

# AiryLab

## **Genika Astro user manual**

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## Introduction

Genika is a video capture software suite for GigE, USB and IEEE1394 cameras.

The version you acquired targets planetary, lunar and solar imaging. For scientific applications you may use Genika Trigger available from [Airylab](#). The user interface has been designed to be as simple as possible for easy capture on the field.

This application is developed to deliver the best performances possible, including advanced software features such as heavy multithreading and DirectX to leverage multicore CPU and GPU. Nevertheless a good hardware is required to get all the performance your camera can deliver: Code 2 duo CPU, fast disk and GE/USB3 interface are preferable.

Genika license is linked to your camera and you can install it on several PC as long as the license file is copied along the application. It is also possible to acquire a personal license from us.

*Ephemeris data: Institut de Mécanique Céleste, 77, avenue Denfert Rochereau, 75014 PARIS, FRANCE*

*Genika uses TIFF TiffLib.net Copyright (c) 2008-2011, Bit Miracle, All rights reserved.*

*Genika uses SlimDX for DirectX rendering.*

*The SER toolbox uses Aforge and OpenVC for some color image debayering modes and FFT transform.*

*Hristo Pavlov's librairies are used for native ADV file format support.*

## Features

The current Genika release supports the following features:

- Selectable color themes
- Stream display with user selectable refresh delay and four zoom levels (free size in DirectX)
- Trigger mode
- Spectrum ramp, inverse and log palette display mode
- Programmable screen stretch
- H/V programmable levels display
- On the fly de-selectable bayer conversion for display
- On the fly image averaging and dark/offset
- Exposure, auto exposure
- Gain (gain boost on IDS), sensor gain on IDS CMOSIS cameras. Display gain for some color cameras
- Black level if available
- Gamma
- 8 bits, 11/12/14/16 bits mode
- Camera cooling and fan control (Andor and Raptor)
- Shutter mode selection (E2V sensors for IDS and Basler)
- Lin/log for IDS E2V camera
- Can manage two different Basler cameras with two application instances
- Camera settings load/save, automatic camera setting saving at acquisition start
- Free Aol and Aol offsets selectable with the mouse directly on the image or with a user defined list, calculation Aol mode
- Binning
- FPS and bandwidth display, FPS graph
- Low/High display thresholds in >8 bits monochrome modes
- Histogram with min, median, max and programmable refresh
- Real time image stabilization on positive or negative image (8 bits only)
- External DLL call for image or display processing
- Multiple optic configuration with quick selection
- List and optic configuration editor
- SER, AVI (8 bits only), TIFF, ADV and GNK file format
- Timestamping of the capture files and images in SER and GNK
- Text file including acquisition parameters and WInjupos date format
- User defined file prefix
- Selectable filter file suffix
- SER conversion toolbox to AVI, ADV, TIFF and FiTS (single image, Cube FiTS, multi image FiTS) format
- SER file analysis tool, GNK converter
- Ephemerides with sampling analysis. Planet position in real time
- Optical alignment (collimation) assistant and PSF analysis
- Center of gravity or phase correlation autoguiding with pulsemode Ascom mount capable
- Mosaic helper on overlay
- Sampling calculation tool and auto F/D detection on planets

- 2D Focus assistant with micro-contrast display and advanced focus score, noise distribution analysis with graph and data to disk
- Autofocusing when connected to an ASCOM focuser
- Reticle with user selectable pixel/ArcSec ticks and circle
- Multiline sequencer with loop capability and automatic filter/focuser offset change
- Auto acquisition mode with a Solar Scintillation Monitor (SSM)
- ASCOM filter wheel and focuser control
- Focuser jog window
- GPS precision SER and GNK file resynchronization for occultation



## Installation

You need the Microsoft the SDK from your camera supplier with .NET SDK option.

IDS uEye	uEye 4.21
Basler	Pylon 5
AVT/Prosilica	UNI 2.1
TIS/Celestron	IC Imaging control 3.3
Andor	SDK3
Raptor	EPIX drivers
Pointgrey	Flycap
ZWO ASI	Camera driver
QHY	Camera driver

You can then extract and launch the exe file to install Genika. Previous install should be removed prior new version installation. When installed the application further updates and done through the Internet from the update menu.

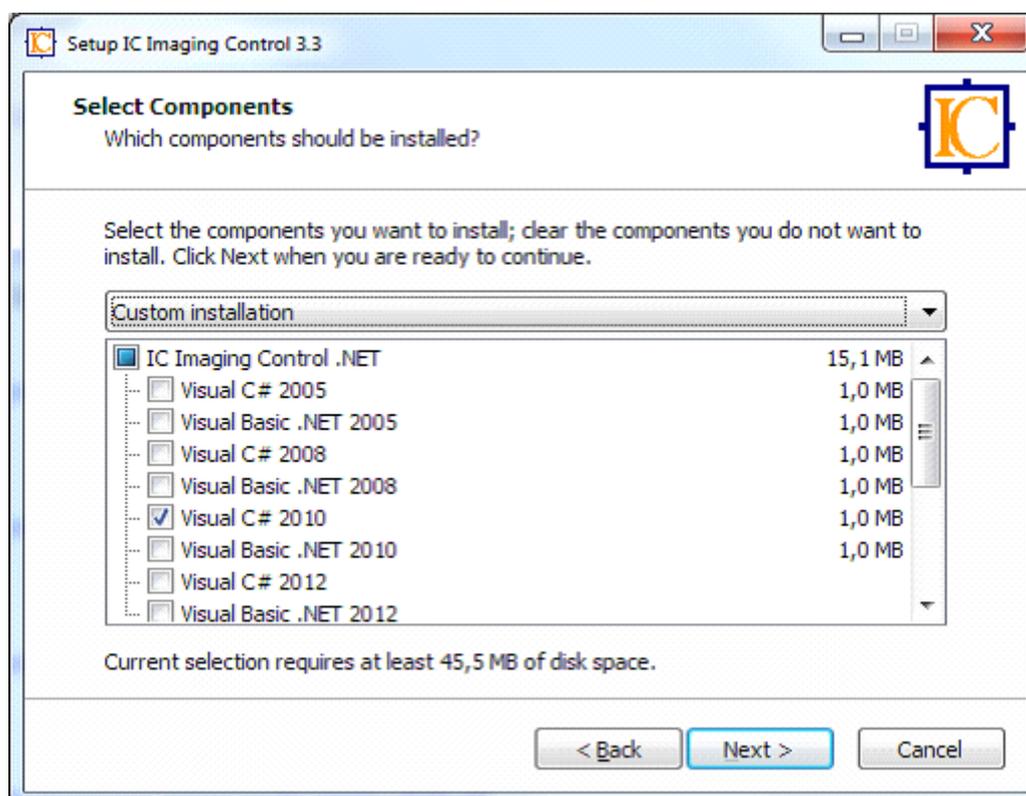
For ASCOM filter wheel and focuser control you need the ASCOM 6 platform.

You don't need to deactivate the idle C-States from the camera driver with IDS cameras, that is handle automatically by Genika.

Raptor Photonics requires a registry change for the 32 bits version to be used on 64 bits OS, please refer to the EPIX user manual or use the 64 bits version of Genika.

**If you are using Flycap x86 on a x64 system, you have to use the x86 version of Genika Astro. The x64 version requires the x64 Flycap release.**

TIS/Celestron requires the IC Imaging control SDK 3.3 with the following installation options:



You can download the version required by Genika here : <http://airylab.com/Drivers/ic3.3setup.exe>

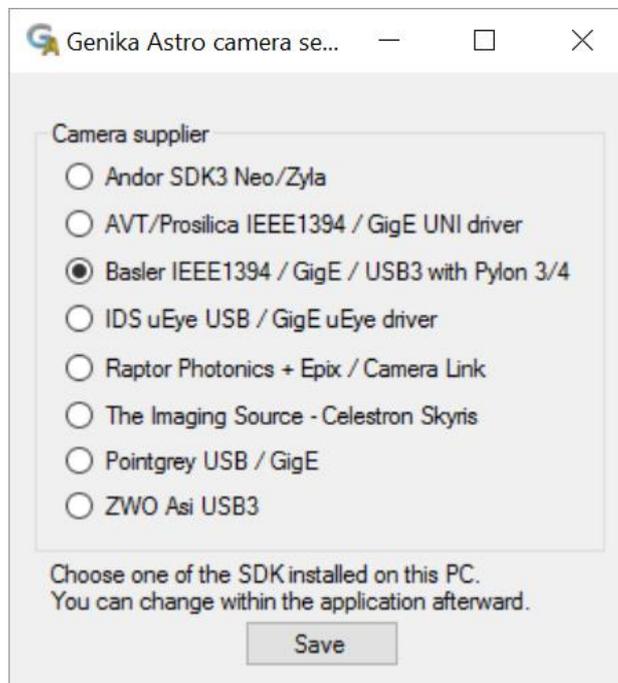
## Supported cameras

Camera	Genika Astro
Andor Neo/Zyla	✓
Basler IEEE1394	✓
Basler GigEthernet	✓
Basler USB3	✓
IDS USB2 & USB3	✓
IDS GigEthernet	✓
AVT IEEE1394	✓
AVT GigEthernet	✓
Pointgrey USB2 & USB3	✓
Pointgrey GigE	✓
Raptor Photonics	✓
TIS / Celestron	✓
ZWO ASI USB3	✓
QHY USB3	✓

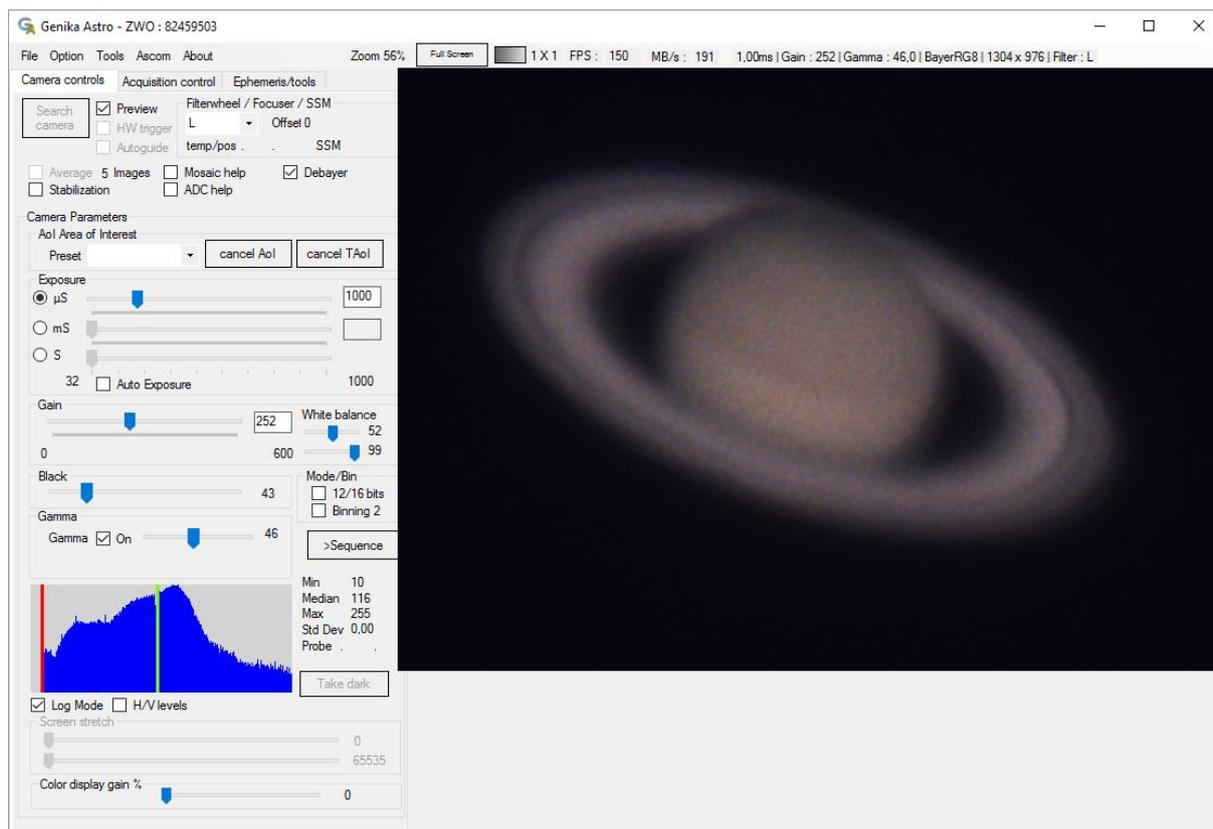
## Using the application

### Launch and camera connection

Double click on the shortcut to launch the application. At the first launch you'll be asked for the camera brand you want to use. You can change this on the fly from the application afterward:



The main window will appear and the application will start looking for your camera automatically. Your camera can be connected before or after you launch Genika. When the camera is detected, the video stream will be displayed. You may have to press the *search camera* button on some cameras.



Note: if you disconnect the camera or switch of camera (same brand) Genika may recognize automatically the new camera depending on the camera supplier. You don't have to launch it again. If the camera isn't opened automatically you can retry with the *search camera* button.

**Note: if two Basler cameras are connected to the network, Genika tries to open the first one. If this one is busy, it will try to open the second one. That allows to open two cameras with two instances of Genika Astro at the same time. Nevertheless, the configuration files are shared amongst the two instances. If you want different settings (directory, options...) it is recommended to install Genika twice in different directories.**

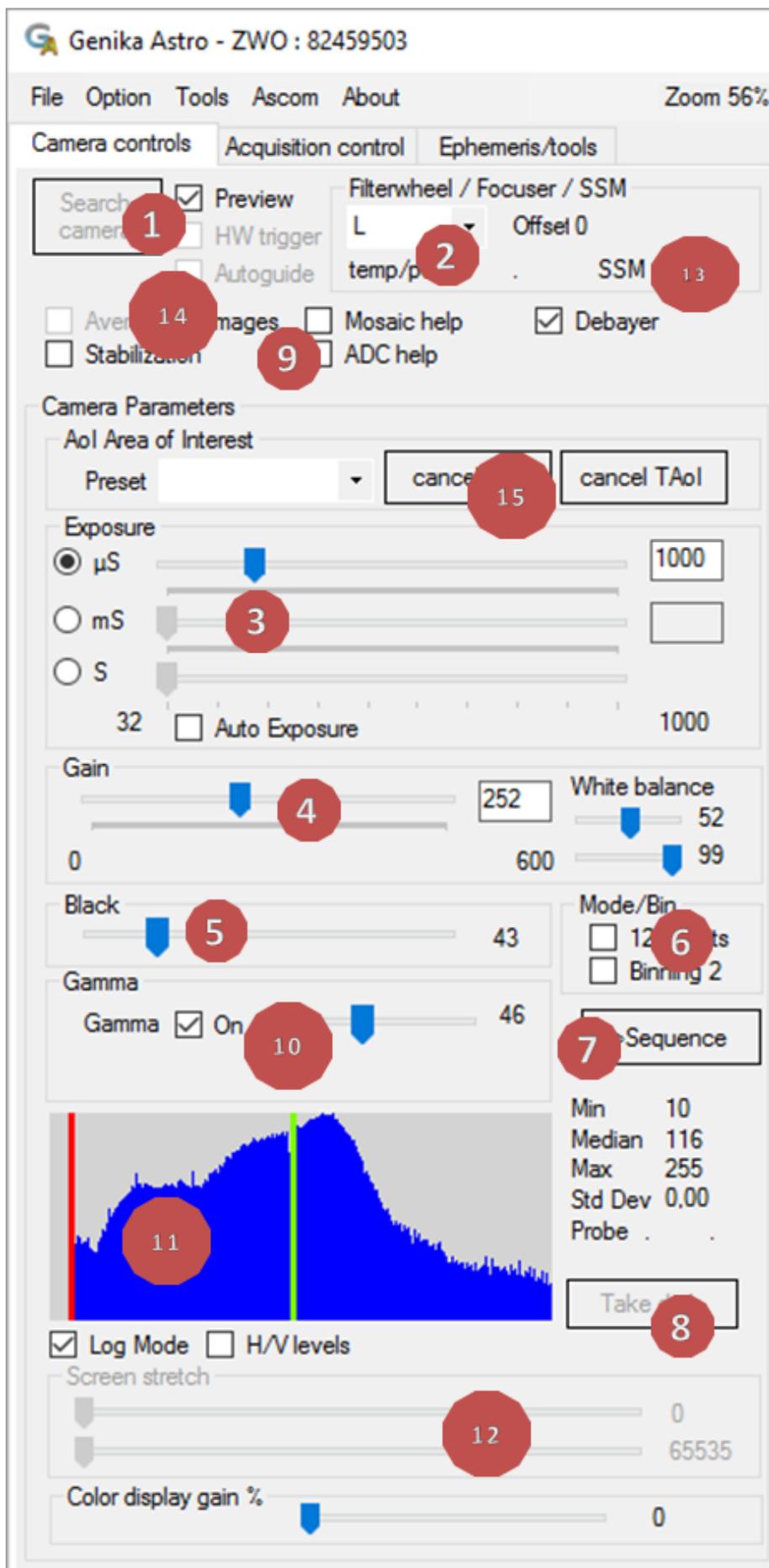
Note: If your camera is connected through a GE switch, the behavior is exactly the same as for a direct connection. Using your camera behind a router would severely impact the performances and is not advised.

If the picture is bigger than your actual screen, you can resize it through the zoom command in the *tools* menu or scroll the image around. You can use F5 for an automatic fit to screen.

You can also reverse the image on X axis from the option window (Basler cameras).

## Acquisition settings

The left tab gives access to the acquisition controls.



1. Open camera, display and trigger mode: if the camera hasn't been detected at launch or if you changed of camera or camera supplier you may start the camera detection using the *open camera* button. You may then launch image acquisition using the *preview* checkbox; and set up the hardware trigger mode. For some color camera, it is possible to cancel the display debayering.
2. Filterwheel and focuser control : you may choose the active filter from the list box. A default filter list is proposed. You can change the filter names editing the text file as described in a dedicated chapter. If you connect an Ascom filter wheel changing the filter name will move automatically the filter wheel and possibly focus position if an Ascom focuser is connected.
3. Exposure : Those controls allow to set the exposure time. Three sliders are available for microseconds, milliseconds and seconds. Note that all exposure time not available depending on your camera specifications. Sliders are linked to the input area. Sliders may also be moved using the arrow keys or your mouse wheel. Note that the exposure value will determine the final FPS, up to the maximum camera performance. The  $\mu\text{S}$  slider extends to  $3000\mu\text{S}$  to solar imaging. Exposure range depends also on the pixel clock setting for IDS cameras.
4. Gain : The slider allows gain setting. Note that the min and max values can change depending on your camera model and other settings such as the pixel depth. The Lin/Log mode is available on some E2V IDS cameras. In that mode the gain determine the knee point between linear and log response. A secondary gain setting is available for some cameras. For some color camera, a white balance setting is available here (Red and Blue gains).
5. Black: Use this slider to control the black level. Note some cameras don't support black level setting.
6. Bit depth 8/12 Bits and Binning : This setting specifies the pixel depth. It doesn't reduce the FPS, but increases the file size and the dynamic. 12 bits is a preferable choice if you can keep the gain low, such as for Lunar or Solar imaging, and if the 12 bits mode doesn't reduce the frame rate. More images is always preferable to more dynamic. If the gain is too high, amplification will annihilate the additional dynamic of the 12 bits mode. Note that in 12 bits mode the maximum admissible gain is the maximum gain. The actual bit depth may be 11, 12, 14 or 16 bits depending on the camera. Binning is available from this control. Binning will increase the acquisition rate of your camera and decrease the resolution of a factor 4 for example for 2x2. Sensitivity will as well increase by a factor 4. TIS cameras don't support Binning.
7. To sequence : the sequence button copies current setting to a sequencer line.
8. Dark subtraction : It is possible to take a dark frame to correct hot pixels on the fly, the master dark is built with 10 frames averaged.
9. Utilities : Different feature are present in the upper area :  
 The mosaic helper displays an overlay of the actual image with transparency to help with mosaic composition.  
 For color cameras, you can deactivate the debayering. Note that debayer only applies to display.  
 The ADC helper shows only the blue and red channel when a color camera is used to help you in setting the prisms.  
 Image stacking adds a number of image to have a better signal to noise ratio.  
 Stabilization center the image with the center of gravity. This is applied to the images saved to the disk as well.
10. Gamma: you may activate the Gamma and choose its value using the slider and the checkbox.
11. Histogram and probe : An histogram is available. You can select its refresh rate from *option* window. Histogram calculation is performed during acquisition as well. With very fast cameras you may want to decrease the refresh rate. Vertical bars show the Min, Max and Median values. If a sub-region has

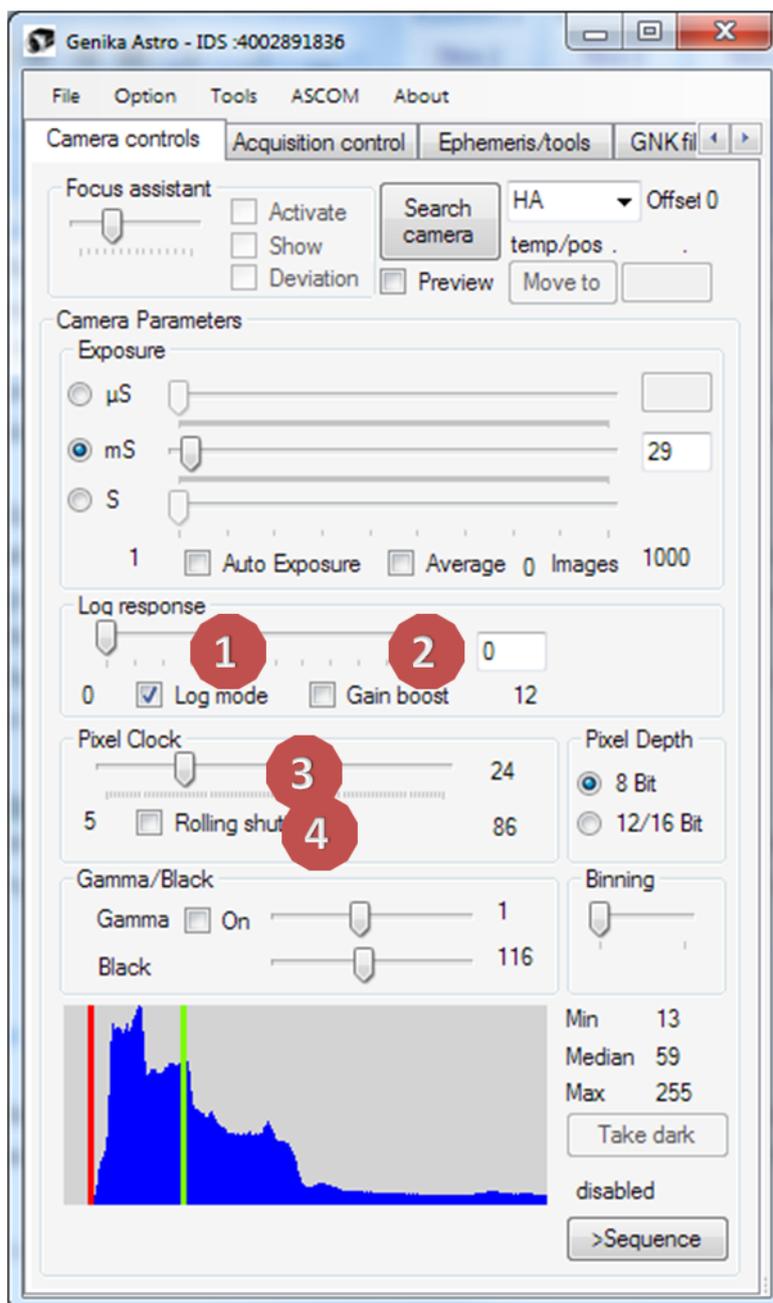
been defined with the “focus” AoI it also applies to histogram calculation. By default, the histogram response is a square(log) mode, you can have a linear response with the corresponding checkbox. If a mark has been placed on the image (right click), the value of the center pixel is displayed. Image standard deviation (noise level) is also calculated.

12. Visualization threshold : See description below.
13. Seeing value : When a SSM is connected, the seeing value in ArcSec is shown.
14. Autoguiding engage : When a mount supporting pulseguide is connected with ASCOM, this check box engage autoguiding.
15. AoI : Sets quick center Area of Interest. You can edit the AoI from the tools menu.

Status and parameters status bar : It gives the real software acquisition speed and bandwidth throughput. If your hard drive isn't fast enough, with value will decrease after a while when the system cache is full. Acquisition parameters are also recapped in the status area, including the active filter.

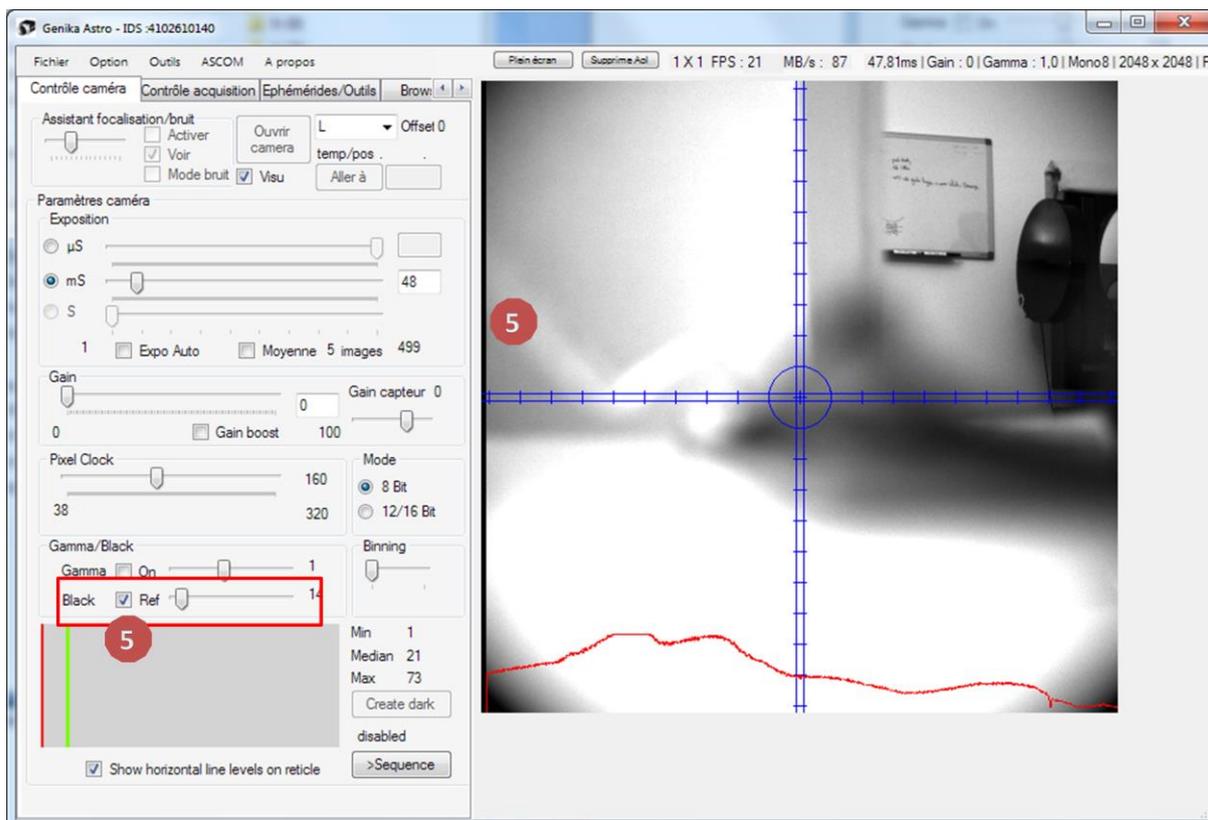
### **IDS camera specific settings**

IDS cameras support specific features such as the speed used to read the sensor.



