1. Getting Started

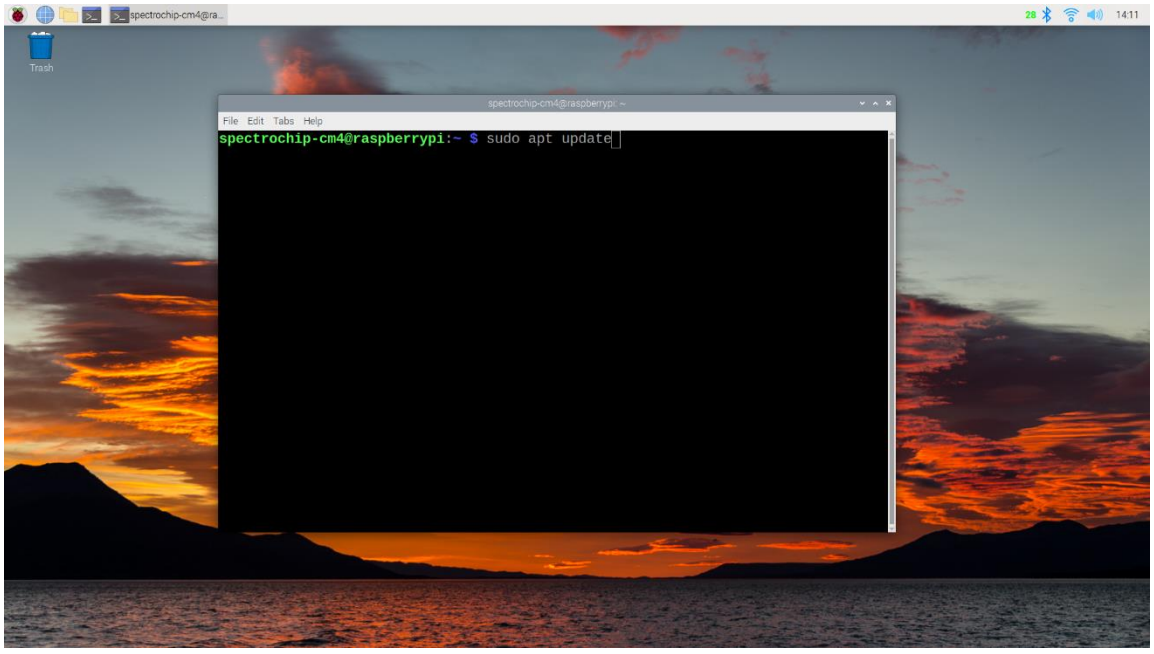
Before you start, you have to make sure all the requirements have been fulfilled or can follow the instruction bellow.

1.1 Installation

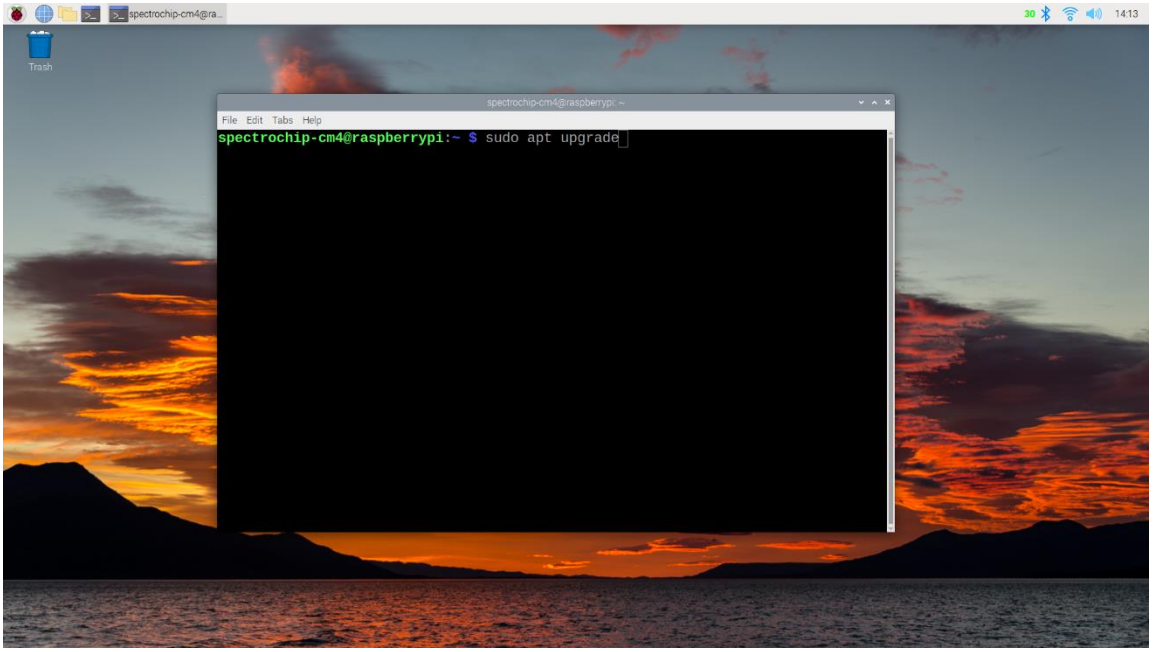
Before you follow the steps below, make sure that you have python/python3 and pip already installed. Open terminal and follow the steps bellow.

Installation steps:

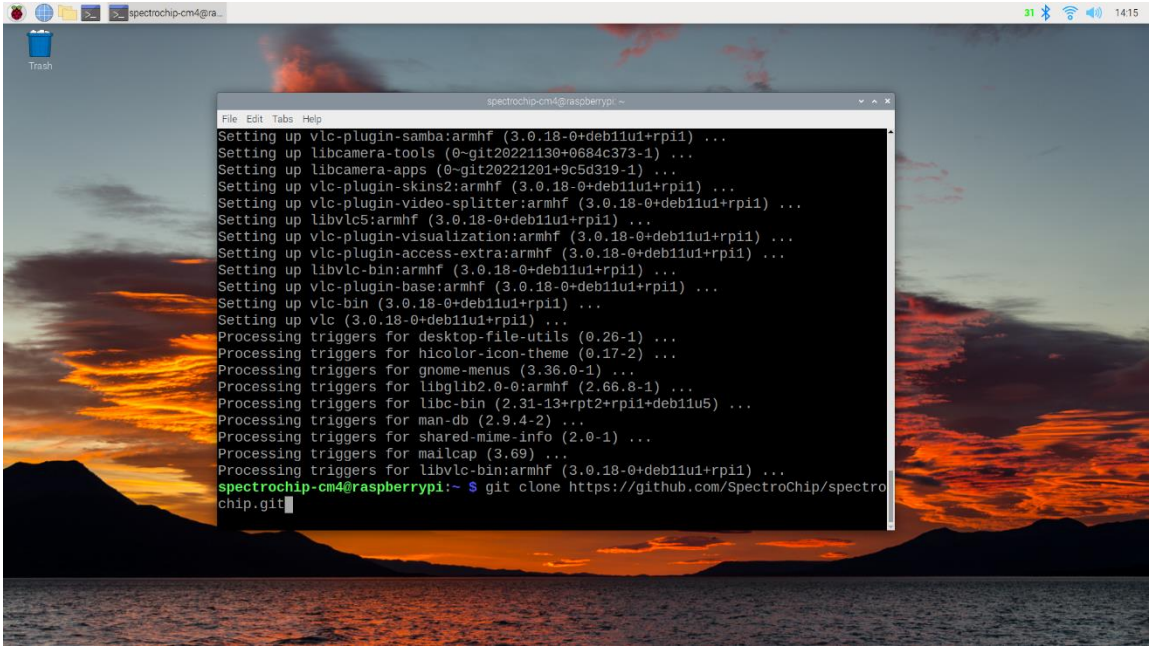
1. sudo apt update



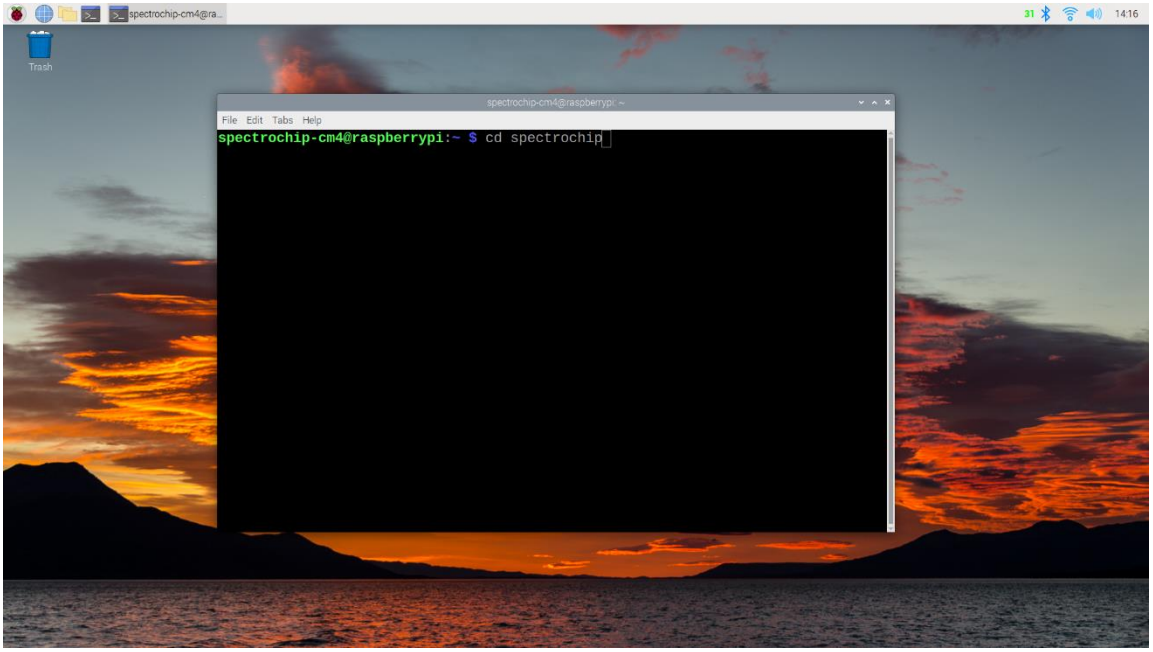
2. sudo apt upgrade



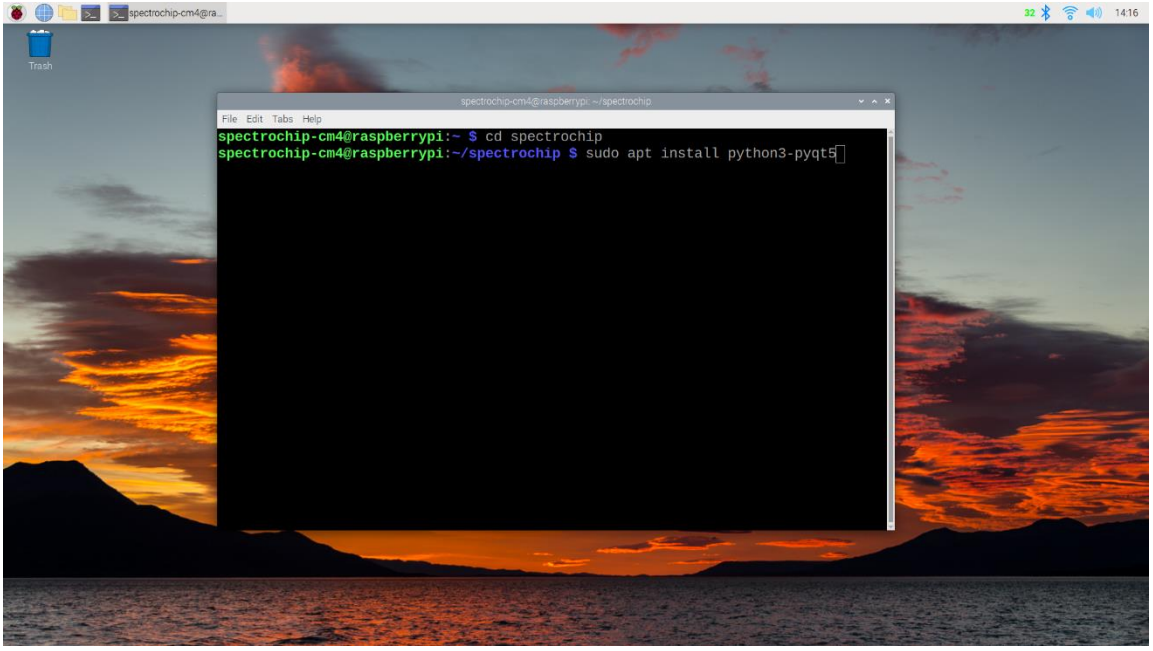
3. git clone https://github.com/SpectroChip/spectrochip.git



