



Personal Remote Observatory

“Merlino”



INSTRUCTION MANUAL

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1. Merlino Observatory Description

Merlino is the Personal Remote Observatory of Avalon-Instruments. It is designed to be totally "user friendly", and it is current state of the art in providing you with a vastly more comfortable and efficient use of your telescope, allowing the photographic using from remote darker sky locations, when time is limited or weather conditions are uncertain.

The main benefits of our design is its compactness and simplicity of use. Located inside is a PC and a dedicated electronic board that manages an entire series of sensors for complete control of your system, in terms of both functionality and safety. The system is controlled by a custom made software interface that allows the Merlino to be used in a mode very similar to a typical mobile setup. In fact, many commonly known software applications are integrated into the system, further increasing easy of use.

Thanks to its compact size, Merlino can be used in your terrace, your garden or nearly any available space. The Merlino is entirely powered by a 12 volt, which allows it to promptly close the session and automatically recover in case of blackout. This feature enables Merlino to be installed in locations where there are no local power supplies, by using a solar panel energy setup.

Merlino is remotely controlled via Internet. The internet connection is customer responsibility because its availability types and reliability is strictly linked to the local internet situation. We advise, for sake of simplicity, speed and dependability, to use a simple 4G or 3G pen drive to be connected directly on the PC USB port (shown as an example on the figure at page 5. Other solutions, if available, are possible, such as the direct connection to an existing ethernet network or to an ADSL modem. In extreme cases, when Internet is not available at all, it is possible to use Satellite modems.

The Merlino project was developed around Avalon Instruments mounts, that solves most of the problems related to the management of a remote Observatory thanks to its special characteristics:

- 1 Installation of Merlino in a terrace or backyard does not require any permits. It is shipped already mounted inside a pallet, complete with all its features.
- 2 The structure of the Avalon Instruments single arm mounts allows you to avoid the annoying problem of the Meridian-Flip, thus making it possible to perform an entire imaging session without interruption and without pointing limits near the meridian.
- 3 Moving mass is greatly reduced (requiring perhaps only small counterweights to balance it), therefore reducing interior room required for slewing, as the telescope rotates virtually on its own axis.
- 4 The Avalon Instruments mount requires extremely little maintenance, while maintaining consistent & excellent performance over time, thanks to the exclusive Fast Reverse technology, designed by Avalon Instruments and using special high precision toothed belts and pulleys, providing high reliability and durability
- 5 Polar alignment is adjustable by the use of two stepper motors, painstakingly adapted to allow fine polar alignment adjustments even via remote control (Optional Kit).

The Merlino enables you to schedule photo sessions using macros created directly by the user, using the macro editor provided as standard equipments.

This allows you to automate both the beginning (startup) and closing (shutdown) of various operations. The Merlino is able to autonomously shut down the system in case of unexpected events or problems, thanks to the included rain sensor, thus ensuring the safety and security of your system. It can be programmed to send you an alert via SMS. An optional alarm system GSM allows the alert in case of an attempted at forced entry.

The following table provides the Merlino observatory specifications:

Monitored Parameters	<ul style="list-style-type: none"> • Temperature • Rain • Battery voltage • Internet connection • Total management control software
Standard Features	<ul style="list-style-type: none"> • inox steel bearing structure (see attachments), resin coated outside. • Motorised open/close remote controlled mechanical shutter • PC with Windows software (in English language) for the Merlino functions control (no keyboard, no monitor) • Electronic I/O control board (diagram attached below) • Motorized webcam for internal inspection and visual sky (rain) monitoring • Rain detector. • Software management system for P.R.O. Merlino and mount • Insulated, internally wired electrical system • Power supply with 12VDC & battery charger • Instruction manual in English
Optional Accessories	<ul style="list-style-type: none"> • Low profile pier to support the mount • Motorized system for Polar Alignment (drivers are already included) • Remote electric Focuser, several models available

2. Merlino Control System

2.1 User Interface Description

The observatory control hardware (Merlino Control Center – MCC) is completely commanded by the Merlino.exe software, developed inside of Avalon Instruments.

Merlino can be launched by a double click on its icon like a normal Windows program, if it resides on the PC desktop or with a simple click if its icon is placed on the Windows applications bar. In order to optimize the observatory remote control, it is advised to launch Merlino.exe contextually to the start of Windows and always leave it opened and active. Its re-launch will only become necessary in case of unexpected program crash. Remember that, in case of launch, the program requires the administrator privileges in order to correctly work.

