

# INTI

## Calculation of a Helium Image with free line tab

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To observe and generate an image of the solar disk in a shallow spectral line and therefore low contrast, INTI offers the tab "Free Line" to facilitate the necessary operations.

In the case of the spectral line of helium He I, also identified as the D3 line, there will be three steps

- Calculation of the polynomial that models the shape of the slit
- Locating the assumed position of the line
- Calculation of the spectral image with subtraction of an average image of continuum

Consequently, it is necessary to first acquire three videos of precise area that we will describe, then proceed to the treatment with INTI.

### Acquisition of the data necessary to calculate the helium D3 image

Rotate the grating to cover the wavelengths around the helium line D3 at wavelength 5875.65 Å which is in the vicinity of the famous sodium doublet, lines D1 and D2, respectively at wavelengths 5889.97 Å and 5895.94 Å

**Video 1 - Make a scan on a near and dark spectral line.** Do not change the orientation of the array but move the acquisition ROI. It is not useful to know which spectral line it is because its shape will only be used to calculate the polynomial that models the shape of the slit.



#### Move the ROI to the region of the yellow D3 helium line (HeI)

To see it well it is necessary to observe very close to the solar limb, where it is revealed as a "bright" line.

#### Video 2 - Acquire a SER video of the D3 yellow line region of Helium

We position the solar limb almost tangent to the slot, we make a SER of 50 to 200 frames (not more), without moving the mount (hence the term static).



**Video 3 - Then make a video acquisition of the same ROI by moving the mount, classic scan of the solar disk.**



## Calculation of the polynomial

Launch INTI

**1 - Load video 1 of the intense dark line for the calculation of the polynomial: 09\_44\_21.ser**

- Select the general tab
- Click on Ok

INTI will detect the darkest spectral line and calculate the polynomial. It will create an image `xx_mean.fit` which is the average of all the frames in the video file.

The coefficients of the polynomial are displayed in the console and saved in the log file as follows:  
Coef  $a*x^2$ ,  $b*x$ ,  $c$  :3.2034828347376455e-05 -0.040186456587511396 37.07034261352035

**2 - Load the static video 2 of the area near the limb : 09\_47\_40.ser**

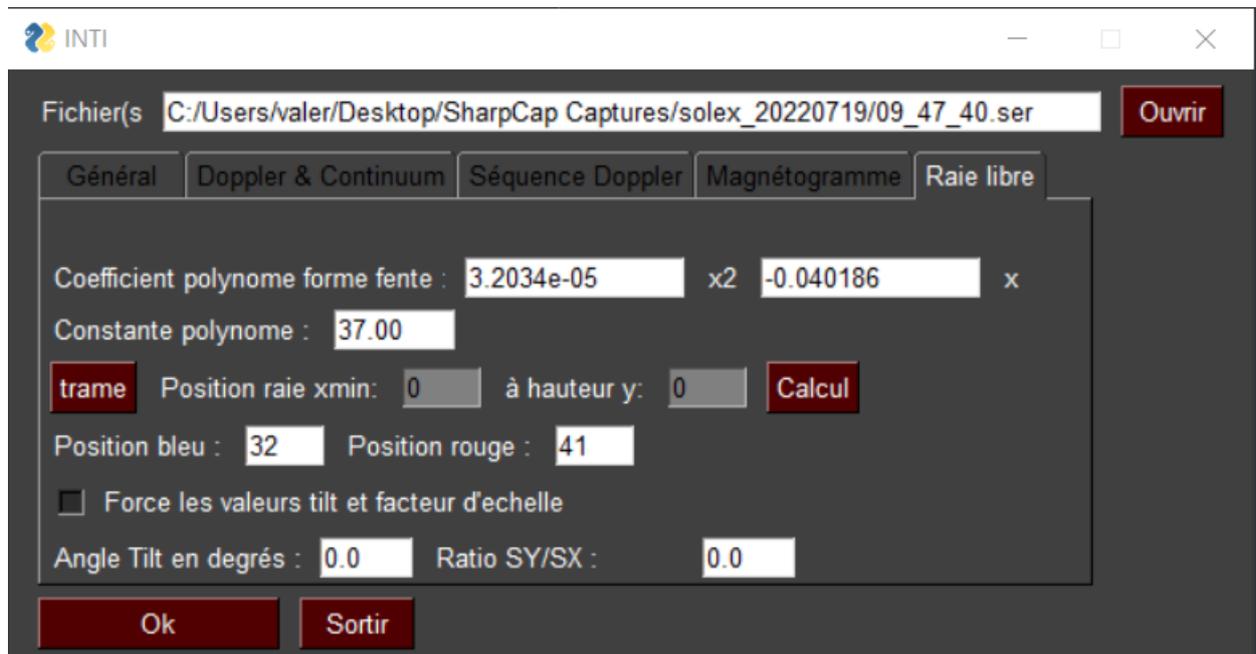
- Stay on the general tab
- Click on Ok

Even if there was no movement of the mount, INTI will calculate the average frame and then attempt to reconstruct the images of a disk. The video being static these images will be irrelevant. This video will be used to locate the position of the helium line to reconstruct the disk from this position and shape of the slit even if the spectral line is not or not very visible.

