



Goyalab

IndiGo

Handheld modular spectrometer

1. Introduction:

This document describes the IndiGo modular spectrometer and provides you with instructions for its correct operation. Please do not hesitate to contact us through contact@goyalab.fr if you have any questions about this manual.

The IndiGo consists of a modular spectrometer connected by Bluetooth to a smartphone working in the visible range. Optional modules are available on demand and allow the user to add either a light source, an optical fiber adapter or a chemical analyzer to the main spectrometer unit. The IndiGo is designed to be easy to use, compact and portable.

The IndiGo is ideal to record visible spectra directly in the field.

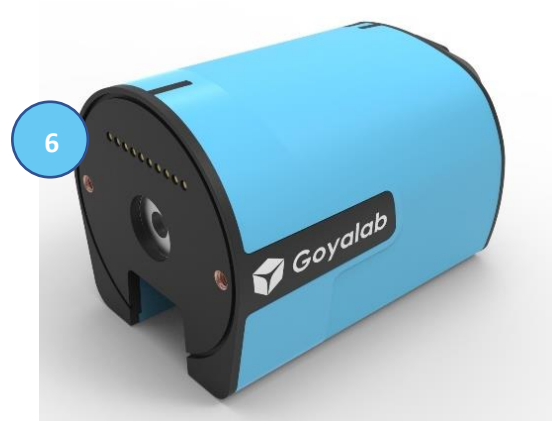
2. Operation:

2.1. Package content

- The IndiGo core module
- USB-C power cord 1m long
- Protective case

Carefully inspect the devices and make sure there is no damage. In the event of a damage, do not use the device and please contact us at contact@goyalab.fr

2.2. Material description



1	On/off switch
2	USB-C connector
3	BLE connection LED
4	Loading LED
5	Data transmission signal
6	Pin connection for additional modules

2.3. Before use

Before the first use, plug the USB-C power cord to a power supply and connect the other end to IndiGo's USB-C connector (2). Once the power charge LED (4) is green, the IndiGo is ready to be used.

Note: if the IndiGo is off, all the LEDs will be off even if the IndiGo is in charge mode. To turn on the LED during the charge mode battery, please turn on the switch (1).

Then, you will need to download the “Goyalab” mobile app on the Google Play Store. The iOS version will be available soon.



2.4. Maintenance

After each use, the IndiGo should be stored in its protective case to protect it from dust.

The IndiGo contains a 1000mAh LiPo battery. It is recommended to load the battery at least once every 6 months to prevent electrical damage.

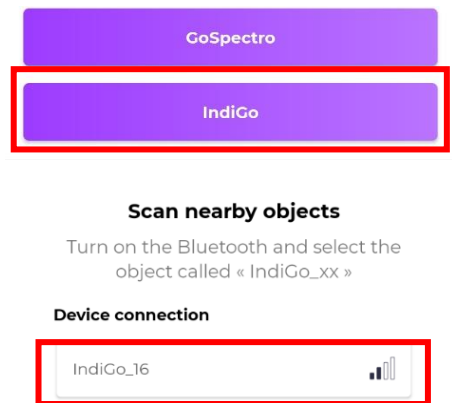
3. First step

3.1. Connexion to the smartphone

1 - Once your IndiGo is fully charged, start the Goyalab app and select IndiGo.