At the operating system start, besides Merlino.exe, also the monitoring program Watcher.exe that has the task to monitor the correct operation of the Merlino.exe and the MyWlan.exe (if needed) application will be contextually launched. The latter controls the Internet connection. Therefore the aspect of the desktop after the access will be similar to that shown in Figure 1.

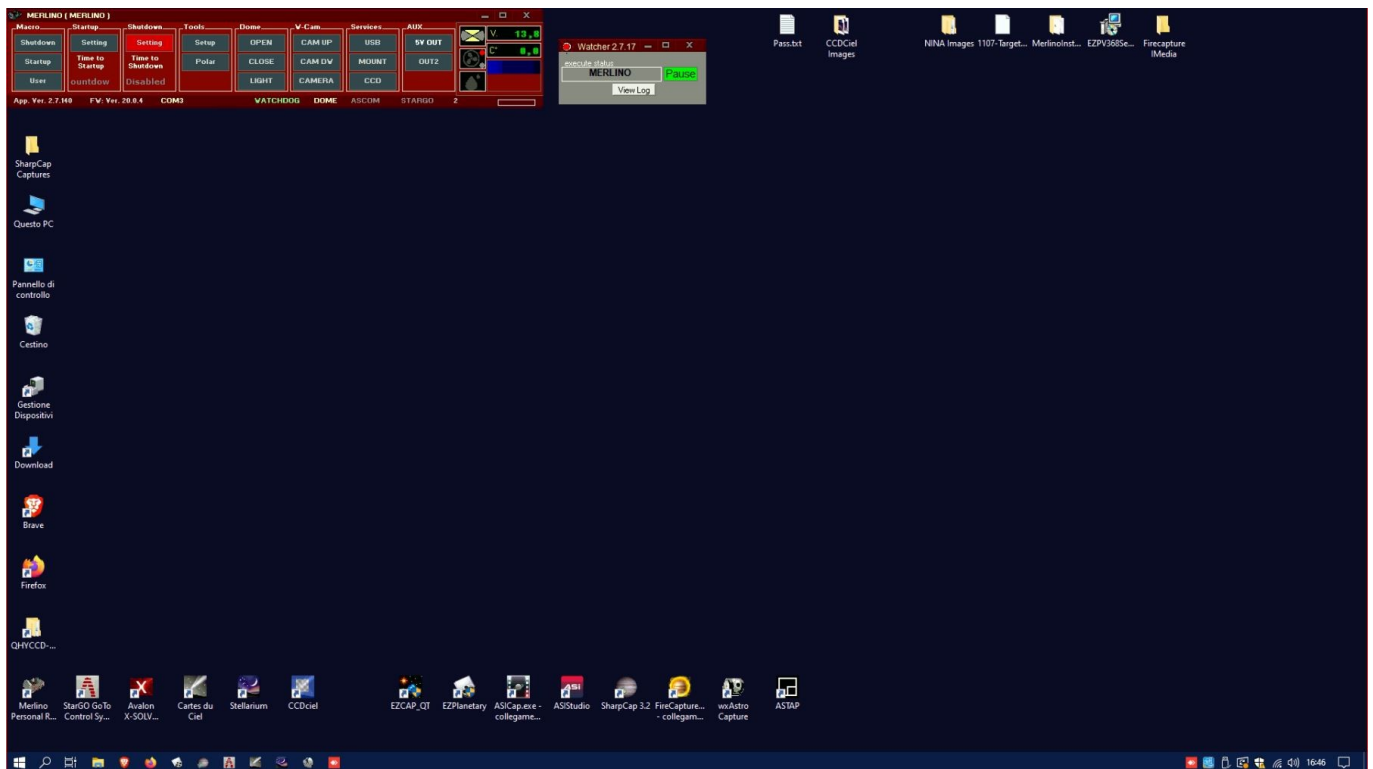


Fig. 1 – PC Desktop after a fresh computer Start

This figure shows the Merlino.exe main interface on top left and the interface of the other two support applications on top right.

The Merlino.exe GUI is reported in the following Figure 2.




Fig. 2 - Merlino.exe GUI











The interface is subdivided in several functions, grouped in homogenous way, that allow the execution of all the possible operations on the observatory. On the right side are placed the important pieces of information related to the power supply battery voltage, the environmental temperature inside the observatory cabinet, besides the icons that describes to the state of closing or opening of the observatory and the rain information.

The keys inside the function matrix represent the switches of activation of the single Merlino hardware operations. If the keys are of lighted red color it means that the associated functions are active (ON), if they are of dark red color their states are OFF. Some keys (as the keys OPEN and CLOSE) activate and change their color only while they are pressed and return dark to their release, indicating that their function is active only when they are pressed (they act as push buttons). The other keys, once pressed, change status like simple ON/OFF switches.

