Uspectral PLUS User Manual
V 8.2

1   installation

This section describes how to install and run Uspectral-PLUS software on your computer and consists of two parts: system requirements and installation. There are two types of system requirements: minimum system requirements and recommended system requirements. The Installation section will describe detailed installation and uninstallation procedures. If you have any questions about the installation of the Uspectral-PLUS software, you can send email to venuslabtech@gmail.comfor assistance.

1.1 System Requirement

If you need to run the Uspectral-PLUS software on a computer, the minimum system requirements are listed below:

Supported operating systems: Note Windows XP (not supported)

- Windows Vista

- Windows 7

- Windows 10

Minimum hardware configuration:

-Processor: Intel Core 7 1.4GHz

-RAM: 4 GB

-Available hard disc space: 300 MB

-Screen resolution: 1024 * 768 pixels

-Graphics card: Sufficient GDI+ graphics speed is required

The following hardware and software configurations are the best we recommend for efficient use of the software:

Supported operating systems

- Windows Vista

- Windows 7

- Windows 10

Recommended hardware configuration

-Processor: Intel Core 11 or better 2.8Ghz

-RAM: 8GB or more

-Available hard drive space: 600 MB

-Screen resolution: 1024 * 768 pixels or higher

-Graphics card: sufficient GDI+ graphics speed required

-Driver: spectrometer driver, serial port driver (corresponding file name PL2303_Prolific_DriverInstaller_v1.10.0.exe)

-Runtime library: VC++2015 runtime library.

1.2 setup

1.During the installation process will pop up several times can not verify the publisher of this driver software warning, as shown in the figure, click on "Always install this driver software", the next time the warning continues to click on "Always install this driver software" until the completion of the installation of the driver.

2.After the installation is complete, select "Yes, restart the computer now" and click "Finish" to restart your computer.

3. Click "Finish"

Installer Success View

4.   After the software has been successfully installed, a shortcut to Uspectral-PLUS will be created on the desktop, and you can double-click it to open the software. Or go to the installation directory of the software and find Uspectral-PLUS.exe to open the software.

5.   To set the Uspectral-PLUS software to run as an administrator, right-click "Properties" on the desktop, as shown in the figure below, click on the "Compatibility" page, and tick the "Run as administrator" checkbox on the privilege level.

6.   If the resolution is abnormal then you can switch on the function as shown in the figure.

Note: You may need to have administrator privileges to install and run Uspectral-PLUS on Windows Vista and Windows 7 operating systems.

1.3   Problems that may be encountered during driver installation

1.4.1 Firstly, check if the driver is installed in the device manager

A yellow exclamation mark will appear if the driver is not installed

1.4.2 Update drivers, install drivers

1.4.3 Win10 needs to disable the signature to install

1.4   How to disable Win10 signature

If it is win10 operating system, you need to set windows disable signature authentication before installing the software, the specific method is as follows:

1, win10 start menu - select settings - update and security;

2, click on the left menu recovery options - advanced startup select Immediate restart - Troubleshooting - advanced options -Startup Settings - Reboot;

3, after booting, press the number keys to select Disable driver forced signature;

4, and then install the software can be.

In the installation process will pop up several times can not verify the publisher of this driver software warning, as shown in the figure, click on "always install this driver software", the next warning continue to click on "always install this driver software" until the completion of the installation! Click "Always install this driver software".

2   Running Mode

Uspectral-PLUS supports the following operation modes

1. Raman mode

Through the spectrometer, the laser and the probe match, builds the Raman spectrometer, carries on the Raman measurement.

2. Transmission Mode

Transmittance measurement with a spectrometer

3. Reflectance mode

Reflectance measurements with a spectrometer

4. irradiance mode

Irradiance measurement by means of a spectrometer.

5. Absorption mode

Absorbance measurement by means of a spectrometer

6. Trace UV test mode

Trace UV concentration measurement by means of a spectrometer.

7. Spectrometer only mode

Simple spectral measurements with the spectrometer

When using the software for the first time, a pop-up box will appear, allowing the user to select the mode in which the software will run.
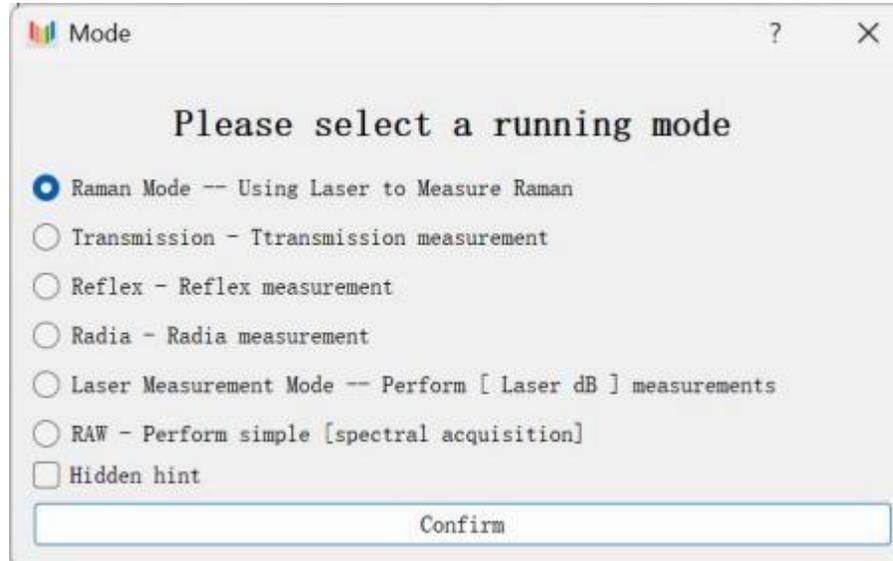
3 Device Connection Interface

Connect the spectrometer device and the computer through the USB data cable, the serial number of the spectrometer is available in the spectrometer

Click the "Laser Type" sub-menu under the menu "Device", select the laser type, tick the type of the connected instrument, (this figure is the type of on-board laser) after successful connection, the status shows "Connected" status, as shown in the following figure:

Currently, Uspectral-PLUS software supports

Spectrometers:
- USB spectrometer
- serial spectrometer

Laser：
- Venuslab Spectrometer Controlled Lasers(on-board lasers)
- USB Laser
- Serial Lasers
- 532 special custom serial laser（locomotive shape）
- USB to Serial Lasers
- External manual Lasers

Uspectral-PLUS supports different combinations of spectrometers and lasers.

Combinations Type	Spectrometers / Lasers
1	USB Spectrometers and Venuslab Spectrometer Controlled Lasers
2	USB Spectrometers and USB Lasers
3	USB Spectrometers and Serial Lasers
4	USB Spectrometers and 532 special custom serial laser
5	USB Spectrometers and external manual Lasers
6	Serial Spectrometers and Venuslab Spectrometer Controlled Lasers
7	Serial Spectrometers and USB Lasers
8	Serial Spectrometers and Serial Lasers
9	Serial Spectrometers and 532 special custom serial laser
10	Serial Spectrometers and external manual Lasers
11	USB to Serial Lasers

3.1   Description of laser types

On-board laser: refers to the Venuslab Raman all-in-one device(not build Raman). The model with only a USB cable connected to the computer, the laser is automatically on and off, and the state of the laser is completely controlled by the spectrometer.