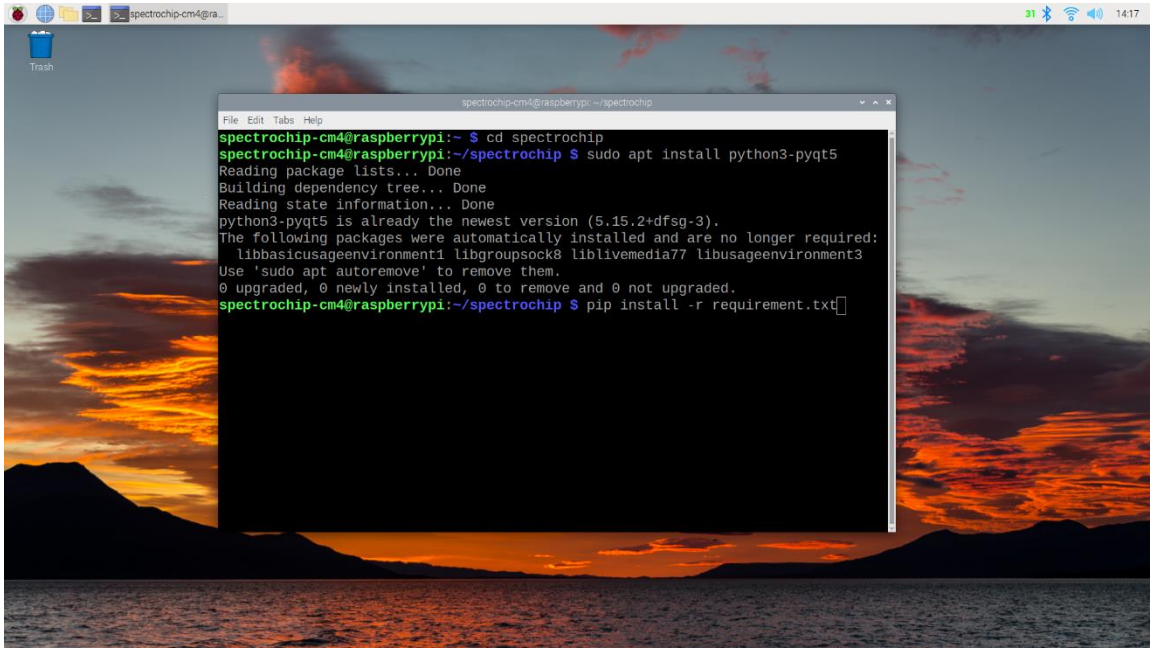
4. cd spectrochip



5. sudo apt install python3-pyqt5



6. pip install -r requirement.txt


spectrochip-cm4@ra...
14:17
Trash
spectrochip-cm4@raspberrypi: ~/spectrochip
File Edit Tabs Help
spectrochip-cm4@raspberrypi:~ $ cd spectrochip
spectrochip-cm4@raspberrypi:~/spectrochip $ sudo apt install python3-pyqt5
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
python3-pyqt5 is already the newest version (5.15.2+dfsg-3).
The following packages were automatically installed and are no longer required:
libbasicusageenvironment1 libgroupsock8 liblivemedia77 libusageenvironment3
Use 'sudo apt autoremove' to remove them.
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
spectrochip-cm4@raspberrypi:~/spectrochip $ pip install -r requirement.txt

2. Window Contents

There are 2 windows in this application:

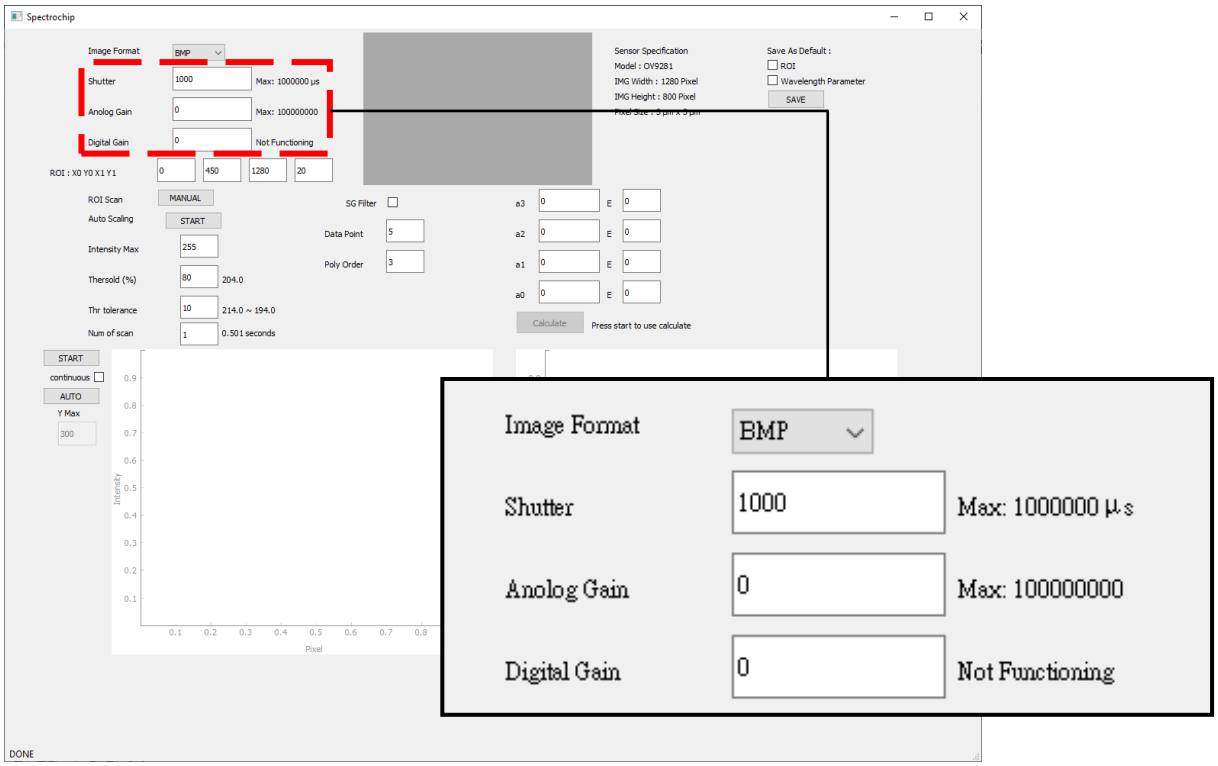
1. Spectrochip (Main Window)
2. Wavelength Calibration (Second Window)

2.1 Main Window

This window will fulfil the needs for a simple spectrum capture.

2.1.1 Sensor Settings

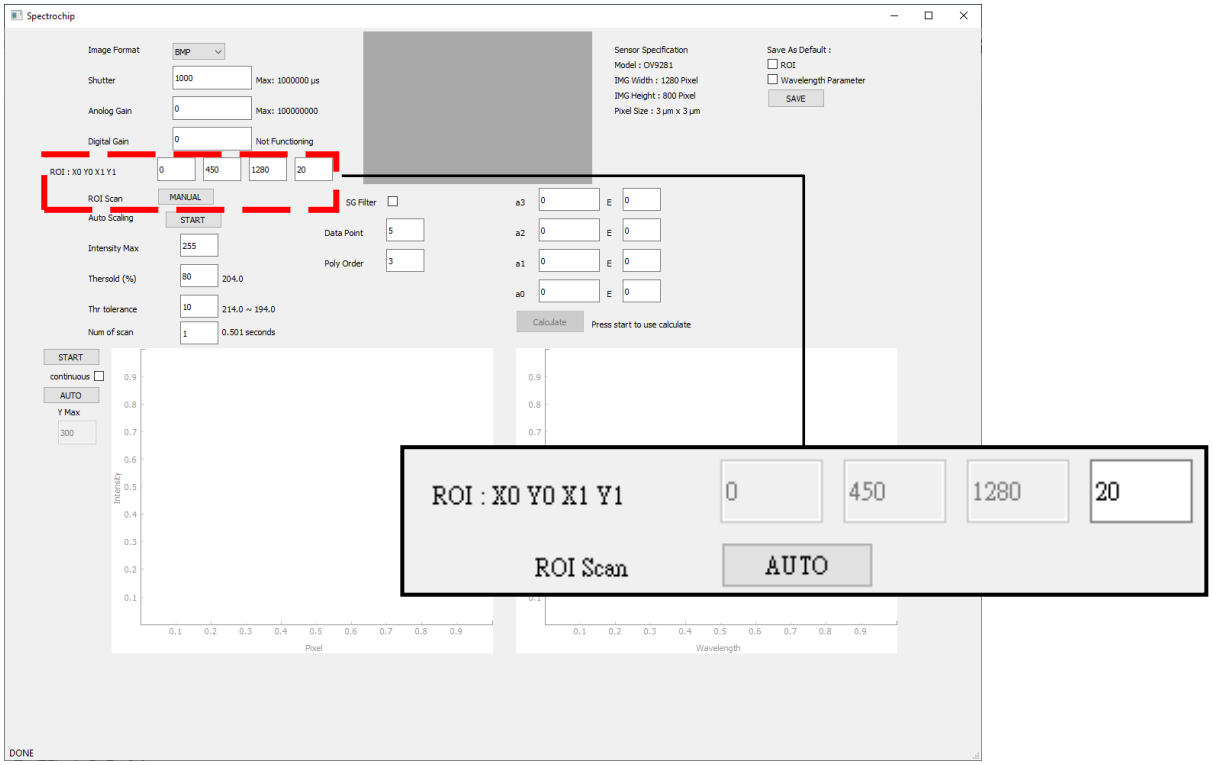
You can change the sensor settings as needed.



1. Image Format：Changes save file format.
2. Shutter：Change exposure time (microseconds) for the sensor.
3. Analog Gain：Change gain value for the sensor.
4. Digital Gain：Not functioning.

2.1.2 R.O.I Settings

You can change R.O.I. settings as needed.



1. ROI: X0 Y0 X1 Y1：Manual insert parameters for X0, Y0, X1 (Delta X) and Y1 (Delta Y) (X0, Y0, X1 will not be able to insert when ROI Scan mode is at Manual).