The table that follows describes in detail the single commands, subdivided by functions.

Funzione	Operazione	Descrizione dell'operazione
	Shutdown	The Shutdown key starts the macro that sequentially executes the deactivation of all the peripheral and the applications in execution in order to put the observatory in safety conditions.
	Startup	This key starts the execution of the Startup macro for the execution of all the operations necessary to put the observatory in a fully operating status.
	User	It opens the windows to customize the mentioned macros adding or delating operation lines as required by the user. The macros will be explained in detail in section 2.2.
	Startup SETTING	This is the key to calculate the time to observatory startup. It can be useful, if a software for the automatization of the photographic shooting is used, to determine when startup the observatory. Even this function is described in section 2,3.
	Shutdown SETTING	This is the key for the calculation of the photographic session duration. The pressure of Shutdown "SETTING" provokes the appearance of a setup window through which it is possible to define the timing of the operations before the automatic shutdown of the observatory starts. The use of such function is described in detail in the section 2.3.

	HOMING	The key HOMING is a very important as it will allow to bring the telescope in the “Home” starting position with extreme precision, making the objects search during the photographic session very precise. Its use will be described in detail in section 2.4.
	POLAR	The key POLAR opens the windows related to the telescope movement in the horizontal (Azimuth) and vertical (Height) directions, in order to optimize the mount polar alignment. The use of the “POLAR ALIGNMENT” function will be described in section 2.5.
	Setup	This key allows the access to a setup panel allowing to insert limiting temperatures
	OPEN	Such button activate the observatory roof opening system motor. The roof opens until the button is pressed. It stops to open when the button is released or when roof reaches the complete opening. The roof closing  , partial opening  and full opening  conditions are graphically indicated by the appropriate icon. The opening of the roof is inhibited in case of rain.
	CLOSE	This is the inverse of the previous function and it is activated in the same way holding pressed the button in order to close the observatory until complete closing of the roof occurs. The indications of position of this are the same already described. The system of Closing/Opening is protect by safety clutches.
	LIGHT	Switch of the lighting system inside the observatory. It is of On/Off type and is initially in Off position with the internal light turned off. Pressing it once it turn on the internal lights. Pressing it a second time the lights are turned off. In the course of a photographic session the lights should remain turned off in order to avoid reflected parasites lights in the telescope. It is useful switch the lights on in order to monitor the observatory status or the telescope position and during the realignment operations.
	CAM UP	It is a button that moves the monitoring CCD towards the high until is held pressed. This allows to move its FOV at will. The maximum reachable position is the vertical one, which is useful for the observation of the sky to estimate of the cloudiness conditions.
	CAM DW	It has the inverse function. It moves the monitoring CCD toward the bottom and the maximum reachable position is horizontal.
	CAMERA	By clicking on this button, the internal camera will switch on and start to show to the user the observatory internal view.

	USB	This switch activates all the observatory USB devices (Mount, main CCD, guiding CCD, internal Webcam, Allsky cam, etc). It must be in ON position (closed) for monitoring CCD that is USB driven
	StarGO	StarGO is the key that closes the mount electric power supply circuit. It is of On/Off type and initially it is in Off position. Pressing it, a window of warning is opened asking to confirm the action. Pressing OK in such window the mount is powered and the button assumes the red color. Pressing it a second time the power circuit is opened and the mount is turned off. The button returns dark. Such button launches also the software of the StarGO mount management.
	CCD	CCD is the key that closes the mount electric power supply circuit. It is of On/Off type and initially it is in Off position. Pressing it, a window of warning is opened asking to confirm the action. Pressing OK in such window the mount is powered and the button assumes the red color. Pressing it a second time the power circuit is opened and the CCD is turned off.
	5V OUT	Auxiliary switch to turn On/Off additional components
	OUT2	Auxiliary switch to turn On/Off additional components

As already mentioned, some of the described commands demand a confirmation before they are executed. The confirmation assumes the aspect of the classic window in which to accept or reject the execution:



USB



Beneath of the described function frames a series of relative information to the state of the Merlino software is supplied.



In particular the first three pieces of information are relative to the state of the installed software, that is: the version of the application, the version of the Firmware and the COM port to which Merlino is connected. In case of missing connection, instead of the indication the used port an error condition is given.

The three successive indications are relative to the state of the Watchdog (redundant safety control), of Avalon ASCOM device driver and, the last, the status of the StarGO software. When they are colored in yellow they are active and the relative software is operating.

