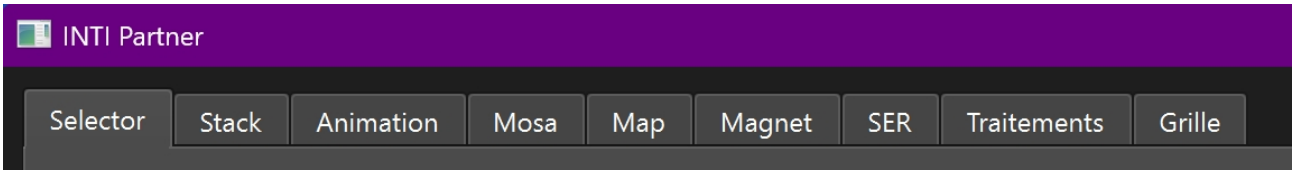
User's manual

INTI Partner V0.x

INTI Partner is a set of applications grouped together in a single software package for processing spectroheliography images.

Images may come from software other than INTI, such as the Sunscan or JSolex application, and from a Spectroheliograph other than Sol'Ex. However, in some cases, this may not be the case. the presence information in a log file created by INTI or Sunscan will be necessary.



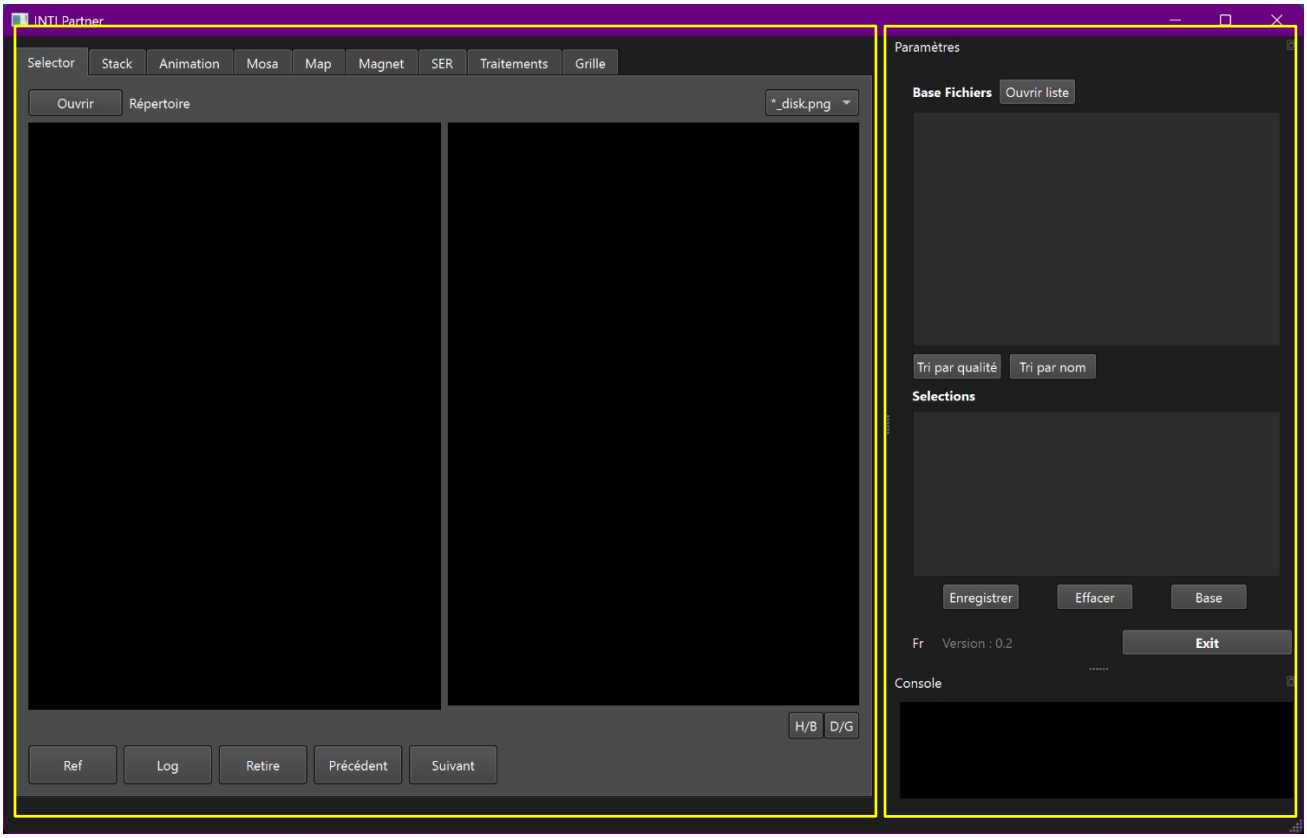
- **Selector**: makes it easy to select the best images from an observation by two-by-two comparison
- **Stack**: correction of distortions in a series of images before summation to increase image quality.
- **Animation**: an animation from a series of images
- **Mosa**: a composite image from several partial images of the Sun
- **Map**: "spectro-localization" of a region in the solar spectrum
- **SER**: display of SER file frames with image correspondence spectroheliography, display of spectral profile
- **Processing**: additional image processing
- **Grid**: application a Stonyhurst coordinate grid

Installation

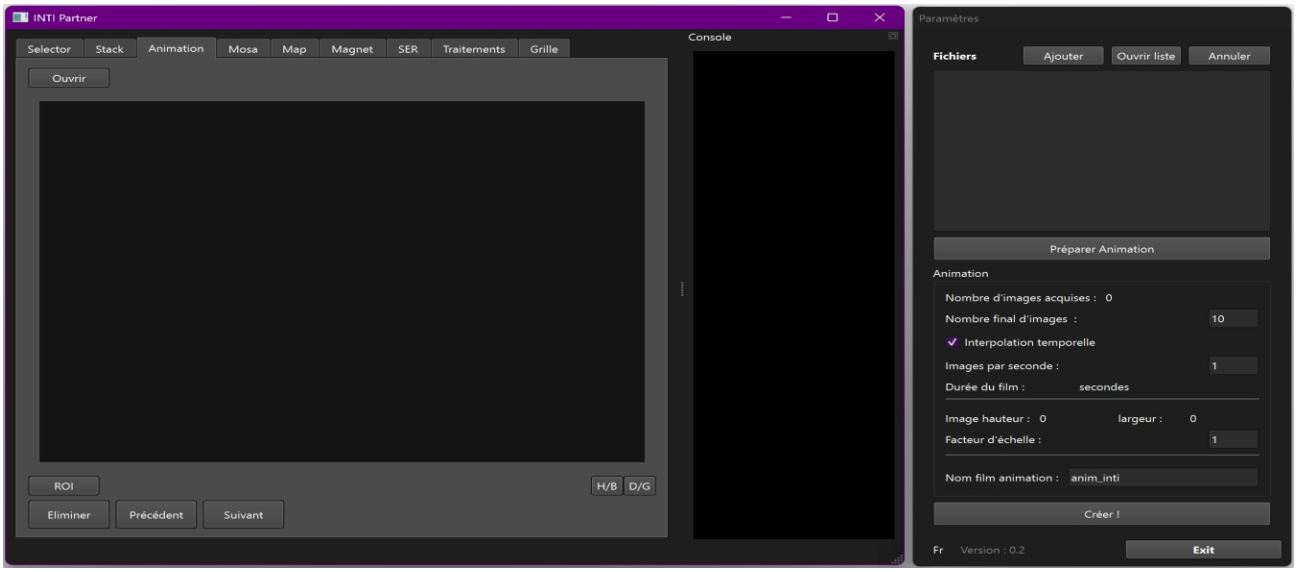
Unzip the file INTI_partner.zip downloadable from xxx

General presentation

On launch, the window below appears. It takes the form of a tabbed area and a panel on the right with two blocks (docks): Parameters and Console.



The window can be enlarged. The two docks can be independently enlarged, moved to the left or bottom, or even detached as independent windows. To re-dock floating panels, double-click on their title bar.



The interface style depends on the system style. In the case above: Windows11 style, Dark mode.

The application remembers your interface layout for the next launch, as well as the last active tab.

Language

To change the default language from French to English, click on the 'Fr' button, then restart the application.

Version check

If you have an Internet connection, the application checks the current version number on the web. If the version is different, the version color changes to red.

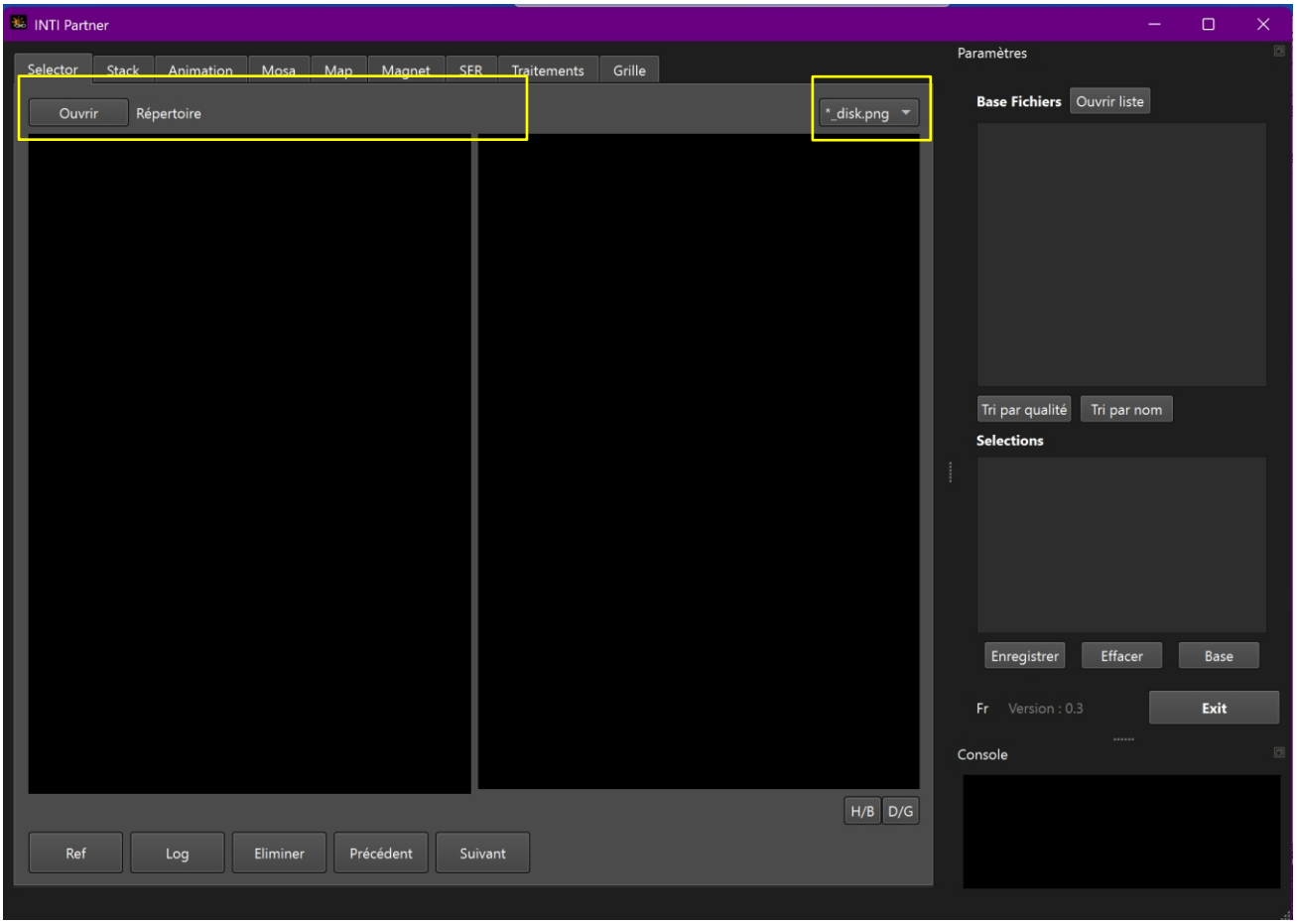
Tabs

Each tab corresponds to an independent application, with its own parameter block or "dock" on the right-hand side of the application window.

Selector

The Selector application displays all png images in a given directory and compares them with an image chosen as a reference to select the best image(s) and store their names in the "Selections" list.