USB laser: refers to the laser provided by Venuslab, which is connected to the computer via USB, and the laser is automatically controlled by the PLUS software (not by the spectrometer), which belongs to the build Raman.

Serial laser: refers to the laser provided by Venuslab, which is connected to the computer through the RS232 serial port, and the laser is automatically controlled by the PLUS software (not controlled by the spectrometer), which belongs to the build Raman.

532 Serial Laser: This refers to the customized 532 serial laser provided by Venuslab, which is connected to a computer via an RS232 serial port, and the

laser is automatically controlled by the PLUS software **(not by the spectrometer),** which belongs to the build Raman.

USB to Serial Laser: The laser has a built-in USB to serial module with a USB interface, and when plugged in, It will be recognized as a serial port on the computer

Manual laser: refers to the laser is not controlled by Venuslab software,external manual laser.
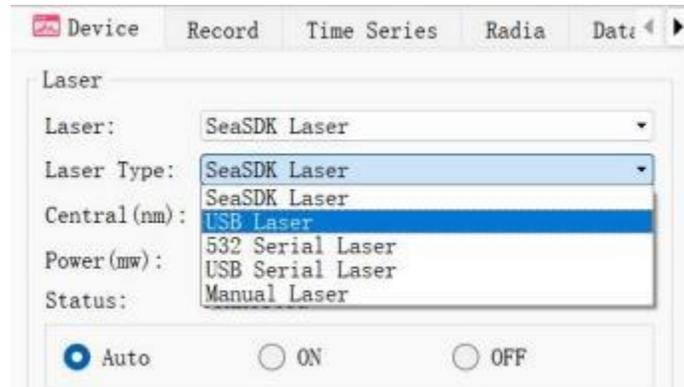
3.2   Laser control

There are three modes of laser control：

Laser Auto: The laser switch is fully controlled by the PLUS software. The PLUS software does not switch on the laser first but collects a frame of background noise data, and then switches on the laser to collect a frame of signal data.

Laser On: The laser is on. It can be used to detect whether the laser has been connected to the computer, and can detect whether the laser can be controlled by PLUS software.

Laser Off: The laser is off. Typically used to acquire background signals under certain circumstances.

When the laser does not emit light, there may be the following questions:

1. the laser driver is not installed

2. when the laser driver is correctly installed, the laser connection type may be set incorrectly

3. when the laser driver is installed correctly and the laser connection type is set correctly, but the laser power may be 0

## 3.3 Description of spectrometer types

USB Spectrometer: The spectrometer provided by Venuslab is connected to the computer via USB cable, and the spectrometer can be controlled by PLUS software.

Serial Spectrometer: The spectrometer provided by Venuslab is connected to the computer via RS232 cable and can be controlled by PLUS software. After connecting the serial spectrometer, you need to click the "Connect Serial Spectrometer" button to open the serial spectrometer.

Caution: Before installing the software for the first time, please make sure that the device driver has been installed properly. If the device driver is not properly installed, the PLUS software will not work properly!

3.4 Rescanning equipment

Scanning a device is to scan the connected device and the scanning result is displayed in the device view.
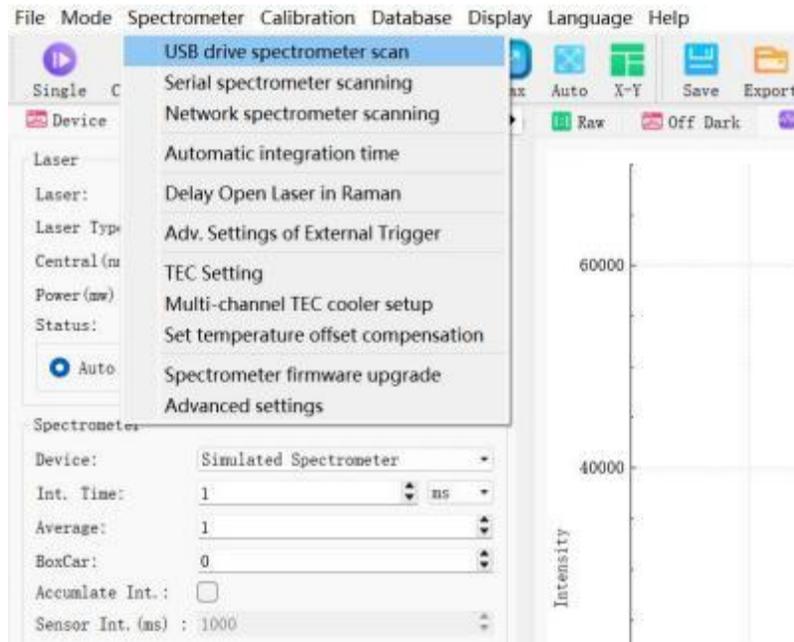
3.5   Spectrometer Parameters

Averaging Count: PLUS software can do averaging operations on the collected data through multiple acquisitions to get the average value.

Support software averaging and hardware averaging.

Integration Time: the integration time range of 1ms~65535ms.

The unit will automatically adjust the unit according to the entered value. Please confirm the unit before acquisition.

Please be careful not to reach to maximum value(saturate state). The maximum value is 65535.

Pixel Smoothing: Average the values between N pixel points around the pixel point.

N is a setting value, default is 0.

Segmented Integration: If the light intensity saturates within the desired integration time, you can enable this function. Check the box in the software to activate segmented integration. Once enabled, the integration time will be divided according to the maximum integration time per segment. Each segment will be collected separately, and the spectra will be accumulated and displayed at the end.

e.g. Integration time 1s, maximum integration time 300ms, will be divided into 300ms+300ms+300ms+100ms.

Auto integration time: the software will automatically adjust the integration time to make the light intensity to the appropriate range after checking the box.

3.6   Serial Spectrometer Connection

When we use the serial spectrometer, the "spectrometer"box will displayed as COM port, the serial spectrometer connection needs to be opened by clicking on the "Connect serial spectrometer" button additionally.

3.7 Network Spectrometer Connection

First, configure the IP address of the network interface. Open the network adapter settings, right-click on Ethernet, and select Properties.

Click on 'Internet Protocol Version 4 (TCP/IPv4)'

Change the first three octets ofthe IP address to match the spectrometer's IP address, and ensure the last octet is different from the spectrometer's.

After completing the settings, open the PLUS software and click on 'Spectrometer Settings' -> 'Add Network Spectrometer' in sequence. The network spectrometer will appear in the automatic search, and then you can click 'Connect'.

