

*FASTLITE*  
**FROZZER**

# Frozzaer

Startup guide



**FASTLITE**

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# 1 SETUP

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**All documentation about Frozzer alignment, Frozzer software and Frog\_Processing software is accessible in clicking on “Documentation” in Frog\_Processing software.**

## 1.1 COMPONENTS

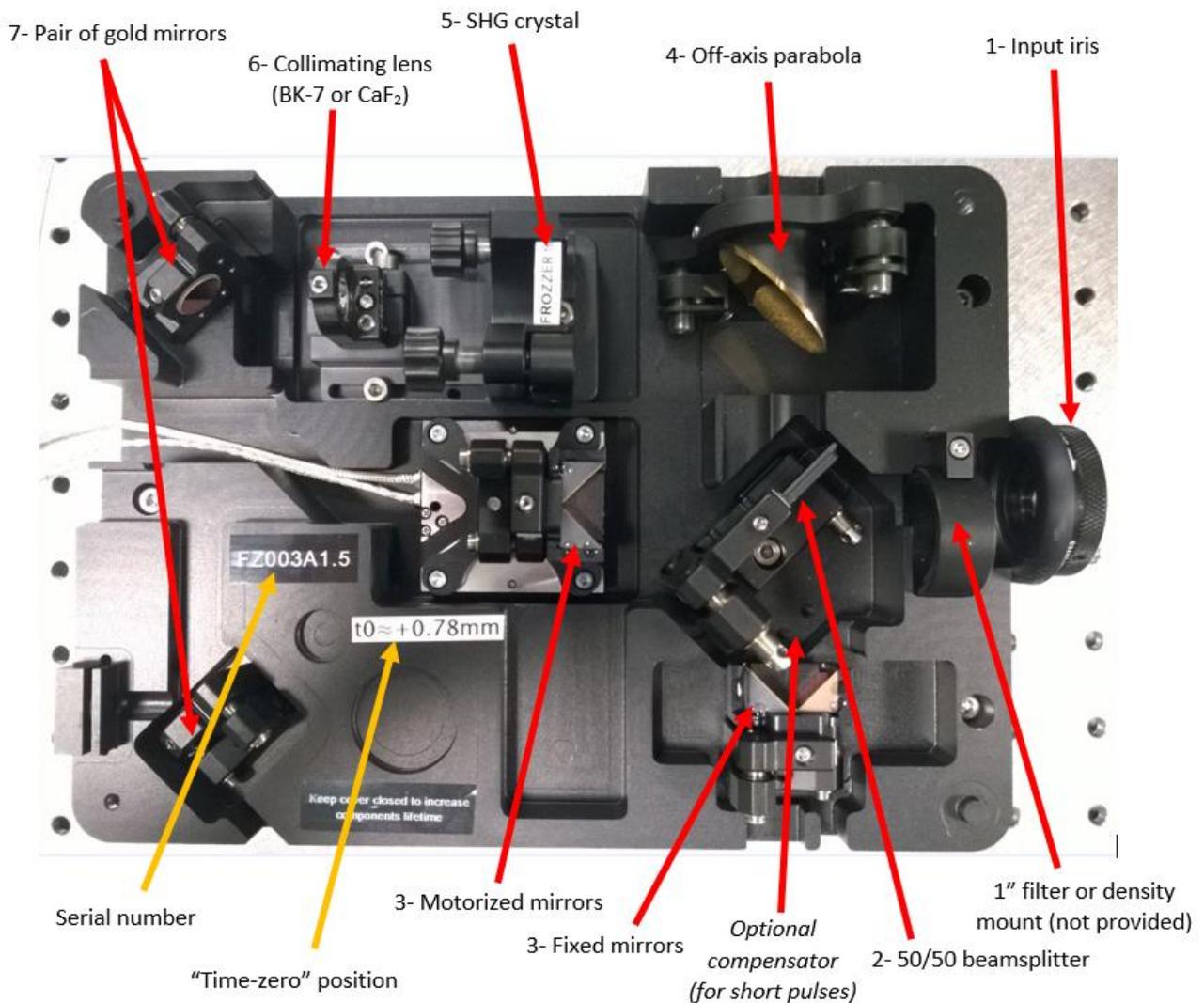
The setup comprises, at least:

- One optical module
- One controller unit (PI, E-871 or E-873) with a power cable adapter
- One spectrometer
- Two USB cables
- One spectrometer trigger cable
- A set of pedestal posts and clamps
- A USB key with softwares
- + optional optics and spectrometers

## 1.2 OPTICAL SPECIFICATIONS

- Input polarization: linear, S-polarization (vertical if the optical unit is horizontal)
- Optical aperture: max 2 to 3 mm
- Typical energy input range: 0,1 to 10  $\mu$ J (5 to 10  $\mu$ J is recommended for alignment)
- Max scanning range : 70 ps
- Input beam height: Minimum 2”
- Mirrors: gold
- Lens: non coated BK-7 (or non-coated CaF<sub>2</sub> for Frozzer 1-9 $\mu$ m)

