Automatic DIMM System

Installation and user manual

Decembre, 2025 revision

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Acronyms	Meaning
RA	Right Ascension (coordinates)
DEC	Declination (coordinates)
DIMM	Differential Imaging Motion Monitor
CCD	Camera Couple Charge Device
TPD	Thermal Design Power
DHCP	Dynamic Host Configuration Protocol
FPS	Frame per seconds

FAILURE TO COMPLY STRICTLY WITH THIS DOCUMENTATION MAY LED TO SYSTEM FAILURE OR SYSTEM NOT WORKING AS EXPECTED.

NEVER AIM THE SUN DURING THE DAY, NEVER USE THE SUN AS A TEST TARGET, THIS CAN CAUSE DEFINITVE DAMAGES.

1 System installation

Some good knowledge of astronomical instruments (telescope, CCD camera…) is required, at least the user (or some) must have used a telescope before to perform visual observation of the Moon, or other objects like the main solar system planets, and could do some video imaging of the Moon, or the Sun.

If the user has no knowledge of telescope, this system can be difficult to install and use. So please, get the help of someone that has some experience, otherwise, if never achieved before, it is recommended to use a cheap amateur telescope to acquire the minimum knowledge on how to use a telescope and understand some concepts written in this manual.

Knowledge on mount polar alignment, and some astronomical software is required as well as astronomical coordinates system.

Please be aware that this documentation focuses on the **belt drive mount setup**, and in case of a **directdrive mount**, a specific installation documentation will be provided directly to you. Please read it.

Fig. 1 *Complete system (Belt drive mount)*

1.1 Mount installation (Belt drive mount)

1.1.1 Introduction

The GM-2000 mount is a German mount, which embeds absolute encoders. On mount startup, the mount knows where it is located, and with a very good accuracy. The pointing accuracy of the mount can be as low as 15 arcsec RMS, this ensuring that the star is inside the field of view of the DIMM (17x10 arcmin) camera at any slewing end.

The manual of the mount installation can be found on the USB Stick named “10 MICRON Astro technology”

[USB Drive Letter]:\10Micron_AstroTechnology\10Micron Mount's Manuals\HPS Types\English\GM2000\ GM2000HPS Quick Setup en.pdf

GM2000HPS Quick Setup en.pdf	26/05/2017 13:12	PDF File	60 KB
GM2000HPS-en-2.16.pdf	17/05/2019 13:58	PDF File	3528 KB
GM2000HPSULTRAPORT-en-2.16.pdf	17/05/2019 14:00	PDF File	3586 KB

Please read carefully this manual, it contains all the information to install the mount and to run it.

The mount shall be polar aligned, so when installing the pier/tripod, pay attention of the mount orientation, to avoid any dismount-remount cycle.

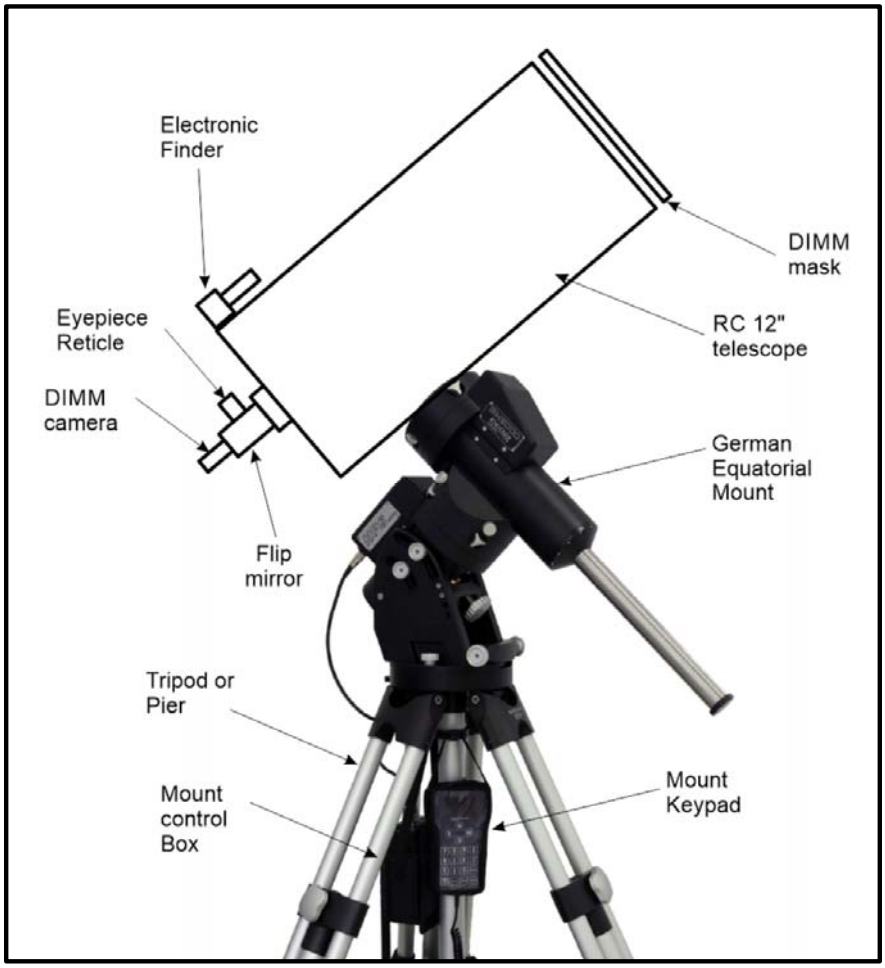


Fig. 2 *Complete system (schematics)*

1.2 Tube Installation (Belt drive mount)

1.2.1 Introduction

The telescope is a 300mm F8 RC telescope type, with 2400 mm of focal length. The focal plane is located exactly 282mm from the telescope backside plate.

1.2.2 Tube installation on the mount

Before installing the tube, an interface plate must be installed. Orientation of this plate is very important.

Put is as the picture shows below:

First align the DEC marks, and then clamp the DEC axis with the knobs.

Pay attention about the 4 M6 screws, and how the dovetail plate must be aligned with respect to the threaded holes. This is very important. Then tight the screws strongly.

Then slide the tube into the female dovetail, with the KEPLER sign being up, the electronic finder on the right side (when the user is located at the tube output and tube looking toward north in the northern hemisphere).

Fig. 3 *Orientation of the tube (mandatory)*

The distance from the telescope tube back plate to the interface mount plate is 15 cm, this allows good tube balancing, when the mask and the DIMM camera are installed.

Fig. 4 *Tube position for optimum DEC balancing*

1.2.3 DIMM Mask installation (All mounts type)

Before doing this, do remove the plastic caps that protects for shipment the main mirror and the secondary mirror.

The mask is held by two cylinders fitting into the 4 holes designated with the red arrows on the top ring section of the tube.

Put the tube in vertical position, and put the mask on the top ring section, and screw the M6 screw with the special washer. The two holes mask orientation is not important. It can one axis, or the orthogonal axis.

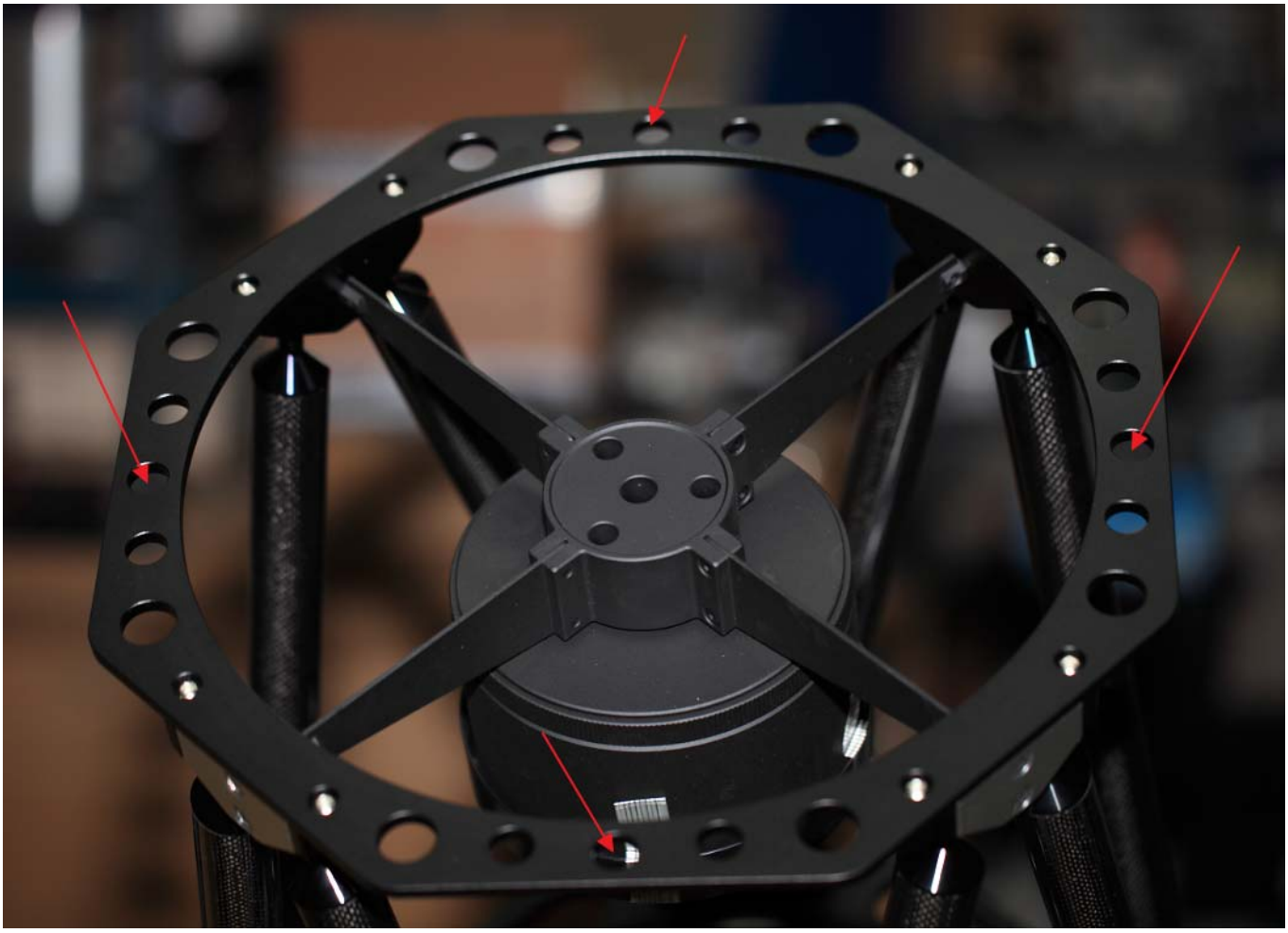


Fig. 5 *Holes position for the DIMM mask*

Tighten the 4 screws gently, and the DIMM mask is in place. The red arrow shows the screw to be tighten, do not touch to the opposite screw.

The holes diameter is 51 mm and are 240 mm center to center distance.

The screw on the back of the mask is to be unscrew, not the one on the front.

The mask is not black, but has no color anodization. A hood can be screwed on top of the prisms, this prevents the dew from forming by reducing the solid angle seen by the prism.

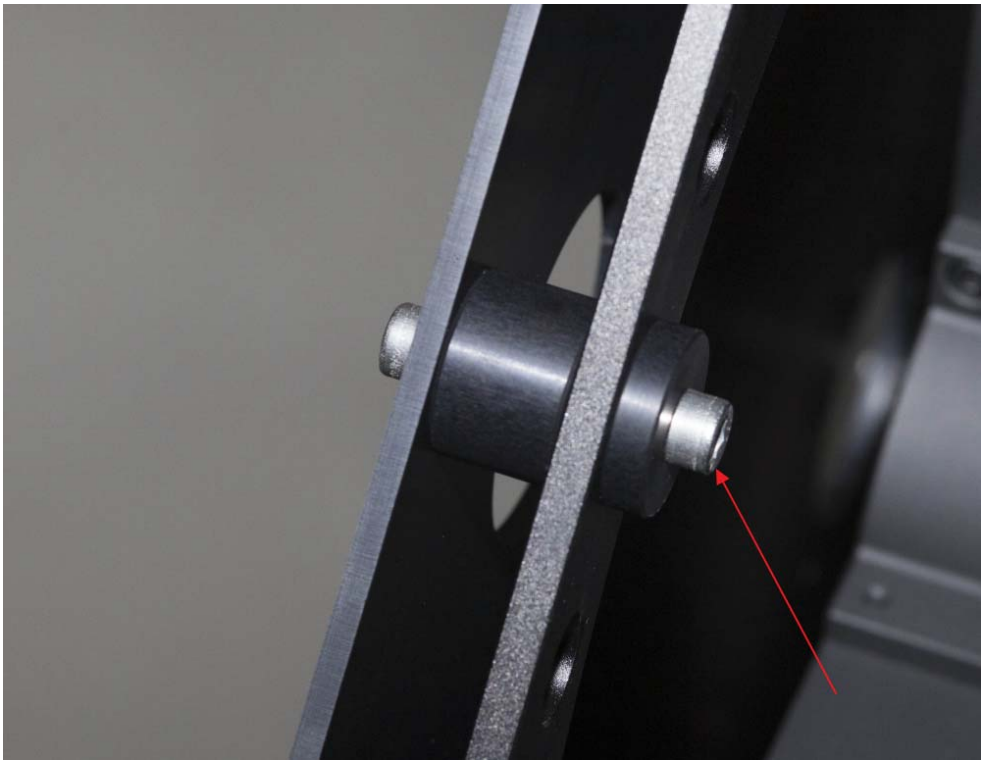


Fig. 6 *DIMM mask installation on the telescope top ring*

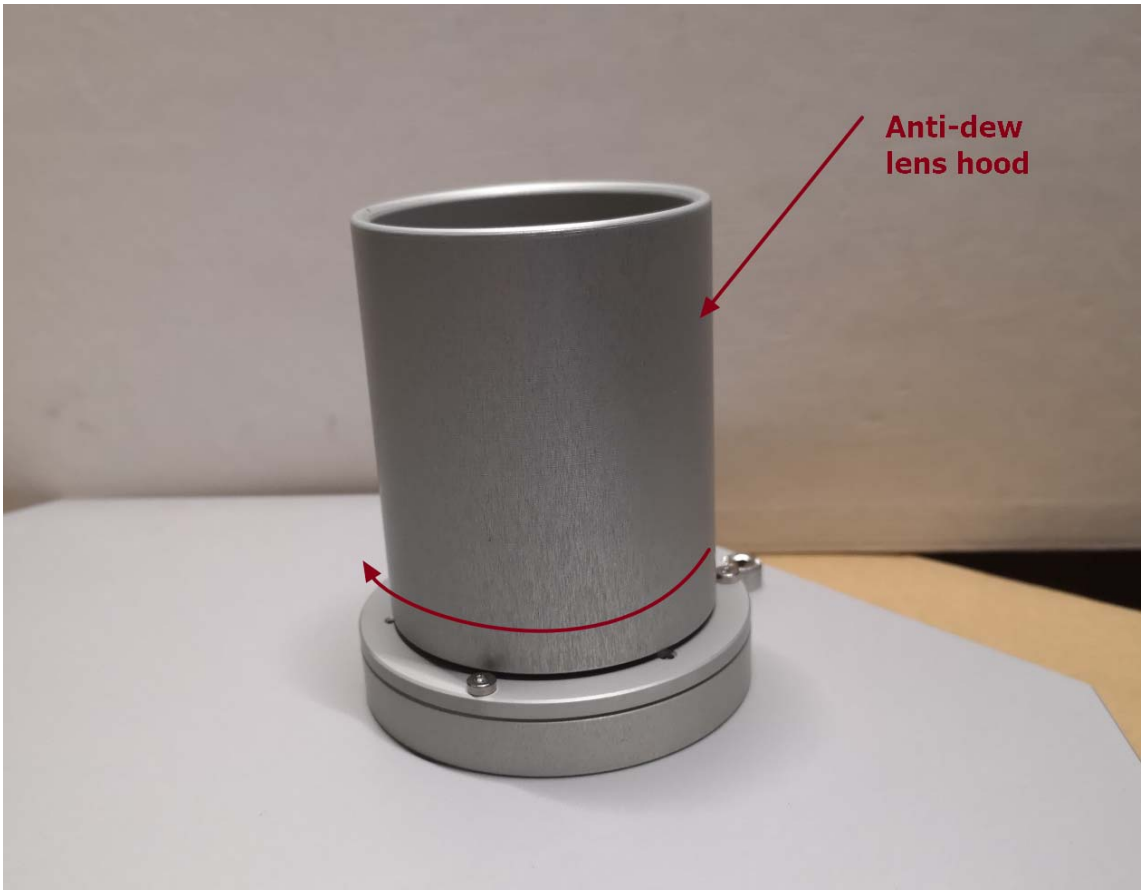


Fig. 7 *DIMM mask ant dew prism hood (it reduces dew effects)*

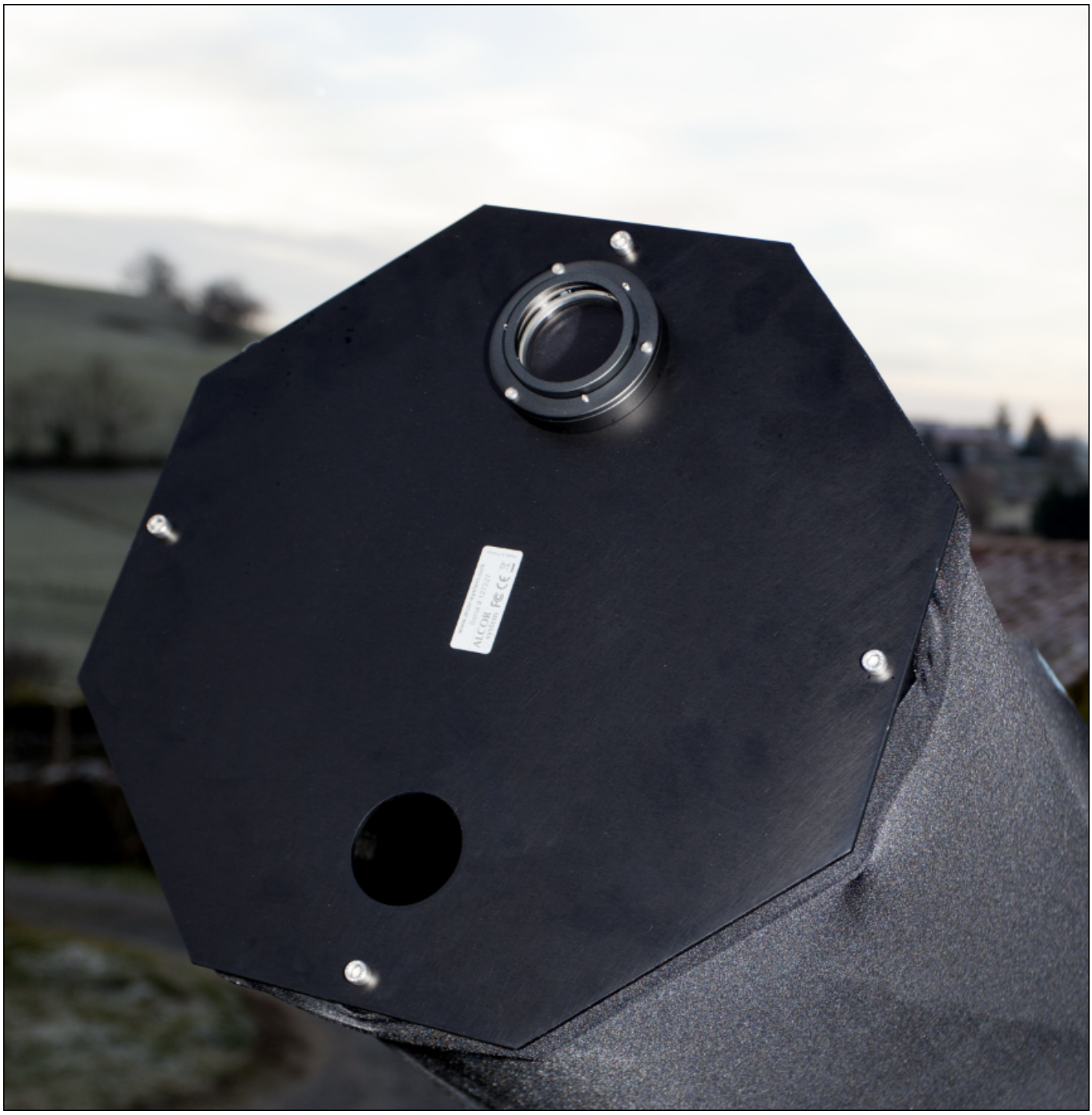


Fig. 8 *DIMM mask installation (and light shroud)*

1.2.4 Electronic finder installation (All mounts type)

The orientation and the position where the electronic finder installed is very important! This is used by the software to adjust telescope slewing and put . It is held by two M6x30 CHC screws to the tube structure by a

special adapter part. The alignment of the electronic finder with respect to the optical axis can be tuned by the user.

Fig. 9 *Electronic finder*

Despite this is a USB 3.0 camera, it will be used as USB 2.0 camera. This is fully compliant and since the camera is used by still image by still image (the video stream capabilities of the camera are not used in this case, and does not bring any added value).

The focusing of the electronic finder is not required, it has been achieved on factory (but can be refocused if necessary). The focal length of the electronic finder is 100 mm. the field of view is 4.3° x 2.9°, with 3096x2080 pixels.

In the end, the electronic finder image provides a vertical orientation with respect to the sky.

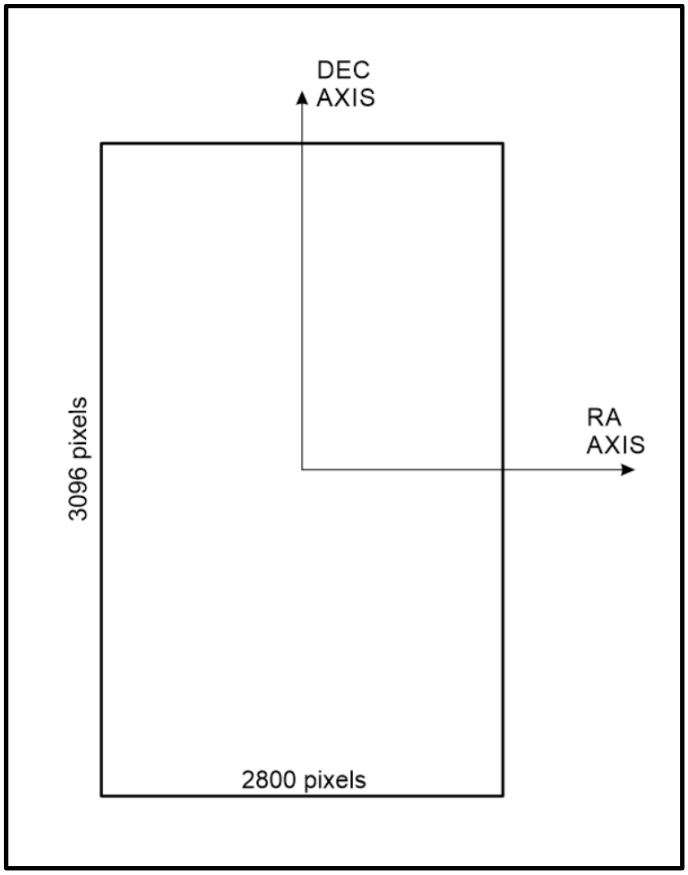


Fig. 10 *Electronic finder field of view*

1.2.5 Light Shroud installation (All mounts type)

The “Astrozap” light shroud installation is not mandatory, it serves to prevent Moon light from entering the DIMM camera and to limit the amount of dust to get into the main’s telescope mirror.

Do not wrap the DIMM mask with the light shroud; the next picture shows how to end the shroud in the telescope input section.

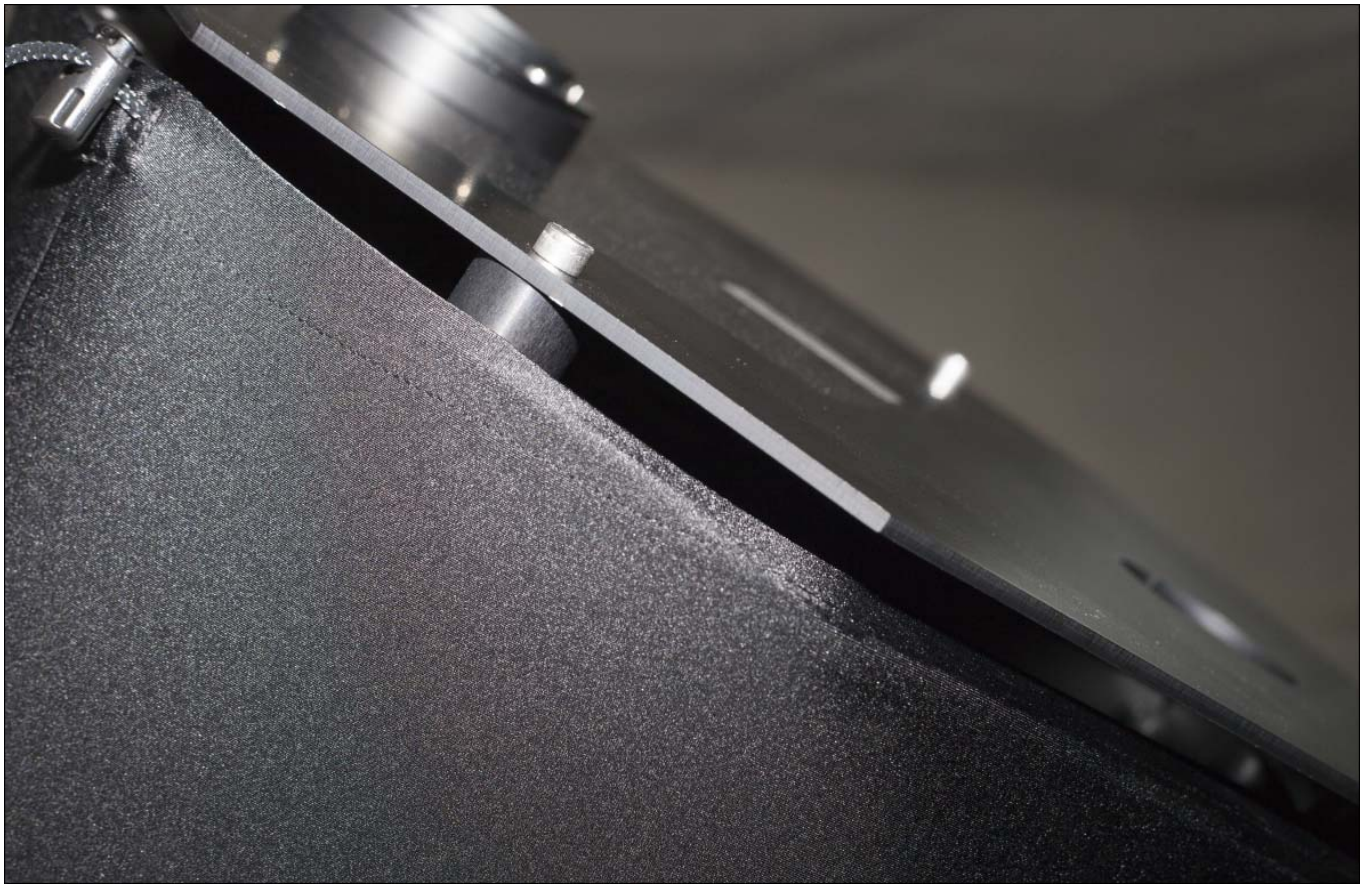


Fig. 11 *Light shroud installation at the DIMM mask level*

1.2.6 DIMM Camera installation, flip Mirror and eyepiece (All mounts type)

The eyepiece is a 12 mm focal length, with a double illuminated reticle, providing 200x magnification, the field of view is 15 arcmin (or ¼ of a degree)

The field of view of the DIMM camera is 17x10 arcmin.

The flip mirror lever, allows either the light to go to the eyepiece when down, and when up the light goes to the DIMM digital video camera. The light of the telescope does not go at the same time to DIMM camera and to the eyepiece, please keep this in mind!