Note: If the network spectrometer cannot be found through automatic search, disable all network firewalls.

4 Function introduction

Uspectral-PLUS is a new generation of spectral analysis system integrating spectral acquisition, data analysis and database management. Uspectral-PLUS needs to be used in conjunction with spectrometers and lasers, and the functional modules are mainly divided into the following categories:

Spectrum Collection：

Single collect

Continuous collect

Integration time, average count, pixel smoothing.

Spectrum Pre-processing:

Data clipping

Baseline processing

Data smoothing

Remove background (Dark noise)

Spectra derivative

spectral peak detection

interpolation：

linear interpolation

spline interpolation

Normalization：

Unit Vector Normalization (UVN)

Maximum Value Normalization (MVN)

Standard Normal Variable transformation (SNV)

LOG10

Specified Peak Normalization (SPN)

multivariate analysis：

Principal Component Analysis

Raman shift calibration

Search methods：

positive correlation

negative correlation

Database Management：

Create, remove, modify, check on database

Database search

Uspectral PLUS has many new algorithms from chemometrics and computer science to improve the quality and performance of the software.

Here are advantages of Uspectral PLUS software:

- High performance and accuracy calculations based on BLAS and LAPACK.

- Sparse linear algebra algorithms with high speed and low memory consumption.

- State-of-the-art pre-processing for spectral smoothing and baseline drift correction.

4.1   Spectrum import

Spectral data can be imported into the software in the following five ways:

- Import DX file, DX file can contain a lot of annotation information, such as integration time, laser power, it is generally recommended to save as DX format

- Import CSV file, the CSV file only contains Raman or wavelength information, the X-axis can be the wavelength or Raman, the Y-axis contains Counts information, the

CSV file does not contain other information.

- Import TXT file, TXT file contains only Raman or wavelength information, X-axis can be wavelength or Raman, Y-axis contains Counts information, TXT file does not

contain other information.

- Import MIC file, MIC file is a special file for microscope mobile platform, which contains ROW, COLUMN data, wavelength type, XY axis information when the microscope platform is collecting.

- Import SPC file The SPC file is a standard SPC spectral format file.

4.2 Pre-processing

In chemometrics, a spectral preprocessing algorithm is a series of linear algebra calculations performed on a spectral matrix. Spectral preprocessing is important and it is a very critical part of all chemometrics algorithm applications.

The preprocessing module of the PLUS software performs data clipping, data smoothing, baseline processing, linear interpolation, spline interpolation, unit vector normalization, maximum normalization and standard normal variable transformation, LOG10, normalization of specified peaks, and spectral peak detection.

5 Raman Spectrum acquisition

5.1 Single acquisition

Select the device to be controlled in "Available Devices" of "Devices".

In the "laser" in the "center wavelength" set the center wavelength of Raman spectroscopy laser test report fill in here, the size of the center wavelength and the subsequent wave number and Raman shift conversion is closely related. For example, if the laser is 785nm, then the center wavelength must be filled in 785, otherwise the calculated Raman shift will be inaccurate. The center wavelength supports decimal point. The center wavelength will be saved in the registry, and will be filled in automatically next time you start the program.

In the "Power" of "Laser", fill in the required laser power, the setting range is the same as the laser specification of the device, the higher the power, the higher the energy on behalf of some dark-colored substances are easy to be too high because of the energy and "burnt", while some weak Raman shifts will be accurate. The higher the power, the higher the energy represented, for some dark substances are easy because the energy is too high and "burnt", and some weak Raman signal substances need higher power to stimulate the Raman signal, set the appropriate laser power is crucial to the collection of the Raman signal. The value of the laser power is an integer between 0 and 500, and the unit is mW. After inputting the value, click the "Setting" button to make the setting take effect.

In the parameters of "Spectrometer", there are "Average times" and "Integration time" for selection, which indicate the time and times of the spectral feed.

After setting the device parameters, click Single Acquisition. The single acquisition is an adaptive process, the software will automatically collect the dark spectrum once, and then turn on the laser to collect a frame of bright spectrum, and the software automatically deducts the dark current and adaptive integration time, and directly get the better Raman signal under the better equipment parameters.

Note: Only when the laser is an on-board laser, or a usb laser, the Uspectral-PLUS software will automatically control the laser on and off. If it is a manual laser, you need to collect the dark spectrum by yourself. Users first turn off the laser, click "Save Background" button to save the dark spectrum once, then turn on the manual laser and click Single Acquisition, the software will automatically deduct the dark spectrum signal.

5.2   Continuous acquisition

Continuous acquisition mode is a cycle of single acquisition until the user clicks on "Stop Spectrum Acquisition" to stop the acquisition, and the spectral view is constantly updated during the acquisition process. Spectral trends can be observed in continuous acquisition mode.

Continuous acquisition is generally used for adjusting the position between the laser and the measured substance.
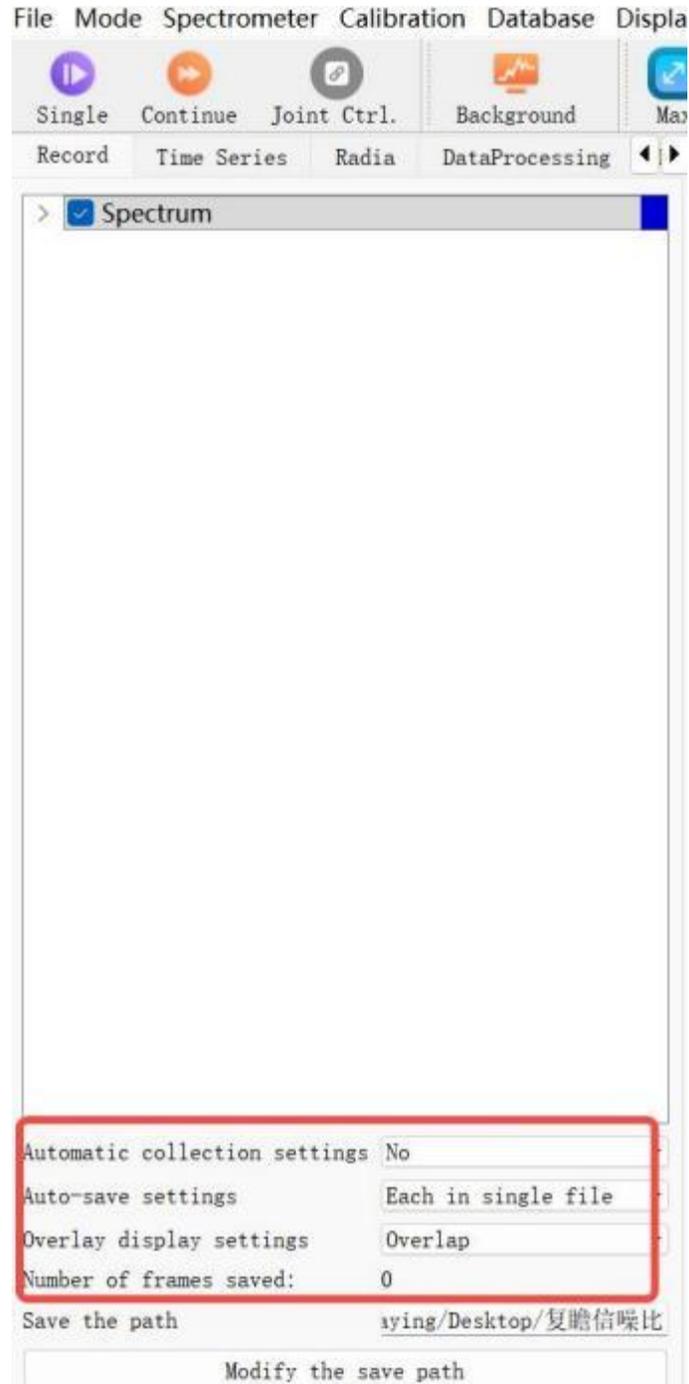
On the Record page, you can check Auto Acquisition Save, which allows you to automatically save all plots during a continuous acquisition.