Figure 3 shows the part of the main Merlino panel containing some environmental and functional information:

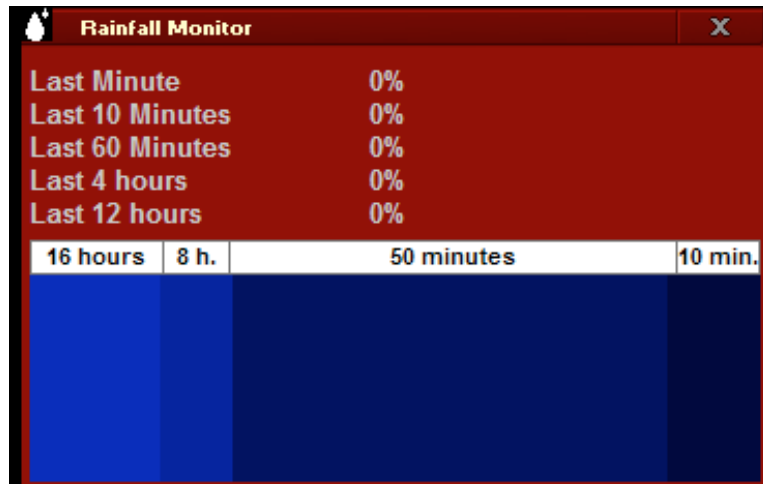


Fig. 3 Aux and enviromental informations

The **three** icons on the left indicate respectively:

- the observatory conditions as previously described
- The activation of the electronic panel cooling fan
- the activation of the rain alarm (the two droplets turn blue) and the consequent activation of the protection function, causing the immediate roof closure and the prevention of successive re-openings if the rain conditions persist.

The rain intervals and its intensity are shown in the last blueish rectangle to the bottom right. Clicking on this rectangle the Rainfall Monitor window with more detailed information will appear:



On the right of figure 3, the first two windows indicate the service battery voltage and the temperature inside the electronic cabinet. Clicking over the C° symbol the measurement unit will change to F° (and vice versa).

2.2 Macro Editor Description and Use

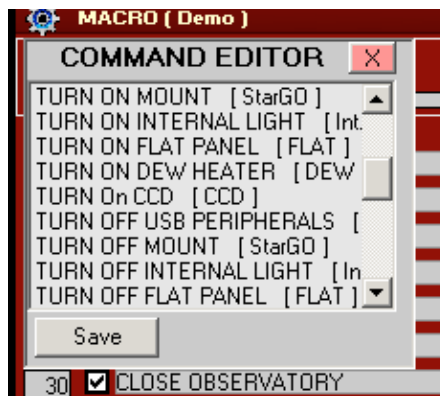
The USER button, as mentioned in the previous section, allows the access to the command editor to prepare command sequences. Pressing the button the MACRO window opens showing the last macro developed (in this case a demo) as reported in the below left figure. The buttons Start and Stop allow the launch or to end the execution of the macro. Pressing the Edit button the MACRO window extends in order to show the column of the editing commands, as it is seen in the figure to the right:



The check box columns to the left of the command list indicates if the execution must be executed or not. This feature allows to skip some commands in particular case, for example during testing.

The leftmost columns delay contains the estimated time needed (in seconds) to complete the command execution. This value is very important for those commands requiring to be completed before the next one is started, especially for the commands that, for their nature, require a longer time to be completed, such as mount parking and roof opening/closing. By choosing a right value the risk to perform a command before the previous is completed is avoided.

To modify a command line it is sufficient to click it and then press EDIT button to the left (or double clicking on the command line itself) The Command Editor window will pop up containing all available commands among which to select the needed one, using the lateral sliding bar.



To add further commands to the macro list is sufficient to press the ADD key and choose the various command up to the macro completion.

To move up and down the existing command of the macro list is sufficient to select the command and using the two up and down arrows available in the editor window.

The complete list of the available commands in the system is the following:

