independence from external PC while it uses Tablet to remotely control the system. Details on this approach are given in sections 3.3 and 3.4.

In this modality, being the StarGo Plus a mere commands executor of input coming from an external device connected without wires, the configuration cannot be considered as much as stable as the FULL CONTROL WITHOUT EXTERNAL DEVICE option.

Being required the constant commands transmission between the remote device and the StarGo Plus, a temporary lack of transmission could affect the session result.

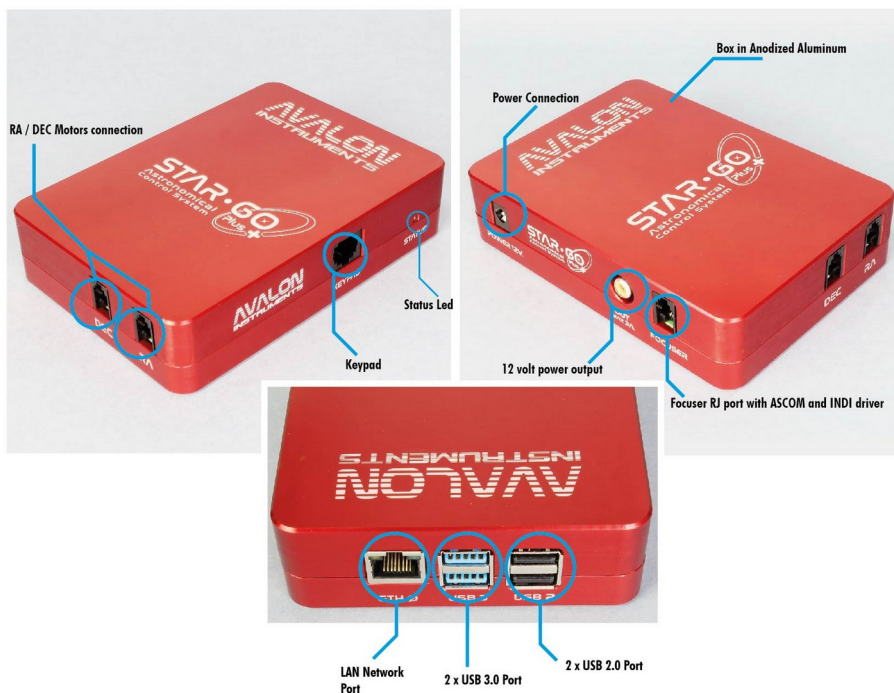
2. The StarGo Plus Controller

The StarGo Plus controller is constituted by an aluminum box with compact dimensions,

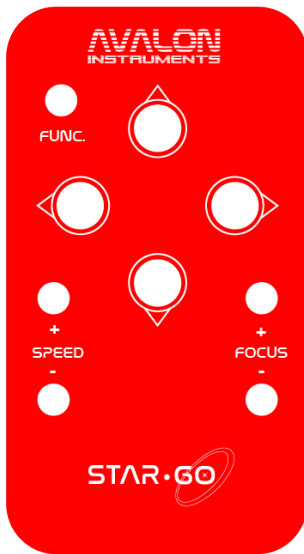


The box is provided of all the input/output connectors for communicate by wire with the mount motors. It is also provided of one RCA connectors providing 12 VDC supply to external devices such as CCDs, Filter wheels, Focusers, etc. All these power outputs may be controlled by the operator. Furthermore, the StarGo Plus is also provided of the Raspberry PI typical Ethernet and USB I/Os. Figure 1 shows the StarGO 2 schematic.

STARGO PLUS INPUT/OUTPUT SCHEME



2.1. Use of the StarGo Plus Handcontroller



The full control of the setup is made through the StarGo Plus 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 control of 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 instance 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:

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-:

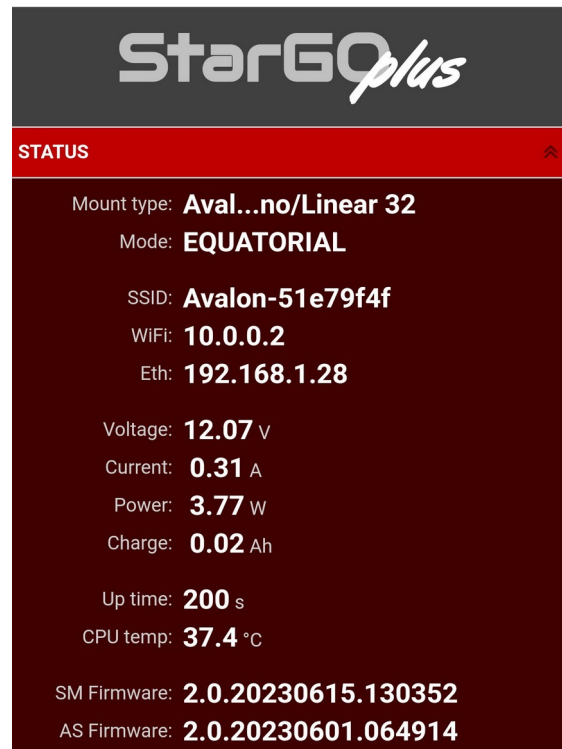
In display equipped controllers decreases display brightness

Instead in no display controllers, if pressed for at least 5 seconds, triggers "**Park**" if unparked or "**Unpark**" if parked

2.2. Use of the StarGo Plus WebApp (SGWA)

The StarGo Plus WebApp (SGWA) has 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.

The **STATUS** panel (Figure 2.6a) provides a list of parameter values to keep under control during the telescope operations.

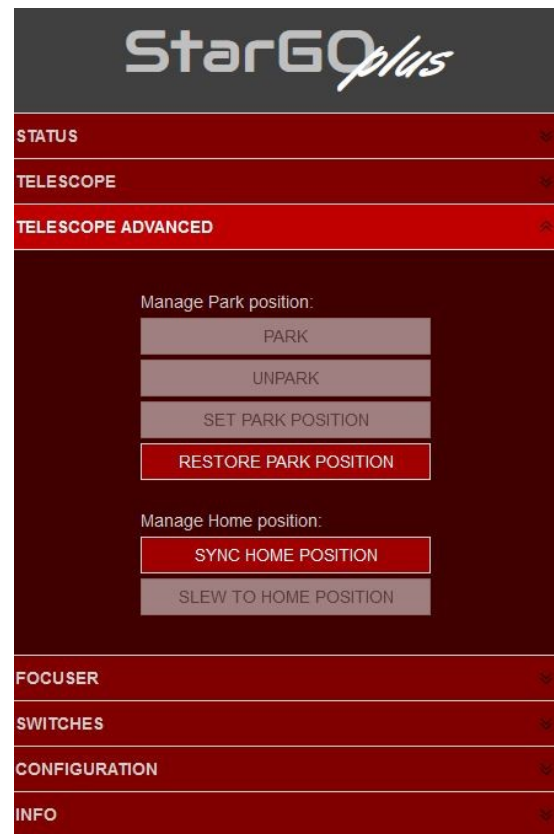


The **TELESCOPE** Panel (Figure 2.6b) contains the StarGo Plus virtual keypad with which we can duplicate all operations performed with the hardware keypad with the addition of other information:

- 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.



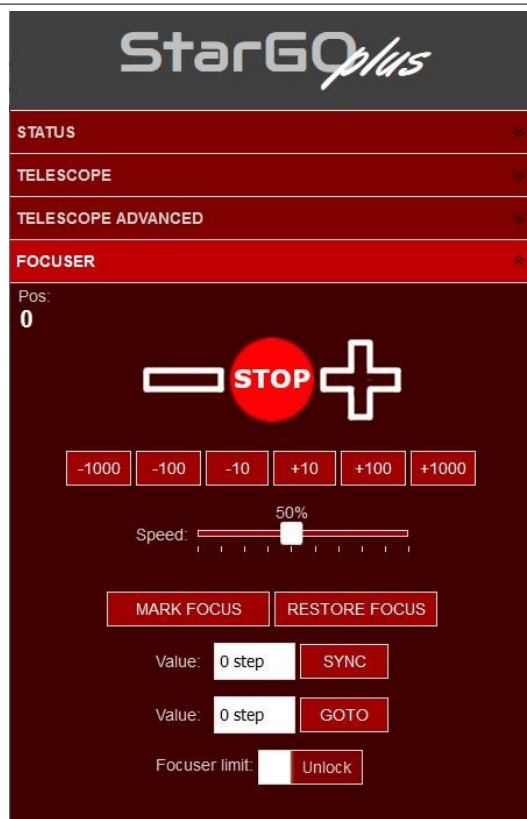
The **FOCUSER** panel shows the operations that can be performed to a suitable focuser (Avalon, Starlight and other brand to be tested), connected to Focuser plug available on the StarGo Plus box.

The - / + buttons make to focuser to move in and out from the current position, which is shown on the upper left corner of the panel.

Below these two buttons there is a string of other small keys with - / + numbers. Clicking one number, the focuser will move inward/outward matching the correspondent number of steps on the key.

The cursor below allows to set the focuser motion speed.

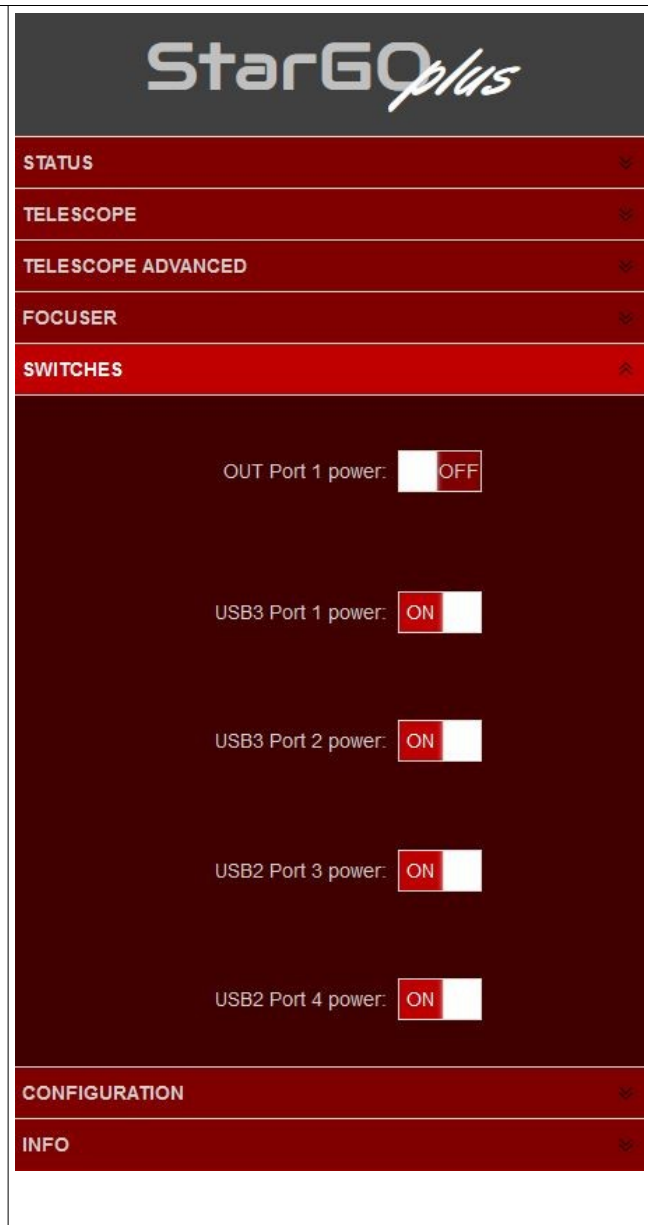
Finally, using the two buttons below, it is possible to set a fixed focuser position that can be used as starting point on focus search (MARK FOCUS) and bring the focuser to this position in case of need.



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 StarGo Plus, used to control peripheral devices, like those cited above.

The sixth panel INFO (Figure 2.7c) report a summary of the StarGo Plus 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 StarGo Plus 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 StarGo Plus.
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 StarGo Plus 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. Telescope Operations with the StarGo Plus

The StarGo Plus is shipped with an Open-Source set of applications (KStars, EKOS, INDI) already installed on the internal Raspberry SD, together with other useful programs.

The use of the StarGo Plus telescope with only a mobile device is called “**Smart-device Direct Operations**” whereas the use of it with a PC is called “**Computer Direct Operations**”. They will be described in section 3.1 and 3,2 respectively.

An alternate approach is the use of a set of application residing on a remote device or PC that manage all the telescope operations. The advantage of this approach is that the users can choose the most suitable applications for their needs with emphasis on astrophotography. This approach, called “**Computer Remote Operations**”, will be reported in section 3.3.

A final approach consisting of the installation by the users of the desired applications, directly on the StarGo Plus Raspberry, allowing in this way to manage the telescope with on StarGo Plus third party software accessed with smart devices or PC both wired or wireless. This approach, called “**Advanced Direct operation**” will be described in Section 3.4, including the management with both smart-devices and PCs. This method, requiring the access to the Raspberry OS, is more demanding in term of informatic competence by part of the users and is recommended to the Raspberry and Linux experts.

3.1. Smart Device Direct Operations

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 StarGo Plus 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 StarGO via its USB ports.

To use the StarGO 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 StarGO to Skysafari 6:

- 1 Connect the device to the StarGO 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 StarGo Plus: 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 StarGo Plus 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.