5.3 Save background

If you use manual lasers, you need to collect the dark spectrum yourself.

The user first turns off the laser, clicks the "Save Background" button to save the dark spectrum once, then turns on the manual laser, clicks Single Acquisition, and the software will automatically deduct the dark spectrum signal. In general, it is not necessary to click the Save Background button. Only in the case of manual laser, you need to use the save background function.
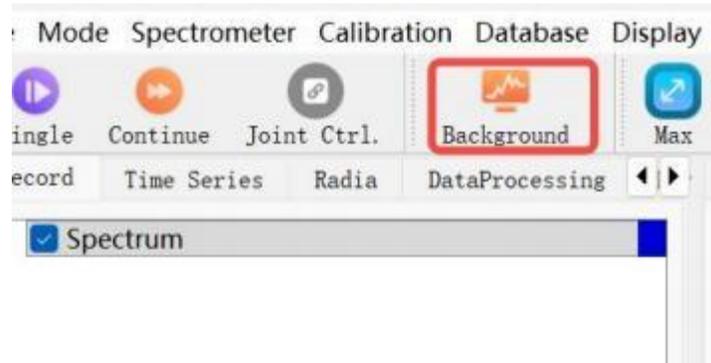
5.4 Save Data

Saving data is to save the collected spectrogram data in text format to the specified path, after clicking save data, the interface prompts the user whether to continue to export or not, after clicking confirm export, a text box will pop up, in the box, enter the file name of the saved file can be.
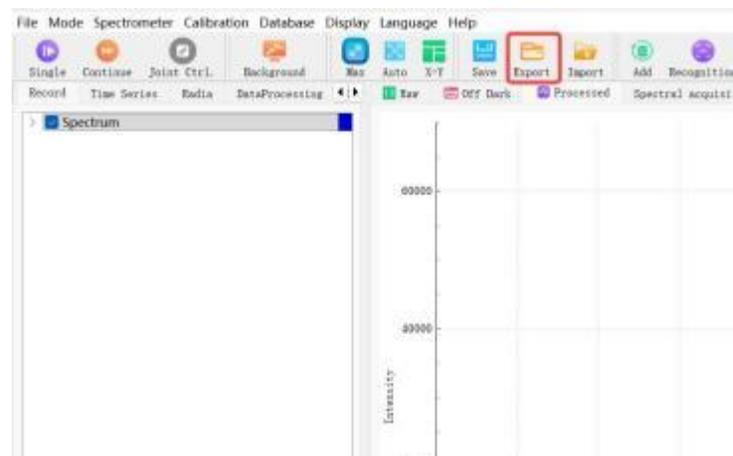
5.5 Quick Save

Sometimes when doing experiments, you want to quickly save the plot you want, you can click on Quick Save, the system will use the current time as the file name to save the spectral information

6 Cyclic Acqusition

Cyclic acquisition is an acquisition method that collects data uninterruptedly at the same time interval. The acquired data can be saved and exported. The basic parameters are the interval time and the number of acquisition times. The minimum interval for cycle acquisition is 1 second, and cycle acquisition can be performed at fixed intervals to obtain data stability indicators. For example, up and down fluctuation values, laser stability and other indicators.

6.1 time interval

Interval time is the time interval of each acquisition in the process of cyclic acquisition, the time unit is (sec/s), because of the inaccuracy of the cyclic acquisition, so the minimum interval can only be 1 s. If the user wants the interval time to be more than 25ms, please select the batch acquisition function.

6.2 Acquisition times

The number of acquisitions is the total number of acquisitions during the cyclic acquisition process.

6.3 Current saved frame count

The current saved frames are used to display the current number of frames captured during the cyclic acquisition process to show the role of the current progress.

6.4 Save mode

there are two saving modes:

1.Each map is saved independently as a file, advantage: fast saving speed, disadvantage: large number of files.

2.All the maps are saved in one file, advantage: fewer files, disadvantage: more memory consumption, after the number of large, the saving speed slows down significantly.

Note that the X-axis is wavelength, the data saved in the cycle is wavelength information, and the X-axis is Raman, the data saved in the cycle is Raman information.
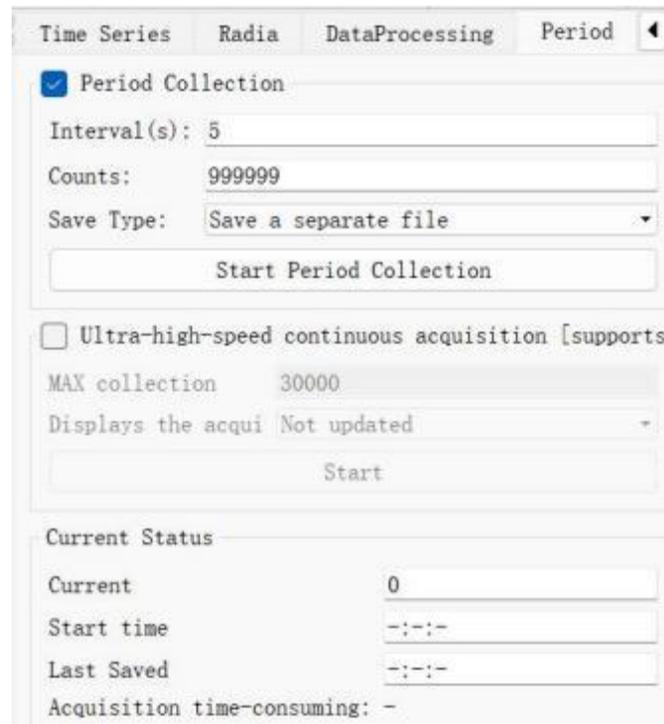
6.5 Ultra-high speed continuous acquisition

For acquisition of more than 40 data per second, the system will buffer the data in memory first, and when the measurement is completed, it will be written to disk uniformly.