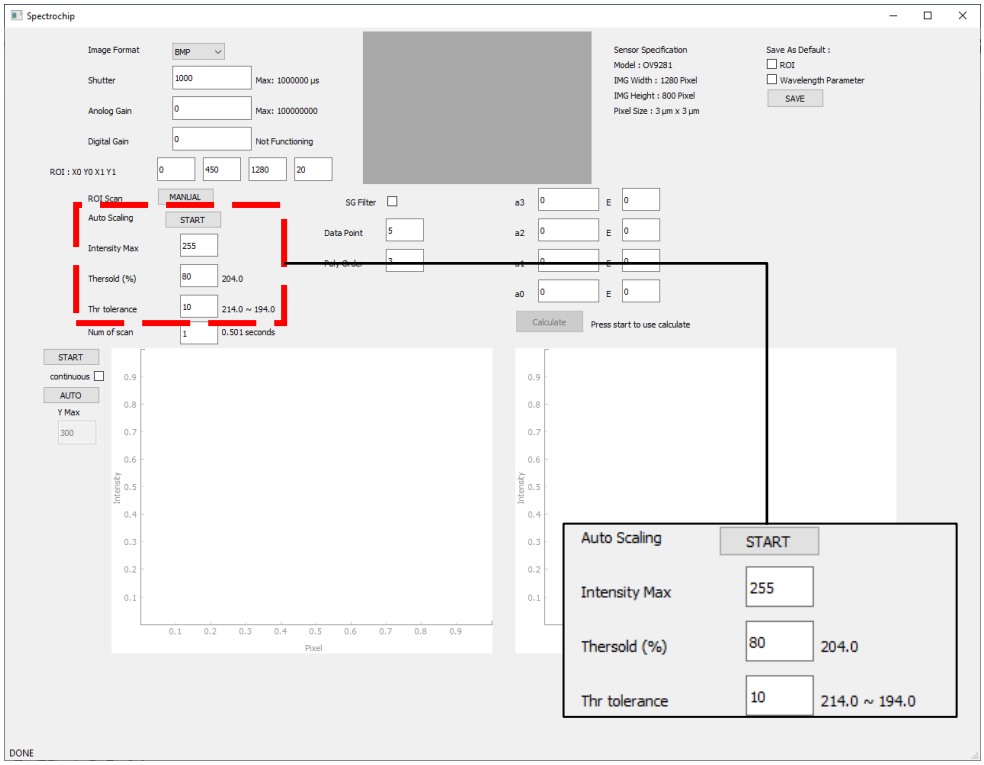
$$\begin{array}{c} \overset{X0}{\longrightarrow} \\ Y0 \downarrow \end{array} \begin{bmatrix} (0,0) & \cdots & (1279,0) \\ (0,1) & \cdots & (1279,1) \\ \vdots & \ddots & \vdots \\ (0,798) & \cdots & (1279,798) \\ (0,799) & & (1279,799) \end{bmatrix}_{(800 \times 1280)}$$

(X0+X1, Y0+Y1)

2. ROI Scan：There were 2 modes
   A. AUTO：Auto find R.O.I.
   B. Manual：Manual fill in R.O.I.

2.1.3 Auto Scaling

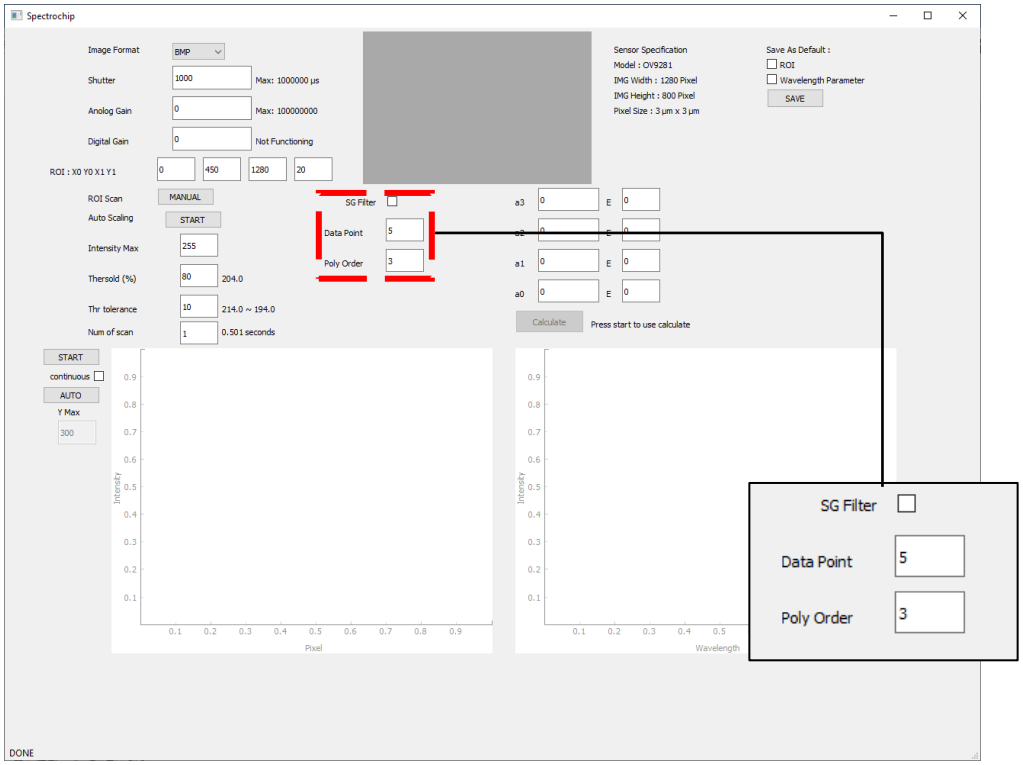
You can change Auto Scaling settings as needed.



1. Auto Scaling Button：Press to start auto scaling (For more information, please refer to Section 3.2)
2. I Max：Set Max Intensity
3. Threshold (%)：Set threshold percentage
4. Thr tolerance：Set threshold tolerance

2.1.4 S.G. Settings

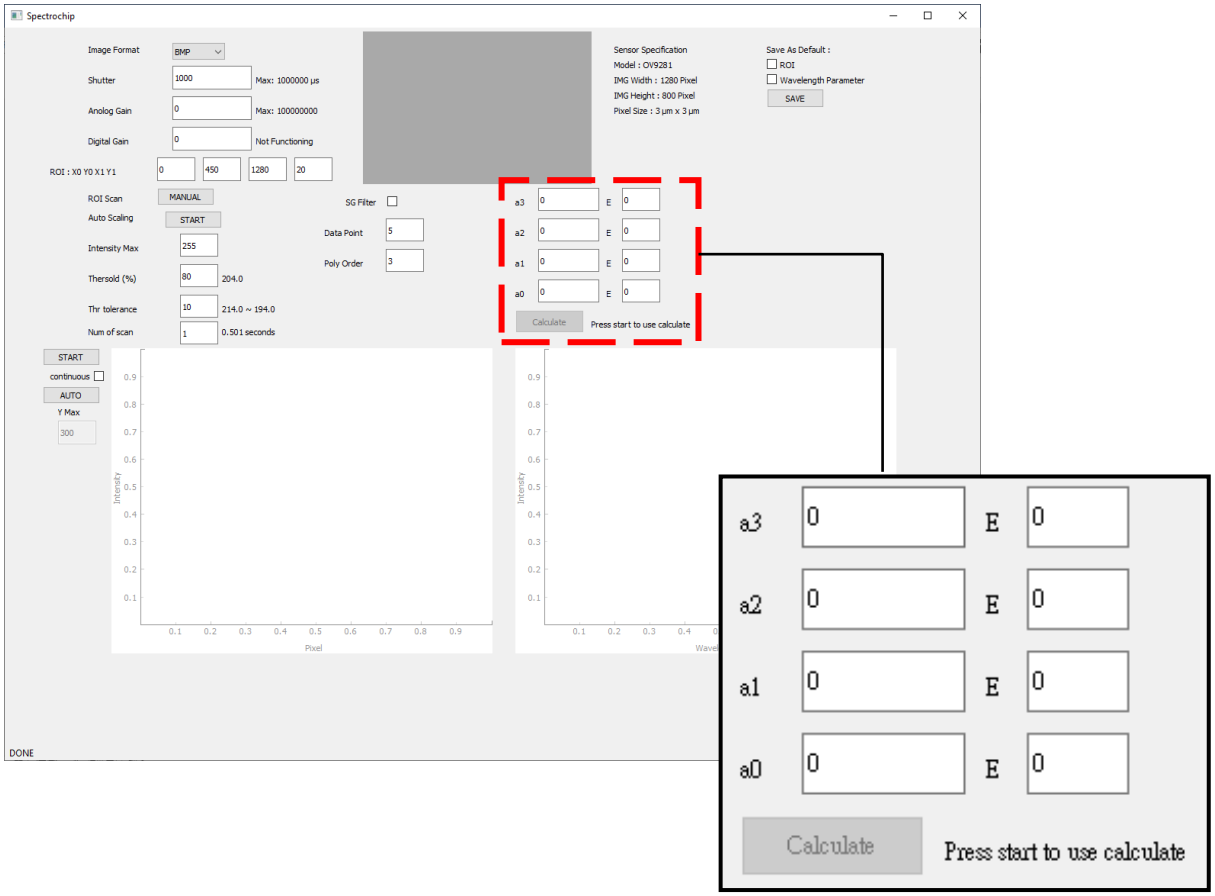
You can change Savitzky–Golay settings as needed.



1. SG Filter checkbox：Check to activate S.G. Filter
2. Data Point：Change window length parameter
3. Poly Order：Change the order of polynomial

2.1.5 Wavelength Convert

You can change the parameter for the equation used to convert pixel to wavelength as needed.



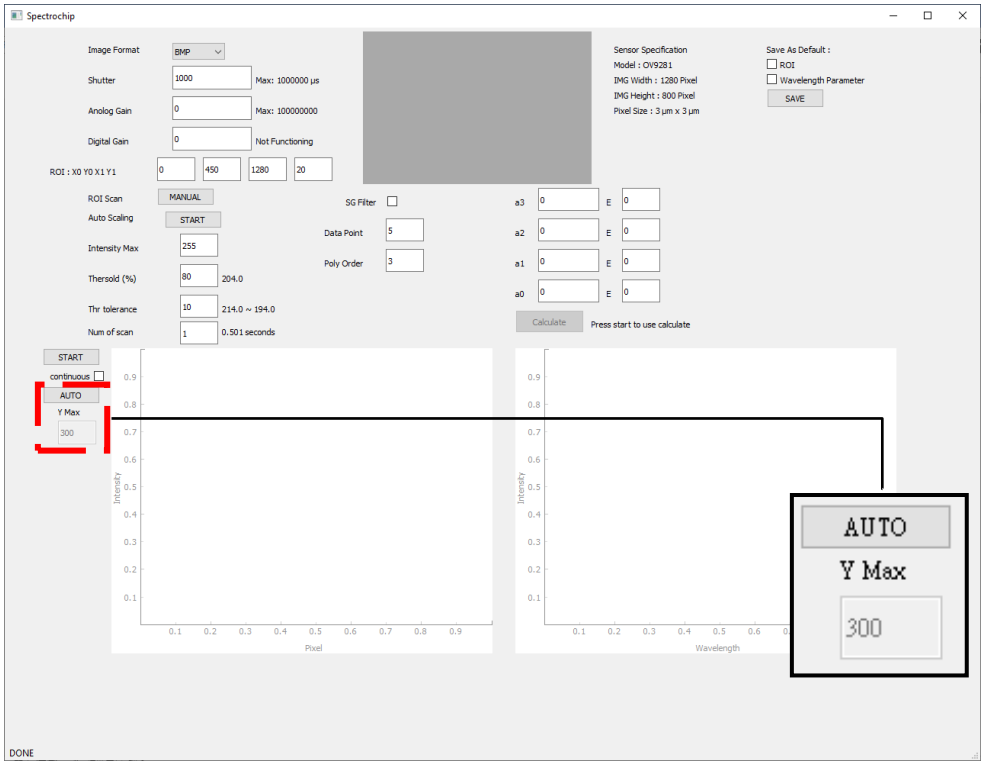
Equation used for wavelength convert :

$$\lambda_{(P)} = a_3P^3 \times a_2P^2 \times a_1P \times a_0$$

1. a_3 = a3E0
2. a_2 = a2E0
3. a_1 = a1E0
4. a_0 = a0E0
5. Calculate Button : Have to press the start button to get at least 1 dataset before it is available to press, after press will pop up another window for wavelength calibration (For more information, please refer to Section 2.2)