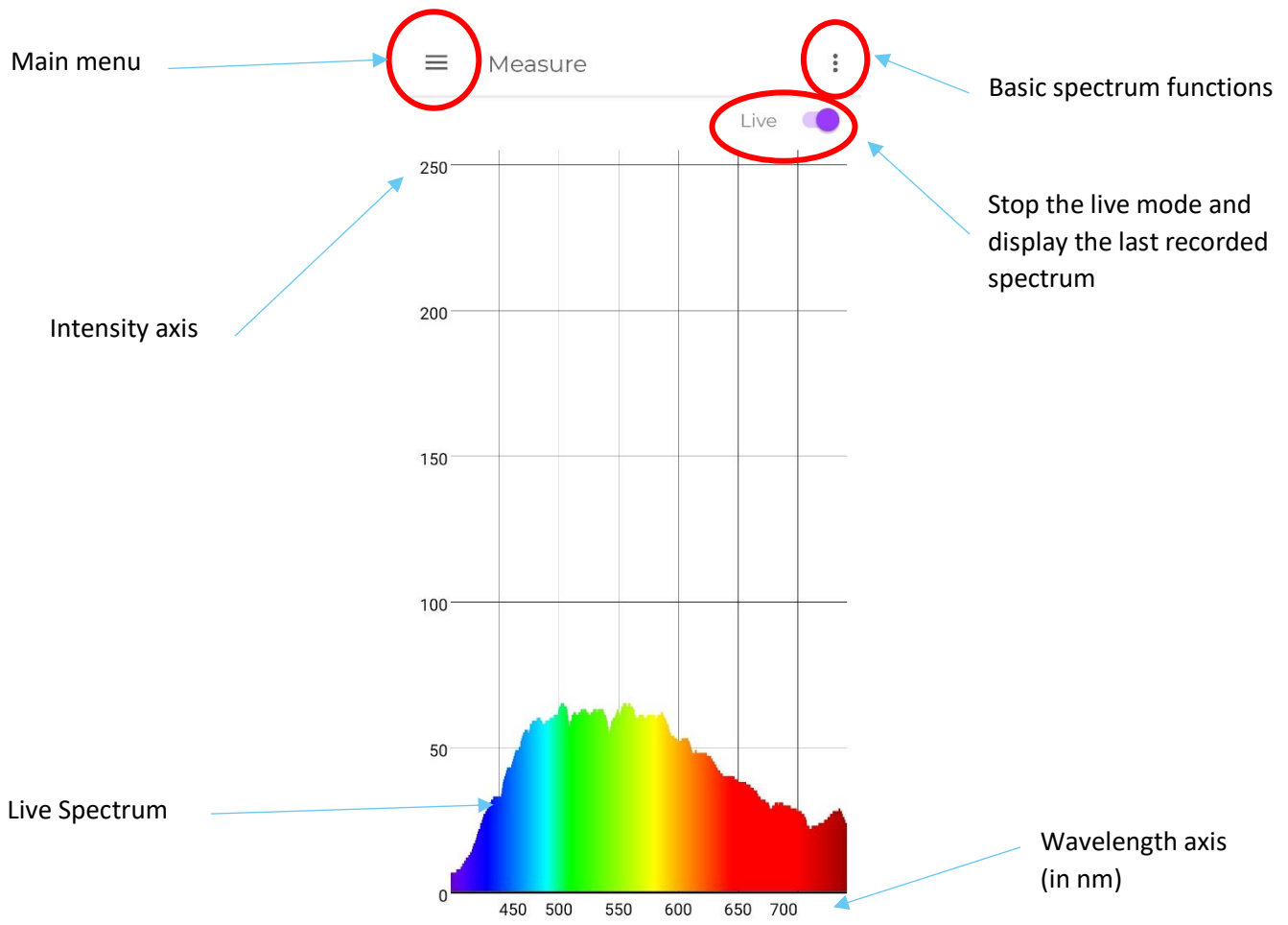
2 – Turn on both the Bluetooth and the GPS on the smartphone to allow the detection of the IndiGo. Wait a few seconds until your IndiGo appears on the screen. Then select “IndiGo_xx”.

While IndiGo is connected to the smartphone, the BLE connection LED (3) flashes red and orange. When the LED became orange, the IndiGo is connected to the smartphone and is ready to be used.



3.2. MEASURE menu

Once the smartphone and the IndiGo are paired, the app launches the MEASURE menu.



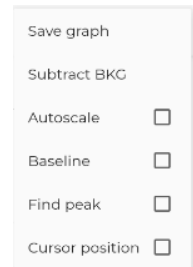
The spectrum of the light measured by the IndiGo is displayed live on this screen.

Note: When the IndiGo is sending data to the smartphone, the data transmission LED (5) flashes orange and green successively. The flashing speed depends on the acquisition time. The longer the acquisition time, the slower the flashes.

The spectrum is pre calibrated in wavelength.

4. Basic spectrum functions of the app

The different functionalities of the MEASURE menu are available from the buttons on the upper right corner.