6.6 Running status

Displays the number of frames currently saved and the time of the last save

7 Display

This section will briefly introduce the graphical user interface (GUI) in the software. In order to familiarize the user with the software, each interface of the GUI will be briefly introduced with its function.

7.1 Spectrogram display type

Raw Spectrogram: The raw spectrogram is the spectrogram of the data collected by the spectrometer without any processing. This spectrogram contains noise information. The raw spectra collected without the laser are called background noise, and the raw spectra collected with the laser on are called signal.
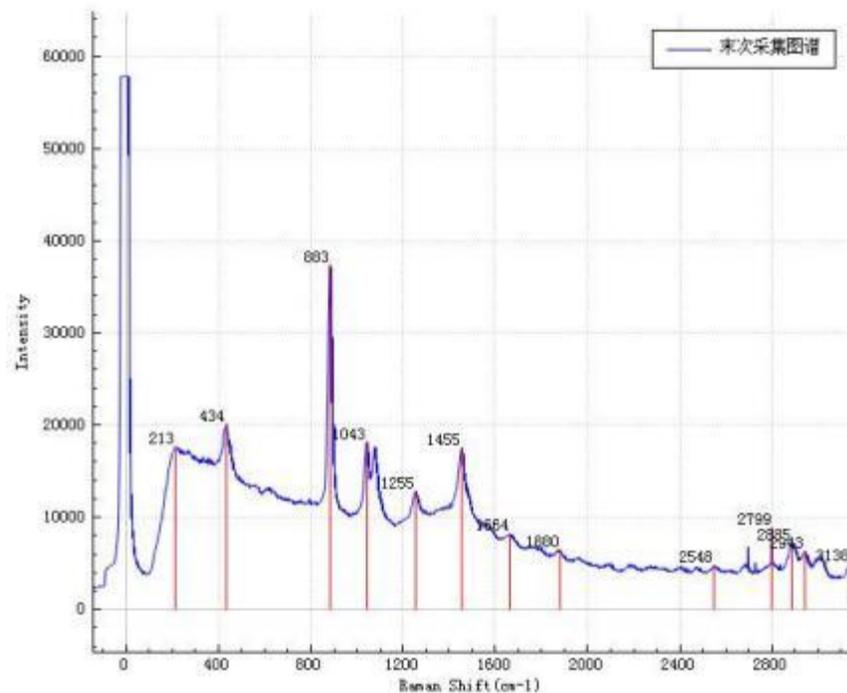
Fig. Raw Spectrum

Deducting the background: The background, also known as dark noise, is the electrical signal received by the spectrometer in the absence of light. When we do not turn on the laser, the acquired spectrum is the background spectrum. Usually we use the original spectrum with the laser on to subtract the background spectrum without the laser on to obtain a spectrum with the background noise removed. After subtracting the background, you can see that the baseline of the spectrum is near the X-axis.
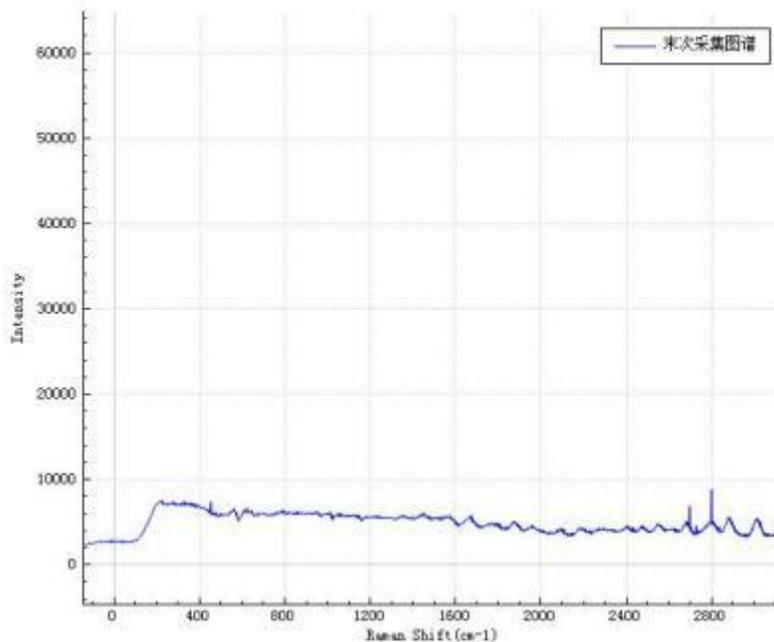

Fig. Noise Spectrum
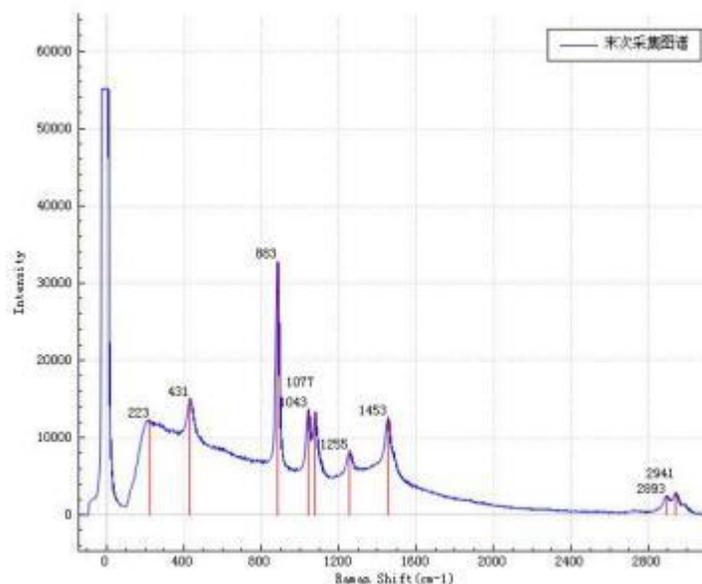
Fig. spectrum after deducing background