A suffix filter must be applied such as *_disk.png, *_protus.png , *_clahe .png, *_cont.png, *_raw.png or *.png



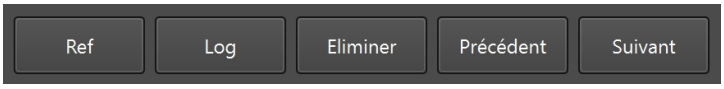
The list of image names is displayed in the right-hand dock in the 'File Base' area.

The first image is displayed on the left, the second on the right.

can invert the right-hand image Up/Down or Right/Left by pressing the buttons:

The png image is automatically saved.

Navigation buttons



The "Previous" and "Next" buttons used to display the previous or next image.
next in the list in the right-hand image area.

If you wish to keep the right-hand image as the new reference image, use the "Ref" button to transfer it to the left-hand area. To save its name in the
In the "Selections" menu, use the "Logbutton.

The "Log" button allows you to memorize the name of the image by adding it to the list.
"Selections

Selected image names are stored in the Dock Selections list.

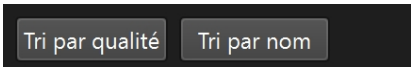
To remove an image from the list, display the image on the right and click on the "Remove" button.

Quality criteria

Beneath each image is displayed the name of image and a number similar to a quality . This criterion is indicative, and is calculated at the center of the image over an area of 400 pixels, according to https://pyimagesearch.com/2015/09/07/blur-detection-with-opencv/.

```
img2=cv2.medianBlur(img2, 5)
dst= cv2.Laplacian(img2, cv2.CV_64F,3)
var=dst.var() ** (1/2)
```

You can sort the list of files according to this quality criterion, or return to a sequence ordered by file name.

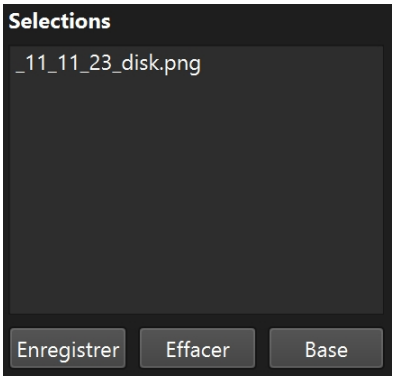


Save and recall a list of best images

It's sometimes difficult to judge the best image in a series. Selecting a sub-list can be a first step in sorting. This first sorting can then be saved with the
Click on "Save".

The "Clear" button clears the sorting list

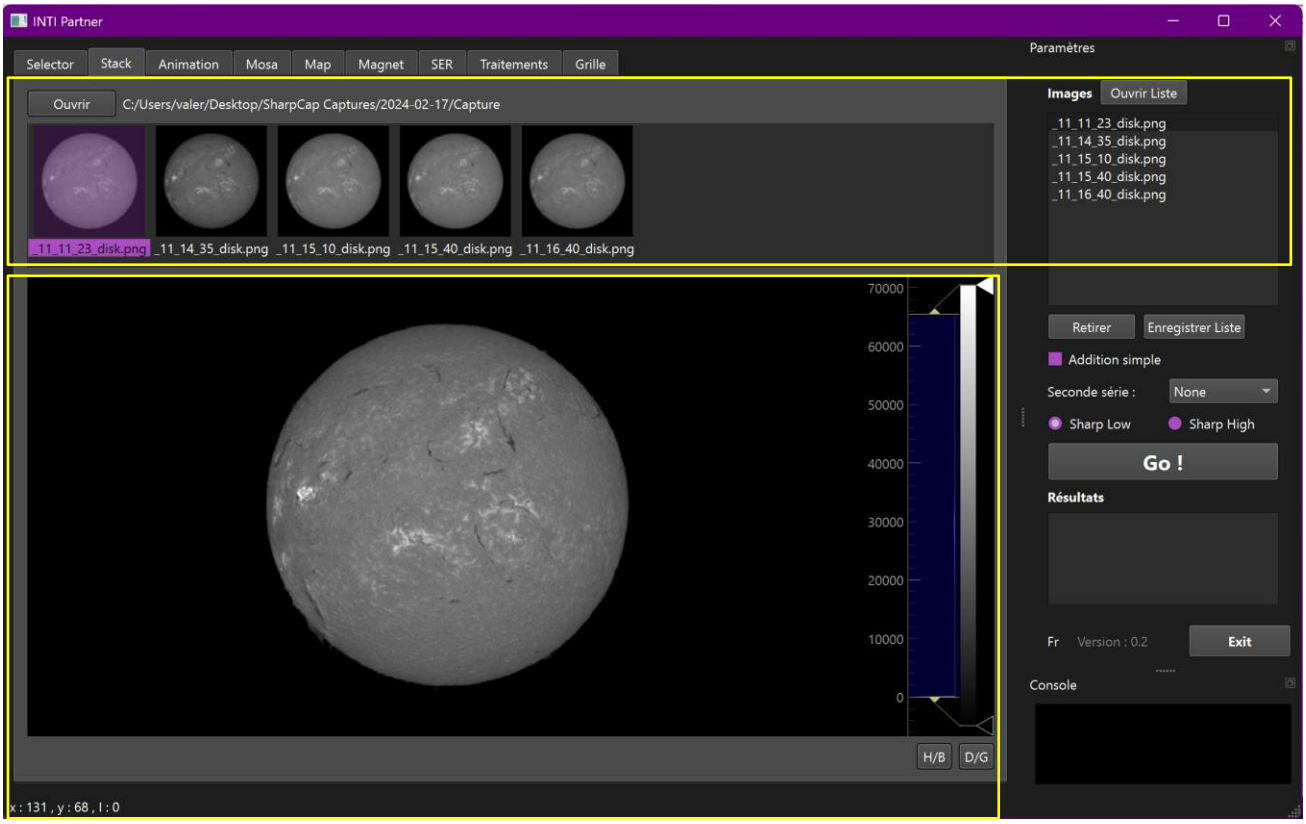
The "Base" button replaces the main file list with this new list to restart sorting.



To call up a sort list, use the "Open list" button in the File Base main list zone.

Stack

The Stack application can be used to sum a series of images, either by simple addition or after a distortion correction calculation. The name "Stack" is the English translation empilement. This operation is designed to increase image quality by reducing noise. It should, however, be used sparingly, on images of good quality and not extending over a reasonable period of time: unaffected by the sun's rotation or showing no major local variations on the sun's surface such as flares or protuberances.



The "Open" button is used to select the png files to be stacked - the Images list in the dock on the right contains the file names, and a preview is also displayed in the upper area of the application section.

You can navigate through the images using the arrows or the mouse, and even remove an image from the list using the "Removebutton. The selected image is displayed in the main image area.

Thresholds can then be changed with the mouse by moving the sliders on the histogram from right, orientation with "H/B" and "L/R buttons, view pixel intensity
under the mouse at bottom left.

The mouse can also be used to pan/zoom the image with the left button.

The right mouse button brings up a contextual menu that allows you to return to
display entire, centered image with 'view all' and also export the image in png format with 'export'.

The "Open list" button lets you call up a list images already sorted with Selector, for example - The "Save list" button saves the current list if, for example, images have been removed.

Simple stacking

Click on the "Simple additionbox. You can then choose the reinforcement filter. Click on "Go!

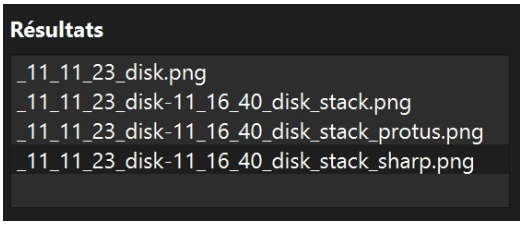
Stacking with distortion correction

Dedistord algorithm was written by Christian Buil. It calculates the 32 pixel by 32 pixel patch distortion matrix for each image, starting with the first image. The matrix thus calculated is then applied to correct each image, with the first image being the reference image.

These distortion matrices can only be calculated on images with good contrast. This is not the case for protruding images or continuum images, but we'll see how this limitation can be overcome.

To stack images with distortion correction, check that the "Simple addition" box is not checked. Choose the strength of the reinforcement filter and click on "Go!

Once the calculation is complete, the result images are displayed in the dock list. "Results



The first image is the reference image, the single image.

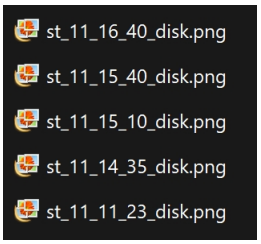
The image xx_stack.png is the result after correction and addition and without enhancement.

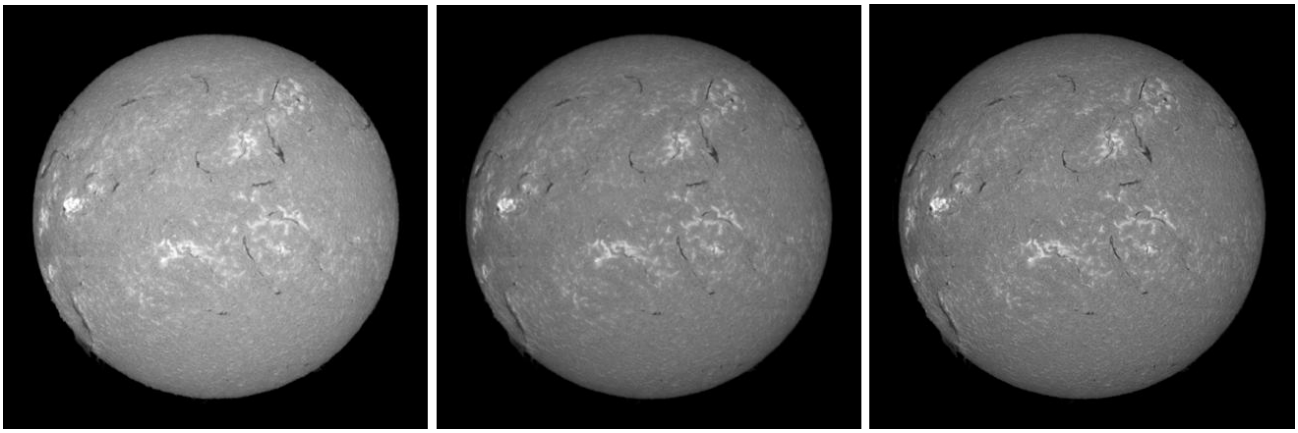
The xx_protus.png image is the stack image with thresholds to highlight protuberances and a virtual eclipse mask. This image is only present if the xx_log.txt file generated by Inti is present, as it contains the diameter of the solar disk to be eclipsed.

Image xx_stack_sharp.png is the stack image with chosen level enhancement filter applied.

These images are saved in the start image folder.

Unit images corrected for distortion before addition are also saved with the prefix "stxx.png".



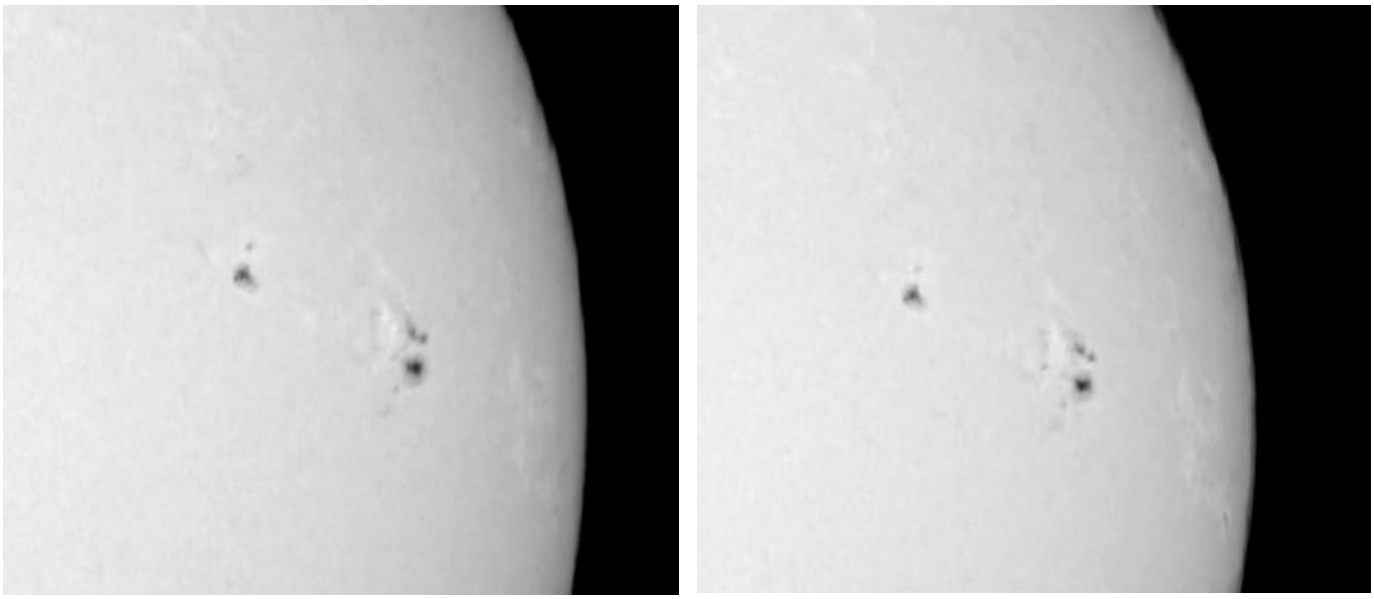


From left to right: single image, stacked image, stacked image with "Low" enhancement filter

Stacking images protuberances or continuum

When calculating the distortion of a series of images, the correction matrices are stored in memory. They can then be applied to a series of "secondary" images to produce a stacking image, despite their low contrast.