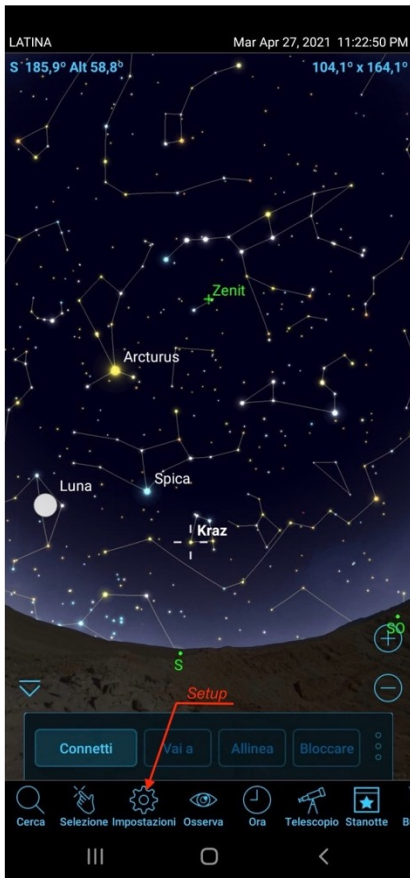


Fig. 3.1.1a



Fig. 3.1.1b

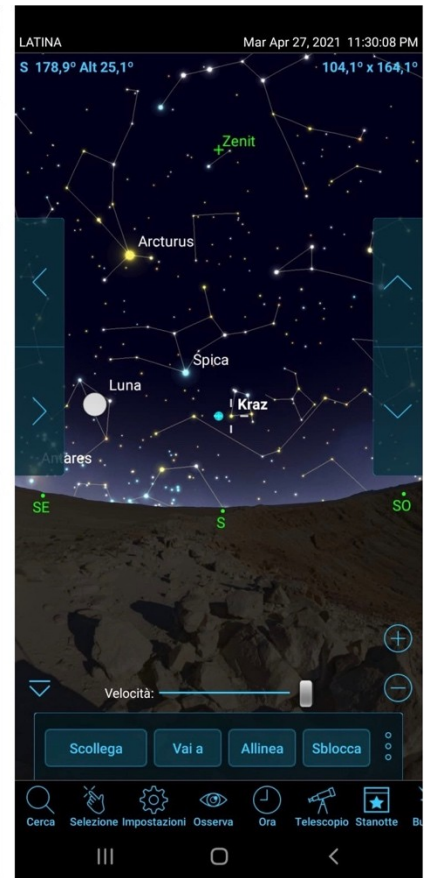


Fig. 3.1.1c

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 StarGo Plus. 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 StarGO 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 operazioni for the other two modes of connection:

- 1 Connect the device to the StarGO 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 *Presets* label. The Presets page will open (see Figure 3.1e).



Fig. 3.1.1d

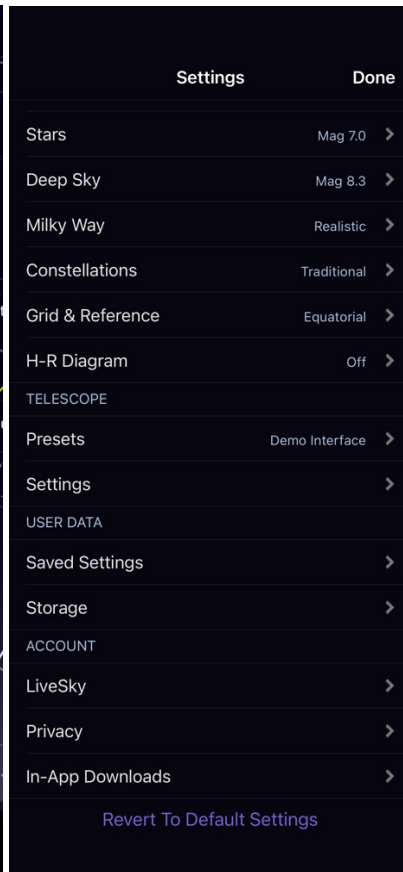


Fig. 3.1.1e



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 StarGo Plus 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 StarGo Plus 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

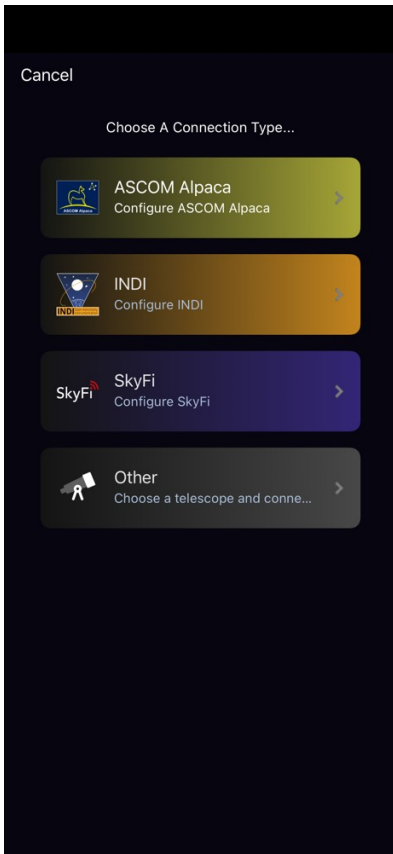


Fig. 3.1.1g

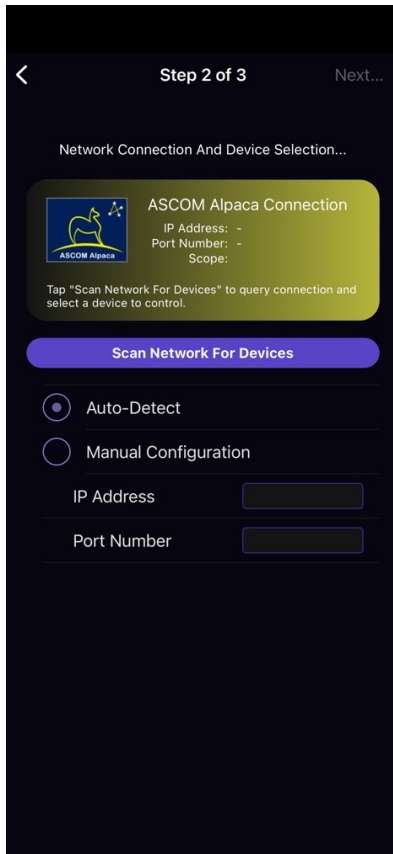


Fig. 3.1.1h

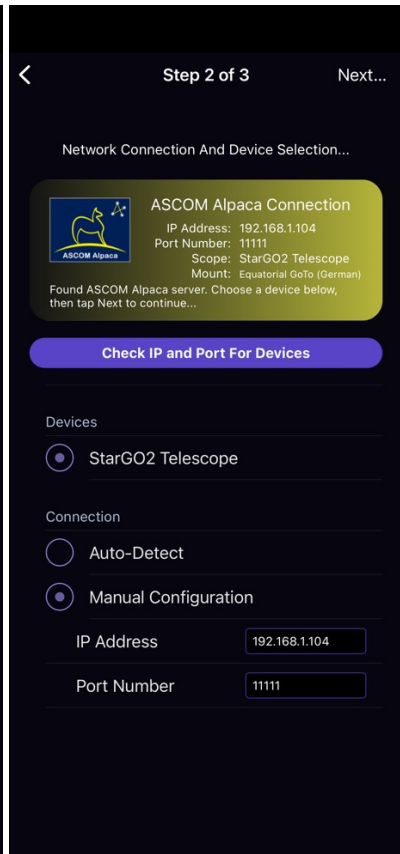


Fig. 3.1.1i

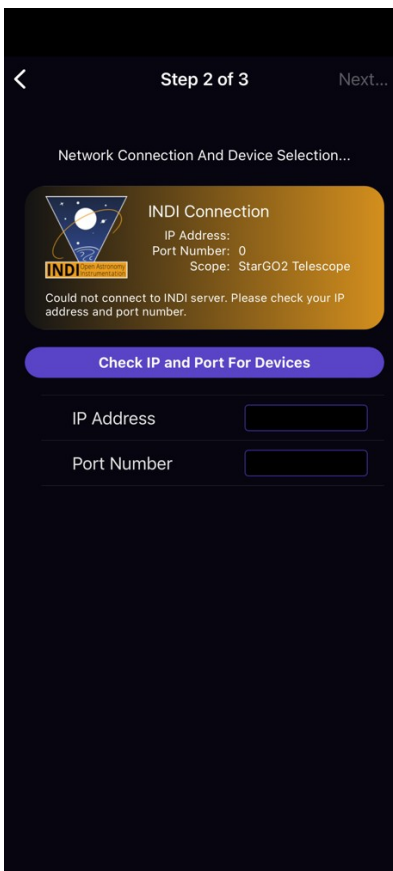


Fig. 3.1.1l

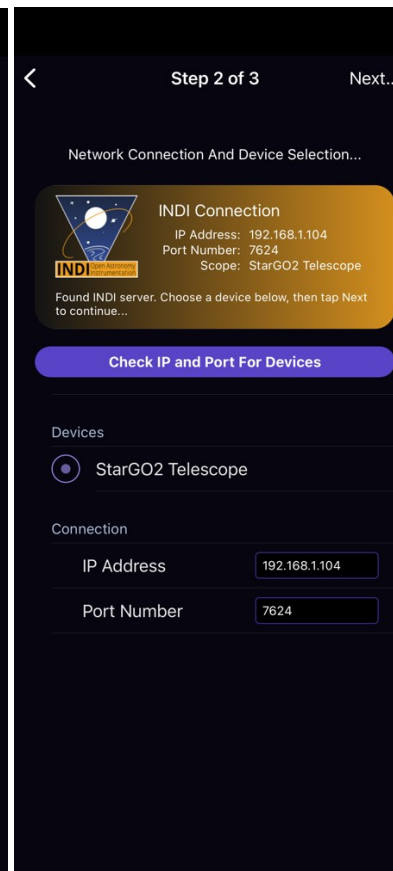


Fig. 3.1.1m

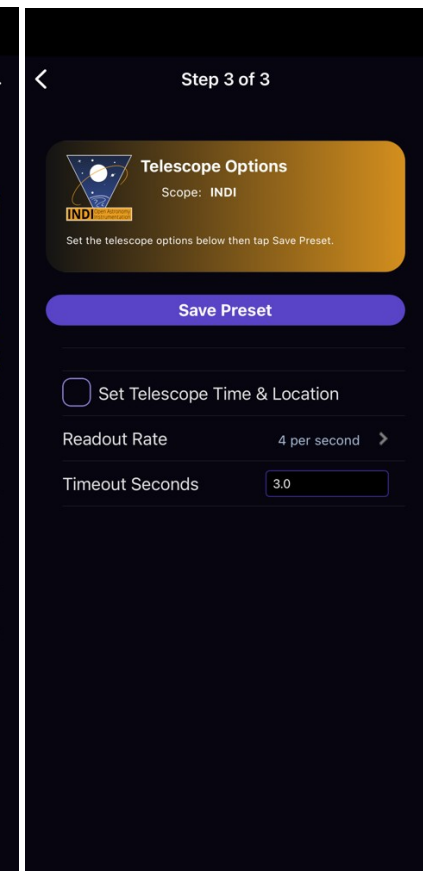


Fig. 3.1.1n

- 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 StarGo Plus to synchronize with Time and Location of the device. The second is the refresh rate of the application planetary which doesn't affect the StarGo Plus 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 StarGo Plus 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 StarGo Plus 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 activate them again. Choose the set of features which are more suitable to your needs and taste.

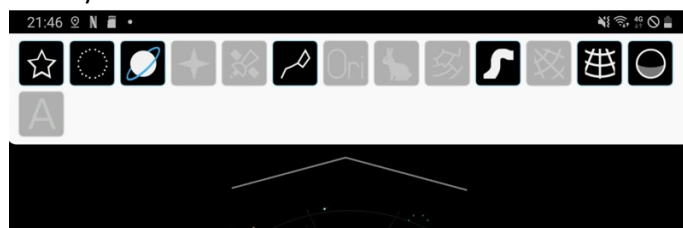


Fig. 3.1.2a

- For connecting the device to the StarGO 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 StarGO 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.

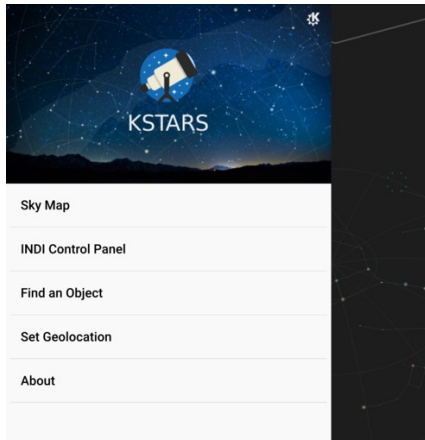


Fig. 3.1.2b

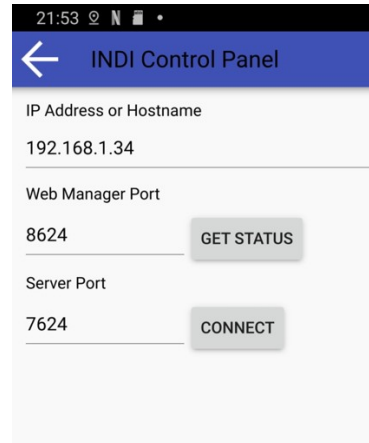


Fig.3.1.2c

- 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 StarGo Plus Telescope section.
- 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).

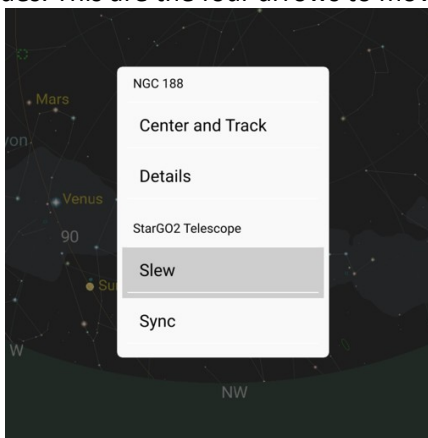


Fig. 3.1.2d

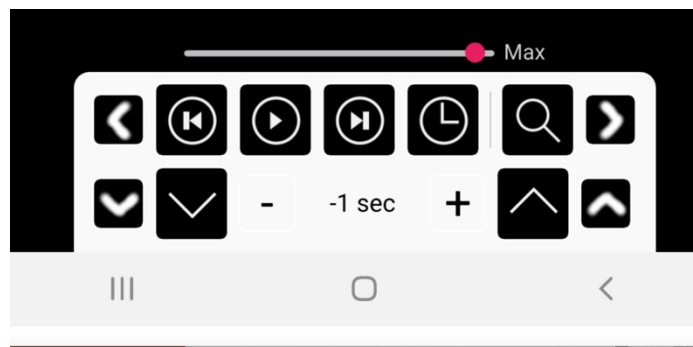


Fig. 3.1.2e

- 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 StarGo Plus is already connected to the device, a different page will appear. In this page click “StarGo Plus 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.
- 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).

