RG Raman spectrometer

User Manual

Version 202301

Lightnovo

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Safety

General Information

Read the following safety instructions carefully before operating RG Raman spectrometer and keep this manual for future reference available at any time. Always observe the instructions described in this manual to ensure user safety and to avoid property damage. Improper use or failure to follow these safety instructions can result in serious injuries and/or property damage. Any non-observance of the precautions will infringe the intended use (i.e. performing measurements by Raman spectroscopy) of RG Raman spectrometer. In this case Lightnovo ApS will not assume any liability. It is the operator's duty to plan and implement all necessary safety measures and to supervise their observance. Moreover, the operator must ensure that RG Raman spectrometer is in proper functioning condition. A safe and faultless operation can only be guaranteed if RG Raman spectrometer is transported, stored, installed, operated and maintained properly according to the procedures described in this manual. Never remove or deactivate any supporting safety systems during RG Raman spectrometer operation. Ensure that objects and/or material not required for the measurement is out of the instrument operating area.

Qualified Personnel
Primary installation and all maintenance and repair works not described in this manual should only be performed by Lightnovo service personnel. Only authorized operating personnel that have been briefed about the instrument operation and all relevant safety aspects should operate and maintain (i.e. only maintenance works that are described in this manual) the instrument. All repairs, adjustments and alignments on any RG Raman spectrometer component must be performed in accordance with the safety regulations and standards applied in the country in which the instrument is installed.

Correct Usage
RG Raman spectrometer and its components should only be used according to the instructions described in the manual or advised by a Lightnovo engineer. In case of accessories or components made by other manufacturers and used in connection with the spectrometer, Lightnovo does not assume any liability for safe operation and proper functioning.

Warning labels

This warning symbol indicates the existence of laser radiation.
Class 3B lasers **are hazardous for eye exposure**. They can heat skin and materials but are not considered a burn hazard. For visible-light lasers, Class 3B lasers' output power is between 5 and 499 milliwatts. Class 3B lasers are **normally hazardous under direct beam viewing conditions**, but are normally safe when viewing diffuse reflections.

Safety instructions

The following chapters describe all relevant safety aspects of the instrument operation. Depending on the degree of hazard the safety instructions are classified as follows:

Danger
indicates that death, severe personal injury or substantial property damage WILL result if proper precautions are not taken.

Warning
indicates that death, severe personal injury or substantial property damage CAN result if proper precautions are not taken.

Caution
indicates that minor personal injury or property damage CAN result if proper precautions are not taken. Important draws your attention to a particularly important information.

Note
draws your attention to an useful information on the product, e.g. product operation or to a special part of the manual.

The safety instructions Danger, Warning and Caution are marked by the corresponding warning labels.

Laser safety

General Information
The analysis system RG Raman spectrometer uses the light of a laser (405, 532, 633 or 785 nm). The used laser diodes emit visible and partially visible laser radiation in the near infrared region.
According to the standard EN 60825-1/10.2003, RG Raman spectrometers are Class 3B laser products. Therefore, they are **normally hazardous under direct beam viewing conditions**, but are normally safe when viewing diffuse reflections.

Safety Instructions
In additions to the safety instructions given below, also comply with all local regulations concerning laser safety.
The analysis system is specified as a laser class 3B product, i.e. it considered safe if handled carefully, with restricted beam viewing. Nonetheless, observe the following safety instructions:

Warning:
Avoid eye and skin exposure to direct or scattered laser radiation under all circumstances! Failure to do so can cause permanent and irreversible eye damage and/or serious skin injuries!

Installation

General Information

Unpacking and initial installation including hardware setup and cable connection is done by qualified Lightnovo service personnel. The operating company has to provide the required utilities and an installation site that meets the site requirements described in this chapter.

Delivery Scope

Standard Components

- RG Raman spectrometer (including user manual and quality test report)
- USB-C cable, 12 V Power supply (See section *Cable Connections* below in this chapter.)
- Accessories (includes spares, adaptors, objective lenses, sample preparation tools etc.)

Inspecting the Packaging

After having received RG Raman spectrometer, inspect the packaging for damages. If there are any signs of damage, contact your local shipping representative before opening the shipping box.

Warning:

Do not put RG Raman spectrometer into operation if there are signs of damage. Failure to do so may result in severe personal injuries and/or property damage.

Transportation

When transporting the spectrometer, use the original packaging to avoid damages.

Site requirements

Space Requirements

RG Raman spectrometer requires a space of 20 cm in diameter and 7 cm in height. (For the exact instrument dimensions refer to *Specifications*.) At the instrument side, take a clearance of at least 5 cm into account for cables.