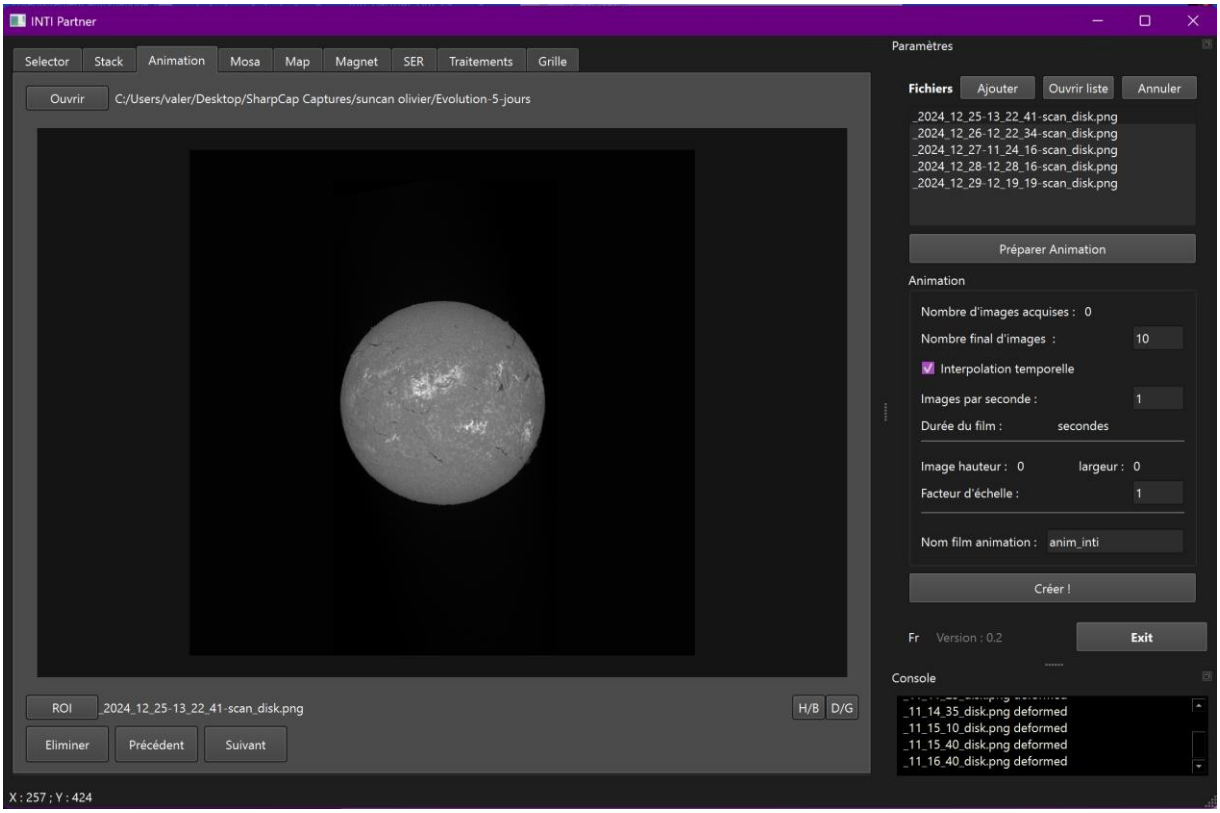
To do this, select the image series suffix "_protus" or "_cont. It's a good idea to first generate your images with INTI. Remember that the protuberance image is systematically generated by INTI, while continuum image is not.



From left to right: single continuum image, stacked continuum image with enhancement filter (details)

Animation

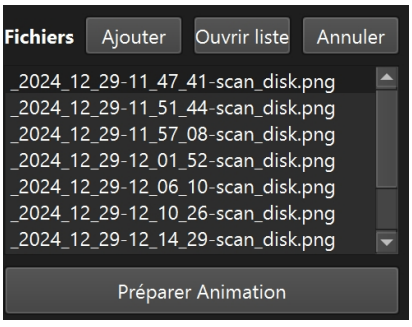
The Animation application lets you create the equivalent of a movie from a series of images.



The animation is available in gif and mp4 formats.

Two types interpolation are proposed: simple interpolation without taking the date into account, and temporal interpolation where each image is inserted at time it was shot, and the temporal sequence is therefore resampled from this temporal sequence, which is not regularly spaced in time.

The "Open" button is used to select the images in the series, and the name of each file is displayed in the "Files" list in the dock. Files can be added with the
Click on "Add. You can also open an image list file that has already been sorted.

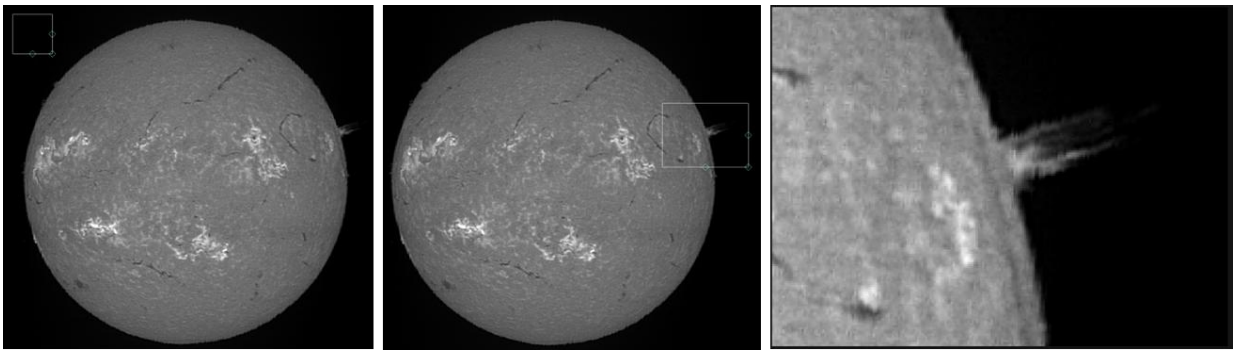


Each image in the series is displayed in the application's image area. You can zoom in with the mouse wheel and move the image with the left mouse click. You can also navigate through the series using the "Previous" and "Nextbuttons, or remove an item from the list.

At this stage, you can define a "ROI" (Region Of Interest) to crop the images before animation. This is ideal for zooming in on a protuberance or tracking the evolution of a flare in an active area.

However, it is possible not to apply a ROI and create an animation from complete image. Care must be taken with image size, however, as interpolation can be significant for images larger than 1024x1024 in temporal interpolation.

Click on the "ROI" button - a small square appears on the image. Move it with the mouse and enlarge it to the desired size using the right and bottom handles.

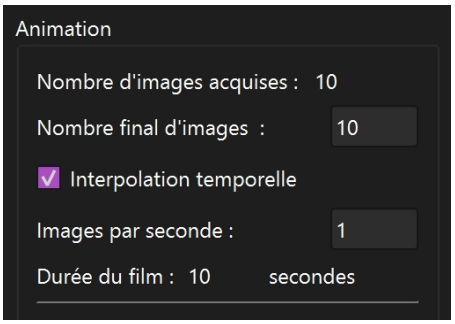


To generate ROI zone images or complete images and extract date and time information, click on the "Prepare animation" button.

The image list the series is then replaced by the ROI images if this is enabled. Visit
The number images in the series is updated in the Animation section of the dock.

Animation settings

Important: you must press "Enter" to validate each value modification in editable fields.



Indicate the total number frames to be generated for the animation. A value greater than the number of frames will create intermediate frames by interpolation.

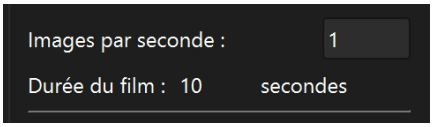
If the Temporal interpolation checkbox is active, each frame of the native series will be placed in the sequence at the exact time of .

For example, if the image sequence was acquired at times 11:12:00, 11:14:00, 11:15:00, 11:15:30 and 11:17, i.e. 5 images, and 10 images are requested, then the 10 images will be interpolated from the native images, but all resampled at the times (11:17).
(11:12) i.e. a total of 5 minutes divided by 10, i.e. spaced 30 seconds apart, i.e. the sequence 11:12, 11:12:30, 11:13, 11:13:30, 11:14, 11:14:30, 11:15, 15:30, 11:16, 11:16:30, 11:17 with blue interpolated images.

If time interpolation is not activated, the sequence will be: 11:12, 11:13, 11:14, 11 :14 :30, 11 :15, 11 :15 :15 ,15 :30, 11 :16, 11 :17

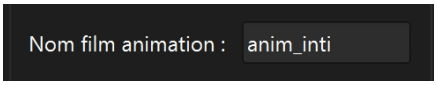
However, it is recommended not to activate temporal interpolation for large differences in time or date, as the calculation time required does not really enhance the fluidity of the animation. Similarly, it's not always useful to create intermediate frames: if you specify the same total number of frames as the number of frames in the series, no interpolation will be necessary.

You can then choose to speed up or slow down animation by indicating the number of frames per second. If you specify 2 frames per second for 10 frames, then the total duration of the animation will be 5 seconds.



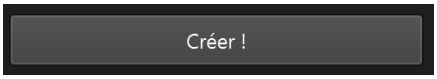
You can also choose to modify the size of the final image with the factor.

And choose the name of the animation file, which will be anim_name.mp4 and anim_name.gif.



Before creating the animation, you can display a ROI again. In this case, it will be used to calculate an average value in this region and normalize image intensities to this average. This will correct any differences in brightness between images. If no

Finally, click on the "Create" button to generate the animation.



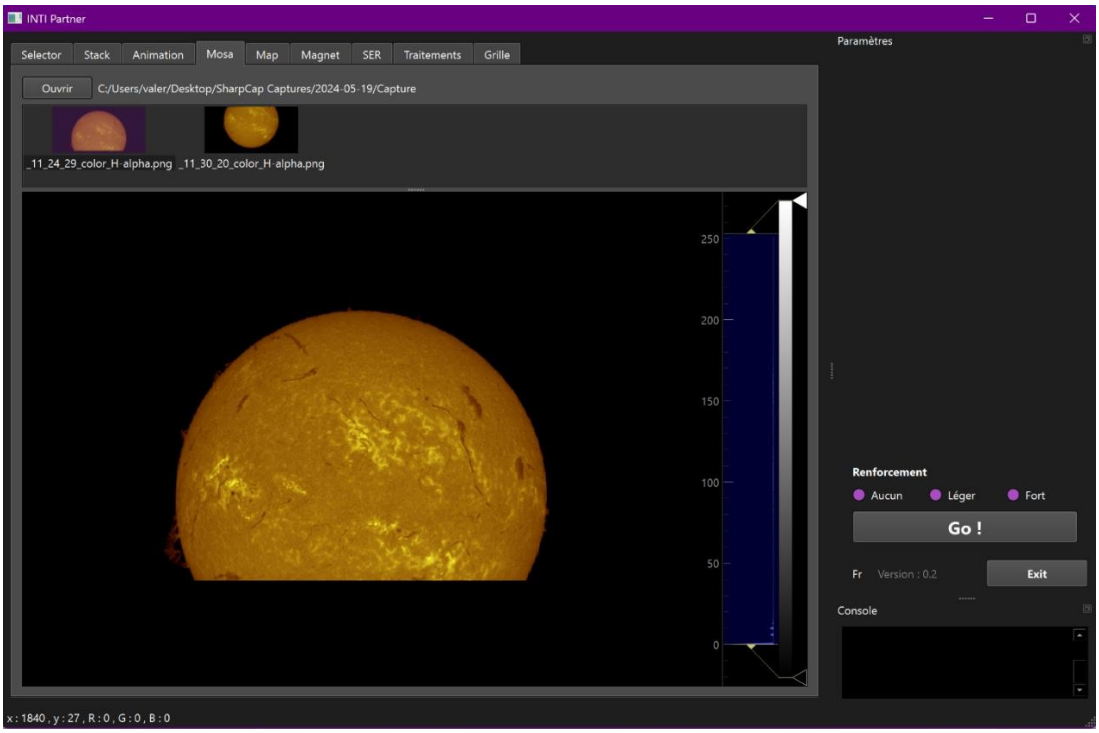
Once the animation has been created, the mp4 file will be displayed in the application area. Click on the "Play" button to replay the animation. Viewing is adjusted to screen size.