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### Select Free line tab

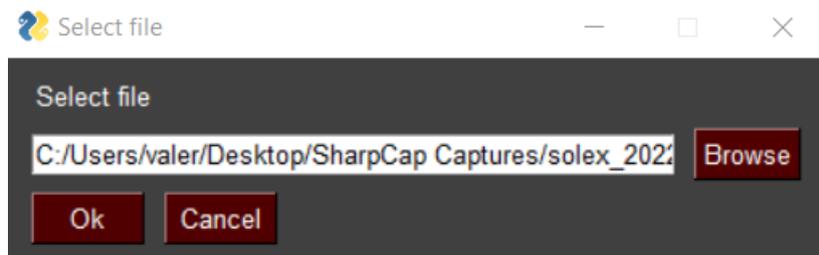
Enter the coefficients of the previously calculated polynomial - you can either look in the console in step 1 or open the log file from the previous file 09\_44\_21\_log.txt.



The constant of the polynomial is the position x of the slit for  $y=0$ , y defined in pixel the height in the spectrum starting from the bottom. The value  $y=0$  is not always obvious to identify, so we prefer a new constant or position reference by giving a pair of x,y values so that INTI calculates the new position reference. For this, the buttons "Raster" and "Calculation" will help us.

### Click on the frame button

In the popup window find and select the image fits\_09\_47\_40\_mean of the file you just processed in step 2 it is part of the result files of this step. Click on Ok.

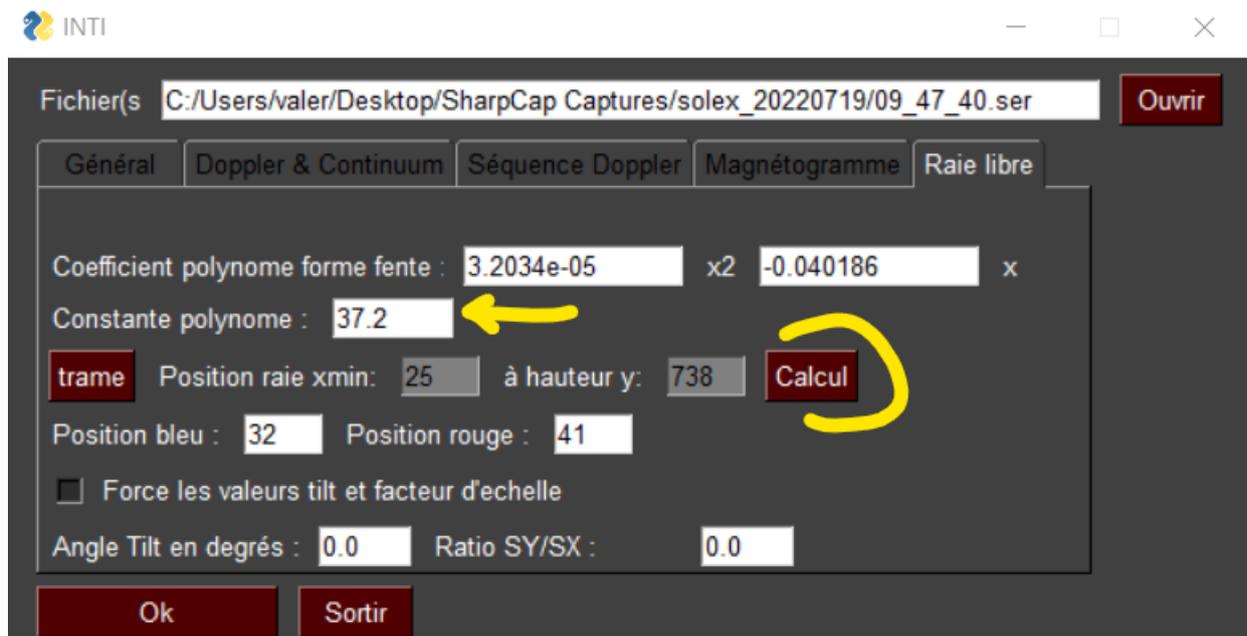


[Tapez ici]

The average frame image will be displayed. Place the mouse on the image at the position of the bright line, it is the helium line in emission. Click on it. The position in x and y is displayed in the image.



Close the image by clicking on the cross at the top right, or by pressing the "escape" key - The x and y positions are automatically transferred to the x min and y height fields of the tab when the image window is closed. Click on " Calculation " to update the constant of the polynomial.