2.1.6 Graph

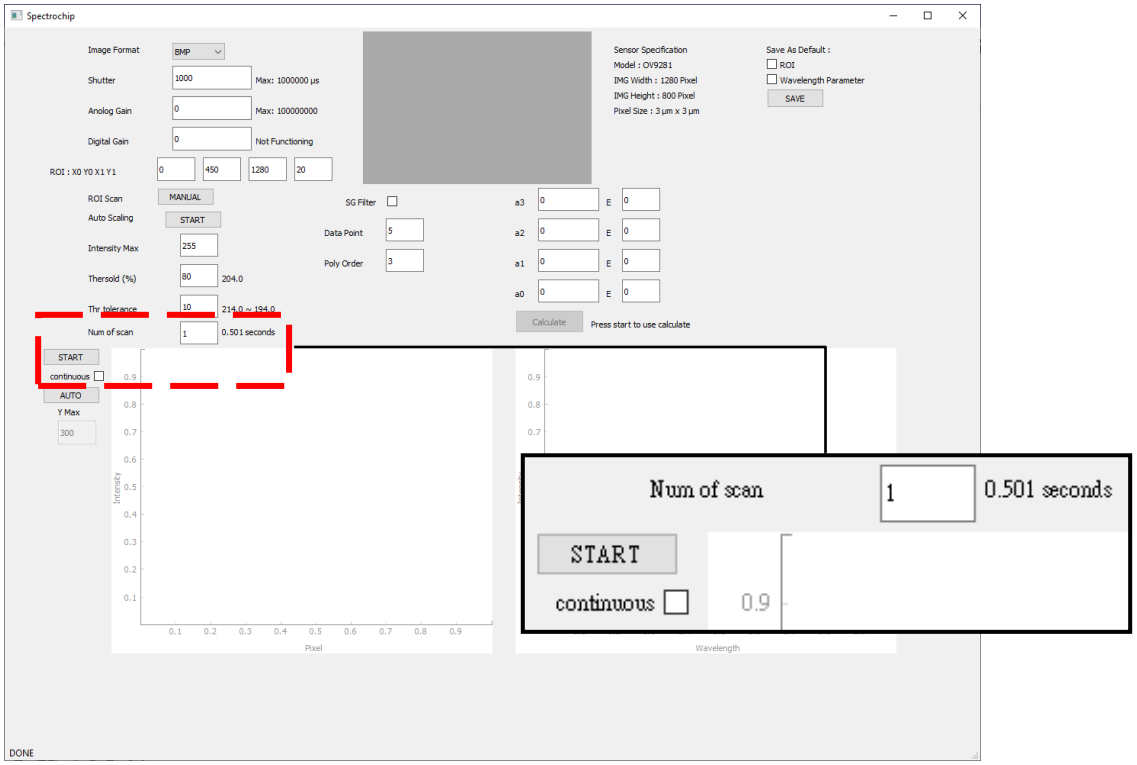
You can change the settings for Y-axis for the graph as needed.



1. Mode button：There were 2 modes
   A. AUTO：Auto scale the range for Y-axis
   B. FIX：Fix the scale from 0 to Max that is input by the user
2. Y Max : Change the scale from 0 to the Max that is input by the user

2.1.7 Sensor Mode

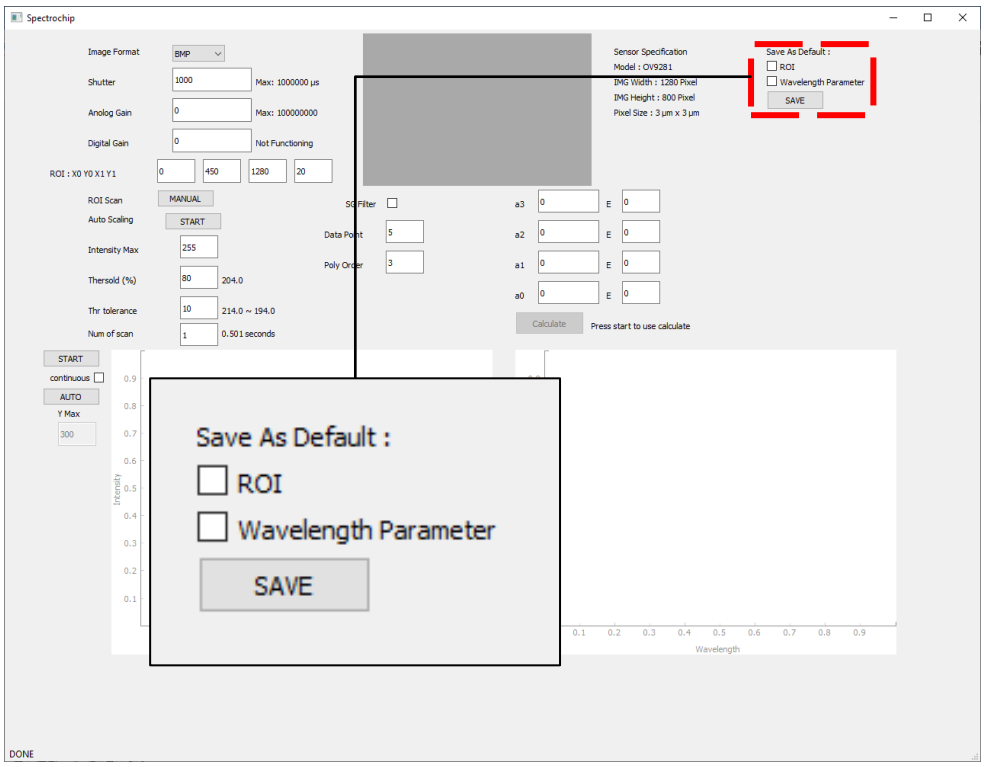
You can start the sensor and set how many times you wanted to scan.



1. Num of scan：Set the times you wanted the sensor to scan (Will count the average according to the number you set)
2. START button：Start the main function (For more information, please see Section 3.1.1)
3. continuous checkbox：Check for continuous data scan (For more information, please see Section 3.1.2)

2.8 Change Default

Change Default to your likes



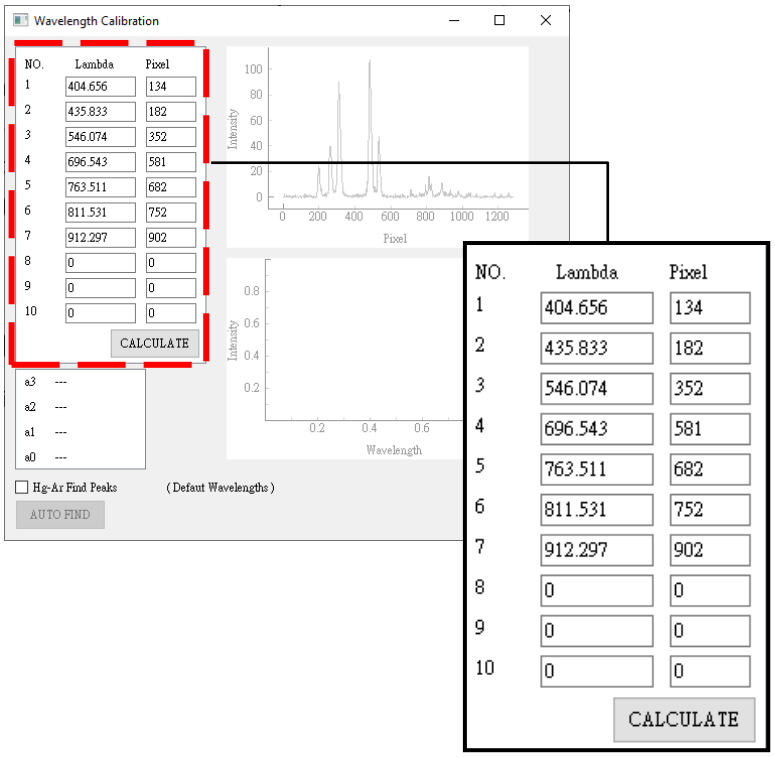
1. ROI : Change R.O.I default value
2. Wavelength Parameter : Change Wavelength Paramater

2.2 Second Window

This window will fulfil the needs for wavelength calibration.

2.2.1 Calculate Equation

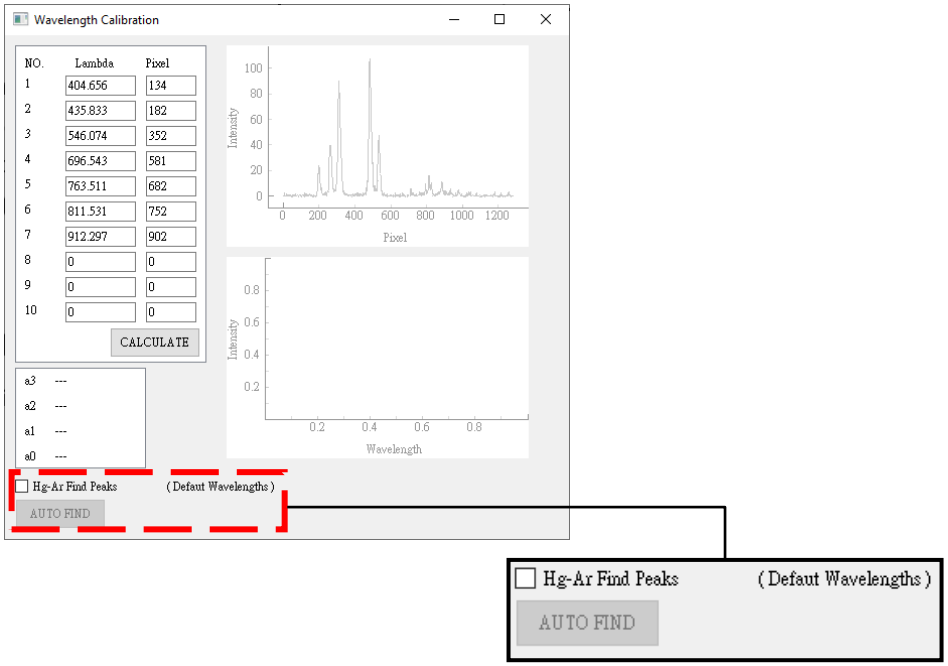
You can change the parameter for Lambda and Pixel as needed.



1. Lambda 1 ~ 10：Standard Lambda
2. Pixel 1 ~ 10：Pixel in the image which corresponding to the standard lambda

2.2.2 Auto Find Peaks

Can be used for automatically find Hg-Ar peaks with default wavelengths.