If the size of the images to be interpolated is large, the calculation time may be considerable. A warning message is displayed, which you can choose to ignore if you accept the significant calculation time. If this is not the case, then reduce the image size with a ROI.

The individual images created for the animation are saved in the image directory
with "fr" as prefix and the frame number.

Mosa

The Mosa application lets you assemble several overlapping images to create a composite or mosaic image. This application is used to create an image of the whole sun images of the partial disk acquired with a long focal length.

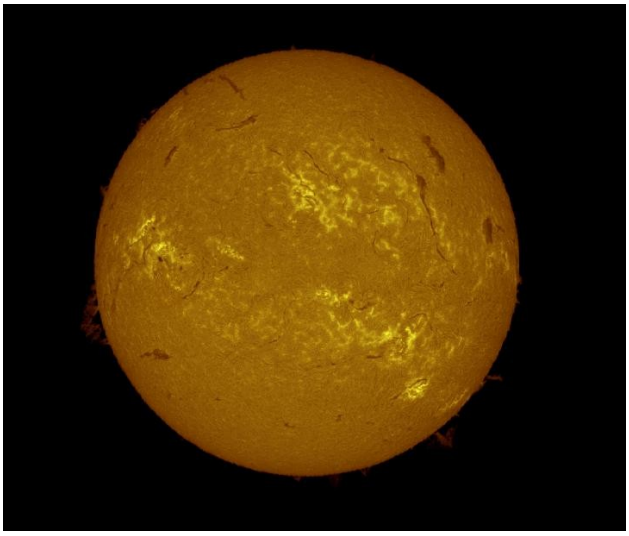


The "Open" button is used to select the images to be assembled. These images can be in black & white or color png format, or in fits format. For png files, INTI's xx_log.txt file must be present in order to read the geometric information on the position of the solar disk in the image.

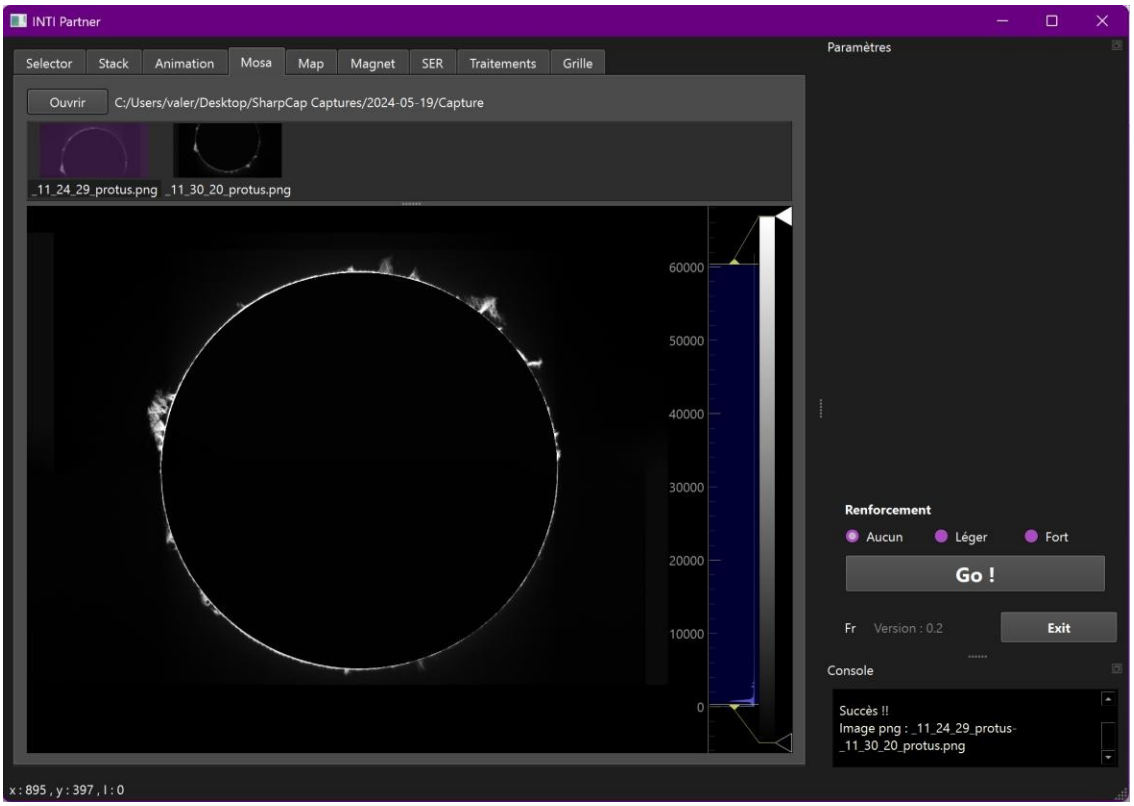
A preview of each image is displayed in the upper area. The preview can be clicked view the image in the main image area. The intensity indications under the mouse are displayed at bottom left, and it is also possible to move/zoom the image with the mouse.

If required, select the application a reinforcement filter, then click on "Go!

The resulting image will be displayed in the main image area.



The *_log.txt file for each png image also be used to assemble images of protuberances or continuum images.

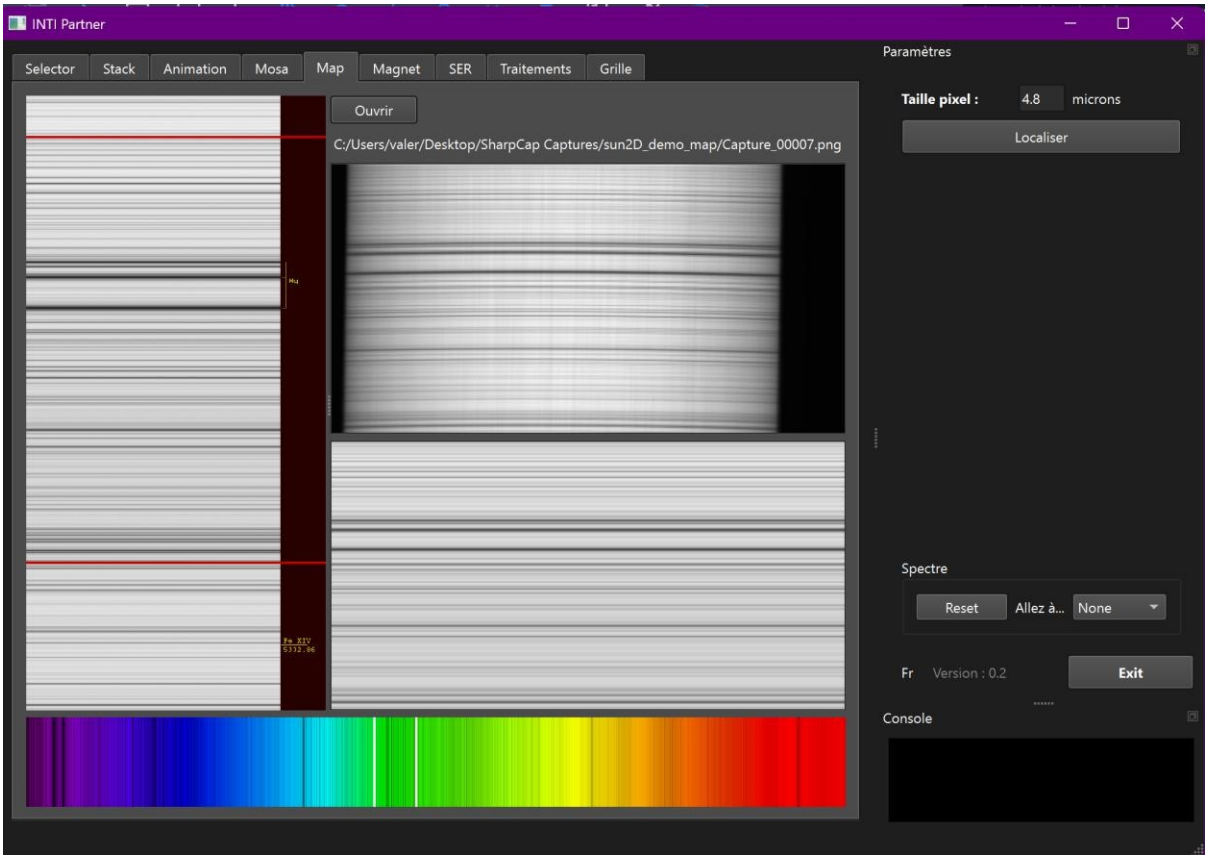


Map

One of the advantages of the Sol'Ex spectroheliograph is that you can change the orientation of the grating and move around the spectrum. You can position yourself on remarkable lines and obtain a monochromatic image in the line of your choice.
But it's not always easy to find your way through the forest lines in the solar spectrum... the spectrum is in black and white, and above all Sol'Ex/Sunscan's excellent spectral resolution only gives access to only a limited portion of the solar spectrum, even in full frame on the acquisition camera.

The big question is: "Where am I in the solar spectrum?" or "Is that the H-alpha line I'm seeing?

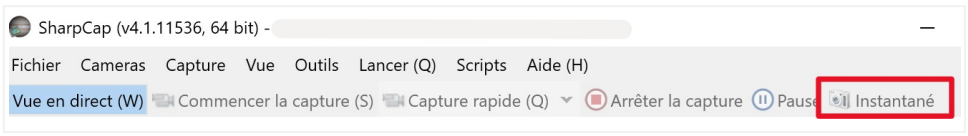
The Map application uses the fixed geometry of the Sol'Ex/Sunscan to locate an image a wide-field spectral zone in the solar spectrum identify the target spectral region.



The image area on the left shows the entire solar spectrum, with some notable spectral lines annotated. Use the left mouse button to move and zoom.

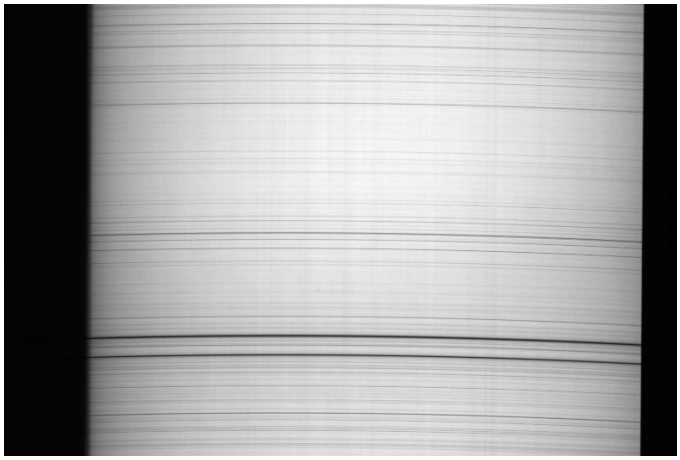
The lower image area contains a false-color image of the solar spectrum.

To identify the spectral zone targeted by your Sol'Ex, first acquire a single, png image. Note the binning value, as this will affect the equivalent size required for automatic localization.