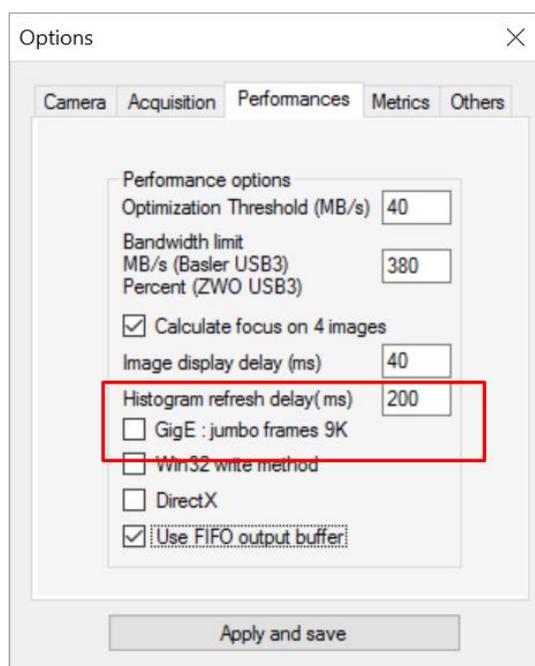
- 1 Lin/Log Mode : some sensors support specific ADU conversion known as linear/logarithmic. When the level reach the specific value the response mode switch from linear to logarithmic to avoid saturation. You can activate this mode using the checkbox. The log response slider specifies the inflection point between the two response modes.
- 2 Gain Boost : this checkbox double or triple the gain value depending camera model.
- 3 Pixel clock (IDS) : IDS camera allows pixel read speed setting. This setting may change the exposure range and the throughput. When using a high pixel clock, frames may be lost because the interface isn't fast enough (USB3 camera on USB2 port for example). In that case reduce the speed until no frames are lost.
- 4 Shutter mode : Some camera supports both global and rolling shutter mode. The rolling shutter decrease the read out noise level, but introduce temporal discrepancies between pixels. It is recommended to keep the global shutter mode when exposure time is below 5ms.

- 5 Black reference bar (CMOSIS sensors) : you can display the black reference bar for the CMOSIS sensors with the *ref* checkbox near the bacl setting slider.



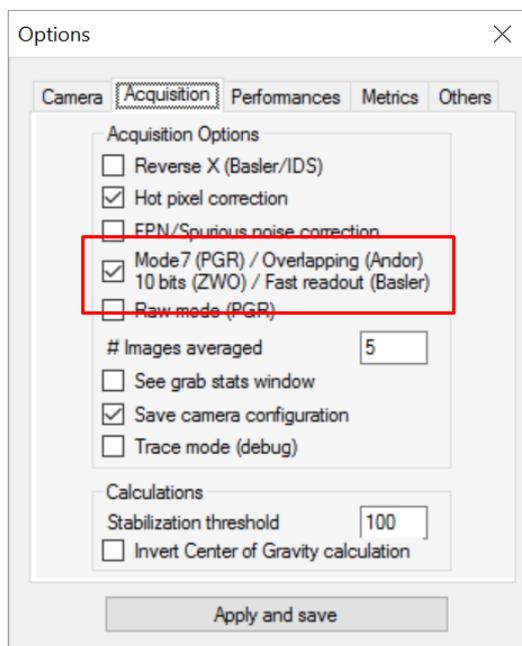
## GigE cameras

On GigE it is possible to use jumbo frames up to 9000 bytes. This should be enabled on the NIC (if available) and by selecting the jumbo frames in Genika from the option window :



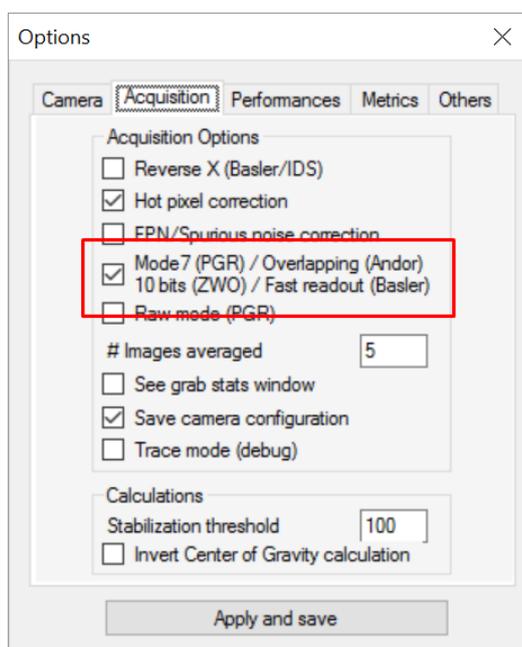
## PointGrey cameras

Most PGR cameras have both the Mode0 (fastest) and mode7 (slower but better quality). Those are reminiscence from the IEEE1394 world. It is possible to select the mode from the option window. The mode is applied immediately on validation. The mode0/7 is available only for Binning 1x1 as Bin2 uses mode1.

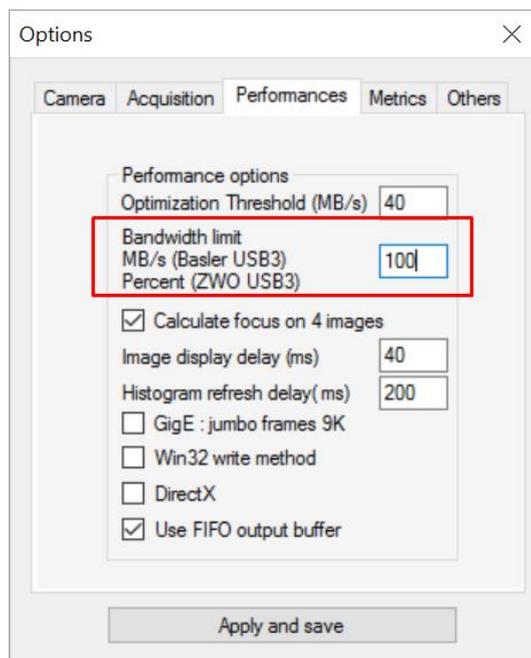


## ZWO ASI cameras

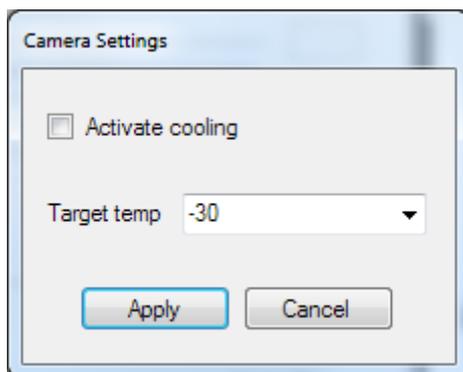
ASI camera have a 10 bits mode that deliver the throughput advertised by the manufacturer, but with a degraded image quality (higher read out noise). It is possible to select this mode from the option window as shown above. The mode is applied immediately on validation.



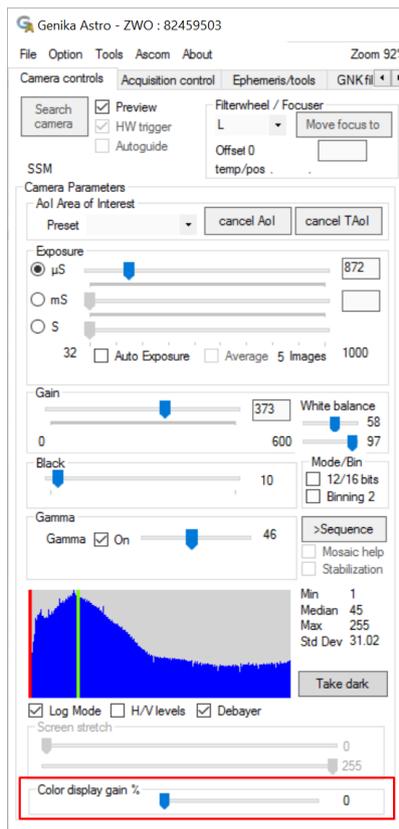
It is also possible to select the percentage of the USB3 link available for the camera. If your USB3 controller isn't fast enough, you may use this setting:



ZWO cameras have a temperature sensor that is displayed in the Ephemeris tab. It is possible to control cooled camera from the Setting menu :

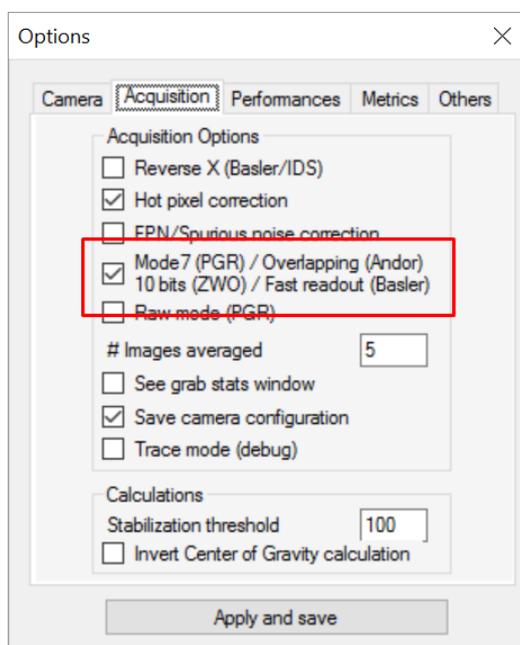


For color camera, a display gain is available when debayering is active. You can boost the gain to 1000% when imaging low signal deep sky object in luck imaging. When disabling the debayering you have all the mono camera features back (color palettes and thresholds).

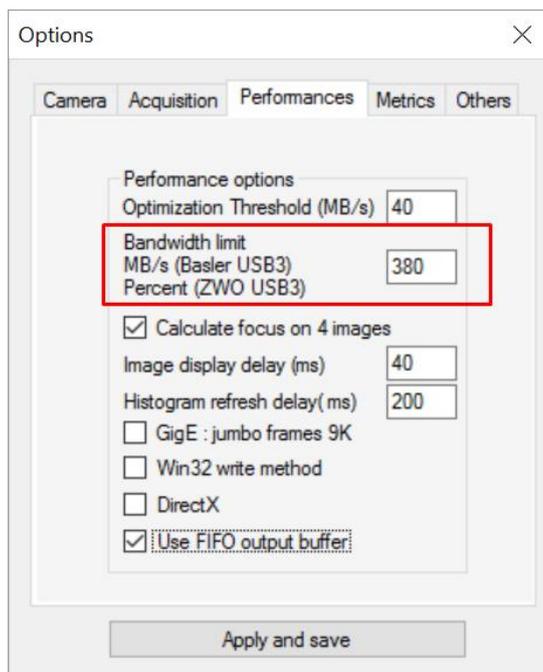


### Basler cameras

Basler cameras using ON semi Python sensors have a high speed mode that can be enabled from the option window to achieve the maximum throughput :

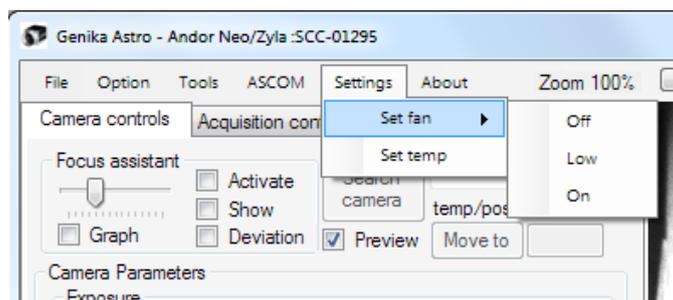


It is also possible to limit the USB3 bandwidth utilization. The throughput is given in MB/s. For high speed cameras such as the acA1920-155um you may use 390MB/s if your USB controller supports this speed.

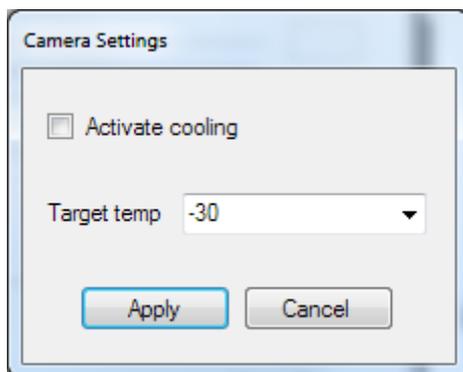


### Andor Neo/Zyla specific settings

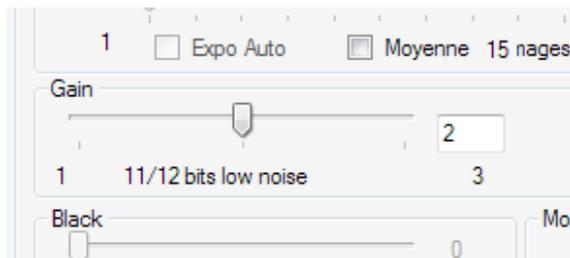
Andor cameras on Bitflow Camera Link frame have a specific gain/dynamic setting and can be cooled. Additional cooling/fan options are available through a dedicated menu *settings*



This menu allows you to choose the fan speed and the cooling temp and activity :



Actual Gain/well depth and dynamic are displayed in explicit text in the gain setting area :

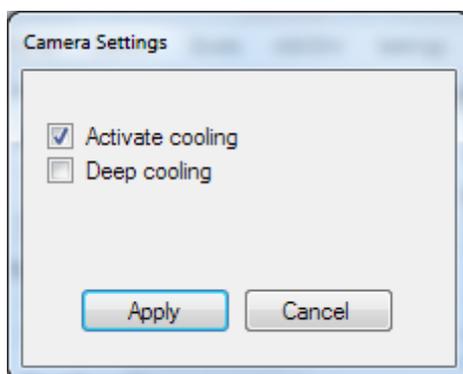


The dynamic setting depends only on the acquisition mode (11/12/16 bits). In 11 bits mode (Neo) the recording is performed on a 12 bits base, but the display is scaled from 11 bits. A saturated area will read a value of 2048/4096 in the file, but is displayed as white.

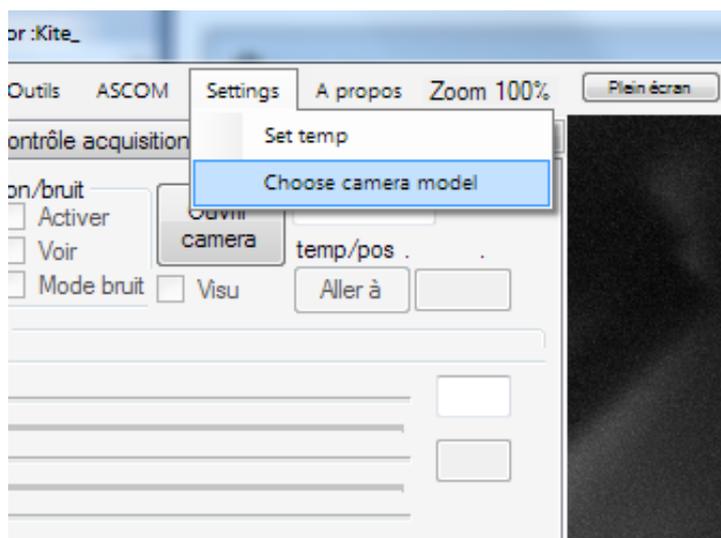
It is possible to change the overlapping setting in the option windows. With overlapping the camera throughput may exceed the camera link bandwidth and lead to latency above 30 fps.

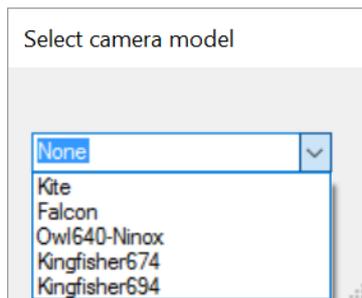
### Raptor photonics specific setting

As for Andor cameras, Raptors have a cooling management.



**It is mandatory to select the camera model after choosing Raptor Photonics in the camera selector or the Option window.** This is possible from the *setting/choose camera model* menu :





**Then you must close and relaunch Genika Astro.**

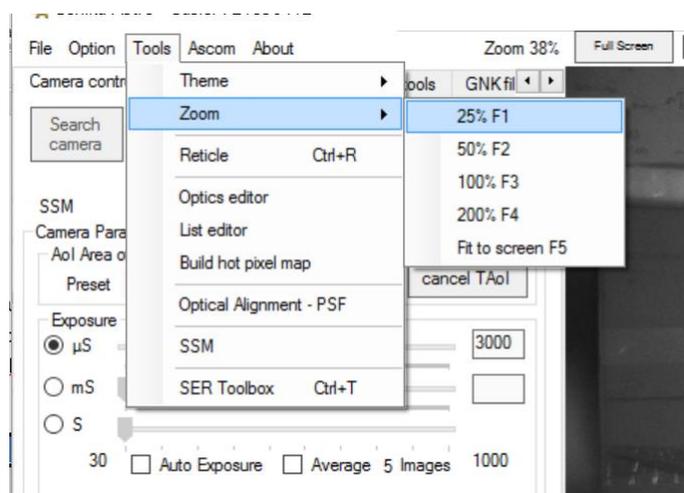
## Color management

Genika acquires RAW images from color cameras without compression. Images are bayer processed for display and AVI only. Note that the RGB24 format for AVI uses three more time disk space than monochrome images. Genika uses a high quality debayering model from the scientific library OpenVC.

File format	Mode 8 bits	Mode 12/14/16 bits
SER	RAW	RAW
TIFF	RAW	RAW
GNK	Not supported	Not supported
AVI	RGB24	Not supported
ADV	Not supported	Not supported

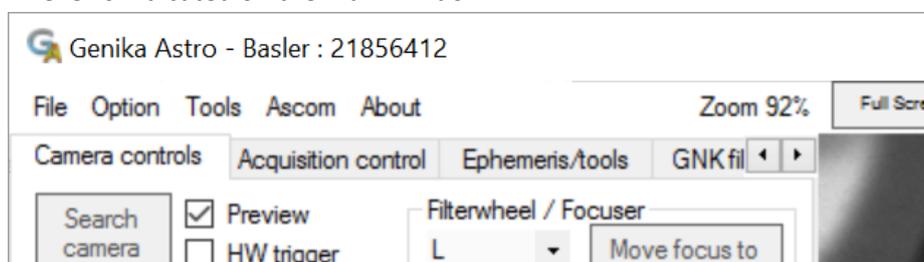
## Zoom

Zoom can be accessed through the view menu from 25 to 200%. It is possible to access directly to each zoom level with F1 to F4 keys. Using F5 fits the image to the maximum window size.



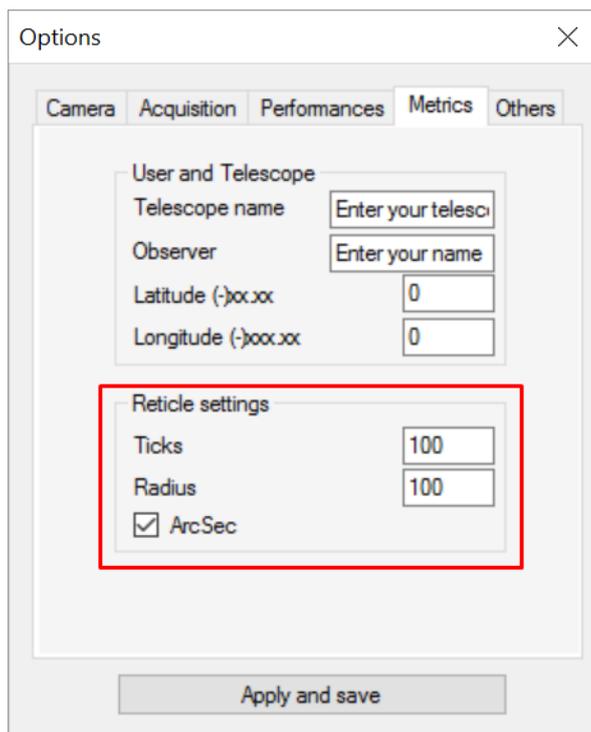
In DirectX mode, you can select more zoom levels by positioning the mouse over the image and using the mouse wheel or using page up/page down keys.

Current zoom level is indicated on the main window :

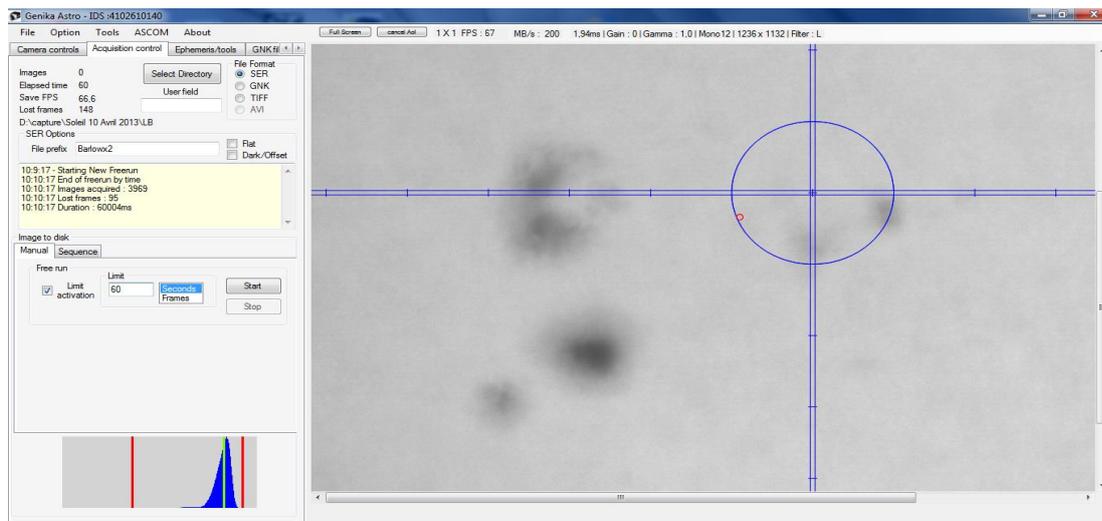


## Reticle

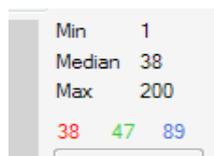
A fully programmable reticle can be displayed on top of the image. The reticle shows a double cross with programmable ticks and programmable sized circle. Those two elements can be scaled in pixels or ArcSec if the ephemeris and telescope data has been set. You can access those elements from the options window.



If an area of interest is being defined the sensor center is symbolized by a red circle.

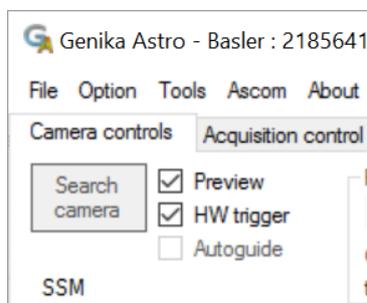


You may also define a mark on the image (green square) with a right click on the image. Click on the mark to remove it, or somewhere else to move it. The value of the pixel under the mark is then displayed near the histogram values:



## Trigger Mode

A trigger mode is available for AVT, Basler, IDS and Raptor Photonics cameras. When this mode is activated, one frame is taken each time the edge rises on the first camera electrical input.



This feature has been implemented to slave the camera to a precise GPS clock. In that case, the precision is better than a few  $\mu$ seconds. We recommend to use the TimeBoxUTC sold by Airylab for high precision image timestamping.

Note that if you need more advanced features such as burst mode, multi-camera synchronization, stereoscopy and more, you need to use Genika Trigger.

## Visualization thresholds and specific image rendering

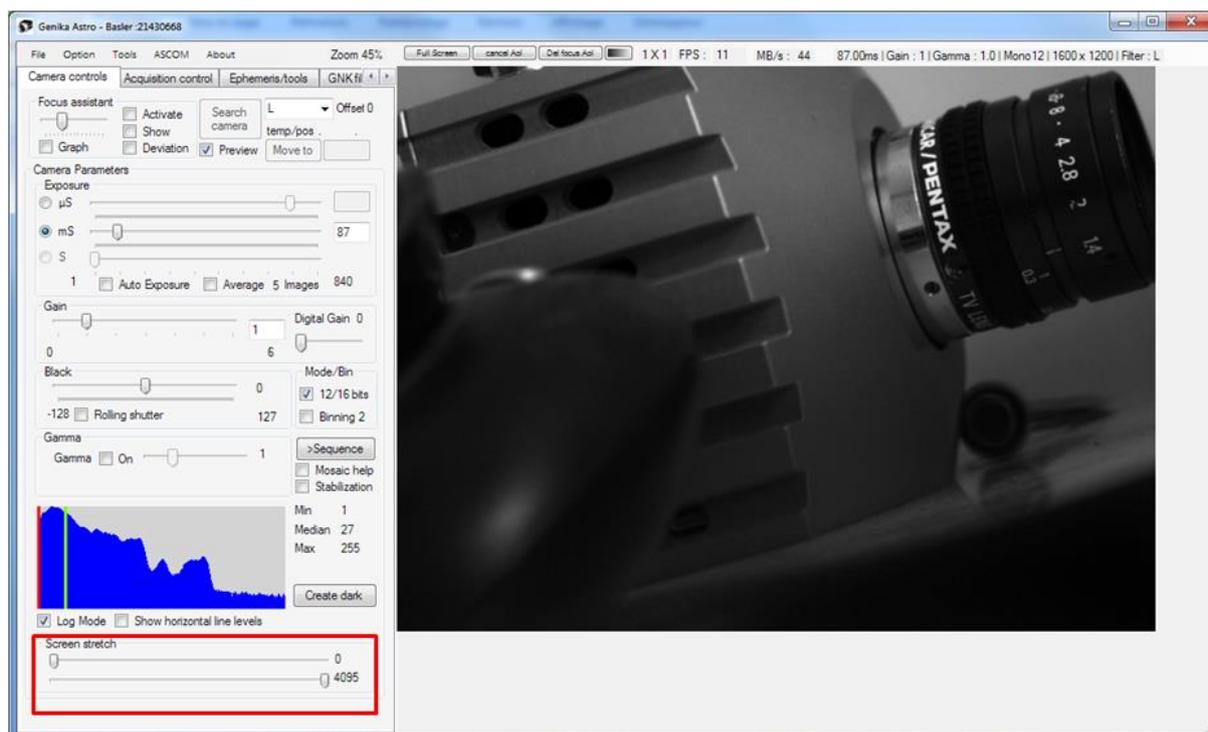
### Screen stretch

Genika displays the camera stream in 8 bits mode whatever the pixel depth is actually selected. This limit comes from Windows DirectX / GDI that doesn't handle more than 256 grey levels.