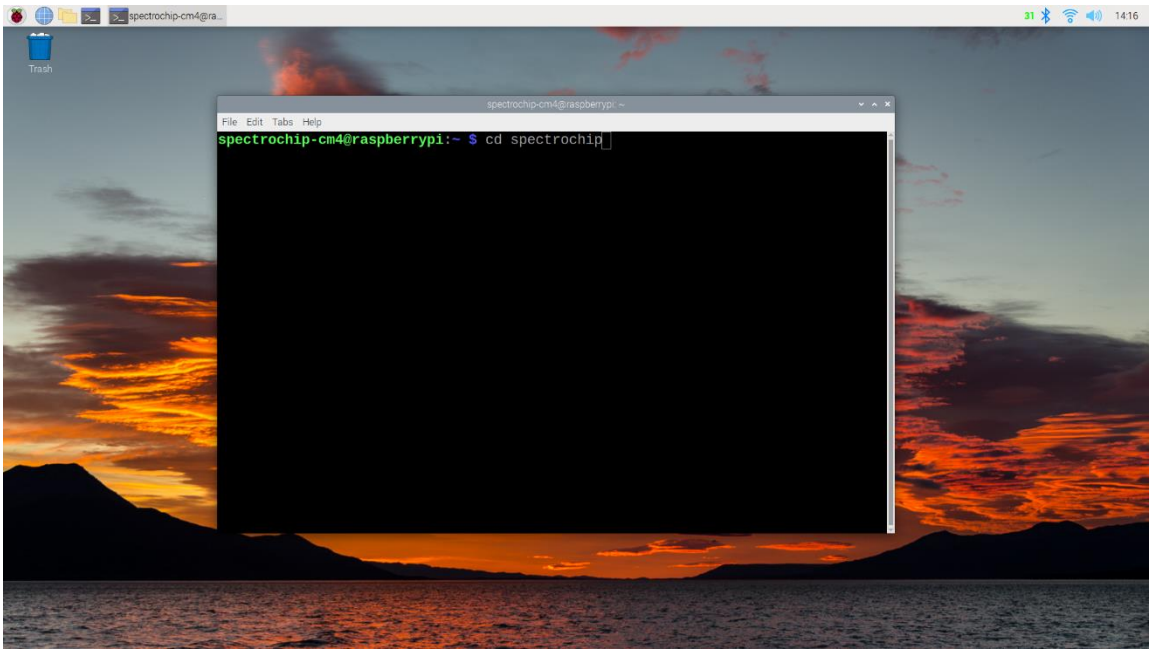
A. Hg-Ar Find Peaks checkbox：Check to unlock AUTO FIND Button
B. AUTO FIND Button：Start auto find peaks with default wavelengths (For more information, please refer to Section 3.3)

3. How to use

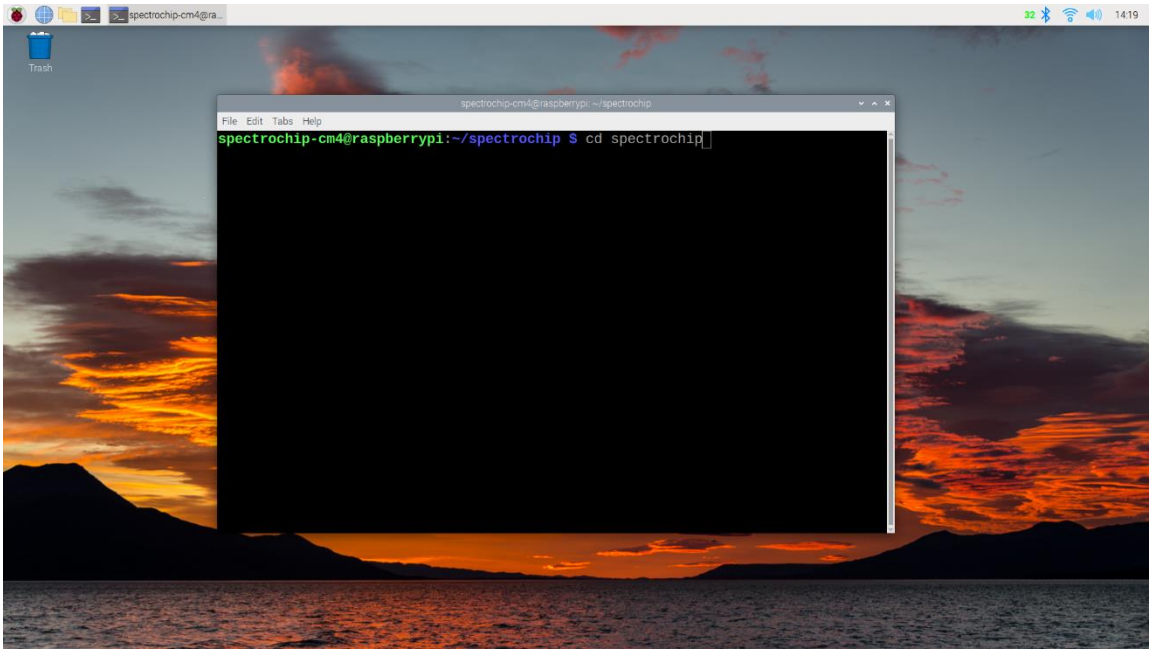
Before you start using, please make sure you have fulfilled the requirements for the software and have the hardware connected properly. To run the program, please follow the step below :

1. Open terminal

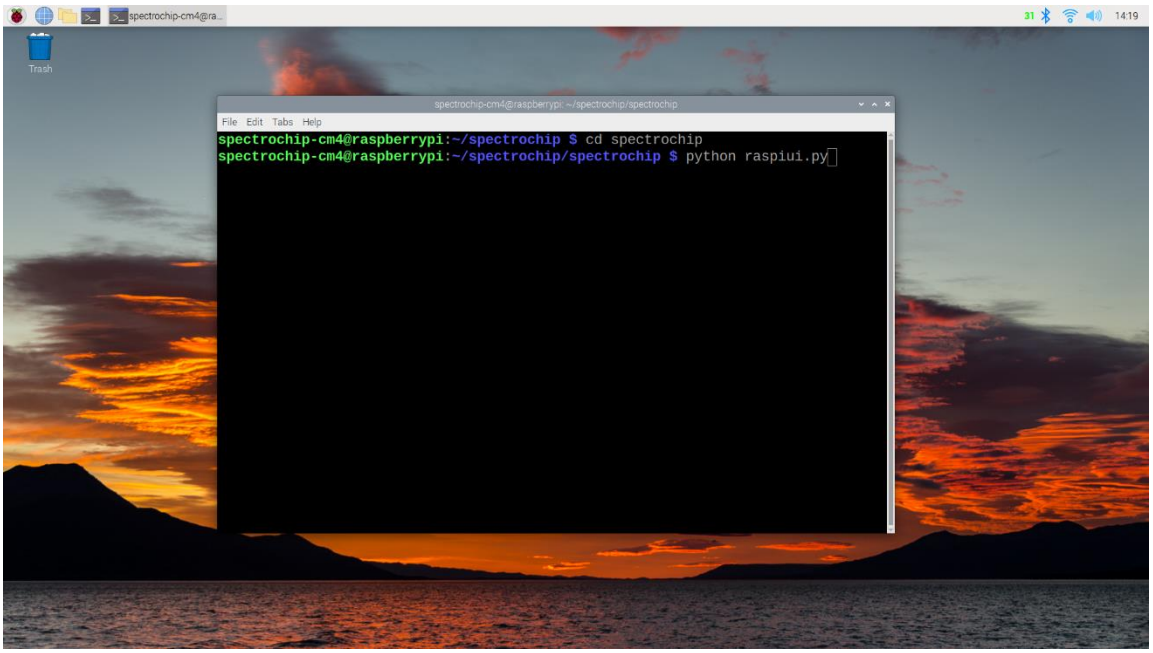
2. Go to the folder location



3. Go to the script location



4. Run the script by typing python raspiui.py



3.2 Main Function

This function is used to take spectrum.

There were 2 modes:

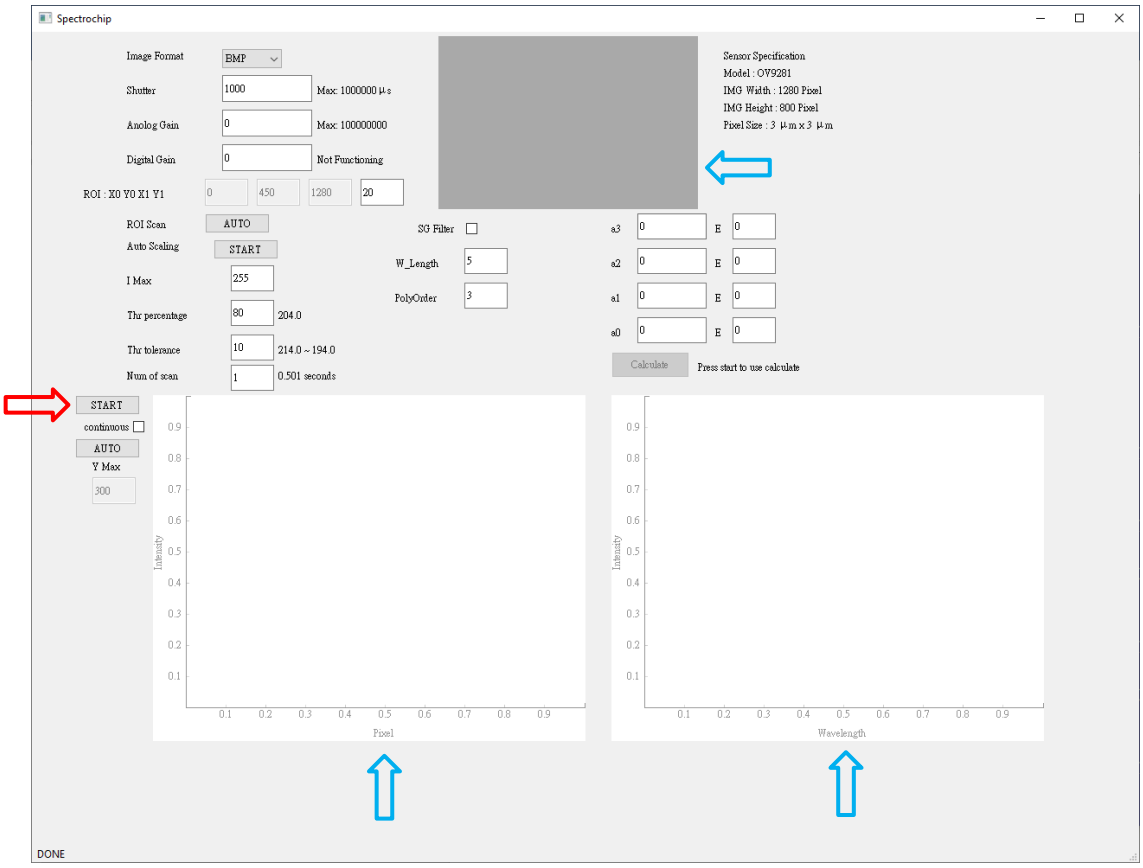
1. Single capture mode
2. Continuous capture mode

3.2.1 Single Capture Mode

This mode is used for single captures.