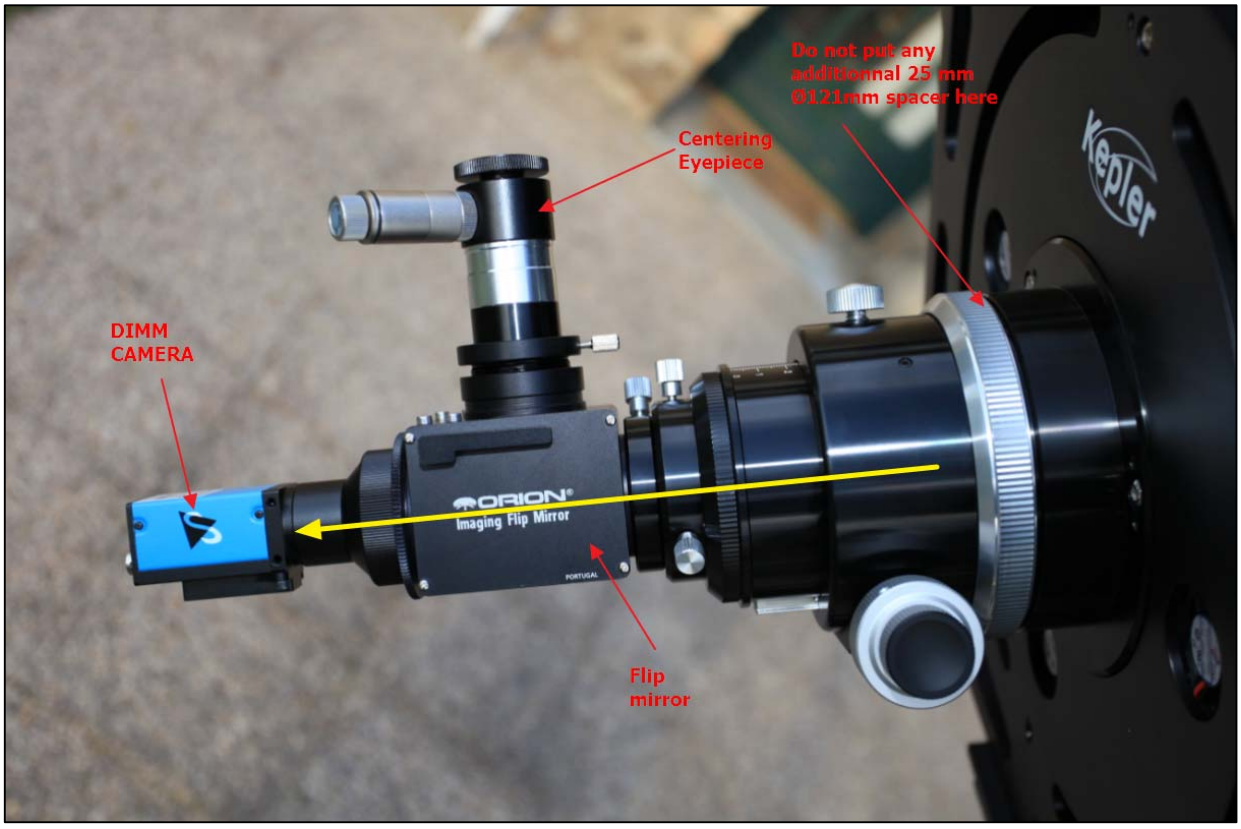


Fig. 12 *DIMM camera, flip mirror and reticle eyepiece, light going to camera*

Fig. 13 *DIMM camera, flip mirror and reticle eyepiece, light going to eyepiece*

The next pictures show the different field of view of the DIMM camera, electronic finder and reticle eyepiece.

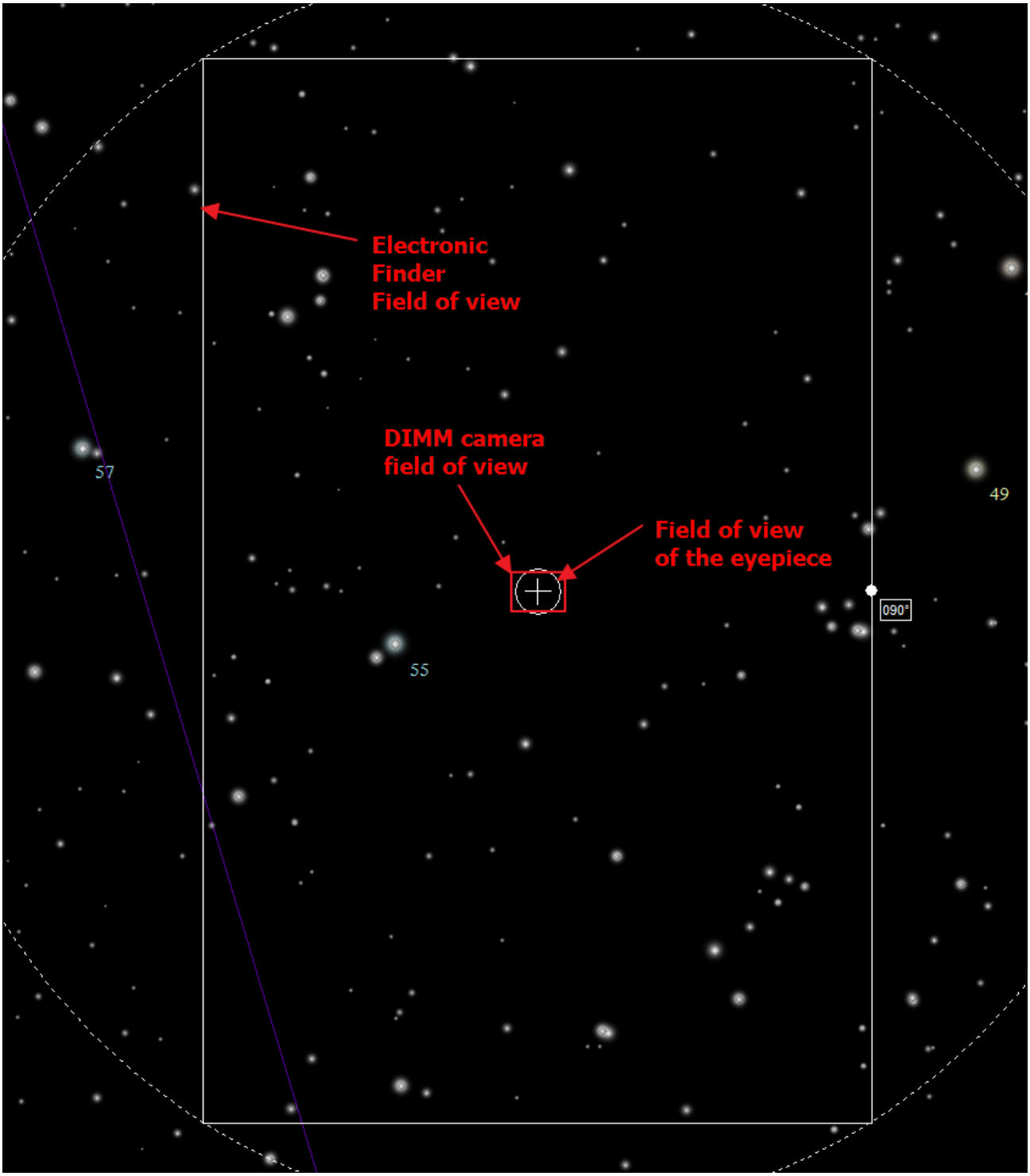


Fig. 14 *Relative field of view of the DIMM camera, electronic finder and eyepiece*

To lit the reticle grating, rotate the knob (red arrow), the reticle intensity can be adjusted, do not forget to switch it off, otherwise batteries will fade away! The focus of the reticle can be adjusted to the sight of the user by rotating the top part of the reticle eyepiece (green arrow).

Fig. 15 *Reticle eyepiece settings*

1.2.7 Visual scope finder installation

The visual finder has to be attached to the tube, and is aiming at finding star into the main telescope at the beginning of the operations. Warning, the reticle is not illuminated, the field of view is around 10°

Fig. 16 *Visual scope finder*

1.2.8 Cable attachment to the tube and the mount (All mounts type)

Once all the equipment is installed to the telescope, the cables have to be attached as follows. A gigabit switch and a PC computer are required (not supplied).

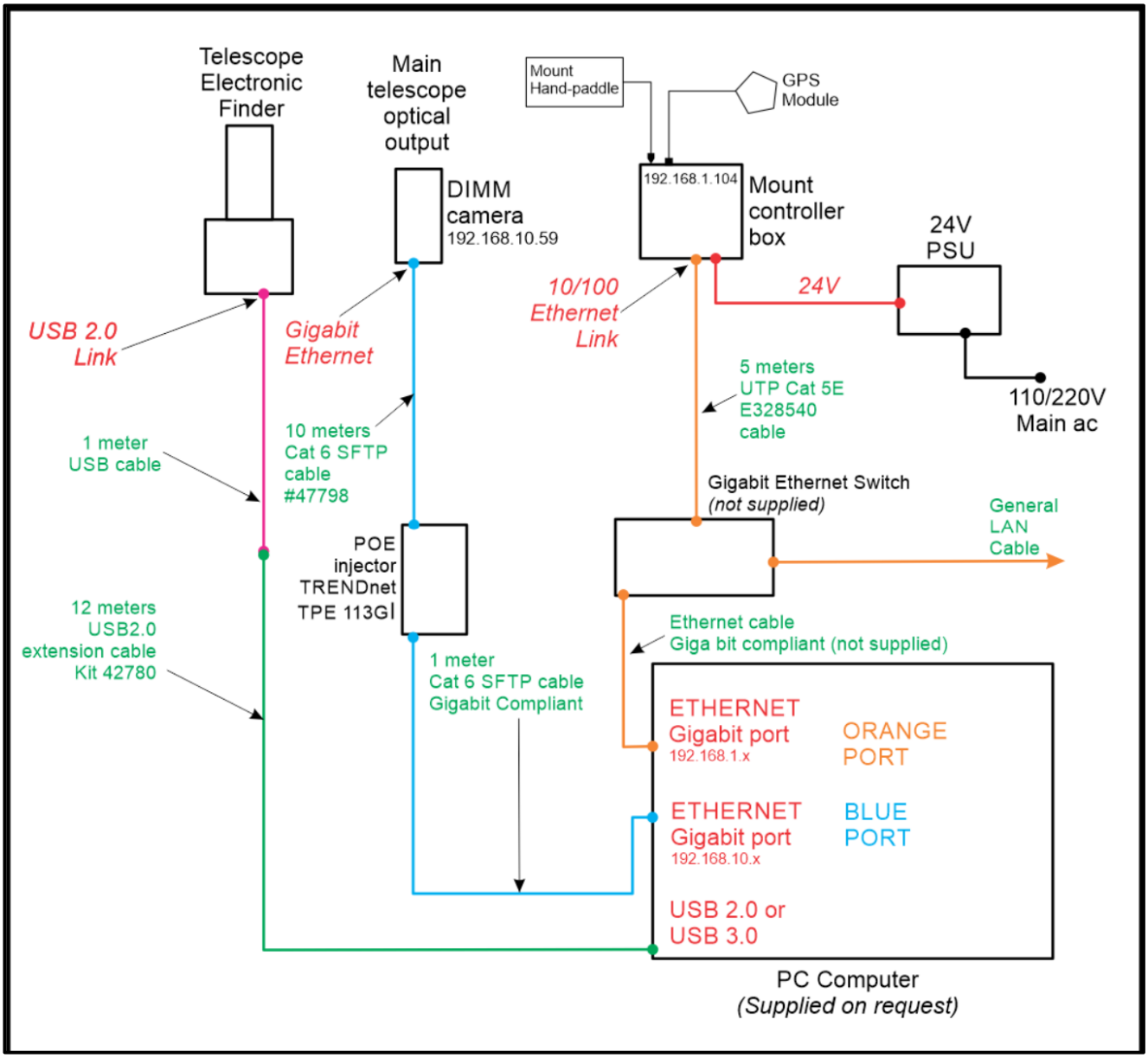


Fig. 17 *System chart, cable connection between all system devices*

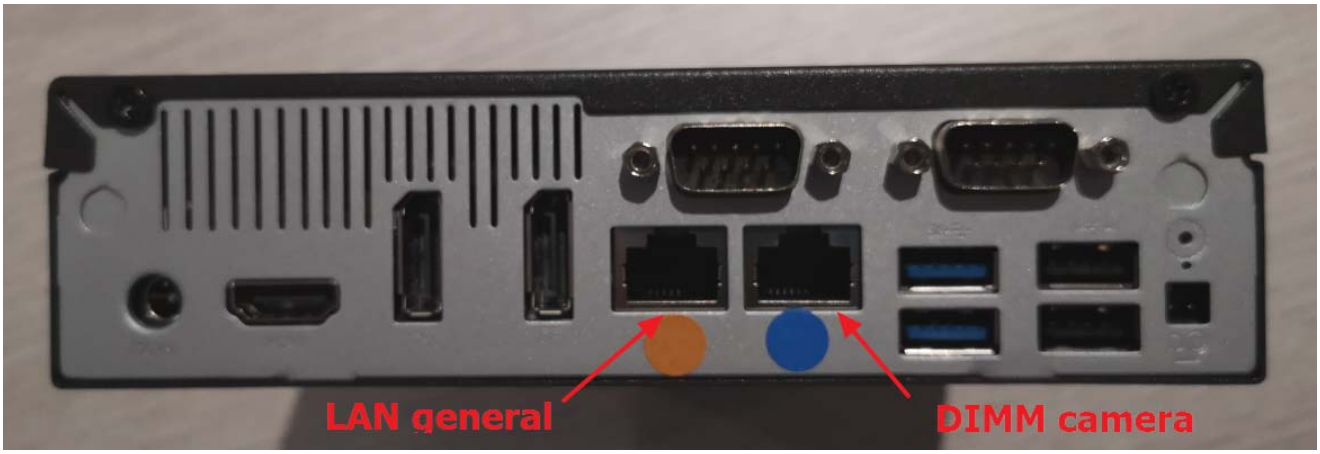


Fig. 18 Backside of the Small PC provided (if required) for this system.

1.2.9 Cable attachment to the telescope tube and mount (Belt drive mount)

USB and Ethernet cable must be attached properly, so that the mount can achieve meridian flip with no problem.
If cables are not attached, cables can hook on the mount, and prevent accurate slewing. The next pictures show how to attach the Gigabit Ethernet cable from the DIMM camera and the USB cable from the electronic finder and bind them together. This is very important especially when the mount performs a meridian flip that the cables are not wrapping around the mount.

Fig. 19 *Path of the cables*

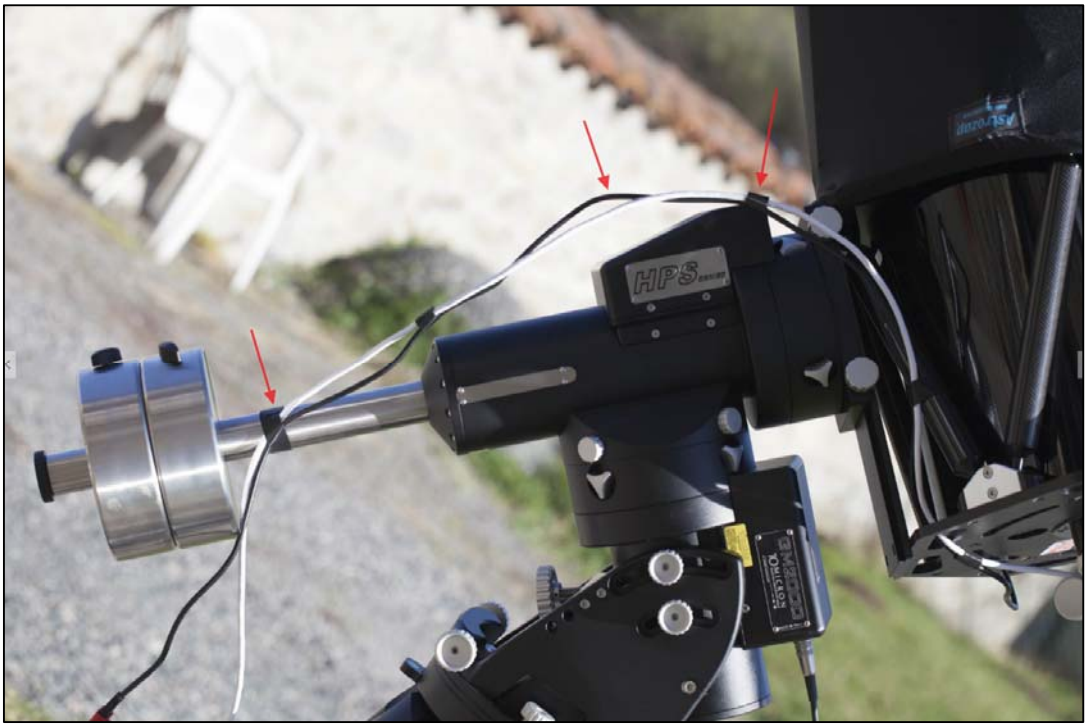


Fig. 20 *Path of the cables, counterweight side.*

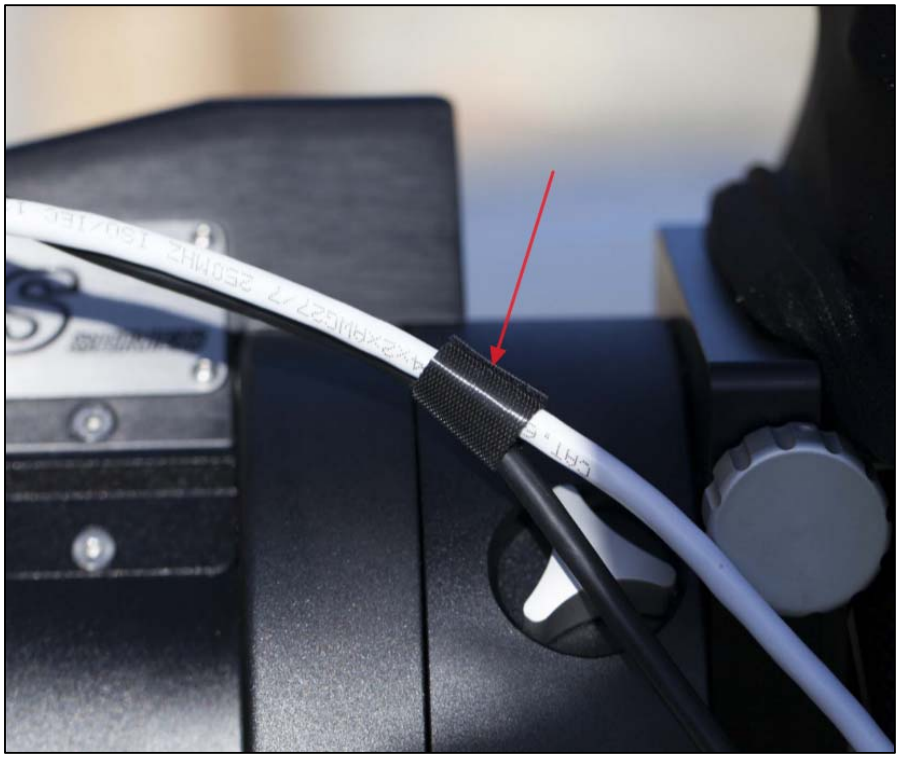


Fig. 21 *cable binder*

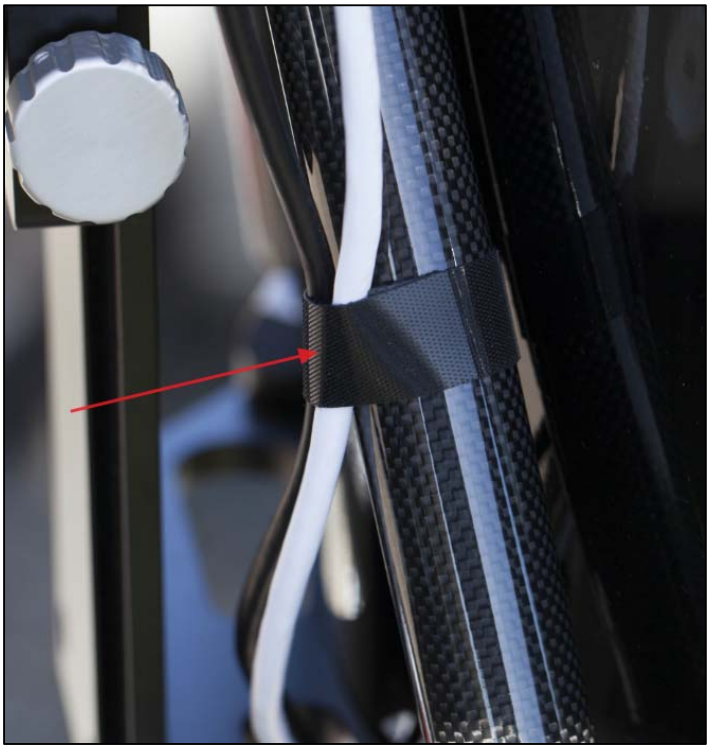


Fig. 22 *Cable attached into carbon truss tube*

1.2.10 Telescope balancing

Before running the system, the tube must be very well balanced on the RA and DEC axis. Check this when the knob of the mount is released and move the two counterweights accordingly, and the tube along the dovetail if necessary.

2 Software installation

This chapter is about software installation, please proceed software installation **in the same order as presented in the next section.**

2.1 PC System requirements

The PC computer must comply with these minimum requirements:

- I3, I5 or I7 or above intel CPU based computer
- 128 Go disk (SSD or HDD)
- 8 Gb RAM
- Display resolution 1900x1080
- Gigabit 1000 Ethernet port (Dual port advised)
- One USB 2.0 Port
- Operating system: Windows 10 or 11 x64 version

- English operating system language is advised, no test have been achieved with operating systems running with Arabic, Chinese, Thai-language, Japanese, Hebraic …(non-Latin alphabet EN/EU characters)

Small PC can do the job, with for instance an Intel core I7 4500U CPU, which has a TDP of 15W works and has been validated. If the PC is inside a LAN, it is recommended (but not mandatory) to get a PC with a dual LAN Ethernet board, one dedicated to the system, and the other for network link to another computer and internet.

Warning, at full speed (1920x1200 @ 50 fps) and full frame, the DIMM camera can use 95% of the Ethernet Gigabit bandwidth.

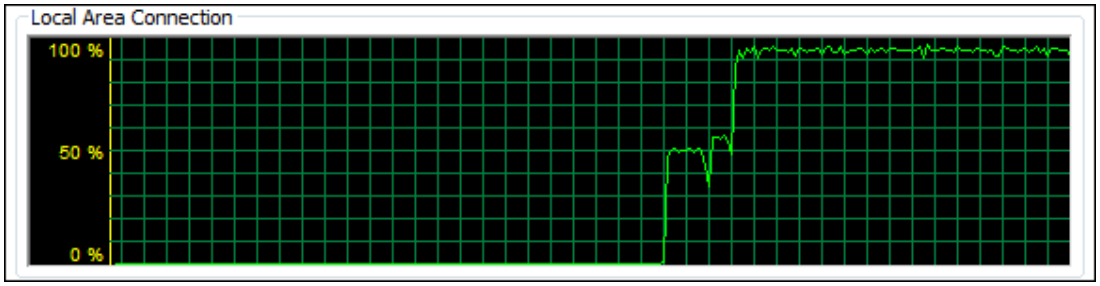


Fig. 23 *Gigabit bandwidth allocated by the DIMM DMK 33GX174 camera*

2.2 System control software

The system control software is PRISM. **It should be installed first. This software resides in the ALCOR-SYSTEM USB Stick, and "PRISM" folder.**

Start ***setup_prism.exe***

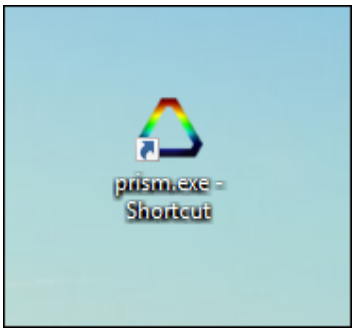


Fig. 24

PRISM is a large complete general multi-purpose astronomical software embedding camera and telescope devices control.

This software has a dedicated automated DIMM feature that controls the mount, the DIMM camera and the electronic software.

PRISM software documentation can be accessed by the ***Help/Local Help*** menu and this manual will focus on the automatic DIMM feature embedded into the PRISM software.

Some video tutorial to start are visible in Prism's web site: http://www.prism-america.com/

2.3 Mount software (Belt drive mount)

2.3.1 Virtual Keypad

The virtual key pad software must be installed and can be found on the ALCOR System USB stick in the "MOUNT" folder:

Run ***gm_qci_virtkeypad2.0.exe***

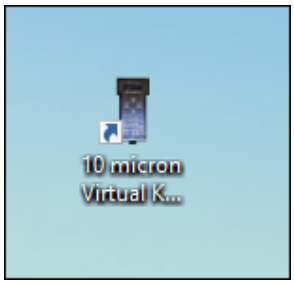


Fig. 25

It is a very useful software that mimics the use of the hardware keypad controller, by just being sitting in front of your computer.

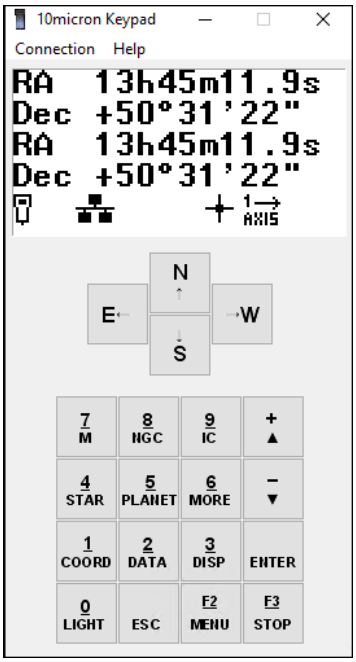


Fig. 26

The default IP mount address is 192.168.1.104

If the IP address can be changed, the keypad must be used for that purpose. Ask local network administrator to get a valid IP address suitable to your network and not being used by another connected device.

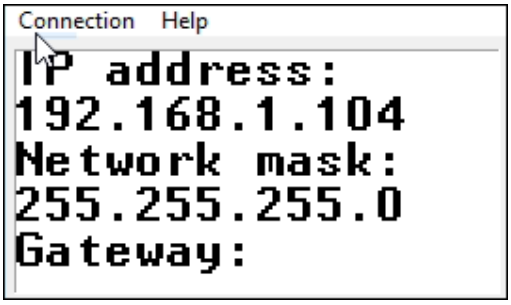


Fig. 27

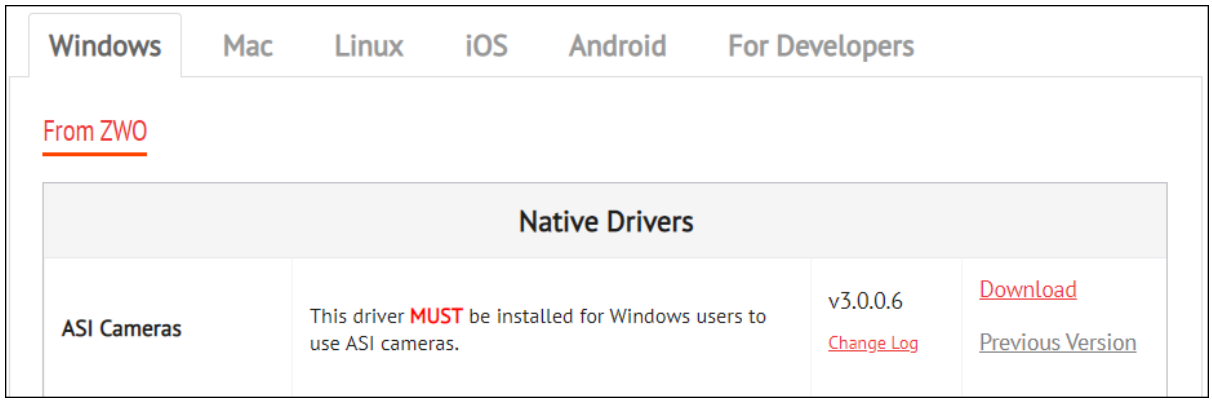
2.3.2 Mount ASCOM Driver (Belt brive mount)

The mount ASCOM driver software must be installed and can be found on the mount USB stick:

Run ***10micron_ascom_driver1.5.1.0_setup.exe***

2.4 Electronic finder software

Latest camera drivers can be found here : https://astronomy-imaging-camera.com/software-drivers



Once the camera driver is installed, camera can be connected and this device appears in the windows device manager.