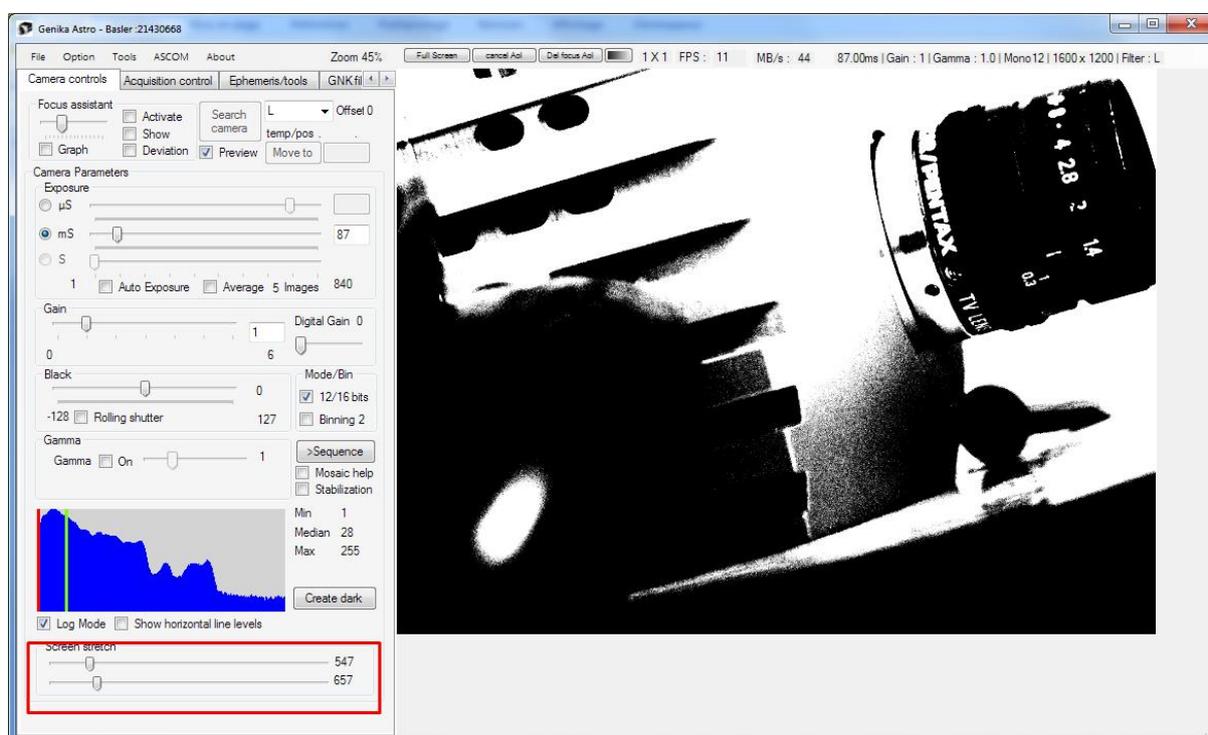
Genika has two user selectable sliders that select the low and high intensity limits for image display for monochrome camera and color camera in RAW display mode. It is possible to use a small ADU range to focus on the image real dynamic. For example in the case of a 16 bits image (Mono16) the image dynamic (0-65535) is compressed to 8 bits mode for display (0-255) with a linear response. The compression ratio is 256 (65536/256). If we set thresholds to 100-500, then those 400 ADU levels only are compressed to 256 levels, thus allowing seeing more dynamic although in a limited range. The ratio is then 400/256.

When activated, the threshold is also used for histogram calculation except for Basler cameras. If the low threshold value is above the high one, the image is inverted.

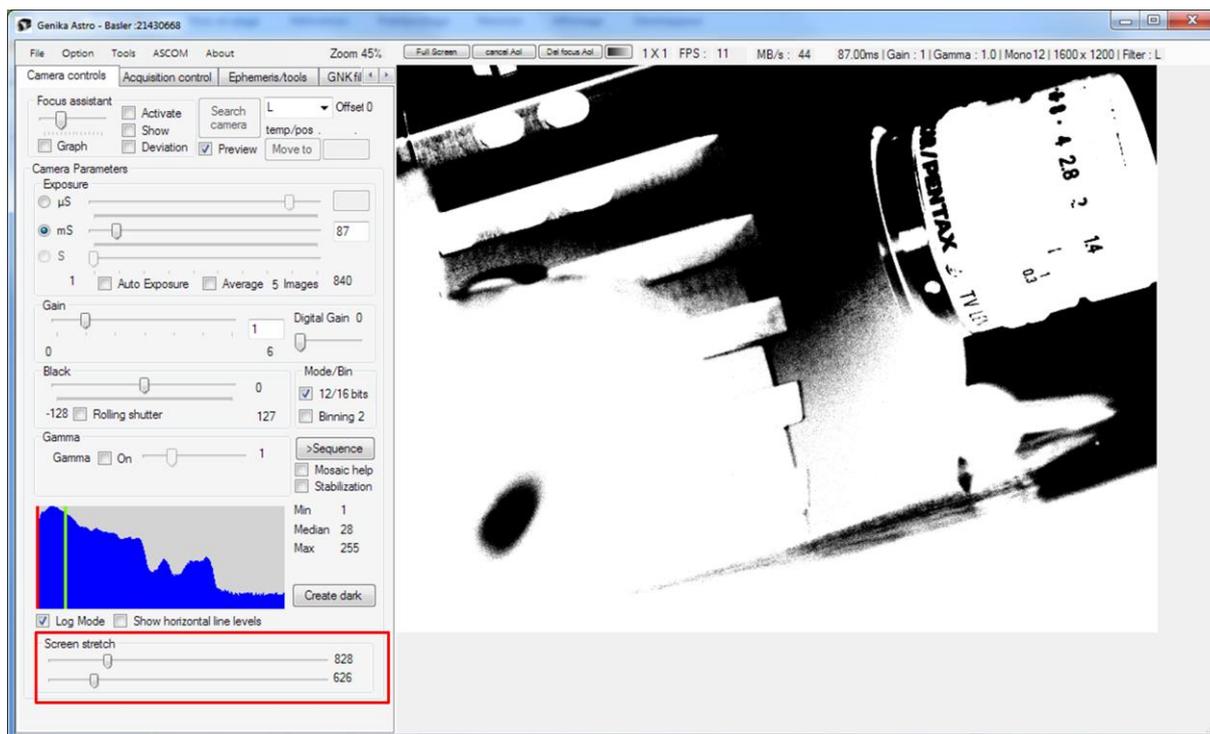
Here are some examples:



*Full range display : no effect on image*



*Highly stretched image: both thresholds are very close.*



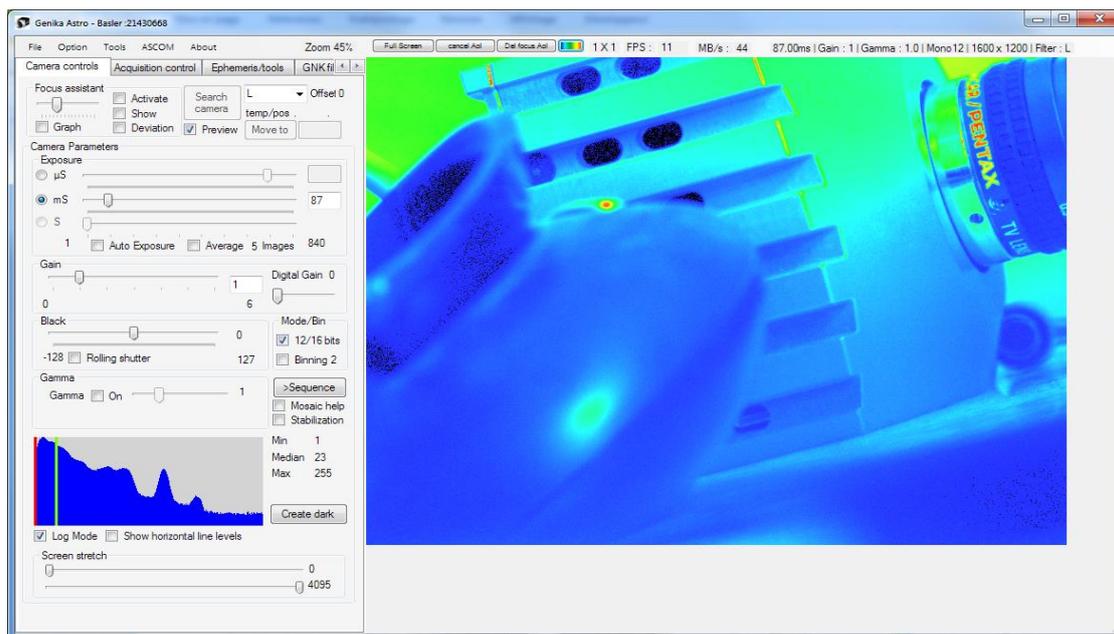
*Inverted thresholds: the image is negative*

## False color image display mode

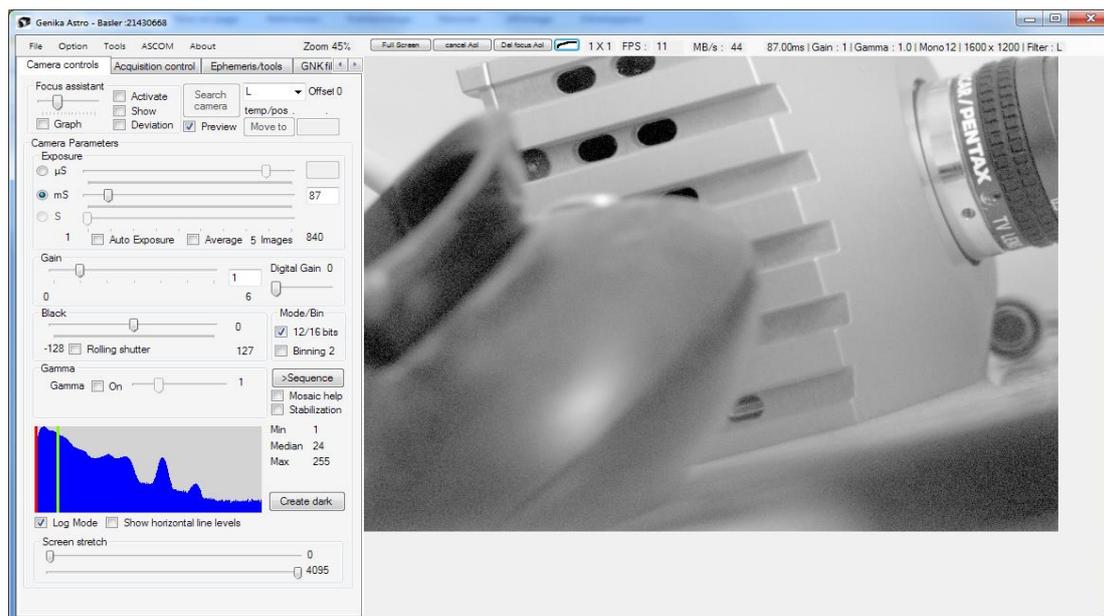
For all pixel depth it is possible to alter the 256 grey levels palette for monochrome camera and color camera in RAW display mode (debayering unchecked). Four modes are available:

Icon	Name	Rendering mode
	Standard mode	From black to white, linear response
	Spectrum ramp	Back is black, intermediate levels from blue to red, white (saturation) is white.
	Negative mode	From white to black, negative image. Linear response.
	Log	From black to white, log response to see low keys.

Note that the rendering mode cumulates with the screen stretch thresholds.



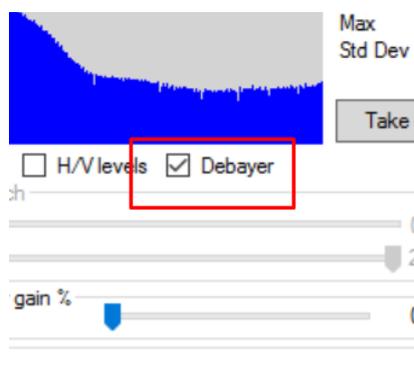
*Spectrum ramp mode*



*Log mode*

## Color cameras rendering

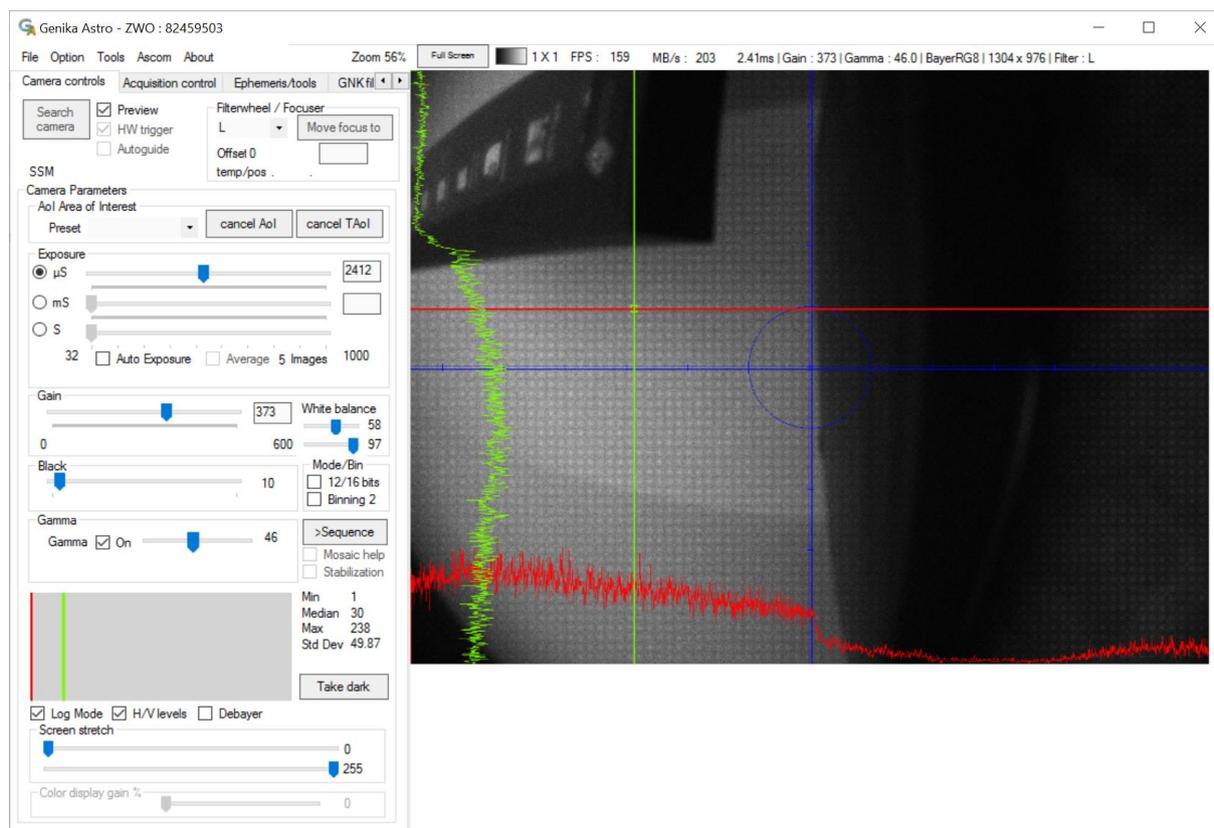
By default, color camera image is displayed with on the fly debayerization. It is possible to uncheck the debayer for a RAW display.



In that RAW mode, all monochrome display settings are available (palettes and thresholds).

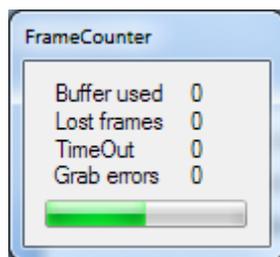
## Horizontal and vertical levels

Genika can show the signal level on a selectable line and column when the reticle is shown by using the checkbox under the histogram. Level display suspends histogram calculation and is refreshed at the same rate. It is possible to select the central position with a right click on the image.



## Grab statistics window

You may display statistics from the camera acquisition from the *options* window.



This window shows you the number of buffers actually used by the camera, the number of frames that have been lost, the number of time out and grab errors. A progress indicator shows the elapsed exposure time if exposure is above 990ms. In case of high CPU load the number of buffers being used will increase up to 24. Then the application starts to lose frames. If it loses more than 100 frames in a row the acquisition would stop and a window notifies you that load is too high.

You should then do whatever is necessary to reduce the CPU utilization such as choosing an another file format, reduce acquisition rate or check that your computer is not in energy saving mode.

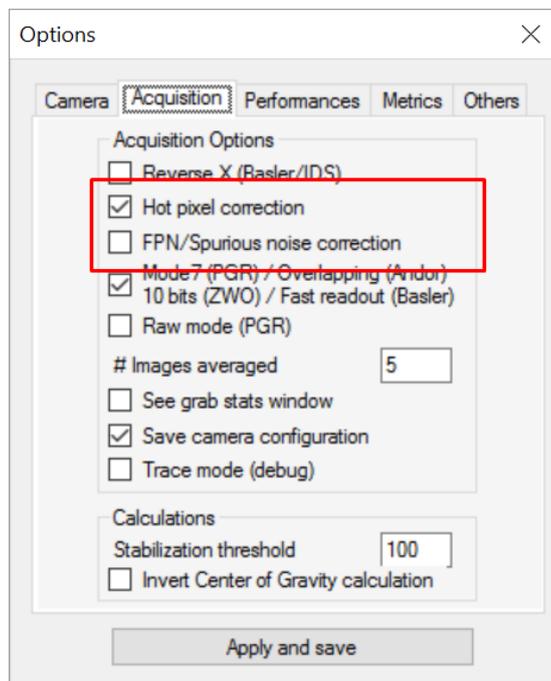
If you lose frames with USB3 interface, please refer to the USB3 chapter in performance section.

### Camera settings resiliency

Gigabit Ethernet camera setting are preserved even after power out. Genika automatically initializes with the current settings at connection.

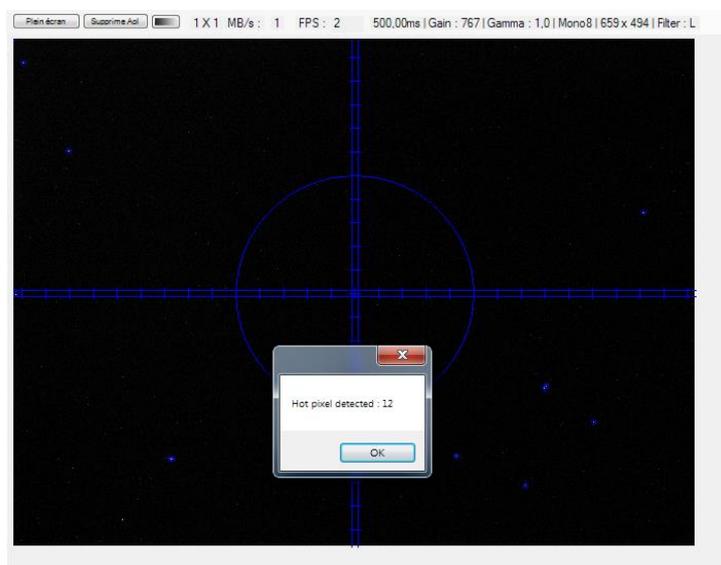
### Hot pixels and offset correction for CMOS IDS cameras

IDS cameras support sensor artifacts hardware correction. The settings are available from the option window. That includes hot pixels correction and fixed pattern correction depending on the camera model.



## Software Hot Pixels correction

Basler cameras have no hardware pixel correction system. Genika Astro embeds software correction on the fly. You have to launch a hotpixel discovery from the menu tools, then cover your camera sensor. Genika acquires an image with 500ms exposure and  $\frac{3}{4}$  gain and then reports the number and location of the hot pixels :

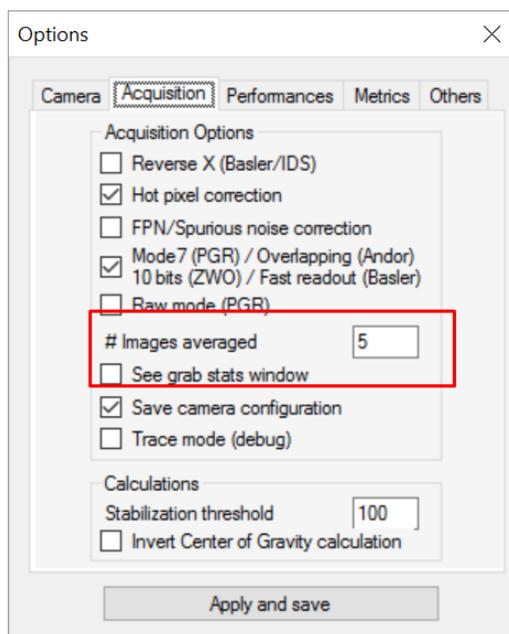


The map is stored in a txt file named after the camera serial number.

The correction is enforced when this file is present.

## Image average

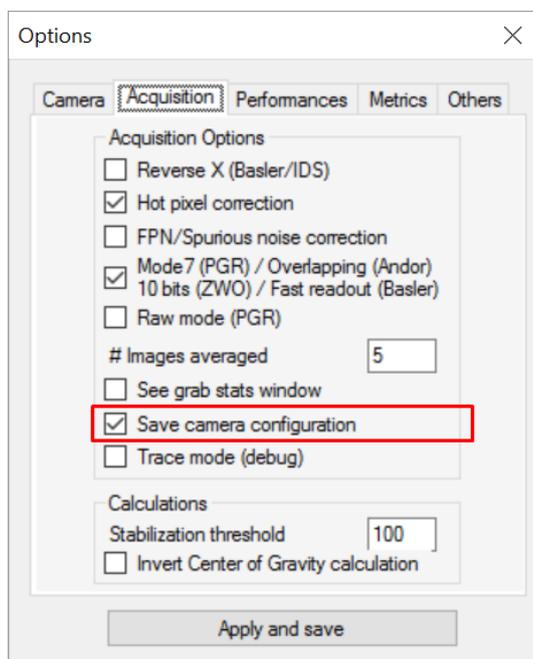
Genika can average images on-the-fly. The number of images to be averaged is specified from the option window. Note that this feature requires high CPU utilization and therefore should be avoided at high rates.



## Saving and loading camera configuration

It is possible to load and save camera configuration (Basler, IDS, AVT). When doing this you retrieve the exact configuration including area of interest and binning. The configuration can be saved automatically at the start of an acquisition or sequence. This option can be set from the option window.

Not that in sequence mode only the first occurrence for each line is saved.

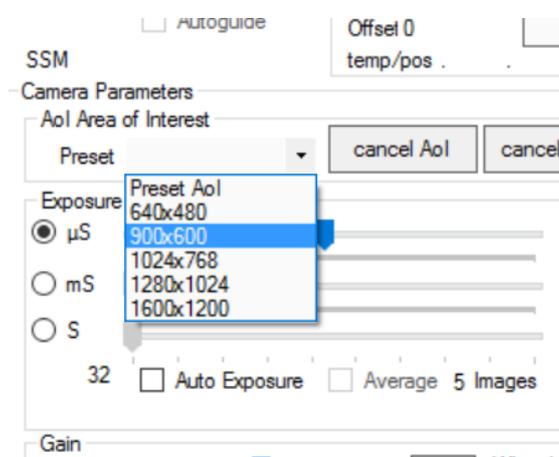


## Area of interest

It is possible with most camera to reduce the area of the sensor that is acquired. These saves disk space and increase the achievable frame rate. Usually the frame rate depends on the number of lines within the acquisition area. Note that The Imaging Source/Celestron cameras don't support hardware Aol.

You can specify the area to be captured by clicking on the image and drawing a rectangle. A window then appears to resume the area of interest sitting and get confirmation. The Area of interest is then enforced.

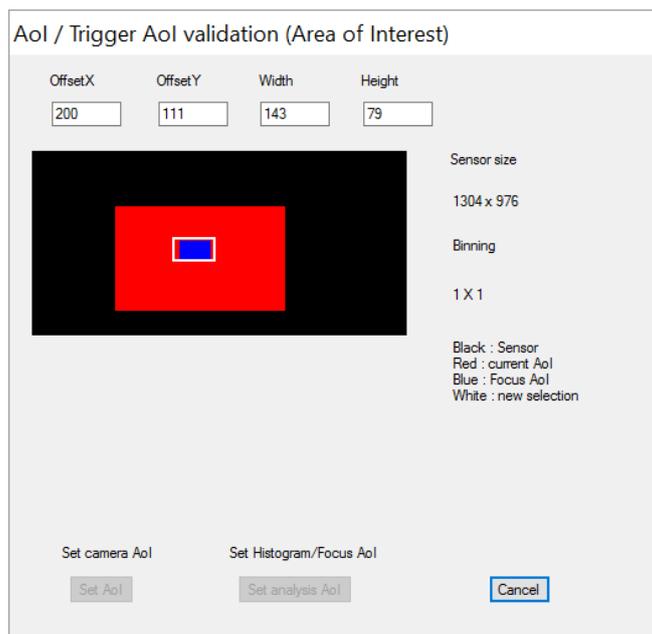
It is also possible to define quickly a centered Aol from the acquisition tab. The Aol list can be edited from the list editor.



It is not possible to define another area of interest while one is already active. You need to cancel the current sitting using the cancel Aol button.

Area of interest is difficult to produce using mouse selection. Also it is wise to save the camera configuration should you need the very same setting for example for flat or offset acquisition. That can be performed automatically from the option window.

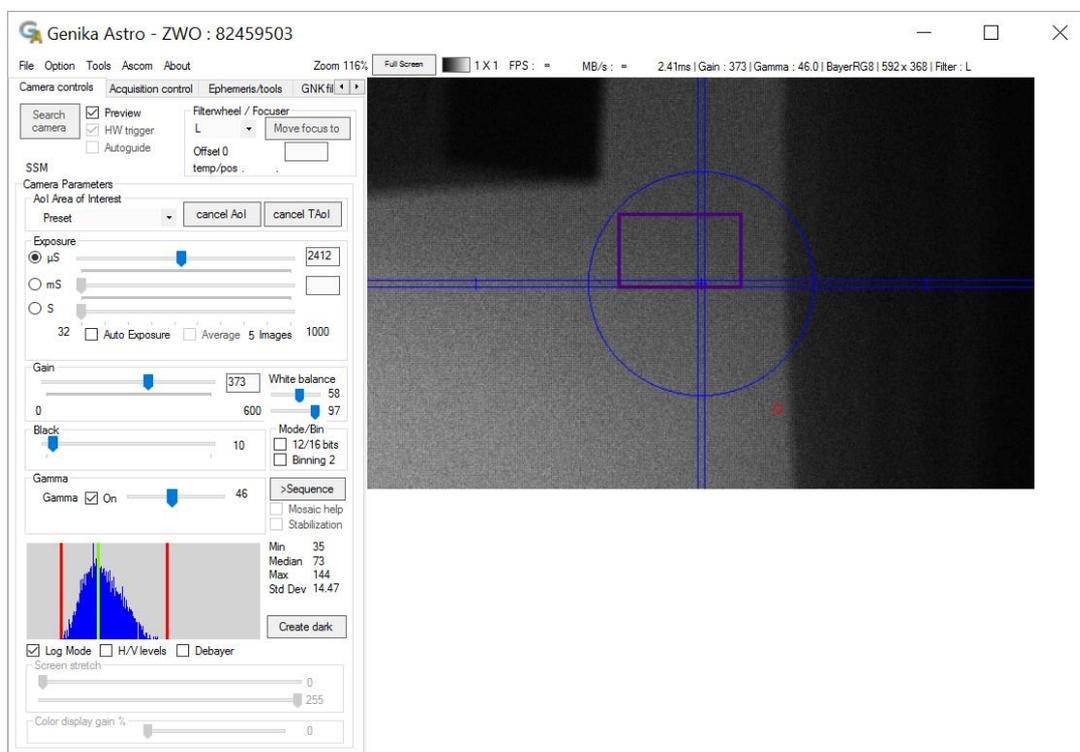
It is also possible to enter manually the Aol setting from the Aol confirmation window.