Step 1

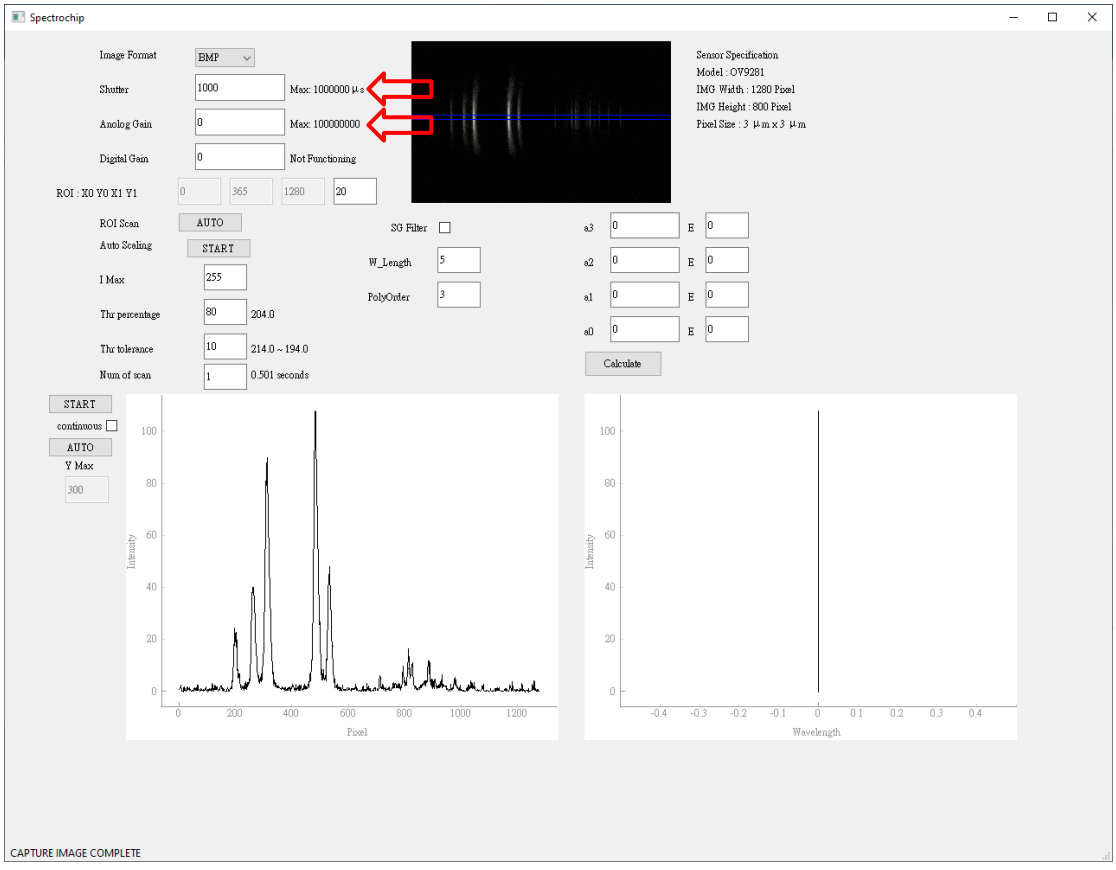
Press the start button and wait for it to complete. The image, pixel graph and wavelength graph will show the results upon completion.



Step 2

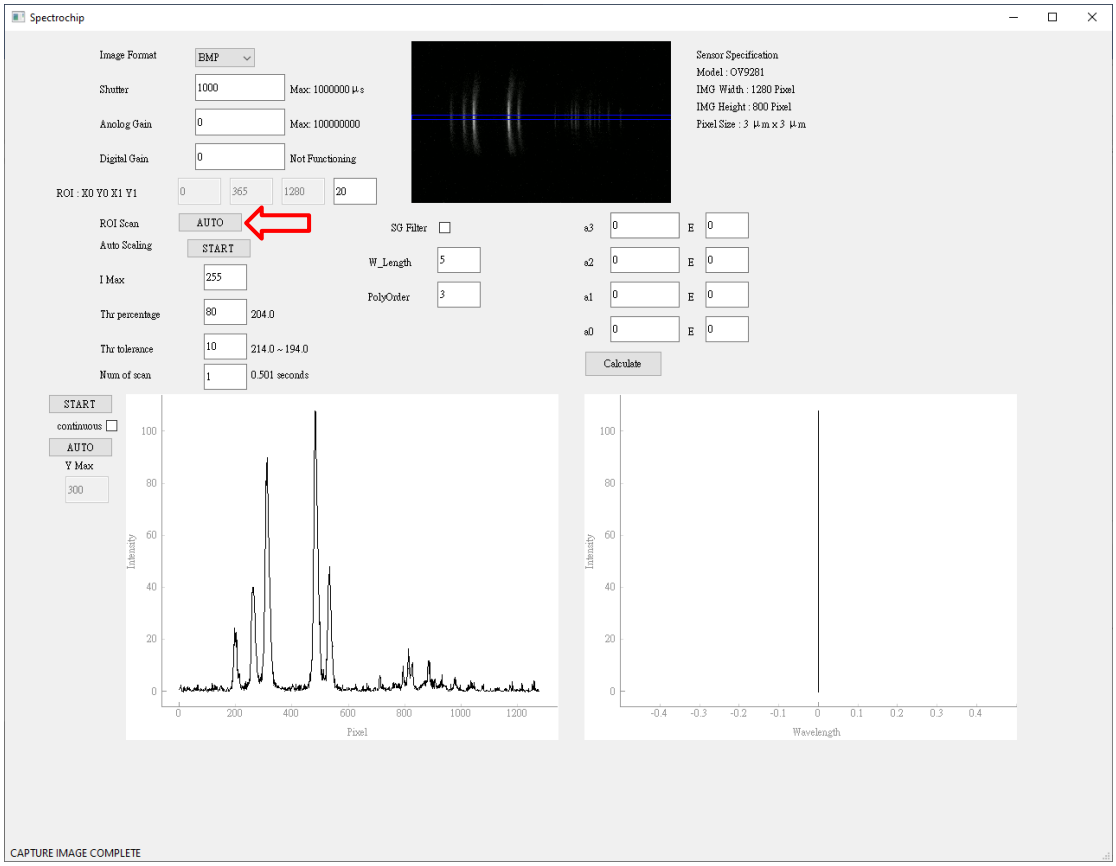
After it's complete,

1. If you are not satisfied with the result,
   A. If the result intensity is too low or too high,
      i. You can change the Shutter or Analog Gain value to increase the intensity of the spectrum (Shutter is preferred), then back to step 1.
      ii. If you don't know which Shutter or Analog Gain value to use, you can press the Auto Scaling Button (For more information, please refer to section 3.2).
   B. If the auto R.O.I. range is not the one you want, proceed to step 3 (Optional).
   C. If you want to reduced noise, please proceed to step 4 (Optional) or step 5 (Optional).
2. If you are satisfied with the result, you can use the data that is save as a txt file for your research.



Step 3 (Optional)

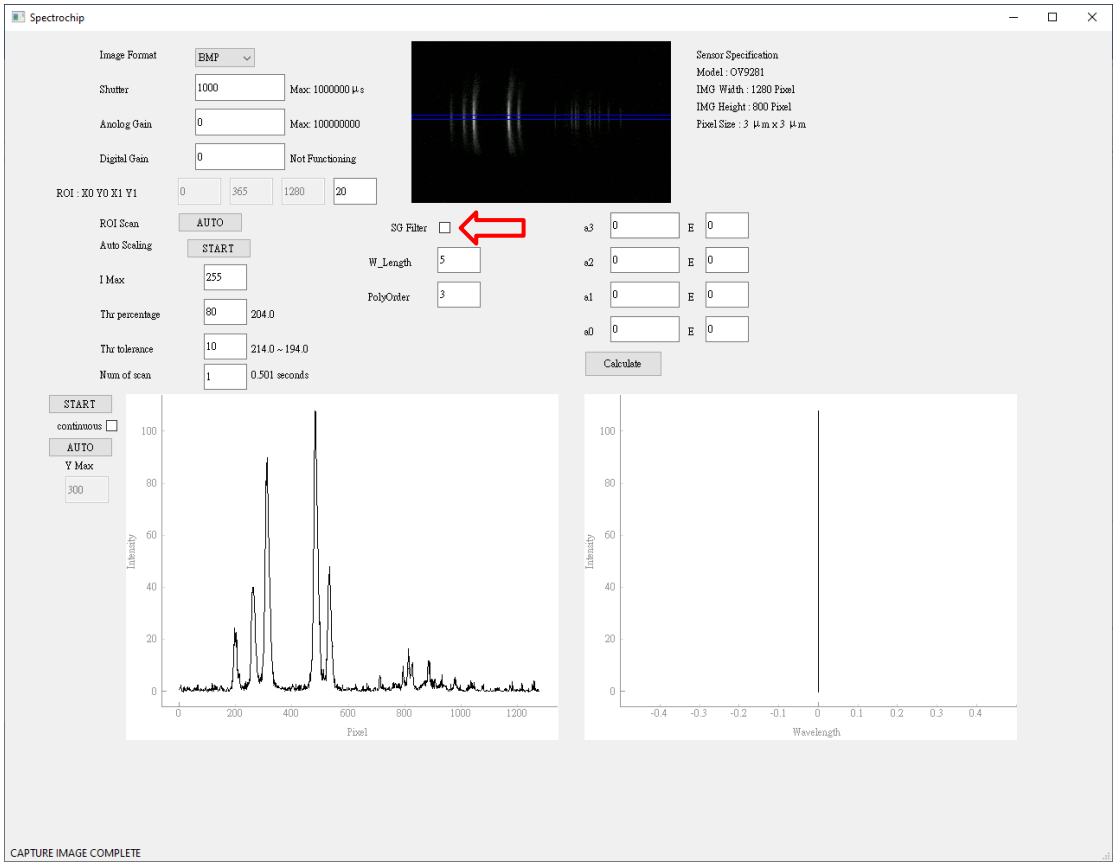
You can change the R.O.I by clicking the ROI Scan button to change from auto to manual, then you can edit the R.O.I. of the picture. Then proceed back to step 1.



Step 4 (Optional)

You can reduce the noise of the data by ticking the SG Filter checkbox, or you can proceed to step 5 for the other option to reduced noise.

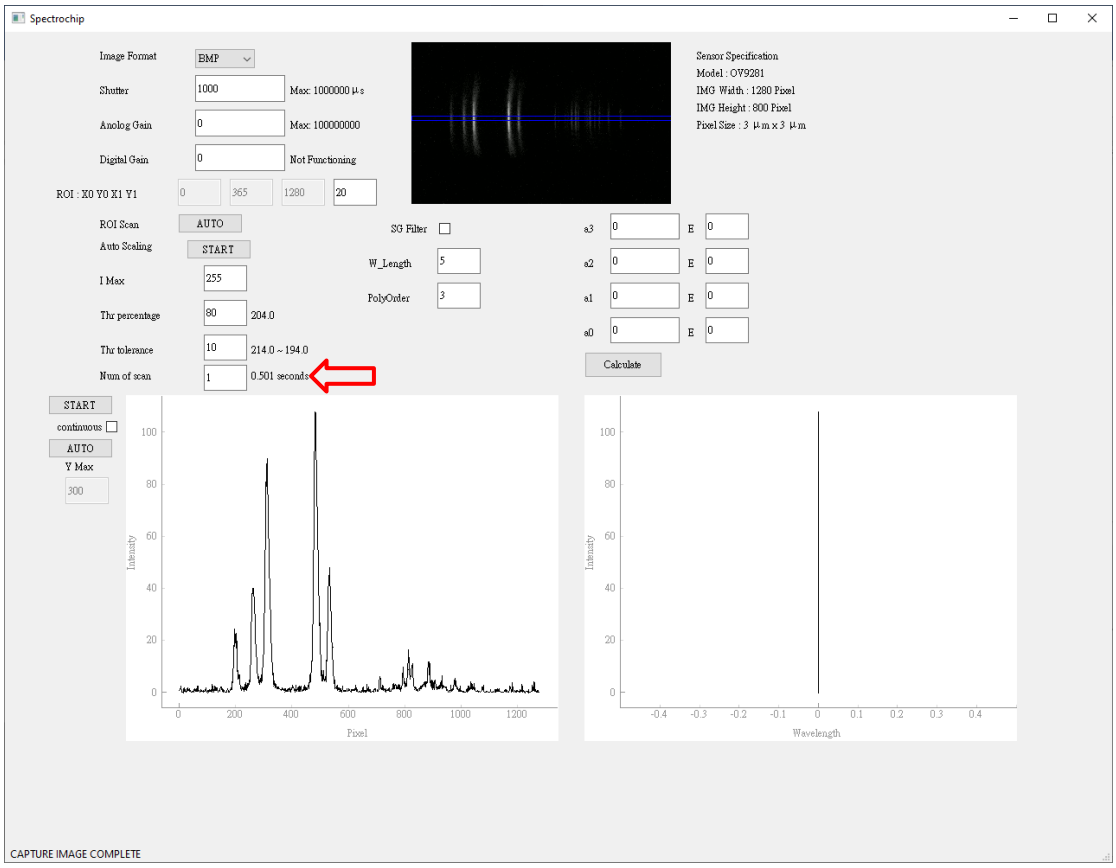
You can change the parameter for the filter (For more information, please refer to Section 2.1.4).