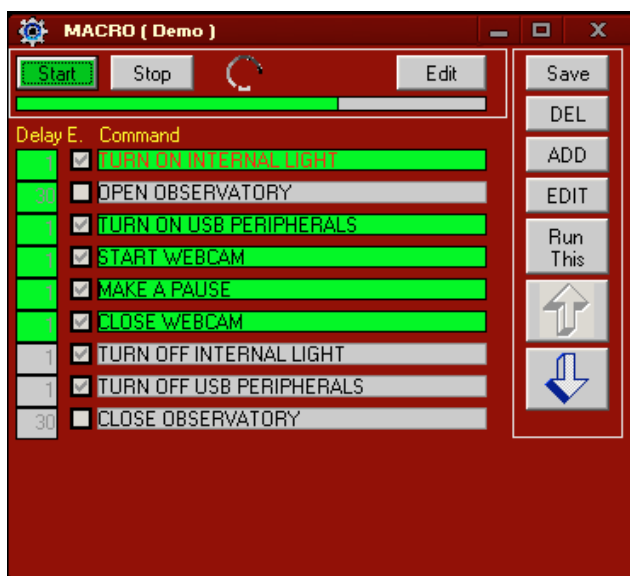
```
WEB CAMERA MOVE UP (CAM UP)
WEB CAM MOVE DOWN (Cam DOWN)
USER RELAY 3 ON
USER RELAY 3 OFF
USER RELAY 2 ON (OUT 2)
USER RELAY 2 OFF (OUT 2)
USER RELAY 1 ON (5V OUT)
USER RELAY 1 OFF (5V OUT)
TURN ON USB PERIPHERALS (USB)
TURN ON MOUNT (MOUNT)
TURN ON INTERNAL LIGHT (Int.Light)
TURN ON FLAT PANEL (FLAT)
TURN ON DEW HEATER (DEW)
TURN ON CCD (CCD)
TURN OFF MOUNT (MOUNT)
TURN OFF INTERNAL LIGHT (Int.Light)
TURN OFF FLAT PANEL (FLAT)
TURN OFF DEW HEATER (DEW)
TURN OFF CCD (CCD)
START WEBCAM (CAMERA)
STARGO COMMAND
SET PARKIMETER IN MINUTES
RUN MACRO
RUN
REMOVES SOLAR FILTER
RELOCATING SOLAR FILTER
PROGRAM START
OPEN PARKTIMER (TIMER)
OPEN OBSERVATORY (OPEN)
MAKE A PAUSE
KILL PROGRAM
EXTERNAL CONTROLS
END PROCEDURE
CLOSE WEBCAM (CAMERA)
CLOSE THIS PROGRAM
CLOSE PARK TIMER
CLOSE OBSERVATORY (CLOSE)
CHECKED OBSERVATORY CLOSE
```

Note that two of the listed commands (START PROGRAM and KILL PROGRAM) require the access to an external program. When one of these commands is used in the macro, a classical Windows choosing window is opened to allow to choose the needed program.

As an example, we will build a macro to monitor the observatory using the available monitoring CCD without activating the other observatory components. The following is the operation sequence to perform:

- Roof opening
- USB activation
- Start the default monitoring CCD program
- 60 seconds pause to observe the sky
- End the default monitoring CCD program
- USB deactivation
- Roof closure.

By inserting the commands to execute these operation we will obtaining the following:



Such figure shows the Macro window during the execution of the commands. Note that the commands already executed and those under execution are totally or partially colored in green. The bypassed commands (check the box unselected) remain of the original color. The image has been taken to the end of CLOSE WEBCAM command execution.

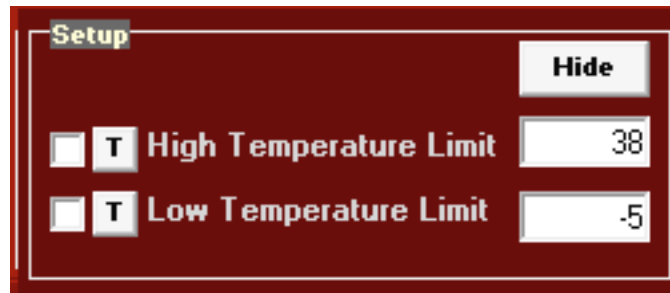
The following table describes the function of all the editing buttons on the right of the MACRO editing window:

Save	Save the current macro. It calls the file saving Windows function..
DEL	Delete the currently highlighted command
ADD	Add a new command line. It calls the opening of the command list windows allowing the selection of the wanted command.
EDIT	Modify the selected command. It calls the opening of the command list windows allowing the selection of the command to replace the existing one.
Run This	Execute the current macro.

2.3 Temperature Control and Timer description and use.

2.3.1 Temperature Control

Merlino observatory is provided of a cooling fan to keep the temperature inside the electronic control cabinet below set limits. Optionally, for the use in cold countries, an optional electrical heater may be provided to increase the internal temperature when needed. Both the cooling fan and the heater are managed by the control panel via the Setup window, which is activable pressing the Setup key in the Tool panel of the main GUI:



The High and Low Temperature setpoint are inserted on the right and the Cooling and / or heating functions may be activated by checking the checkboxes on the left.

The checking of the two function's operability is possible to click on the "T" keys near the respective check boxes.