The camera can be tested quickly with the sharpcap software: https://www.sharpcap.co.uk/

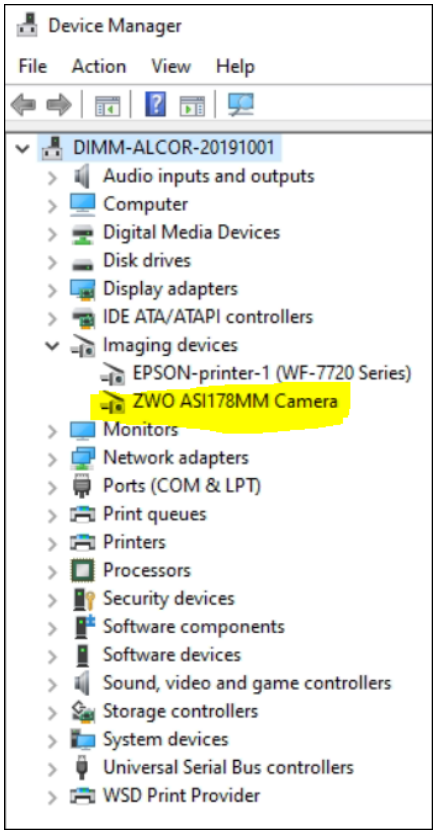
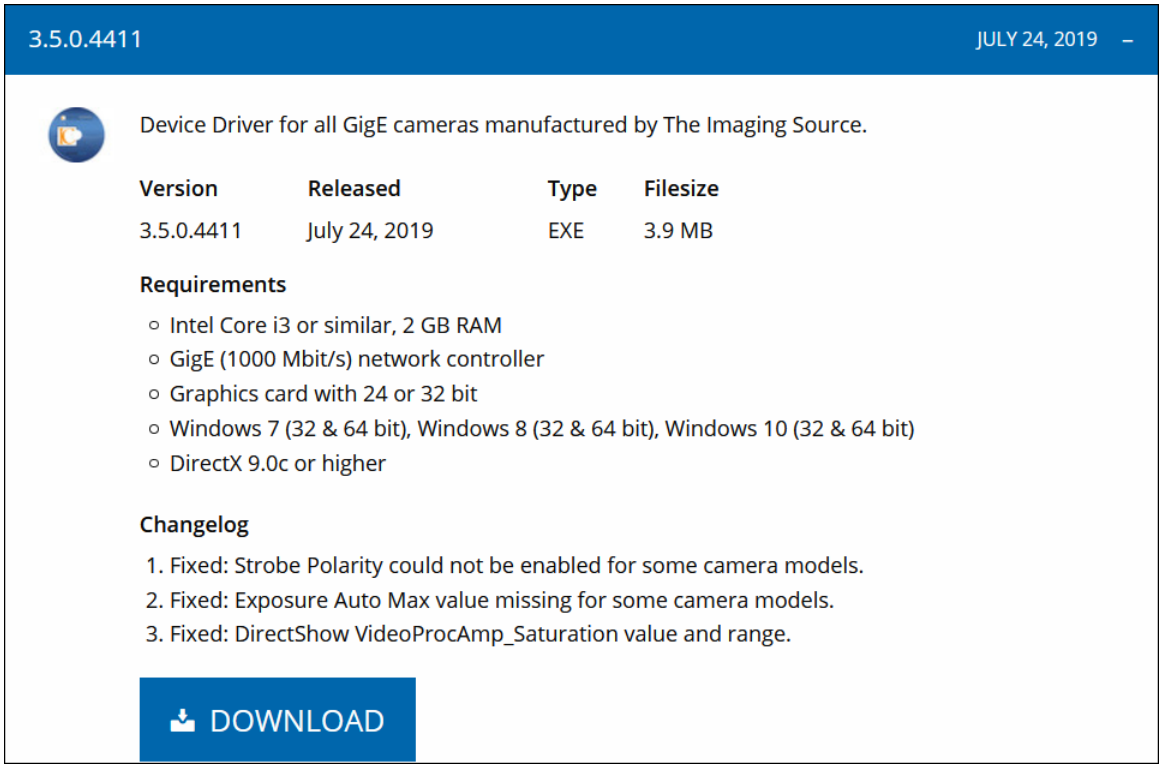


Fig. 28

2.5 DIMM camera software

The DIMM camera driver software must be installed and can be found here:

https://www.theimagingsource.com/support/downloads-for-windows/device-drivers/icwdmgigetis/



Start the

gigecam_3.5_0.4411_setup.exe

When this driver is installed, the icon on the right bottom of the screen appears, expand it:

Fig. 29

Power on the camera, and after some seconds, the DIMM camera should appear as "**DMK 33GX174e**"

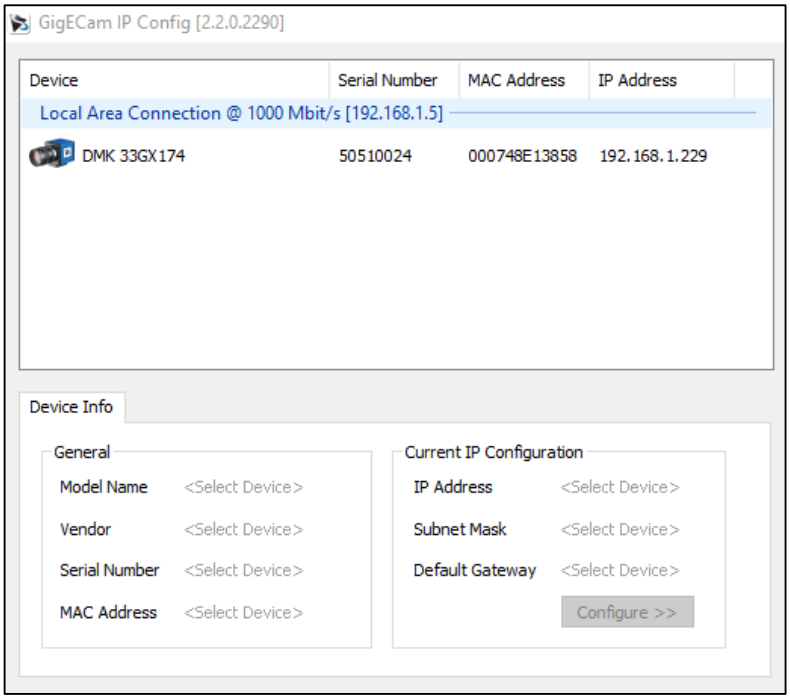


Fig. 30

Either the IP address of the camera is provided by network DHCP mechanism, or can be assigned to a persistent and fixed IP address. If the camera gets IP address like 169.254.227.159, it means that there is no DHCP mechanism to provide the IP address to the camera, and in that case persistent IP address shall be entered.

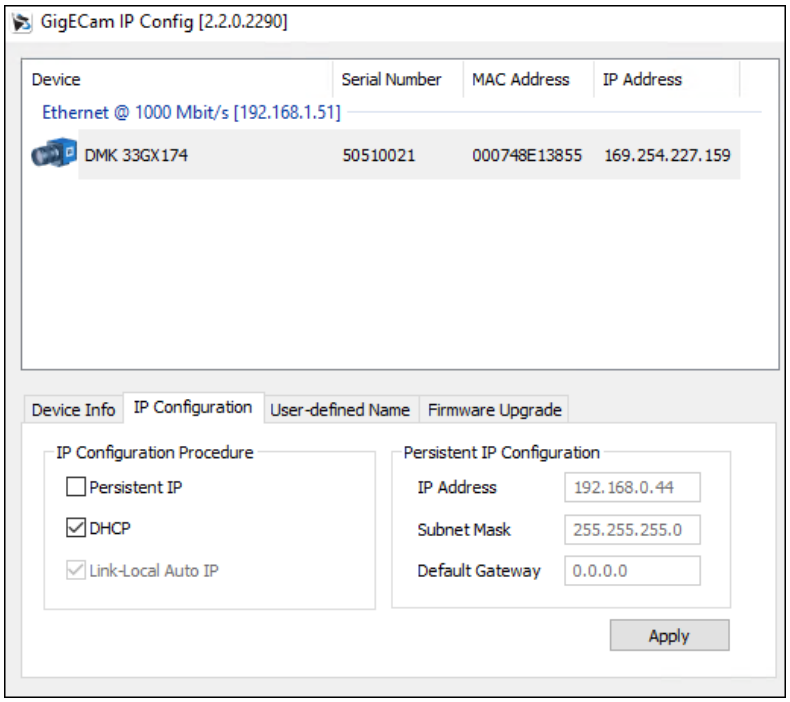


Fig. 31

For instance, here we decided to assign the persistent IP address to 192.168.1.92, but you must ask your local network administrator to provide you a valid persistent IP address, not used by another device. If you do not fell easy with this, please do this step with your local network administrator.

In the case of dual ethernet board and PC provided by our company, the camera IP is persistent, and set to 192.168.10.59

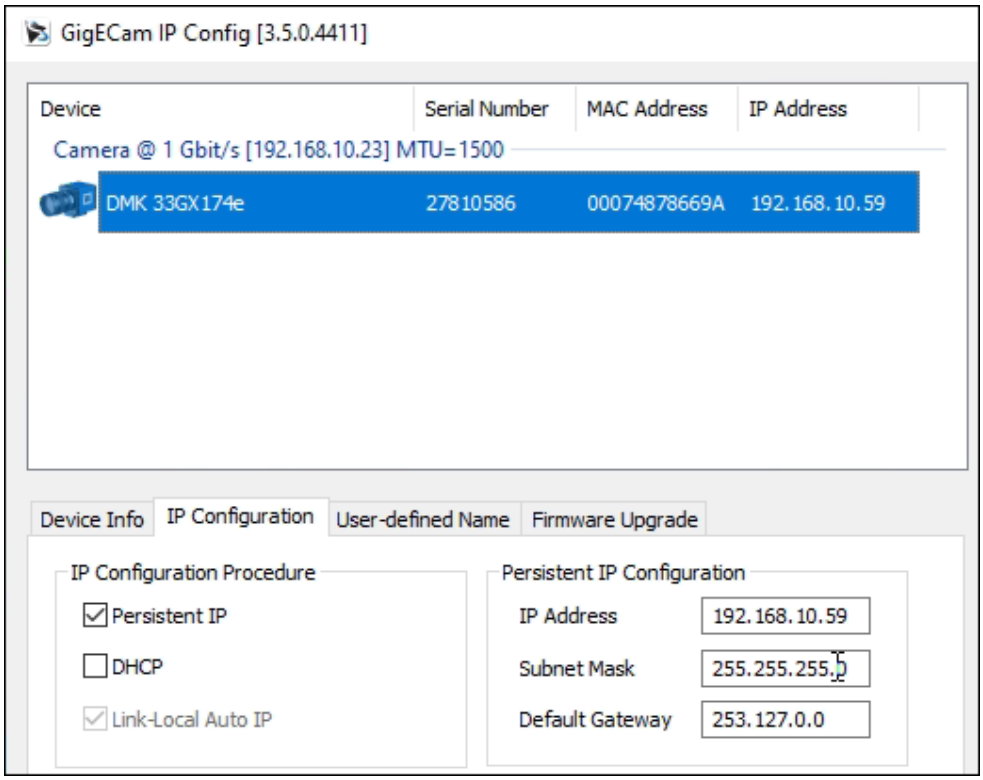


Fig. 32

Install the IC Capture software, get it here : https://www.theimagingsource.com/products/software/end-user-software/ic-capture/

PRISM embeds directshow camera control, but IC Capture can be useful to test quickly the DIMM camera.

Fig. 33

If installed properly the camera appears like this and immediate image capture can start.
Warning: this software will not do any DIMM analysis, only PRISM software can achieve this.

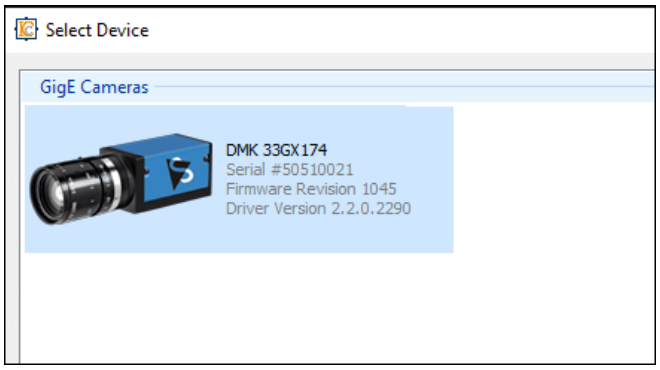


Fig. 34 On IC-Capture the camera will appear this way.

IC-Capture is straightforward to use.

3 System startup

3.1 Hardware startup (Belt drive mount)

On a clear day, the OTA on the mount is perfectly balanced, aim at a remote object in the horizon, more than 3 km distance and tune the visual finder scope, with respect to what you see at the reticle eyepiece located above the flip mirror. Tighten the 6 screws of the finder as strong as you can. Check again that the center of the visual scope finder reticle matches perfectly to what is seen in the 12" telescope eyepiece above the flip mirror. Never power on the mount to perform this task! Use mount knobs to clamp the RA (Right ascension) and DEC (Declination) axis, so that the telescope's tube does not move unexpectedly.

Now, at that stage, be sure that all the software is installed, and mount, DIMM camera and electronic finder are all connected.

On a clear night, power on the mount. PLEASE NOTE THAT THE MOUNT MANUAL must be considered and fully and carefully read.

Set the time of your observing place (unless you have the GPS module of the mount) using the mount keypad or using the virtual software keypad.

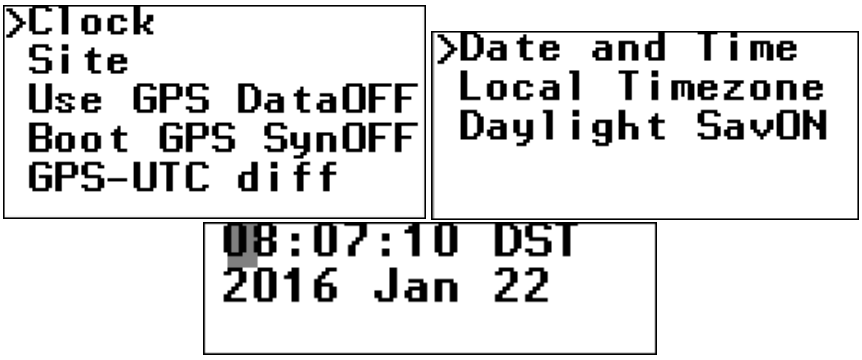


Fig. 35 Belt drive mount controller display

Then set the place where the telescope is located (unless GPS module):

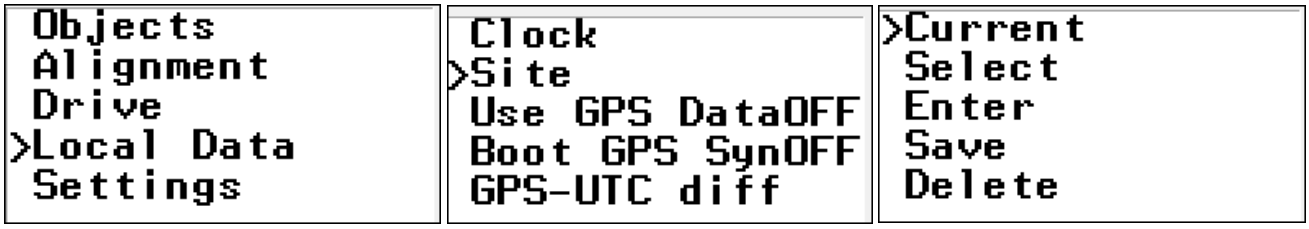


Fig. 36 Belt drive mount controller display

If a GPS module is provided, please connect it the mount main control unit and turn ON these 3 features (Menu LOCAL DATA).

Do a rough polar alignment, with a laser stick (not provided), for instance to aim the RA mount axis to Polaris star (if system located in the northern hemisphere), by first rotating the mount tripod, and then by using the latitude and azimuth adjustment knobs. See mount manual for more information about this process. It is strongly advised to print the sky chart from §8.3.1 to 8.3.8 from the mount manual, because the mount keypad will display star names, that might not be familiar to the user. Sky chart are useful to find them out visually in the sky. Also be sure that the 4 knobs clamping the RA and DEC axis are now tightened.

Then, on the mount keypad, go to "***Alignment***", and then go to "***Clear Alignment Data***". Clearing alignment data must be performed whenever the mount polar axis is moved.

Then go to "***Alignment***", and then go to "***3 stars***", the 1st star name must be selected. The mount will move toward the 1st star. Use first the visual finder scope, and center it using the direction keys:

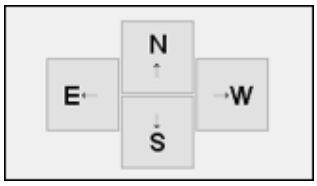


Fig. 37

The speeds can be changed by pressing these keys from several degrees per second down to 4" per sec.

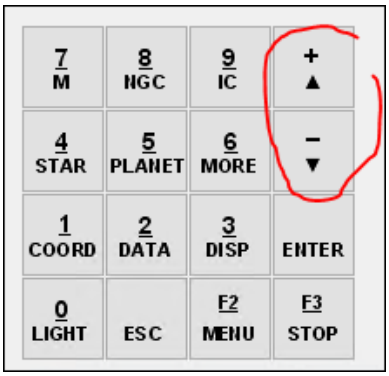


Fig. 38

Perform an accurate centering with the reticle eyepiece sitting on top of the flip mirror and slow speeds. Warning, the magnification of the 12" RC telescope is 200x! The image of a bright star through the telescope with the DIMM mask is looking this when focused:

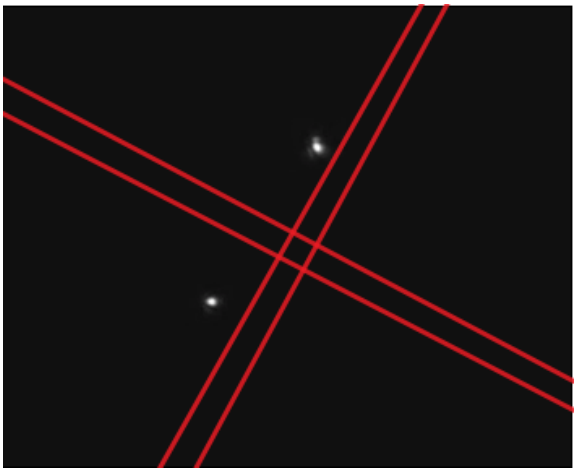


Fig. 39 *Image of a single star throughout the DIMM mask and the 12" telescope in the reticle eyepiece*

Do focus this image as best as possible. Select three alignement stars that are bright enough, and far enough each other, like 60° and located on both side of the meridian. The common error is to mixup stars in this process, this will lead to a very poor tracking and pointing performance!

More information can be found in the mount PDF manual: ***GM2000HPSM2ULTRAPORT-en-2.12.21.pdf***

Proceed the same way with the 2nd and the 3rd star. Do not use the electronic finder, because this latter is not centered with the telescope optical axis at that stage.

In the mount keypad menu, ***Alignment*** and ***Align info*** check the Polar alignment error (here only 4'26'') and the number of star used for this simple model.

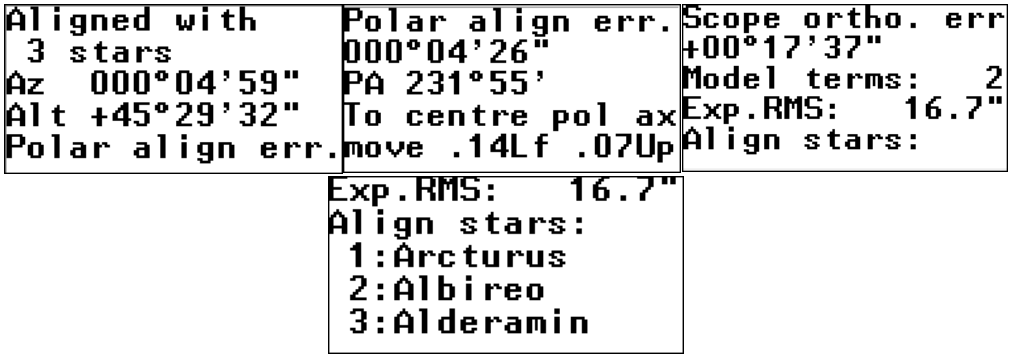


Fig. 40

The mount polar axis alignment can be improved if the polar axis alignment error is higher than 5 arcmin. The mount documentation (***GM2000HPSM2ULTRAPORT-en-……pdf***) §5.5 explains well to you how to improve the mount polar alignment.

Perform iterations so that the mount polar axis alignment error is less than 5 arcmin in both directions.

3.2 Software startup (All mount type)

3.2.1 Observing place setup

PRISM is the central system software. It can control the mount, the two cameras and will perform all DIMM measurements in an automated fashion. From dusk till dawn, the telescope will run automatically DIMM seeing measurements by selecting an appropriate star, then changing to another star when the previous one is losing too much elevation. It will avoid the Moon, and will Park the telescope at the end of the night, then the next night will resume automatically measurements, if the software is left alive, and telescope power is not turned off.

Insert in your PC the blue USB dongle that looks like an USB stick (but is not!)

Then start ***PRISM***

Go to Menu **Settings** and the **Default Observing Site**

Set the observing place using this form, once selected, « ***Select this place as default*** » GOOGLE maps can help you doing so.

This is a very important step, do not neglect it.

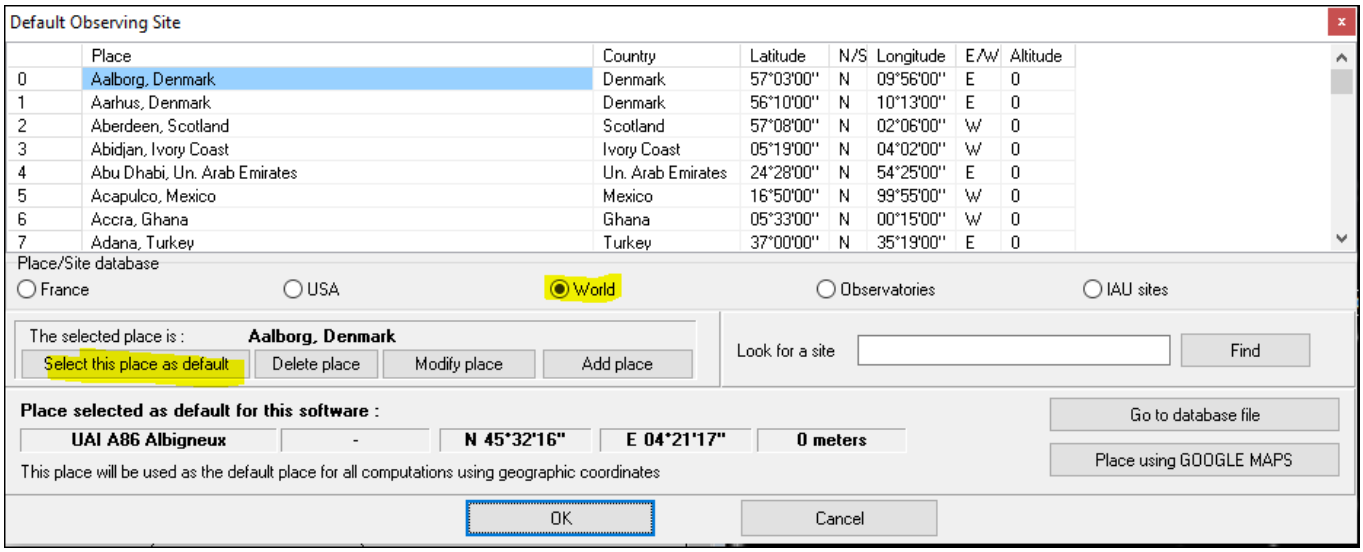


Fig. 41 *The site place in bold characters defines the overall observatory site.*

3.2.2 Hardware settings

3.2.2.1 Telescope mount setup

Now go to "***Settings***" and then "***Hardware Settings***"

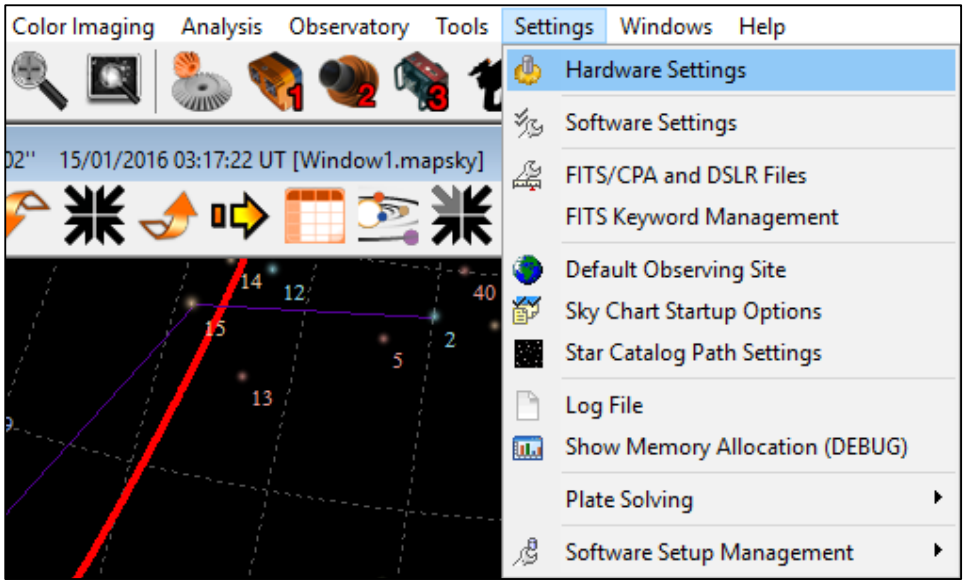


Fig. 42

Go to ***Settings***, then ***Hardware settings***, in the telescope tab, select ASCOM, then "***Choose telescope type***" then select "***10Micron Mount***"

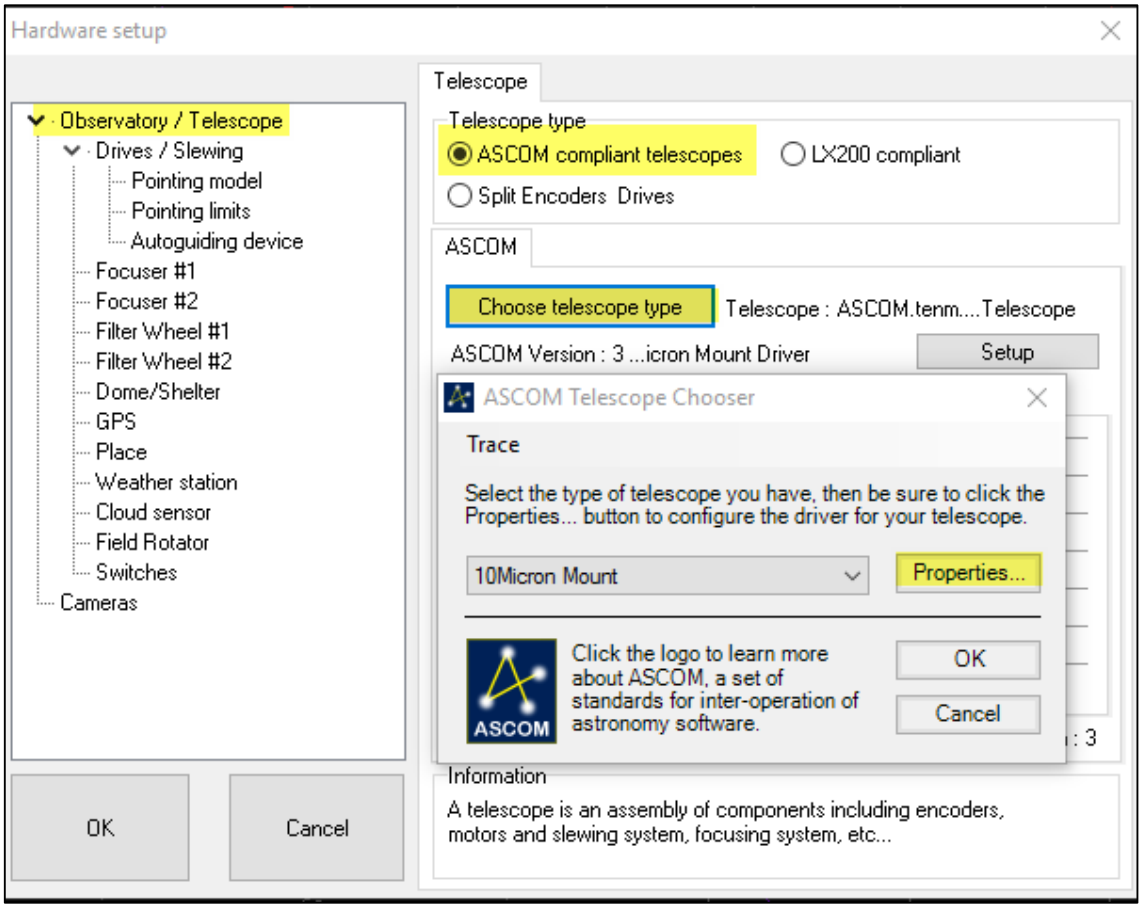


Fig. 43 *If 10Micron mount is not found, install the ASCOM mount driver (Belt drive mount)*

Click ***Properties***…

And set the IP address of the mount as it has been set using the Keypad, and check the three other checkbox like the next image.