Processed Spectrogram: The processed spectrogram contains the following equation

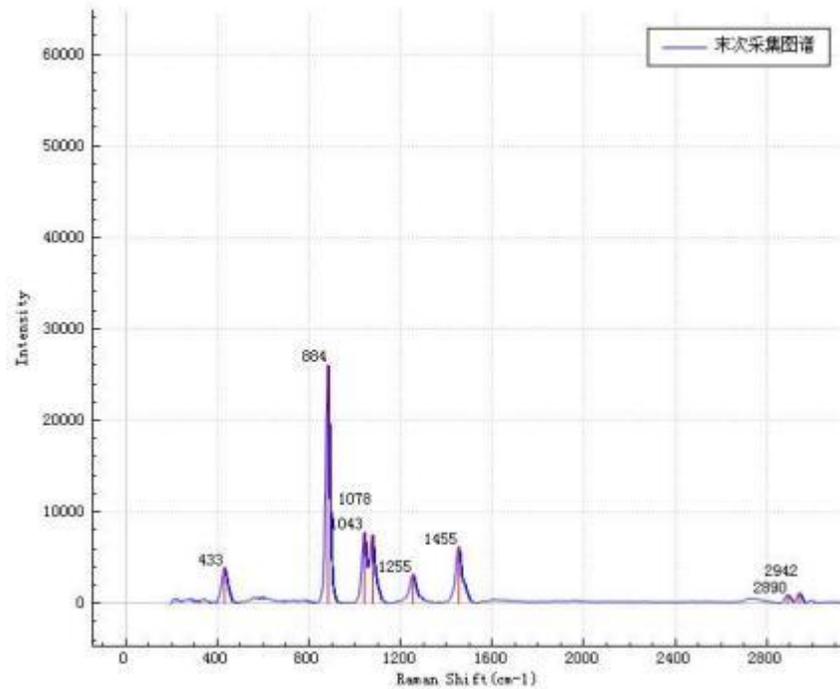Processed spectrogram = preprocessing algorithm (original spectrogram minus background)

Fig. Processed Spectrum

7.2 Spectrogram scaling type

Maximize: Displays the maximum range of 0 - 65535 Counts

Adaptive: Automatically adjusts the X-axis and Y-axis intervals based on the current plot maximum and minimum values
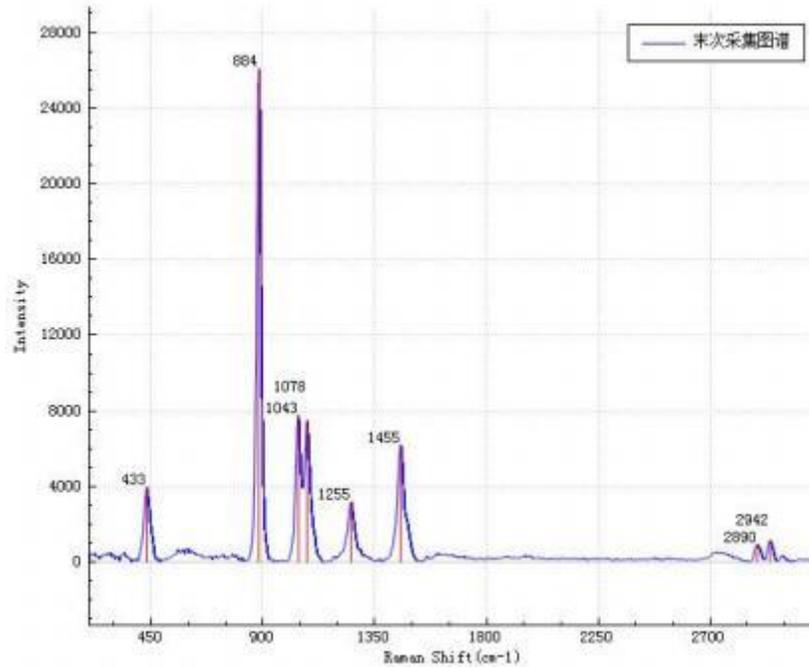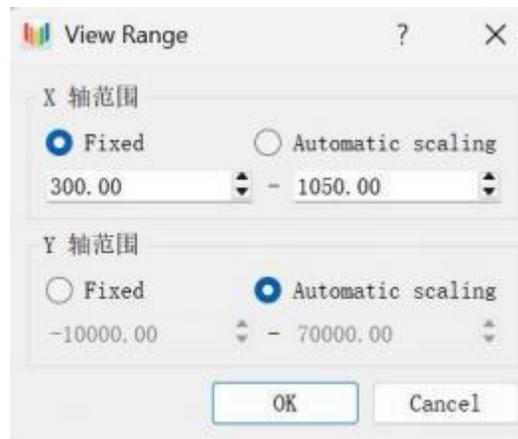
Customize X-axis and Y-axis

Fig. adaptive spectrum

Customize the plot, you can choose the range of X-axis and Y-axis.

You can also fix the X-axis coordinates. When the X-axis coordinates are fixed, the X-axis will not change when you click Adaptive Display, which is more suitable for observing curves in a certain wavelength range.

8   Color Measurement

8.1   Color Measurement type

Color measurement is also an important feature of the Uspectral-PLUS software.
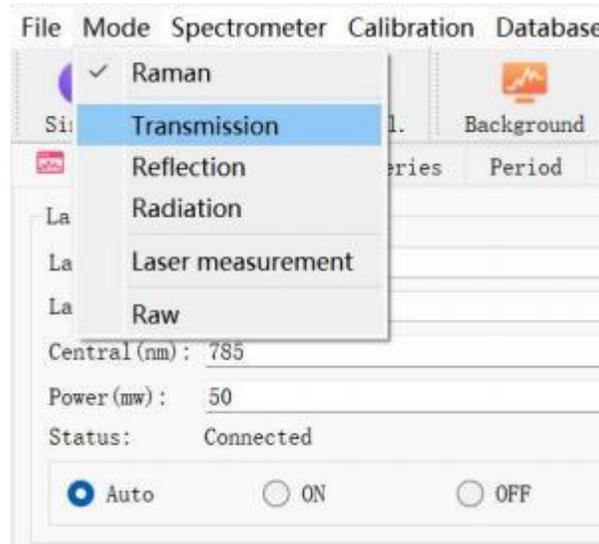
8.2   Color Measurement Basics

According to the formula, Transmittance, Reflectance, Absorption, Irradiance, are expressed by the following formula. In this formula, each variable corresponds to the following icons in this software.

For example, if the light is currently off and the probe is masked, pressing the "Signal Dark" button will save the currently acquired spectrum as Signal Dark.

For example, if the light is turned off and the probe is placed in front of the whiteboard, pressing the "Standard Dark" button will save the currently acquired spectrum as Standard Dark.

Transmission, Reflection, Absorption mode standard file is the file of the standard reflector.

Irradiance mode standard file is the calibration file of the standard lamp, please ask the standard lamp supplier for this file.

Note that the standard file is a TXT file. The format inside is as follows, the left side is the wavelength and the right side is the calibration coefficient corresponding to this wavelength. Between the number on the left and the coefficient on the right is a tab split.