Step 5 (Optional)

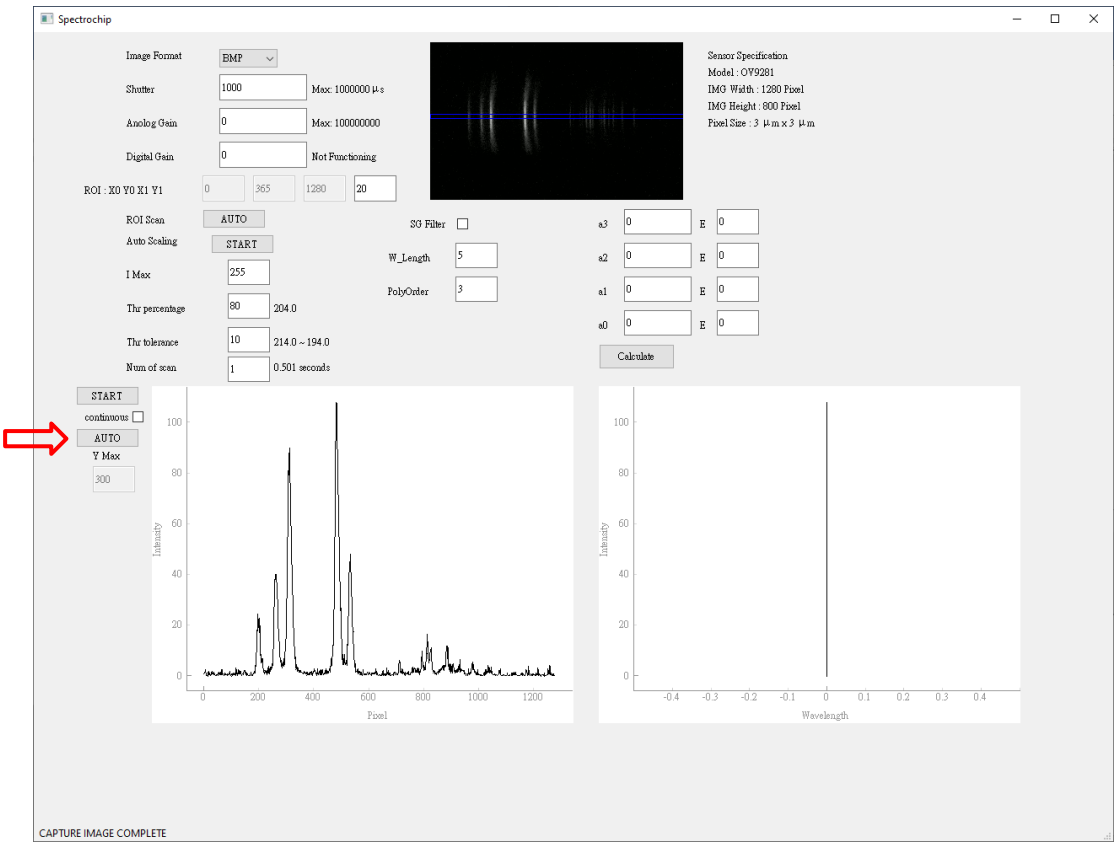
You can increase the number of scans to reduce the noise. Number of scans calculates by averaging all the data captured.

This step can also be used with step 4 to minimize the noise.



Additional Options

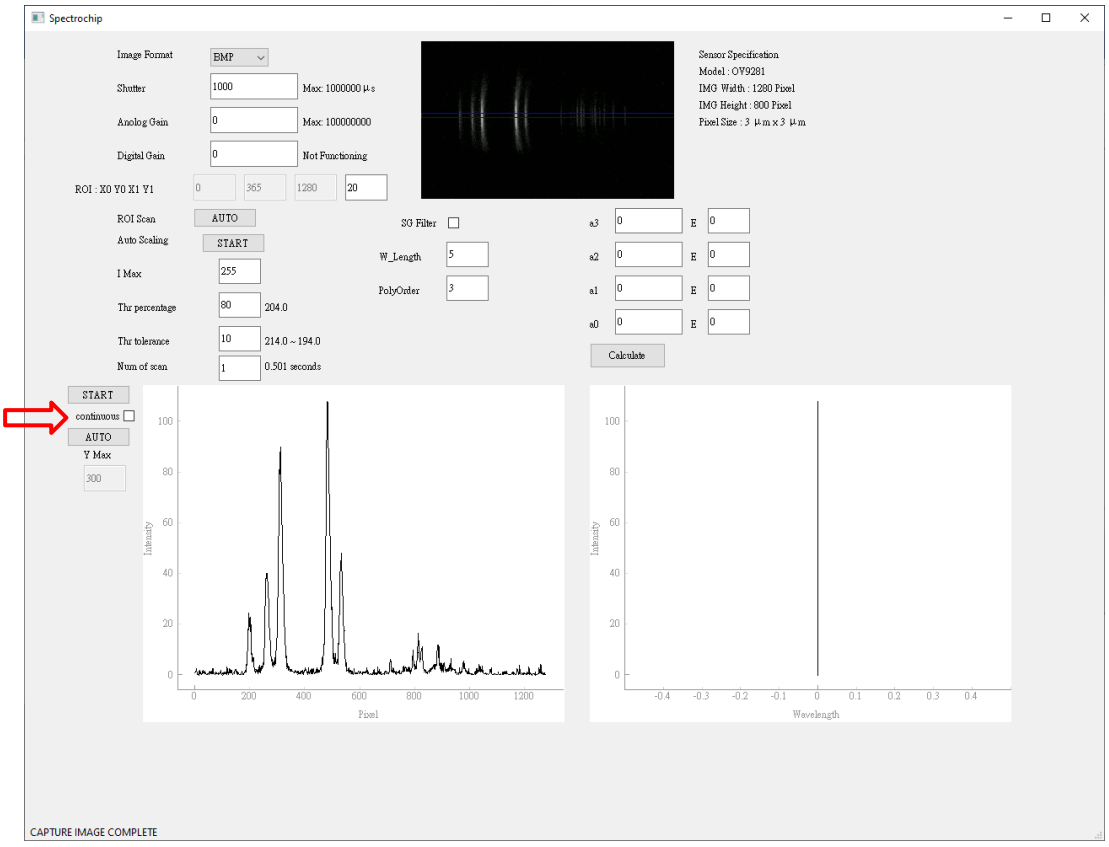
1. Fix Y-Axis to your own scale favor
   A. Click AUTO Button to change from automatically scale to fix scale.
   B. You can edit the Y Max parameter to your own needs.



3.2.2 Continuous capture mode

This mode is used for continuous capture.
Please note that the data.txt will only save the last data captured.

Step 1
Tick the continuous checkbox, the step afterward is same as Section 3.1.1, so proceed to Section 3.1.1 step 1.

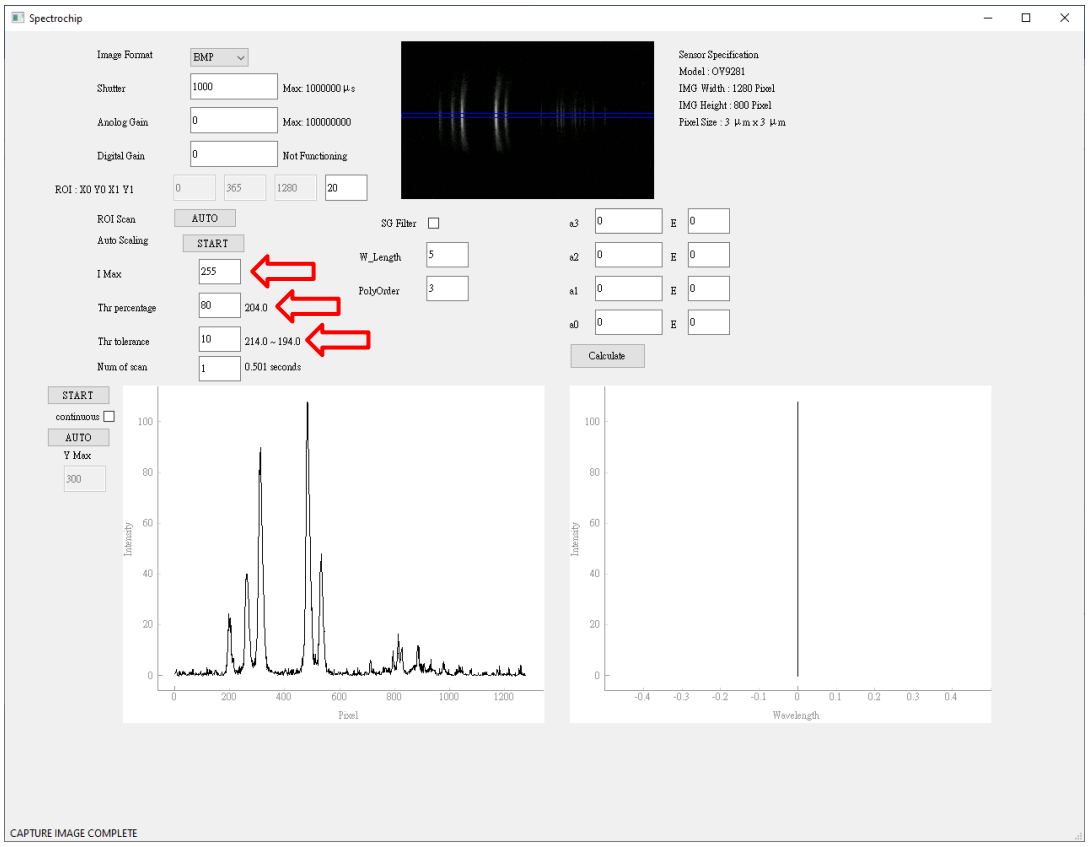


3.3 Auto Scaling

This function is to automatically calculate the required shutter.