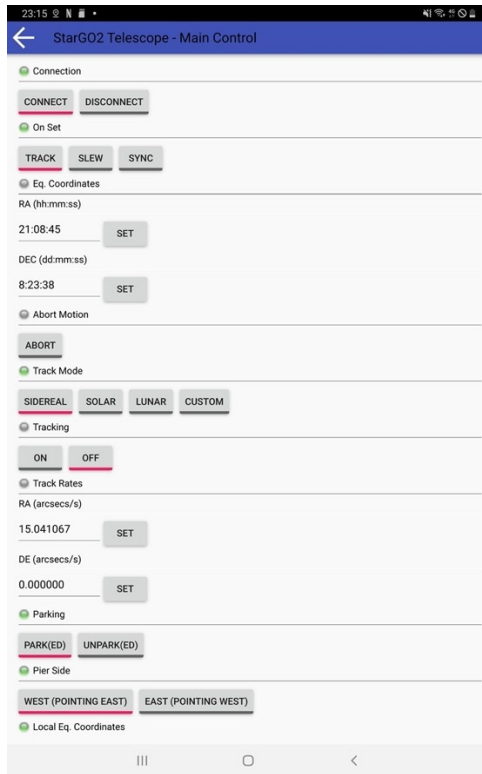


Fig 3.1.2f



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 StarGO 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.

3.2. Computer Direct Operations

This method of StarGo Plus management is more oriented toward astrophotography applications or more sophisticated visual sessions, for example with automatized planning. It involves the use of astronomy software provided with the StarGo Plus and embedded in the SD card coming with the hardware. 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 results of shooting will be preferably saved on external USB flash pens to be processed afterward in an external computer.

The only external contribute to the setup is the graphical interface for the user through which the operator will interact with the internal Raspberry. The connection will be established via WiFi or Ethernet cable using VNC (provided with the StarGo Plus) or any other suitable other remote-control software. The logic schematic of the system is given in the following figure.

3.2.1. How to establish a Remote desktop connection via VNC

This modality allow the full control of the setup (mount, focuser, camer etc.) without the needs of any other external device.

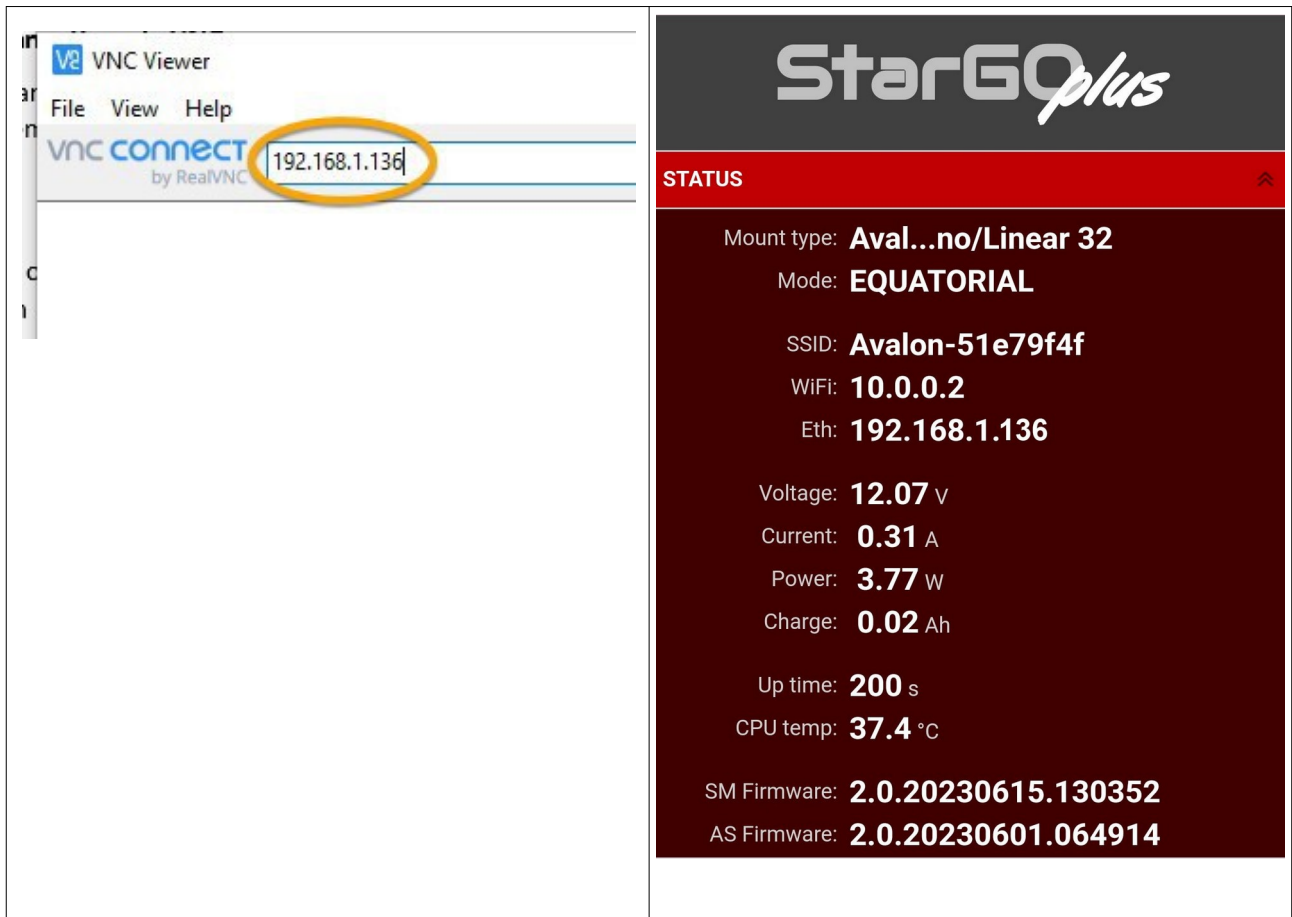
By default, on the StarGo Plus, is already installed the VNC server, so, in order to establish the connection from a remote device such as a laptop or a PC, it must be downloaded and installed the VNC viewer.

After the installation of the software, in order to establish a remote desktop connection with the StarGo Plus, perform a double click of the VNC icon app.



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.

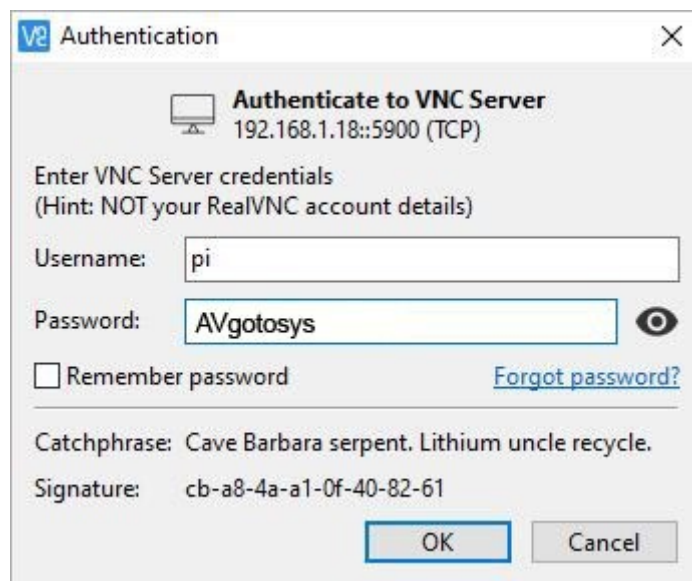
In the corresponding field, write the I.P. (in our sample is 192.168.1.136, as shown in the pictures below) and press Enter.



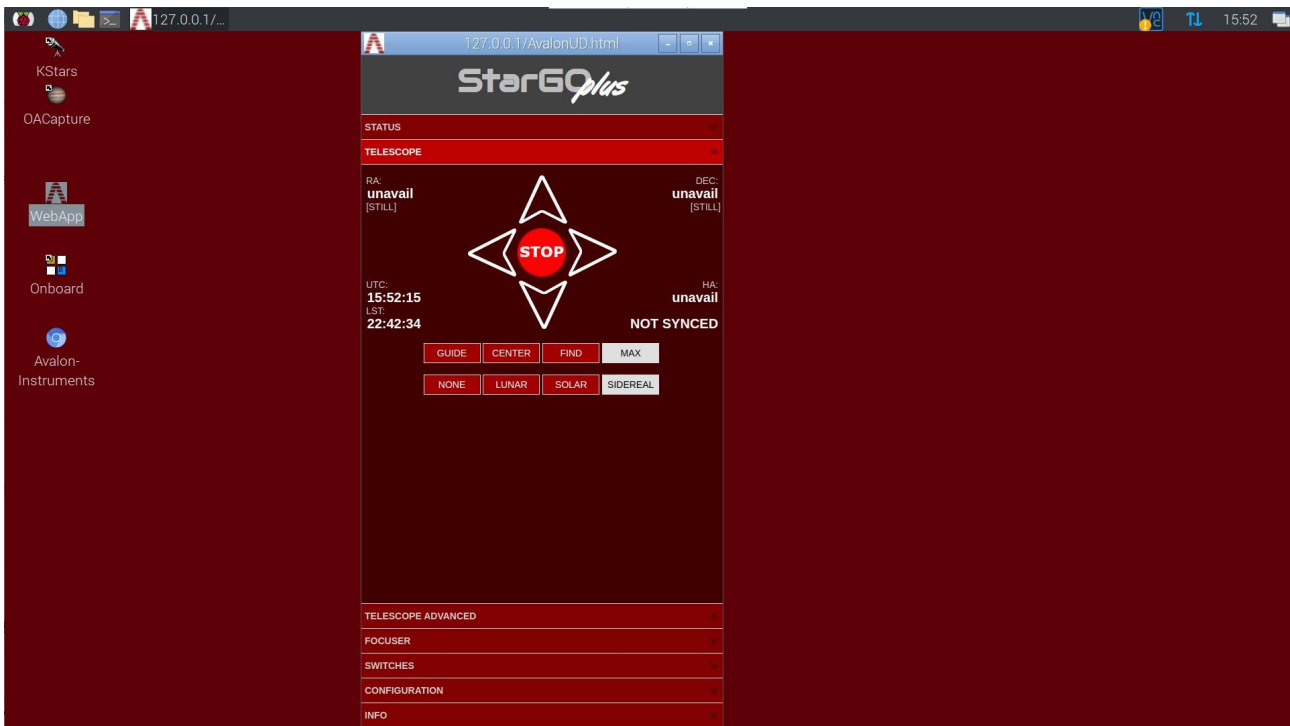
Now a new window will pop up asking Username and Password, the credentials for the log in are the following:

Username: pi

Password: AVgotosys



After pressing the OK button it will be possible to get inside the StarGo Plus Operative System.



3.2.2. KStars, EKOS

The first planetarium application we will take into consideration for using the StarGo Plus 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 StarGo Plus 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 StarGo Plus (Windows PC, Mac, Linux PC, iOS and Android devices). In any case it is necessary to use a Remote Desktop Application such as VNC, AnyDesk and others to connect to the Raspberry desktop in which will find the KStar application icon.

Telescope Setup with KStars

Before to start the step-by-step procedure, it is necessary to access to the Raspberry desktop (Figure 3.2) using the chosen Remote Desktop application and the IP address of the StarGo Plus that can be read on the main page of the On Device DisplaySODD.



Figure 3.2 – Raspberry Desktop

At the VNC request enter the Raspberry credential **pi** and **AVgotosys**. Once entered the desktop, double click on the kStars icon (the first on top left):

- 1) **Enter in EKOS environment:** Launch KStars and, 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). If a wizard window will appear before (see figure 3.3), don’t hesitate to close it).