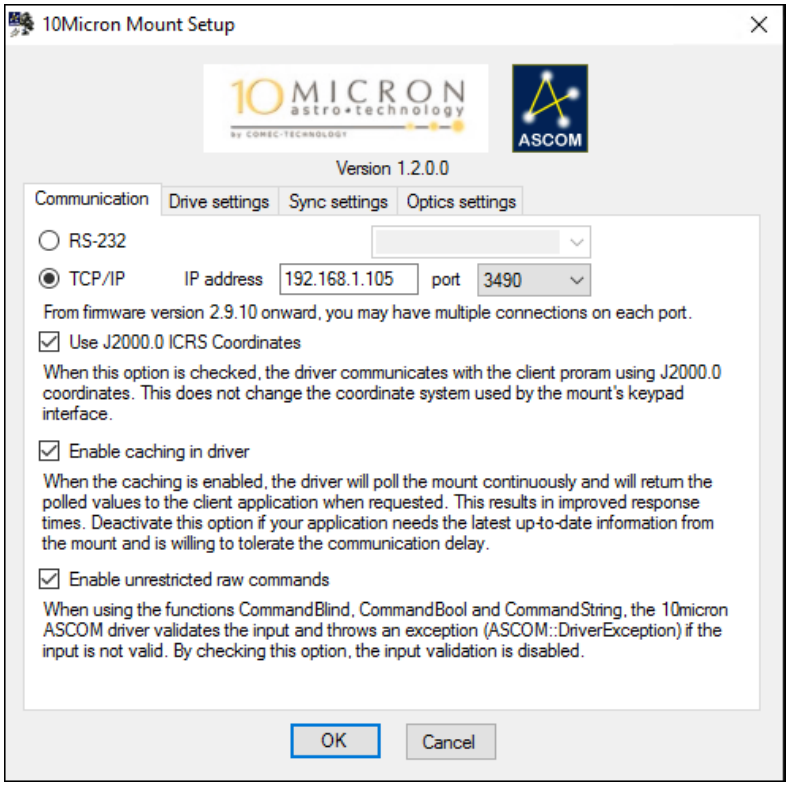


Fig. 44 *Communication tab setup (Belt drive mount)*

On the "***Drive setting***" tab copy these settings:

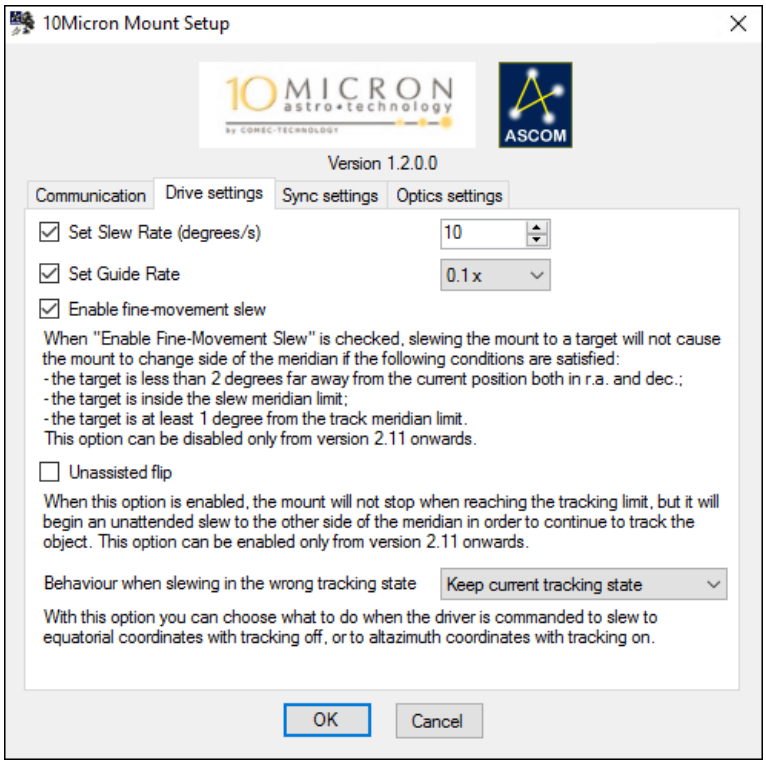


Fig. 45 *Drive settings (Belt drive mount)*

On the "***Sync settings***" tab apply these settings:

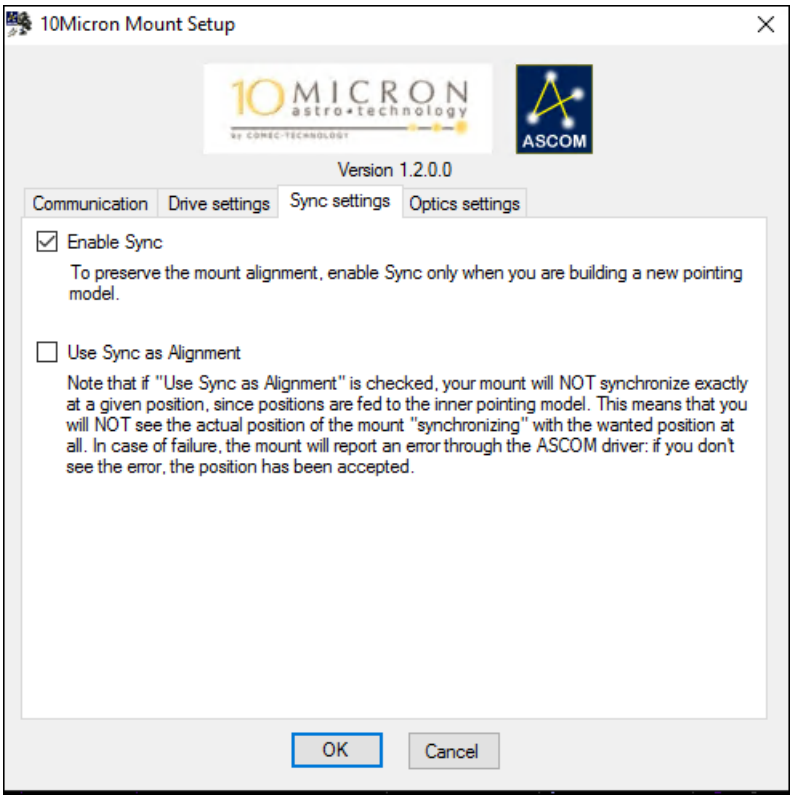


Fig. 46 *Sync setting tab (Belt drive mount)*

When "**Enable Sync**" is checked, this will sync the telescope position as a simple offset, but it will not add this sync position into the database of the mount's pointing model.

When "**Use Sync. as alignment**" is checked, PRISM on mount position synchronization will add the RA/DEC position into the database of the mount's pointing model (if any), nevertheless the telescope cursor position will not be exactly where it has been synchronized.

The "***Optical settings***" has no importance. Then click "***OK***"

Important: going back to the telescope settings, go to the "***Guiding***" tab

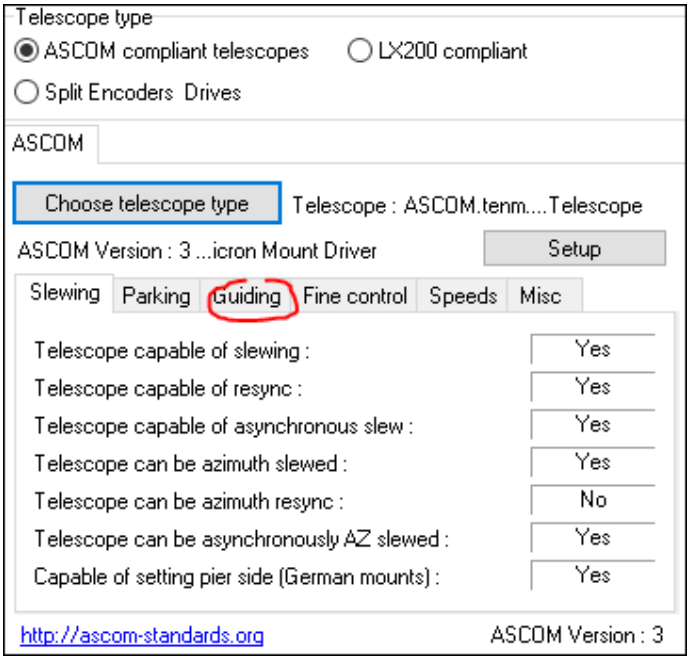


Fig. 47 *Guiding tab*

Verify that this checkbox highlighted in yellow is not checked!

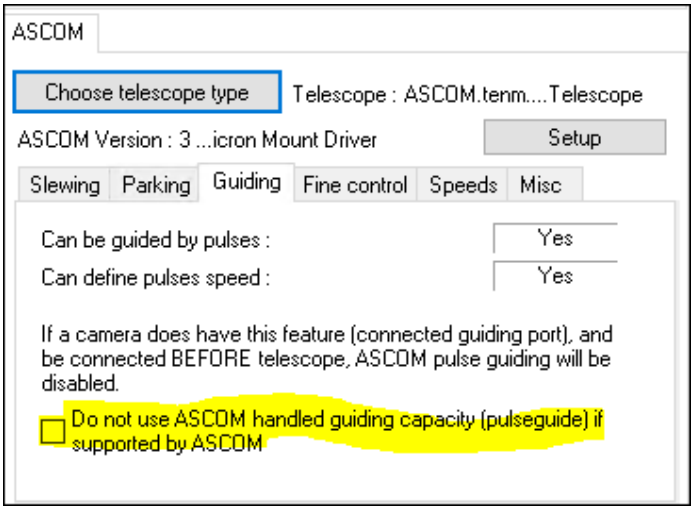


Fig. 48 *Do not check this box!*

3.2.2.2 Electronic finder camera setup

Setup the electronic finder camera, now remove the cap on front of the electronic finder lens. Set the camera #1 as an ASCOM camera.

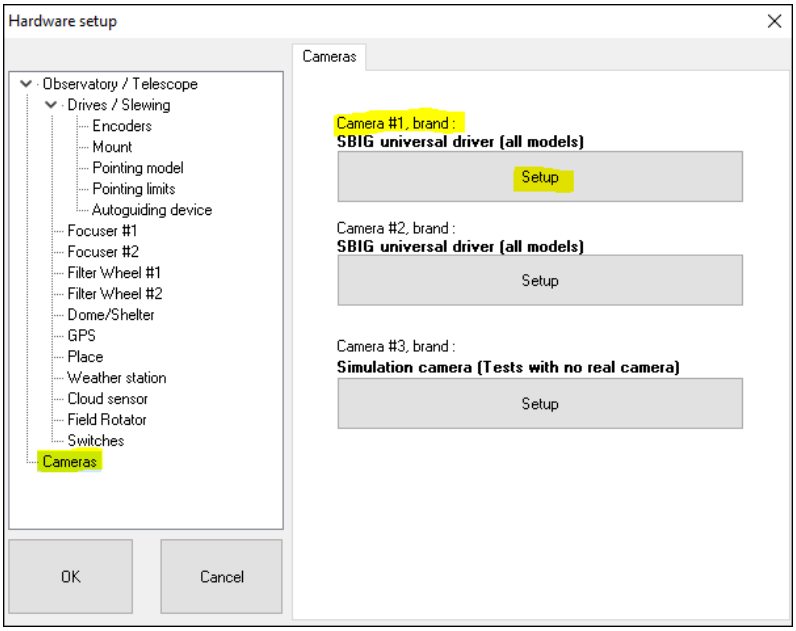


Fig. 49 *Electronic finder as ASCOM camera #1*

Then click "***Setup***", this form will appear. Setup all the highlighted in yellow field as follows. The "telescope" tab is the most important, the other does not need attention.

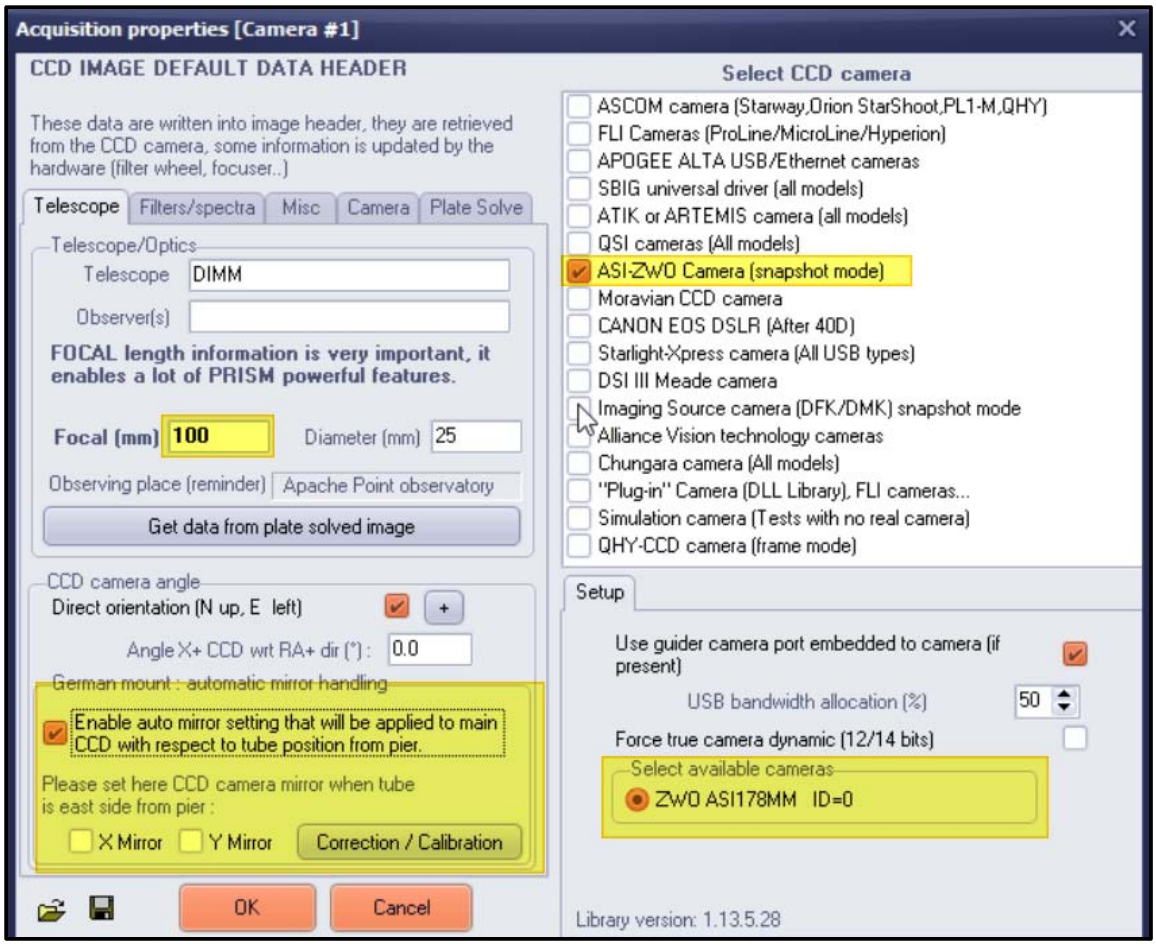


Fig. 50 *Electronic finder camera setup*

Setting the fields highlighted in yellow, the focal length is very important and set to 100mm, the "**German mount**" group box is also very important, set it as the screen capture shows it. These setting are bound to the electronic finder position on the telescope's tube.

3.2.2.3 Connection to the camera and the mount

Then close the hardware setting form. To connect to the electronic camera finder, click on this icon:

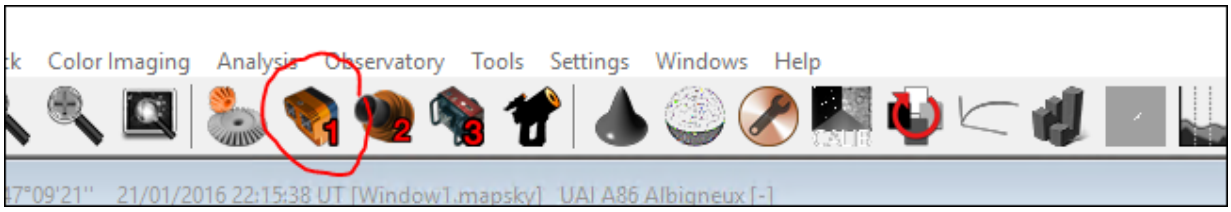


Fig. 51

This form appears, the "***Option***" tab, check that the bow are checked like this screen capture. The mirror controls are grayed, because the software takes care of camera image rotation according to the side of pier of the telescope mount.

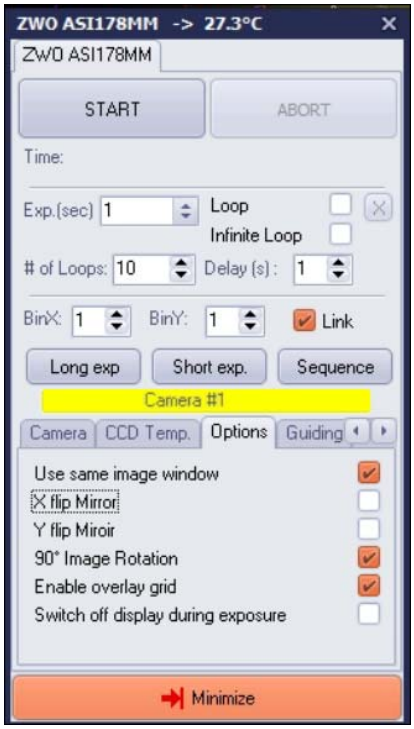


Fig. 52 *Check the 90° image camera orientation*

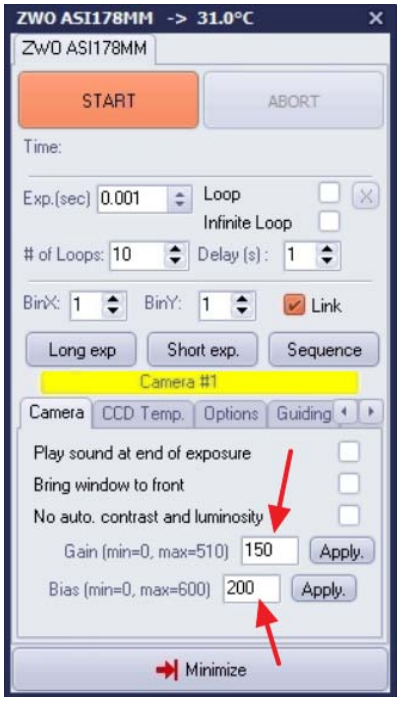


Fig. 53 *Check the gain and Bias to these figures.*

Then, in order to connect the telescope mount to the PRISM software, click this icon:

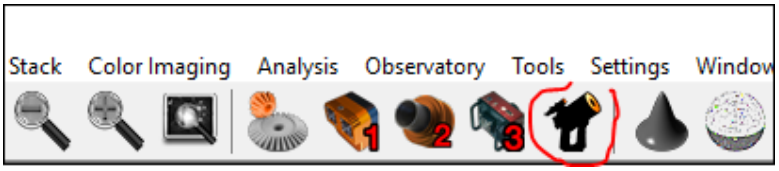


Fig. 54 *This connects telescope mount to the PRISM software*

After 20s this form appear, stating that the mount is connected to PRISM software.

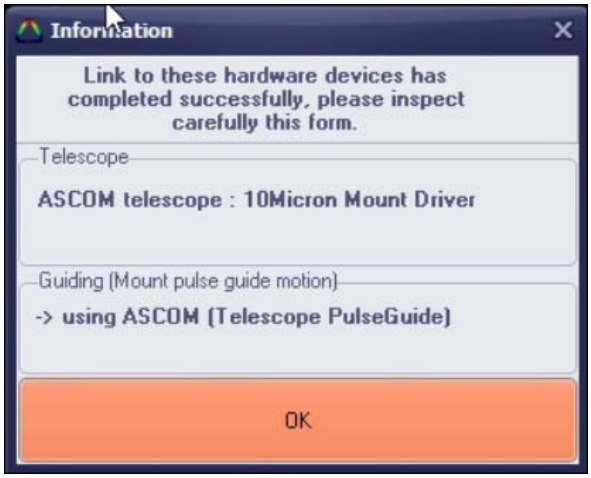


Fig. 55 *Form informing what is connected to the PRISM software. A wide range of hardware can be controlled by PRISM.*

By using the software Sky map, the telescope can be aimed at any position on the sky. For instance, the yellow target shape shows the current telescope position in the Sky. By double clicking to a star, information can be retrieved and telescope can be aimed at it.

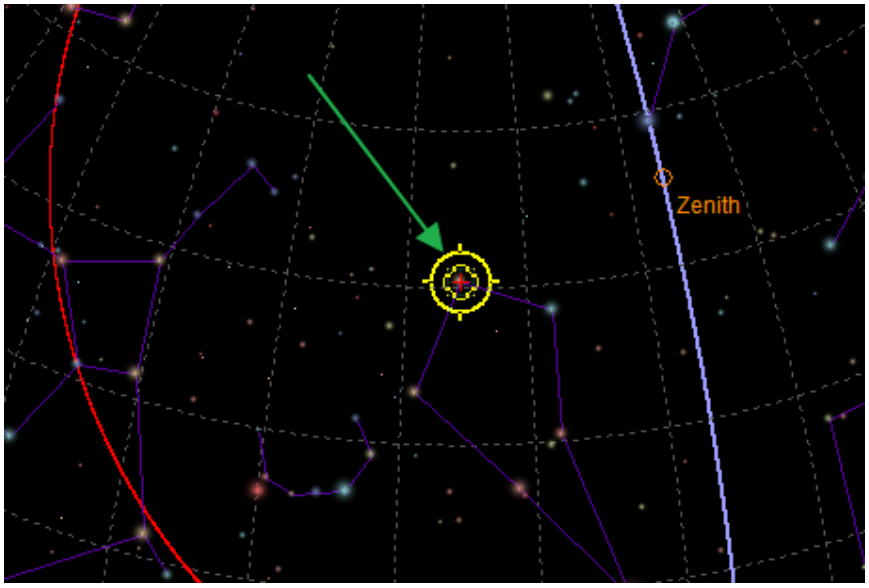


Fig. 56 *Cross showing current telescope position*

3.2.3 Electronic finder alignment

The electronic finder might not be aligned with respect to the 12” RC telescope optical axis. It could be misaligned during shipment. The electronic finder is not factory aligned.

During night, aim at a bright star (magnitude 0 or 1), and then center the star at the reticle eyepiece on top of the flip mirror.

Then take an exposure of 3 sec with the finder camera using the PRISM software.
The next image (Sirius star) shows a strong misalignment of the electronic finder. The star is at the end of the red arrow, the center of the electronic finder is the green arrow.

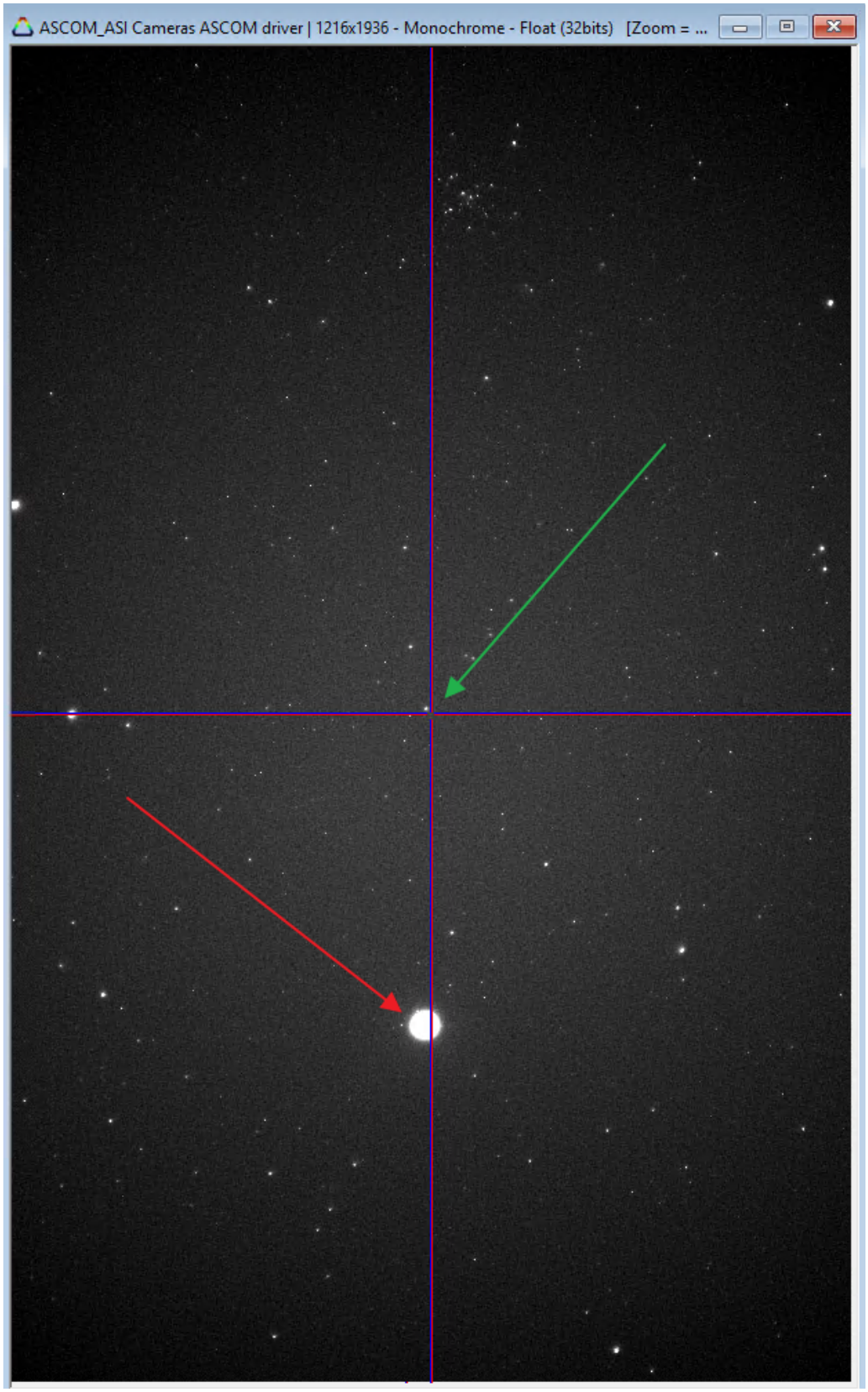


Fig. 57 *Sirius star on red arrow, should be on at the end of the green arrow*

Using Allen wrenches of 4mm and 2.5mm, the tip tilt of the electronic finder can be adjusted, so that its orientation matches with the optical axis center of the telescope. The green arrow shows screws that pushes the electronic finder, and the screw at the end of the red arrow, pulls the electronic finder base plate. To push the electronic finder, the red screw has to be untightened, and the green screw must be tightened (rotated clockwise). Trial and many iterations can be necessary to center the star toward the violet cross visible in the camera image. Grab regular exposure to check how the centering process is taking place. Check that the star is still visible on the reticle eyepiece center.