250   0.023

300   0.122

350   0.245

...
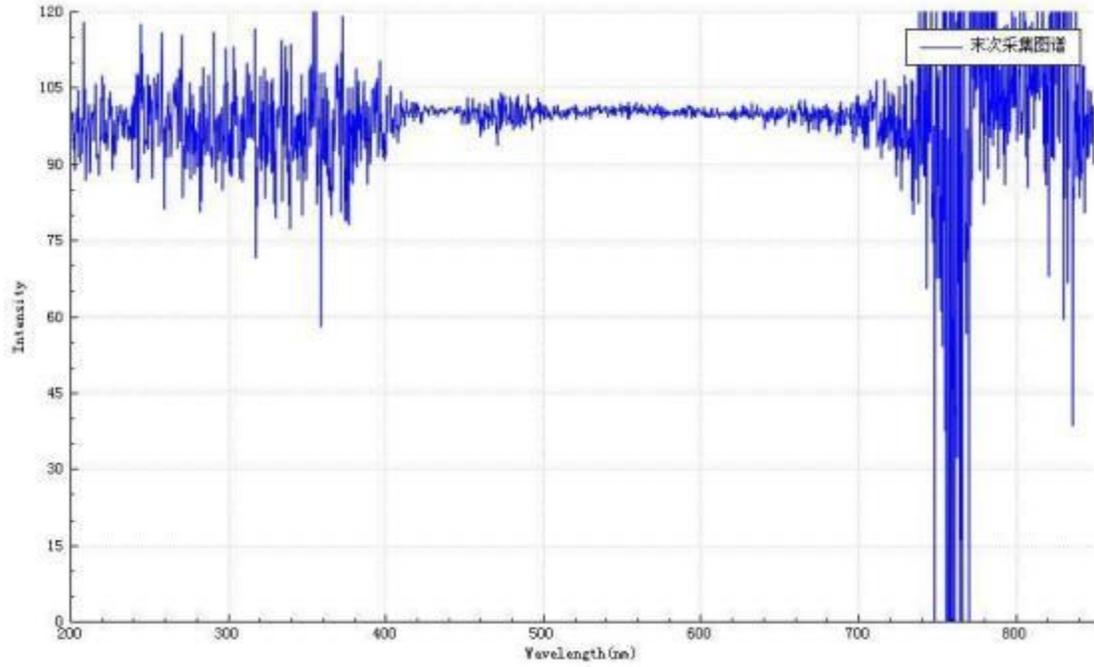
...

2500   2.432

General operation steps

### 1. Turn off the light source and collect the dark spectrum
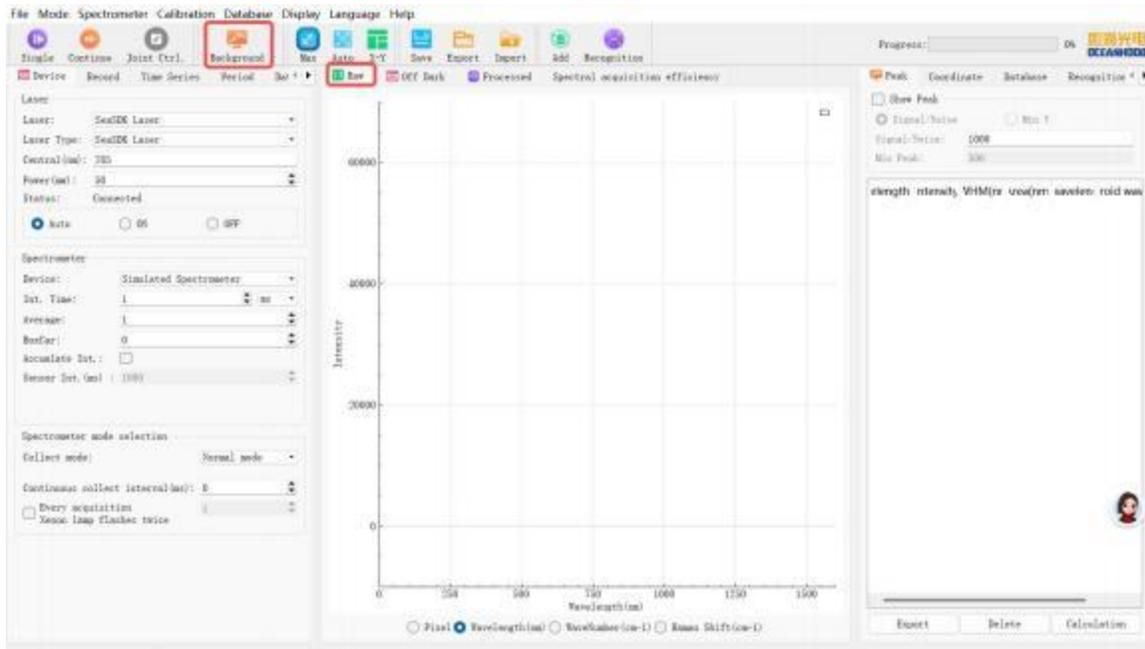
2. Turn on the light source and collect the bright spectrum

3. Click on Continuous Acquisition or Single Acquisition and select "Processed Spectra" to see the transmittance or reflectance.

The final reflectance spectrum is as follows:

Note: during color measurement, please adjust the integration time to ensure that the graph is not oversaturated. Otherwise, it will cause inaccurate measurement
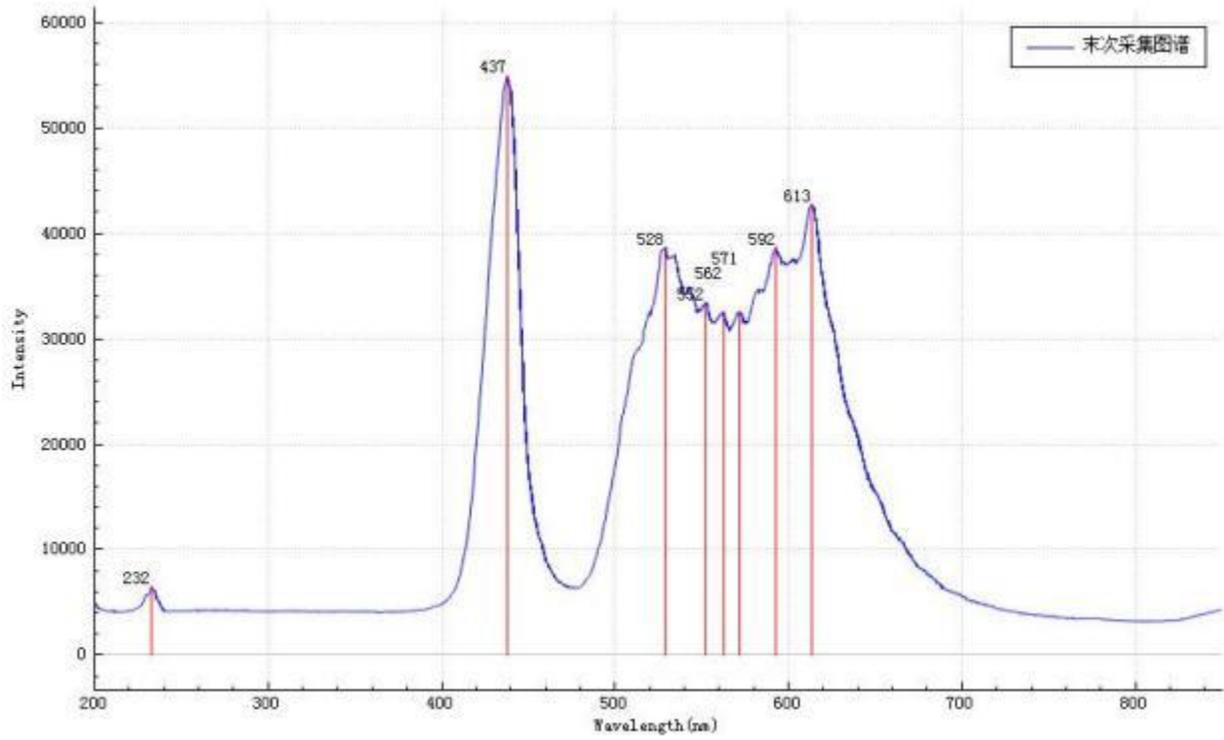
8.3　Reflex mode