SharCap software - click on the "Snapshot" button immediate png capture

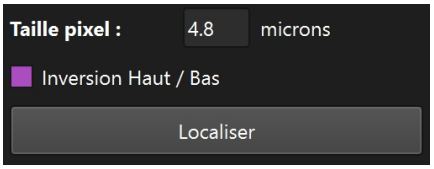
Take care not to saturate the image, to be in ROI mode, or to place a filter such as an H- alpha filter at the Sol'Ex input. You'll get a png image like the one below, which you can save.



For a Sunscan, save with snapshot, apply a pixel size of 4.0 and invert up/down.

The "Open" button loads the black & white png image of the spectral region in question.

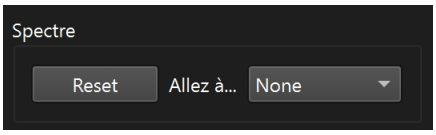
It is necessary to specify the pixel size of the image to be localized, taking into account the binning if applied.



Click on the "Locate" button

The application will position the left solar spectrum over the identified area, and a white rectangle over the colored solar spectrum. The "recognized" image is displayed below the original image.

It is also possible to select one of the remarkable lines using the drop-down box "Go to.." to position the left-hand solar spectrum on this remarkable line.

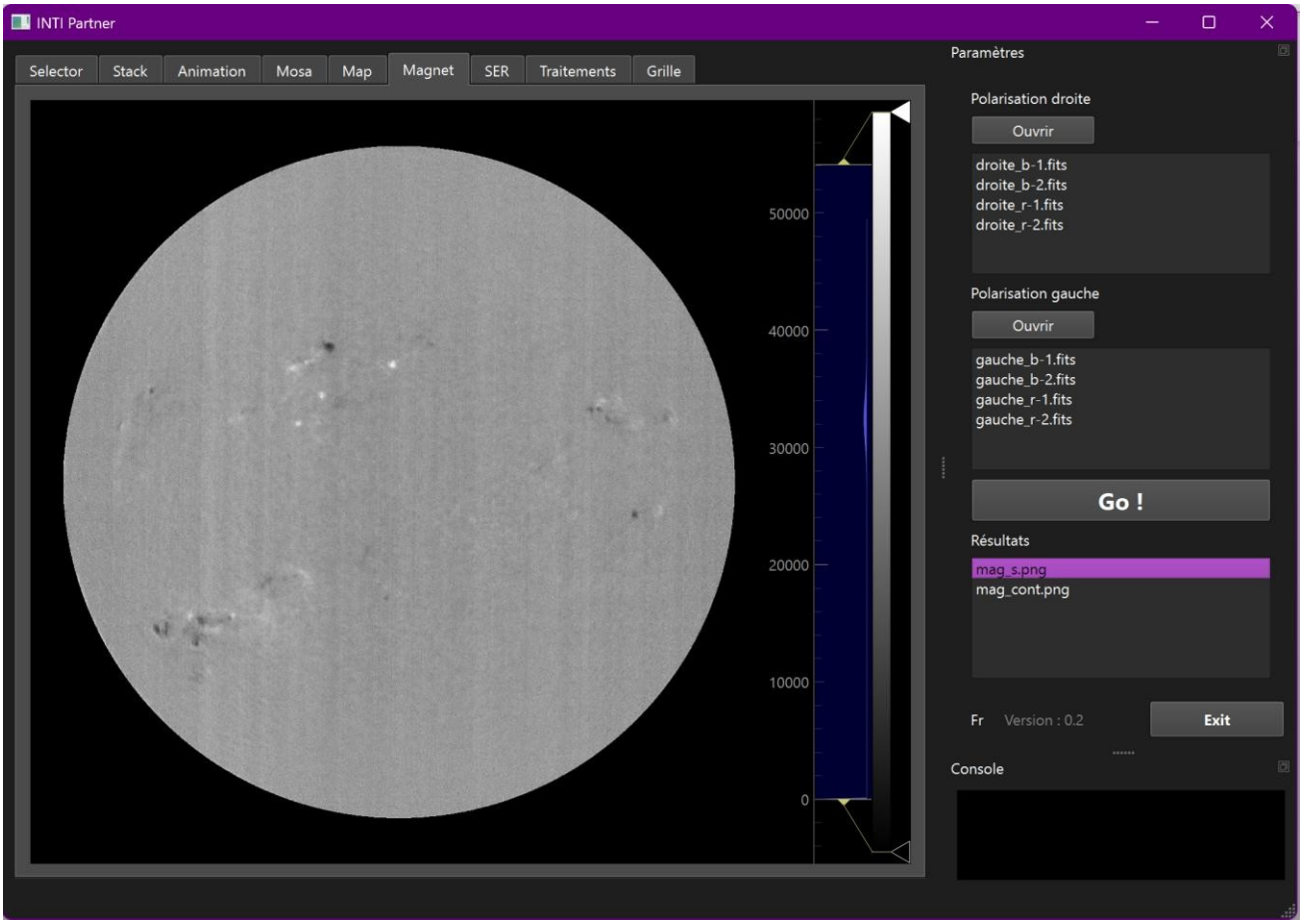


Remarkable lines are :

Elements	Wavelength	Applications
Ca II K	3933.7.	Calcium image
Ca II H	3969 Å	Calcium image
H beta	4860 Å	
Mg triplet	5167.33, 5178.68, 5183,61 Å	
Fe XIV	5302.86 Å	Solar crown
He I D3	5875.62 Å	Helium image
Na D1,D2	5889.95, 5895.924 Å	
Fe I	6173 Å	Magnetogram
Fe I	6302 Å	Magnetogram
Fe X	6374.56 Å	Solar Crown
H-alpha	6562.53 Å	H-alpha image

Magnet

The Magnet application complements the INTI application to create magnetogram images from polarization fits on Zeeman-sensitive lines generated by INTI.



Refer to the observation http://valerie.desnoux.free.fr/inti/INTI_image_magetrogramme_V3.pdf

Once processing with INTI is complete, the polarization files are saved on disk, and for each polarization there should be a blue wing image and a red wing image.

Use the "Open" button in the right-hand polariation image list in the dock. Select the blue "-b" and red "-r wing files. Do the same for the left polarization images.

You can have just one set of images, but you can also have several sequences to increase image quality. Summation will be performed automatically. The application checks for name consistency.

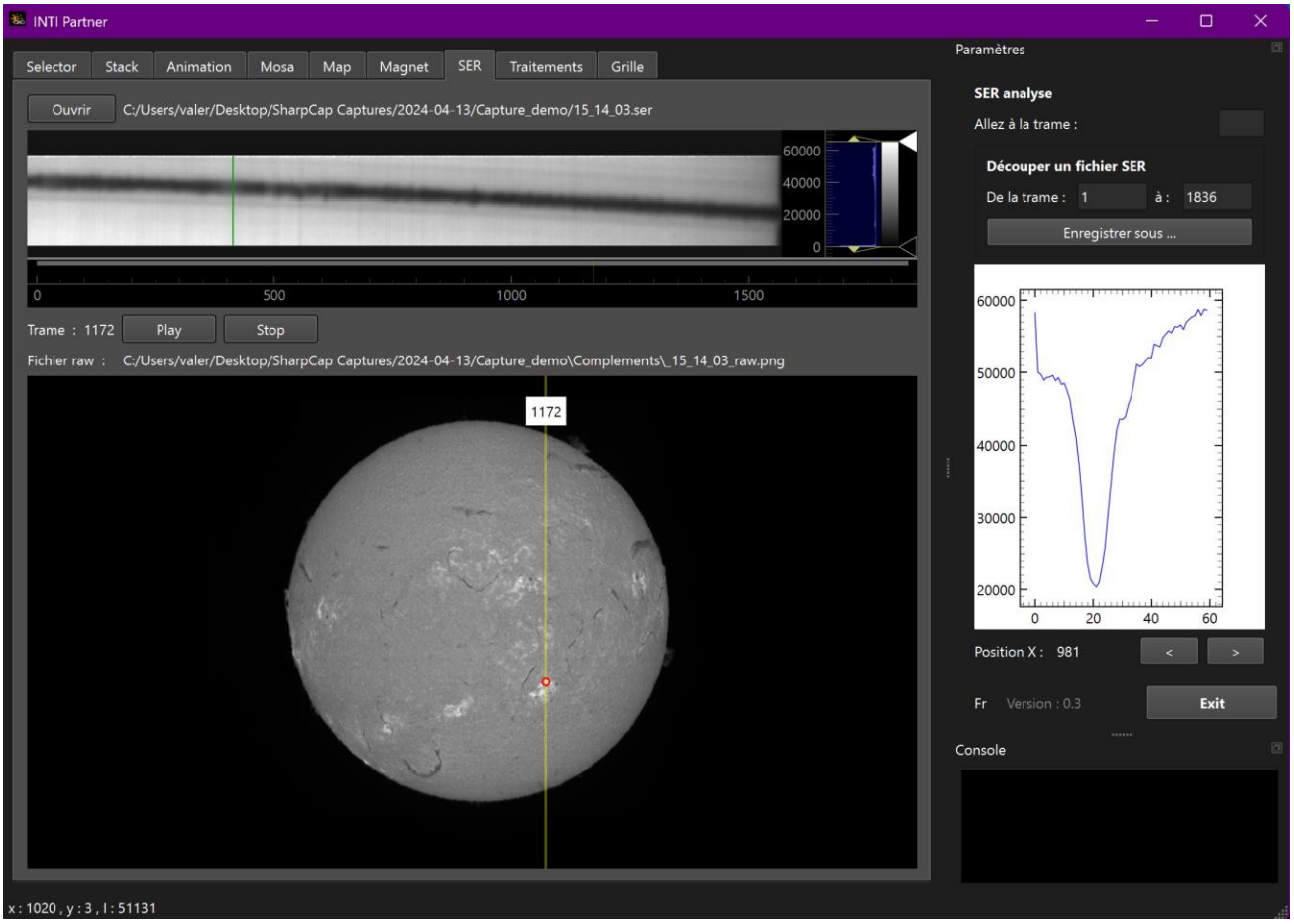
Start the magnetogram calculation with the "Go!

Both the magnetic field image and the continuum image are generated, and their names are displayed in the results list.

The magnetic field image is displayed in the main image area. You can move and zoom into the image with the left mouse button.

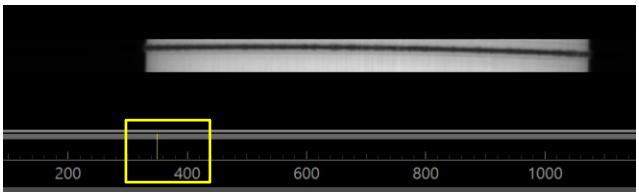
SER

The SER application allows you to view a SER video file and match the profile of the spectral line of interest with the raw image produced by INTI.



Load the SER file using the "Open" button

The first frame is placed in the upper image area of the application. It is black, but below the image a control allows you to move a small vertical cursor on the horizontal axis, the frame number axis.

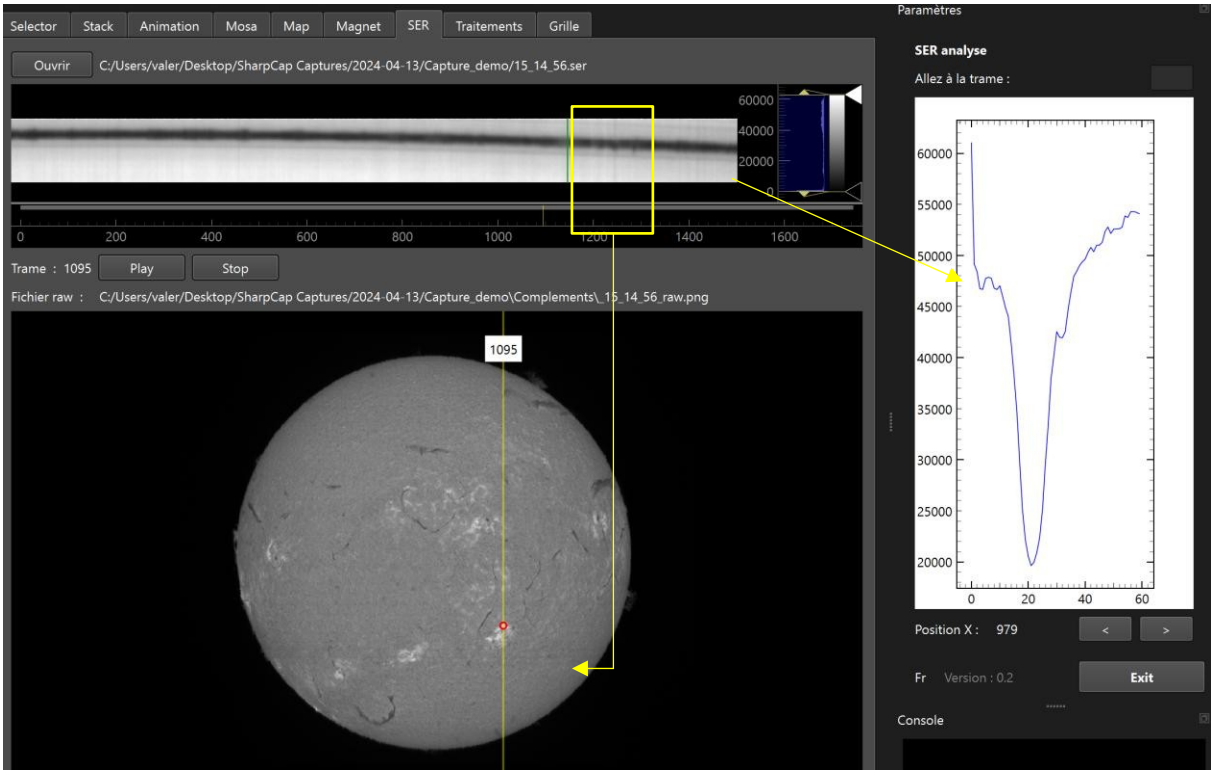


Use the left mouse button to move and zoom the raster image. Thresholds can be adjusted using the histogram sliders on the right.