Environmental Requirements

To ensure optimum instrument performance and long-term reliability the following environmental conditions are essential:

- Ambient temperature range:18 - 35°C (64 - 95°F)
- Humidity (non-condensing): ≤ 70% (relative humidity)

Note:

RG Raman spectrometer is an instrument of protection class I (electric safety).

Cable Connections

Please unpack RG Raman spectrometer and remove it from the transportation packaging.

Please connect power supply cable to the connector on the side panel (Figure 1) and connect to the mains.
Please connect USB-C cable to the connector on the side panel (Figure 1) and connect it to PC from the other side.

Figure 1. Side panel – overview of USB C and power supply connector sockets.

Software Installation

1. Download RG Raman spectrometer software package from Lightnovo website: https://lightnovo.com/lightnovo-software/
   Please select version 32 or 64 bit depending on your operation system.
2. Install all drivers from the corresponding software folder.
3. Run Miraspec.exe file to start the data acquisition software.
4. Software is ready for operation.

Overview

General information

RG Raman spectrometer has no moving parts. This instrumental setup allows for acquiring Raman spectra from 405, 532, 633 or 785 laser. Raman spectra reveal information about the molecular structure and chemical composition of a sample.

This instrumental setup is designed for industry and demanding R&D application in materials science, pharmacy, life science or forensics, for example. Possible fields of application are analyses of SERS signals on plasmonic substrates, identification of powders and liquids. 785 nm RG Raman spectrometer is also suitable for samples that tend to fluoresce when exposed to laser radiation. Due to the usage of a 785 nm laser, the excitation energy is low enough for these samples not to fluoresce or only to a minor degree.

Note:
In Raman spectroscopy, sample fluorescence can yield a much more intense signal than the Raman scatter of the sample, masking any Raman bands in the spectrum. Therefore, Raman spectroscopy is normally not a suitable analysis technique for fluorescent samples.

Specifications

Table 1. RG Raman spectrometer specifications

Feature versus model*	405 / 405 HR*	532 / 532 HR	633 / 633 HR	785 / 785 HR
Laser wavelength**	405 nm	532 nm	633 nm	785 nm
Power on a sample	from 0.1 to 30 mW	from 0.1 to 75 mW	from 0.1 to 50 mW	from 0.1 to 65 mW
Spectral Range	80-3750 cm^{-1} (405) 80-1900 cm^{-1} (405 HR)	60-3750 cm^{-1} (532) 60-1900 cm^{-1} (532 HR)	80-3750 cm^{-1} (633) 450-1800 cm^{-1} (633 HR)	90-2500 cm^{-1} (785) 450-1800 cm^{-1} (785 HR)
Spectral Resolution	4-6 cm^{-1} (405) 2-4 cm^{-1} (405 HR)	4-6 cm^{-1} (532) 2-4 cm^{-1} (532 HR)	4-6 cm^{-1} (633) 2-4 cm^{-1} (633 HR)	3-5 cm^{-1} (785) 1.5-3 cm^{-1} (785 HR)
Signal-to-noise ratio at*:**	1000:1	1200:1	900:1	900:1
Physical dimensions	145 mm x 120 mm x 50 mm (LxWxH)			
Weight	1.3 kg			

* *HR – high resolution model*
** *Custom laser wavelength available upon request.*
*** *Determined as peak signal-to-noise ratio of polystyrene spectrum at maximal laser power, integration time 0.3s, number of repetitions 10.*
**** *Pinhole size dependent, pinhole size can be customized.*

General overview of control elements and components

RG Raman spectrometer has multiple control elements:

1. Laser control (ON/OFF and power control)
2. Spectroscopic sensor for Raman spectra acquisition (exposure, gain, row selection and binning control)

Operation

Hardware connection

Connection via USB-C cable
RG Raman spectrometer starts loading process when USB cable connected. It takes between 30sec to 60sec. When button is blinking “Blue”, device is ready for connection from PC.

Operation procedure

Switching the system ON/OFF
When the analysis system is not used for a longer period of time, it is highly recommended to switch off the Raman excitation laser. This action will prolong the service lifetime of the laser.

Warning:
Do not work with RG Raman spectrometer at laser power that is higher than specified for particular model. This could lead to the decreased life time of the laser diode or laser damage.

Starting the Miraspec software

1. **Connection**
   Press “Connect” button in Connection window (see Figure 2). This will initialize hardware accessories. Connection window can be found in Menu/File/Connection (Figure 3).