## 2 OPTICAL CONFIGURATION



## 3 INSTALLATION

### 3.1 MOUNTING

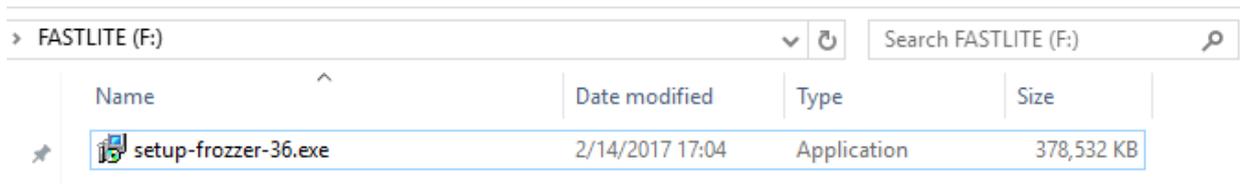
- Mount the feet under the optical module
- Mount the feet under the spectrometer

### 3.2 CONNECTIONS

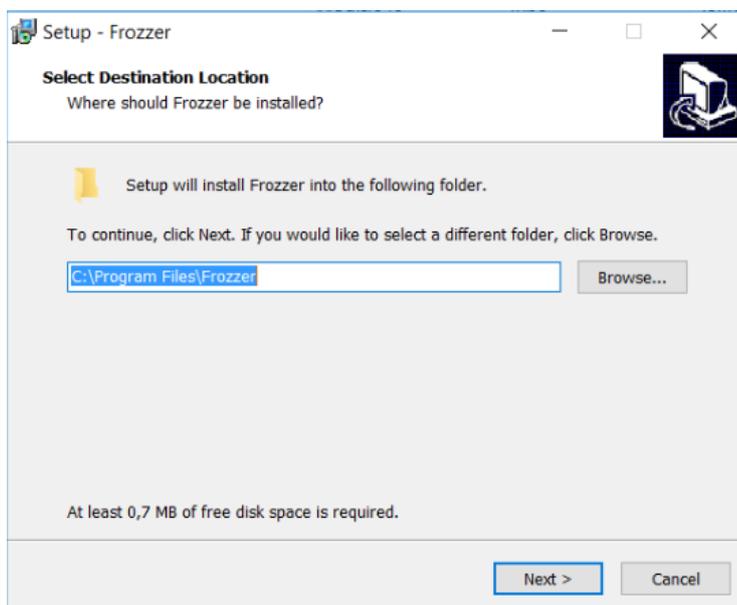
- Do not connect the USB cables to the computer (computer not provided)
- Connect the optical module to the controller (DB25-type cable(s))
- Connect the power adapter to the controller and connect to the power supply
- For NIRQuest spectrometer: power on the spectrometer (power cable)
- Connect the computer to internet