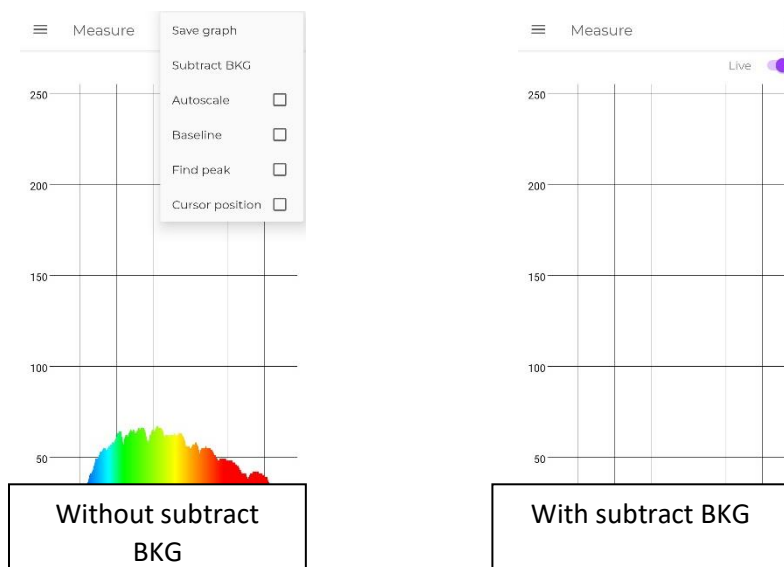
4.1. Save graph

“Save graph” saves the spectrum displayed on the screen. All spectra are saved in .txt format.

The files are saved in a specific folder: PC\Smartphone xx\ Shared internal storage space \Android\data\com.minkagency.goyalab\files. This file is accessible either on a PC and on the smartphone directly.

4.2. Subtract background

“Subtract BCK” subtracts the spectrum currently displayed on the screen. This function can be cancelled just by taping on the “restore BKG” button.

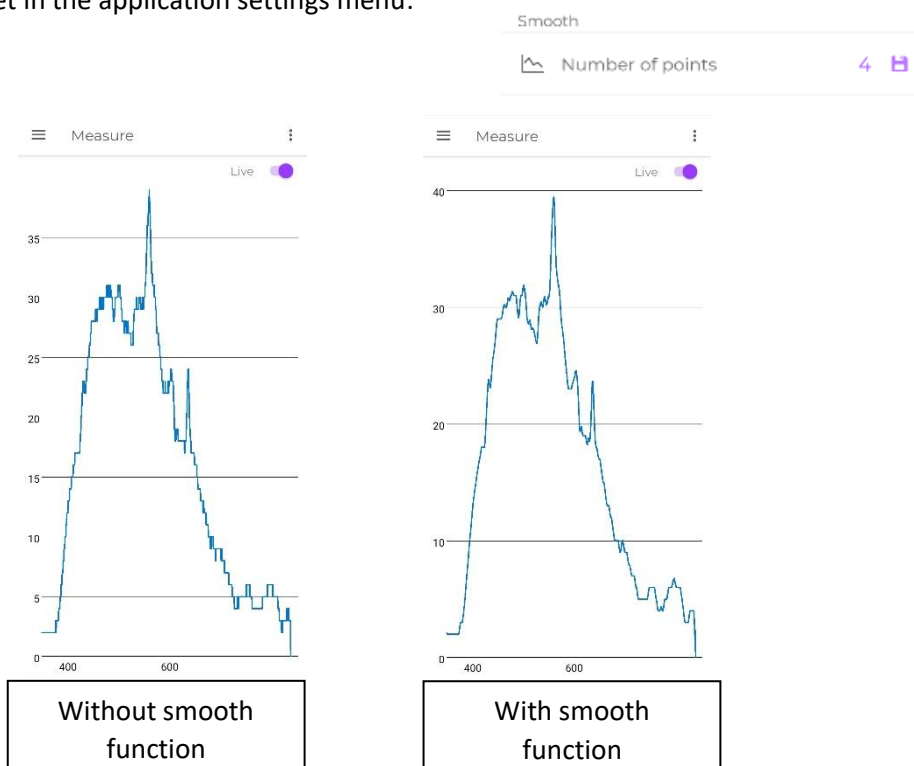


Note: This function is only available when the app is in absolute mode (see § 5.2 f)