Hide key will close the Setup window.

2.3.2 Timer functions

The timer functions have a fundamental function in the management of a remote observatory. They allow to define the moment of observatory opening or closing by automatically executing the Startup and Shutdown macros. Merlino software supplies the two functions of closing and opening using independent software keys.

At the software start, for safety reasons, the Shutdown Timer is automatically activated with predetermined amount of second at the closure, usually an hour or 3600 seconds, in order to permit a consistent period of operations (including the formulation of a more suitable operation time) before the safety closing. This timer is extremely useful because it automatically executes the Shutdown of the system also in case of loss of the Internet connection.

Therefore, quickly after the Startup, it is advisable to set up the operation time sufficient for carrying out the intended activities in order to avoid an unintentional closing of the observatory.

In order to do this it is necessary to press the SETTING key in the Shutdown frame. Such operation will cause, on the left of the Merlino software interface, the opening of a black window for the calculation of the times, as follows:



The use of such window is intuitive: insert the number of the exposures and their individual duration in the opportune fields. The total time, expressed in second, will be calculated and will appear in the Total Seconds field. It is advisable to increase this value of some hundred seconds in order to take into consideration the dead times between the images and those between the other needed operations to be sure to not execute the Shutdown before the session is finished. The Hide key hides the calculation window while the Start/Stop starts the timer with the calculated time.

The passing of the time in second, between the set up time and the programmed shutdown is shown in yellow in the Shutdown frame:



The observatory shutdown can be automatically caused, as well as the reaching of the time limit also by the occurring of some events making useless to continue the observatory operations such as the sky clouding and the consequent failure of the autoguide system.

Analogously the Startup timer is activated by pressing SETTING key of Startup frame and also in such case it will opened, to the left of the Merlino interface, a black window to setup the start time. The Startup timer is useful for the programming of a session starting at a determined date and time.

The information to introduce in such window are somewhat different from those used in precedence. The date shall in fact be inserted (YYYY– MM – DD) as well the hour (H – M). Moreover, in last the two fields, the session duration can also be inserted.



With Hide the window is closed and with Start–STOP the timer for the Startup is primed. The hours, minutes and seconds to the observatory startup execution will appear in yellow in the Startup frame.

Shutdown	Startup
SETTING	SETTING
Time to Shutdown	Time to Startup
14948	01:26:32

2.4 “Start Position” (HOMING) function description

In order to obtain a better pointing precision it is necessary that the alignment operations, described in detail in the StarGO manual, are executed beginning from a Home position as much as possible close to the ideal position, i.e. with the telescope axis aiming exactly to the North Pole. Even if this operation is easily executable operating the telescope locally, just aligning the axis reference notches to those printed in the mount, it becomes more difficult when it is executed in remote.

Being this the first operation that is carried out just after the observatory startup, it will be start with the telescope parked (i.e. in Park position) as defined during the observatory setup operations.

The pressure of the HOMING button in the Tools frame will start the homonymous operation and, if not already on, a warning window will be opened which asks the connection of the peripherals interested to the operation to carry out.



Pressing Ok a second warning window will open asking the startup of the ASCOM driver (if not already running).