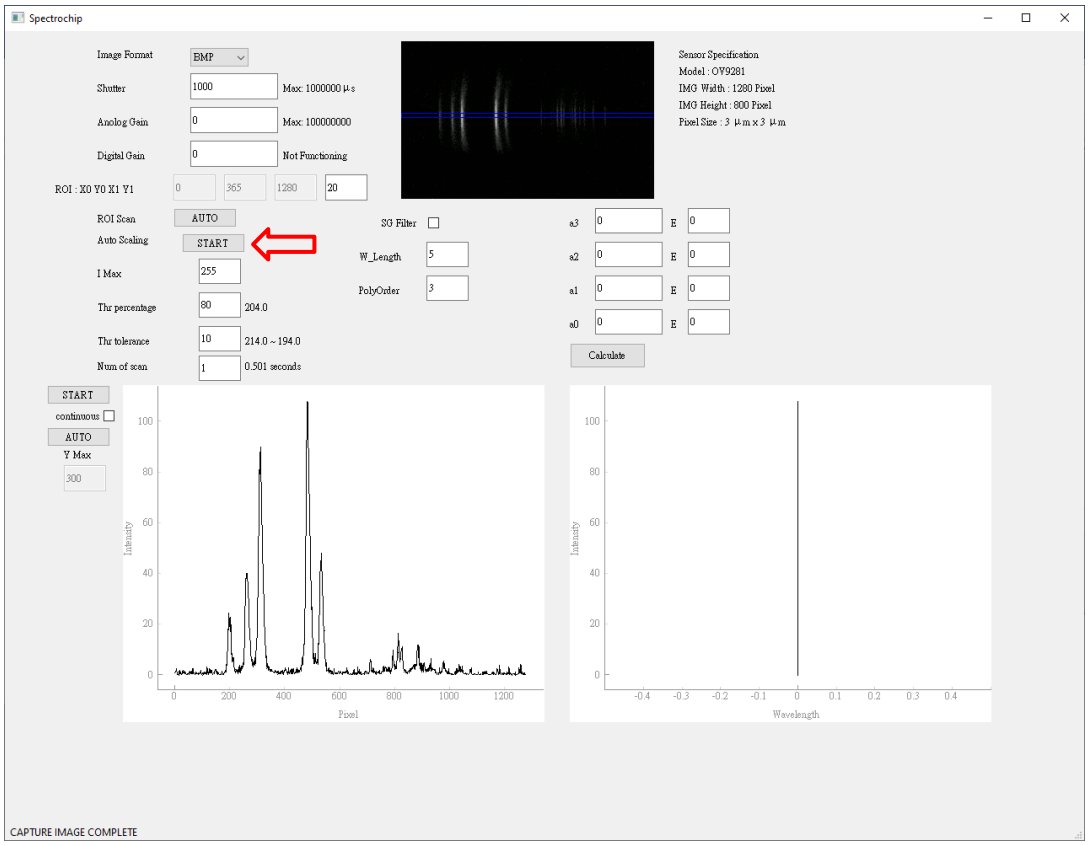
Step 1

Set the parameter that is needed (Have default value).



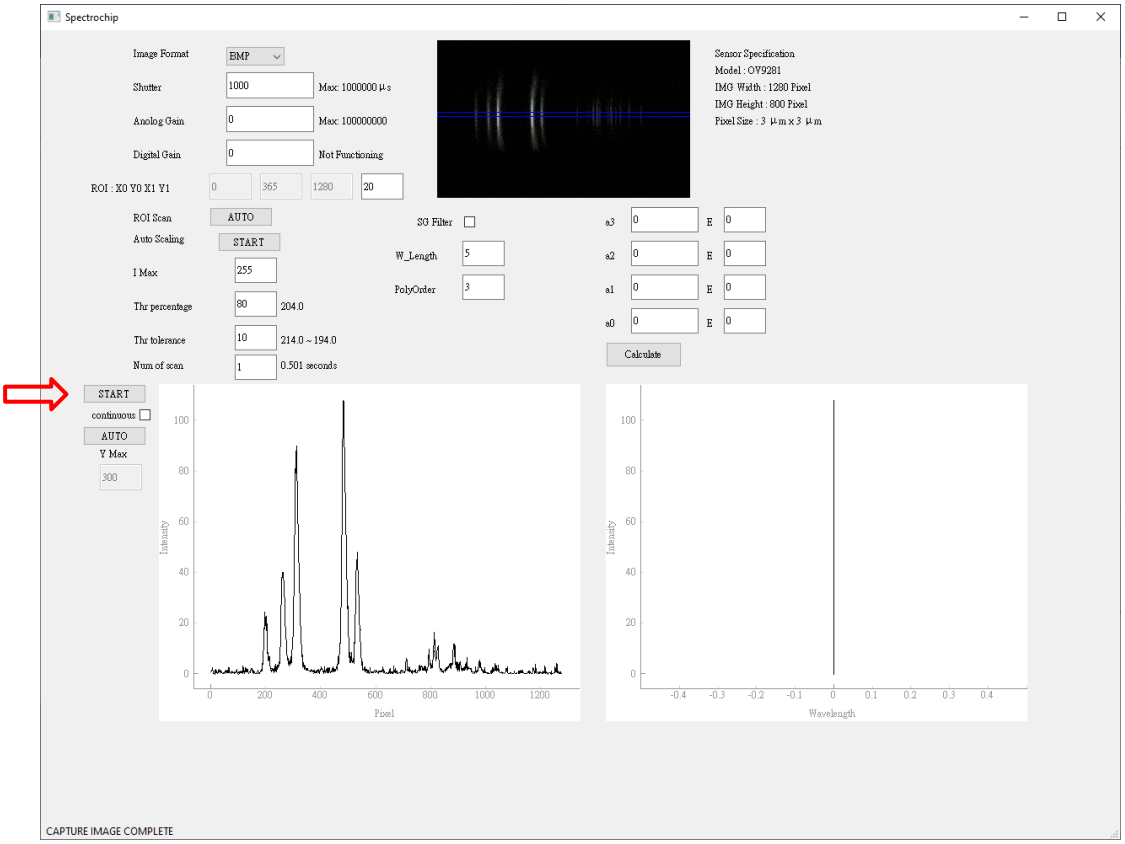
Step 2

Press the Auto Scaling START Button to start auto scaling, then wait for it to complete (May take a few minutes).



Step 3

After it’s complete, press the START Button to show the new result.



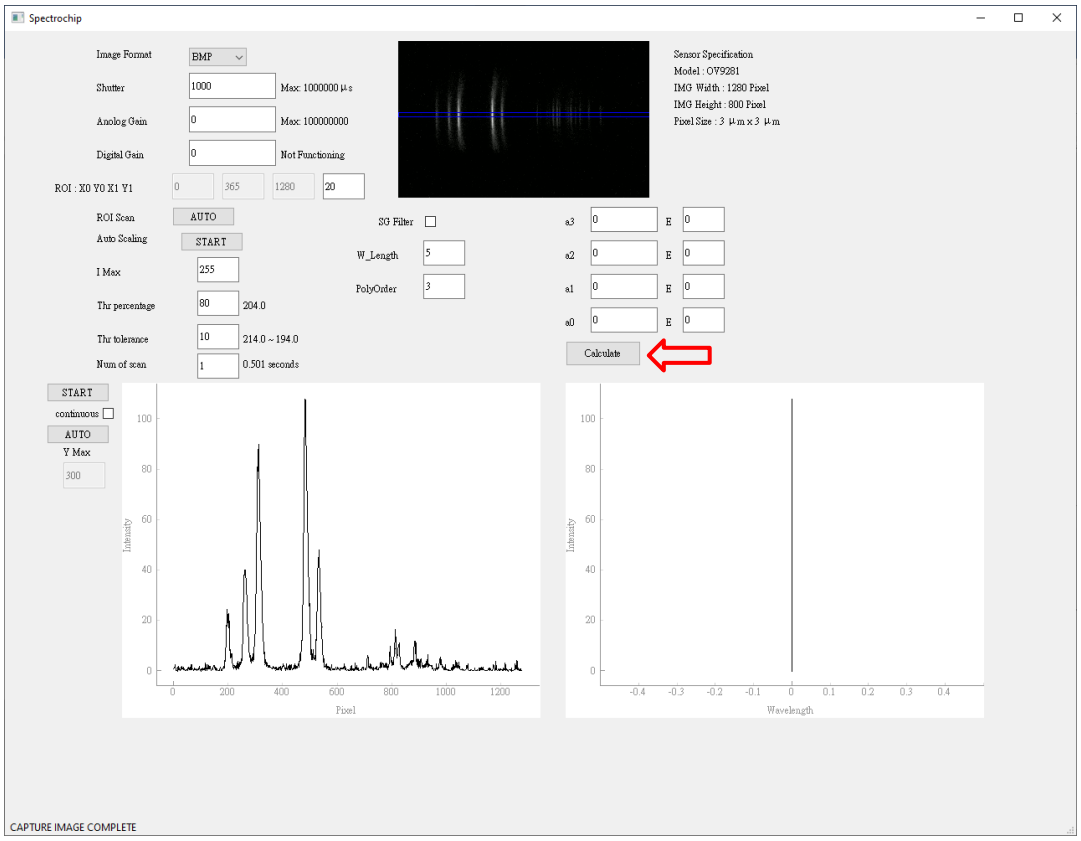
3.4 Wavelength Calibration

This Function is to calculate the equation that is required to convert pixels to wavelengths.

Before proceed to step 1, please make sure you've followed Section 3.1 Main Function steps.

Step 1

Press Calculate Button to open Wavelength Calibration Window.



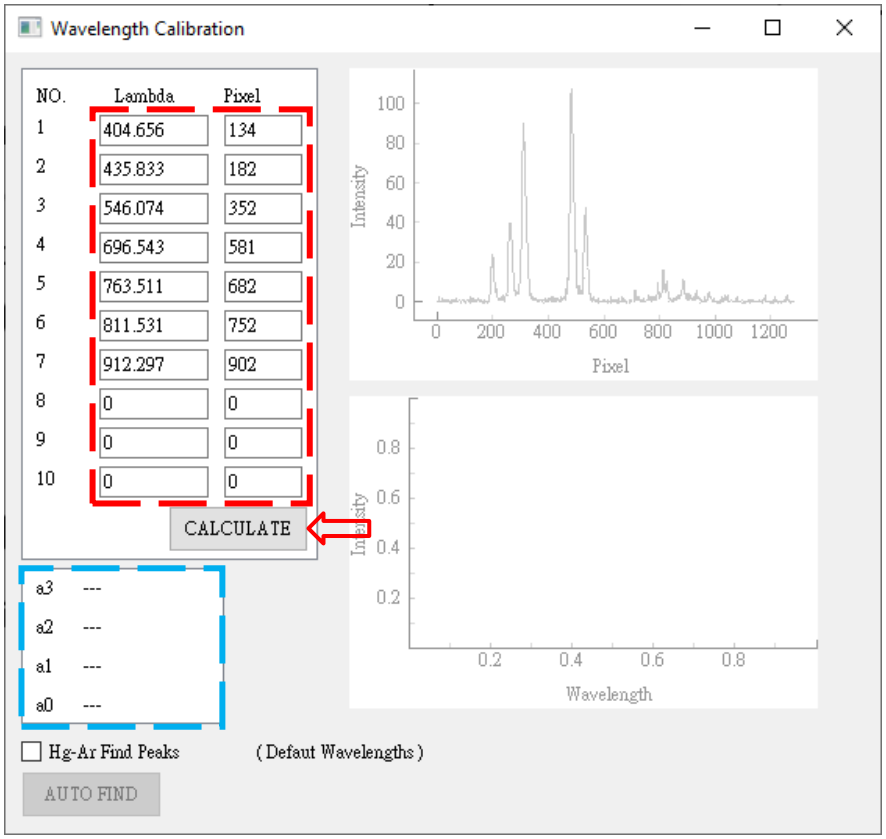
Step 2

You can input the parameter you want into the lambda or pixel textbox, after all parameter have been input, press the CALCULATE Button to calculate the required a3, a2, a1 and a0.

After the calculation is completed, the result will be displayed in the blue box, and the wavelength parameters in the main window will also be updated.

Please note that you have to type 0 into the textbox that's not in use

.



Step 3 (Optional)

If you wanted to use Hg-Ar Find Peaks, you can tick the checkbox and press the AUTO FIND Button to start.

Please note that it will use the default wavelengths and find the corresponding peaks.