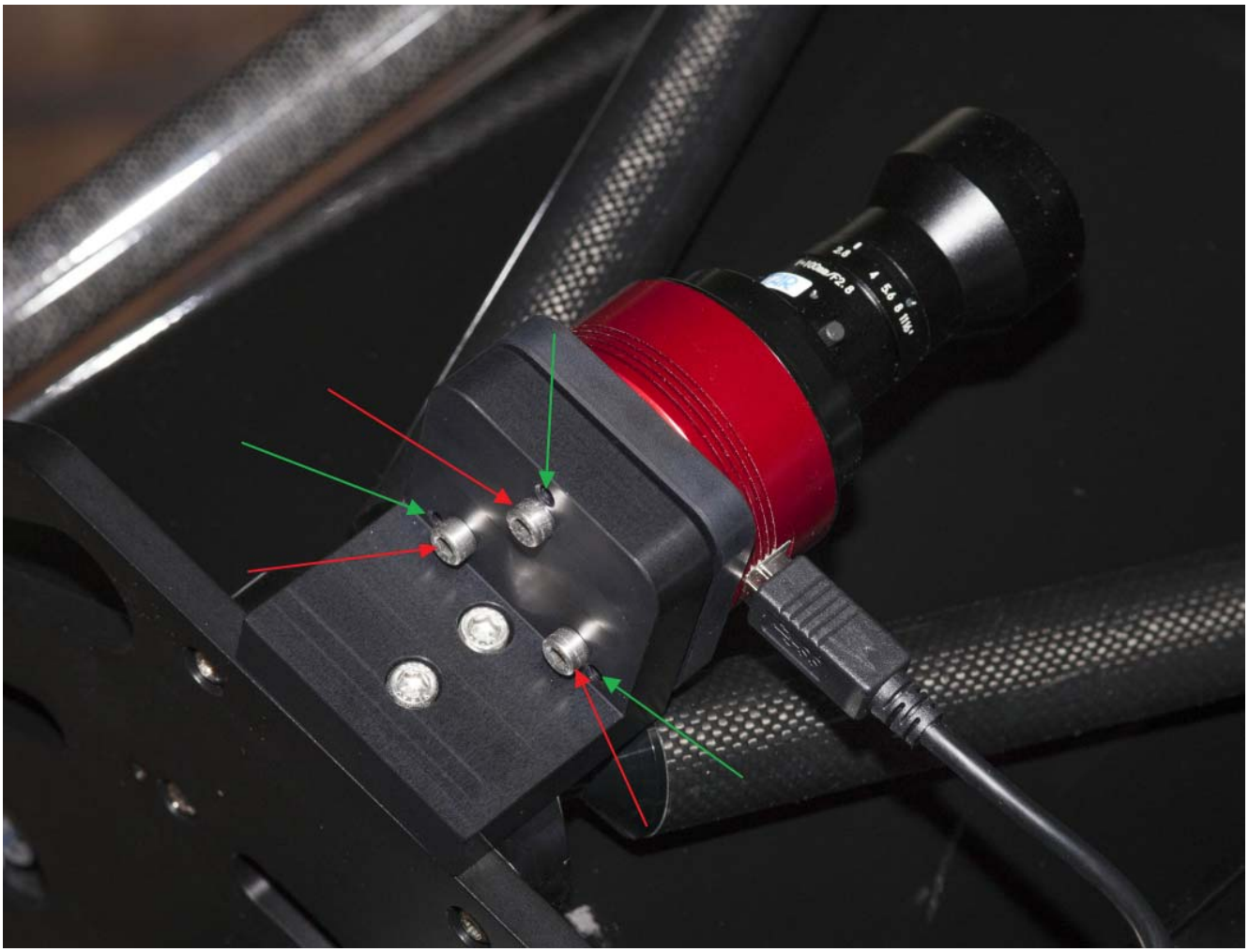


Fig. 58 *Screws used to adjust the angle of the electronic finder with respect to the telescope optical axis.*

Be sure during this process that the star (indeed the double star as seen thought the DIMM mask) stay in the center reticle eyepiece of the telescope.

Nevertheless, extreme accurate centering of the star in the electronic finder is not necessary, because the electronic finder reticle can be moved by software. The next image shows that the star is not at the center of the reticle, and this is suitable anyway, because the reticle position can be moved.

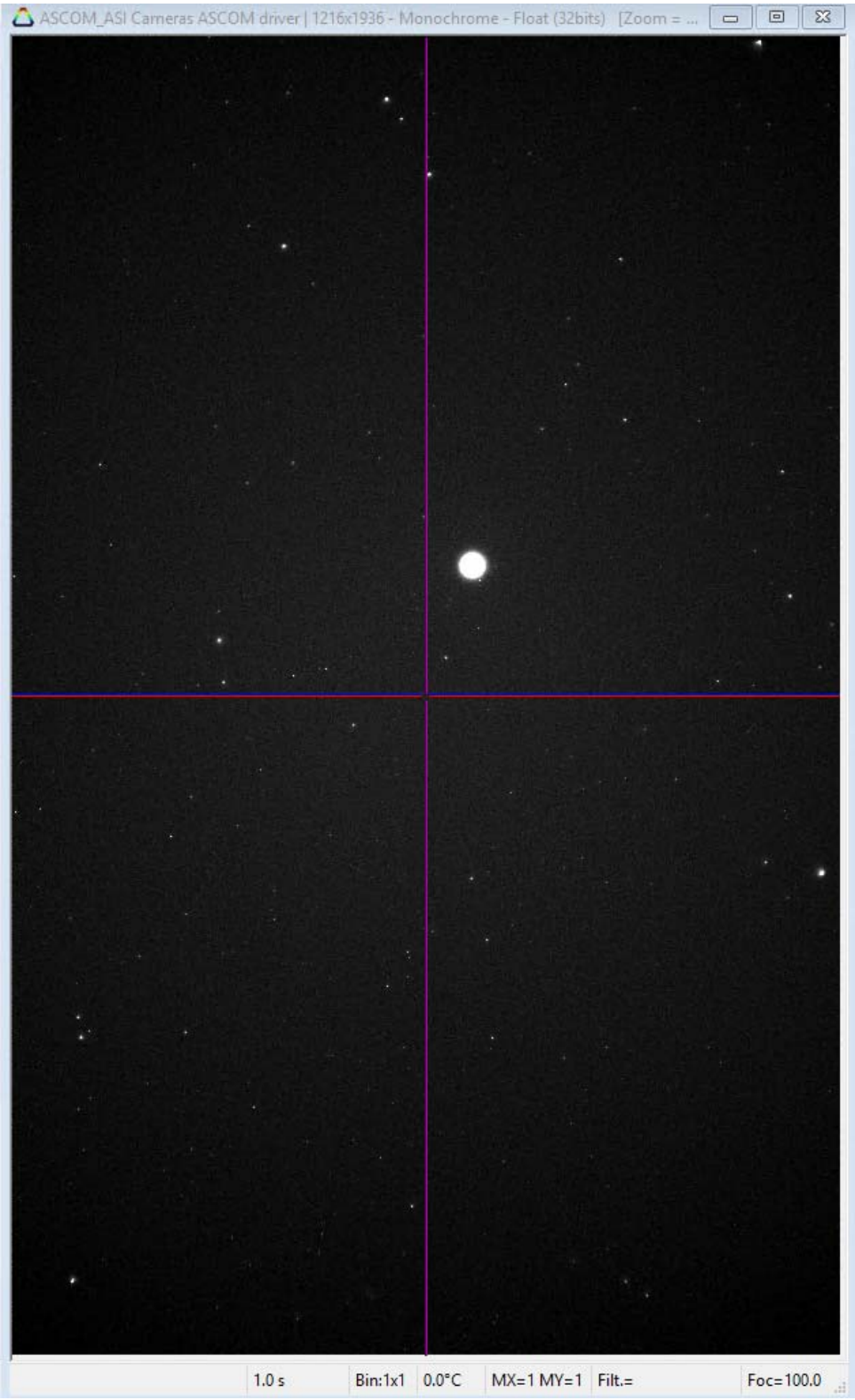


Fig. 59 *Star located at nearly the center of the image, and has a suitable position.*

Put the mouse exactly to the star center on the image, and do a mouse right click, and this context menu will popup.

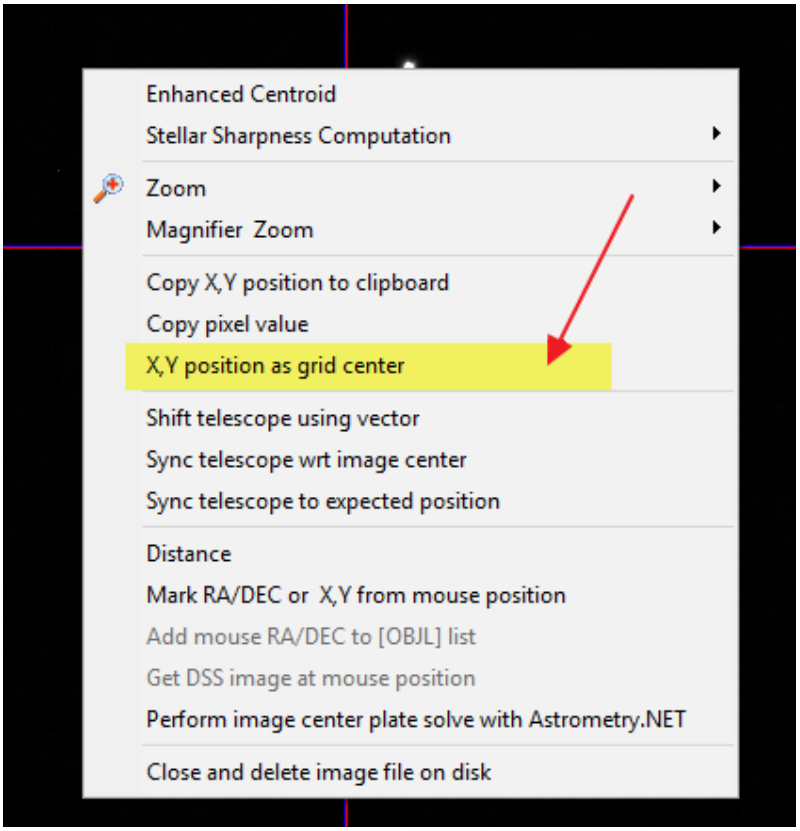


Fig. 60 *Menu to shift the electronic finder reticle to the star position.*

Click on "***X,Y position as grid center***". The reticle will shift and be displayed centered with respect to the star position as follows in this image:

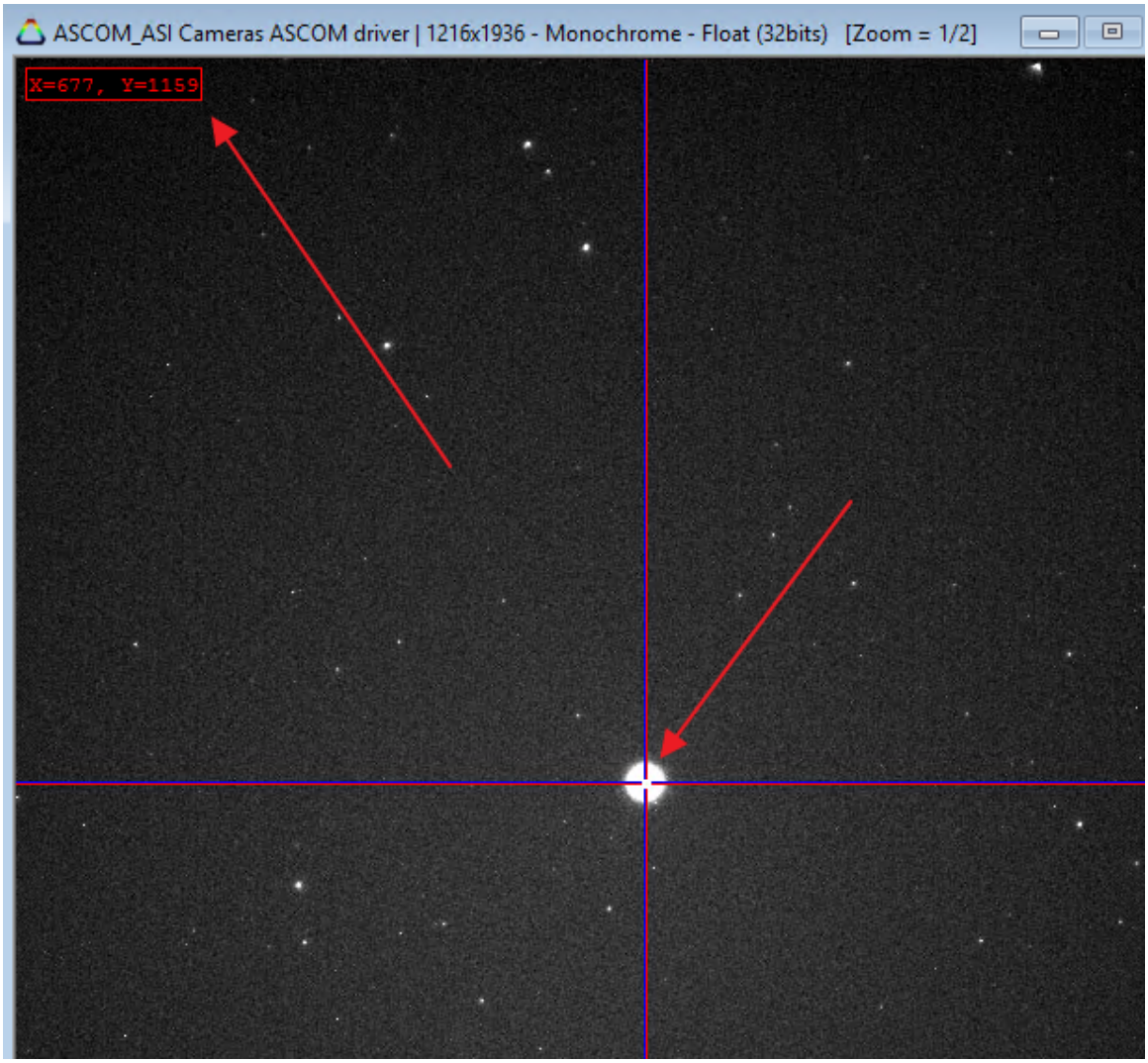


Fig. 61 *I*

The coordinate of the reticle is displayed on the top left on the image, and the reticle will stay now at this position, and will rotate 180°, if the side of pier of the mount, during a meridian flip, is changed.

Fig. 62 *Reticle X and Y position indicator, also stating that a German mount is used. Reference is West side of pier.*

The next image shows that the mount has carried out a meridian flip and that the reference coordinates of the electronic finder have been corrected for (central symetry).

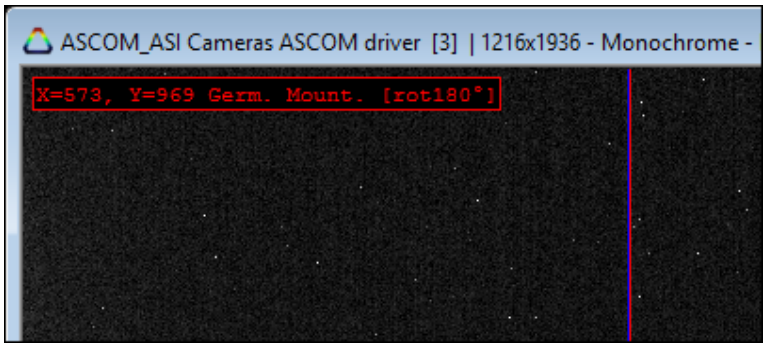


Fig. 63 *Reticle Indicator when mount flip has occurred. Mount is East side of Pier.*

4 Achieving seeing measurements

4.1 Checking star image at the DIMM camera level

Slew telescope to a magnitude 0 star, and open IC-Capture software to get video data from the camera, use 1/220 exposure with a gain of 21.6 dB for instance. Center the double star image with the eyepiece and flip the mirror so that light reaches the DIMM camera.

The next table provides some hints about the exposure time to be used with different star magnitude. This applies for this system only: 12" RC F8 telescope and DMK 33GX174 camera.

STAR NAME	Magnitude	Exposure time	GAIN (x10 dB) as displayed
Sirius	-1.5	1/1000	216
Procyon	+0.4	1/220	216
Beta Gemini	+1.1	1/144	216
Alpha Leo	+1.35	1/144	216
Delta Leo	+2.6	1/40 1/221	216 370
Cor Carolis	+3.0	1/60 1/227	291 418

Maximum camera gain is 48 dB (480) and minimum gain is 0 dB. Never use gain above 310, because camera hot pixels can cause measurement problems and be caught as star.

- NEVER USE AUTOMATIC EXPOSURE AND AUTOMATIC GAIN WITH IC-CAPTURE! -

Very likely the focus will not be good at the camera level, as for instance the next image:

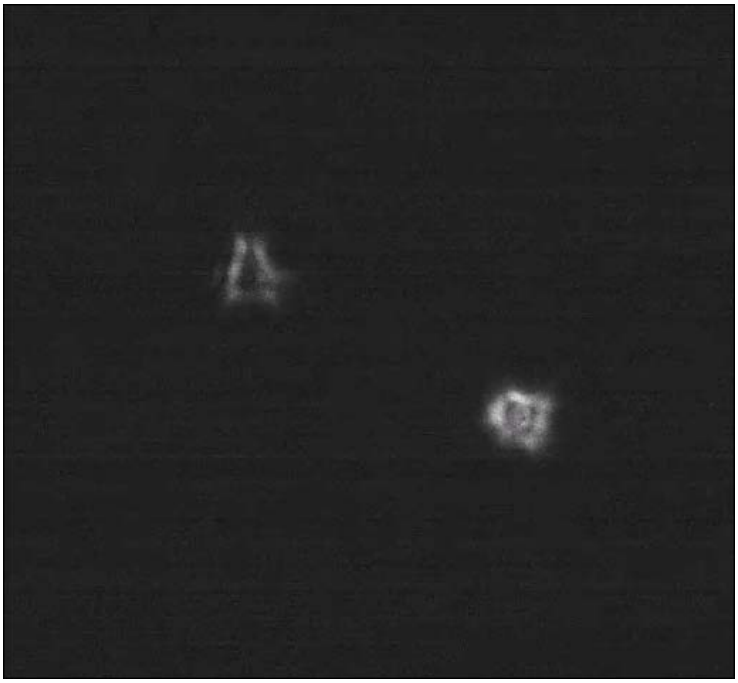


Fig. 64 *Unfocused star image, this is not suitable for DIMM measurements*

Adjust telescope focus (knob showed by the blue arrow) so that the image shows the airy disk of the double star, and this is likely the case because the diameter of 51 mm from the DIMM mask is a small diameter, and can show the star airy disk.

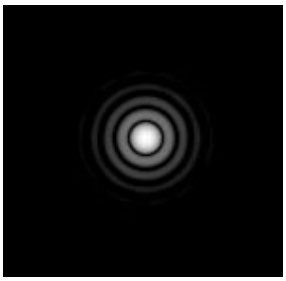


Fig. 65 *Focusing knob of the RC telescope*

Fig. 66 *Suitable and focused images of one star, ready for DIMM measurements*

The DIMM prisms mask is factory tuned so that the star image separation is optimal (1 to 2 arcmin), but this can be changed by unscrewing the set screws (red arrow) and rotate the upper part of the prism optical device. Warning, this is very sensitive and the second star can disappear from the field of view of the camera.

The result of the rotation has to be checked with the DIMM camera running and providing images.

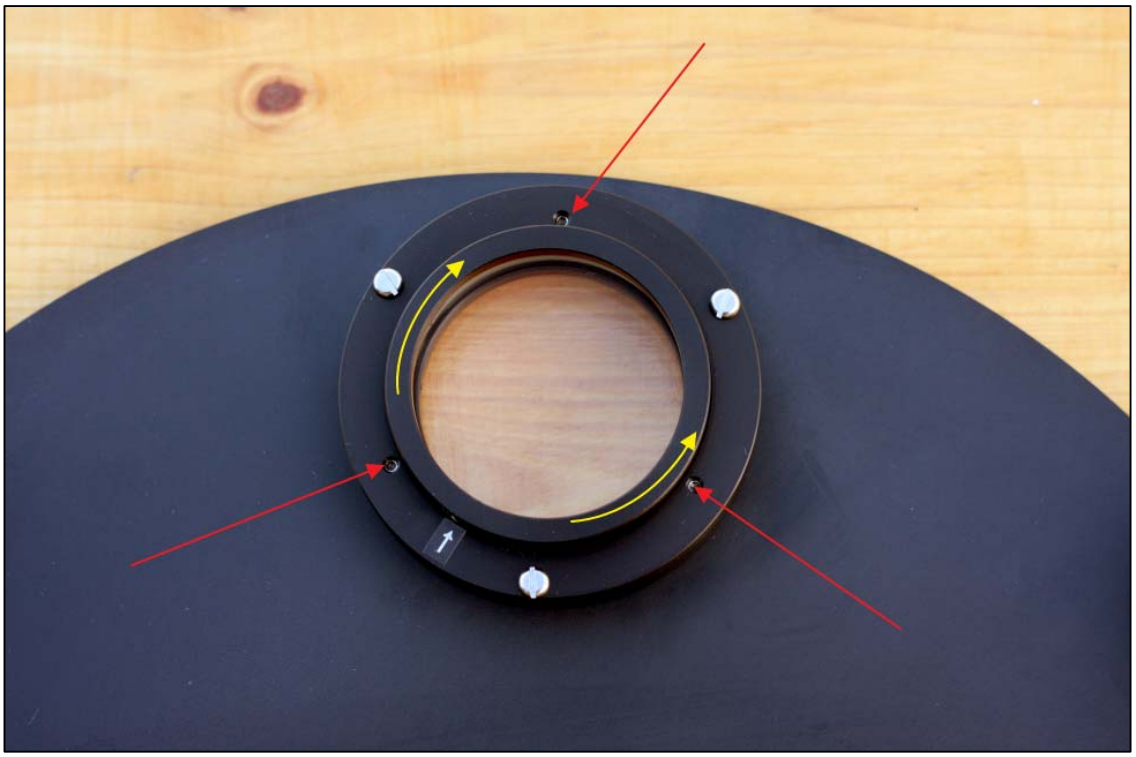


Fig. 67 *Set screws that locks the two adjustable prisms.*

Once the DIMM camera focused properly, ensure that the screws at the end of the green arrow are tightened firmly (see next image).

The red arrow screw will block the focuser translation. Since the DIMM camera is focused properly, it is important to focus now the reticle eyepiece by translating this one (violet arrow), once the eyepiece focus is achieved, do not forget to tight the pink arrow screw.

The camera and the reticled eyepiece are now para-focused (the camera and the eyepiece have the same focus).

This is very convenient.

Fig. 68 *Screws to be used for setting the best focus for the camera AND the eyepiece at the same time.*

4.2 Starting measurements

Now IC-Capture software can be closed, and PRISM will be used as the sole software for this DIMM measurements.

Enable the link with the electronic finder camera:

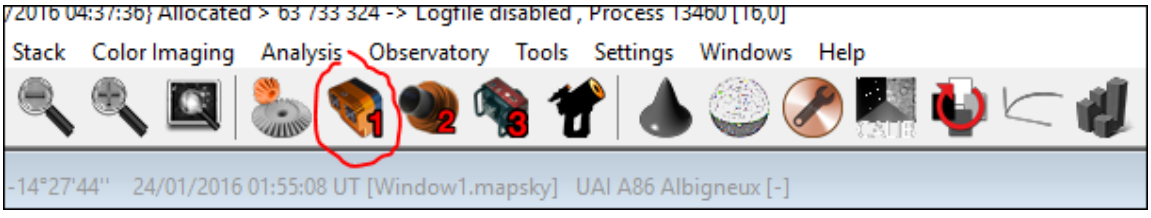


Fig. 69 *Icon to enable the control of the electronic finder*

Enable the link with the telescope mount:

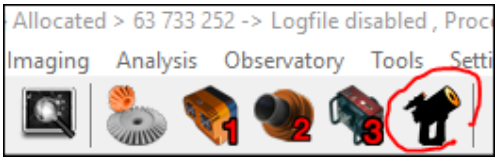


Fig. 70 *Icon to enable the link to the telescope mount*

Then unfold this menu and go to "***Automatic DIMM***"

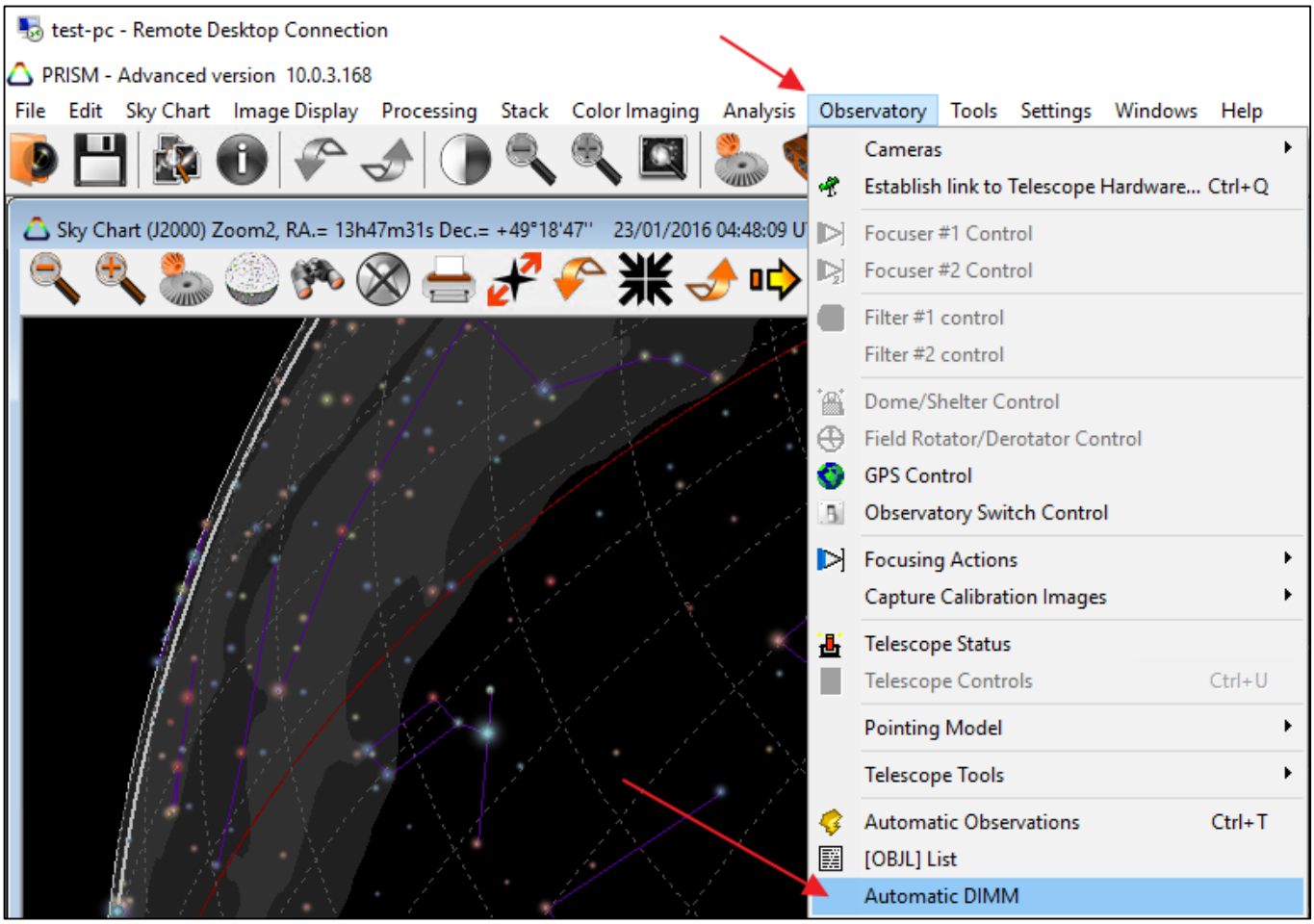


Fig. 71 *Automatic DIMM menu*

4.2.1 DIMM interface setup

The next message appears, since this the first time this interface is opened, it needs to bet set up, so "***Do you want to startup measurement now?***" Click "***No***". This is important.