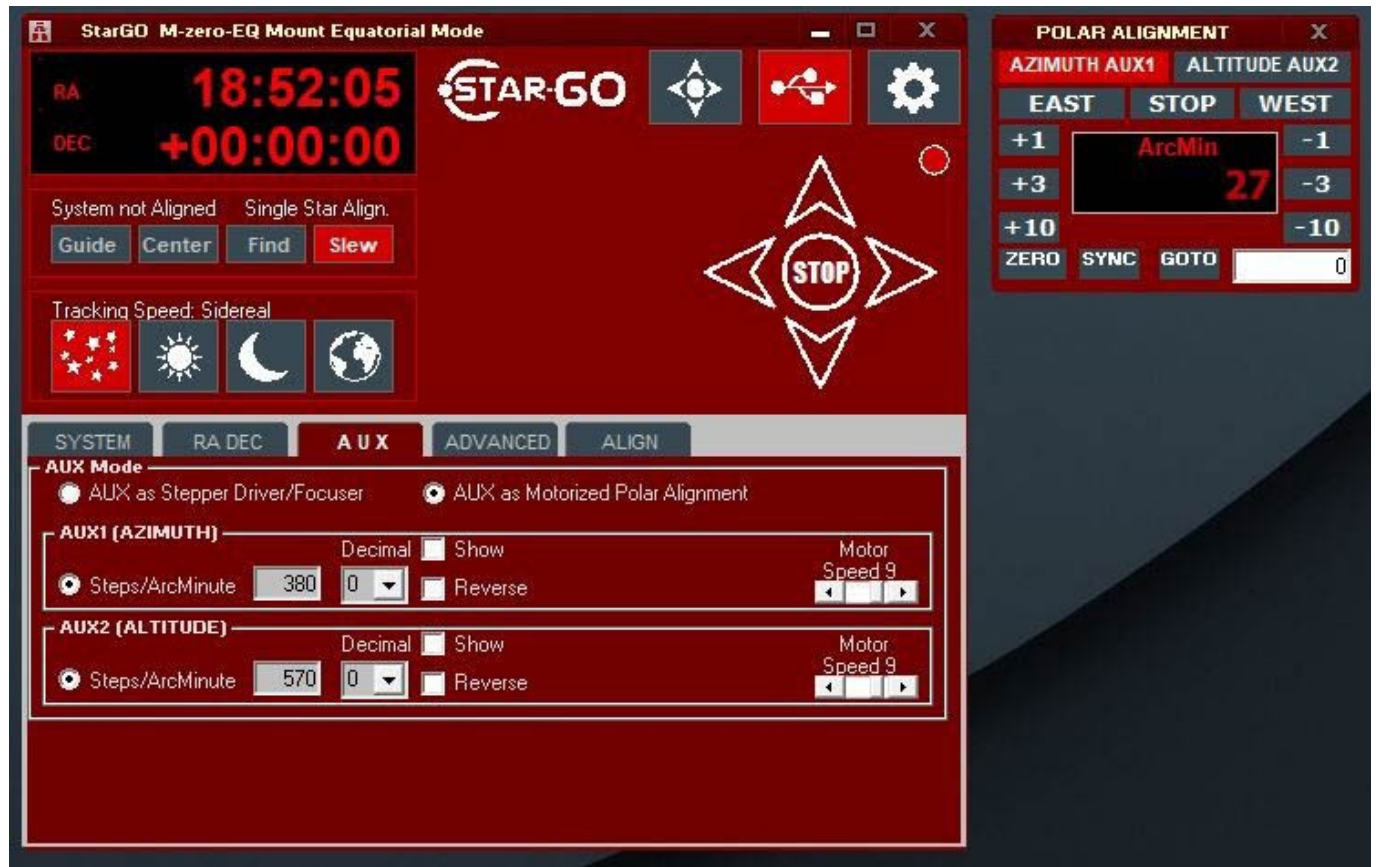
Pressing the UNPARK key on the StarGO application the mount will be unparked and the moving commands will appear and become active in the StarGO.

2.5 “Polar Alignment” (POLAR) Function Description

Thanks to the optional Motorized Polar Alignment kit available on the M-zero OBS, M-uno and M-tre mounts, it is also possible to carry out a remote and precise Polar Alignment.

The motors can be easily controlled with the special Polar Alignment tool that comes with the StarGo software.

The tool can be enabled by clicking on the corresponding radio button available in the AUX tab.



Through these two windows it will be possible to move the mount in the two axes towards EST/ WEST or HIGH/LOW direction in continuous using the appropriate keys. The key STOP will stop the movement. In case is needed to move the mount of a predetermined amount (0.1, 1 and 10) of arcmin in the two directions, the appropriate keys can be used. Finally it is also possible to carry out goto movement using the GOTO keys and the arcmin value inserted in the fields on the left of the keys.



The Polar Alignment tool, if used in combination with Precise Polar Alignment external devices, using their software to calculate the alt-azimuthal offset of the polar axis from the celestial North Pole, allow an easy and precise remote Polar Alignment operation.

Once the device will notice the Alt/Az error, it will be really easy to the user to compensate it “manually” with the Polar Alignment tool commands.

After the correction will be performed, another plate solve can be taken until the errors become acceptable.

Furthermore, thanks to the Realign Absolute Position feature, in case of Parking at the end of the session, this offset can be stored in the system memory and will be saved for the next use even after a system shut down and power off.