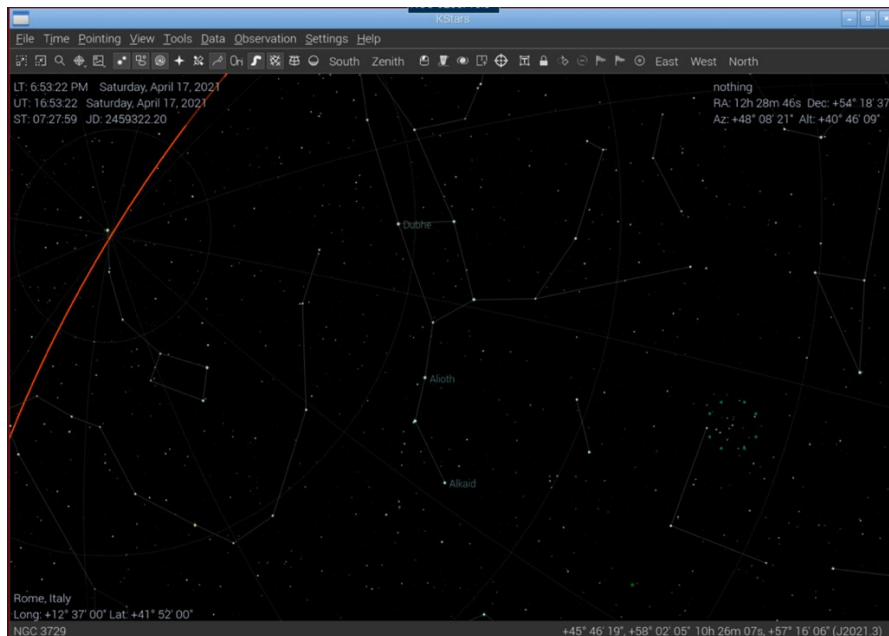


Figure 3.2 – KStar main window

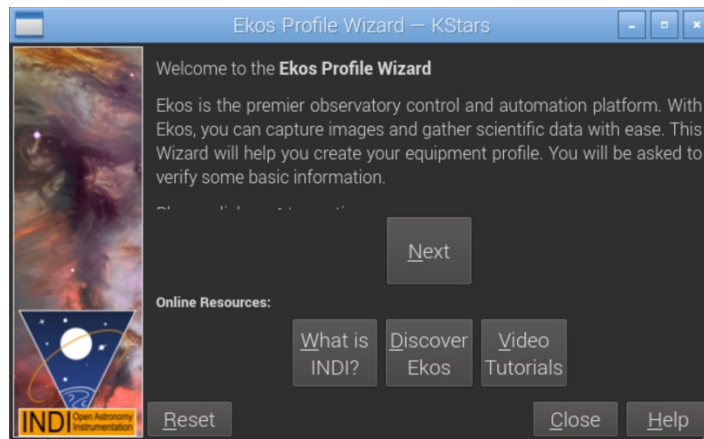


Figure 3.3 – KStar Wizard Window

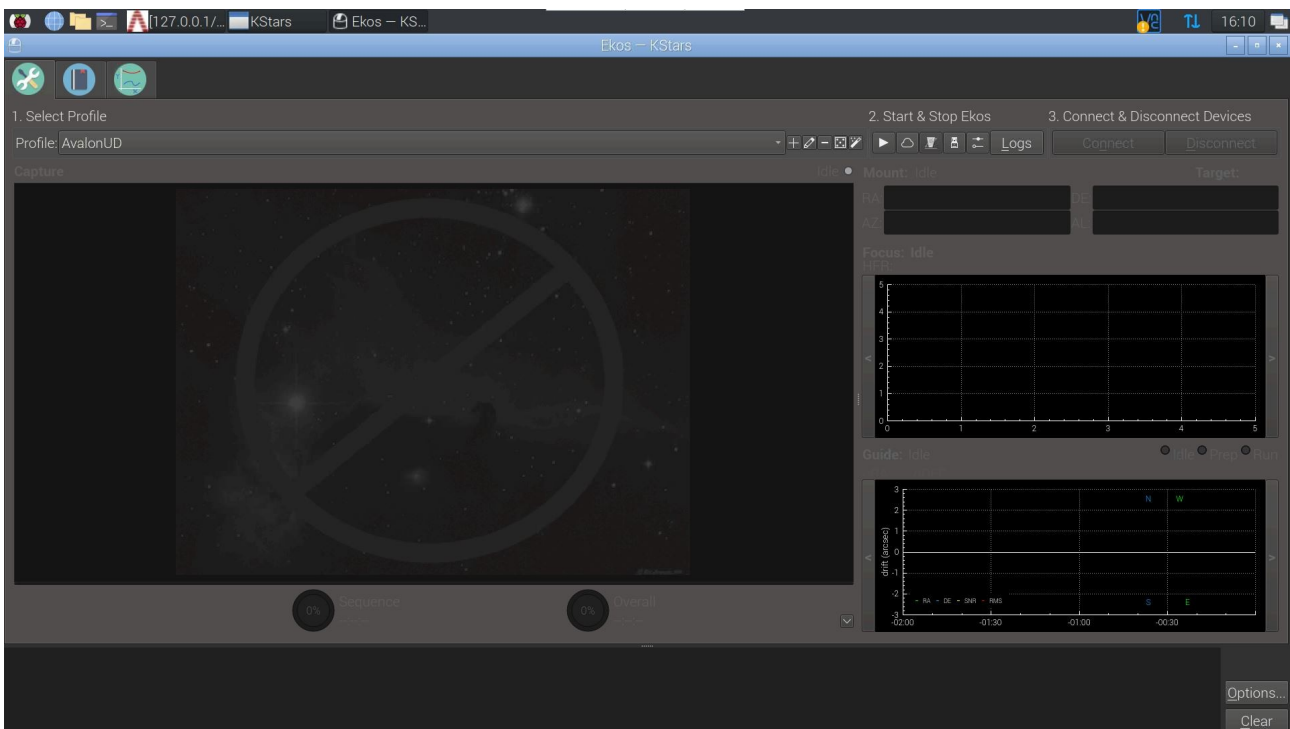


Figure 3.4 – EKOS – KStar window

2) From the EKOS – KStar window we can setup the StarGo Plus file and, once done, we can launch the EKOS session clicking on the triangle icon. The Profile Editor window is opened by clicking the pencil icon between + and -. In Figure 3.5, we can see that only the mount type StarGo Plus has been selected. The CCD and Guider simulator devices have been selected only for description purpose. It is obvious that up to the user choosing the correct drivers, in any of the available equipment dropdown menu, related to the specific piece of equipment available in the system.

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 StarGo Plus.

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.

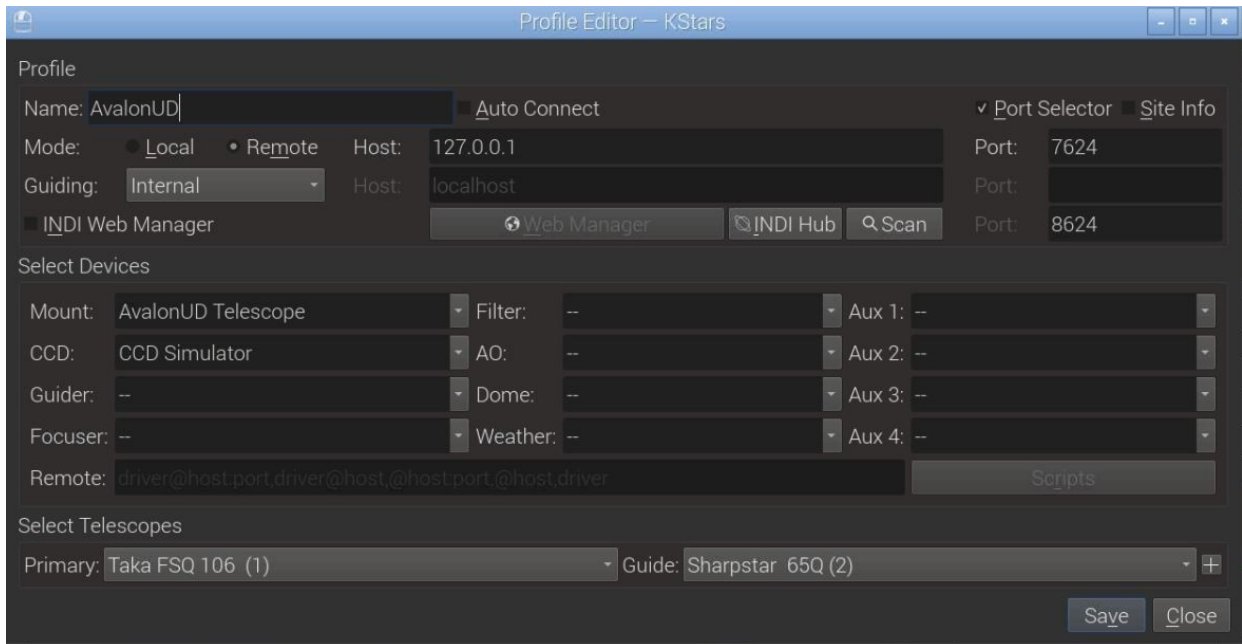


Figure 3.5 - Profile Editor

- 3) To connect the equipment to the StarGO click the triangle icon (see Figure 3.4) in the EKOS – KStars window. The INDI Control Panel will appear, containing a series of Tabs and Sub-Tabs related to the connected devices. What is important for the mount management is the StarGo Plus Telescope tab (see Figure 3.6a). The Sub-Tabs are related to the various setup and or operation commands which are possible to check and/or execute (this operation is necessary only at the first access or any time we need to change any of the mount parameters). The content of the following figures (from 3.6 to 3.6f) is auto-explaining:

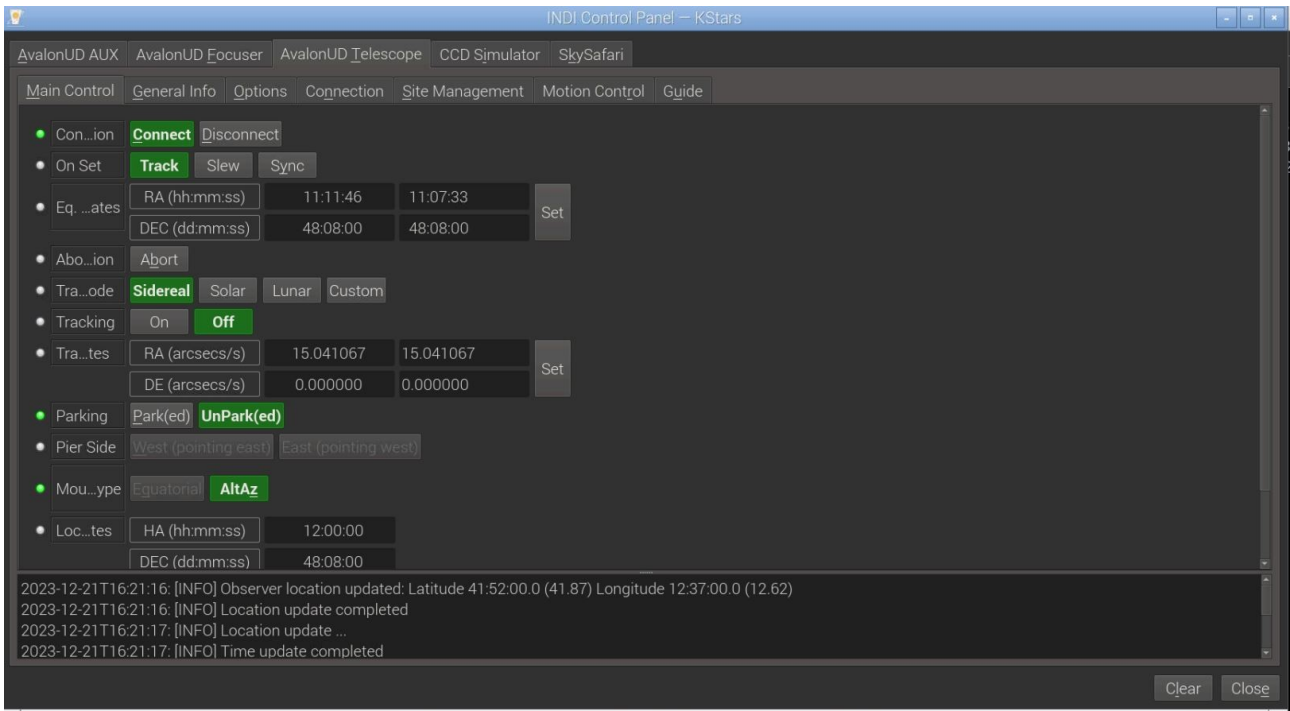


Figure 3.6a – StarGo Plus Main Control Tab

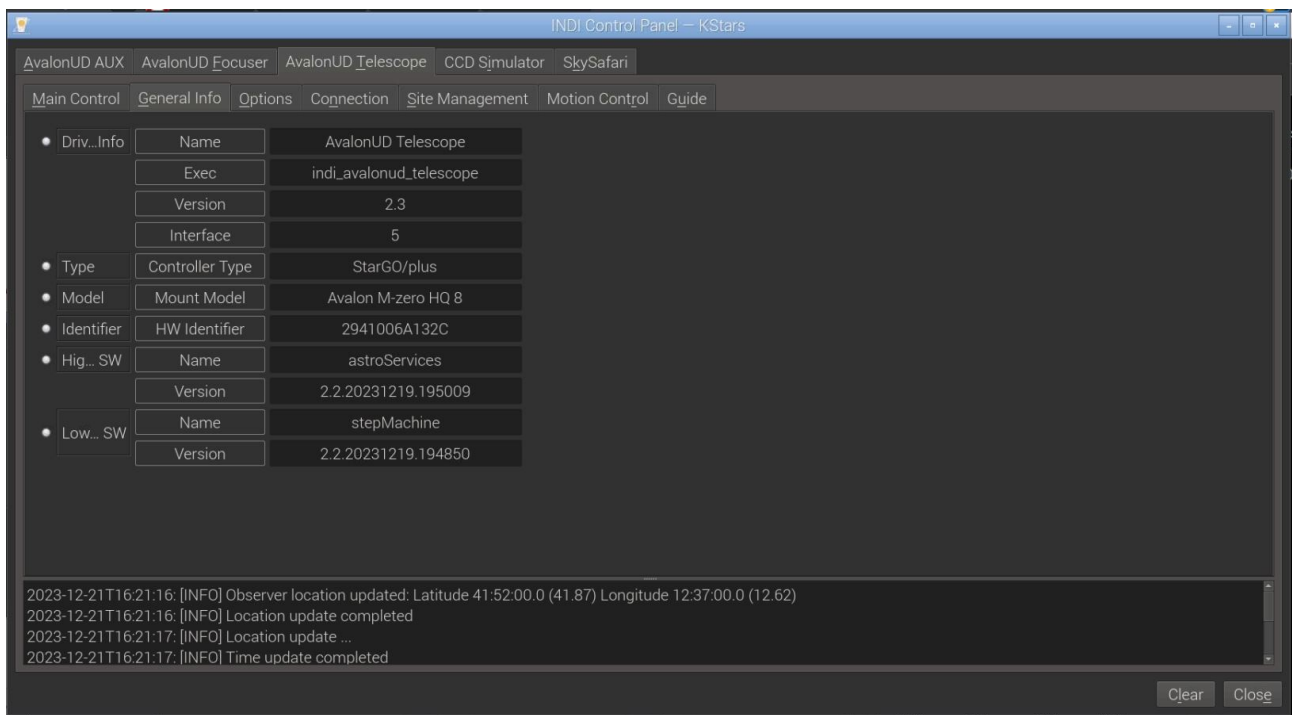


Figure 3.6b – StarGo Plus General Info Tab

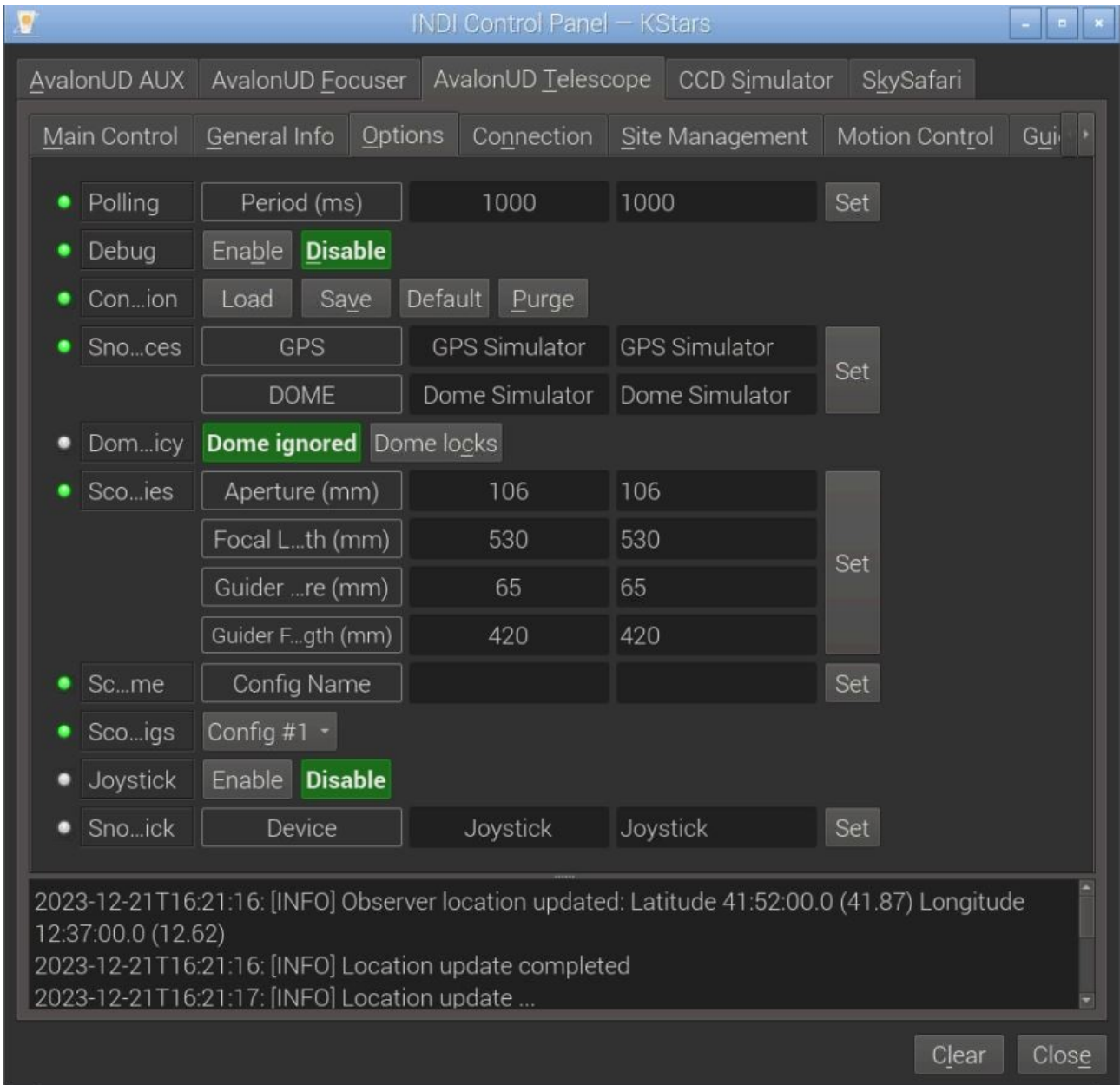


Figure 3.6c – StarGO Option Tab

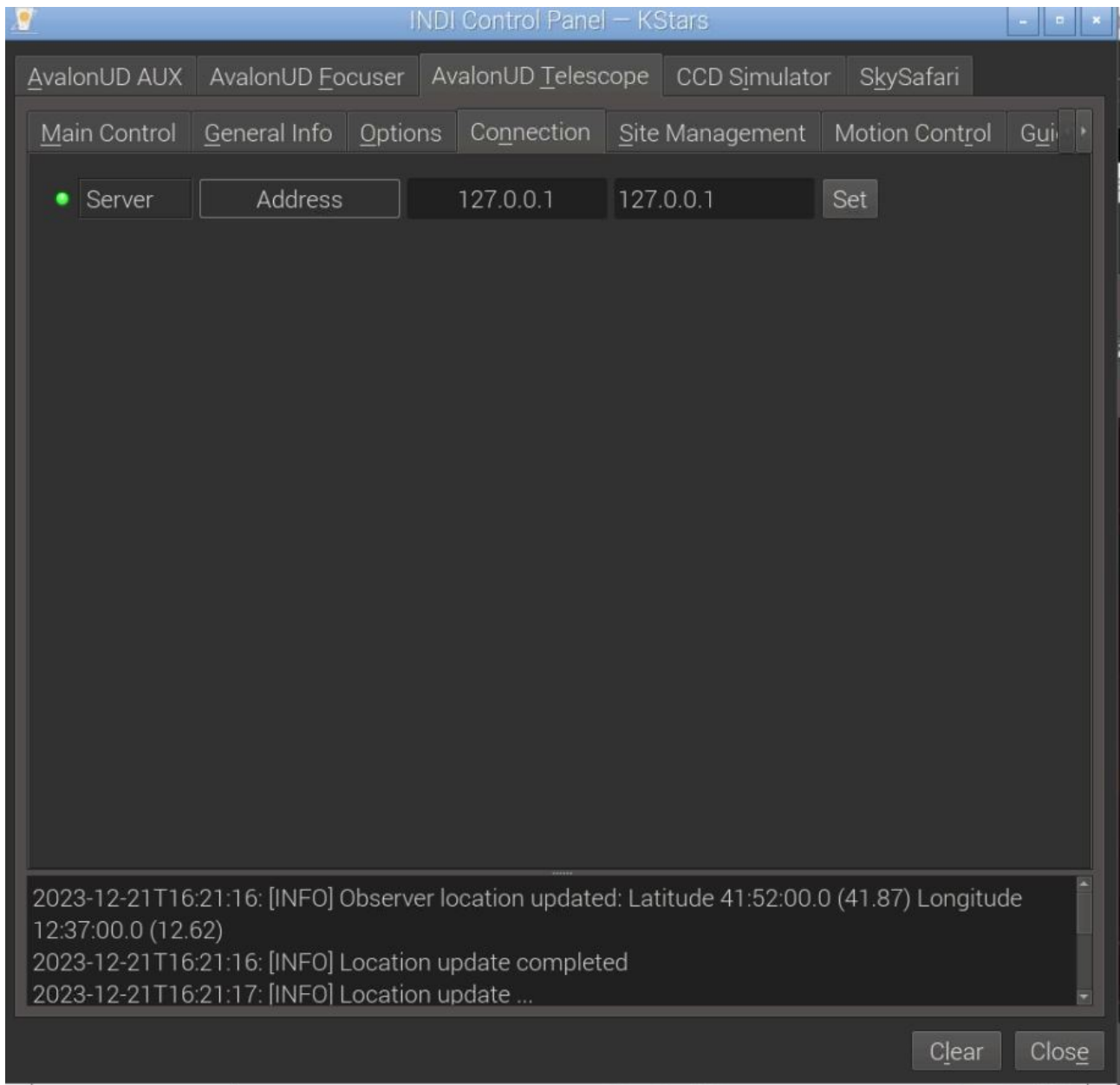


Figure 3.6d – StarGo Plus Connection Tab

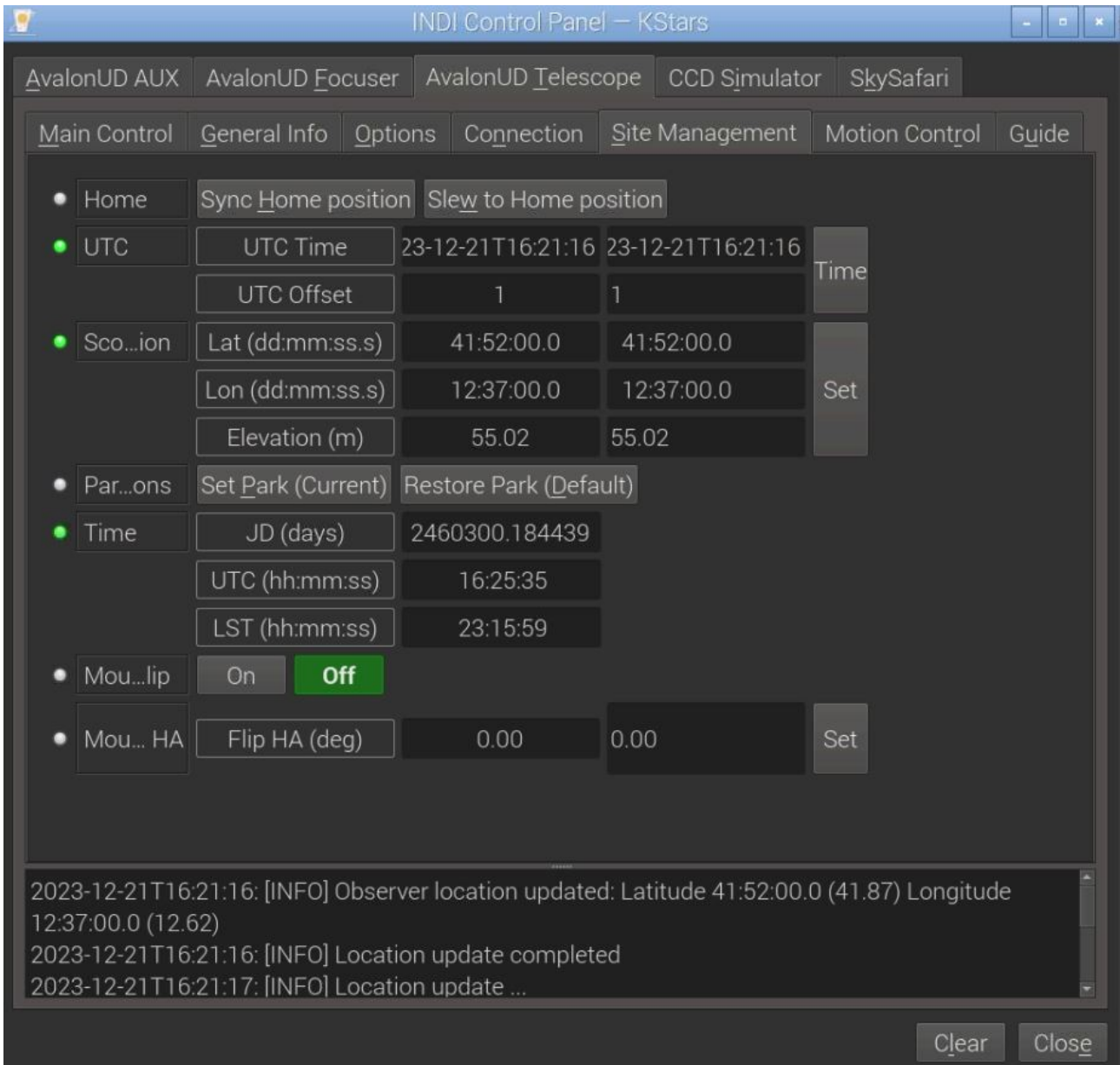


Figure 3.6e – StarGo Plus Site Management Tab

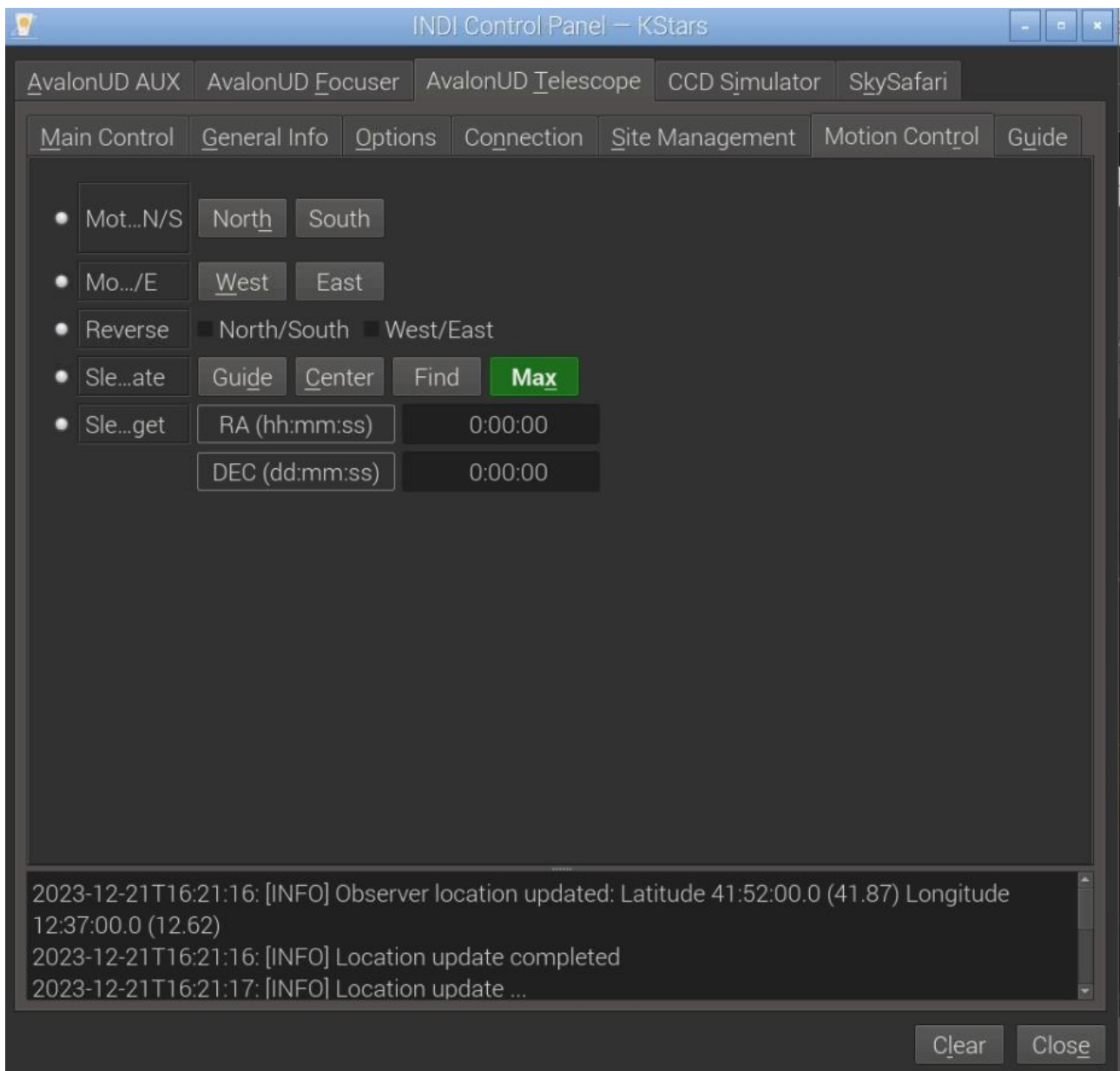


Figure 3.6f – StarGo Plus Motion Control Tab

- 4) 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 – StarGo Plusfile – KStars and its top is now populated with a long row of colorful icons, each related to the tabs necessary to operate the single pieces of equipment in our profile (se figure 3.7).