The focus Aol allows limiting the image area on which some calculations are performed, that includes:

- Focusing
- Noise analysis
- Histogram

When the reticle is shown (Ctrl + R), the calculation Aol is displayed as an indigo rectangle.

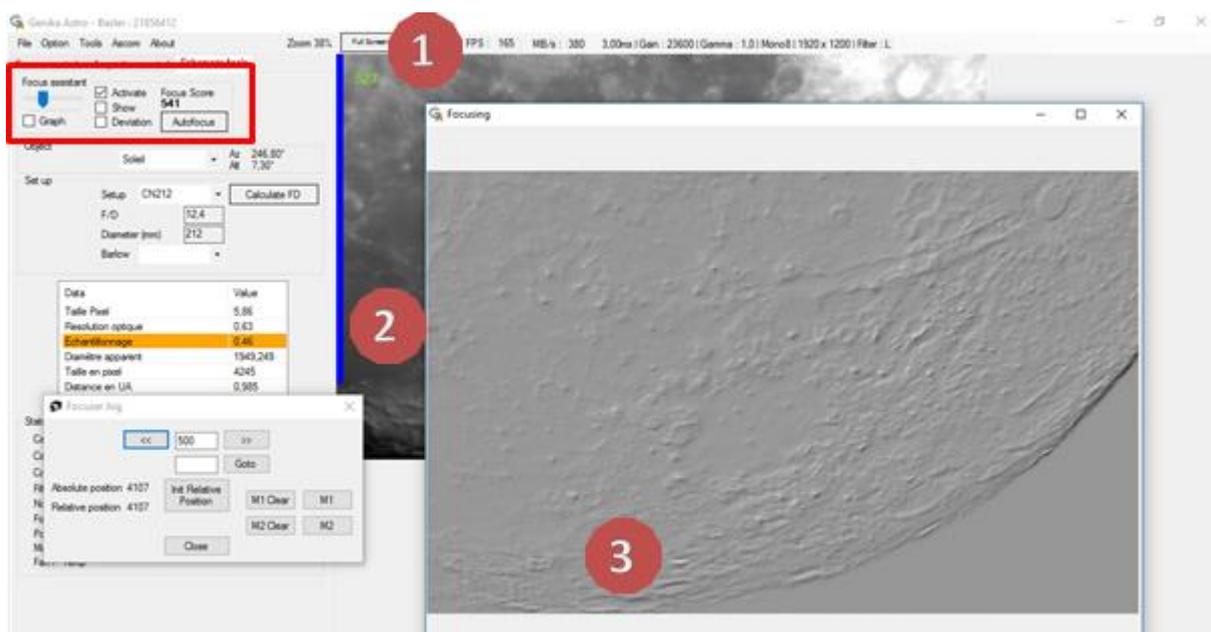


Aol and “focus” Aol can be cancelled from the buttons in the acquisition parameters tab.

## Focus assistant

Genika integrates an assistant to find the best focus by local contrast analysis and another advanced focus scoring based on slopes. The microcontrast algorithm is very efficient on large surfaces as the Moon or the Sun unlike the FWHM analysis that shows limited interest in planetary imaging. The slope score is very effective and more robust to turbulence. Assistance to the focalization is accessible from the camera control tab.

Note that the microcontrast focus assistant and noise analysis can be performed on a subregion of the image when activating the “focus” AoI. This is very useful if your hardware can not cope with a full image analysis. The slope score works on any type of image : 8 bits or more, BW and color.



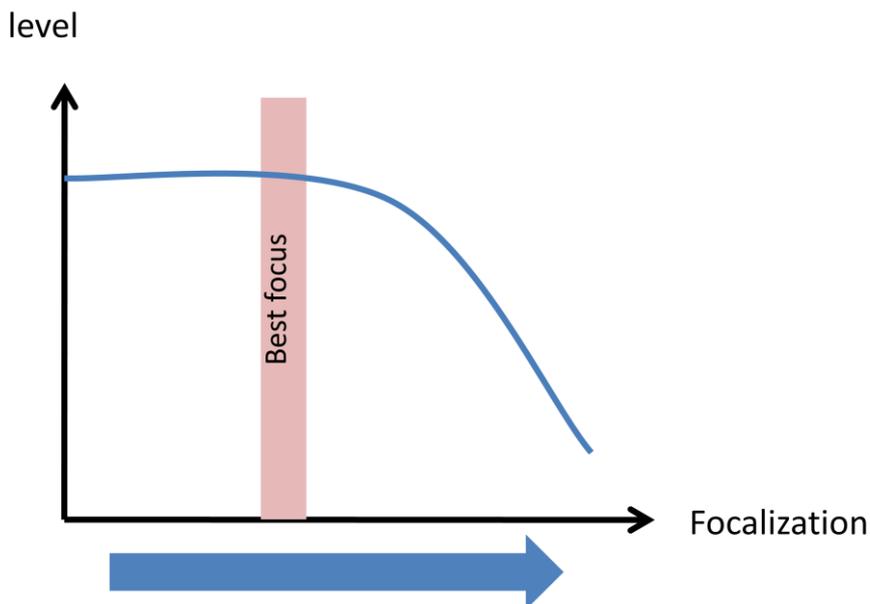
The trackbar defines the sensitivity of the analysis for microcontrast. A low value is suitable for clean and contrasted images, a higher value is recommended for high gain (noise). A bar appears on the left side of the image (2). The larger the bar is and the closer you are from the focus.

The slopes score is displayed both on the image and in the focus command area (1). A new window appears that shows the derivative image with the slopes (3).

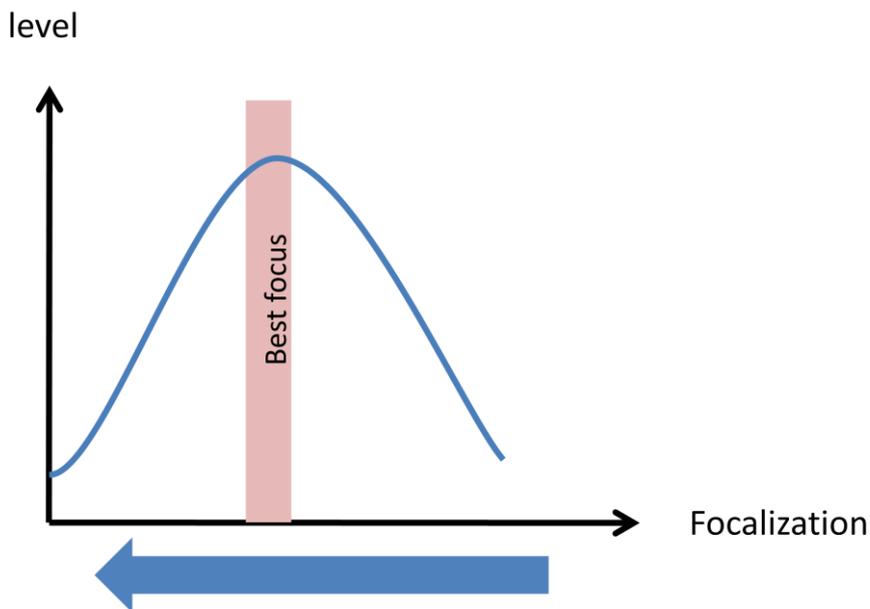
### Focusing procedure :

The method used for analysis is relative and you need to browse the focus range to determine the best focus. That is true for both microcontrasts and slopes scoring.

The first stage, after having opened the window, is to sweep the area your focuser. The bar keeps at the maximum up to the focus, and then decrease then when the point is exceeded:



You can then go back until the bar returns to the maximum level: you're in this position at the best focus. You can refine this position by moving back and forth around this position.



This method works in both directions (to extra intra focal or the reverse). If your exposure time is long, you must move slowly on the axis of focus: Genika averages 4 images to reduce erratic movements of the focusing bar.

To refine the measurement, you can chain several round trips. If you change of framing or if an object slides out of the scope of the camera, you must reset the microcontrast bar with the *Reset Focus* button. The procedure must then be repeated from the beginning.

## Notes regarding the focus assistant

### *Planetary imaging (Saturn, Jupiter, Mars...)*

Surface contrast is very low on those objects : focus must be calculated on the edge. Advised parameters are :

- Over expose the planet surface so that most of it is clipped
- Set sensitivity to 15

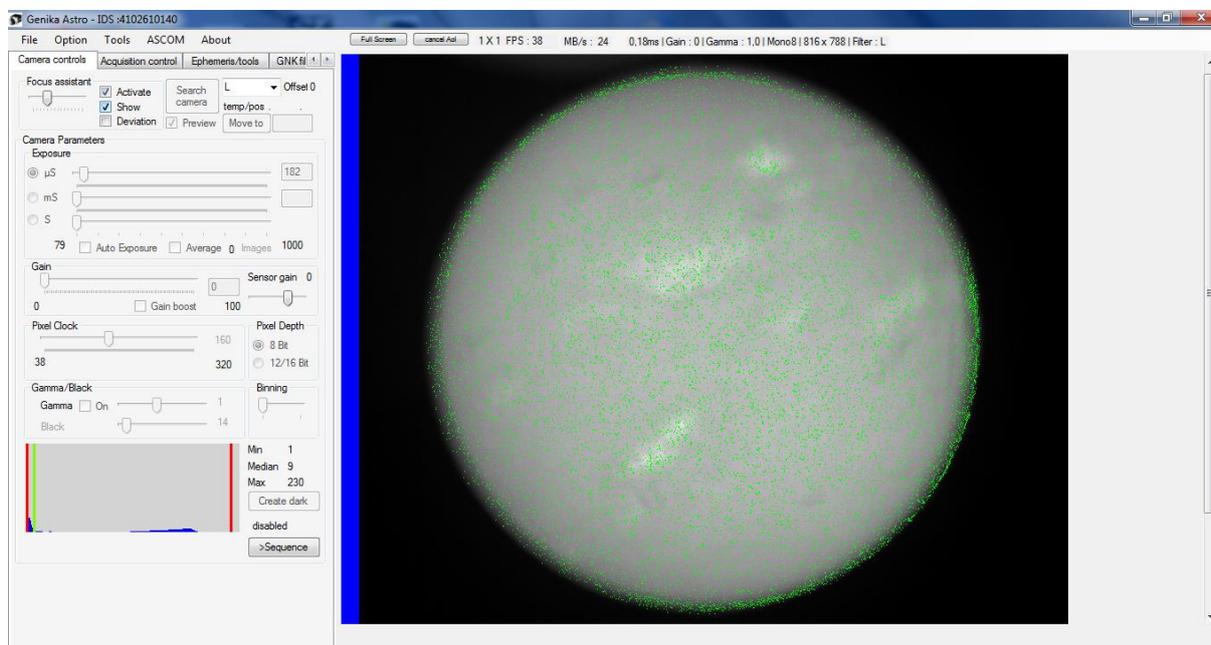
### *Lunar and solar imaging*

In those cases the surface details are contrasted enough for Genika to use a correctly exposed image and the default sensitivity.

### Using micro-contrasts visualization

The micro-contrast display mode allows to work visually only on the local contrast levels to converge intuitively the focus.

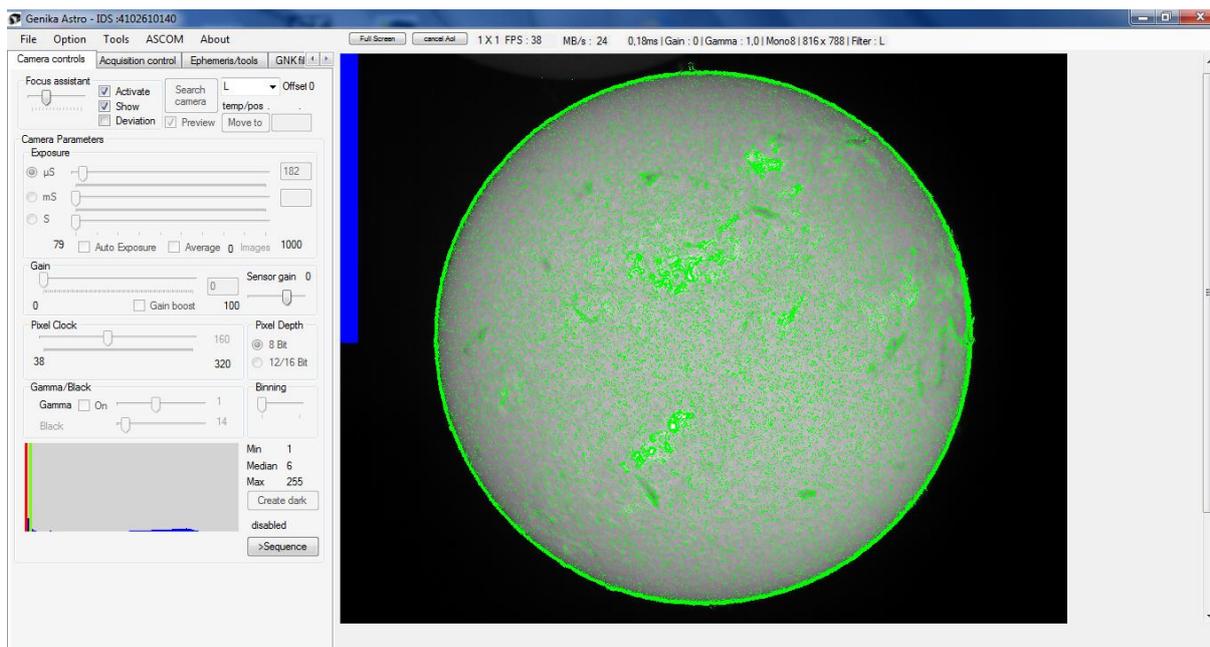
When this mode is activated, local contrasts are displayed as a green overlay on the image :



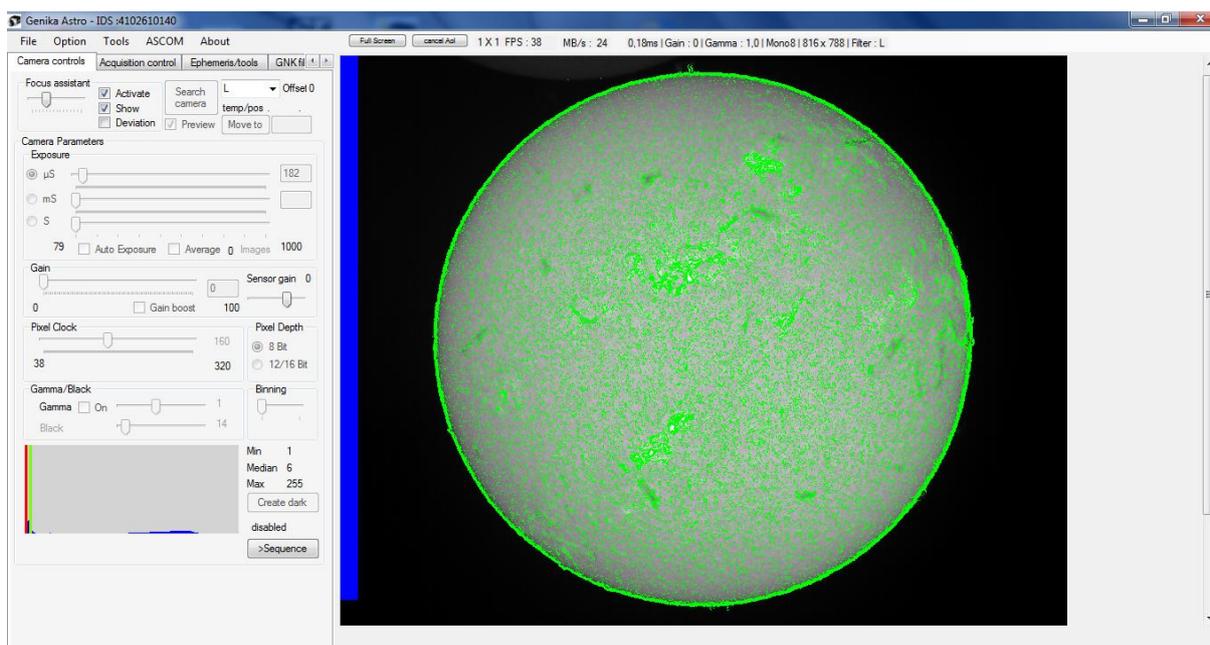
If the sensitivity is set too low the noise generated by the camera is taken into account. In that case set the gain to the minimal value that avoids this situation.

When closing on the correct focus the object edges appears :

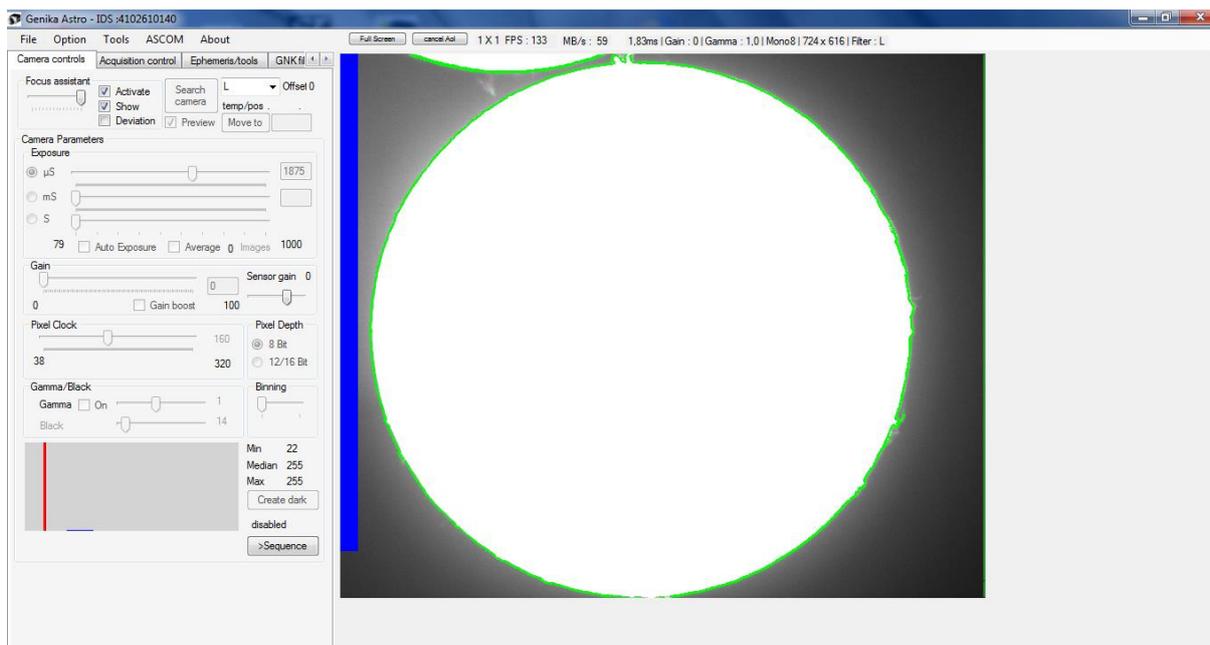
The bar value decreases once the correct position is passed on.



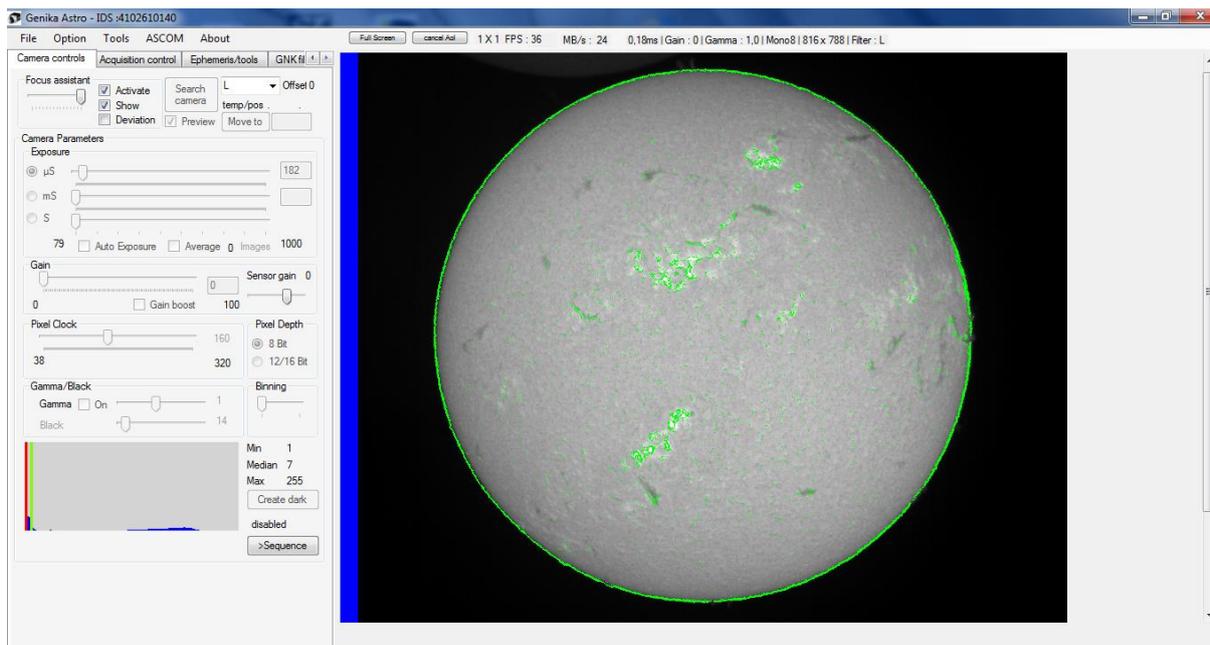
Until you reach focus and the bar is complete :



It is possible to increase the sensitivity to work only on the object boundaries:

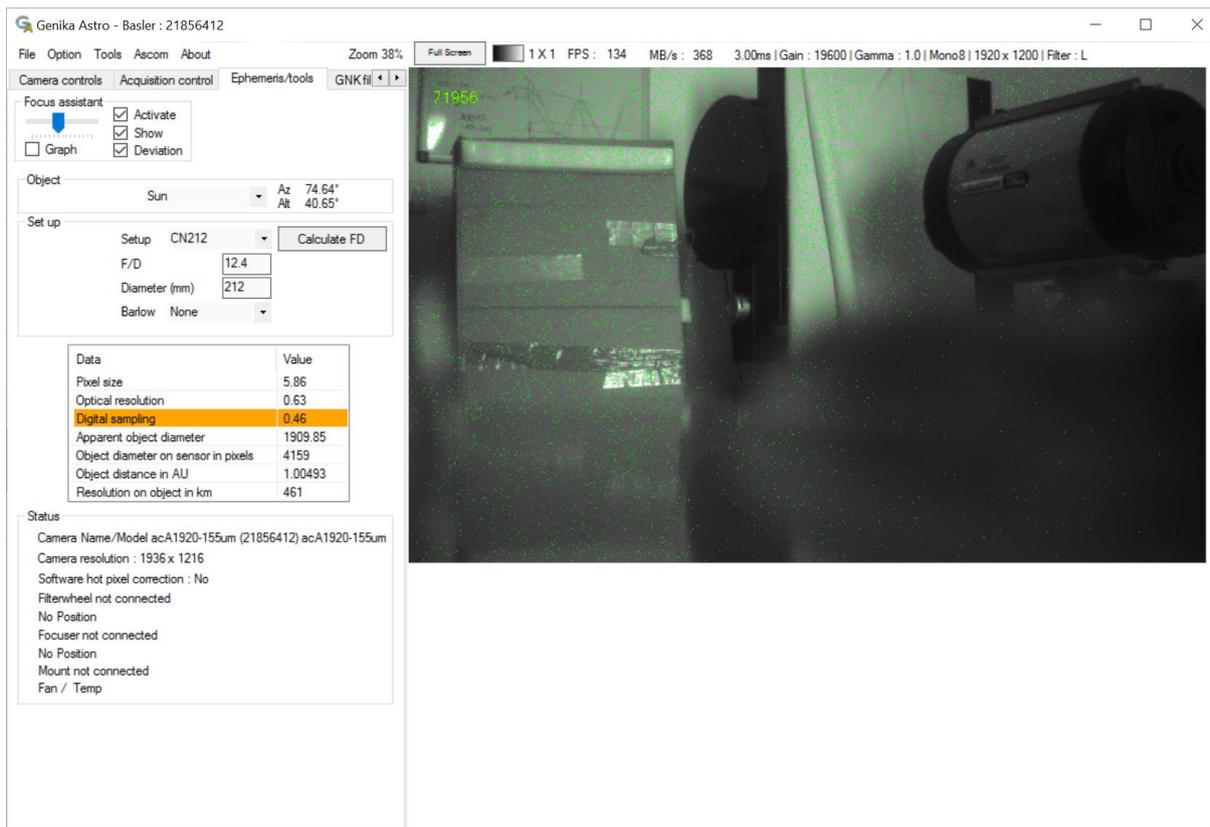


For low contrast objects or if the seeing is poor we advise to use the enlarged analysis mode. In the example (solar HA imaging) this mode makes possible to focus very precisely on the proms :



## Noise analysis

When checking the deviation checkbox the focus assistant switch to noise analysis mode. In that mode the green spots show pixels that changed more than the track bar value in ADU since the last image. The number of pixels that changed is displayed on the upper left part of the image.



This mode is very useful to check acquisition parameters impact on the noise level : gain, shutter mode, black level...

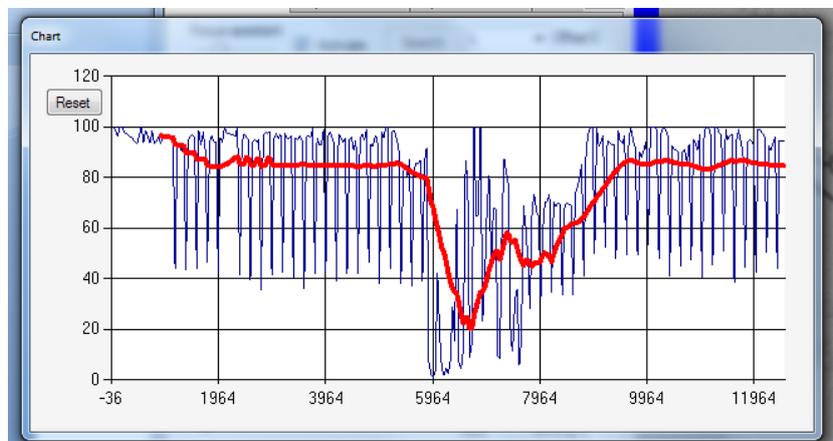
### Focus and noise chart window

It is possible to display a history chart for the focus and the noise analysis.