If in the SER file directory the image "_raw.png" is present in the
If you select "complements", it will automatically be displayed in the lower image area. The same applies to the image can moved and zoomed.

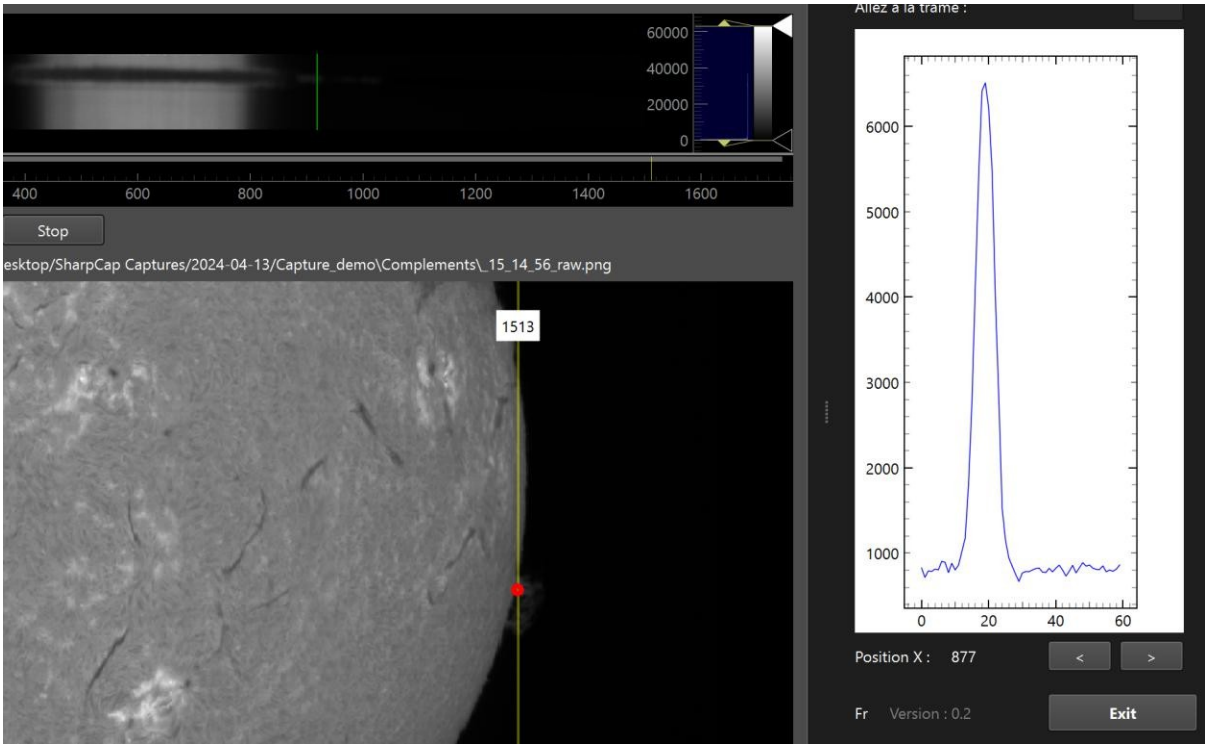
A vertical yellow cursor is positioned on the column of the image produced by the active frame of the SER file displayed. Use the mouse to move this line and view the corresponding frames in the SER file area.

You can also click within the displayed frame. A small green vertical cursor into the frame. The position in corresponding raw image is indicated by a small red circle, and the spectral profile is displayed in the profile area on the right in the dock.



To move through the frame, use the buttons below to see the spectral profile evolve over the height of the disc.

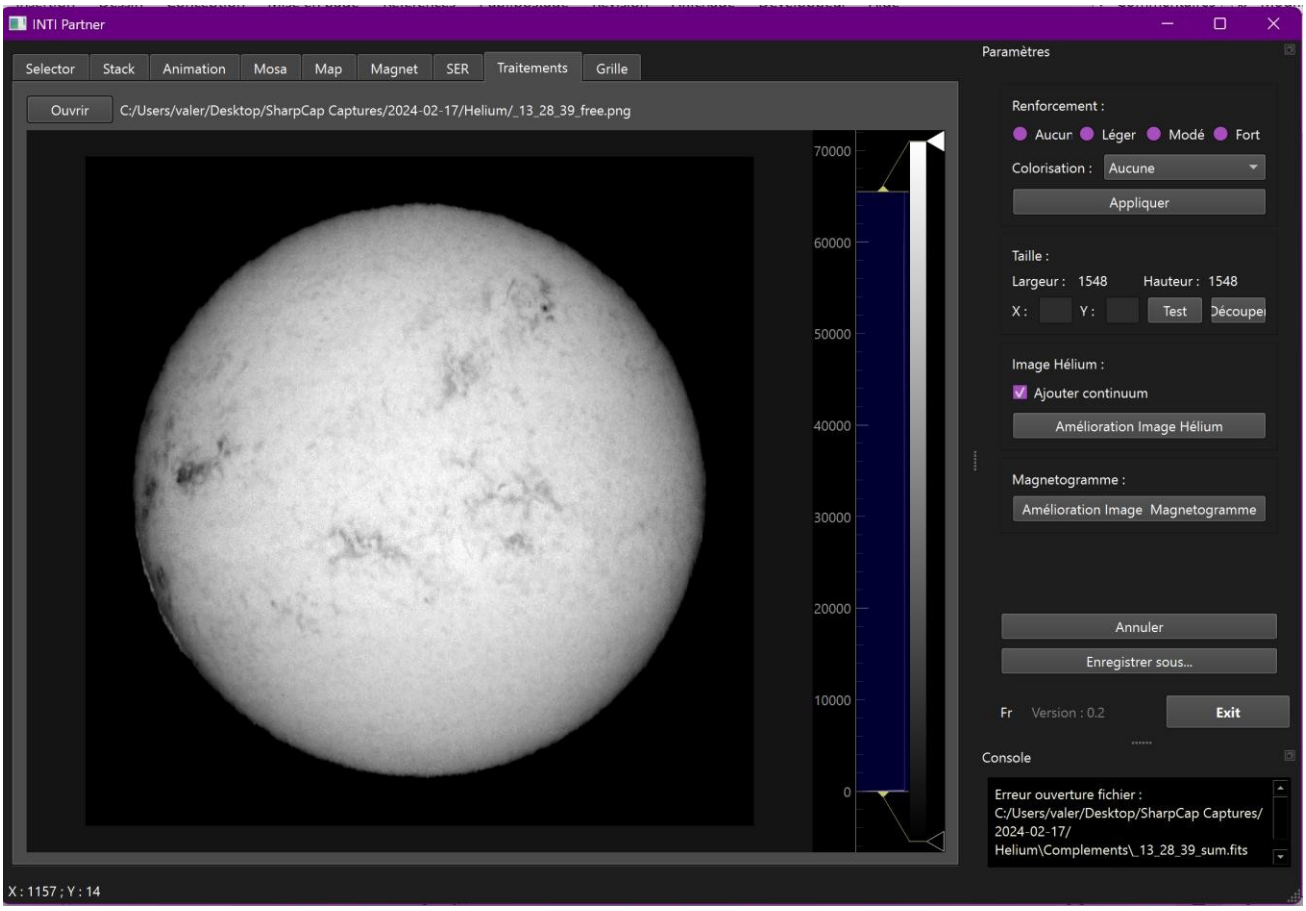
Below is an example of a line inversion at the edge of the disk, indicating the presence a protuberance.



It is also possible eliminate frames at the beginning or end of a video save the modified SER file. To do this, specify the start and end frame numbers, then click on the "Save as..." button.

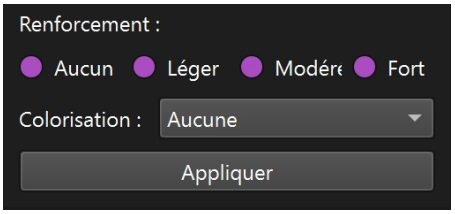
Treatments

The Treatments application lets you apply some basic post-processing to a solar image, such as enhancement or colorization. It also offers non-uniformity band correction on processed images such Helium or magnetogram images.



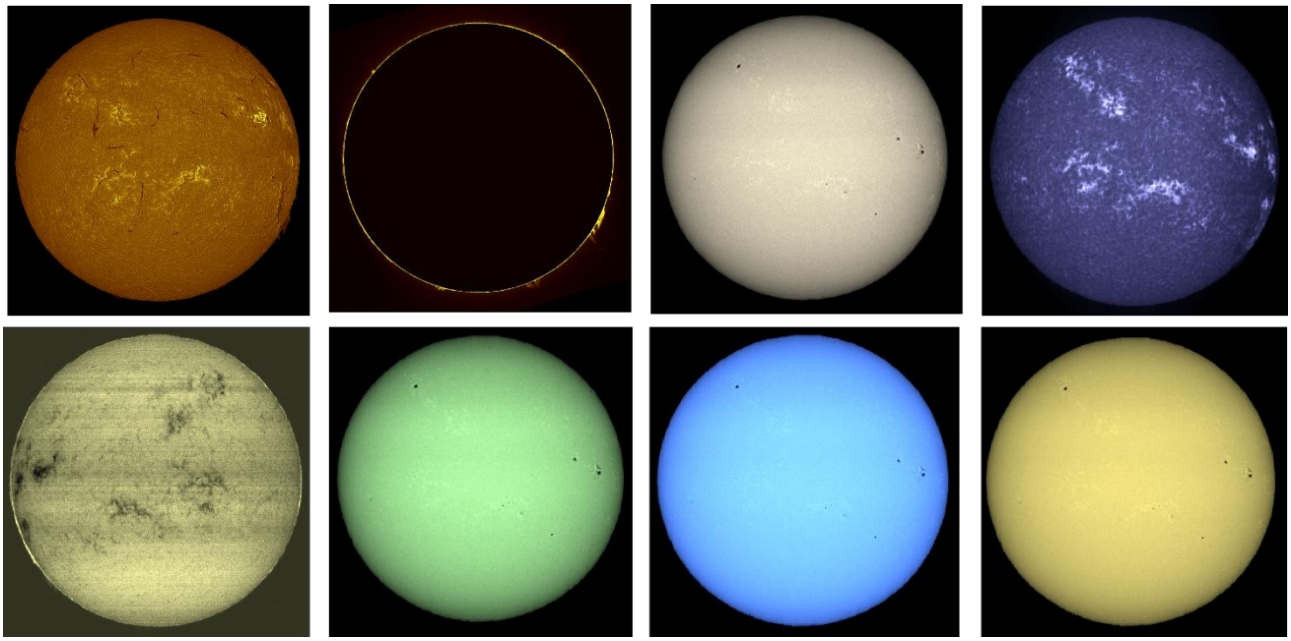
Load the image to be processed with the "Open" button - png and fits formats are accepted.