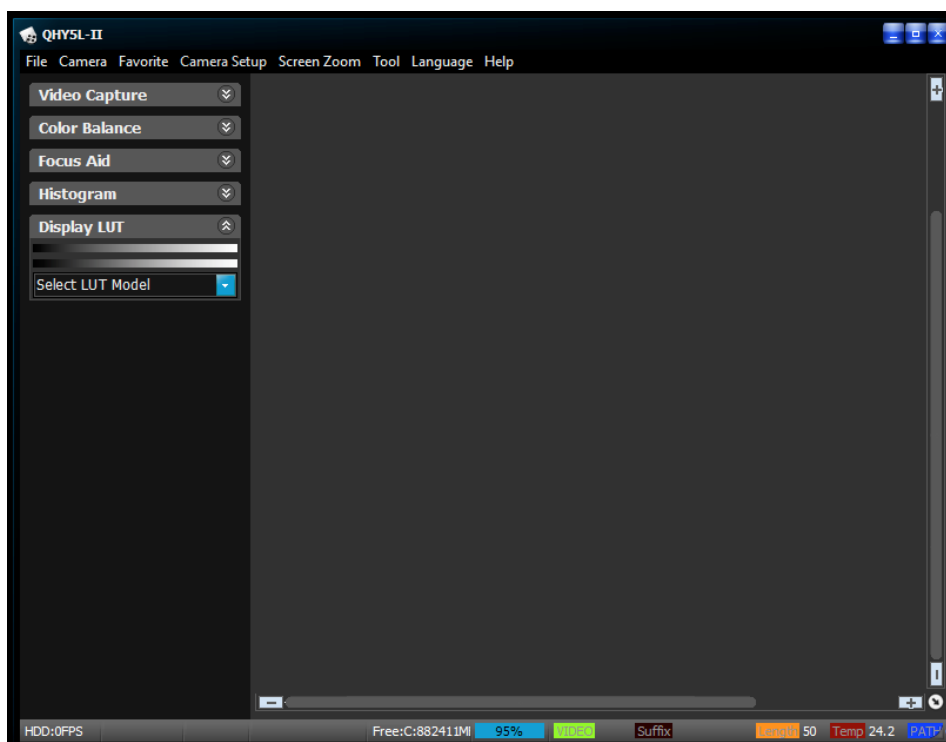
2.6 Using the Monitoring Camera

The Merlino observatory is supplied of a QHY5LII CMOS camera which is moveable from horizontal to vertical view to watch the telescope or the sky.

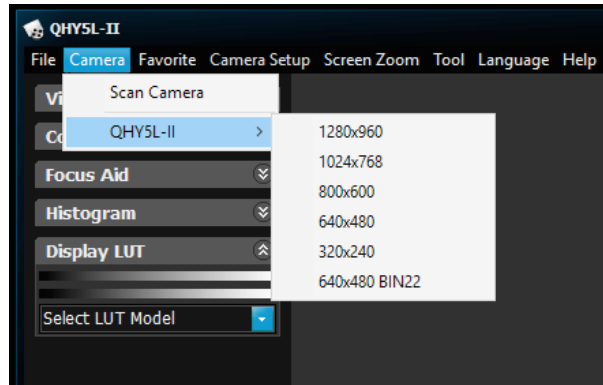
The software used for the management of the camera is that provided with it, called “EZPlanetary, which can be launched by double clicking the icon placed on the desktop:



This will cause the opening of the program main view:



To choose the camera click the QHY5LII item under the Camera menu and select the 640x480 BIN22 resolution as shown in the following figure:



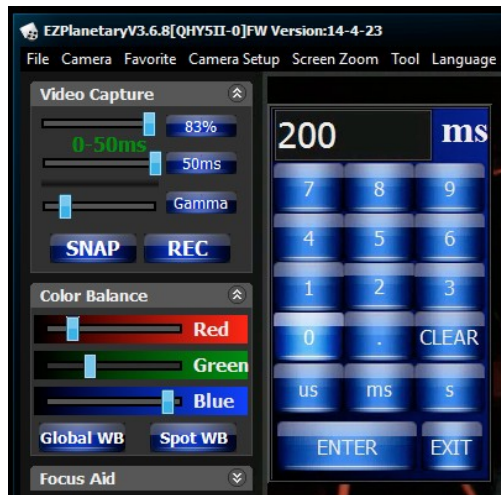
Once the camera is connected the view of the observatory internal is shown insed the main view:



To adjust the vision of the internal switch on the Internal Lights (see the table at page 8) and use the slides on the upper left of the main screen:



Sometime it may be necessary to increase the maximum value of one of the three parameters. To do this is sufficient to click over the blue keys on the right of the sliders. A setup keyboard will pop up where to set the wanted values:



As mentioned before, the monitoring camera can be oriented between the horizontal position for monitoring all parts of the observatory and the vertical positions to observe the status of the sky. To move the camera through the two extreme positions two keys are available in the W Cam frame of the Merlino main GUI.



W-Cam Up moves the CCD toward the sky monitoring vertical position whereas the W-Cam Dw moves the CCD toward the internal monitoring horizontal position.