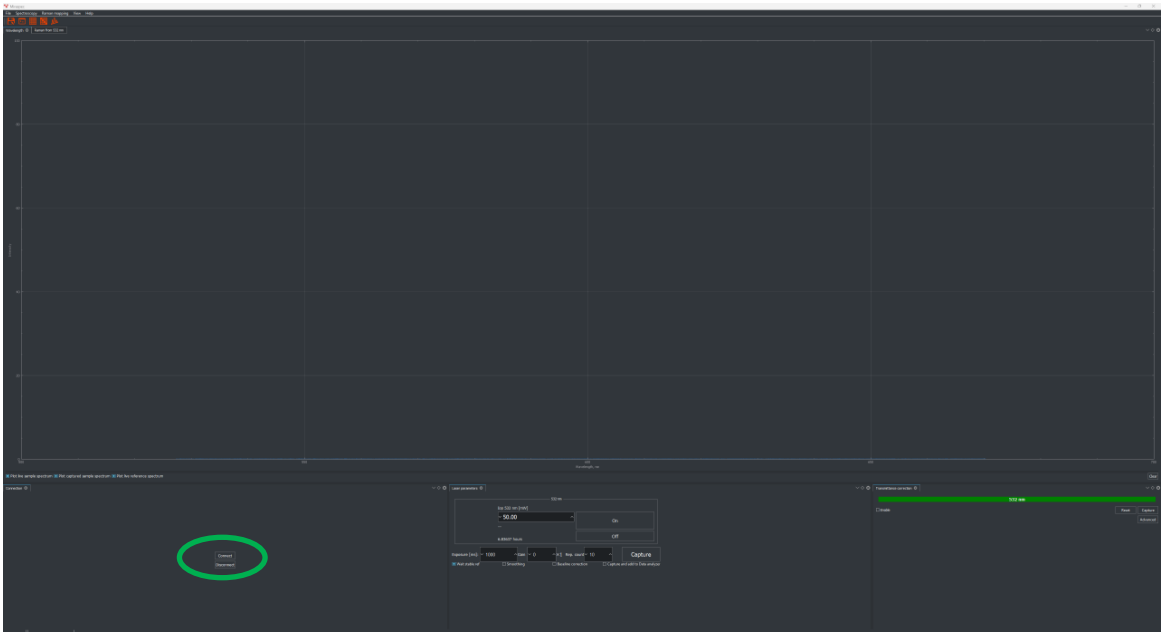

Figure 2. RG Raman spectrometer software interface; connection of accessories

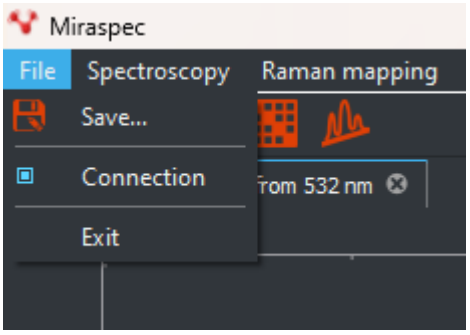

Figure 3. File menu

2. Turn ON/OFF lasers

Press “On” or “Off” buttons, see below.