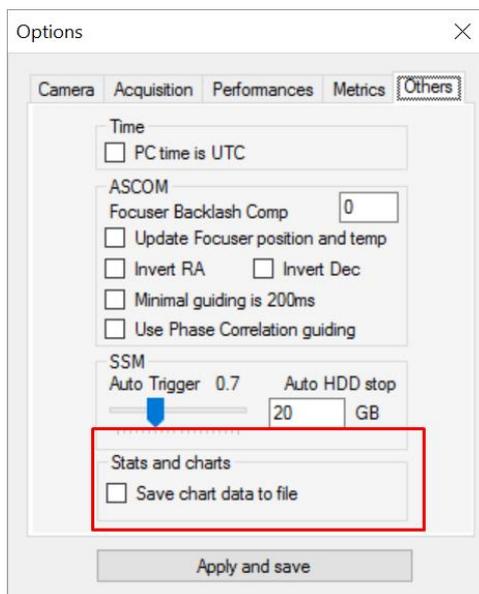
The graph activation button is in the focus assistant group.

The graph shows the focus level (100 is maximum) or the noise total entropy with the blue line.

The red line is the moving average of the last 20 images. The reset button clear the graph.



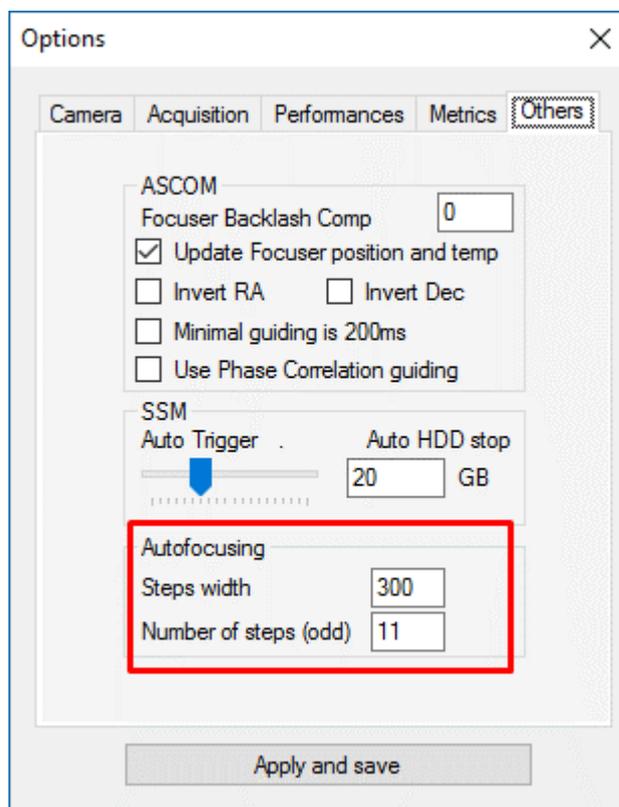
When selecting in the option window the *save chart data to file* option, a file with the entropy history over time is created for further analysis.



## Autofocus

Genika Astro has a unique autofocus feature that uses the image slopes scoring to control a focuser and achieve the best focus. The system moves the focuser on both sides around the focus position and find the best score.

Before using it, you can customize the number of steps (odd number) and the focusing steps size (in focuser steps).



It is better to choose a large focusing range from very blur on one side to very blur on the other side. It is not necessary to set many steps, values from 7 to 15 are usually enough. Focusing is performed quickly, but the final time depends also on your focuser speed and exposure time. At each step Genika averages ten images to increase the SNR.

### Autofocus procedure

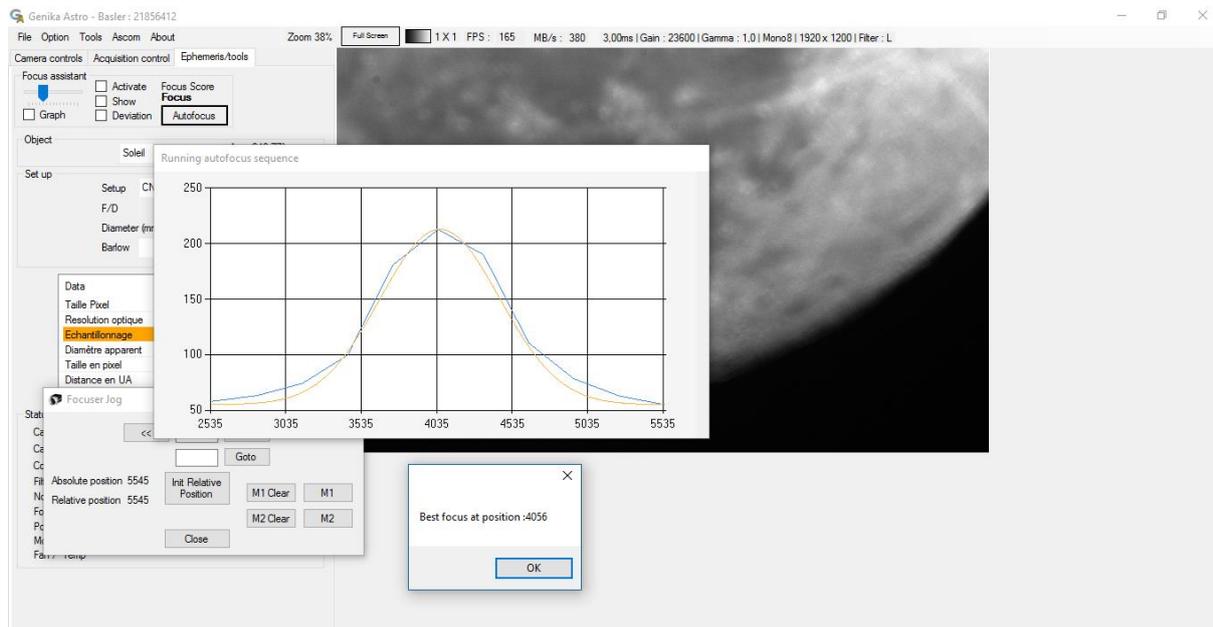
Once the number of steps and their size have been specified in the option window, and the ASCOM focuser is connected, you can roughly move the focuser to the focus position. Then you can click the autofocus button.

If nothing happens that means that either the focuser isn't connected or the maximum travel is above or below the possible focuser positions. In that case, you may change the number of steps, or for a SCT move to the focuser central position and roughly focus with the primary focus knob.

When the focus starts, a new window appears. It will show the focus score for each focuser position.

The focuser is moved to the starting position, that may take a while.

Then the curve is plotted for each position automatically. After the last step Genika calculate a Gaussian law fit on the curve to find the best focus. The fit is displayed on top of the measures.



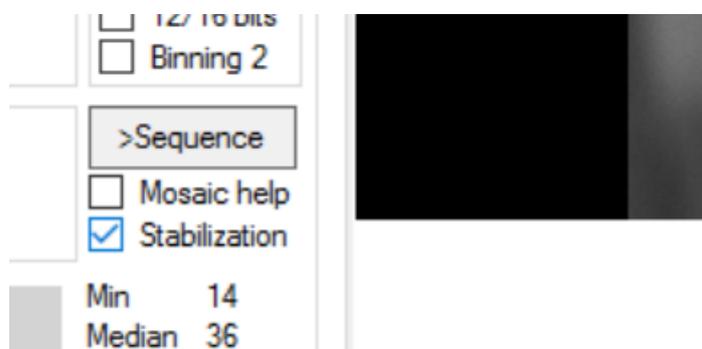
At the end a popup window give the best focus, and when you click *ok* the focuser is moved to this position.

### Autofocus advices

- Although you may start far from the focus position, the results are better if you are close to it.
- It is better to have a wide range. As the fit is a normal law, it will be more accurate if the first values are low as for the image above. If your instrument has a long F/D, you must move farer both side of the focus.
- It is not important that the best focus is between two measurement points, the Gaussian fit will handle this.
- Autofocusing convert all images to B/W before making any processing. It works with all camera modes.
- Use the focuser jog to move manually your focuser when needed, but not during the autofocus sequence.
- The focus assistant must be off during an autofocus sequence.

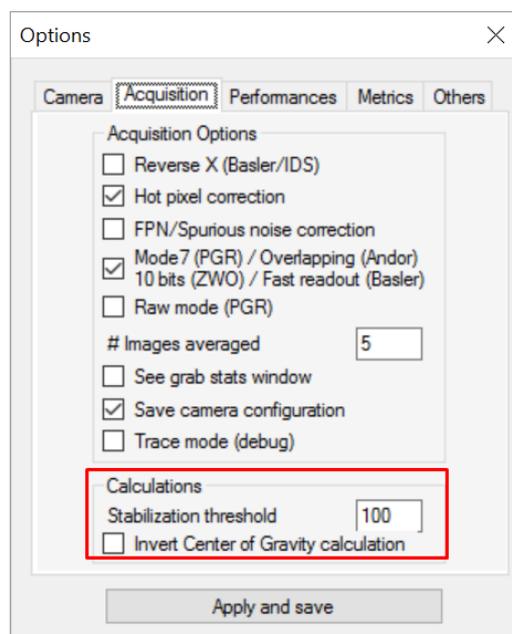
## Image stabilization

Genika can recenter on the fly the image by Center of Gravity calculation. You can press the Stabilization box anytime in 8 bits mode.



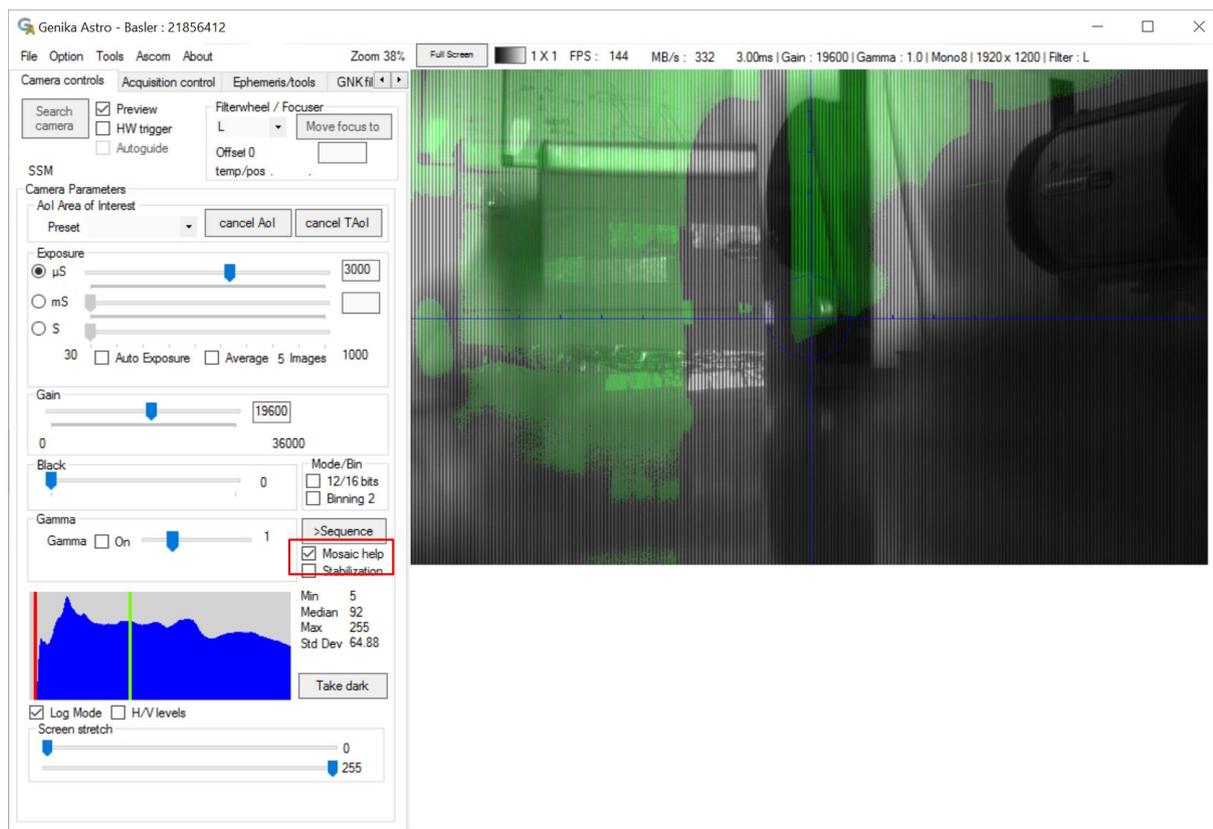
The image is recentered for the display and acquisition to disk.

By default, the barycenter is calculated on the bright part of the image (a planet for example). Pixels considered are those that present a value above the image's minimum value plus a threshold. This threshold can be modified from the option window. It is also possible to make the calculation on an inverted image, for example to guide on a solar dark spot.



## Mosaic helper

The mosaic helper provides you with a help for mosaic overlapping. When pressing the box, a green image overlays the actual camera image. The overlay is resetted each time you activate the function.



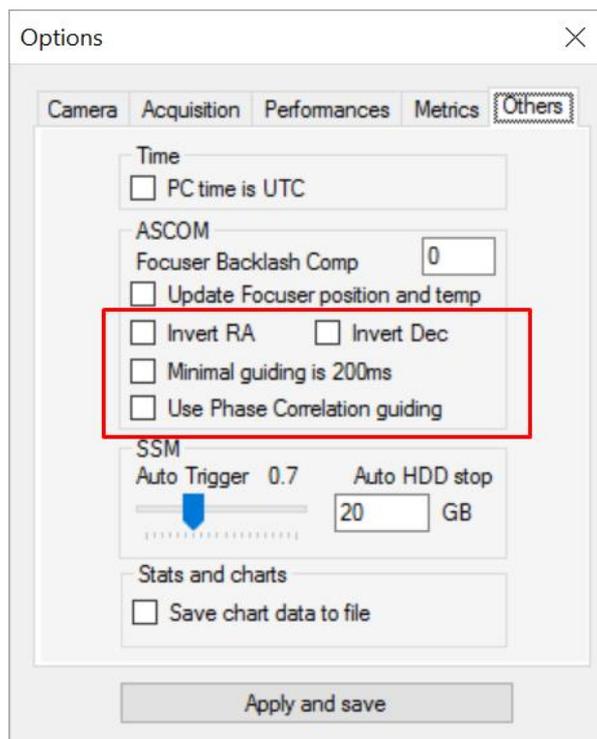
## Autoguiding

Genika Astro can autoguide **by Center of Gravity (CoG) or phase correlation** when an ASCOM mount is connected. The mount must support the pulseguide orders, and the correction rate is set to x1 sidereal speed. You may connect the mount through the ASCOM menu.

Note that the digital sampling must be accurate. Use the option window field to specify the actual diameter and the F/D. In case of doubt, you can use the auto F/D detection from the ephemeris tab and check the actual digital sampling value.

Genika doesn't provide any axis calibration tool, therefore the width of the camera must be the RA axis, and the height the Dec axis. Turn the camera accordingly to match this requirement.

You may reverse the axis direction and select the guiding mode from the option window:



You may then engage autoguiding with the checkbox.

- Guiding is performed every 5 seconds
- Guiding correction are 1s max on each axis
- Guiding won't occur if the correction is less than 200ms at sidereal speed unless the checkbox is unchecked.
- Guiding order in RA and Dec are sent in sequence for mounts that do not support both axis correction
- Guiding speed is forced at x1 the sidereal rate
- In x64 bits mode, use the POTH to manage 32 bits ASCOM drivers

### Guiding with center of gravity

This mode is suitable to planets and objects that are completely inscribed in the camera FoV, or to guiding on a bright or dark feature. The first CoG position is the reference position: guiding orders will try to move back the CoG to this position that is displayed as a small green circle on the reticle. The cyan circle shows the actual CoG. By default the Center of Gravity is calculated on the bright part of the image, this is the standard mode for guiding on a planet. It is possible to invert (guide on the dark part of the image) in the option Window to guide on a Sun's spot for example.

It is also possible to limit the area considered for the center of gravity calculation by defining a TAol (analysis area of interest). To do so draw a rectangle on the zone of the image that you want to use by holding the left button over the preview image. Then in the Aol click on *set Analysis AOI*.

When using the CoG guiding mode, a window appears that shows the part of the image considered for guiding after the different inversion and thresholding have taken place. Use this window to adjust the threshold and the decide for an image inversion.

### Guiding with Phase Correlation

This mode would correct slow drift over a long period of time for surface of the Sun and the Moon. A 512\*512 pixels area with sufficient visible details (ex : solar spot or active zone, moon craters) is defined using the right click mark on the image. The mark should be at least 256 pixels away from the image boundaries. A reference image is taken and all subsequent images would be compared to this one to analyze the X/Y drift. A window appears to show the reference image and the actual.

Depending on the object selected the reference image may change or not:

- For any object BUT the sun, the reference image is taken at the beginning of guiding once for all.
- For the Sun, the reference image is updated every few minutes to adapt to the slow features modification of the photosphere and chromosphere.

If you choose a moving reference (ex: sun's prominence), the guiding would follow it.

### Optical alignment assistant and PSF analysis

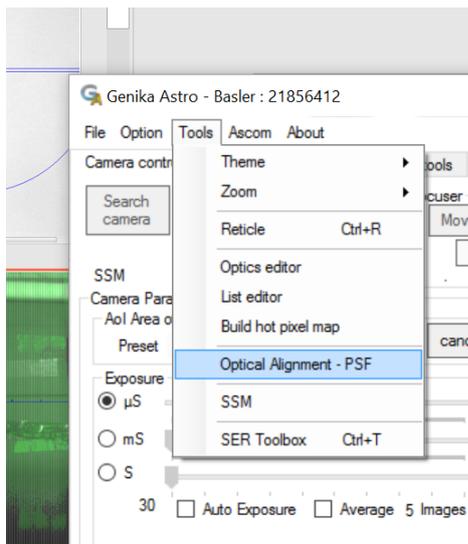
Genika Astro has an optical alignment ("collimation") tool to help you with the fine alignment of your telescope for high resolution imaging. It brings also PSF (airy disk) analysis and transformation tools.

Your telescope should always be aligned with a high magnification star image near the target you plan to image. A proper F/D ratio is between 20 and 40. Unfortunately seeing condition often prevents you to get a clear PSF (Airy disk) image. Genika assistant aligns and stacks on the fly star images to average the seeing and get a clear PSF image that will help you to get the best alignment based upon the first and second diffraction disk image.

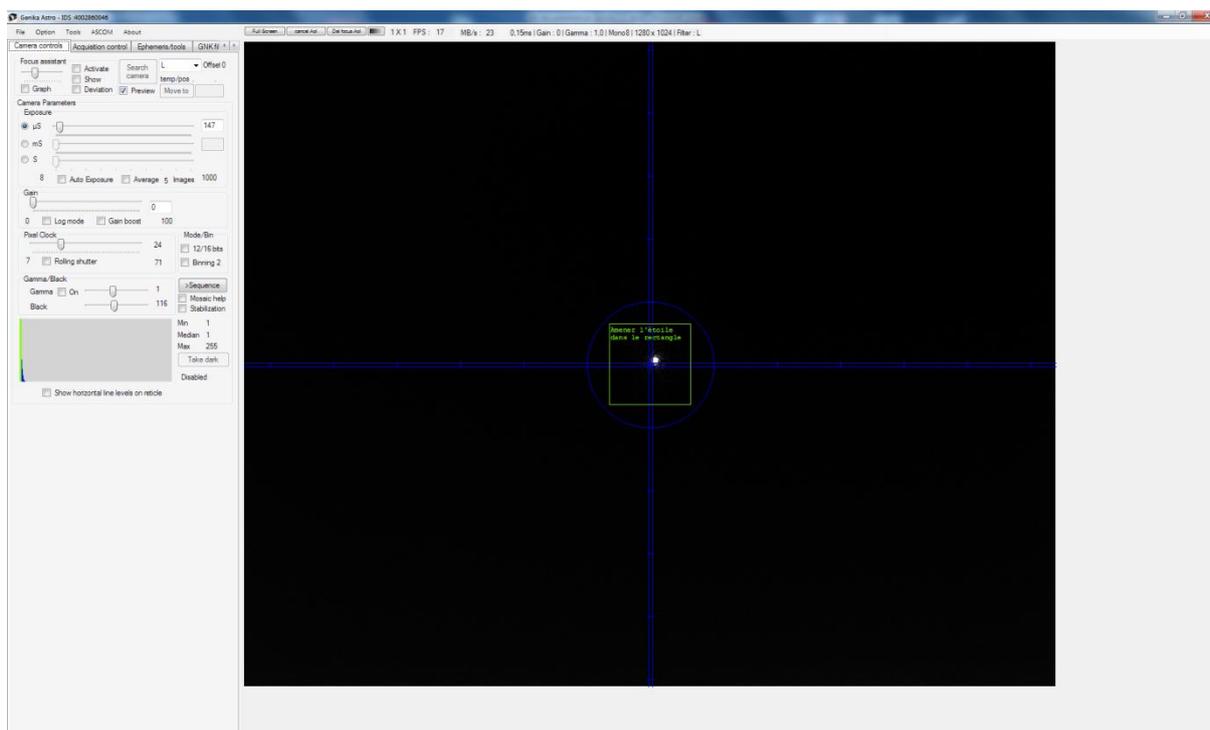
#### Alignment procedure

Before starting you should have already made a gross alignment using the secondary mirror image with a defocus star image. Then you can focus and center the star on sensor and use a proper amplifier (Barlow) to reach a high F/D.

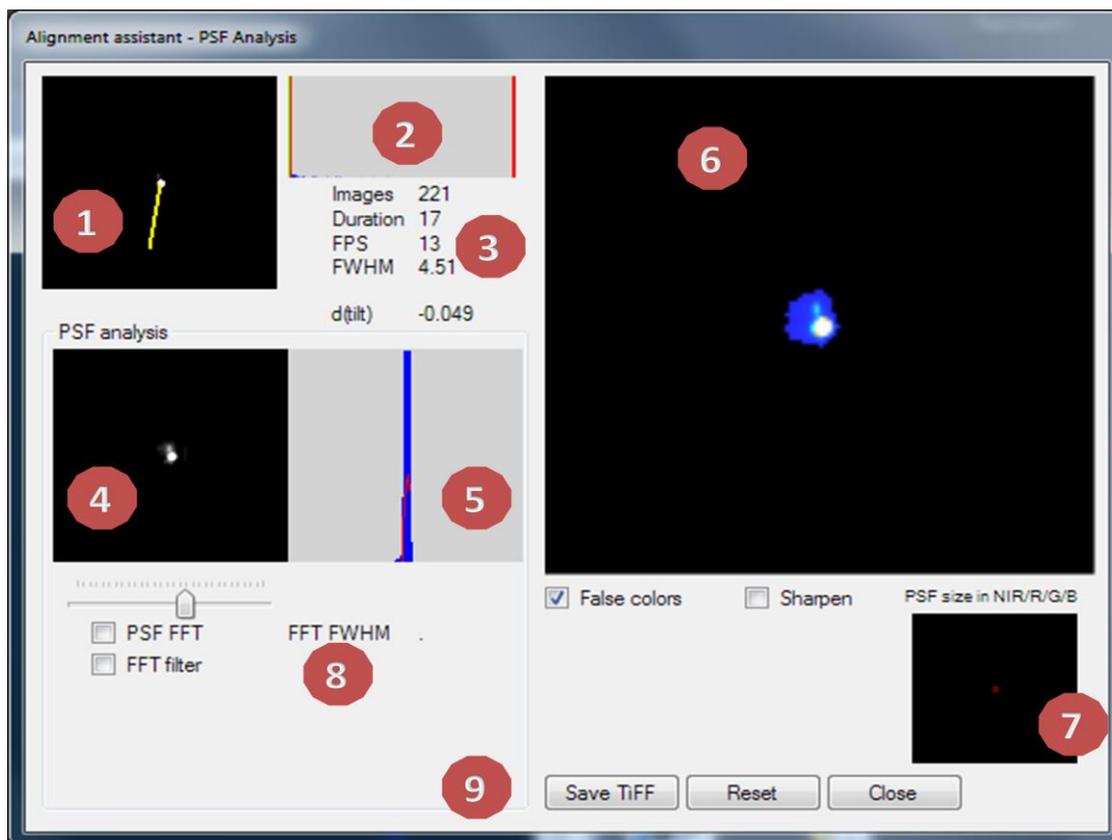
- **1 – Center the focused star on the sensor.** You can use this procedure with an Aol already defined. Nevertheless take care to have the CCD sensor center matching roughly with the Aol center. Genika indicates the CCD center with a small circle on the reticle display when an Aol is defined. With a monochrome camera we advise to use a red or NIR filter to limit seeing impact.
- **2 – Activate the assistant from the menu *tools/optical alignment assistant* :**



- The reticle is displayed with an additional green box in the center of the image. This 128\*128 pixels zone is the area that will be stabilized (by center of gravity) and stacked for analysis. The analysis speed is the same as for the display. Acquisition speed isn't utterly important; the critical metrics are the time to get a convergence on the image and the exposure time. Don't hesitate to use high gain to limit the exposure time below a few milliseconds. Note that the star must be completely included in the green frame!