Spectra type	methods
Standard Light	The probe was placed on a white board, the light was turned on, and the measured spectral lines were standard light
Standard Dark	The probe was placed on a white board, the light was turned off, and the measured spectral lines were standard dark
Signal Dark	The probe was placed on measured object, the light was turned off, and the measured spectral lines were signal dark
White Board Std File	Whiteboard standard file, such as no whiteboard standard file, can be used in the installation directory of the sample_reflex_stdfile as a simple alternative files
Final signal to be measured	Place the probe on the object to be measured, turn on the light, and the spectral line seen in 'reflectance' mode is the reflectance curve

Std file:

The standard file of the whiteboard, if there is no standard file of the whiteboard, you can check

"Spectrometer Settings->Whiteboard Auto Save to File", and click "Save Bright Spectrum", "Save Bright Spectrum" again. "

You can save the standard light and dark as a file, so you don't need to reset the standard light and dark every time.

You need to re-do the calibration (save standard light and standard dark) operation after changes in acquisition parameters (including but not limited to integration time, averaging times, focal length, pixel smoothing).

8.4   Radia mode

Spectra type	methods
Standard Light	By placing the integrating sphere on a standard lamp and turning on the standard lamp, the measured spectral lines are standard bright
Standard Dark	By placing the integrating sphere on a standard lamp and turning off the standard lamp, the measured spectral lines are standard bright
Signal Dark	By placing the integrating sphere on the measured light source and turning off the measured light source, the measured spectral line is the signal darkness
Standard lamp Std File	Please use the standard lamp calibration file
Final Signal to be measured	Place the integrating sphere on the measured light source, turn on the measured light source, and the spectrum seen in 'irradiance' mode is the irradiance curve

8.5   Transmit mode

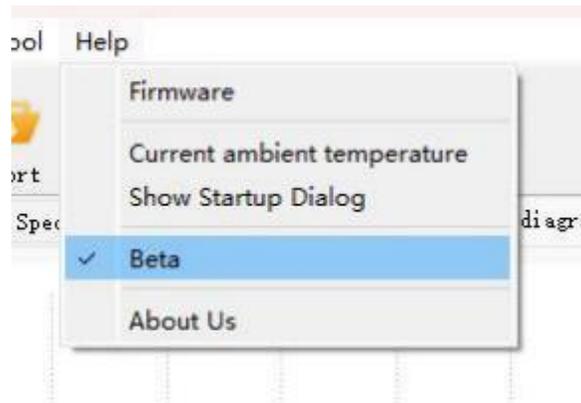| Spectra type	methods
Standard Light	One end of the three-sided pass bracket is connected to the spectrometer, one end is connected to the light source, the three-sided pass bracket inside the cuvette is not put, turn on the light, the measured spectral line is the standard bright
Standard Dark	One end of the three-sided pass bracket is connected to the spectrometer, one end is connected to the light source, the

	three-sided pass bracket inside the cuvette is not put, turn off the light, the measured spectral line is the standard bright
Signal Dark	One end of the three-sided pass bracket is connected to the spectrometer, one end is connected to the light source, the three-sided pass bracket inside the cuvette is put, turn off the light, the measured spectral line is the standard bright
Std file	Use the sample_trans_stdfile in the installation directory as the standard file
Final Signal to be measured	One end of the three-sided pass bracket is connected to the spectrometer, one end is connected to the light source, the three-sided pass bracket into the cuvette, turn on the light, in the 'transmittance' mode to see the spectral line is the transmittance curve

8.6   Absorbance mode

| Spectra type	methods
Standard Light	One end of the three-sided pass bracket is connected to the spectrometer, one end is connected to the light source, the three-sided pass bracket inside the cuvette is not put, turn on the light, the measured spectral line is the standard bright
Standard Dark	One end of the three-sided pass bracket is connected to the spectrometer, one end is connected to the light source, the three-sided pass bracket inside the cuvette is not put, turn off the light, the measured spectral line is the standard bright
Signal Dark	One end of the three-sided pass bracket is connected to the spectrometer, one end is connected to the light source, the three-sided pass bracket into the cuvette, turn off the light, the

|	
	measured spectral line is a signal dark
Std file	Use the sample_trans_stdfile in the installation directory as the standard file
Final Signal to be measured	One end of the three-sided pass bracket is connected to the spectrometer, one end is connected to the light source, the three-sided pass bracket into the cuvette, turn on the light, in the 'transmittance' mode to see the spectral line is the transmittance curve

9 help

9.1 Device Version

View the current spectrometer board STM version number and FPGA version number, which may not be displayed for older spectrometer versions.
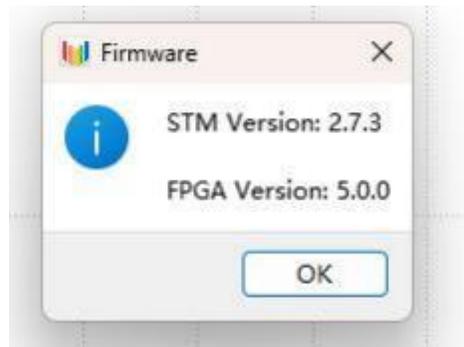
9.2   Spectrometer circuit temperature

View the current spectrometer board temperature, which may not be displayed on older versions of the spectrometer.
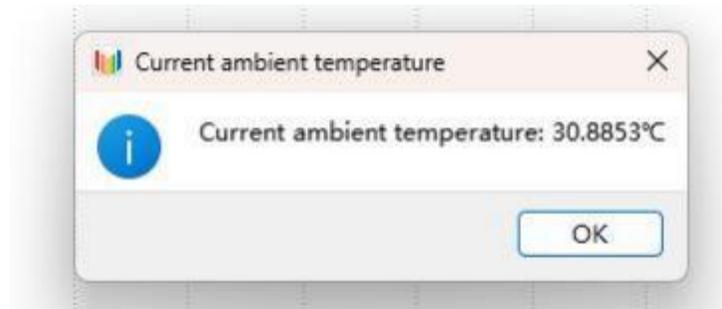
9.3   Show prompt box at startup

Show run mode prompt box when checked