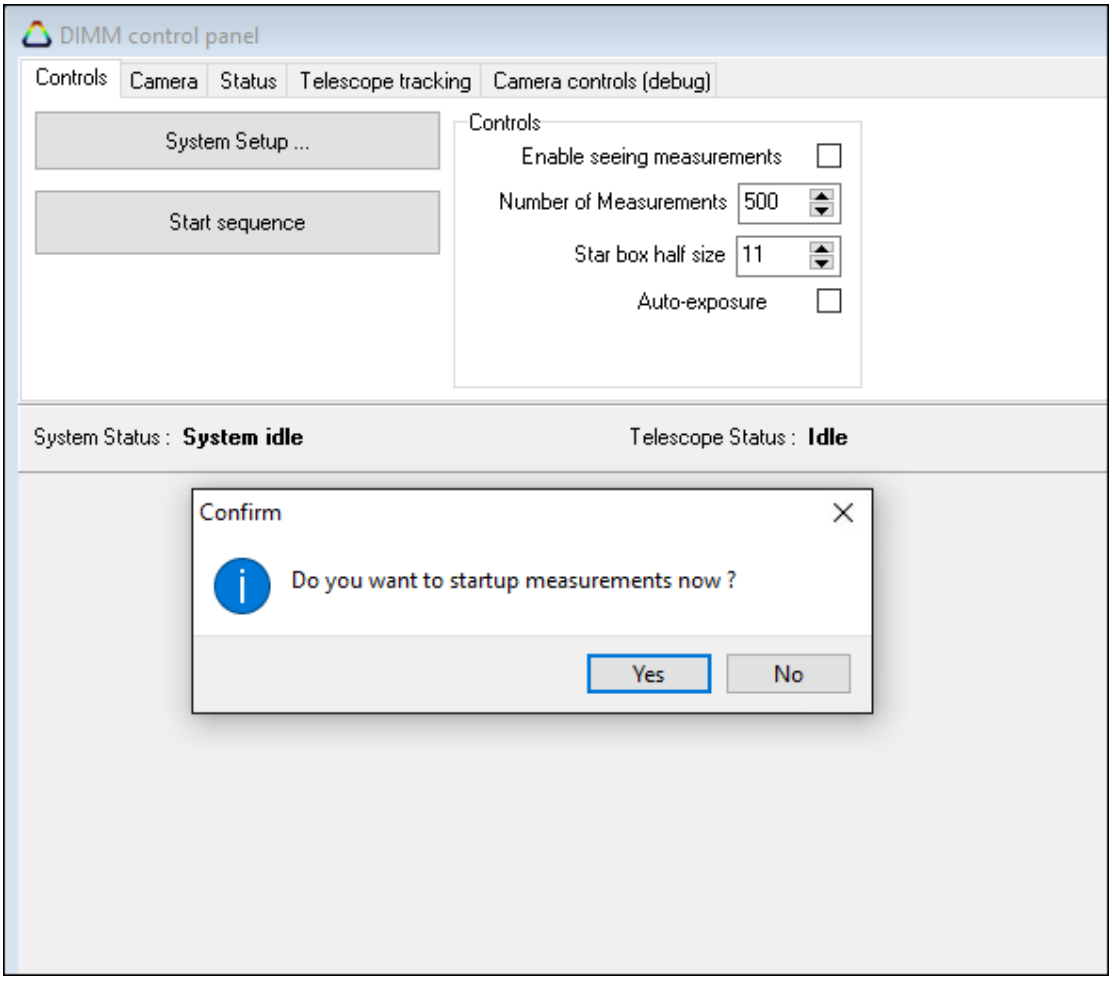


Fig. 72 *Click "No" to access to the System setup*

This form appears, it prompts you to define what will be used as the DIMM camera, click "***DMK 33GX174***" (or any camera installed at the 12" telescope focal plane behind the flip mirror).

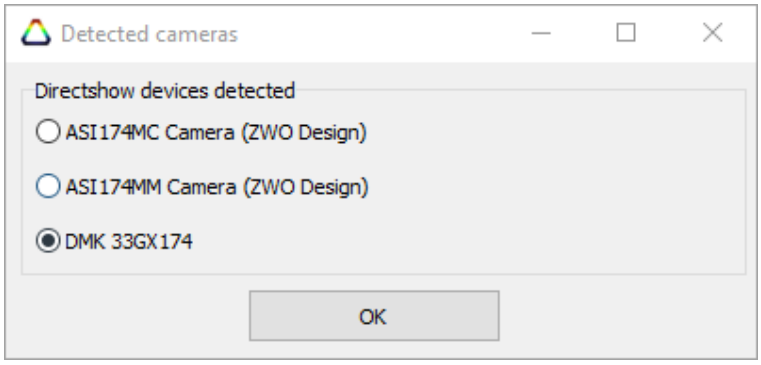


Fig. 73 *Directshow camera selector*

The automatic control panel, is this child window, which is embedded into the PRISM's software:

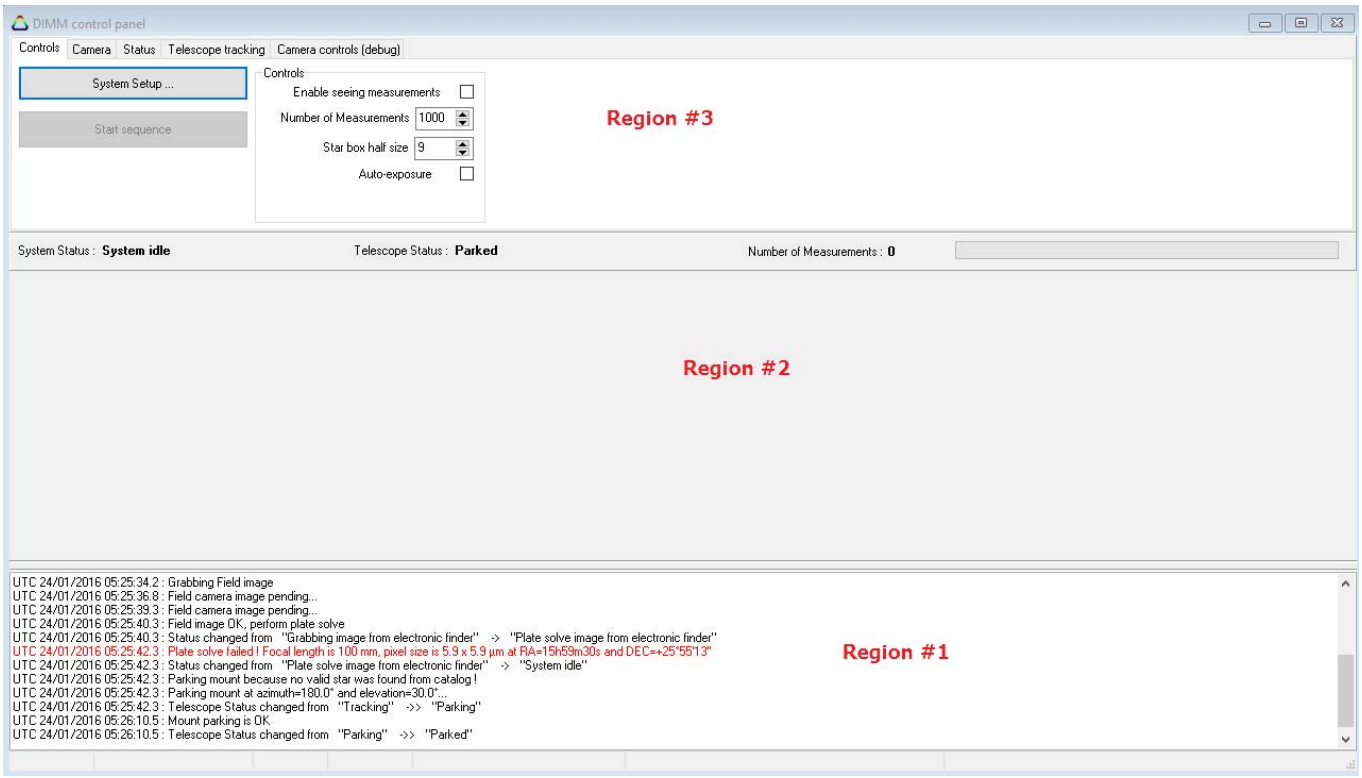


Fig. 74 *DIMM Main window control*

Region #1 provides log of all the events that will happen during the course of the DIMM measurement operations, it shows all telescope actions, and all the automated events. This is saved into a log txt file type.

Region #2 is the place where the DIMM camera will draw its image

Region #3 is the control region, with several tab options. This allows the user to control the system and provides inputs.

Along with the control window, another window is created, where all the measurement results will be output. This will provide the current seeing plots and also other information that help the user to control the good health of the measurements.

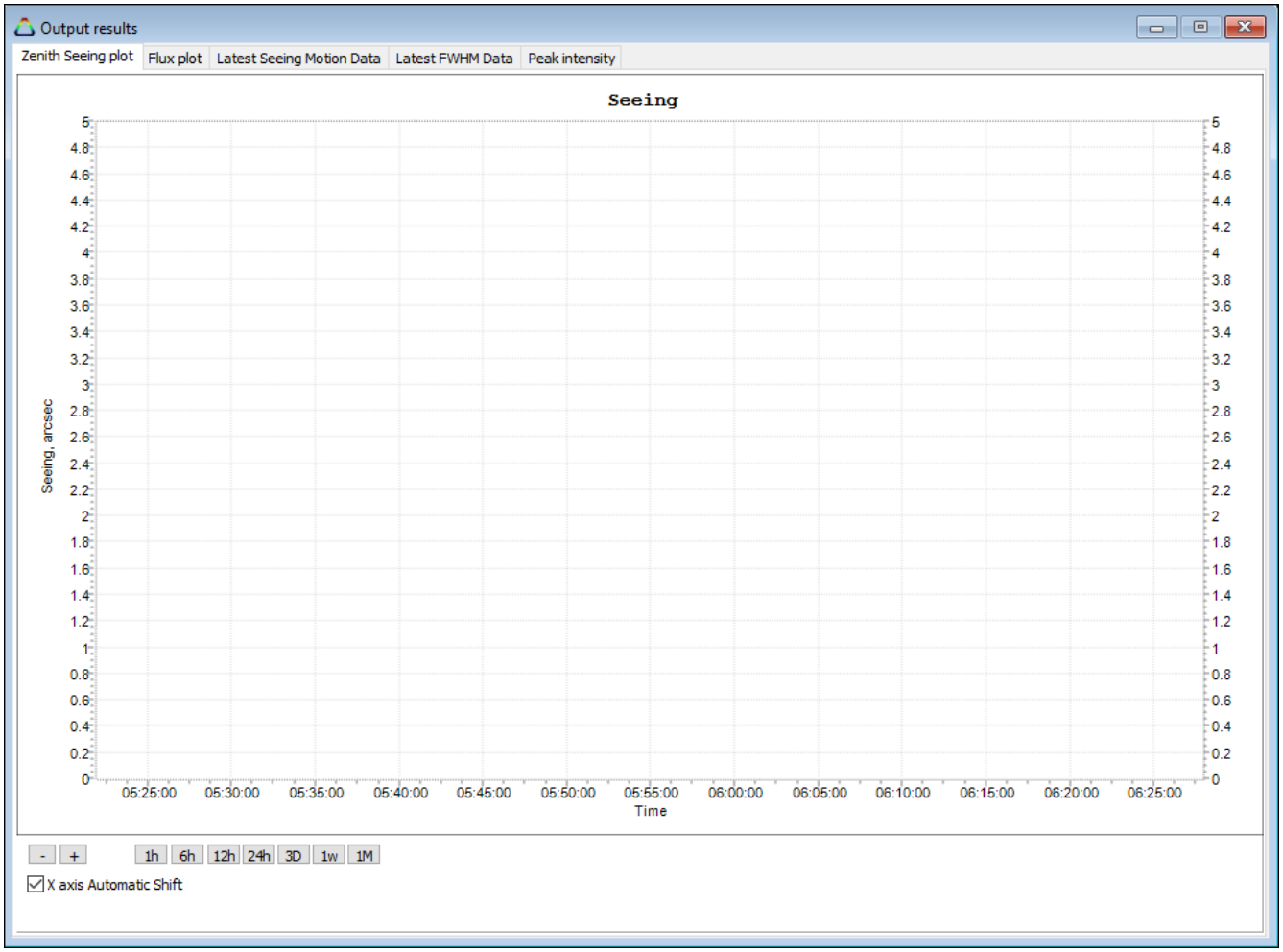


Fig. 75 *Output result measurement window*

Then click "***System Setup…***"

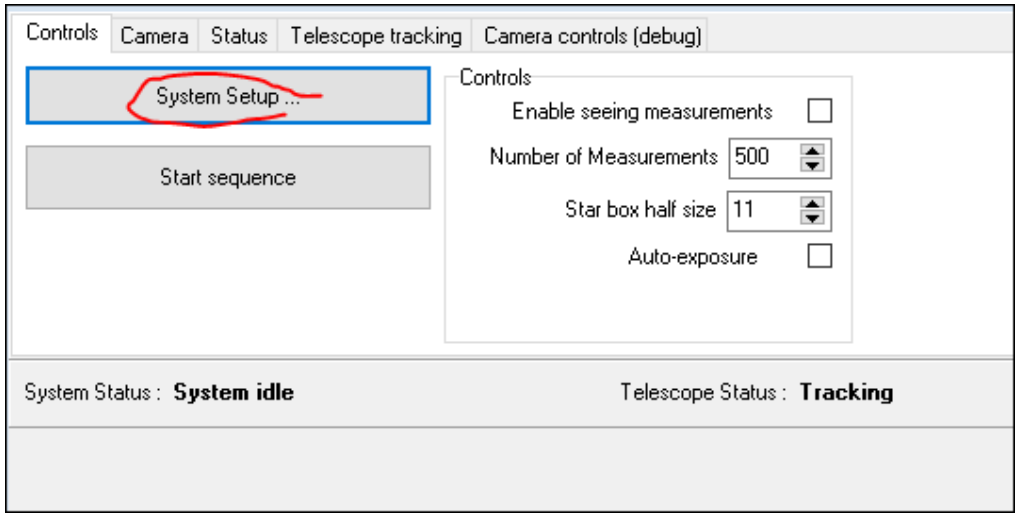


Fig. 76 *Setup system*

This form shows up, enter all the characteristic of your system. Pixel size is important and cannot be retrieved automatically from directshow video cameras, in the case of DMK 33GX174, the pixel's size is 5.86 µm. For other camera inquire the pixel size expressed as microns. The whole distance and the diameter depend of your mask design. For the system described in this manual, the 240 and 51 mm are set for the 12" telescope, as well as focal length.

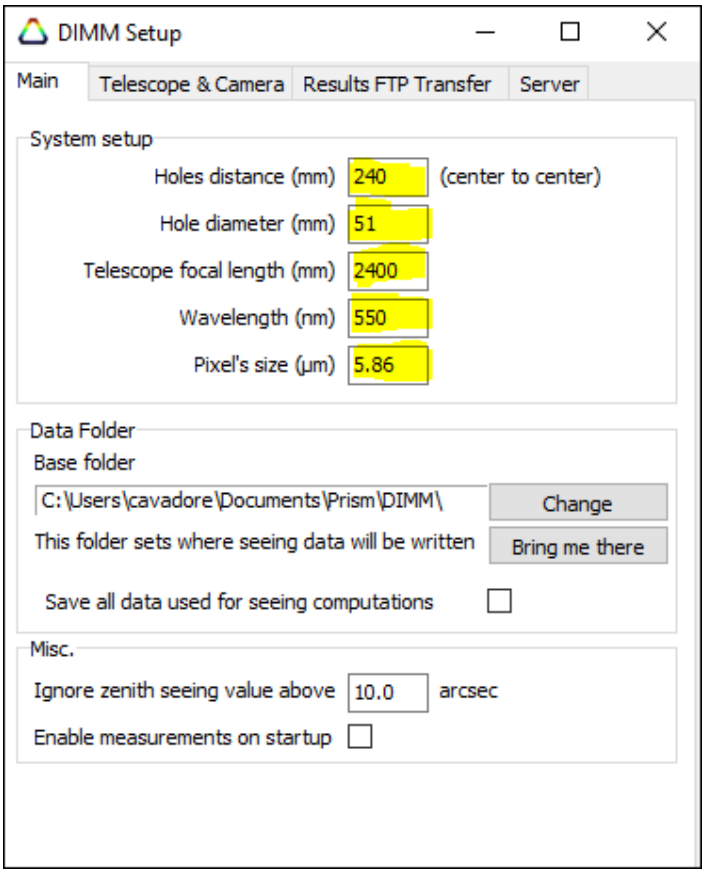


Fig. 77 *Main system setup parameters*

The other parameters are straightforward. Move to the "***Telescope & Camera***" tab and set all the parameters as follows. These a safe point parameter, they can be tweaked upon user requirements.

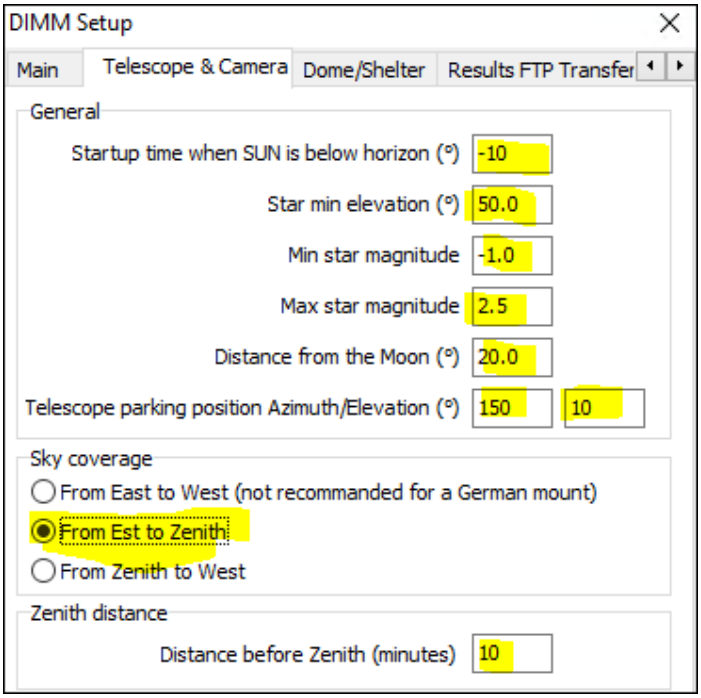


Fig. 78 *Telescope tab*

Parking position, is the position where the telescope will be parked at during the day, waiting the next dusk to come. Azimuth is 0° north, 90° East and 180° South. Elevation is with respect to the horizon. The mount described in this system does not support negative (or under horizon positions).

Sky coverage is the way the telescope will select and track the star for measurements, which are taking place automatically during the whole night. It depends of your mount type, and if some buildings could hide the star:

From East to West: the software will select automatically a star that is anywhere above 50° (user input) from the horizon, the more on the East direction as possible, and the telescope will track the star through meridian if necessary. Nevertheless, when the star reaches the local meridian, the German mount (if the mount is a German mount type) will want to flip around the median, in order the telescope's tube does not hurt the pillar. This can be can be challenging to recover the star position when the telescope had flipped around the meridian. So this option is not really recommended in case a German mount is used other than one described in this system. (Green track in the next image)

From East to Zenith: the telescope can pick up a suitable star at 50° (user input) elevation and located at the East side of the sky, and when the star reaches a position that is 10 minutes before the meridian, the system will select another star with the same criteria. The telescope does not cross the meridian. (Red track)

From Zenith to West: the telescope can pick up a suitable star that is 10 minutes after the meridian at elevation larger than 50°, so located at the West side of the sky, and when the star reaches elevation lower than 50°, the system will select another star with the same criteria. (Yellow track)

The mount that is proposed in this documentation can cope any option above and has been extensively tested, but other may not.

If the dome/shelter control is connected to PRISM, it will also open or close the dome according to the circumstances after and before telescope parking.

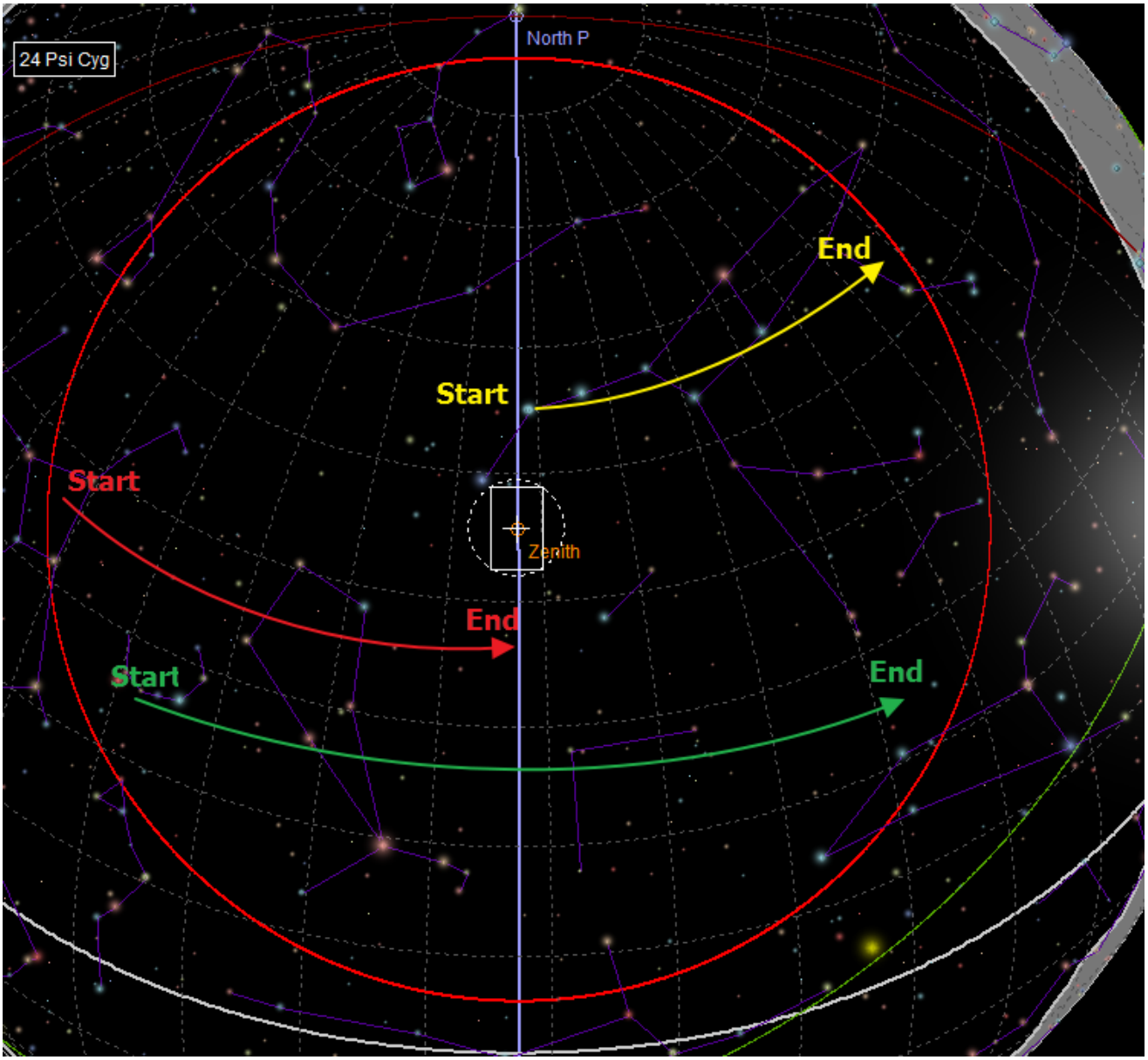


Fig. 79 *I*

The last tab allows to transfer a screen copies of plots during measurements toward a web site for instance, so that results can be monitored by other remote users.

For the telescope parking position, only strictly positive and non-zero figure of elevation can be used.

The next image show how to setup the exposure reference for a given star magnitude, the software does automatic exposure based on this reference data. The data below is tailored for the DMK 33GX174 DIMM camera and the RC 12” and 240 mm focal length. This may be change with different telescope size and camera.

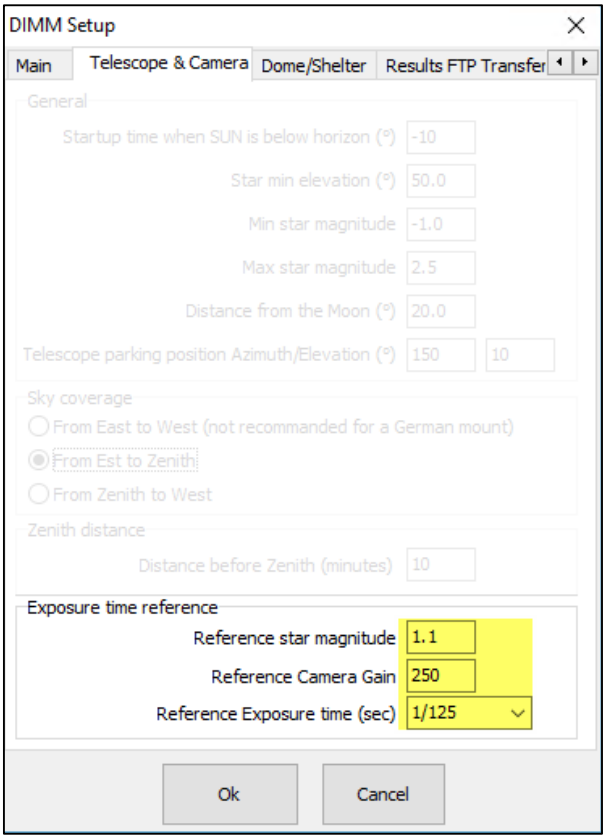


Fig. 80 *Exposure time and gain reference for a given star magnitude*

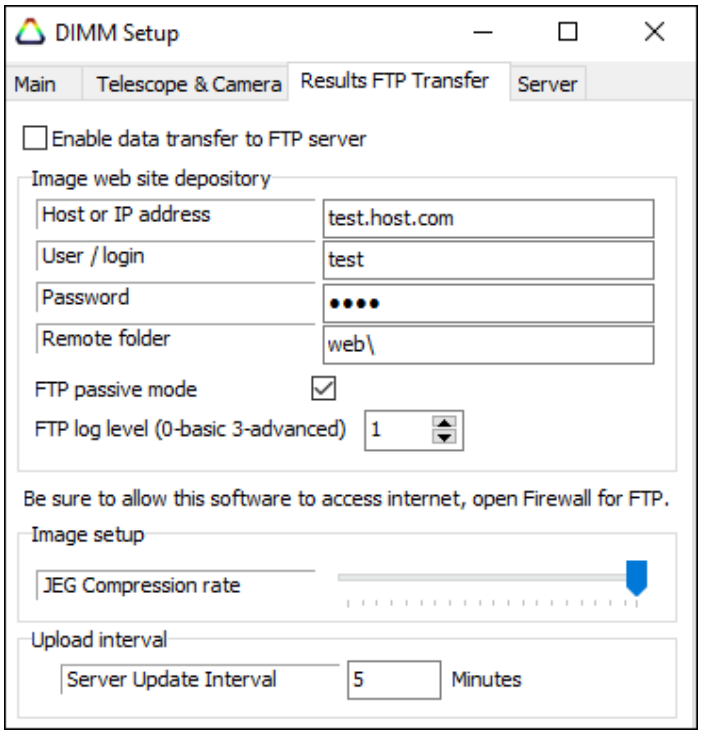


Fig. 81 *FTP tab*

Dome controls allows the system to protect the telescope when being not used during the day.