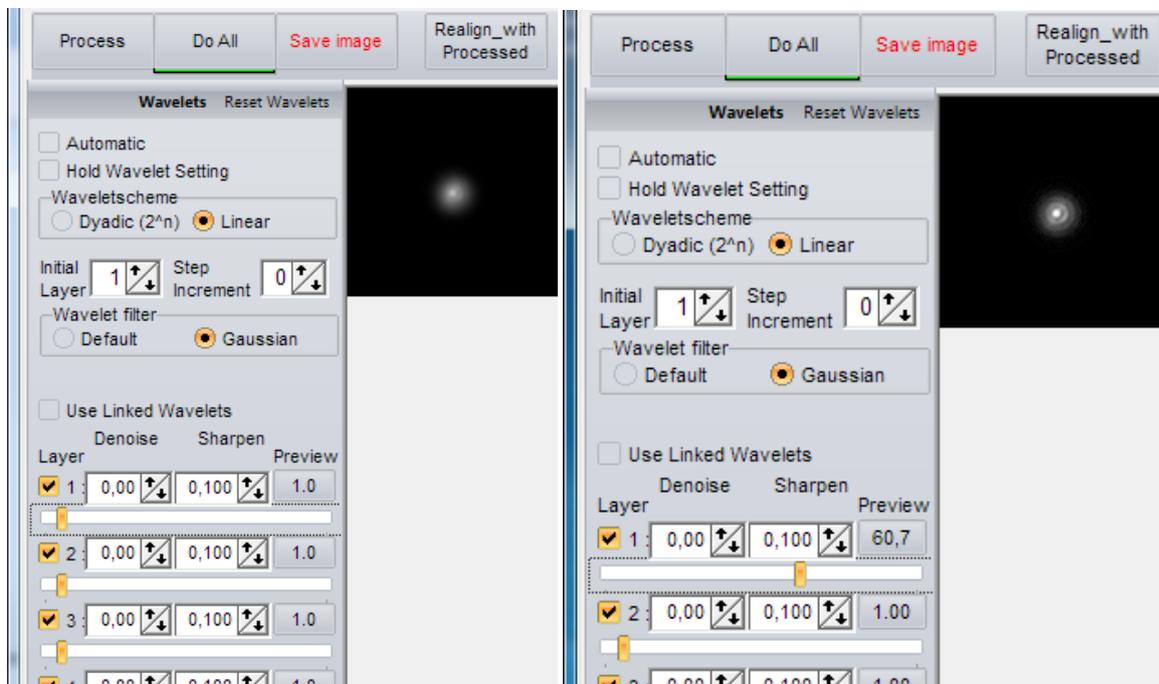
- The alignment window is displayed at the same time :



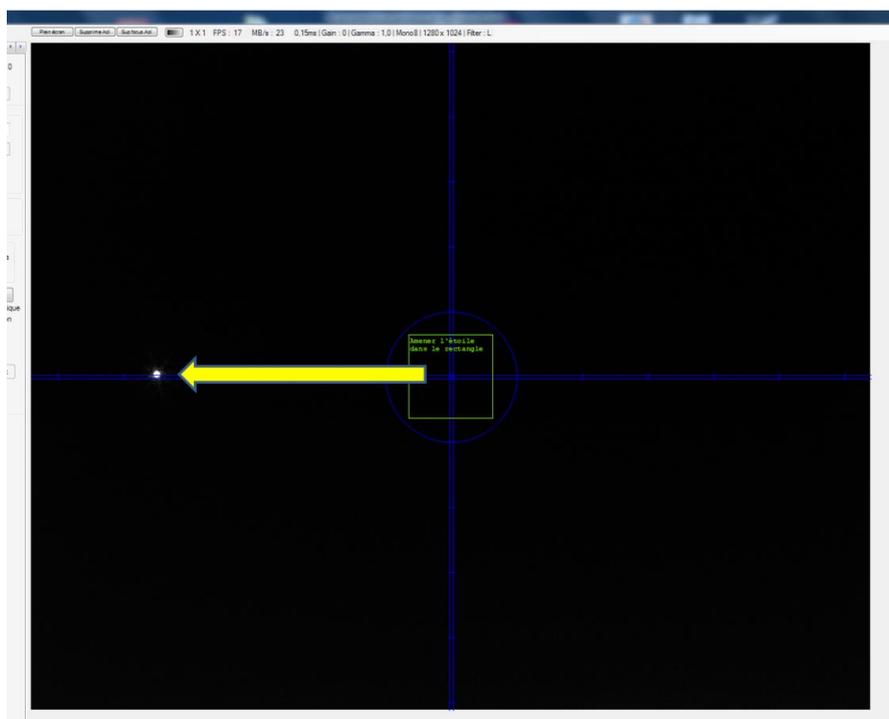
This window provides you with the following information:

1. Actual star aspect in the left area. The star is automatically centered. The red bar indicates you the actual correction made to center the star. Variations of the center position are due to both seeing tilt (40% of the atmospheric turbulence is tilt) and mount tracking errors.
2. PSF histogram. For better results try to not saturate the image.
3. Total stacked image number, throughput and duration. Usually the stacked image converges about 10s after the beginning. The throughput of this window is the display refresh rate in the main option menu. The FWHM is calculated in ArcSec based upon ephemeris data (F/D and diameter) with a gaussian fit. The fit quality may be adjusted from the trackbar in area 8. Refine this value with the automatic F/D calculation if your are unsure of the actual FL of your configuration.
4. This image shows the PSF in log mode to check for low light diffraction patterns.
5. This area gives a longitudinal level of the PSF or the FFT. In PSF mode, the Gaussian FWHM fit is displayed in red.
6. The stacked image. This image is updated every 10 images stacked. You can display with the false color (spectrum ramp) to see easily the diffraction rings and apply a sharpen filter. The image is about three times larger than the real one.
7. A graphic gives you the real diffraction image size (center peak, right image scale) according to the data you entered in the option window about your instrument (F/D and aperture), the amplifier selected in the ephemeris tab (barlow) and the sensor pixel size. The size is given for blue, green, red and NIR at 450, 550, 650 and 850nm.
8. The seeing index reflect the spread of the entropy analysis of the PSF. It represent both the seeing variation, and the focus quality. It can be used for fine focusing on a star.

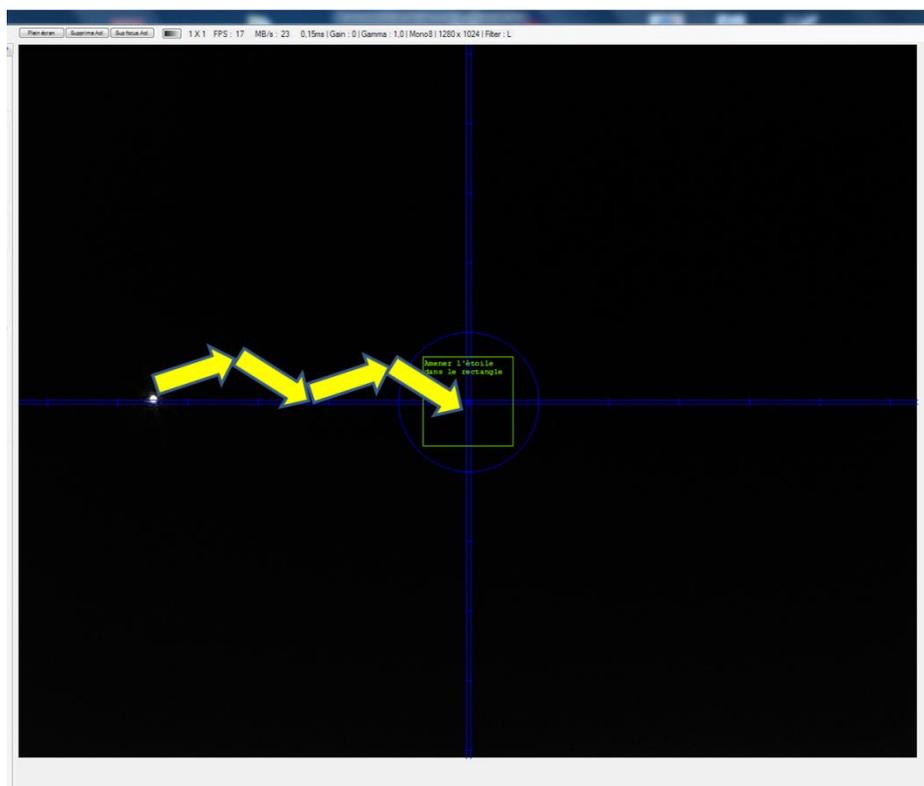
9. You can save the stacked image as it is at the present time by hitting the save button. The format is 16 bits TIFF. The image is saved in the application current acquisition directory and it is time stamped. You can use this image for further accentuation using for example Registax wavelets as in this real example on Vega with a 212mm telescope at F/D 25.



- **3** : Move the star in the required correction direction using your mount handbox. Should it be the opposite direction you would see it pretty fast !



- **4** : Bring back the star in the green box using your telescope optical adjustment knobs. Secondary mirror alignment in the case of a cassegrain, SCT or maksutov, primary for a newton telescope. If it's difficult to be precise enough you can finish using the handbox.



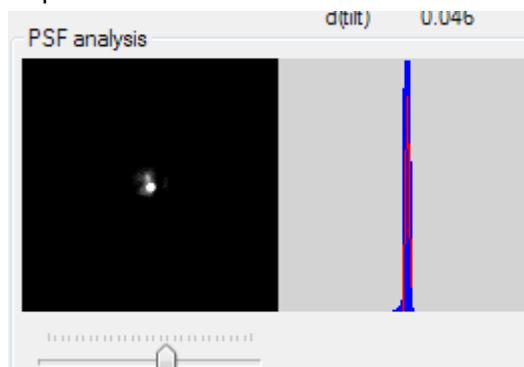
- **5** : Click reset on the alignment assistant. After a few seconds you can see if the correction was in the right direction and enough. If not repeat the steps 3 to 5.

Note that the alignment assistant may also be use for double stars reduction.

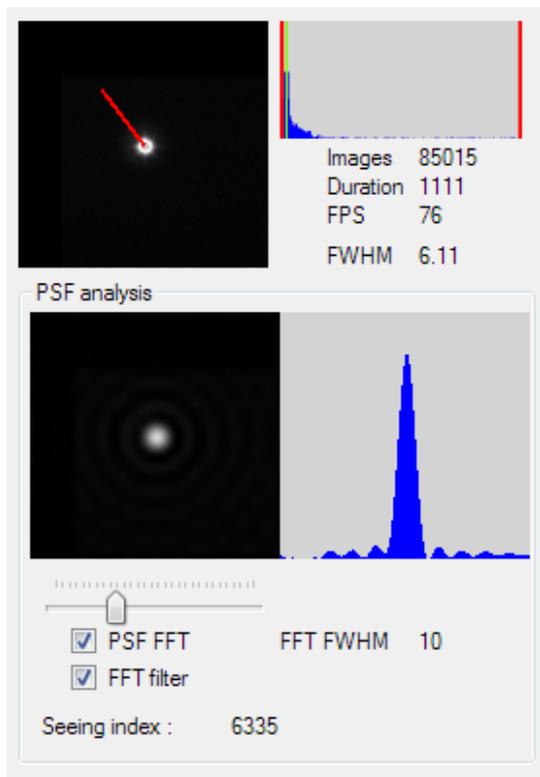
### PSF analysis tools

This window also provide several PSF analysis tools :

- A Gaussian fit of the PSF to calculate the FWHM. The trackbar adjust the fit that is displayed as a red curve over the PSF profile :



- You can have a Fourier frequency space image of the PSF. You can also filter high frequencies of this FFT with the trackbar and transform back in the intensity space. Filtering high frequencies remove image speckles due to the turbulence and allow finding back the PSF more easily. Take care that filtering too low frequencies removes also the PSF itself!



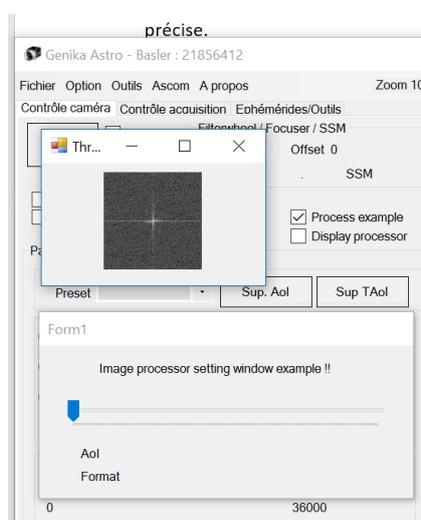
## External DLL call

It is possible from Genika to call two external DLLs for customized image processing.

Two calls are possible :

- One that handles all images from the main thread. The DLL is ImageProcessor.dll (or ImageProcessorx86 for the 32 bits version). All the image acquired by the camera pass through this call if it is activated.
- One that process only images to be displayed by Genika without changing the images that would be save to disk. This is call from the display thread of Genika. It is DisplayProcessor.dll.

The calls are activated when the corresponding check box are checked :



It is possible to change the checkbox names from the DLL.

Two DLL templates are included in the Genika's folder as ZIPed VS2015 project. You need Visual Studio 2015 standard or community edition to open those projects. Note that VS2015 community edition is free to use for personal use.

The examples are doing basic processing. The ImageProcessor in 64bits mode includes in addition a threaded processing example using OpenCV wrapper EMGU. This example extract the central 128\*128 part of a Mono8 image, and calculate the direct FFT and display the real part in a picture box. Note that EMGU DLL are already inside Genika's distribution, and they are different in their x86 or x64 versions.

From those DLL you may call any kind of external DLL including C++, C#, Java (not very good regarding performances), managed or unmanaged... When calling from unmanaged DLL you'll have to use the *unsafe* calls of .NET and manage the interop regarding types and structs. You may use the dll import features of .Net, and any Pinvoke and marshall features.

Genika provides two things :

- The *ImageCam* object that embeds the current image. The image is passed as a reference and can be modified and returned to Genika. It also provides the image type in a separate public variable.
- It also includes callback methods that are called by Genika when the payload size has changed for example.

Regarding heavy processing, we recommend that you do this in a separate thread not avoid blocking Genika, especially for the imageprocessor DLL. The example includes a threading application.

Those DLL are NOT static, and they are instantiated by Genika. That means you can develop a complete application with its methods, variables and windows and not just a library.

NOTE : you returned image MUST have the same payload size and encoding. If you get a 1024\*768 Mono8 image, you must return the same format. But you can make anything you want with a deepcopy inside your DLL, for example stacks Mono8 images in Mono16 or 32 bits images and process them as you wish. For example in x64 mode extract a subpart of the image and performs a FFTD transforms in a complex object.

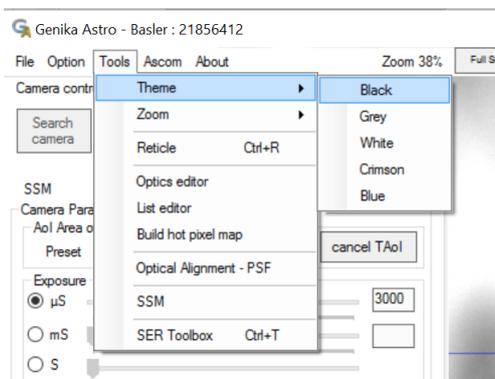
If you wish to make your work available to other Genika users, please contact us we will add them to a repository.

Note that you are not to publish the source code if you want to make only the executable DLL public.

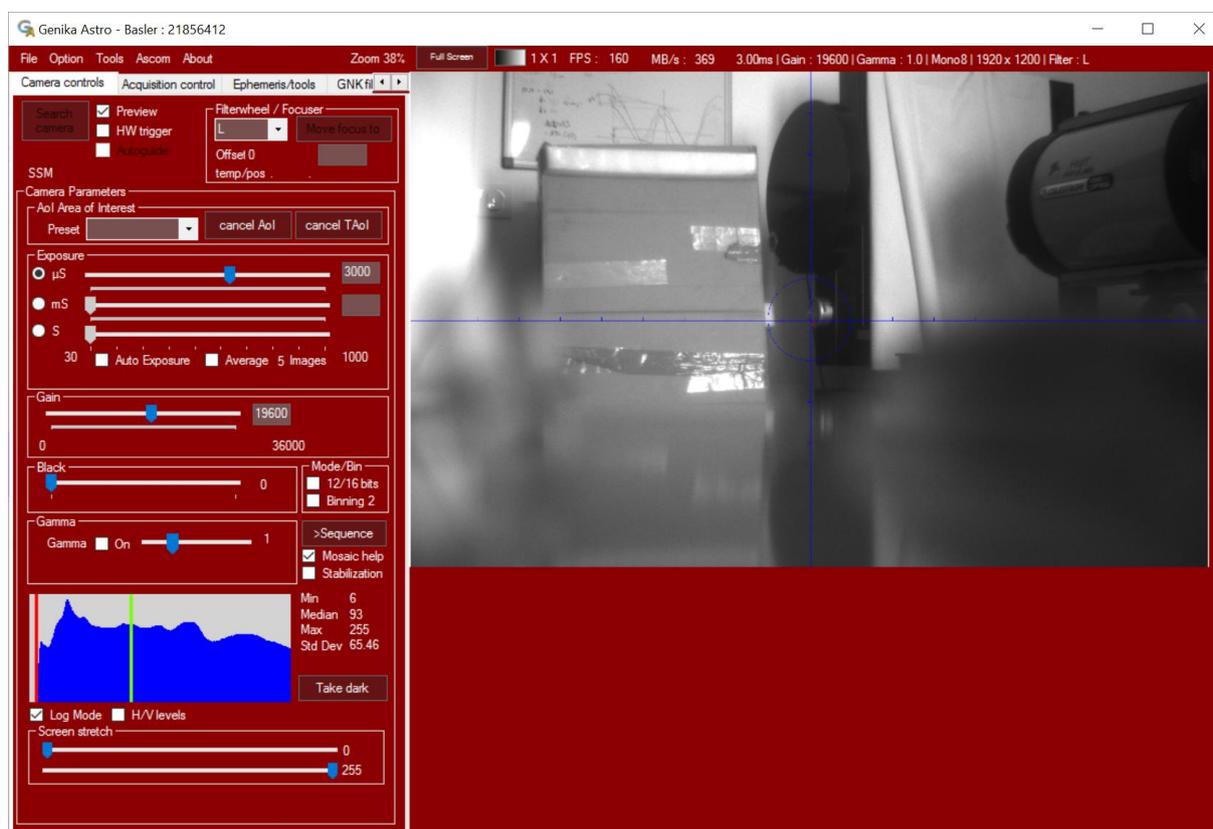
Please refer to the commented Visual Studio dll examples for more details.

## Themes

Genika comes with several color themes that can be changed on the fly :



Themes are only for the main window.



*Genika crimson theme for night vision*

## Ephemeris and sampling

Genika embeds a real time calculation of distance between the Earth and the different planets, the Moon or the Sun. By specifying the parameters of your setup, it can calculate for you the optical resolution, spatial sampling and other information to verify the relevance of your configuration for the object you want to image. Genika also gives you the actual elevation and azimuth of the selected

object given that the latitude and longitude in the option window and system clock are correct. Those data are updated every 10 seconds.

It is also possible to define several instruments, and optical amplifiers. You can quickly select your current configuration.

The Ephemerides are accessible from the *ephemeris/tools* tab.

Genika Astro - Basler : 21856412

File Option Tools Ascom About Zoom 38%

Camera controls Acquisition control Ephemeris/tools GNK f1

Focus assistant

Activate

Show

Graph  Deviation

Object

Sun Az 73.79°  
Alt 43.95°

Set up

Setup HaT 203mm Calculate FD

F/D 27.5

Diameter (mm) 203

Barlow None

Data	Value
Pixel size	5.86
Optical resolution	0.66
Digital sampling	0.22
Apparent object diameter	1909.85
Object diameter on sensor in pixels	8832
Object distance in AU	1.00493
Resolution on object in km	481

Status

Camera Name/Model acA1920-155um (21856412) acA1920-155um  
 Camera resolution : 1936 x 1216  
 Software hot pixel correction : No  
 Filterwheel not connected  
 No Position  
 Focuser not connected  
 No Position  
 Mount not connected  
 Fan / Temp

## Configuration

To get accurate values for the digital sampling you need to select the characteristics of your setup from the setup combo box :

Sun Az 73.64°  
Alt 44.47°

Setup HaT 203mm Calculate FD

CN212  
 HaT 203mm  
 FS60  
 FSQ106  
 Skyvision MT250

Data	Value
Pixel size	5.86

Optical setups are edited by the list editor.

The telescope name and observer name are saved in the text log file as well as in the SER file header.  
Note that digital sampling is required for autoguiding.

To get an accurate digital sampling you need also to specify if you use a barlow lens or a focal reducer. By default Genika provides a generic list of such equipment. You can modify this list to match your own equipment by editing the text file named barlow.txt in the application folder or with the list editor.

You should respect the format which is *Barlow Name ; amplification factor (digital separator : .)*. The changes will apply at the next session. You can select up to 100 different equipments.

*None;1*

*Reducer 0.63 ; 0.63*

*Barlow x2; 2*

*Barlow x2.5 ; 2.5*

*Barlow x3 ; 3*

*Barlow x5 ; 5*

### Provided data

Genika ephemeris lists you the following data:

- Angular resolution : the optical resolution of your telescope : that is optical diffraction resolution without taking into account the optic's default nor the seeing
- Pixels size: Your camera's pixel size and Binning
- Sampling: it is the solid angle covered by each photosite camera
- Apparent diameter of the object: apparent size in arcsecond
- Diameter of the object in pixel: this value allows you to check if the object fits on your sensor, if it is preferable to use a Barlow or to make a mosaic.
- Distance: distance of the object in Earth radii or astronomical unit
- Distance resolution over target body: it is the projection of the optical resolution on the object.

Data are saved between two sessions and present in the log TXT file.

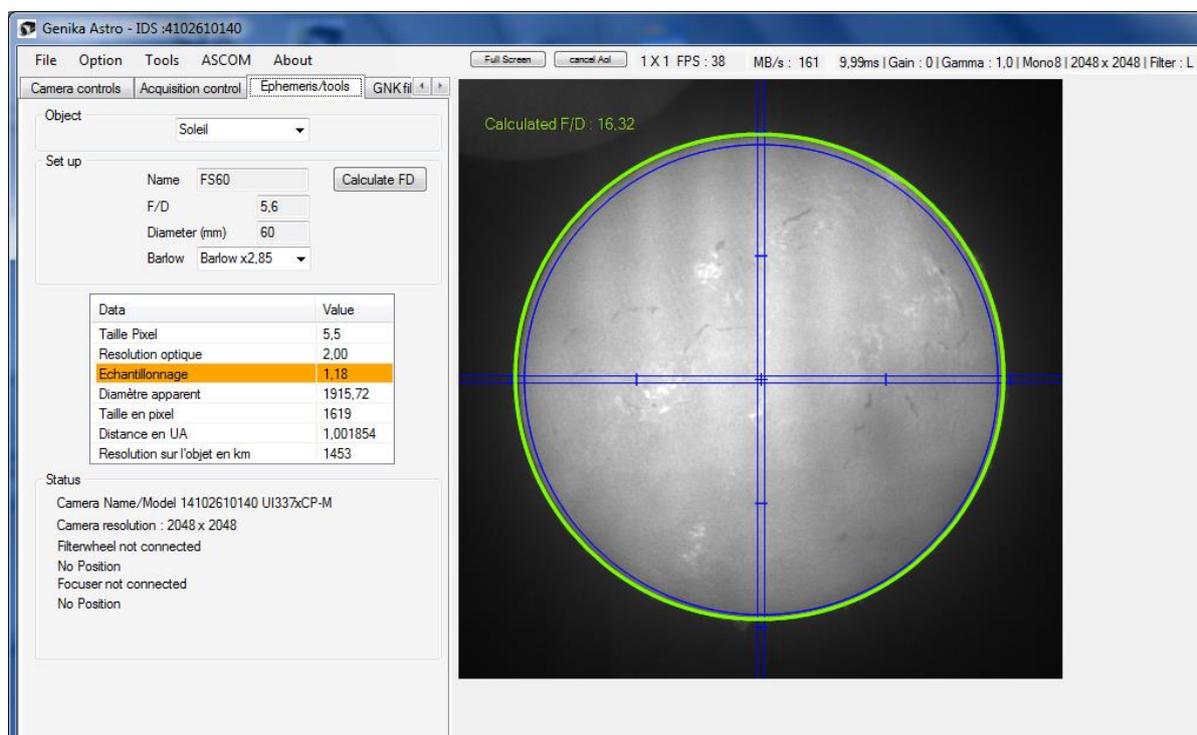
The color of the digital sampling gives you an indication :

- Orange is under sampling
- Green means that your digital resolution is between half and one third of the optical resolution
- Red means that your sampling is too high : you don't gain any resolution and you are losing light

### Automatic F/D detection

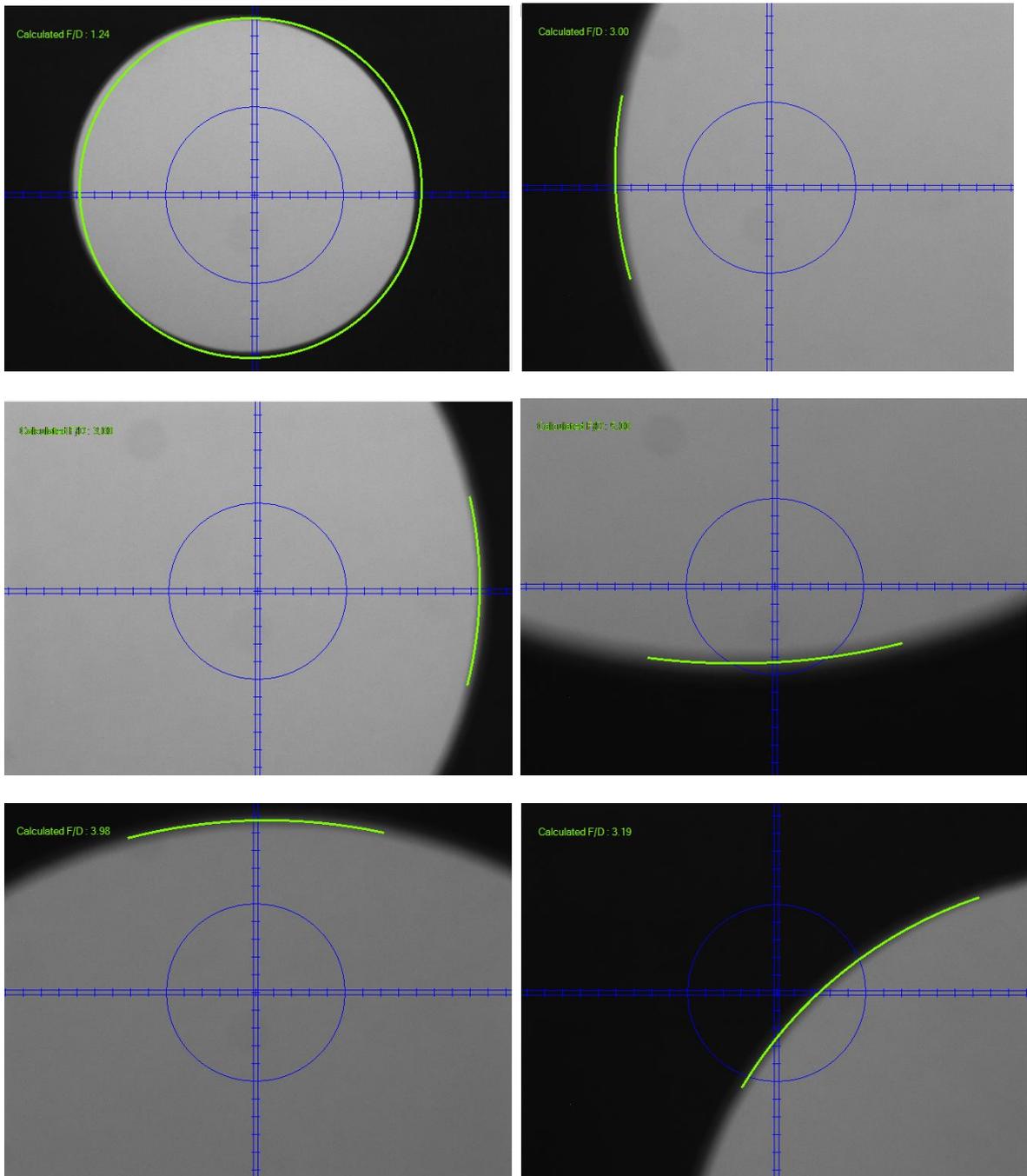
When the object boundaries are partly or entirely visible inside the camera's field of view the application can instantly calculate the actual real focal ratio using the calculate F/D button. Genika only requires as input data the object you are actually imaging. Barlow and F/D ratio selected in the option window or in the ephemeris tab are not relevant for this calculation, but the diameter is. The object can be located almost anywhere on the field. The detection is done horizontally if the object is fully visible on the screen, and in both direction if only a part of the limb is visible. When imaging Saturn the rings should be placed vertically unless you want to take them into account.

When the calculation is done the circle appears around the planet. If the circle is too large try to reduce the acquisition time. If it is too small that means the image is too dim and you should increase the acquisition time. The F/D ratio is displayed at the top left.