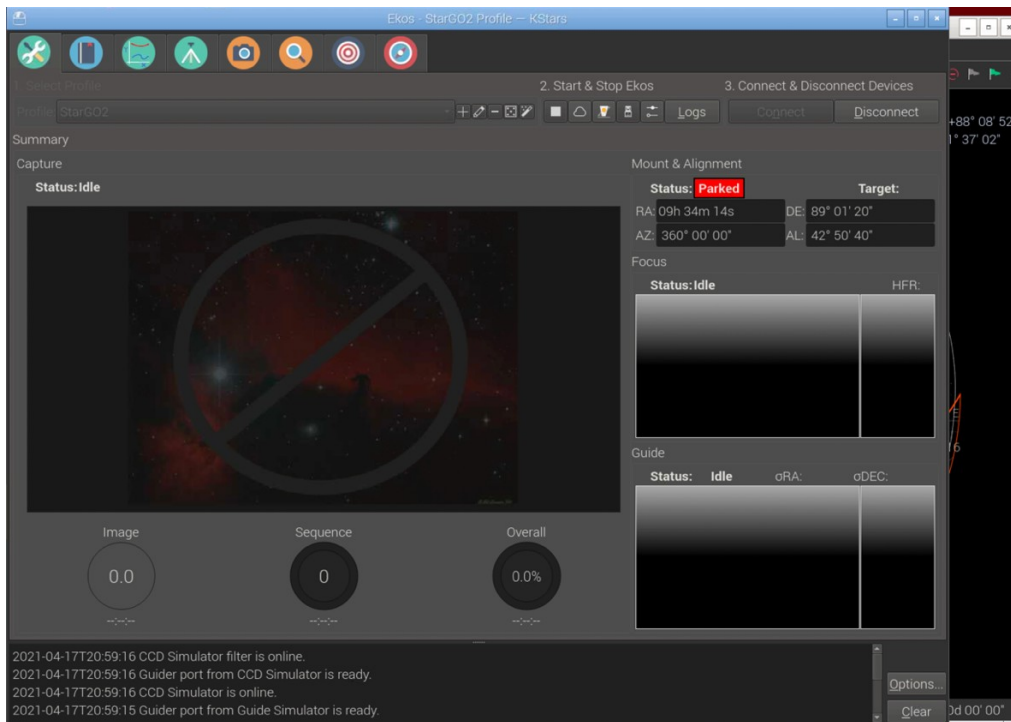


Figure 3.7 – EKOS – StarGo Plusfile – KStars window

- 5) 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.

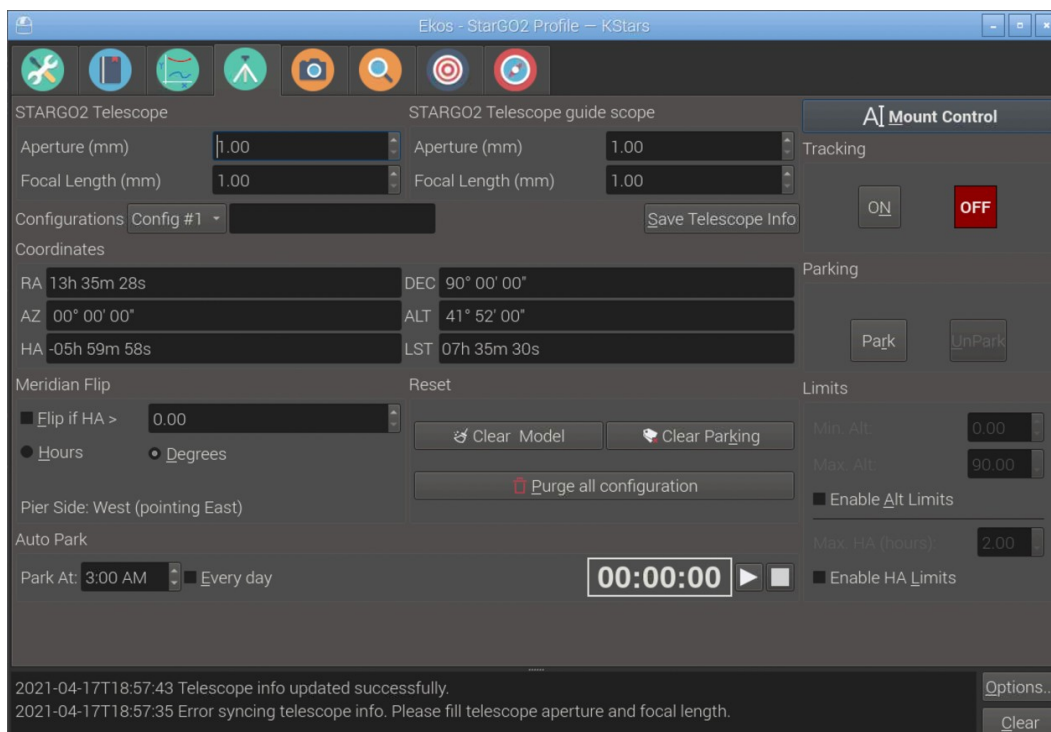


Figure 3.8 – Mount Control window

- 6) 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:

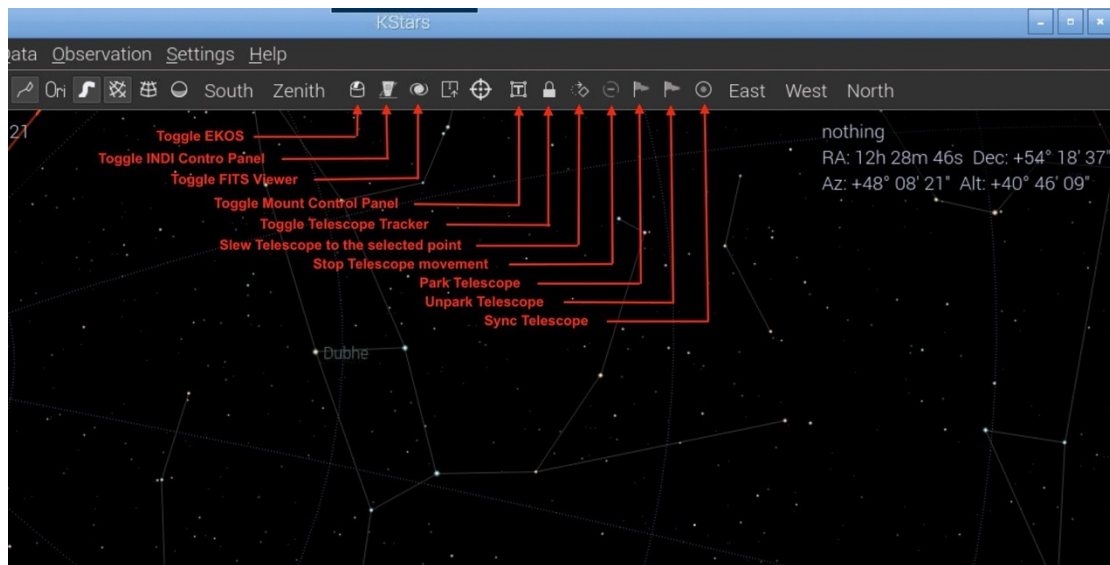


Figure 3.10 – Alternate method of mount control

3.2.3. 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.
- StarGo Plus (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>

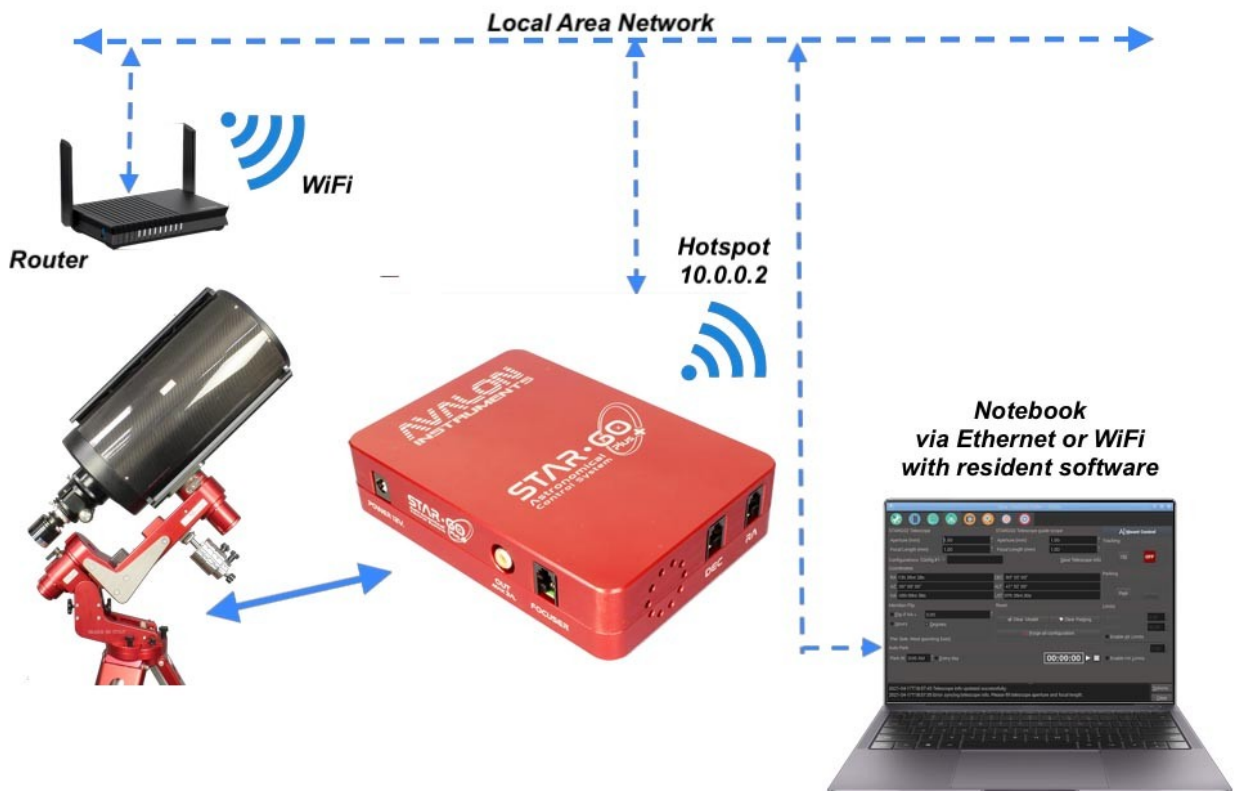
3.3. Computer Remote Operations.

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 StarGo Plus wireless through WIFI or wired via Ethernet cable, being the second preferred due to higher speed and reliability. The software programs proven with the StarGo Plus 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.

The logic diagram of connection with this method is given in this picture:



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 StarGo Plus 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 StarGo Plus on the Device Display (ODD) and the other pieces of information are the default (IP Port 11111, Remote Device Number 0)

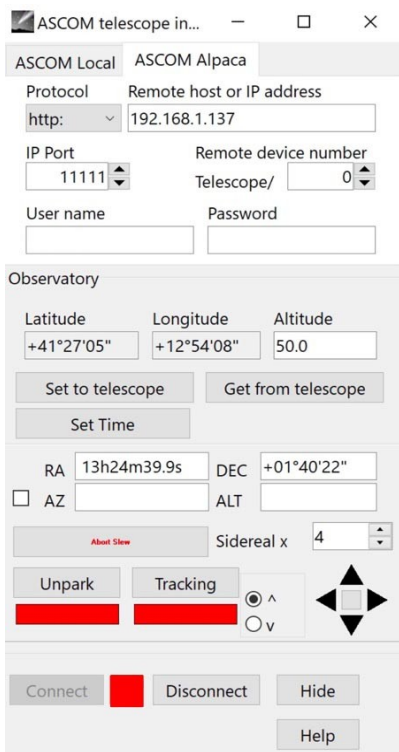


Figure 3.24a - Windows

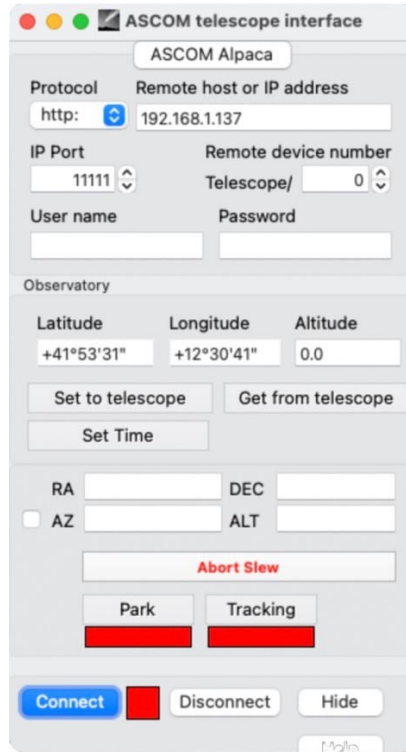


Figure 3.24b - Mac

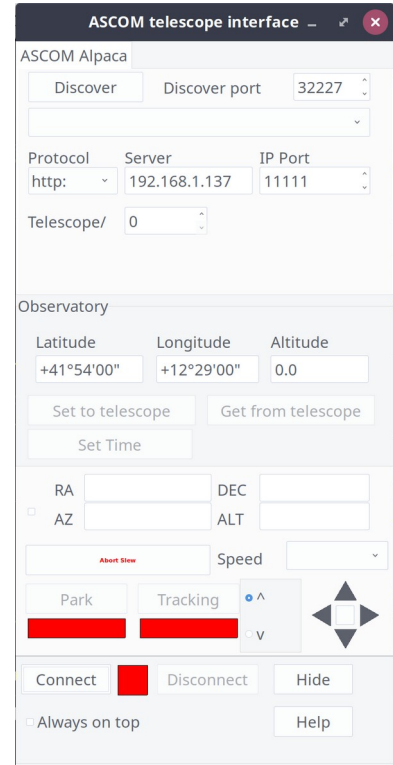


Figure 3.24a - Linux

The telescope coordinate values (RA, DEC, AZ and ALT) are also retrieved from the StarGo Plus 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).