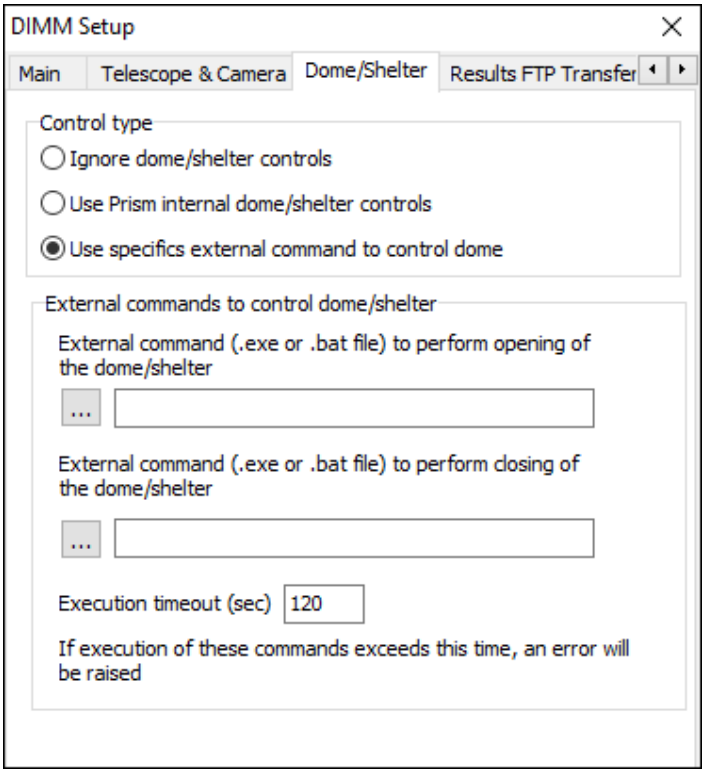


Fig. 82 *Dome / shelter control*

4.2.2 Measurement startup

Now, if the telescope and the two cameras are ready, then press "***Start sequence***", and the measurement will start. If pressing the button is achieved during the day, the telescope will wait for the night to come (here that the SUN is 5° below horizon), otherwise the software will select a suitable star from the catalog of bright star and slew to it. If a star in the catalog is not found, expand the star magnitude and elevation criteria range in the setup form.

Once the telescope gets into the star position, the electronic finder performs an exposure, and carry out plate solving to check that the star is at the right place. Eventually, a small slewing offset will be performed to put the star into the narrow field of view of the DIMM camera.

Then the DIMM camera video starts to grab frames and the double star image shall be visible. Be sure to set properly the "***Star box half size***" so that the green or yellow ring around the star is well larger than the star image diameter.

On each frame that comes from the camera, the software measures accurately the X and Y position of the "two" stars.

Then after 100 frames, the double star barycenter is found, and the camera is switches to small sub frame of 640x480 pixels (if camera allows sub framing, otherwise performs seeing measurement using full frame). Then the number of frames entered below (500) is used to achieve actual seeing measurements.

In the case of the DMK 33GX174 camera, the first 100 image grabbing is achieved with full frame (1900x1200 pixels at 7 fps), and then switch to a region of interest of 640x480 pixels. This can increase the frame rate up to 80 frames per second (depending also on the CPU power of the PC).

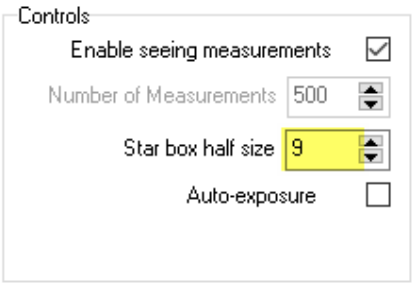


Fig. 83 *Seeing measurement control*

The two-star barycenter is depicted by the red circle and cross. The figure below in bracket provides the X and Y star FWHM in pixels (8.2 and 8.0 in the image). This can be used for focusing to achieve the lowest FWHM value.

Fig. 84 *Yellow circle is the brightest star; the red circle is the two-star barycenter*

The “auto exposure” will change the camera exposure time so that the image of the star is optimized for measurements, and can cope with high altitude clouds passing by.

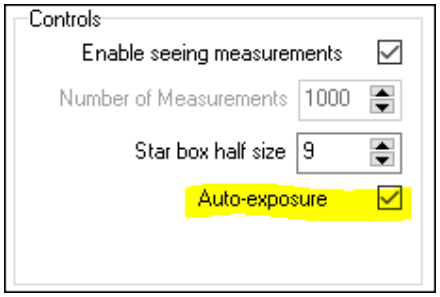


Fig. 85 *Auto-exposure*

Performing measurements with saturated pixels in the star image can jeopardize/bias results! To avoid this, the camera tab helps finding it, and the "***Gain and exposure***" group-box the optimum exposure time and gain if required. The "***Number of Saturated pixels***" must stay to zero.

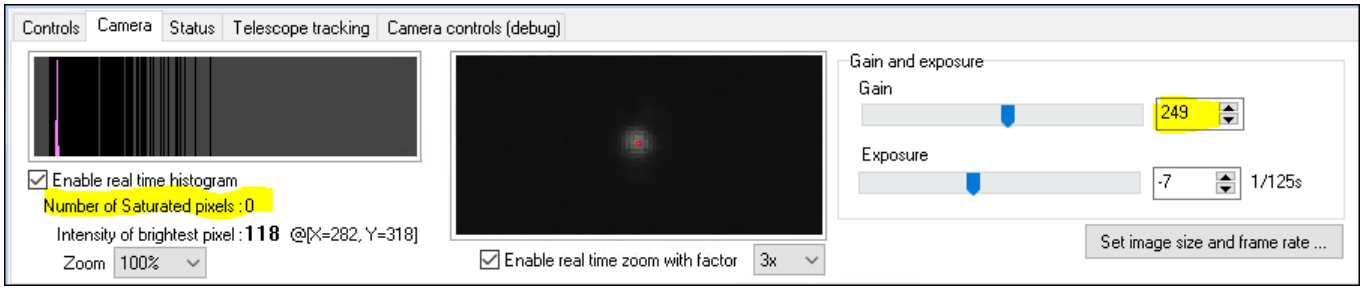


Fig. 86 *Camera tab*

The status tab is providing Telescope and SUN status and the last seeing measurement and Fried R0 data. This is computed as fi the star would be at zenith position.

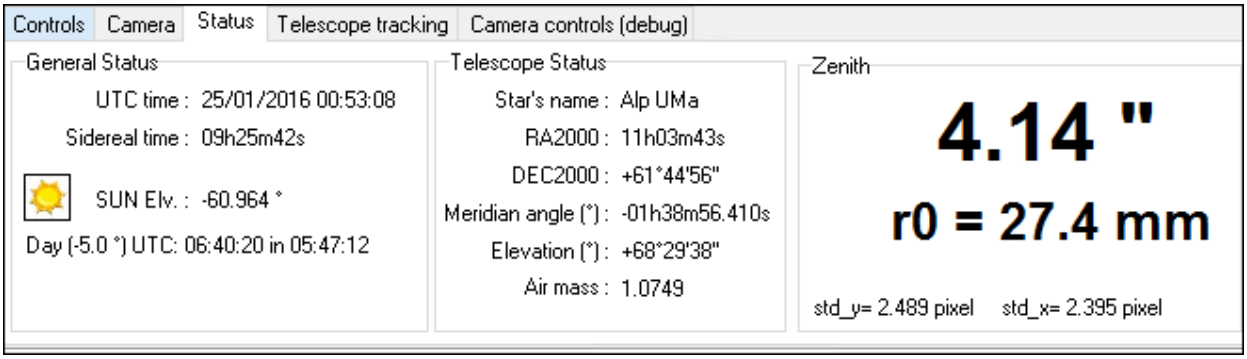


Fig. 87 *Status tab*

4.2.3 Output plots

The seeing plot is built itself as the measurement are provided over the course of the time.

Trends can be clearly seen.

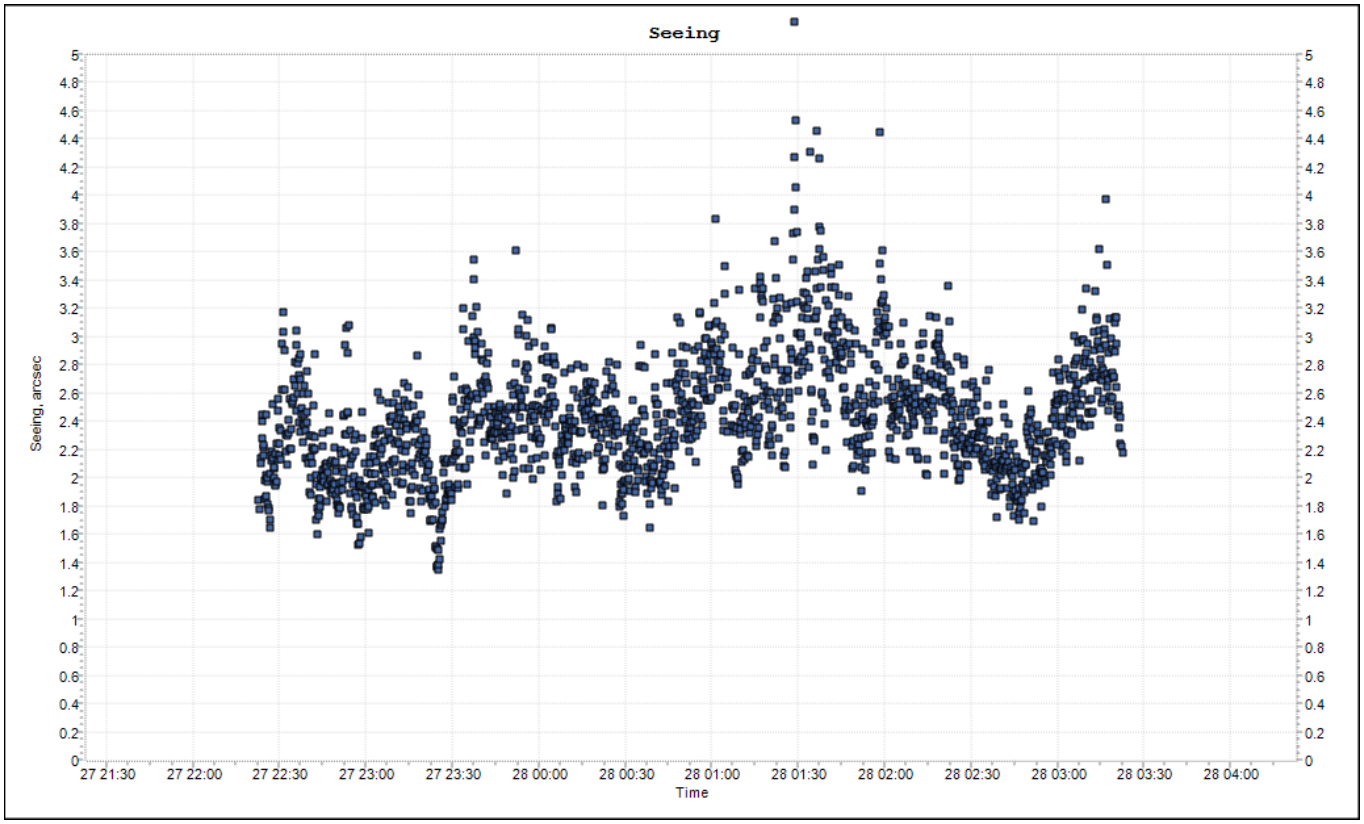


Fig. 88 *Seeing plot versus time*

The motion data plot shows the differential motion of the two images of the measured star.

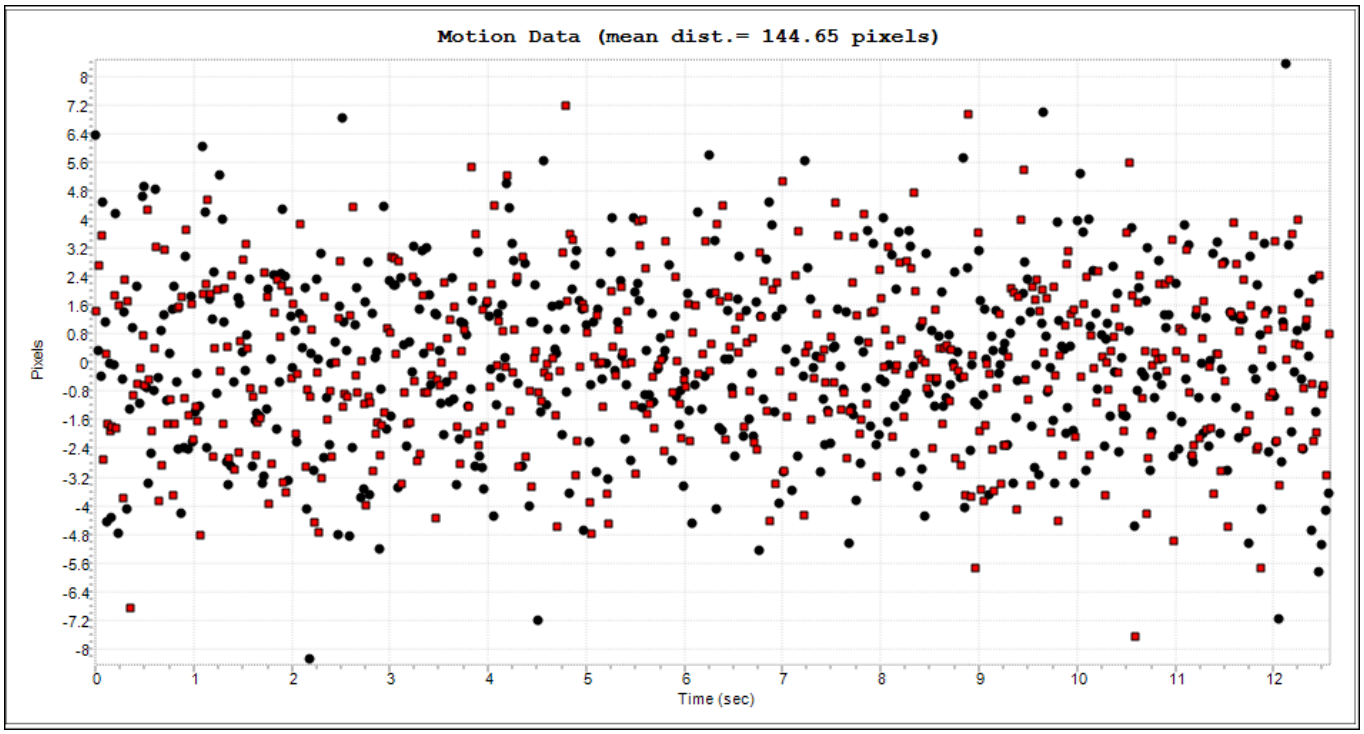


Fig. 89 *Differential motion of the two images of the same star*

The measurement will proceed till the star will be too low from the horizon, or too close to the meridian. Then the system selects another star and slew the telescope toward it and resumes measurement till dawn. At dawn, the telescope is parked and the dome is closed (if setup), waiting for the next dusk, and night. So the human attendance to the system is really minimal, that's why this is an automated system.

```
UTC 27/01/2016 06:43:48.3 : Seeing Ok : 2.26 arcsec
UTC 27/01/2016 06:43:48.3 : FWHM Data (mean= 4.55 pixels)
UTC 27/01/2016 06:43:48.3 : Motion Data (mean dist.= 146.46 pixels)
UTC 27/01/2016 06:43:48.3 : Peak Intensity (mean= 78.0, rms=20.6 ADU)
UTC 27/01/2016 06:43:48.3 : Barycenter position X=271 Y=209
UTC 27/01/2016 06:44:00.1 : Parking mount because SUN's elevation is too high !
UTC 27/01/2016 06:44:00.1 : Status changed from  "Seeing measurement pending"  ->  "System idle"
UTC 27/01/2016 06:44:00.1 : Parking mount at azimuth=150.0° and elevation=10.0°...
UTC 27/01/2016 06:44:00.1 : Telescope Status changed from  "Tracking"  ->>  "Parking"
UTC 27/01/2016 06:44:00.2 : System IDLE waiting for Night to come...
UTC 27/01/2016 06:44:18.6 : Mount parking is OK
UTC 27/01/2016 06:44:18.6 : Telescope Status changed from  "Parking"  ->>  "Parked"
UTC 27/01/2016 06:44:18.6 : Status changed from  "System idle"  ->  "System idle, daytime, no measurements"
UTC 27/01/2016 06:44:33.1 : RA2000=17h41m32s DEC2000=-28°15'31" Elv=+10°01'57"  MA=-02h16m26.720s
UTC 27/01/2016 06:45:33.4 : RA2000=17h42m32s DEC2000=-28°15'32" Elv=+10°01'56"  MA=-02h16m26.510s
UTC 27/01/2016 06:46:00.4 : System IDLE waiting for Night to come...
UTC 27/01/2016 06:46:33.4 : RA2000=17h43m32s DEC2000=-28°15'34" Elv=+10°01'55"  MA=-02h16m26.430s
UTC 27/01/2016 06:47:33.6 : RA2000=17h44m32s DEC2000=-28°15'36" Elv=+10°01'55"  MA=-02h16m26.250s
UTC 27/01/2016 06:48:00.6 : System IDLE waiting for Night to come...
UTC 27/01/2016 06:48:33.9 : RA2000=17h45m35s DEC2000=-28°15'37" Elv=+10°01'42"  MA=-02h16m28.440s
UTC 27/01/2016 06:49:33.9 : RA2000=17h46m35s DEC2000=-28°15'38" Elv=+10°01'40"  MA=-02h16m28.470s
UTC 27/01/2016 06:50:00.9 : System IDLE waiting for Night to come...
UTC 27/01/2016 06:50:34.1 : RA2000=17h47m35s DEC2000=-28°15'40" Elv=+10°01'40"  MA=-02h16m28.250s
UTC 27/01/2016 06:51:34.1 : RA2000=17h48m36s DEC2000=-28°15'41" Elv=+10°01'39"  MA=-02h16m28.210s
UTC 27/01/2016 06:52:01.1 : System IDLE waiting for Night to come...
```

Fig. 90 *Log output at the end of the night*

4.3 End of the night and resuming the next night

During the day, the telescope stays in PARKED mode, PRISM software is still open and wait for the next night. Do not close PRISM software and do not power off the system.

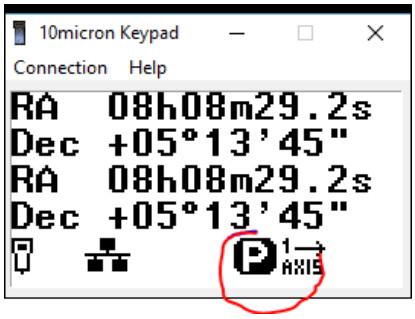


Fig. 91 *Mount parking status logo (Belt drive mount)*

On night restart, if the sky is overcast, the electronic finder will not be able to center the telescope. Then the telescope will be parked back, will wait for ½ of an hour, and will try again, during the whole night, till dawn.

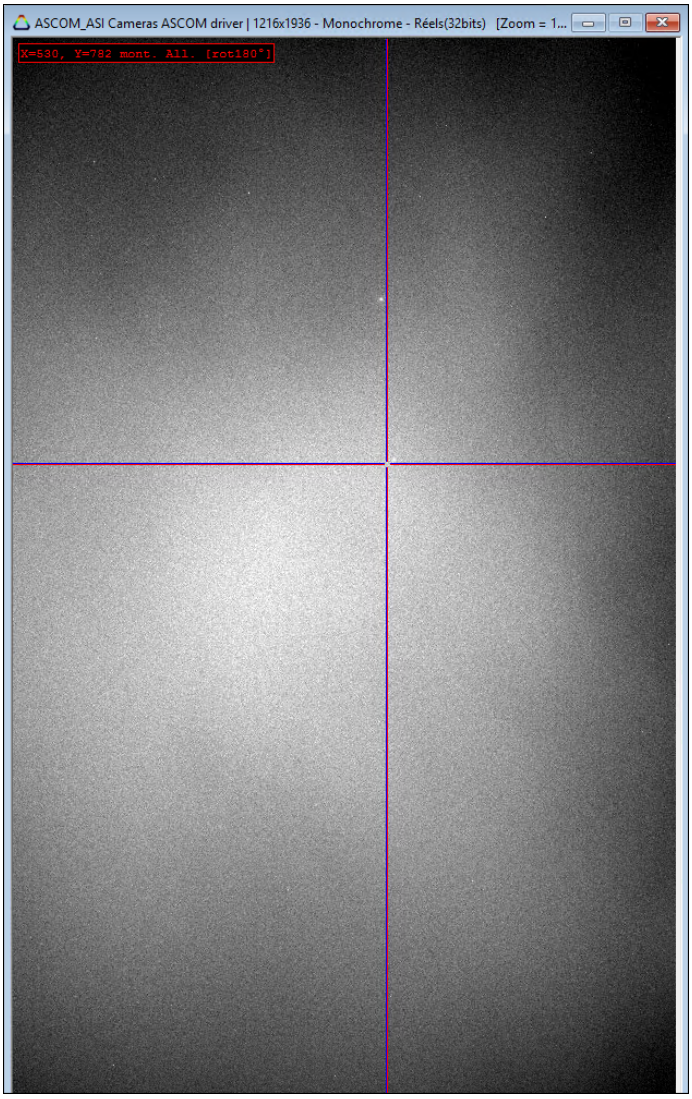


Fig. 92 *Electronic finder image with no star (clouds or overcast sky)*

```
UTC 28/01/2016 19:10:24.0 : Slew pending...
UTC 28/01/2016 19:10:26.5 : Slew pending...
UTC 28/01/2016 19:10:29.0 : Slew pending...
UTC 28/01/2016 19:10:31.5 : Slew pending...
UTC 28/01/2016 19:10:34.0 : Slew pending...
UTC 28/01/2016 19:10:36.6 : Slew pending...
UTC 28/01/2016 19:10:37.6 : Slewing to target completed
UTC 28/01/2016 19:10:37.7 : Telescope Status changed from "Slewing" ->> "Tracking"
UTC 28/01/2016 19:10:37.7 : Status changed from "Unknown state" -> "Grabbing image from electronic finder"
UTC 28/01/2016 19:10:37.7 : Grabbing Field image Xmirror=Oui Ymirror=Oui 90° rot=Oui
UTC 28/01/2016 19:10:40.3 : Field camera image pending...
UTC 28/01/2016 19:10:42.8 : Field camera image pending...
UTC 28/01/2016 19:10:43.6 : Field image OK, perform plate solve
UTC 28/01/2016 19:10:43.6 : Status changed from "Grabbing image from electronic finder" -> "Plate solve image from electronic finder"
UTC 28/01/2016 19:10:46.7 : Plate solve failed ! Focal length is 100 mm, pixel size is 5.9 x 5.9 µm at RA=05h59m32s and DEC=+44°56'51"
UTC 28/01/2016 19:10:46.7 : Status changed from "Plate solve image from electronic finder" -> "System idle"
UTC 28/01/2016 19:10:46.7 : Parking mount because no valid star was found from catalog !
UTC 28/01/2016 19:10:46.8 : Parking mount at azimuth=150.0° and elevation=10.0°...
UTC 28/01/2016 19:10:46.8 : Telescope Status changed from "Tracking" ->> "Parking"
UTC 28/01/2016 19:11:06.5 : Mount parking is OK
UTC 28/01/2016 19:11:06.5 : Telescope Status changed from "Parking" ->> "Parked"
UTC 28/01/2016 19:11:06.8 : Waiting another 1/2 hour to try again...
```

Fig. 93 *Log output after an attempt to start the system, and parked back due to clouds*

5 Star guiding

The telescope can, for several hours, be tracking the star, from east to west boundaries, but due to RA tracking rate error, or bad polar alignment, the star used to measure DIMM can exit the field of view, and this event will stop all measurements. In order to prevent this, the software embeds an automatic guiding algorithm to get the star (the double image) always inside the field of view of the DIMM camera, and proceed with measurements.

5.1 Guiding calibration motion

Guiding calibration has to be performed at least once in the system's life, this is a mandatory step, and needs to be achieved again if one of the conditions is met:

- The DIMM camera is rotated with respect to the telescope optical axis.
- The whole mount and telescope are moved to another place.

It uses the double star image, so do not remove the DIMM mask during this process and press the "***Perform Calibration***" button. The system will move the mount axis at the slowest speed toward the RA and DEC axis in both directions, so this is 4 small moves to be carried out: RA+, DEC+, RA-, DEC-

The dual star must move to at least 100 pixels upon each move, or never disappear from the field. This would mean that the motion time is too long or the guiding speed rate is too fast.

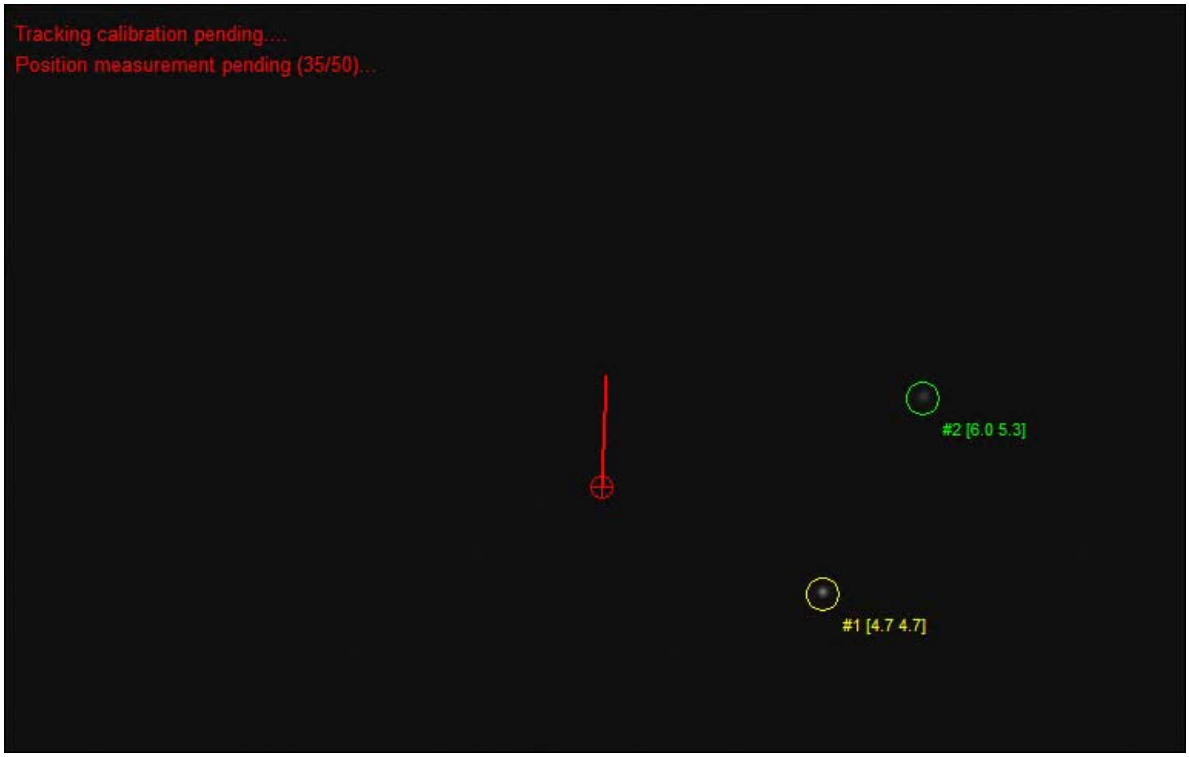


Fig. 94 *Calibration process pending*

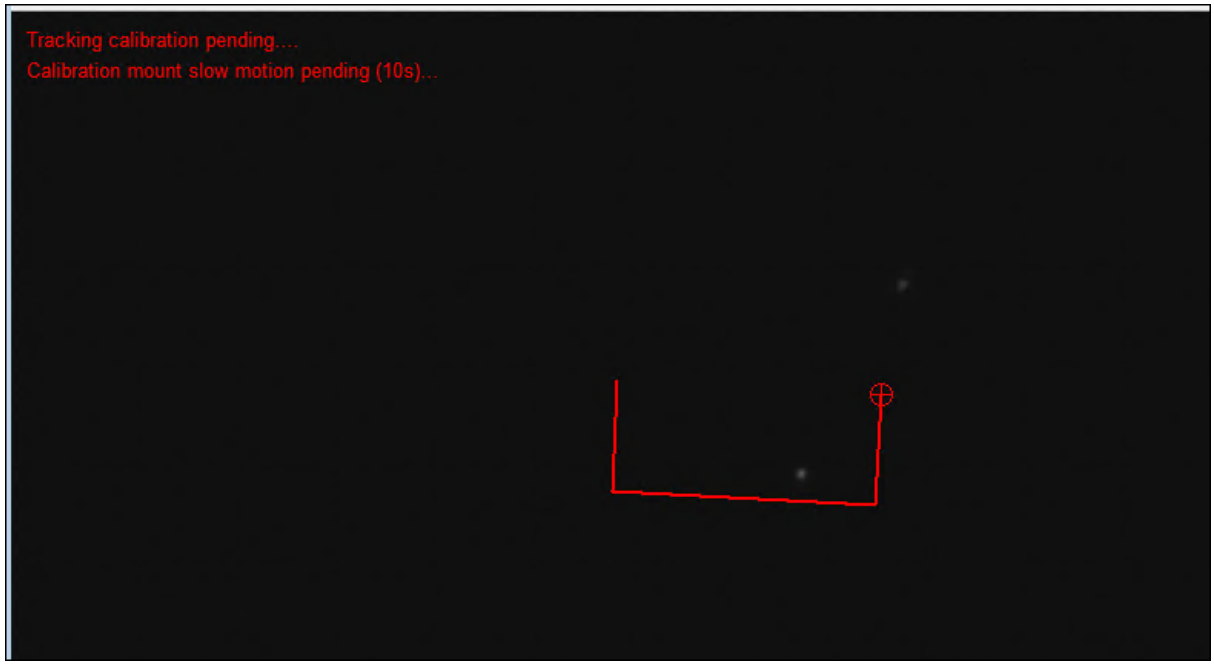


Fig. 95 *Calibration pending, RA+, DEC+ and RA- have been achieved*

When calibration is completed this message must show up.