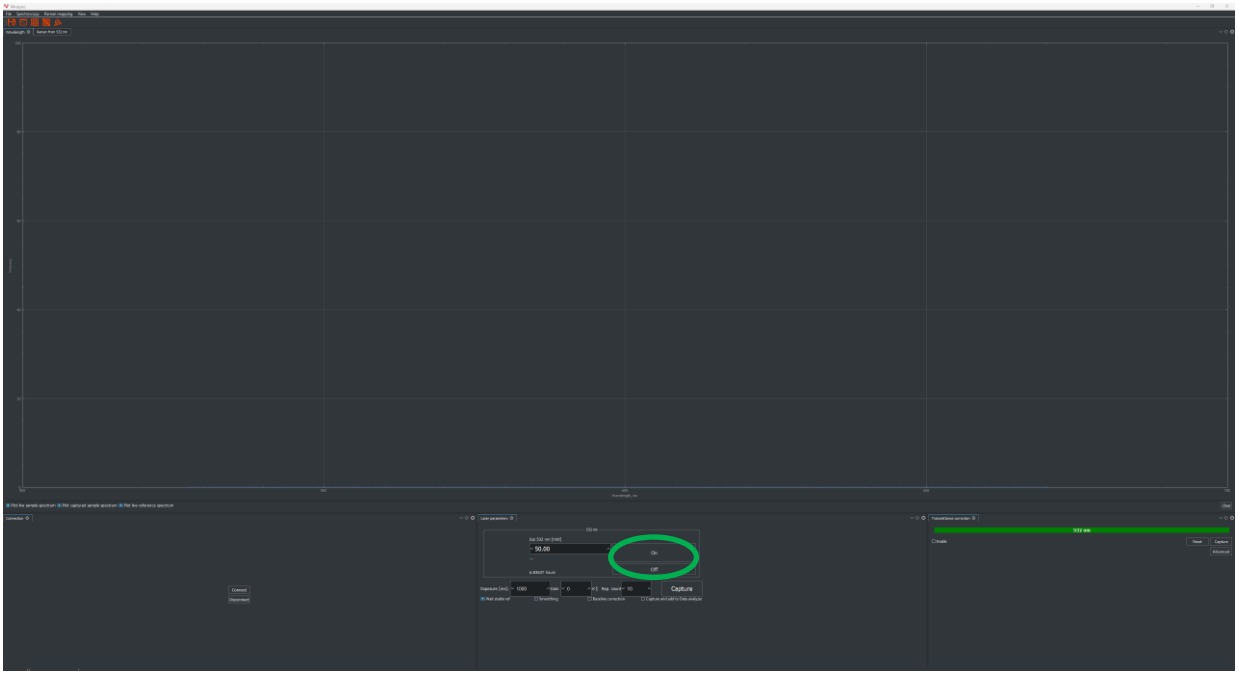

Figure 4. Switch on/off laser

3. Measuring the Raman spectrum of the sample

Raman spectra shown in the “Plot” window, see below.

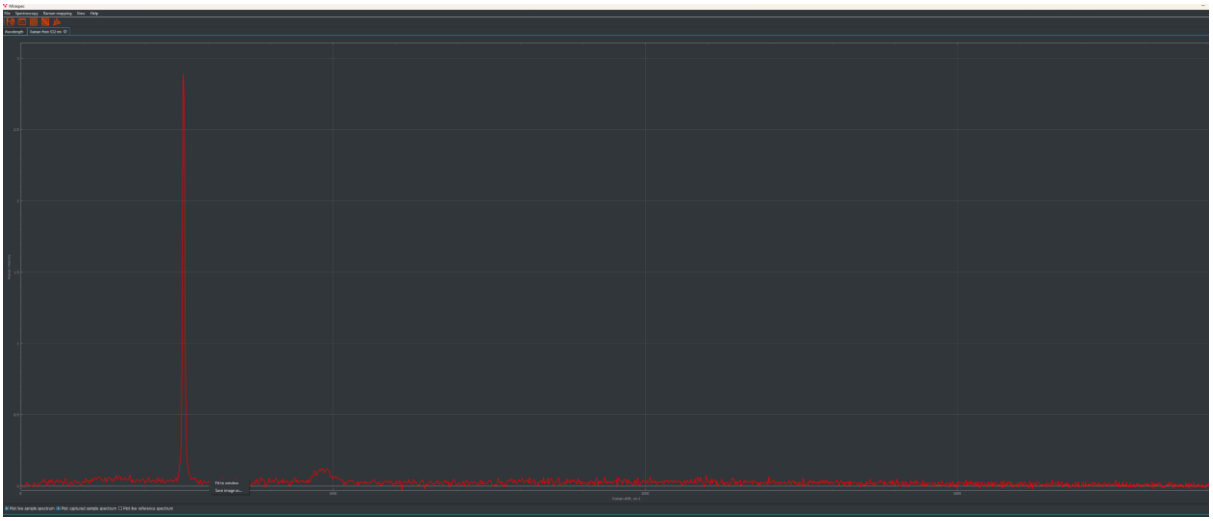

Figure 5. Curve context menu

If laser is ON system should show the “live” spectrum, see below. Spectrum scale can be adjusted by right click of the mouse and selection of “fit to window” bottom.