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At this point, you have freely defined at which positions to extract the intensities on a spectral line that is not very contrasted or even not visible.

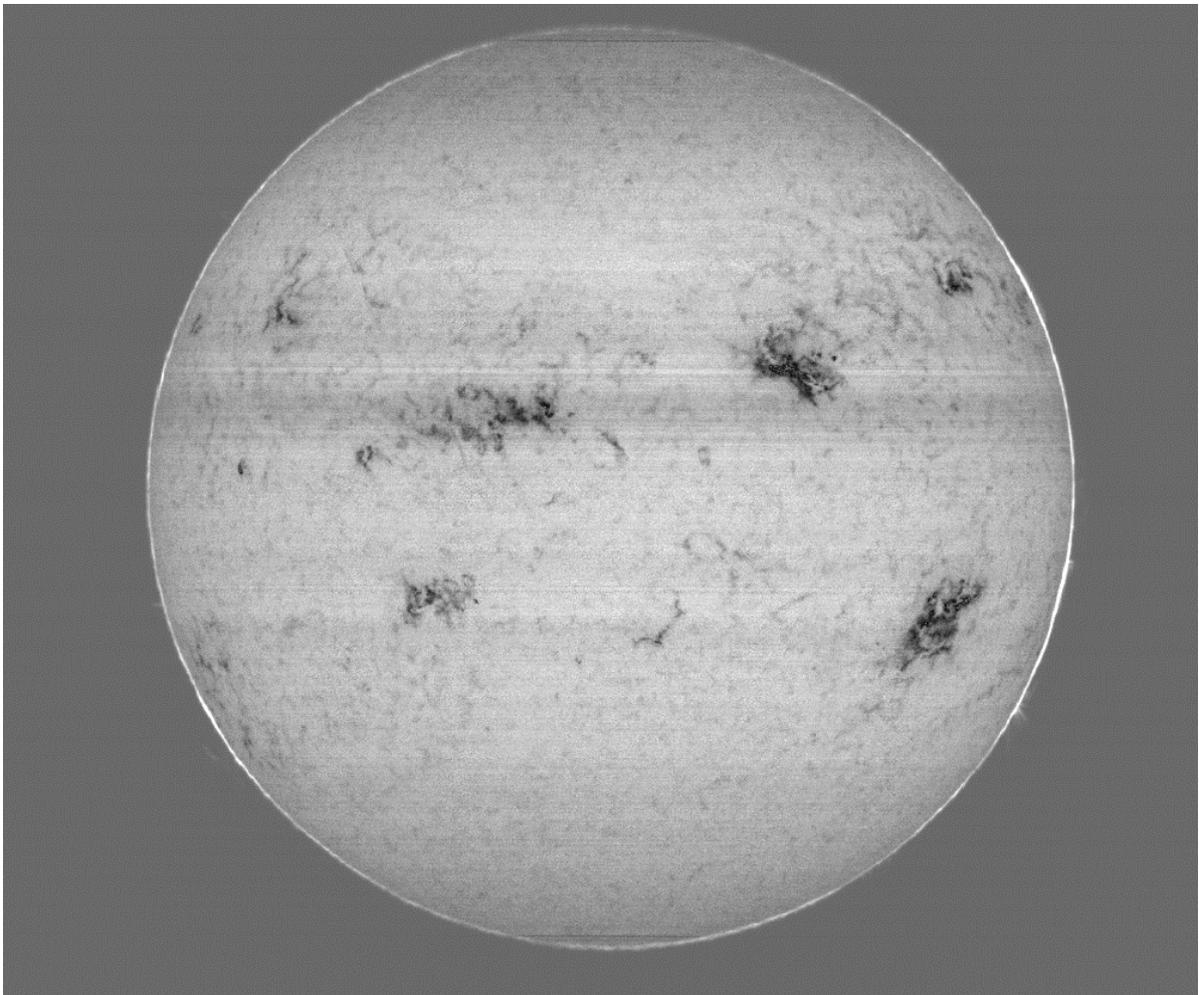
## Helium image reconstruction

### 3 - Load the video file 3 of the helium area: 09\_50\_33.ser

This line being very low contrast, we must subtract an image of an average continuum.

Enter in the blue position and red position fields the positions from which the intensities will be extracted to generate two continuum images. INTI generates them automatically, averages them and subtracts the mean to the image of the free line, here the helium line.

By iterative adjustment of the constant of the polynomial, we can find the image \_free which will present the greatest contrast.



*Image Christian Buil – Sol'Ex on 80mm TS scope with 480mm focal length*

## Generalization

The example of the helium line D3 illustrates how INTI can generate an image of the solar disk at a free wavelength, defined by the operator.

This operation can for example search for the green line of the crown or other lines whose contrast is too low for an automatic search.

The difficulty lies in the iteration often necessary to find the position of this spectral line, iteration nevertheless facilitated by this dedicated tab.