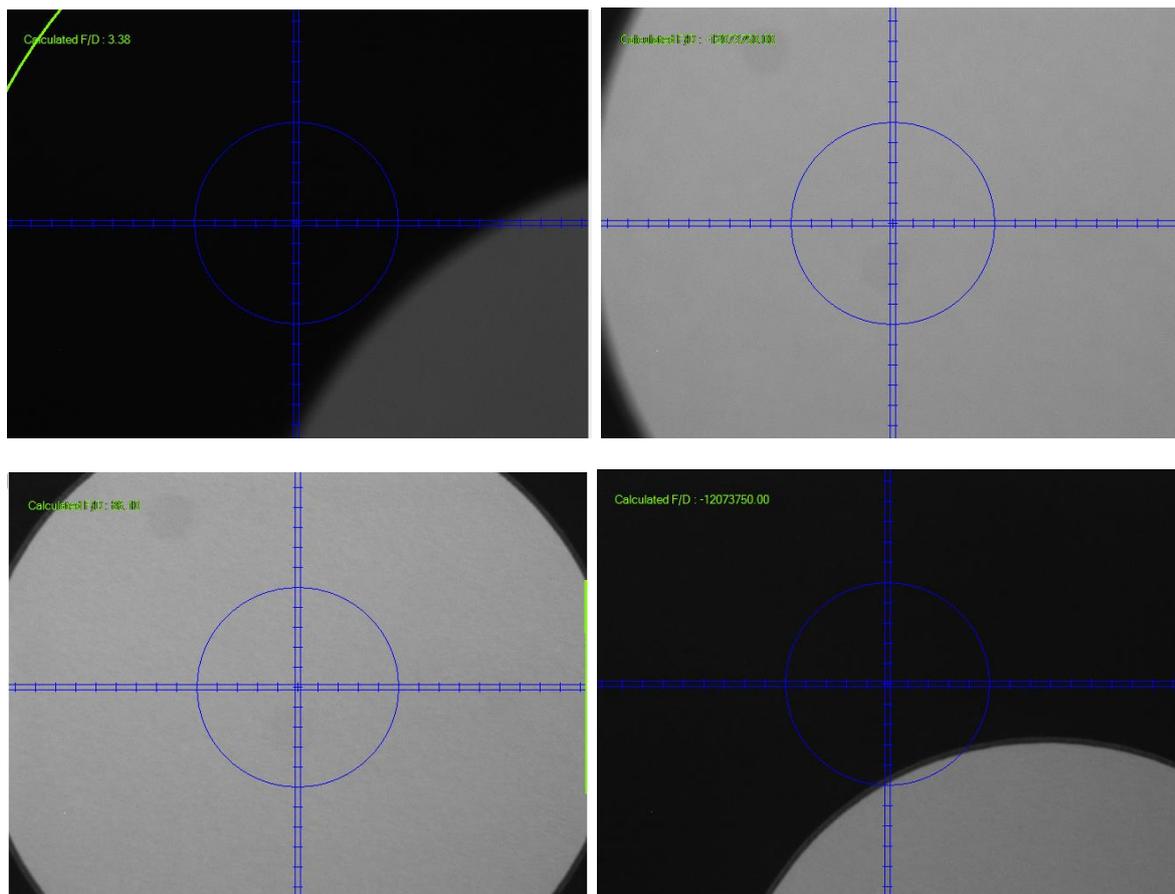


Note that this value doesn't replace the settings specified in the option window but it allows to cross check them. It is up to you to change those settings or to update the barlow file to match the real F/D as it has been detected.

Those cases can be processed:

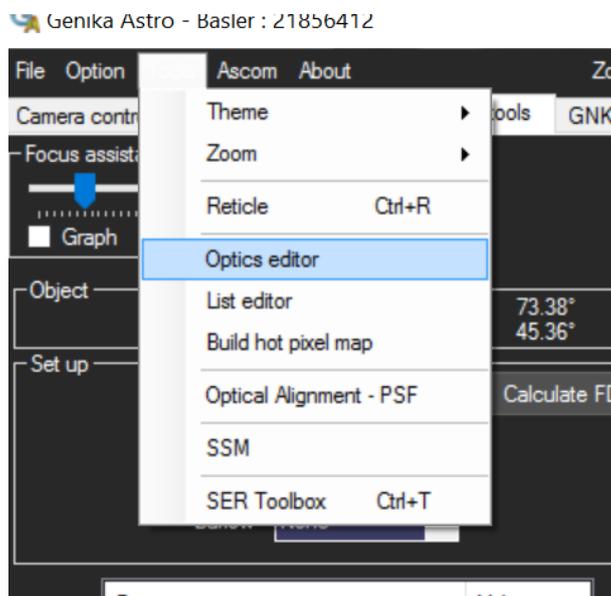


The next cases won't give a accurate result or any result at all:

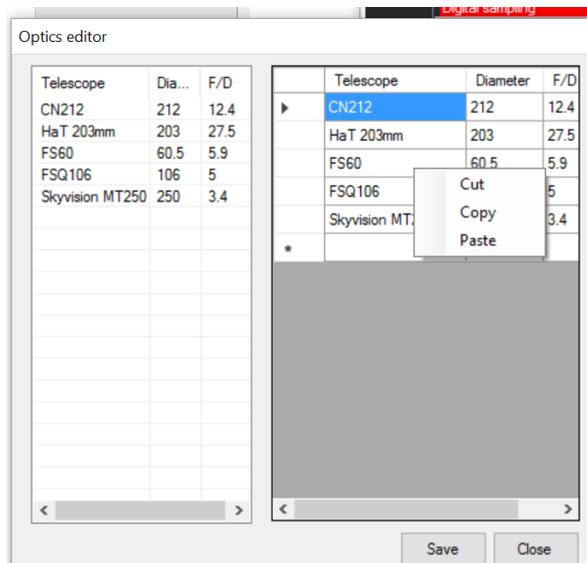


## List and optical setup editors

Genika has an embedded spreadsheet to edit optical configuration and the AoI/Barlows/Filters lists.

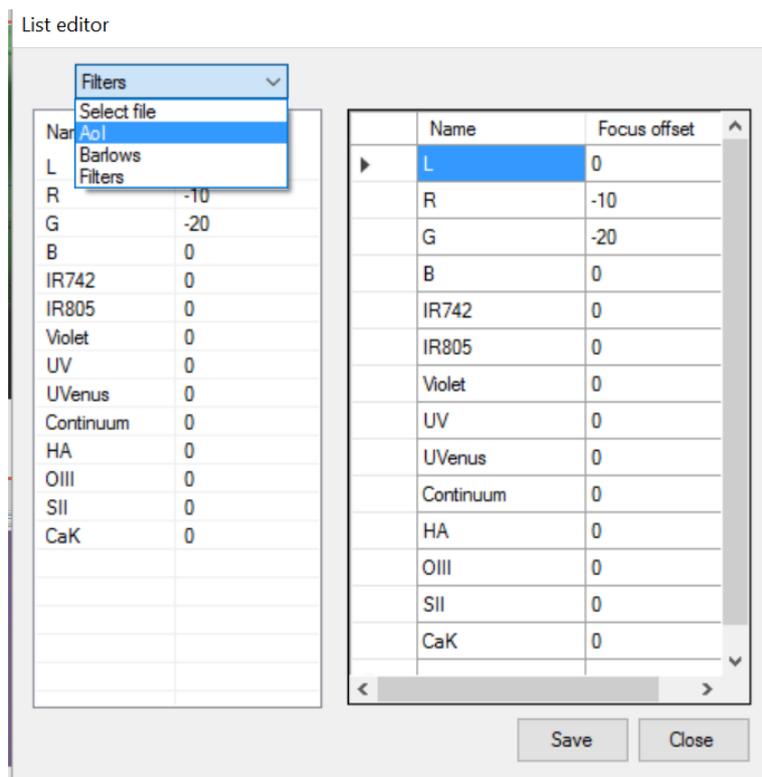


The optics editor allows you to add, delete and edit the instrument name, its aperture and F/D ratio.



For both editors you can select and copy rows, use a right click menu or the standards keyboard shortcuts (ctrl + C/V), use the insert key to add a line anywhere in the list. The left view is the current list, the right is the editor. You need to press *save* to actually save the list. If you made a mistake, you can close without saving. When saving a backup file is generated in case you made a mistake.

From the list editor you have to select the list to be changed :



Don't forget to save before changing of list !

## Acquisition

The current Genika version supports SER, AVI, TIFF and GNK file formats.

You have the possibility to convert GNK files to TIFF from the application, you may convert SER file from the SER toolbox from the tools menu.

### Single acquisition tab

For single acquisition you can use the manual mode from the acquisition control menu.



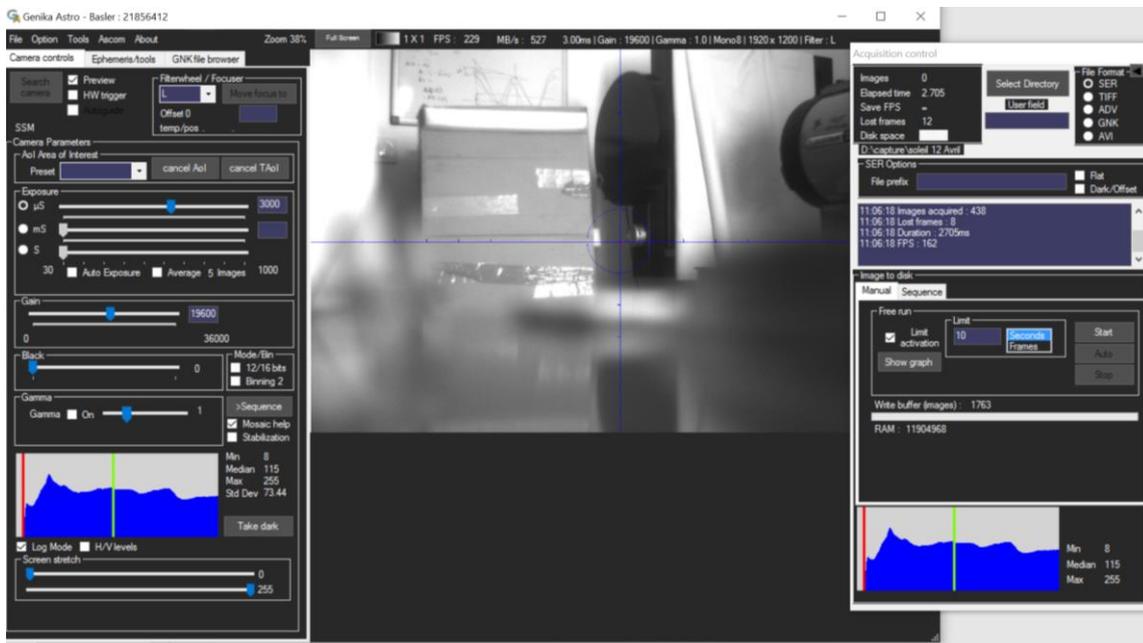
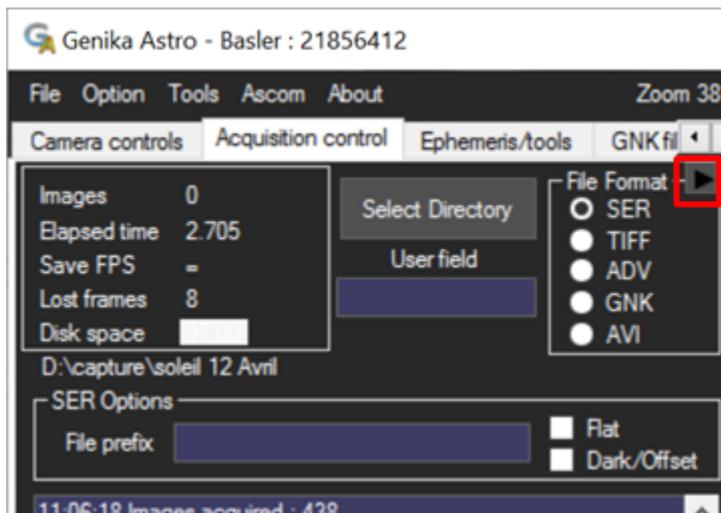
1. Acquisition statistics and directory: In this area are given main statistics of the acquisition. That includes : number of image saved, elapsed time since the beginning of the acquisition including the filter wheel and focuser movement, global acquisition throughput and the number of images that have been lost.
2. Directory : You can specify the active directory. By default c:\ or the last directory used.
3. User field : in this field you can enter whatever you need. This field content would be saved in the text log file.
4. File format: these radio buttons allow the selection the file format. Note that the AVI format is not available for 12 bits acquisition and GNK & ADV for color acquisition.
5. Prefix and acquisition mode: You can provide the file prefix in this input area. If you enter Jupiter the file name will look like this: Jupiter\_date\_T\_hour\_filter.SER. The automatic timestamping avoids files to be overwritten. If you check the flat or dark checkbox the file name is changed accordingly and the free run settings are changed as well. Those settings are automatically saved: you may have three different settings for dark, flat and light acquisitions.
6. Log window: this area recaps the different steps of the acquisition. It is re-initialized for each acquisition.
7. Controls: this area controls the acquisition. If you click on *start*, that's the free run mode. Capture will continue until you stop it or pause it. You can choose as well a number of images or a capture time.
8. FIFO mode information: Genika has two acquisition mode. By default the image stream is stored in a dynamically sized acquisition FIFO buffer in RAM. If the disk isn't fast enough to handle the throughput, frame are temporary stored in this buffer. When the acquisition is over, the buffer is written down to the disk. This mode limits the risk to lose frames, but requires some time after the end of the acquisition to flush all data. When the FIFO is disable (from the option window), the images are send directly to the operating system. If the disk throughput isn't sufficient, frames are loss. Nevertheless this mode has no flushing and the acquisition can be launch again immediately. For data critical acquisition the FIFO mode is strongly preferable.

**If the *save* button is disable, that means your camera hasn't been unlocked. You need to ask again for the license file. It is possible that you or we made an error when proceeding the Mac address and serial number.**

Note: Genika doesn't perform any treatment at the end of the capture only without the FIFO mode: you can launch another one right away if your disk system isn't struggling with the previous acquisition. For this reason the sequence mode never uses the FIFO buffer.

You can display the FPS variation over time after acquisition with the Show graph button.

It is possible to detach the acquisition tab with the small arrow button upper right. Press this button again to bring the tab back in place.



## TXT acquisition log file

Each SER file has an associated TXT file with all acquisition parameters. This file has the same name as the SER file. It also contains the ephemerides data and the detailed time stamping if it has been selected. The time of mid acquisition is indicated in Winjupos format. When using a SSM the seeing values are saved at the end of the file as well as the min/average/max values.

\*\*\*\*\* GENIKA ASTRO CAPTURE LOG FILE \*\*\*\*\*

Observer : FJabet

D:\SER\L\_\_2013-08-04\_T\_09-48-56-0652.txt

Camera manufacturer : Basler  
Camera Model : acA640-100gm

Active filter : L

Number of images : 1229  
Acquisition Length in mS: 10002  
Mean FPS : 122,8754  
Lost frames : 1  
Mid acquisition time UTC (Winjupos hh:mm.mm) : 2013/04/08 7:49,02

User field : commentaire utilisateur

----- Ephemeris data -----

Axis : Geocenter, planetary theory : INPOP10, J2000 epoch  
Crédit : Institut de Mécanique Céleste, 77, avenue Denfert Rochereau, 75014 PARIS, FRANCE

Object : Soleil  
Distance (AU or terrestrial radii for Moon) : 1,001279  
Telescope : CN212  
Diameter : 212  
Native F/D : 12,5  
Amplifier : x1  
Optical resolution : 0,566037735849057  
Pixel size : 5,6  
Digital sampling : 0,435320747303513  
Resolution on object : 411,058778851639

----- Camera parameters -----

Exposure in  $\mu$ S : 8000  
Auto-exposure : False  
Gain : 300  
Black (as read from camera) : 64  
Gamma : 1  
Gamma enabled : False  
Pixel depth : Mono8  
BinX : 1  
BinY : 1  
Aol X : 659  
Aol Y : 494  
Aol X Offset : 0  
Aol Y Offset : 0  
Forced FPS : False  
Forced FPS Value : 9,999999999999999  
resulting FPS : 122,850122850123

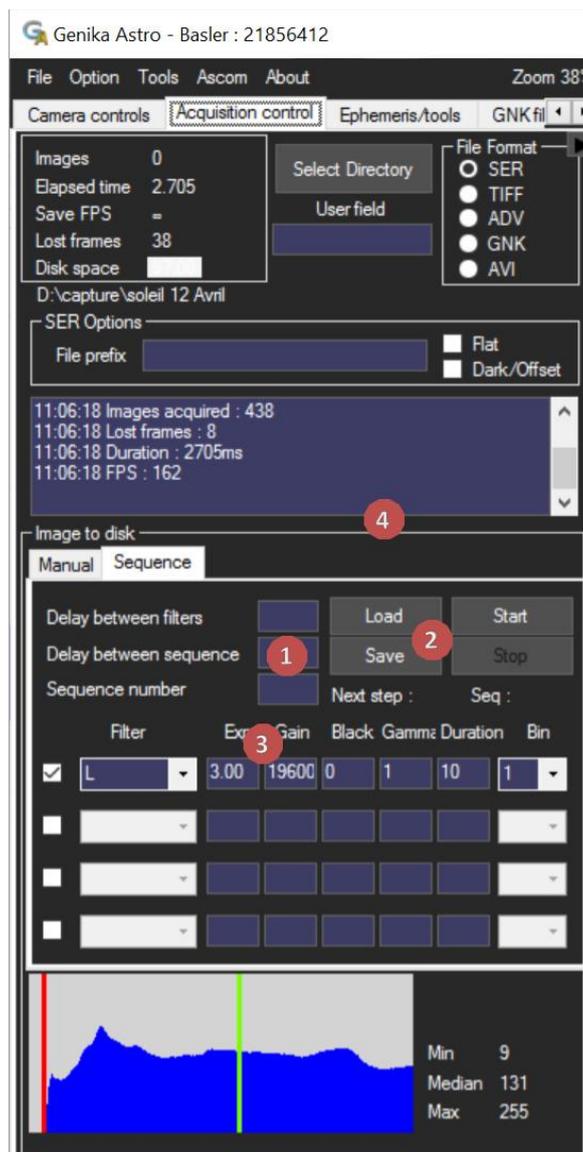
\*\*\*\*\* END OF FILE \*\*\*\*\*

## Sequencer

### Introduction

Some objects require several acquisitions with different filters; it is the case to get color images using a B&W camera (LRGB, RRGB...). Some objects also provide a limited amount of time for the image acquisition because of their fast rotation (Jupiter, Saturn, Mars...) so color images have to be acquired in a limited amount of time. For the same fast rotating objects it is interesting to make acquisition at short intervals to build a rotation animation.

To make those tasks easier Genika Astro embeds a multiline sequencer on the third tab.



1. Pause between each sequence repetition (loop), pause between filters (if an ASCOM FW is connected, you may let that value void) and number of repetition of the full sequence.
2. Load/save sequence definition
3. Parameters for each sequence component :
  - a. Filter name (ASCOM or generic filter list)
  - b. Exposure in ms (decimal accepted for submillisecond exposure)

- c. Gain
  - d. Black
  - e. Gamma (decimal accepted)
  - f. Duration in seconds
  - g. Binning
4. Information control about the ongoing sequence

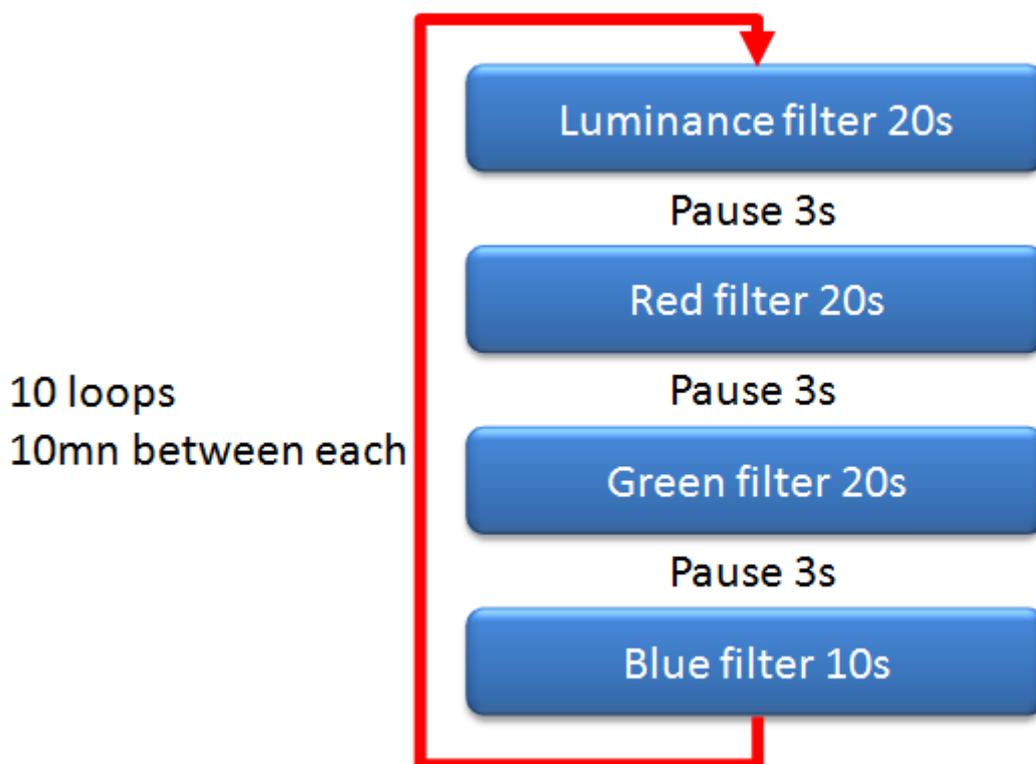
### Sequence definition

There are three different ways to define the sequence details:

- Manually by typing the parameters for each line
- By loading an existing sequence built previously.
- You can transfer actual acquisition parameters from the first tab using the *to sequencer* button. Genika then asks for the filter, the line number and the duration :

### Sequence behavior

A typical sequence rollout with 10 loops, 3s filter pause and 10mn pause between sequence would behave as below :

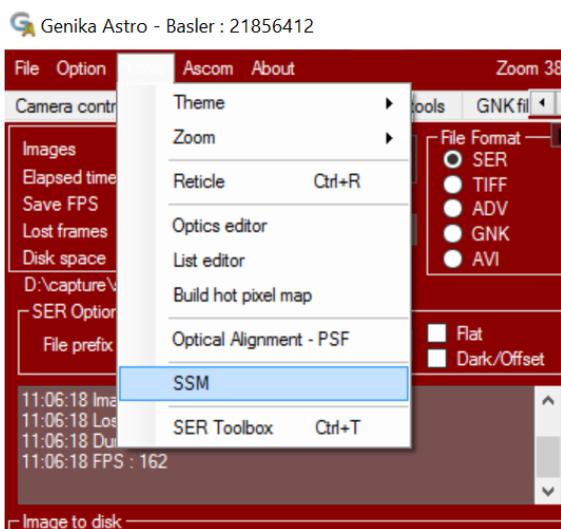


Note : If an ASCOM FW is connected with focus offset, the ASCOM focuser moves as required by offsets values. At the end of the sequence prior focuser position and filter are restored.

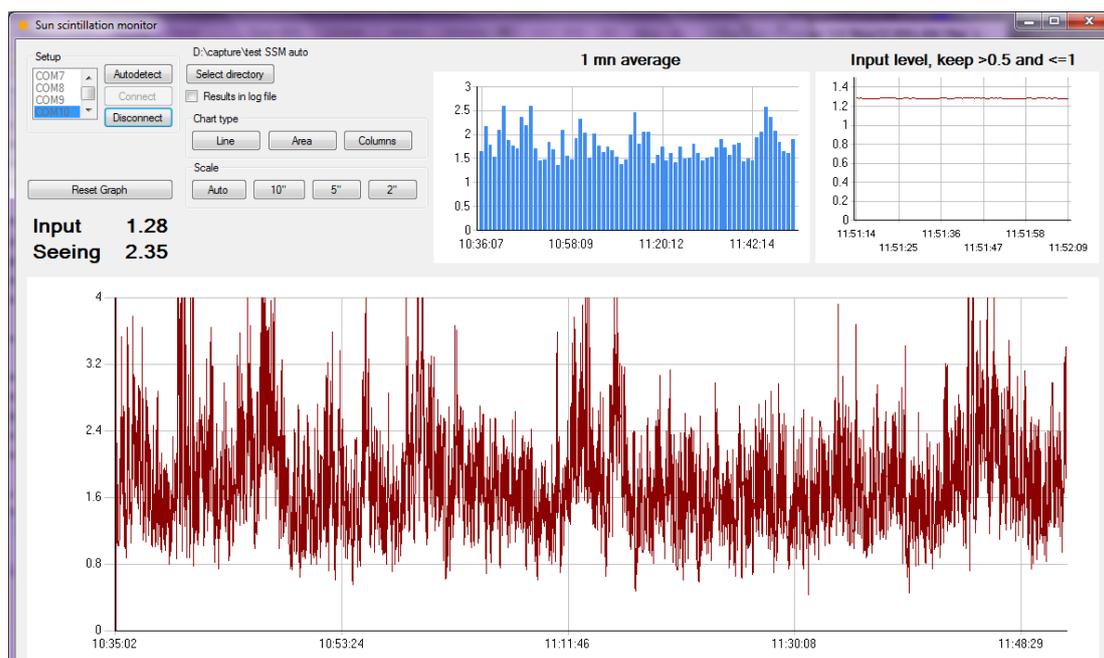
Note: Sequence never uses the FIFO buffer to respect the sequence timing.

## Auto acquisition mode

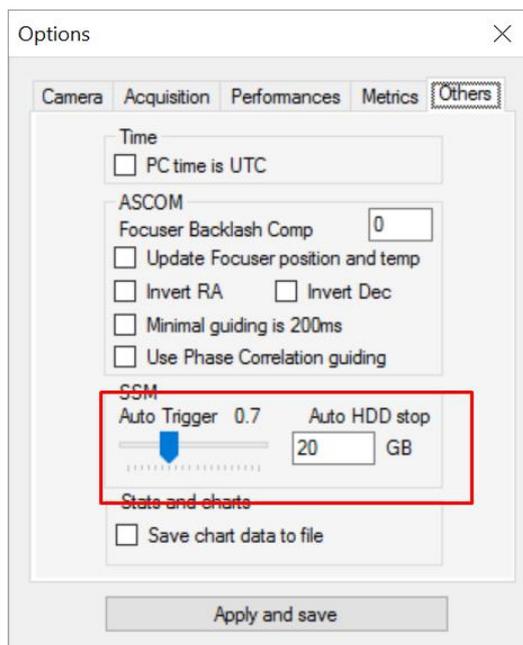
When connected to a Solar Scintillation Monitor, Genika can trigger acquisition based upon a seeing value threshold. The SSM must first be connected from the SSM menu :



Then apply the SSM connection procedure as described in its user manual.