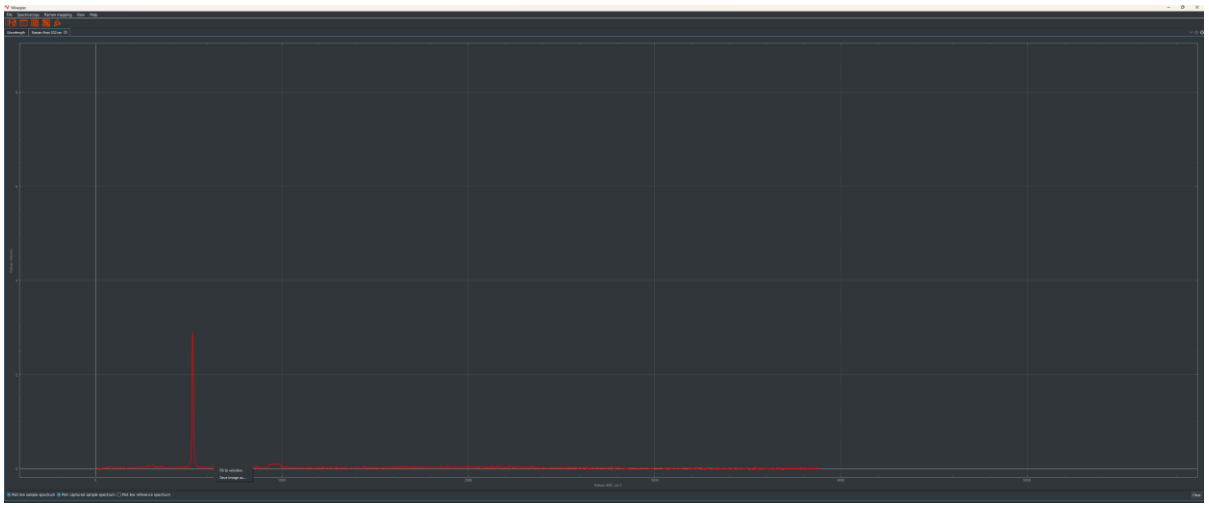

Figure 6. Fit spectra to window

Spectrum will be acquired by pressing “Capture” bottom. Acquisition parameters like laser power, gain of CMOS sensor and exposure time can be adjusted. Icon “Wait stable ref” should be applied if experiment requires high resolution of Raman spectra.