4.3. Smooth

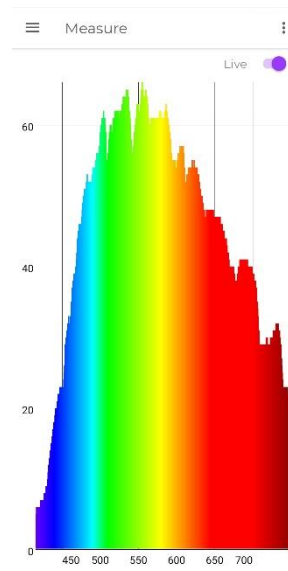
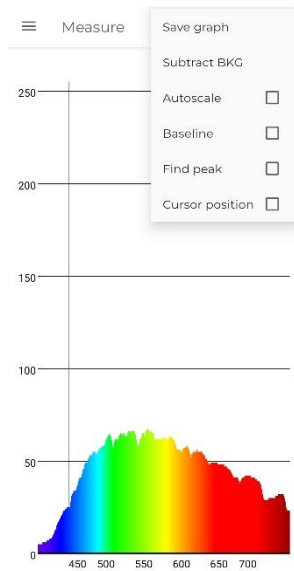
“Smooth” allows to average the intensity values of the spectrum over N values.

The value of N can be set in the application settings menu:



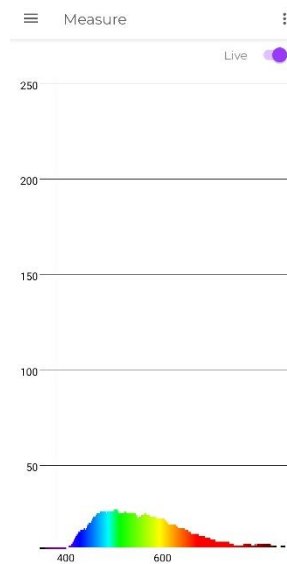
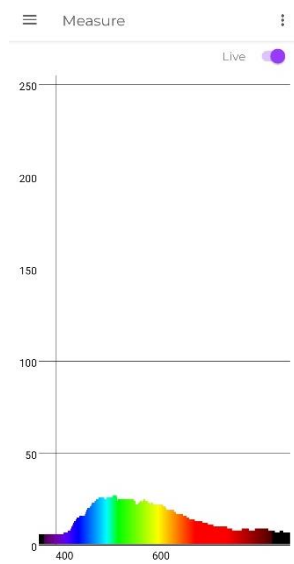
4.4. Autoscale

“Autoscale” scales the spectrum on the vertical axis so that it fills the whole window.



4.5. Baseline

“Baseline” allows to subtract the baseline from the spectrum.

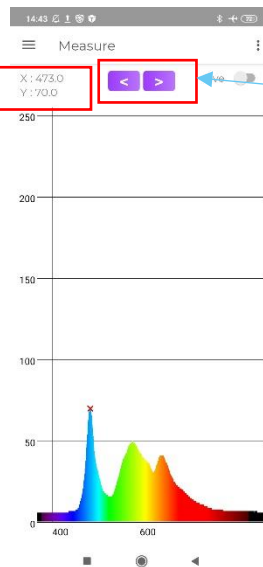


4.6. Cursor and Findpeak

“Cursor position” displays a red cross on the screen that indicates to the user the wavelength of the targeted point and the associated intensity. The cursor can be moved either by using the arrow buttons (by increments of 1nm) or directly by tapping on the screen.

“FindPeak” displays the coordinates (Wavelength in X axis and Intensity in Y axis) of the most intense peak.

Coordinates of the cursor



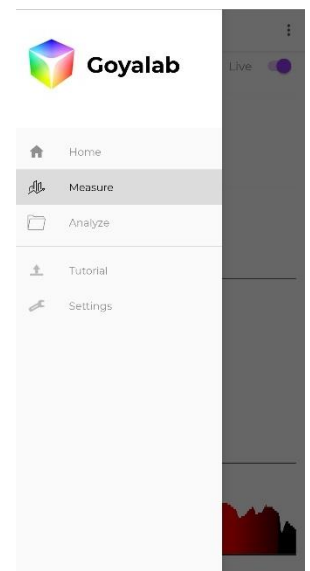
Arrows to move the cursor by step of 1nm

5. Main Menu

Tap on the main menu button to display the scrolling menu and go from one menu to another.