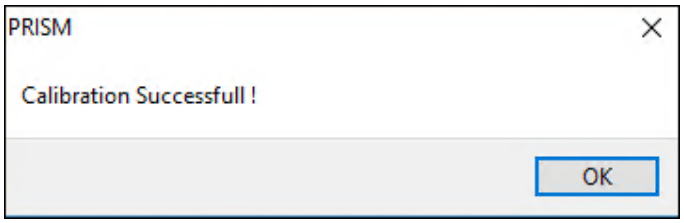


Fig. 96

5.2 Enable Guiding

Check "***Enable Guiding***" so that the system will track on the two star barycenter as a reference. Guiding motion pulse is provided at the end of DIMM measurement series.

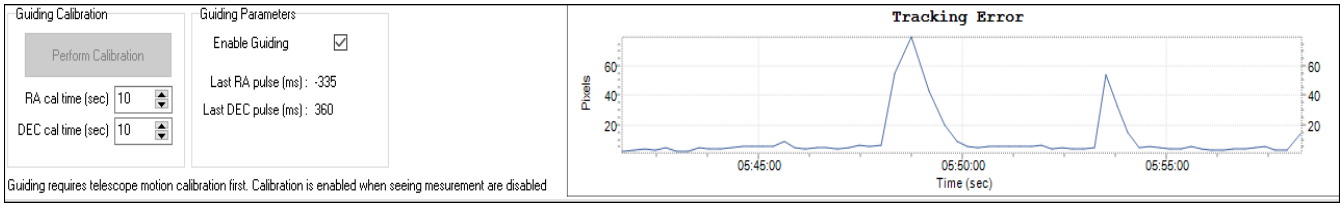


Fig. 97 *Guiding control interface*

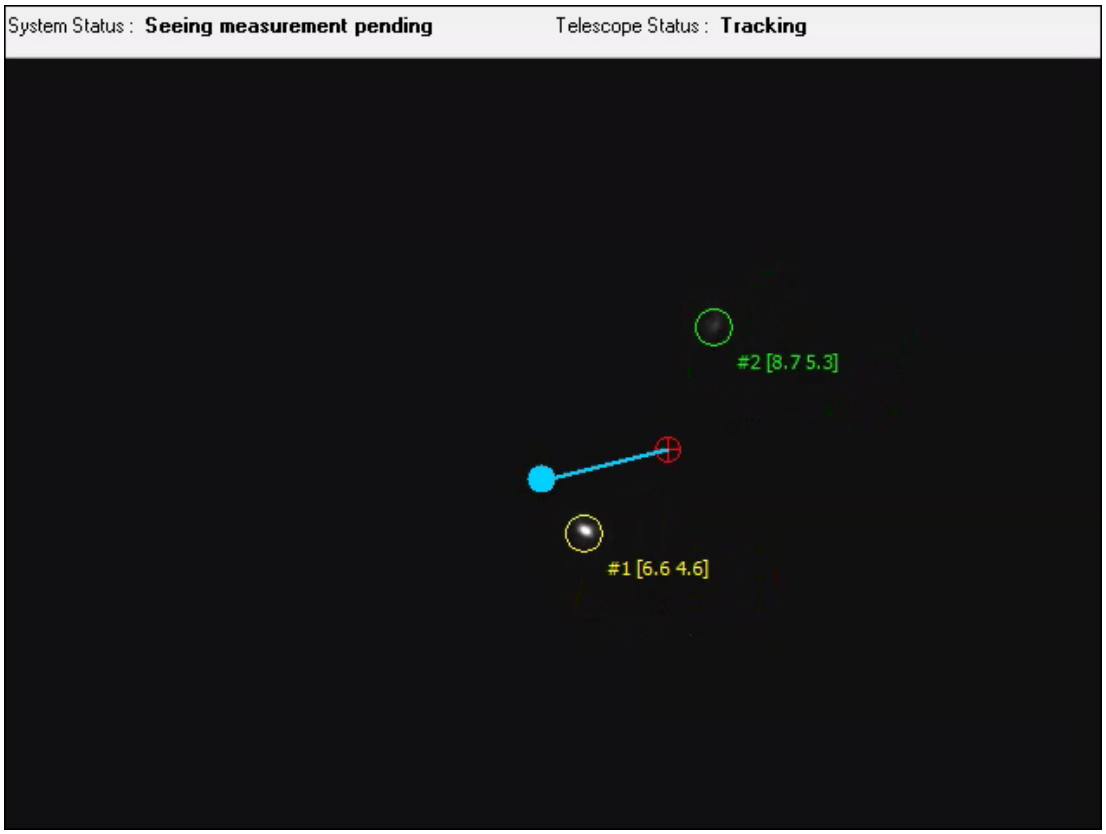


Fig. 98 *Guiding process pending, the tracking shift is depicted by the blue line and filled circle is the reference position.*

The guiding error plot shows that the guiding process is working properly, it should stay within +/- 10 pixels and be stable (not increasing/decreasing continuously).

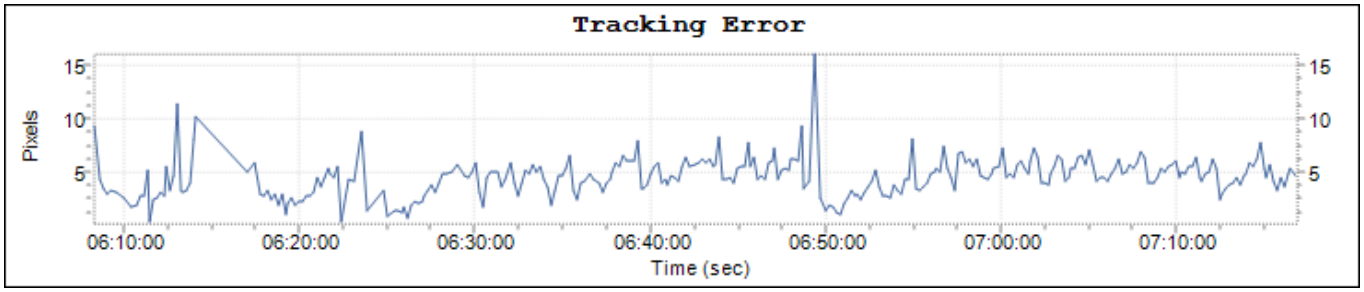


Fig. 99 Guiding error plot

6 Recorded data Output results

6.1 FTP Output results

The plots can be saved as JPG files when FTP upload is enabled to a server, the files can be found here:

<Output_folder>/DIMM/ftpdata

And are uploaded to the server if necessary.

6.2 Data text output results

The data are output as a texts files and a binary file in this folder:

<Output_folder>/DIMM/datas

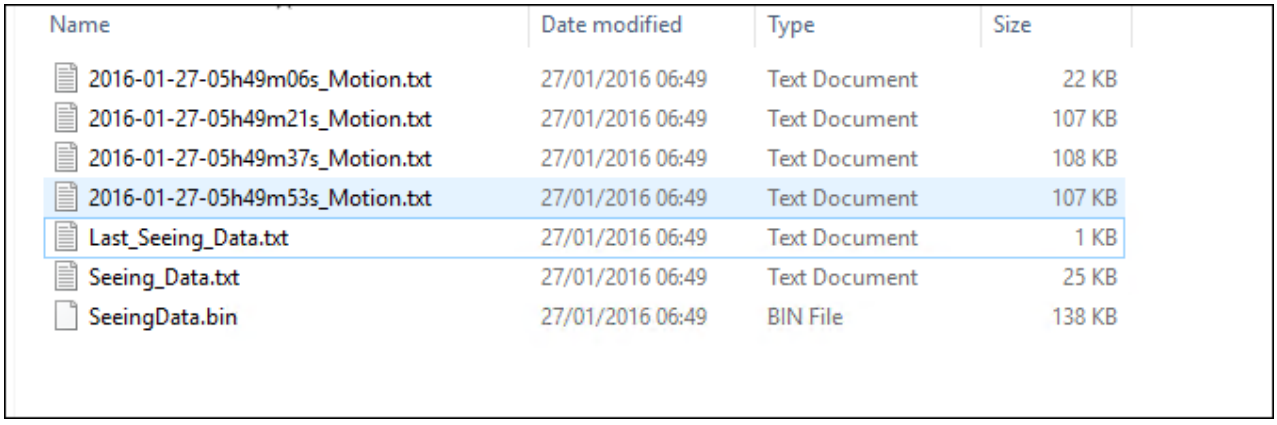


Fig. 100 *<Output_folder>/DIMM/datas*

The purpose of the binary file (***SeeingData.bin***) is to refresh the plot quickly when the DIMM Prism function is enabled.

The YYYY-MM-DD-HHhMMmSSs_Motion.text decodes as follows:

```
11.232,286.221,173.474,354.587,304.231,4.55,5.42,103.0,80.0
11.257,285.889,172.609,354.778,303.526,5.49,5.98,64.0,82.0
11.282,286.400,172.660,353.683,304.821,5.23,6.00,85.0,72.0
11.306,285.920,173.829,351.758,302.864,6.74,5.34,66.0,73.0
11.391,286.663,175.678,357.449,302.581,4.43,5.05,126.0,76.0

3.07
2.70
2.82
12469
```

```
2808
27/01/2016 06:00:55
```

Time	X star #1 position	Y star #1 position	X star #2 position	Y star #2 position	Star #1 mean FWHM	Star #2 mean FWHM	Pic signal Star#1	Pic signal Star#2
Sec	Pixels	Pixels	Pixels	Pixels	Pixels	Pixels	ADU	ADU

The last information file "***Last_seeing_data.txt***" decodes as follows

Seeing	As arcsec
Para motion	Pixels
Perpendicular	Pixels
Mean Flux	ADU
Rms Flux	ADU
Date	UTC date

An example of the "***Last_seeing_data.txt***"

```
27/01/2016 05:20:52 | 27/01/2016 06:20:52 | 2457414.7228289 | 13552.4 | 3541.00 | 2.71 |
41.9
```

This line can be decoded as follows

UTC date	Local date	Julian day	Mean flux (ADU)	Rms Flux (ADU)	Seeing (arcsec)	Ro (mm)

The "***Seeing_data.txt***" file contains all the lines from the "***Last_seeing_data.txt***" gathered over the course of the time.

7 Troubleshooting

7.1 Actual Double star

Keep in mind that a single star must provide two images, but in case of a double star, this is 4 images that will be displayed (see next image). This can cause issues during the measurements. PRISM removes the most famous double star when selecting automatically a star, but this can happen anyway.

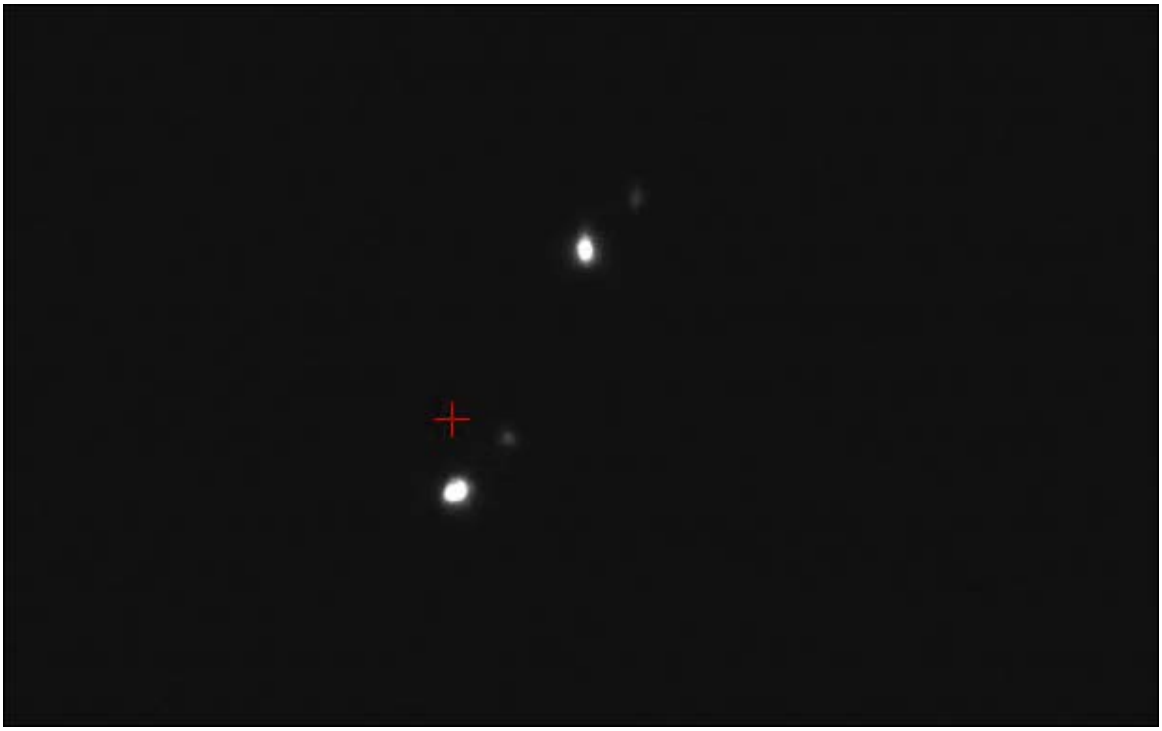


Fig. 101 *4 Images of a double star like Albireo*

7.2 Both star marked as ”Failed” on the image.

The two image star are visible, but two “failed” red circle can be seen. This is because the two image star are saturated, and no measurement can be performed when the images are saturated. Decrease the reference exposure, and gain and the circle will turn green and yellow again.

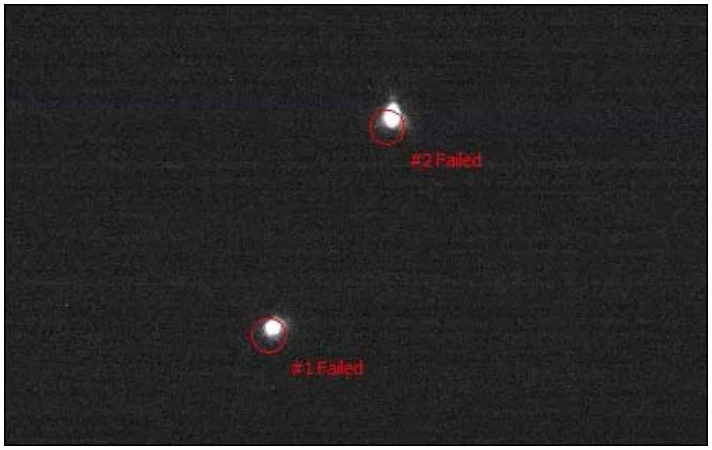


Fig. 102

Watch the peak intensity plot, this is giving valuable information. The next plot shows a problem, with intensity peak reaching all the time 255 ADU. Reduce camera exposure time or gain.

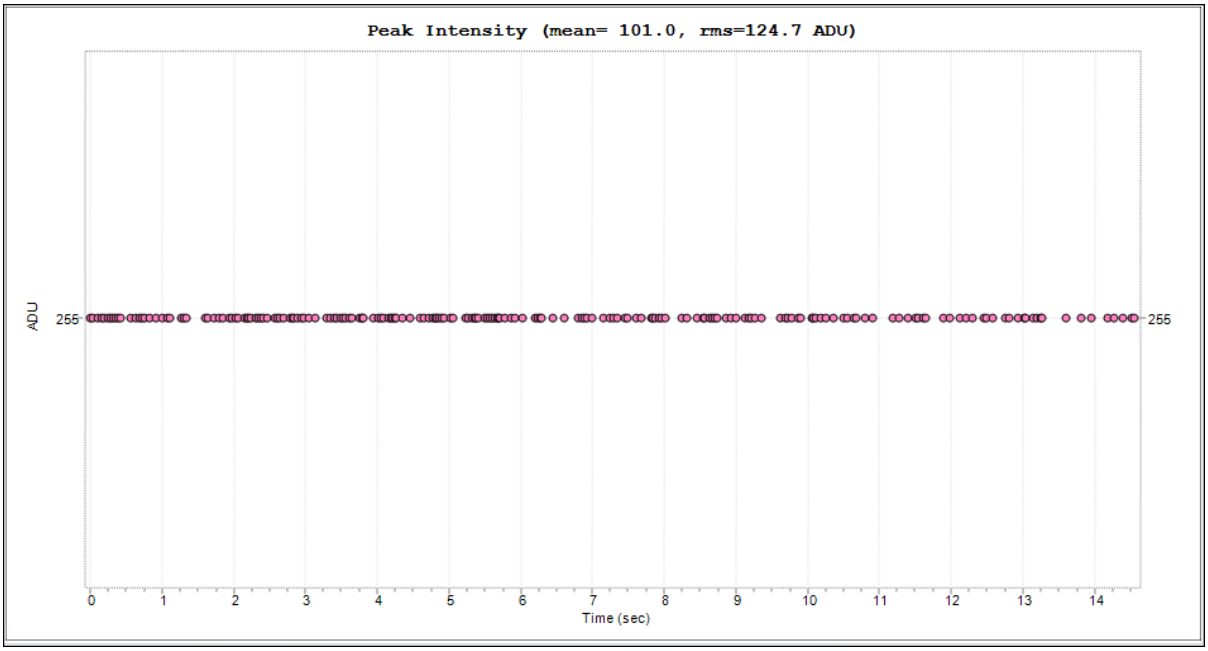


Fig. 103

When the exposure time and the gain are set properly, the next image shows that most of the time the star image can be barely visible.

Fig. 104

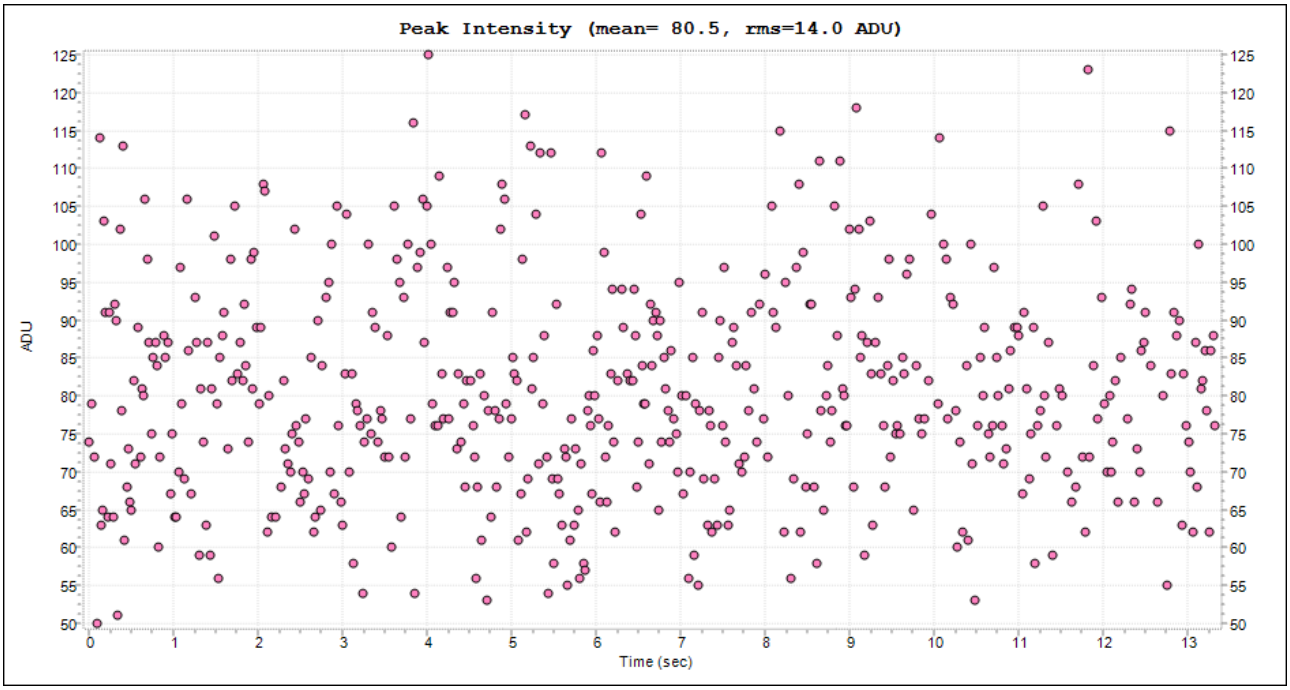


Fig. 105 *Correct plot, where star intensity peak never reaches saturation level*

7.3 One of the images of the star has disappeared

If one of the images of the star disappear, seeing measurement is not possible anymore. This is caused by dew deposited on the external side of the tunable DIMM prisms, which prevents light from entering inside the telescope.
If this is occurring too often ALCOR-SYSTEM can supply a mechanical part that reduce the solid angle seen by the prisms, and can reduce its temperature drop, and dew to appear.

This can happen when RH (relative humidity) is higher than 80% and no wind is blowing.

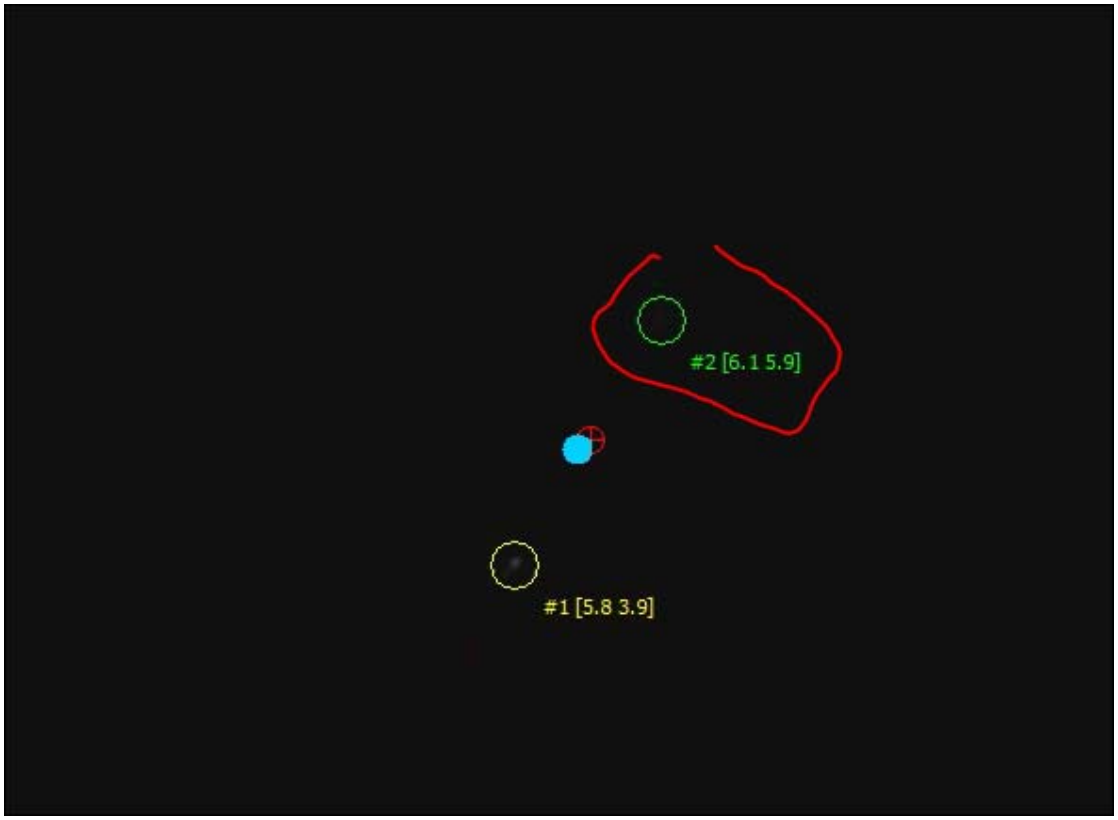


Fig. 106 *The weaker image star, with a green circle has almost disappeared, and failed circles can show up.*

Fig. 107 *Baffle used to prevent prisms to cool down too much and to catch dew. As 2019, this baffle is part of the kit.*

7.4 On startup, or later in the night, no stars are found from the catalog.

If the software complains that no star can be aimed at, this is because the automatic star selection constrains are too high. Reduce minimum elevation, increase magnitude range and/or decrease distance from the Moon.

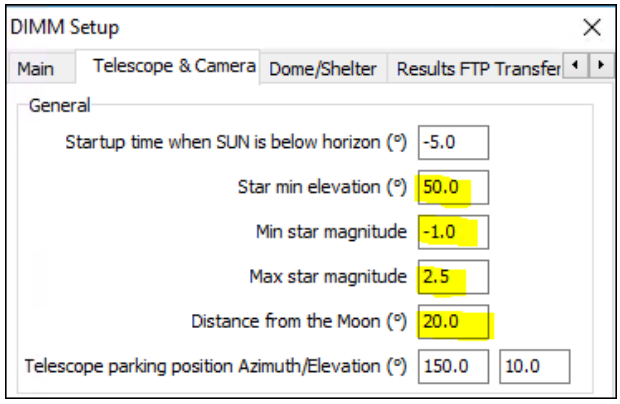


Fig. 108 *DIMM setup parameters for star selection*

8 Support

Support or bug reports should be sent by email to

cyril.cavadore@alcor-system.com

The ***<Output_folder>/DIMM/logs*** folder contains all the information gathered into text file on how the system ran since the DIMM function has been started.

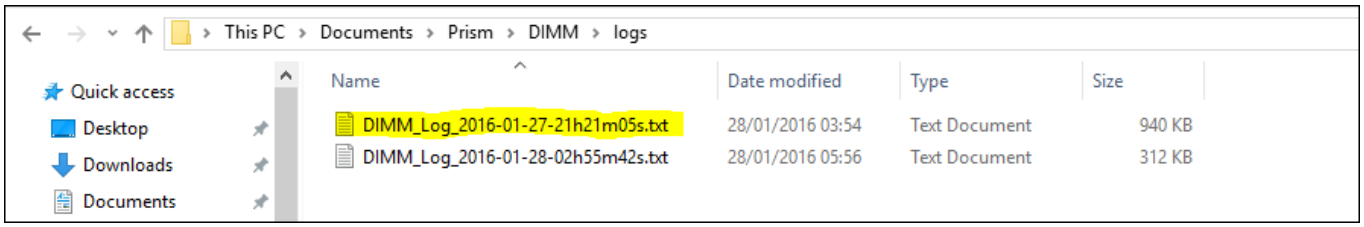


Fig. 109

9 Product terms of use

The use of this product is solely for monitoring the seeing of the night sky educational or scientific purposes.

Use of this product involving people's lives is the responsibility of the user, and in no way ALCOR SYSTEM will be held liable for injuries to persons or property theft as the use of this system described in this manual.

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