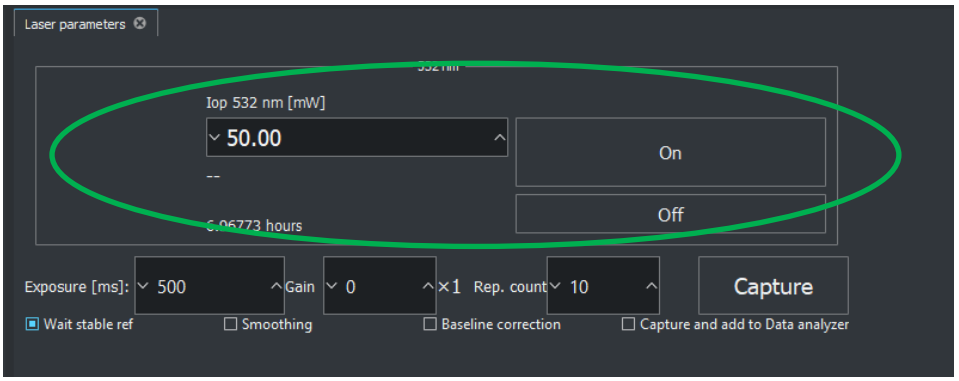

Figure 7. RG Raman spectrometer software interface; laser settings

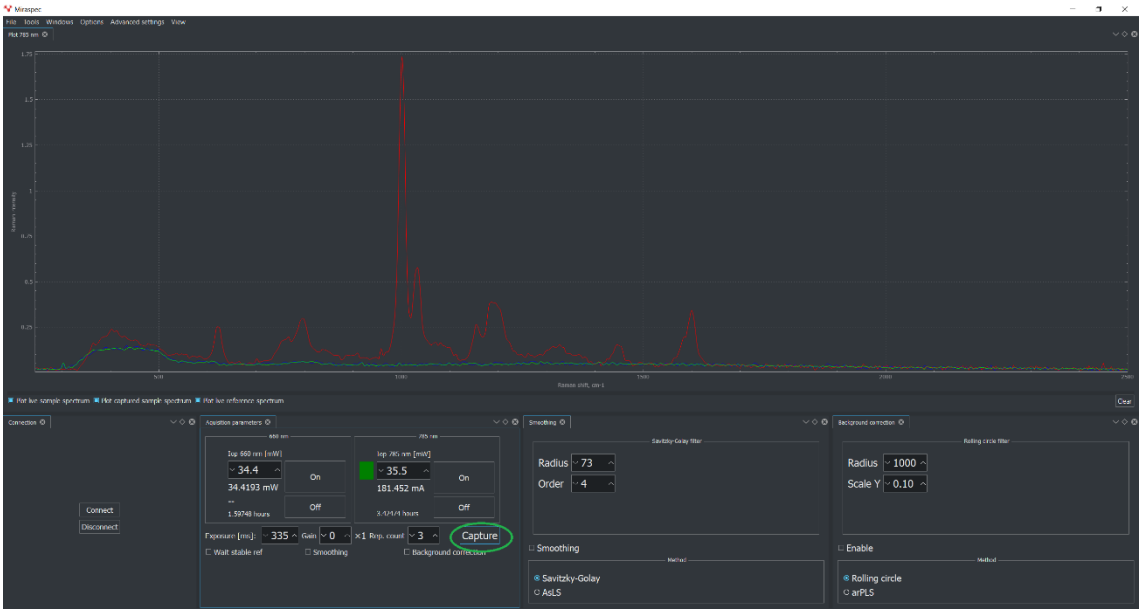

Figure 8. Spectrum capture

4. Spectra preprocessing

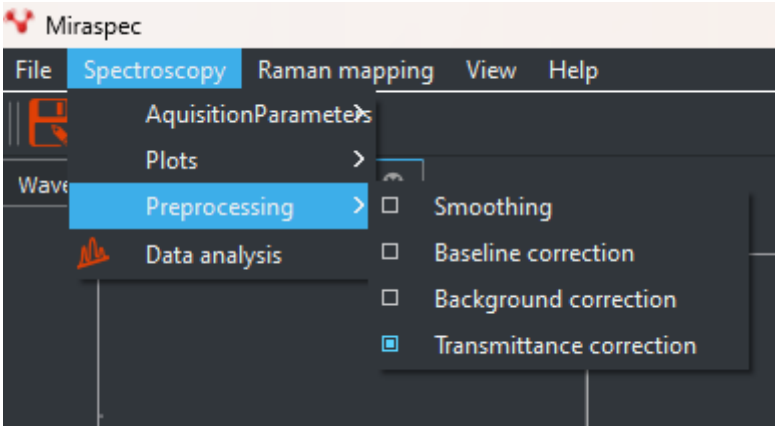

Figure 9. Spectroscopy/Preprocessing menu

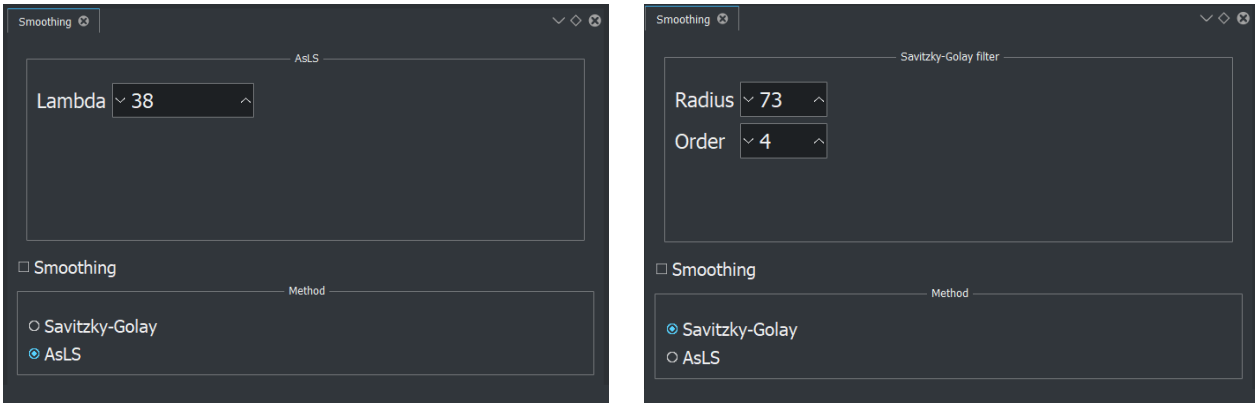

Figure 10. Smoothing methods

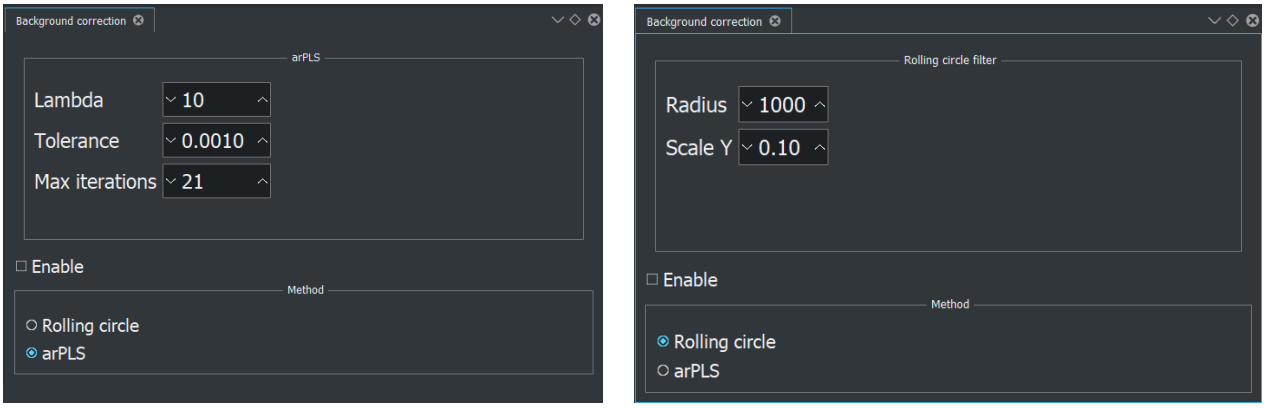

Figure 11. Background correction methods

5. Saving and/or exporting the data

Export spectrum in .tsv: Menu/file/save (see Figure below).