5 menus are available on the Goyalab app:

- “**Home**”: Displays information about the Bluetooth communication parameters and the charge level of the battery
- “**Measure**”: Allows the user to measure spectra
- “**Analyze**”: Allows the user to display and analyze saved graphs.
Note: All the functionalities of this menu are detailed in Section 5.2
- “**Tutorial**”: Starts the pairing between the IndiGo and the app and helps you getting started
- “**Settings**”: gives the possibility to the user to change the acquisition or display parameters.
Note: All the functionalities of this menu are detailed in Section 5.2



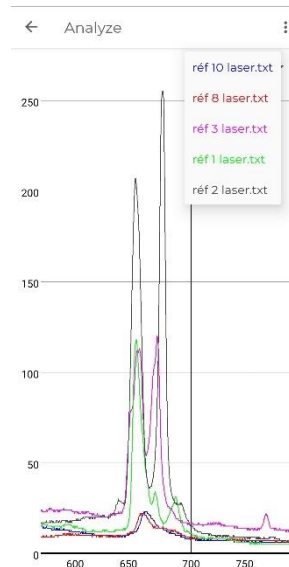
5.1. ANALYZE Menu

The ANALYZE menu gathers all the spectra recorded in the MEASURE menu.



a. Display one or several graphs

As many graphs as required can be displayed by checking the purple boxes corresponding to the spectrum and by selecting **"display files"**. Once done, a new window like the MEASURE menu is opened with all the selected files.



Like with the MEASURE menu, some functionalities are available to rescale the axes, subtract a baseline or display a cursor to read the coordinate of a peak.

Note: when more than 2 graphs are displayed at the same time, the cursor will be placed on the first graph (by default). To change the graph, select the small arrow to display other spectra and select the one you want. The cursor will now display the coordinates of that spectrum.

b. Comparison of 2 files

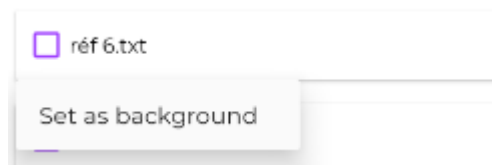
The “*compare files*” button compares two files by calculating two coefficients based on both a derivative and an integral calculation. The closer the coefficients are to 1 the more similar the two spectra. These coefficients are then compared to the threshold set in the SETTINGS menu. If the two coefficients are greater than their respective threshold, the curves are considered similar (marked with a “☑” icon). On the contrary, if at least one of the coefficients is less than the threshold, the curves are considered different (“☒” icon).



Note: The Coefficient “I” will mainly focus the comparison of the curve shapes. The variation of the intensity will not impact the similarity. The coefficient D will also take into account the intensity difference between both curves.

c. Set as a background

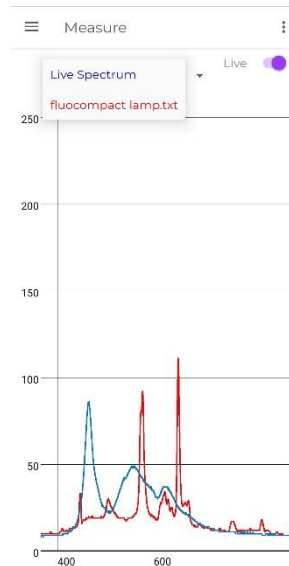
This function displays a spectrum directly on the MEASURE screen. To activate this function, press long on the spectrum you want to display and select “set as a background” measure.



Note 1: only one spectrum at a time can be displayed as a background

Note 2: it is advisable to cut off the ‘rainbow’ display mode to clearly see both spectra (see Section 5.2.c).

Note 3: The spectrum displayed as a background will be automatically removed once the user leaves the MEASURE screen.



d. Delete and rename

To delete or rename a spectrum, swipe left on a spectrum to bring up the Edit or Delete buttons.