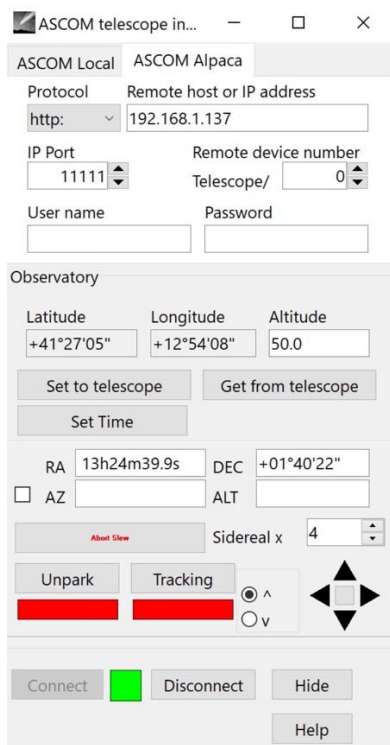


Figure 3.25a - Windows

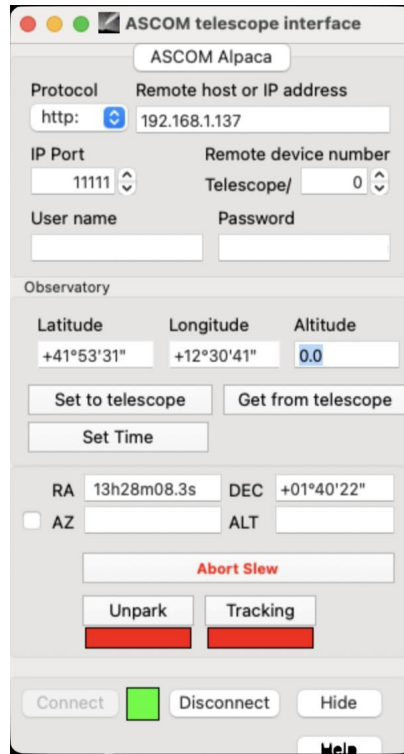


Figure 3.25b - Mac

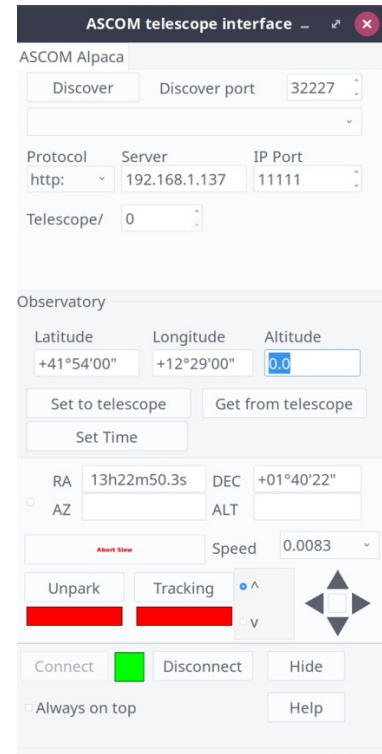


Figure 3.25a - Linux

3.3.2 Connection to StarGo Plus of Stellarium residing on an external computer

The procedure to connect the StarGo Plus 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 StarGo Plus will be inserted.
5. Enter the information as shown in the figure but using the actual IP address as shown in the StarGo Plus 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 StarGo Plus mount. In this section the instructions to connect the Skysafari running on Mac to the StarGO are provided.

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

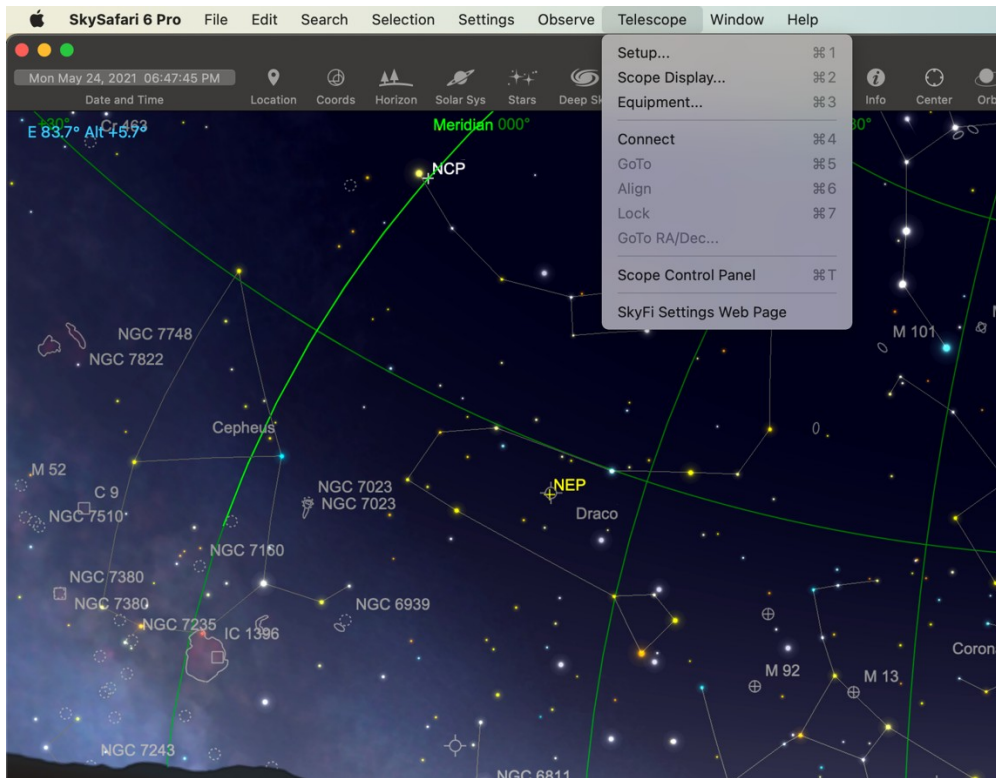


Figure 3.26

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).

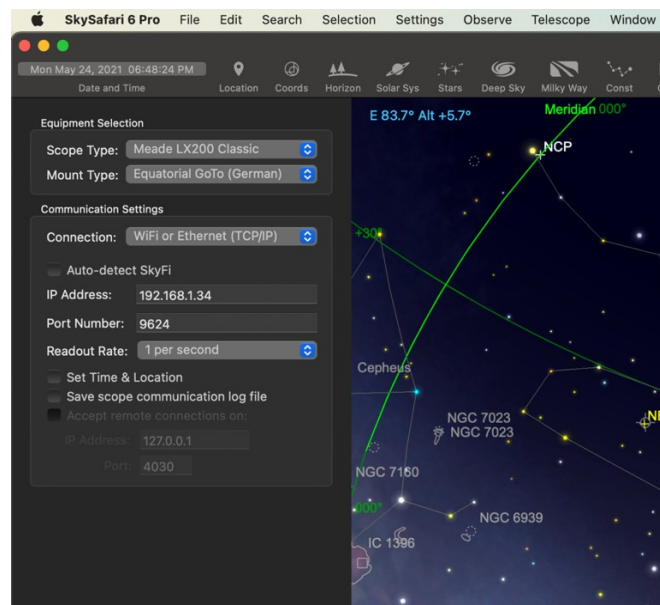


Figure 3.27

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).

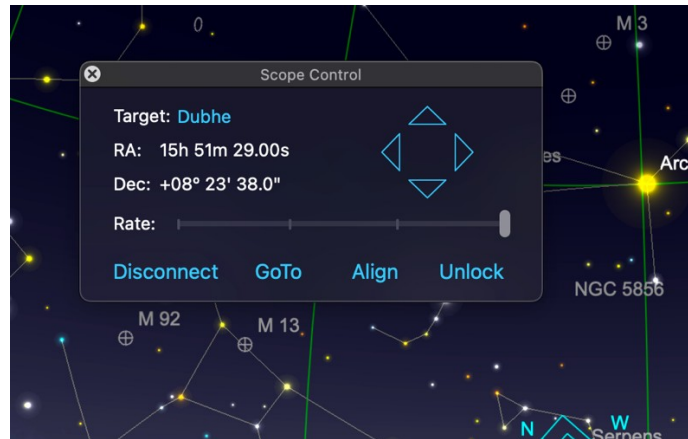


Figure 3.28

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 StarGO 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 StarGo Plus 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 StarGo Plus 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 StarGo Plus, 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 StarGo Plus and not to the use of such tools, especially as regards the connection and use of other hardware devices other than the StarGo Plus.

The key point in connecting the software to the StarGo Plus 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 StarGo Plus 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).

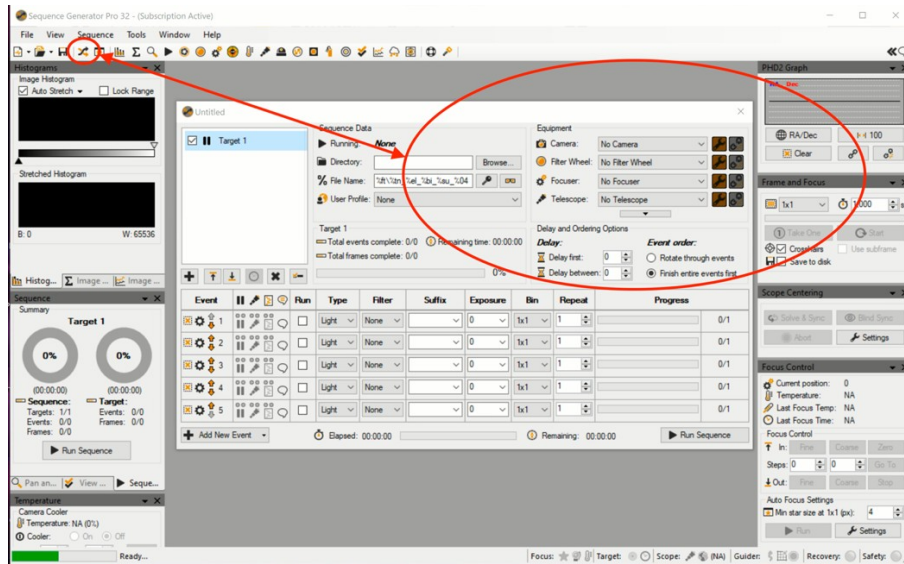


Figure 3.4.1a

In this window select ASCOM in the “Telescope” dropdown menu: the ASCOM chooser will be proposed for selecting the StarGo Plus 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.

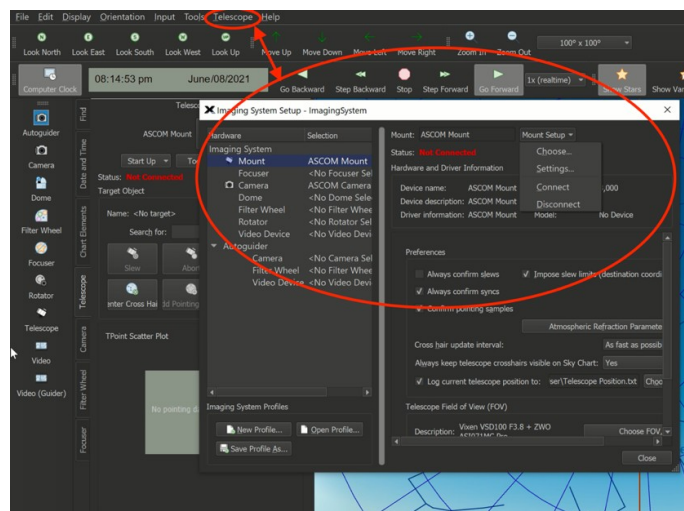


Figure 3.4.1b

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

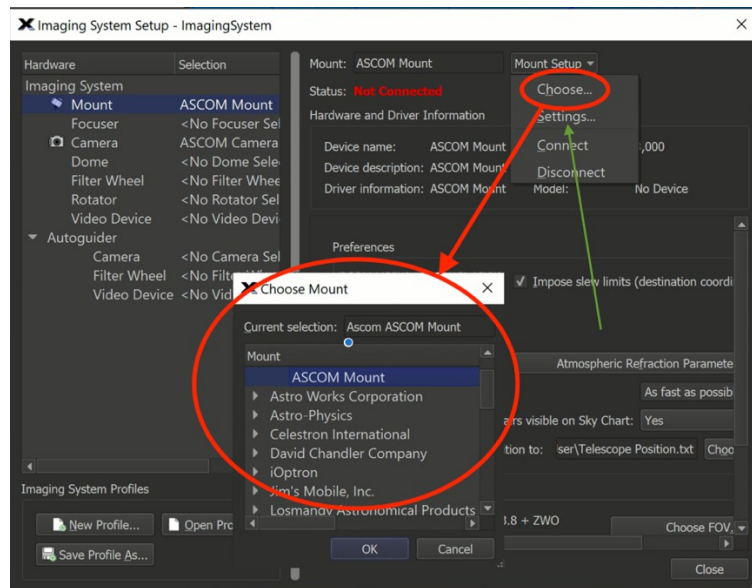


Figure 3.4.1c

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).

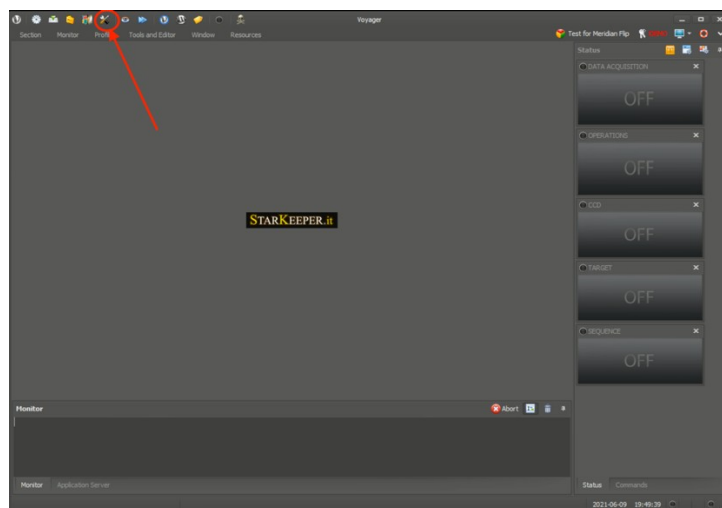


Figure 3.4.1d

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.