Reinforcement and colorization

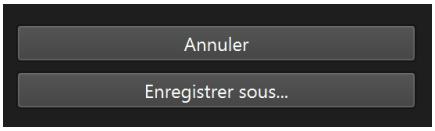


Select the strength of the reinforcement filter. Select the color to be applied from the "Colorization" drop-down list. Leave on "None" to apply no colorization.

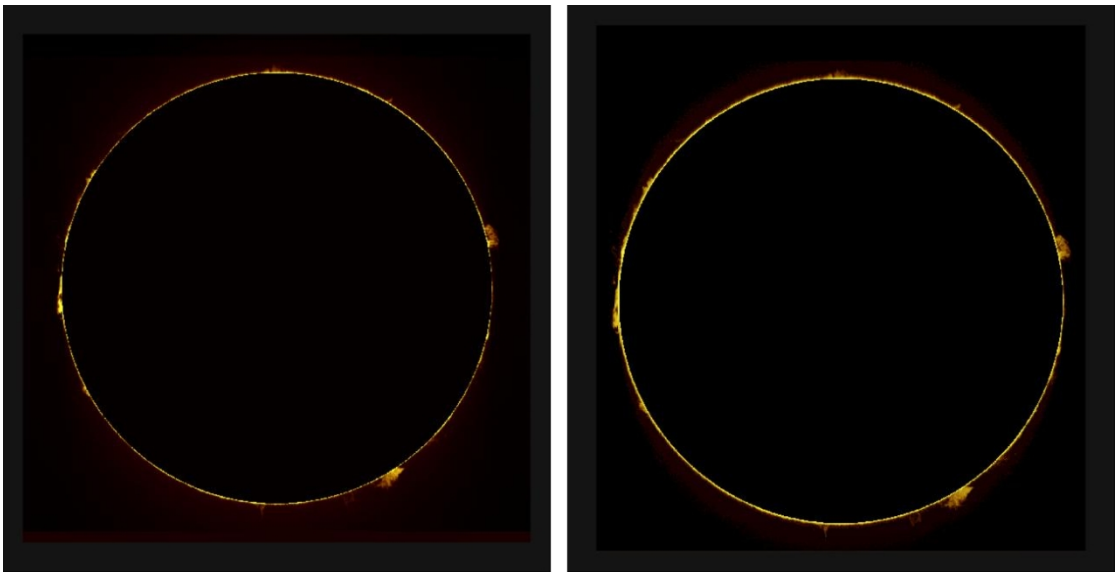
The colors available are chosen according to the main lines: H alpha, Calcium, Pale (for the continuum, for example), Helium (orange D3 line), Magnesium (triplet in green), H beta (light blue), Sodium (orange yellow).



To cancel processing and return to the original image, click on the "Cancelbutton, and to save the result, click on the "Save as..." button.



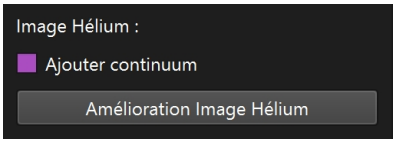
Images not generated by INTI can be processed in this application.



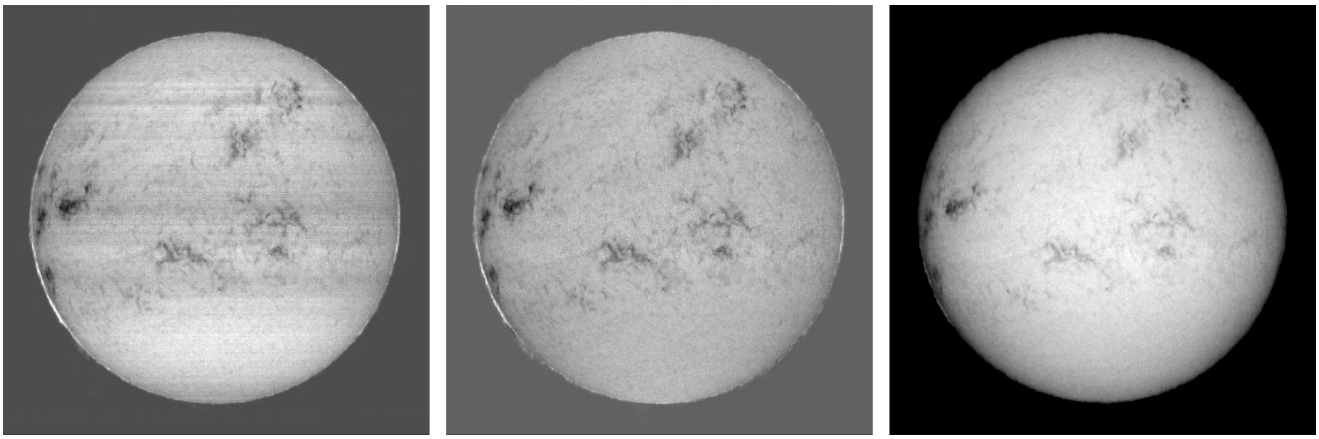
From left to right: identical SER file, protus image generated by INTI and colorized by Inti_partner - protus image generated by JSolex and colorized by Inti_partner

Helium image enhancement

The basic helium image generated has a number of non-uniformity bands due to image subtraction in the process. A new "flat" correction can be applied post-processing. This function is available as an option in INTI 6.4.



Load the image in the main area, click on "Helium Image Enhancement" - if the
If "Add continuum" is ticked, continuum image is combined with the helium line image.

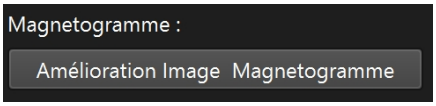


From left to right: single Helium line image generated by INTI, image with Helium image enhancement, image with enhancement and combination with continuum image.

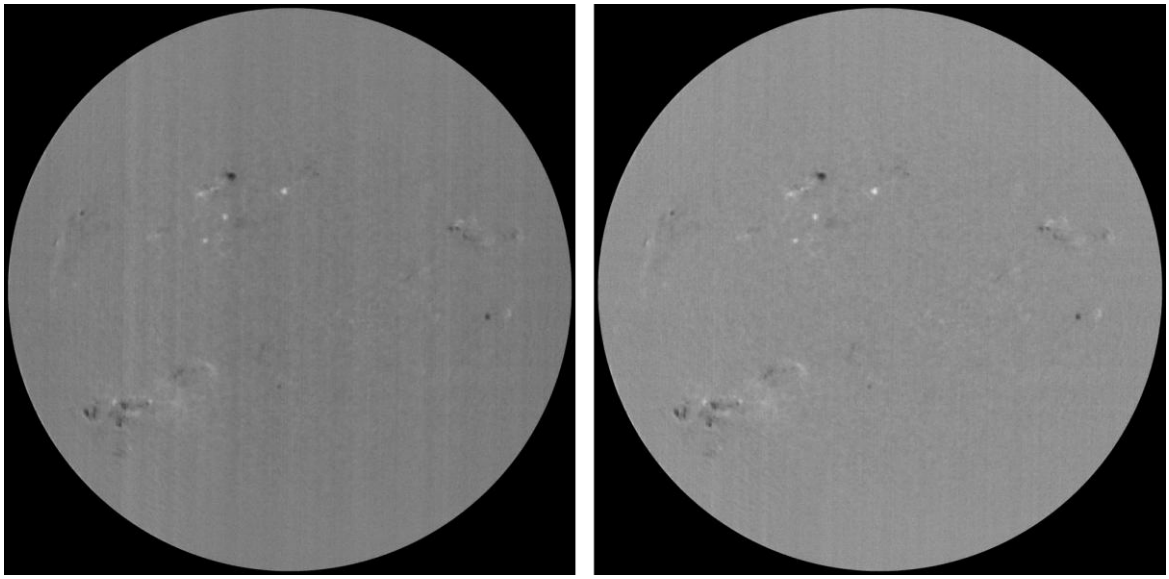
In the same way, the Undo button returns you to the original image, and the
"Save as..." saves the image in 16-bit png format.

The saved image can then be reloaded to apply enhancement and colorization treatments.

Magnetogram Image Enhancement



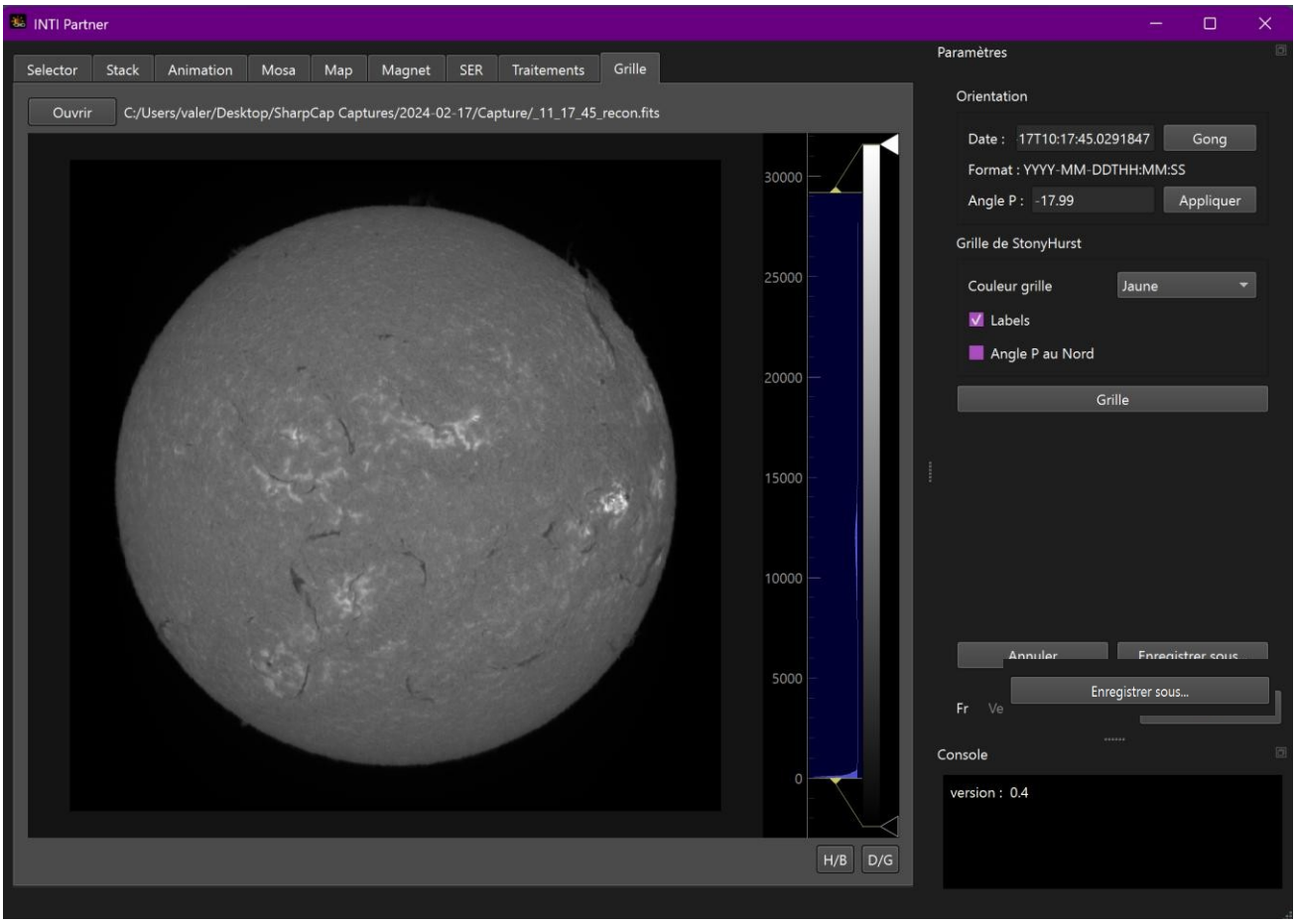
The correction is of the same type as a "non-uniformity" correction as in INTI or the
Helium image , but on vertical bands.