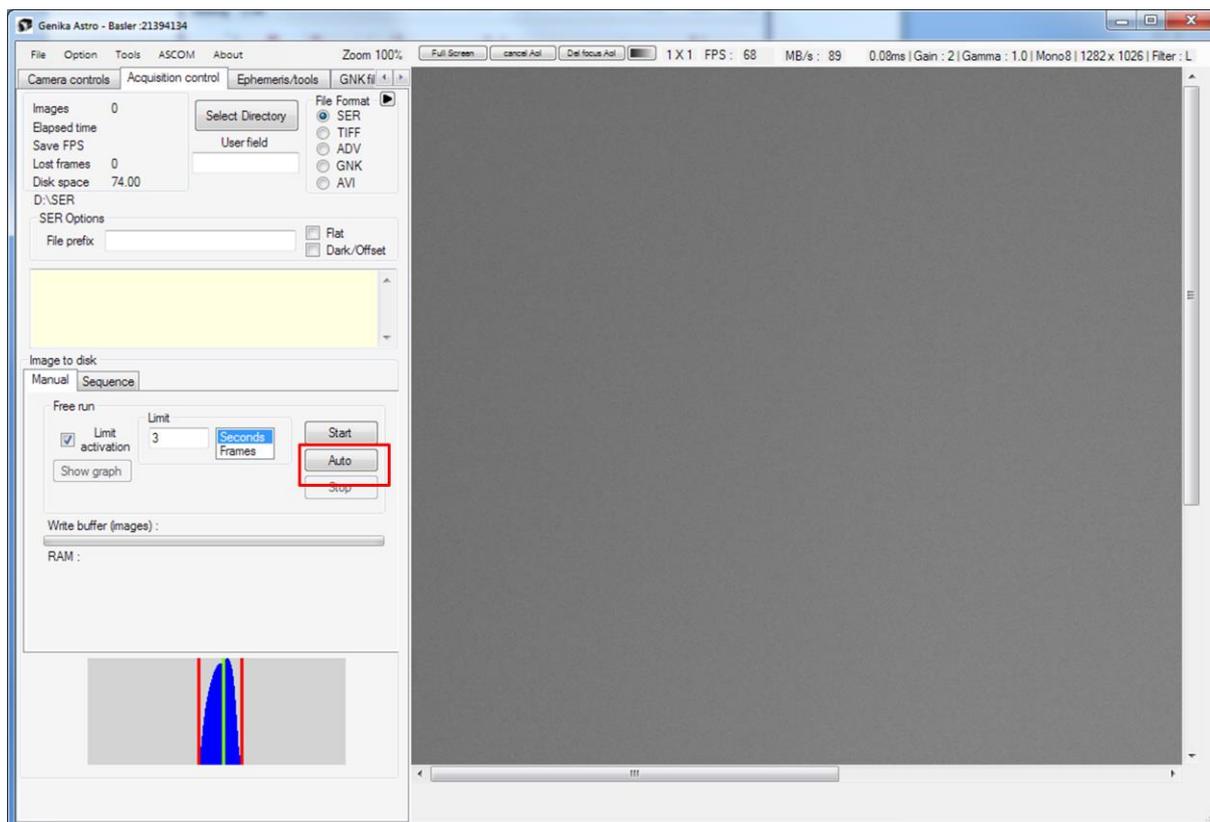


The threshold is selected from the option window. By default the value is 0.7". Another setting allows disengaging of the auto mode when free space on the target HDD goes below a limit in GB.



Then press the auto button to start acquisition, press again to stop. Limits are automatically activated in auto mode.

When operating in auto mode, the average value for each acquisition is mentioned in the text file.



Please refer to the SSM user manual for more details about its operation.

### **Image Timestamping**

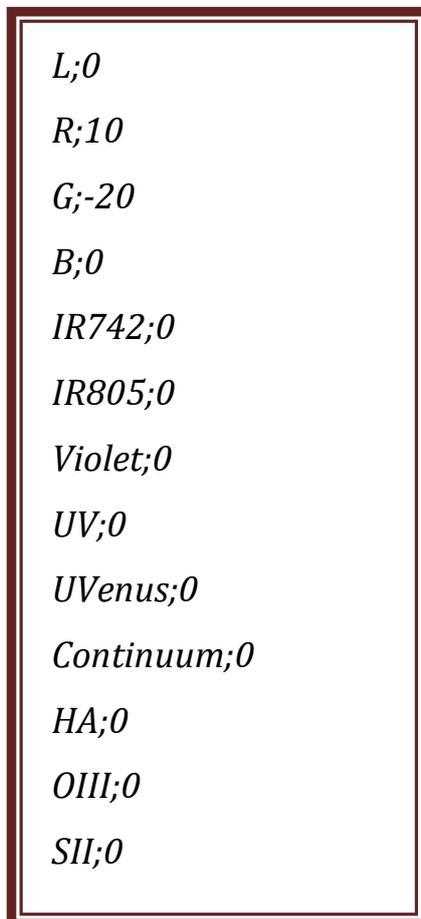
SER and GNK files contains time stamps for each frame. The timing is the frame reception by the application that matches closely the end of exposure.

**The SER header contains both local time and UTC acquisition start time. If the option *PC time is UTC* has been checked in the option windows, then both field have the same date/time. The Sertoolbox checks this point and act accordingly when exporting SER to FITS format.**

**This has to be done when using the TimeBoxUTC.**

## Filter list

The default filter list may be changed as for the barlow list. The file name is Filterlist.txt. The number after the semicolon gives the specific focusing offset for this filter. If an absolute focuser is connected its position is corrected automatically.



```
L;0  
R;10  
G;-20  
B;0  
IR742;0  
IR805;0  
Violet;0  
UV;0  
UVenus;0  
Continuum;0  
HA;0  
OIII;0  
SII;0
```

When a filter wheel is connected its filter list replaces the default one. Focus offsets are also taken into account if available. The filter list can be edited from the list editor.

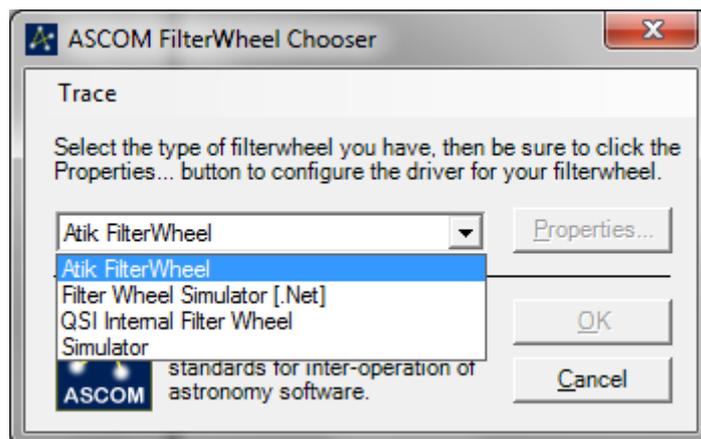
## ASCOM features

### ASCOM filter wheel control

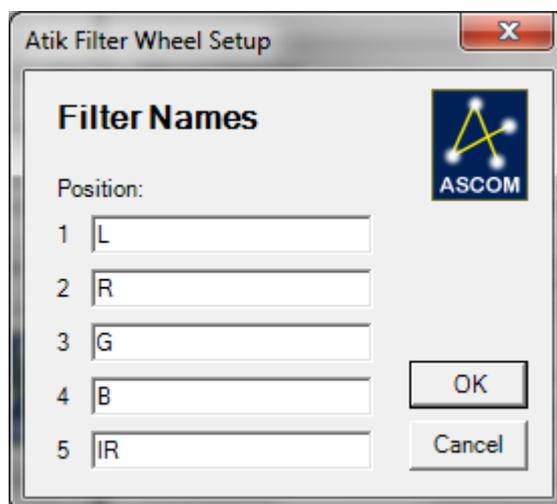
Genika can operate automatically an ASCOM filter wheel using ASCOM 6 platform.

You may connect your filter wheel from the ASCOM menu.

If the ASCOM 6 platform is present, its filter wheel chooser pops up:



You can edit the filter name using the properties:



The generic filter list and offsets is then replaced by the filter wheel's at FW connection. Genika Astro remembers the filter wheel name for another session : you just need to connect then.

You can check the filter wheel connectivity and features from the ephemeris/tools tab.

To change the currently used filter, you can use the filter list on the camera settings tab.

Of course it is possible to use the filter wheel from the sequencer.

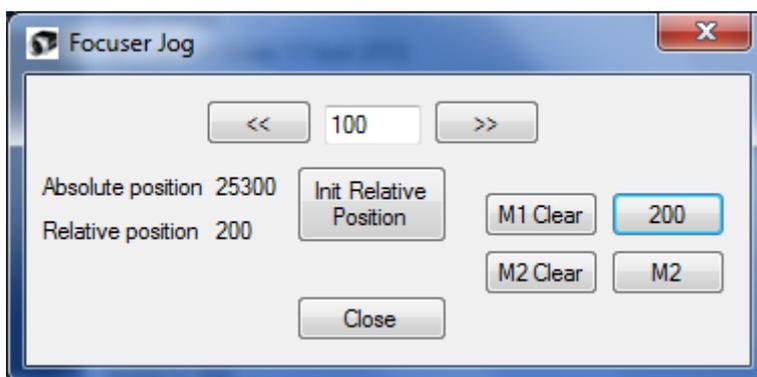
### ASCOM focuser control

Genika Astro can also control an ASCOM absolute focuser. Connection is done the same way as for the filter list.

You can command the focuser from several location :

- From the first tab by typing the position you want to go to and then clicking on “move to”,
- Focuser is controlled by the sequencer if filter offsets are presents,
- Focuser moves also when selecting another filter manually,
- You can access to the focuser jog.

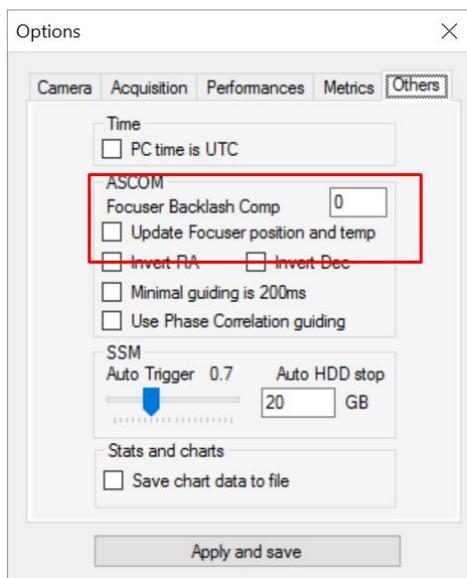
The focuser jog presents several interesting features:



- Relative movements using the left/right buttons. The focuser moves of the value specified in the center field,
- Relative position index reset
- Absolute position
- Two memories that moves the focuser to the previously recorded position

Genika Astro also supports backlash compensation from the options window (out direction).

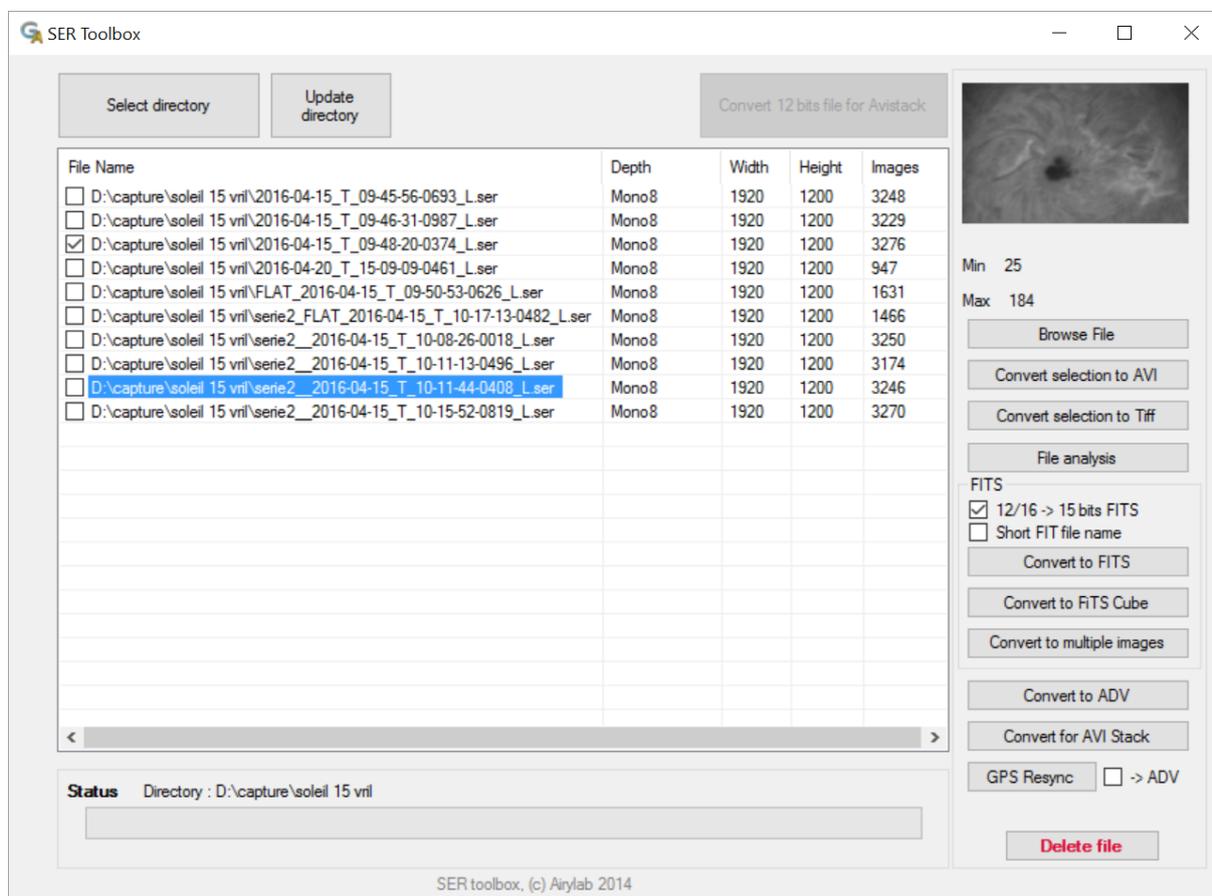
You can stop automatic position refresh (3s interval) when using very high FPS or if your focuser driver isn't multithreaded.



## SER toolbox

A tool dedicated to the SER files management is available. You can launch it directly, its filename is *file\_converter.exe* or you can get it from Genika's tool bar. Note that this module requires the .NET framework installed, release 4.

Color images are bayer processed for display only. TIFF and FITS conversions save RAW frames.



Using this module, you can :

- List all SER files in a directory. You'll see their dimensions, images count and pixel depth
- Get a preview of the first image with its minimum and maximum pixel value.
- Browse the file and save a individual Tiff image
- Convert all 12 bits file in the directory to 16 bits for Avistack processing. Original files are kept.
- Convert 8bits files to AVI format, and 8 bits or 16 bits files to individual TIFF or FITS images stored in an automatically created directory.
- Convert B/W SER files to ADV file format.
- Analyze a file: a text file with all images information will be created.
- Delete selected files (**Be careful : files are definitely erased !**)
- Three FITS format are available and are using the FITSIO.DLL : single FITS file per images, 3D cube FITS plus timestamp file, and multiFITS file.



Note that the viewer resize the frame to a fixed file for display, it is not the acquisition size present on the disk.

You can play the current SER file at 10 fps.

Note for IRIS users : you can have a simple name convention for FIT files : "I"+image number. That makes command line in Iris easier.

## SER and GNK timing synchronization through GPS reference

By default Genika Astro uses Windows internal clock to generate time stamp with 100ns granularity. Some applications may require a more stringent time stamping than Windows internal clock. Windows clock drifts unpredictably and may hinder time stamps pertinence over time. On another hand a stratum 1 clock (ANSI/T1.101-1987) is available with a GPS receiver.



It's possible to use this kind of GPS clock to sync the PC and therefore Genika Astro time stamps as discussed in the *Time stamping strategies* application note. This requires a GPS card such as Meinberg products.

Another way is to use a GPS or IRIG appliance to get high precision time tamps such as the TimBoxUTC.

Both solutions above provide a high precision synchronization at the  $\mu\text{S}$  scale.

### TimeBoxUTC

The TimeBoxUTC available from Airylab is the preferred timestamping solution. This solution has been validated by professional observatories for high precision occultation observations.

The Timebox is a time base that allows precise image timestamping from Genika Trigger and Genika Astro applications.

It is designed to provide time sensitive applications with a reference Stratum 1 time base from the GPS network. It can be used for example for precise image timestamping in astronomy applications as asteroid transit in front of a star.

The Timebox can be use anywhere in the world for lab or outdoor applications. It requires only an USB port.

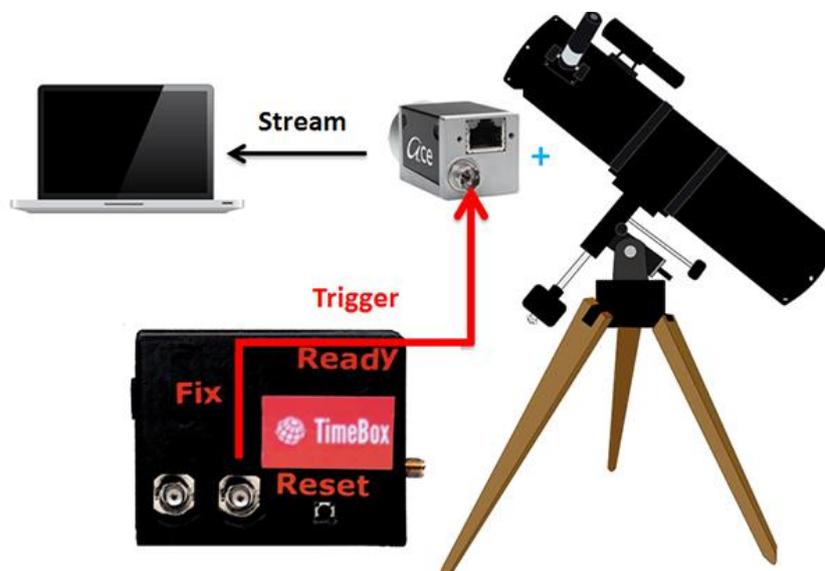
The Timebox has two ways of use.

### Synchronisation Mode



In this mode, the Timebox controls the Windows PC time. Images are directly recorded by Genika with the correct time stamp and there is no need to resync the file after acquisition. Precision is inside  $\pm 2\text{ms}$  compared to the UTC.

### Trigger mode



With this mode, the Timebox, connected to the trigger in of the camera, controls the shutter with a frequency between 0.1 and 60 Hz. This mode also controls the PC clock. Images must be resync to get the most precise timestamping mode (about  $50\mu\text{s}$ ). Depending on the Timebox model, the voltage and current can be selected.

With this mode Genika is set in external trigger mode.

There are two Timebox models.

### **Timebox Standard**



The standard Timebox has the following connections :

- GPS antenna (included)
- USB port
- Slow trigger output (0,1 to 1Hz)
- Fast trigger output (7Hz to 60Hz) /LED firing

The output level of the trigger out is CMOS with low current. This output may not trigger all cameras. In that case the pro version or the Pro extension module is required.

### **Timebox Pro**



The Timebox pro provides a higher level TTL output (6 to 9V) and more current to control all cameras. The output card is physically separated for a better signal control.

## GPS receiver

Starting from release 2.7 Genika Astro provides an inexpensive way to synchronize GNK file with a GPS receiver within a few ms tolerance.

### *Acquiring a reliable GPS clock*

The main communication protocol with GPS is NMEA. NMEA transmits once per second the complete GPS information including the UTC time. Nevertheless this protocol is very slow and it is not designed for high precision system synchronization on the GPS clock.

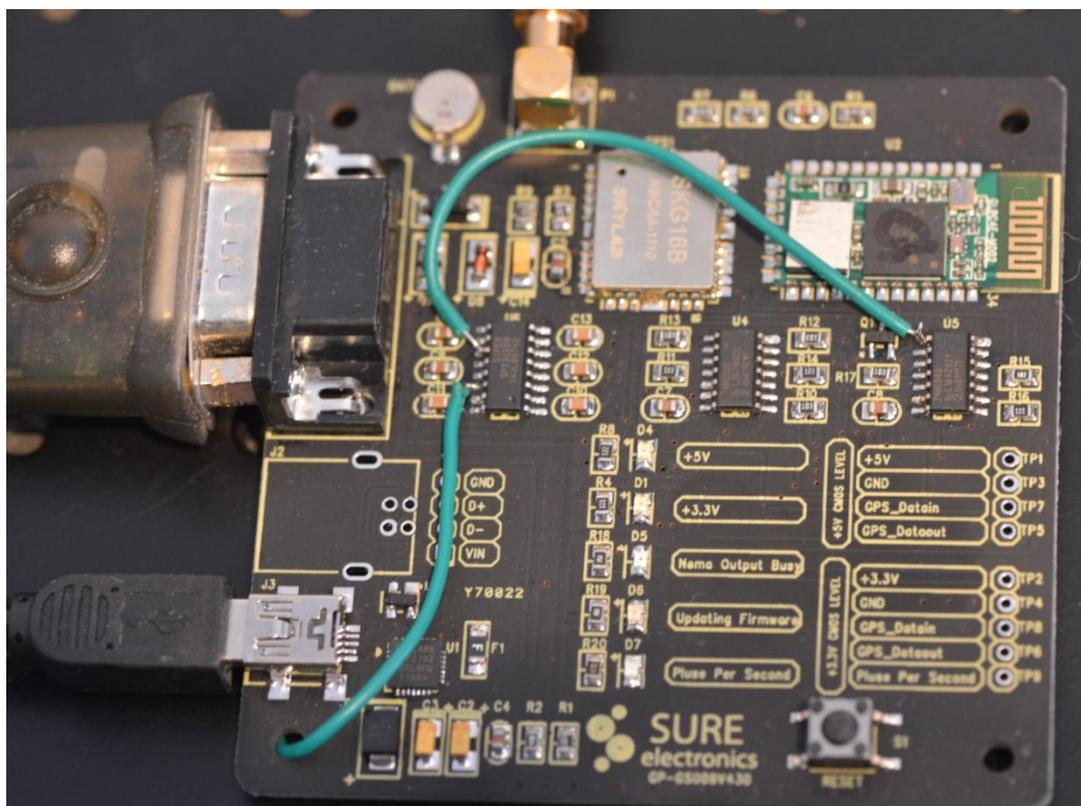
In addition some GPS receivers provide a high precision Pulse per Second line that can be used to mark the beginning on the actual second.

We use this PPS signal to generate a synchronization file between the Windows clock and the GPS Stratum 1 clock.

This signal shouldn't be acquired through a slow protocol stack such as the serial protocol. We use instead inputs that raise immediate events in Windows. One of them is the Data Carrier Detect on a serial input line.

Basically we re-route the PPS signal to the TTL DCD line of a serial port, this port can be native or goes through a serial to USB converter.

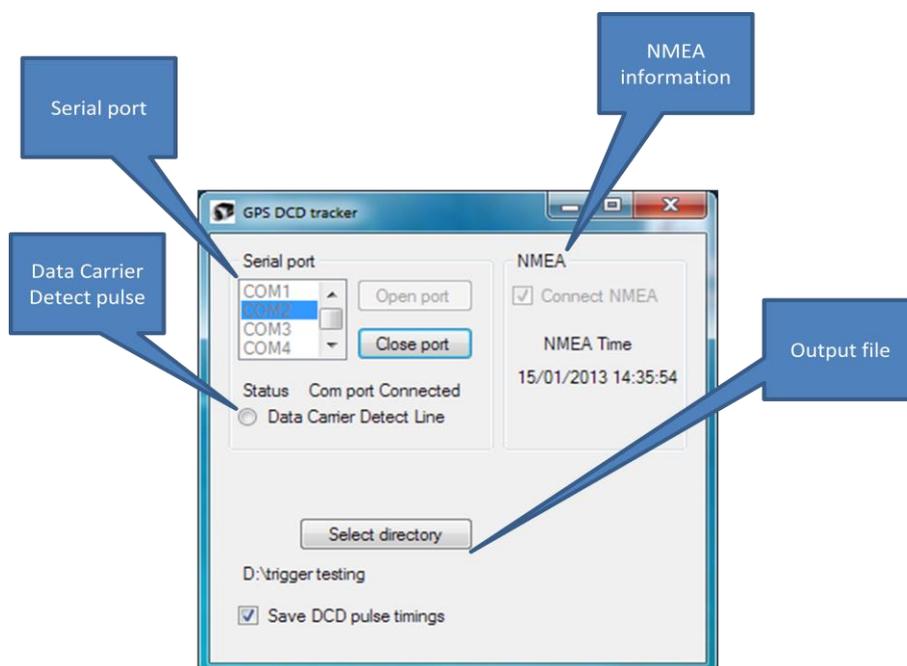
For this example, we use a Sure Electronic GPS board:



Some modifications are performed on the board in order to inject the 3.3V CMOS level PPS signal to the serial TTL DCD pin. The CMOS is converted to TTL using a free line on MAX232 board chip.

### Reference timing acquisition

Genika Astro comes with a dedicated utility to capture this PPS signal and keep a trace in regard with the windows ticks : GPS DCD Tracker.



This application connects to the GPS :

- Using NMEA to get the UTC with one second precision
- Using the DCD line to intercept the GPS Pulse Per Second

When a PPS is detected the application saves the following information in a .stp file (text structure):

#### Genika Trigger PPS log file

\*\*\*\*\*

Date, Time, Ticks, Offset to plain second in ms, jitter in 100ns, NMEA date/time

```
11-01-2013 , 10-47-39-0442 , 634934980594428071 , 442 , 6,34934980594428E+17 , 01/01/0001 00:00:00
11-01-2013 , 10-47-40-0440 , 634934980604408642 , 440 , 9980672 , 11/01/2013 09:47:38
11-01-2013 , 10-47-41-0440 , 634934980614409214 , 440 , 10000512 , 11/01/2013 09:47:39
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 11-01-2013 , 10-48-04-0441 , 634934980844412370 , 441 , 10000640 , 11/01/2013 09:48:02

Windows clock at the reception of the PPS signal : Date, Time, Tick (100ns granularity) and offset to the next plain second,

Jitter of Windows clock in 100ns : that gives the window's clock drift,

GPS Date and time at the PPS : Milliseconds are not given as the information is saved at the PPS reception (i.e. plain second) and NMEA doesn't provide more precise information.

**Important note about NMEA time** : some GPS receivers may deliver NMEA information less often than once per second. The GPS DCD Tracker looks for NMEA updates twice per second. If the UTC time hasn't been updated between two PPS reception, the actual UTC time is interpolated by the application. Such occurrences are marked with a (\*) in front of the GPS UTC NMEA time.

### *SER and GNK file re-synchronization*

SER and GNK file resynchronization is automatically done by Genika Astro. To achieve this synchronization a stp GPS PPS timing file overlapping the GNK file duration is required.

Once the SER or the GNK file has been selected or opened in the SER toolbox or Genika Astro GNK browser respectively it is possible to select a stp file with the *GPS Resync* button.

The SER Toolbox can batch convert all selected files if they are included in the *stp* time reference.

The Toolbox (SER) or Genika Astro (GNK) checks if the file does overlap with the file and if the stp file contains incoherent timings. Genika Trigger duplicate the SER file and readjust timing according to the stp file. It is also possible to convert the resynchronized file to Tangra's ADV format.

### **Results**

It is possible to achieve a precision better than 10ms with this method.

## Keyboard shortcuts

<b>F1</b>	<b>Zoom 25%</b>
<b>F2</b>	Zoom 50%
<b>F3</b>	Native size
<b>F4</b>	Zoom 200%
<b>F5</b>	Fit to screen zoom
<b>Ctrl O</b>	Option window
<b>Ctrl R</b>	Reticle toggle
<b>Ctrl T</b>	SER Toolbox
<b>Ctrl S</b>	Start freerun
<b>Ctrl D</b>	Stop freerun

*End of this document*