5.2. SETTINGS menu


The different functionalities of the SETTINGS menu are described hereafter:

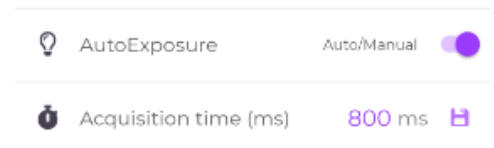
a. AutoExposure

The Acquisition time corresponds to the recording time of a spectrum.

It can be managed automatically by the app or imposed by the user.

When the switch is on Auto, the exposure time is managed automatically by the app. When the switch is on Manual, the exposure time will be the one indicated in the text box.

The acquisition time must be given in ms and can go from 1ms up to 2000ms. The user has to click on the following symbol to  save the acquisition time.



b. Wavelength scale

The wavelength scale can be managed either automatically by the app (Auto mode) or by the user in manual mode.

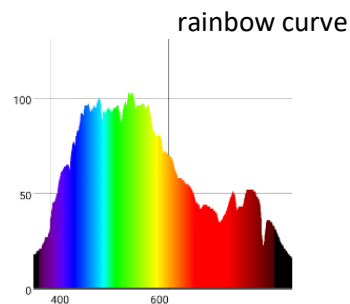
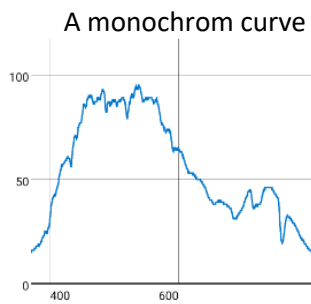
When **“wavelength scale”** is in manual mode, the user has to set the minimum and the maximum values.

Note: When the wavelength scale is in manual mode, the functionalities of the app (Autoscale, baseline and Findpeak) will be effective in this wavelength range.



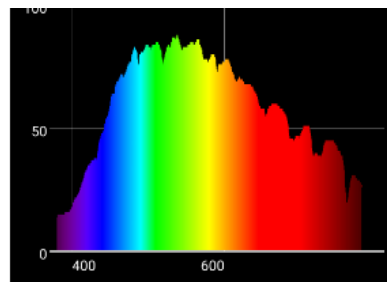
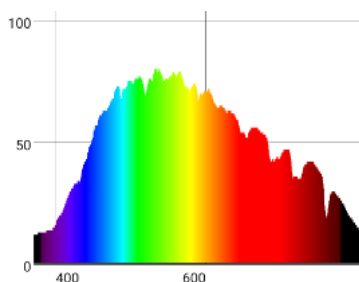
c. Graph color

Two display modes for the live spectrum are available:



d. Screen background

The wallpaper of the MEASURE menu can be displayed either in black or white. The black background is recommended in low light measurements where the smartphone screen light could interfere with the light under study.



e. Coefficients compare

The similarity threshold between two curves can be adjusted by modifying both the D coefficient and/or the I coefficient.

Coefficient D Compare : 90%

Coefficient I Compare : 90%

The values must be given in %.

Note: The D coefficient takes care of both the shape and the intensity of the curves whereas the I coefficient only takes care of the shape of the curves.

f. Absolute/relative


By default, the IndiGo is in the absolute mode which means that the intensity displayed is the quantity of photons recorded on each pixel of the sensor.

Absolute/Relative

Off/On


The intensity can also be displayed in relative mode where the intensity is expressed as a percentage of the intensity received compared to a reference spectrum.

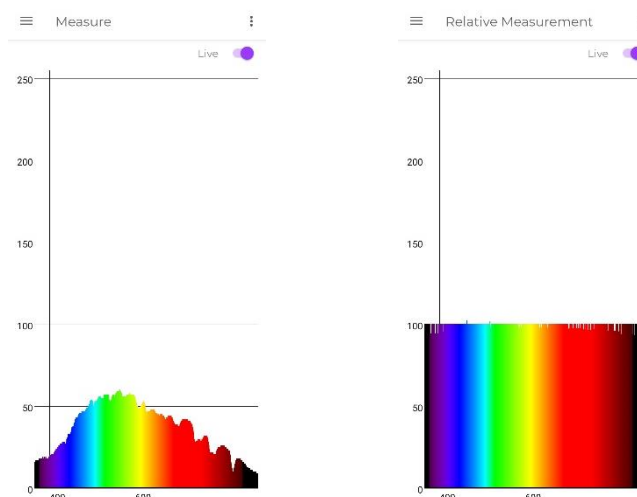
To activate this functionality, the following steps must be followed