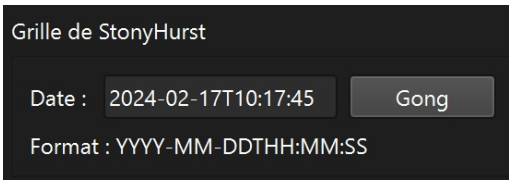
Before / After improvement - Images Olivier Aguerre

Grid

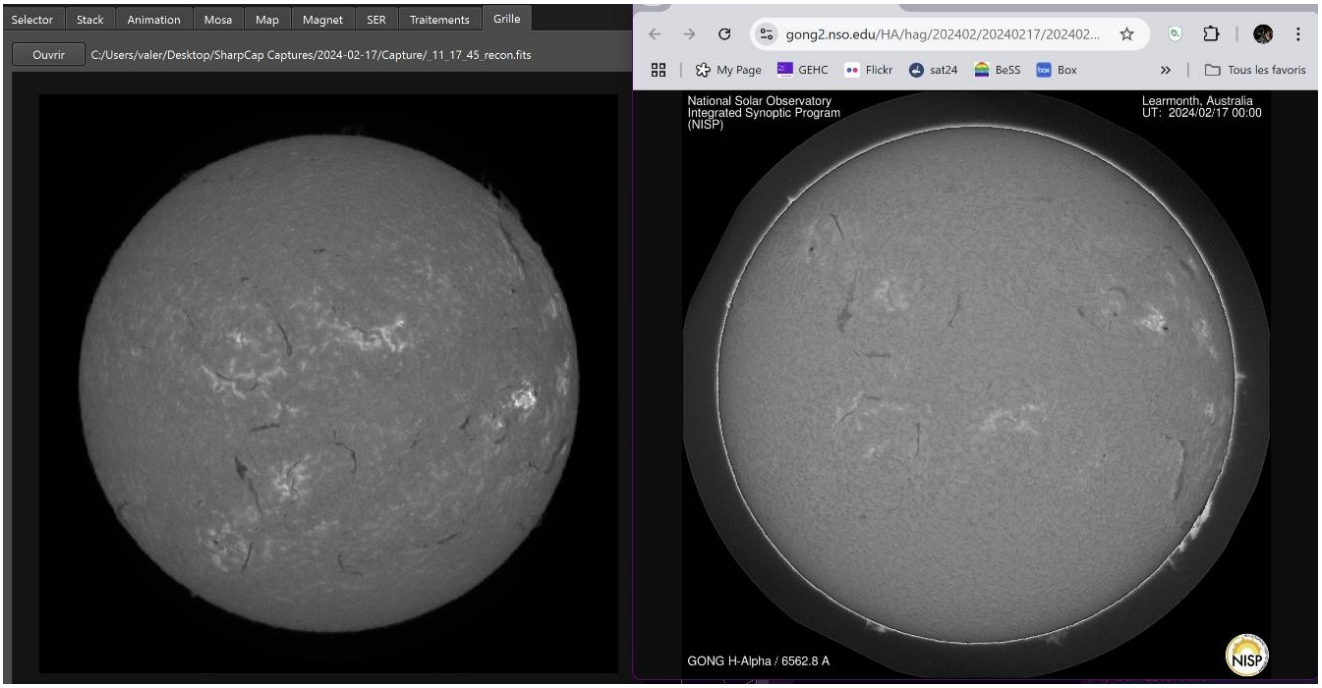
The Grid application creates a Stonyhurst grid of heliocentric coordinates for images in fits format. This function is available as an optional extra in INTI. The application allows you to regenerate a grid and take over image orientations without having to re-process them in INTI.



Load fits image with "Open" button - date extracted fits header is displayed in the dock date field.



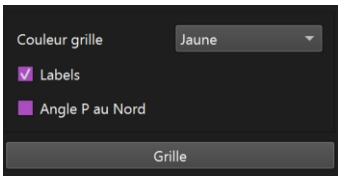
The first step is to check the North-South and West-East orientation of the solar disk. , during acquisition, inversions (camera, scanning direction) can occur. The "Gong" button can be used to display a professional image that respects the orientation conventions. By comparing the two images, you can determine whether H/B or D/G inversions should be applied using the corresponding buttons.

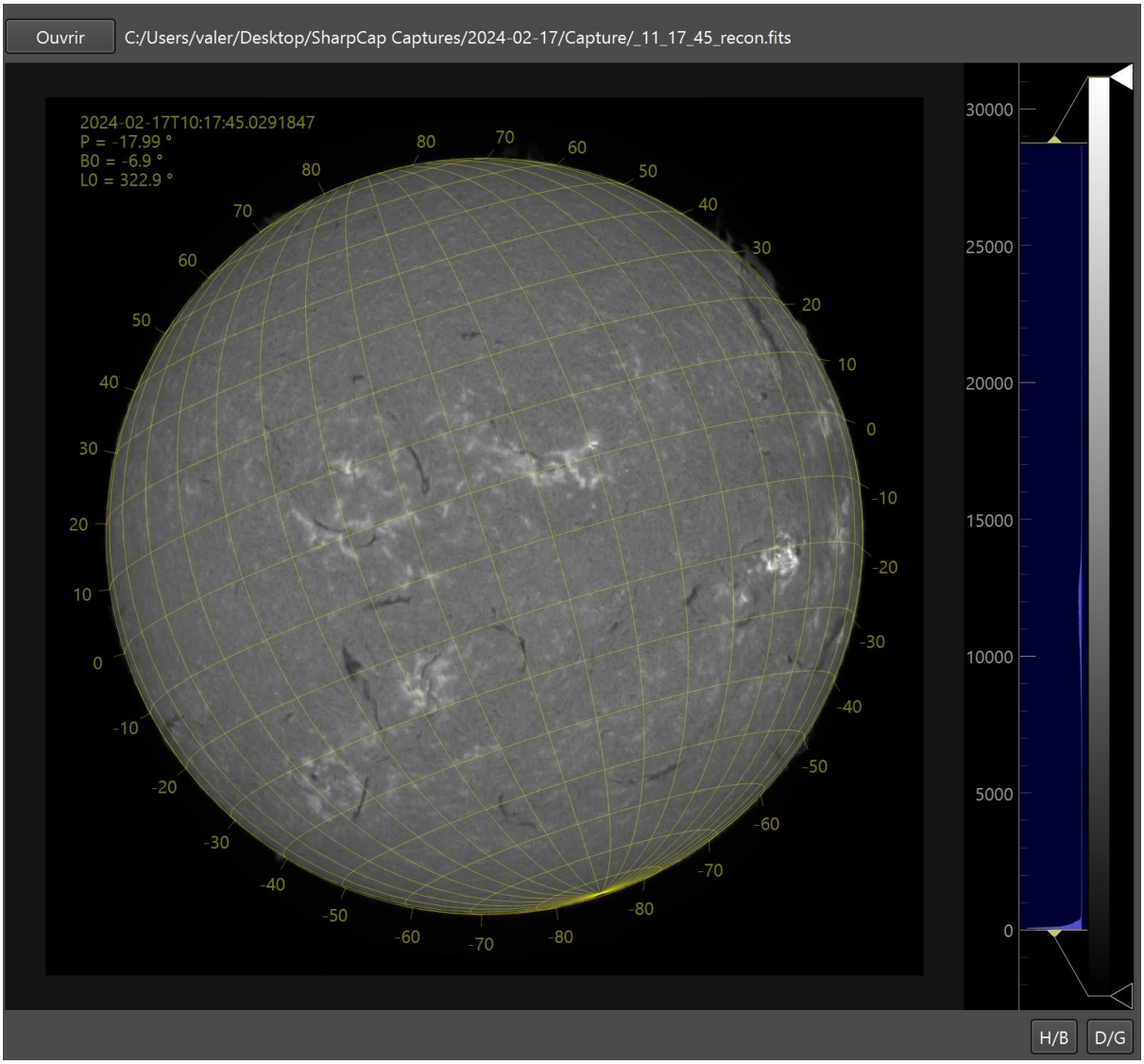


In above example, a D/G inversion is required.

Angle P is also calculated and displayed. If the orientation has already been done in INTI, it is not necessary to correct the orientation to put the North Solar Pole at the top.

Once the image has been correctly oriented, the Stonyhurst grid can be calculated using the "Grid





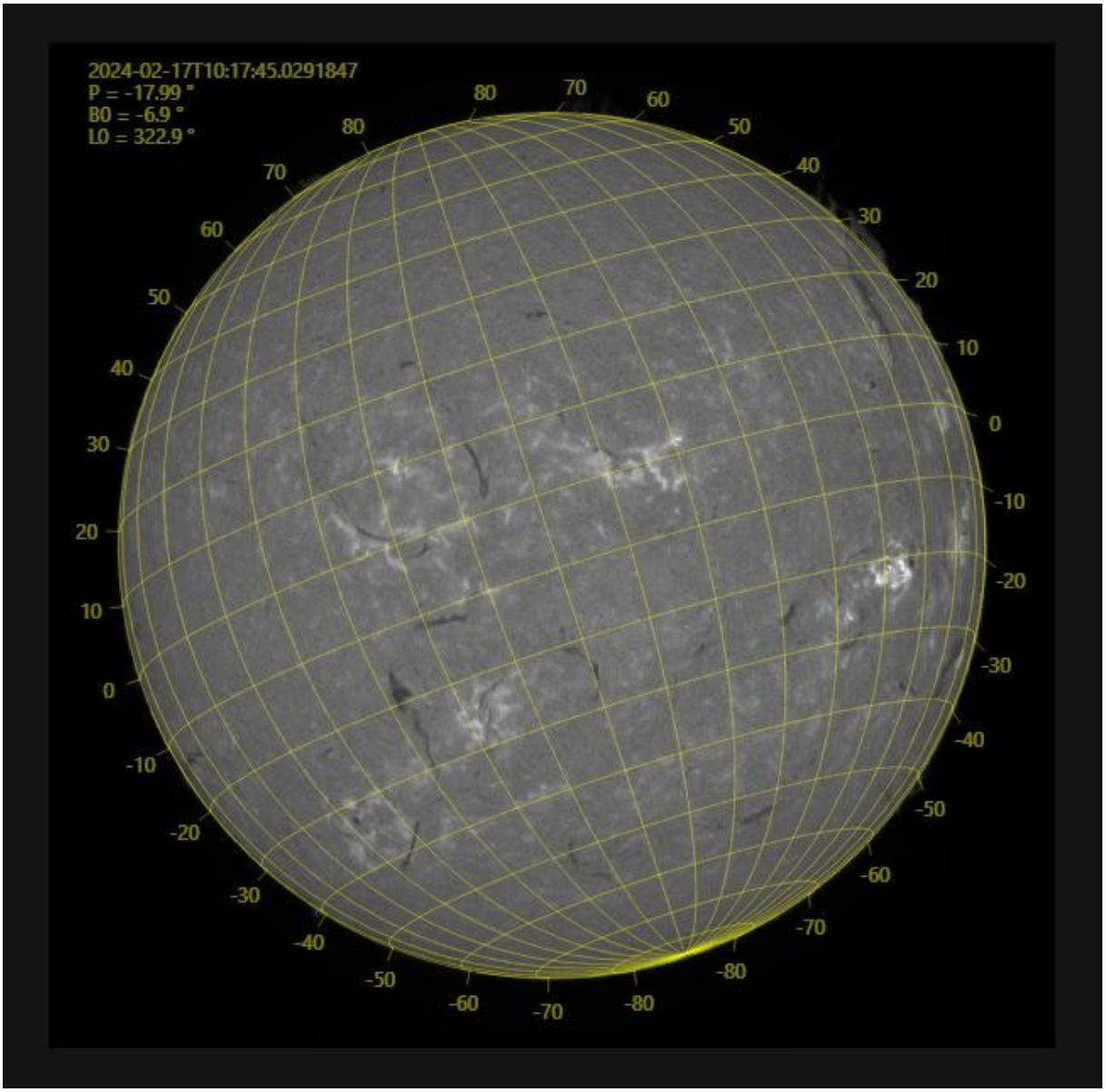
The grid is oriented on the solar heliocentric pole, defined angle P, calculated by the application or applied with the "Applybutton. If the image was created in INTI with angle P correction that places solar north at the top, instead of celestial north, then check the "Angle P to North" box to avoid applying the angle adjustment twice.

You can adjust the color of the grid: yellow, black or white, depending on the contrast of the solar disk. You can also choose not to display labels, i.e. heliographic latitudes.

The P (solar North Pole), B0 (heliocentric latitude of the apparent center of the solar disk) and L0 (longitude of the central meridian) information is calculated and placed in an insert at top right.

To save the result, click on the "Save as..." button - the image is saved in png format.

To return to the image, click on the "cancel" button.



Please note: image fits applications other INTI must be provided in fits header.
keywords / expected format for DATE-OBS, CENTER_X, CENTER_Y, SOLAR_R