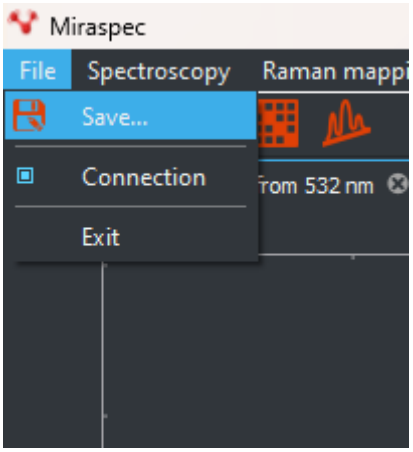

Figure 12. Saving captured spectrum

6. GUI settings

It is possible to optimize user interface based on customer preferences. Windows can be adjusted with docking widgets, see below.

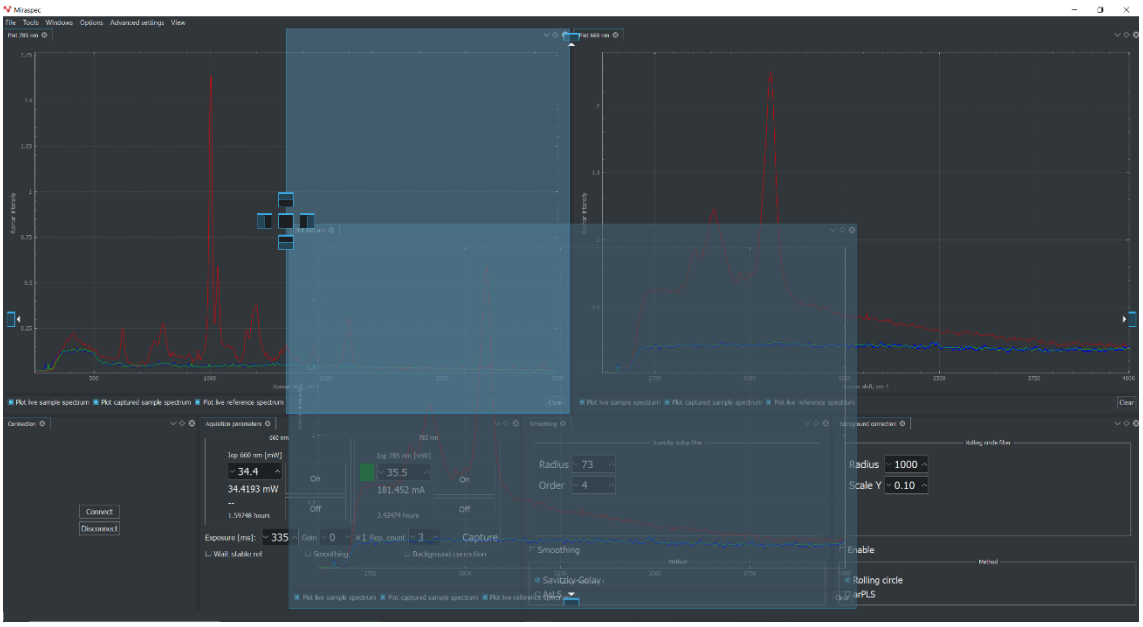

Figure 13. Docking widgets

Each user interface can be saved, see below.

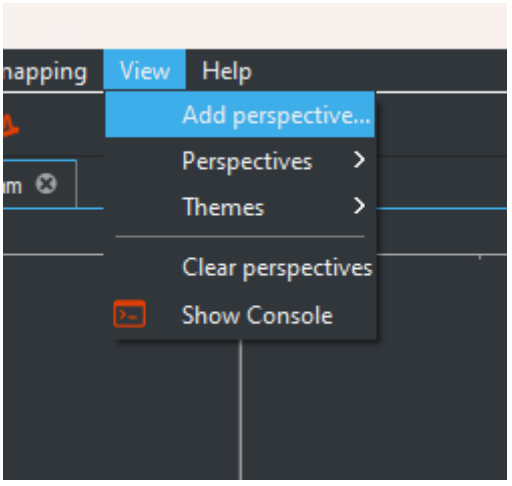

Figure 14. Adding perspective

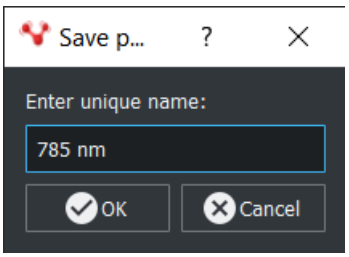

Figure 15. Saving perspective

Saved perspective can be opened at any time later, see below.