- Activate the relative modes in settings
- Go back to the MEASURE menu
- Point the IndiGo in the direction of the reference light source
- When the spectrum fulfils your requirement, go in the functionalities of the app 
- Select **"Save BKG"**. The app will record this spectrum as the reference spectrum
- The spectrum displayed is now a flat curve at 100%.

Note 1: when the user selects "Save BKG", all the spectra will be divided by the reference spectrum.


Note 2: If the intensity recorded is less than the reference the graph will show a dip. If the intensity recorded is greater than the reference the graph will display a peak.

To remove this mode, go to the functionalities  and select "remove BKG".



g. Change of Device

The app can be used with all the product offered by Goyalab. You can switch from one device to another by pressing name of the device.

 Name of the device
IndiGo

6. Using the IndiGo with the UV MODULES

6.1. Precaution for use

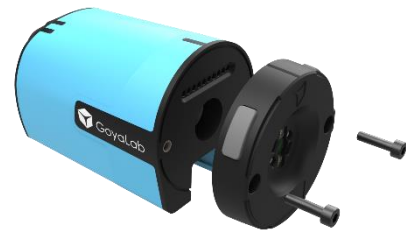
As a standard mode, the UV module is equipped with UV A and/or UV B LED that can be dangerous to eyes and skin when directly exposed to this type of radiation. Therefore, please wear appropriate safety glasses, cover your skin and avoid direct exposure to your skin and eyes when the UV LEDs are emitting.

6.2. Installation

Before installing the UV module, switch off the IndiGo to avoid electrical damage and connection issues.

Then place the 10 metal pins in front of the 10 holes on the front face of the IndiGo. Use two M3x10 screws supplied with the module to fix the UV module.

You can now switch on the IndiGo and take measurements.



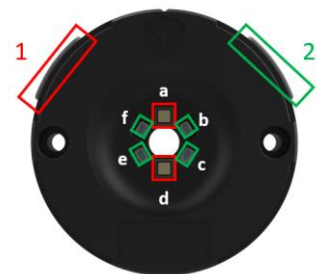
6.3. How it works

a. UV A version

In the standard UVA version, the UV module can be provided with one of the following wavelengths: 365nm, 375nm, 385nm or 395nm.

The left button (1 on the opposite figure) will activate LEDs **a)** and **d)** in high power mode with a power greater than 350mW per LEDs.

The right button (2 on the opposite figure) will activate the LEDs **b)**, **c)**, **e)** and **f)** in low power mode with 20mW per LED.

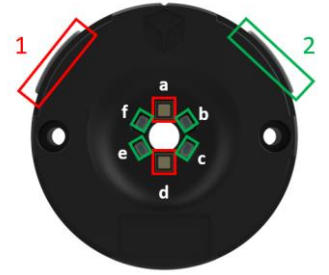


b. UV A/B version

In the standard UV A/B version, the UV module is provided with 4 UV A LEDs at 375nm and 2 UV B LEDs at 300nm.

The left button (1 on the opposite figure) will activate 2 high power UV B LEDs **a)** and **d)** at 300nm.

The right button (2 on the opposite figure) will activate the 4 low power LEDs **b)**, **c)**, **e)** and **f)** at 375nm.



6.4. Use the UV module

Switch on the IndiGo and follow the guidelines described in Section 3 to connect the device to the smartphone and start spectra acquisition.

Once on the measurement page, stop the live mode by tapping on the “live” button.



From now on, use button 1 or 2 (depending on your needs) of the UV module to activate the LEDs and acquire a spectrum. When the acquisition is over, the spectrum is automatically displayed on the screen.

Note 1: all the basic functions of the app can be used (subtract background, Find Peak, cursor, smooth etc.)

Note 2: the duration of LEDs emission is set to be always the same as the exposure time.