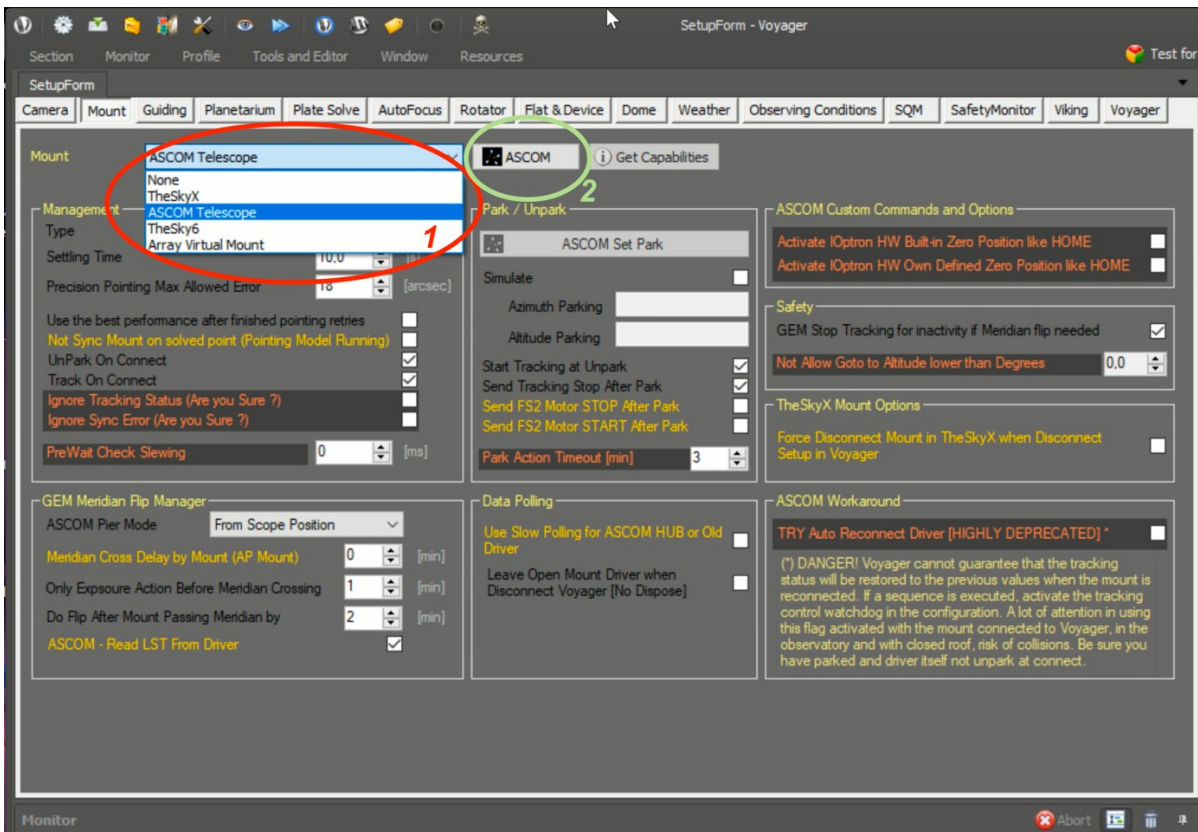


Figure 3.4.1e

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.

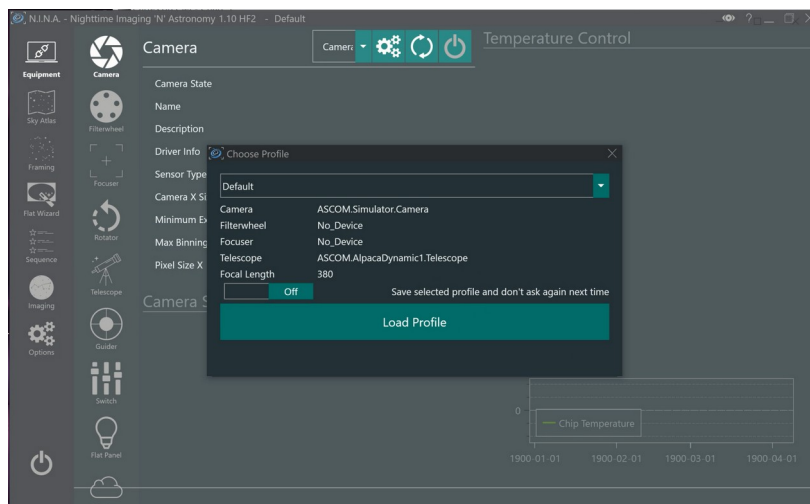


Figure 3.4.1f

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 StarGo Plus telescope as it has been set during the first access.

CCD Ciel

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.

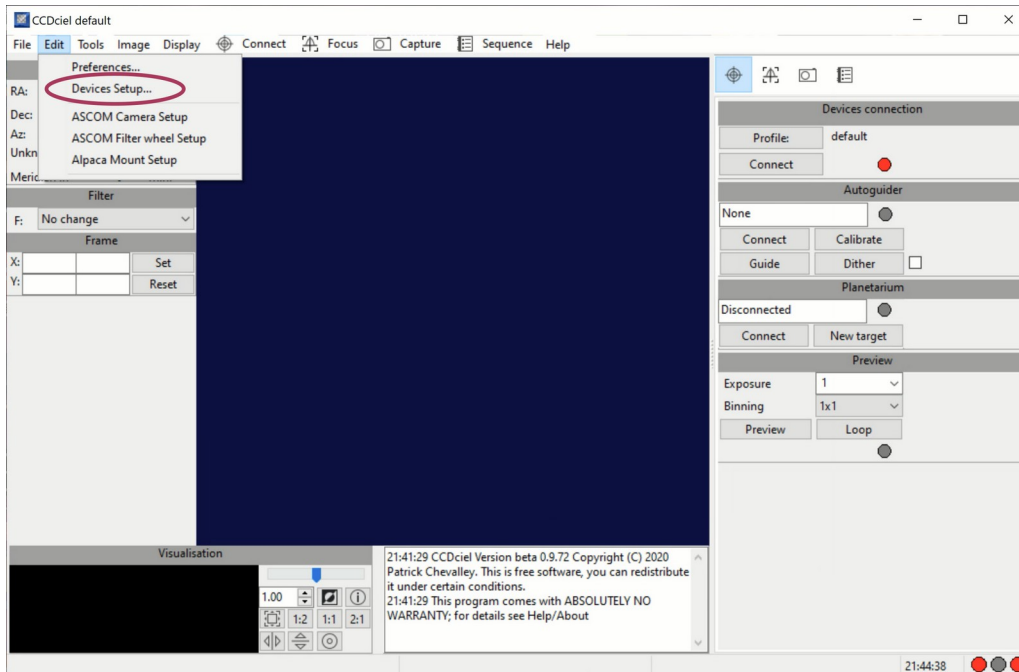


Figure 3.4.1g

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.

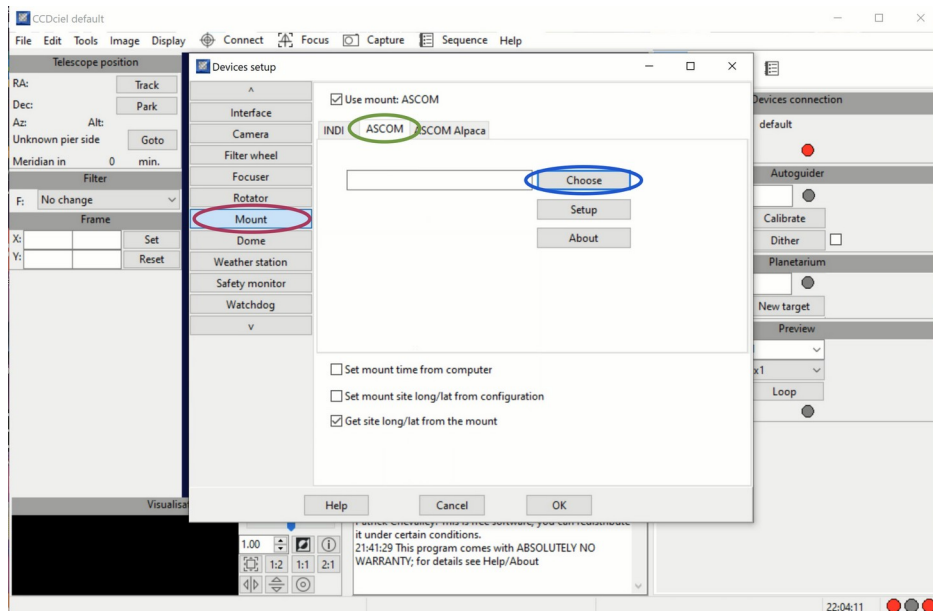


Figure 3.4.1h

3.4.2. Choosing the StarGo Plus 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.

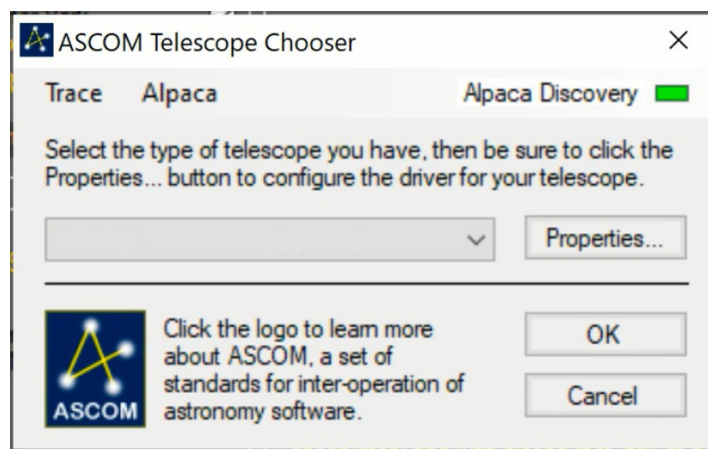


Figure 3.4.2a

To 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.

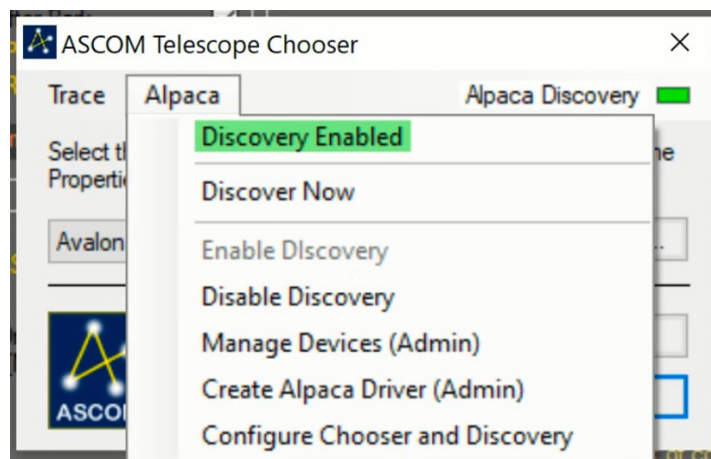


Figure 3.4.2b

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

With the StarGO 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).

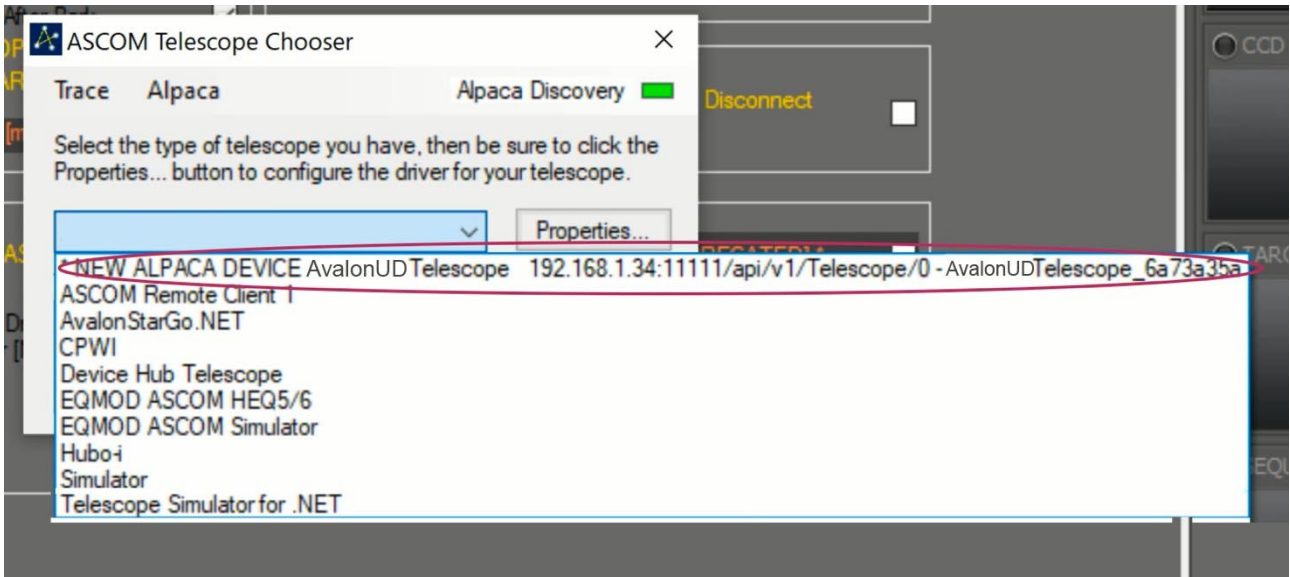


Figure 3.4.2c

In the first row it is highlighted the new discovered device, which is our StarGo Plus, with the indication of the related parameters. Click on the line to select and connect the StarGo Plus 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 StarGo Plus.

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 StarGo Plus one (See Figure 3.4.2d).

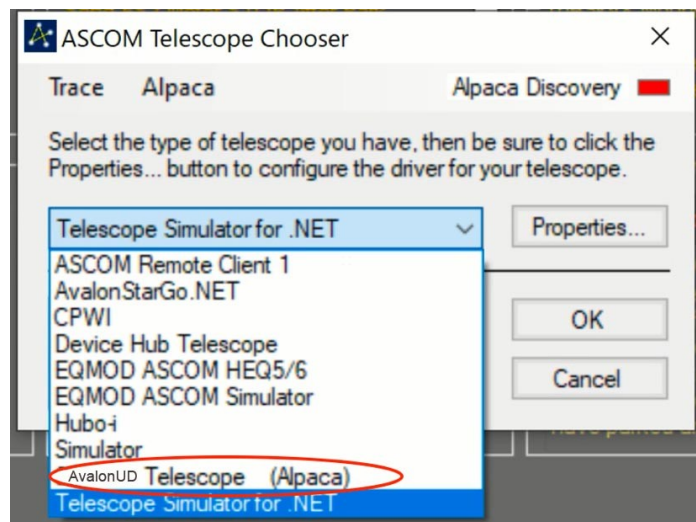


Figure 3.4.2d

Clicking on the highlighted driver will connect the StarGo Plus telescope to the application.