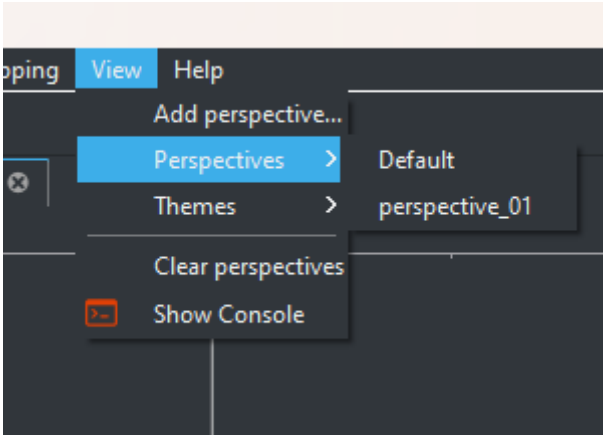

Figure 16. Saved perspective list

Technical drawings

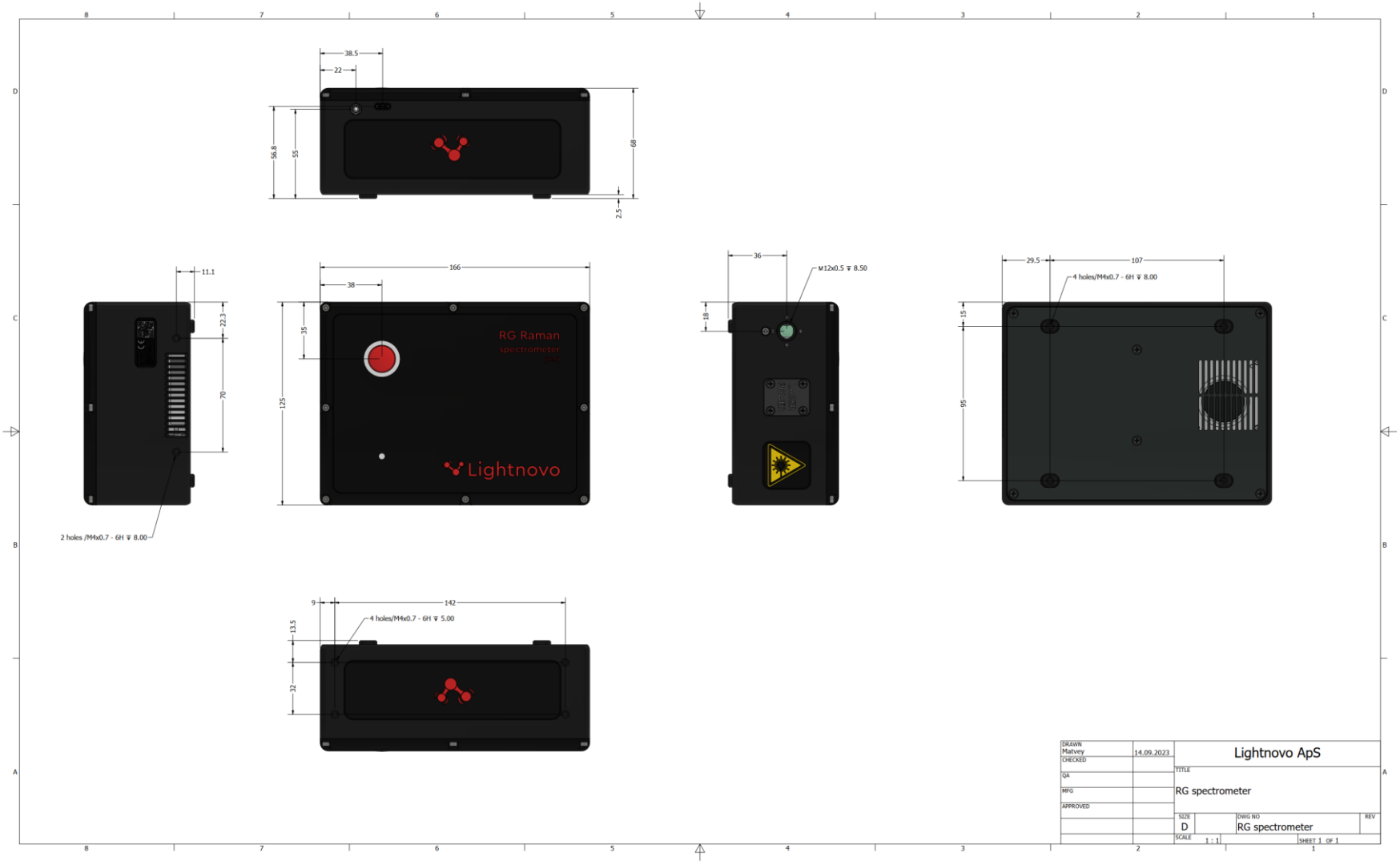

Figure 17. RG Raman spectrometer drawing with dimensions

Service addresses

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