### 3.3 SOFTWARE INSTALLATION

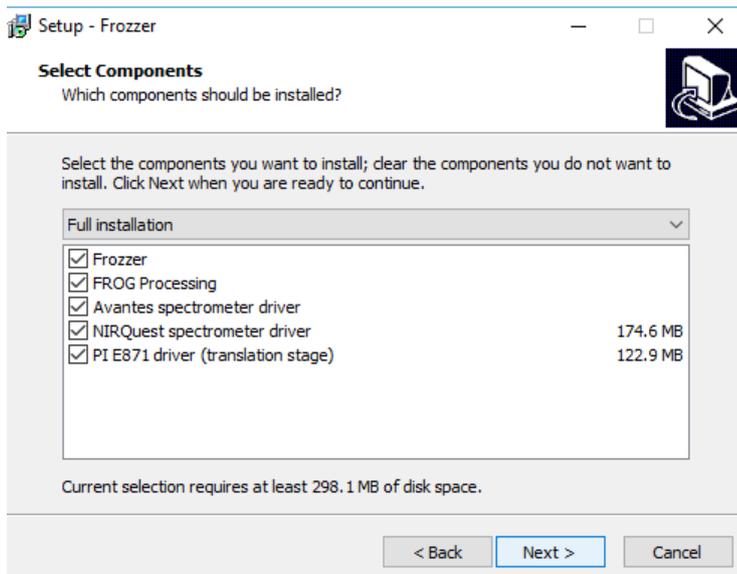
-> Insert the provided USB key



#### 3.3.1 Install setup-frozer-xx.exe

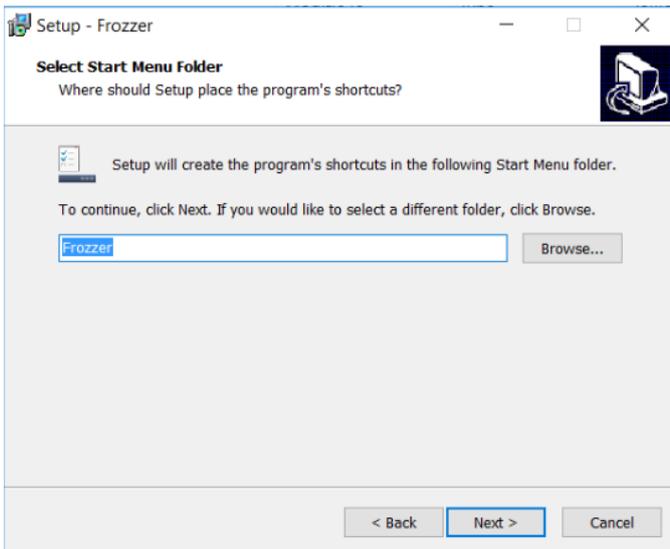


-> Next

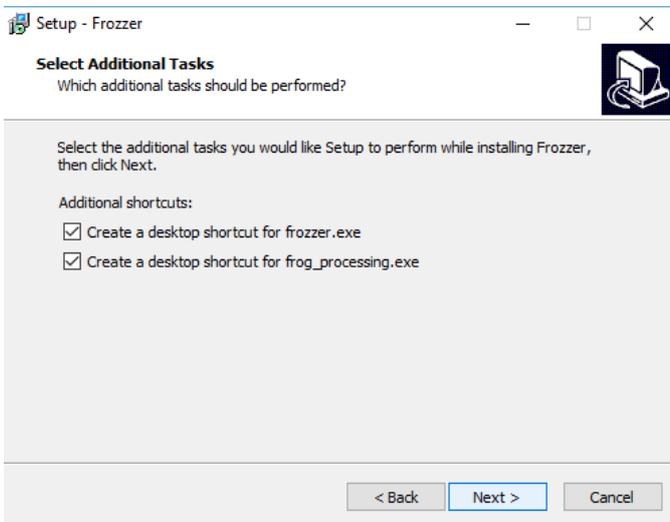


-> Next

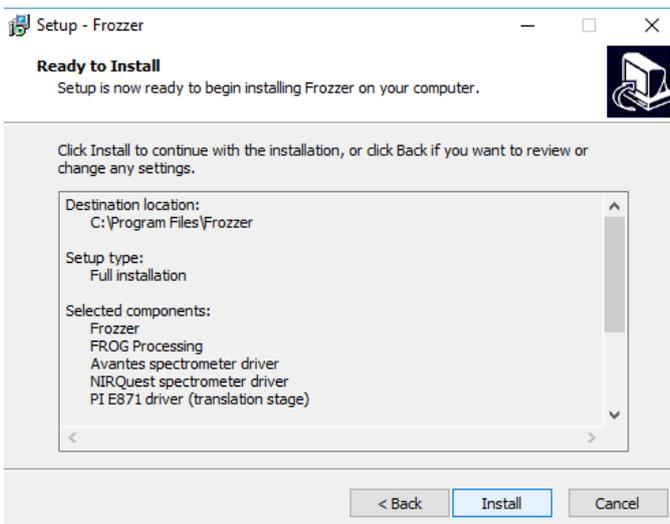
(you can skip "NIRQuest spectrometer driver" installation in unchecking the box if your Frozer isn't delivered with a NIRQuest spectrometer)



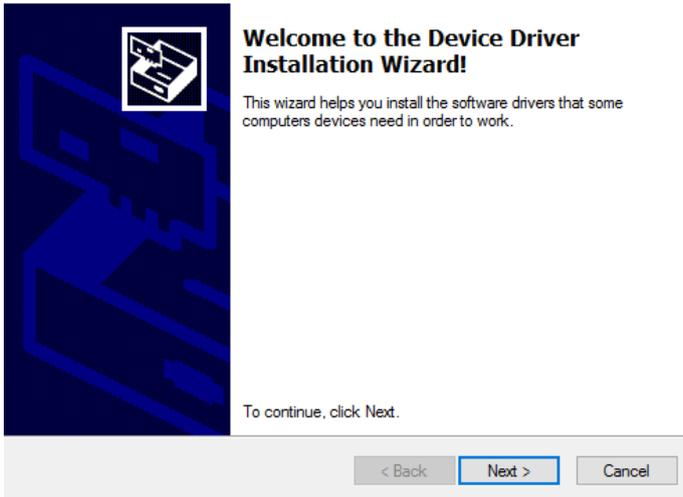
-> Next



-> Next



-> Install



**Welcome to the Device Driver Installation Wizard!**

This wizard helps you install the software drivers that some computers devices need in order to work.

To continue, click Next.

< Back   **Next >**   Cancel

-> Next



**Completing the Device Driver Installation Wizard**

The drivers were successfully installed on this computer.

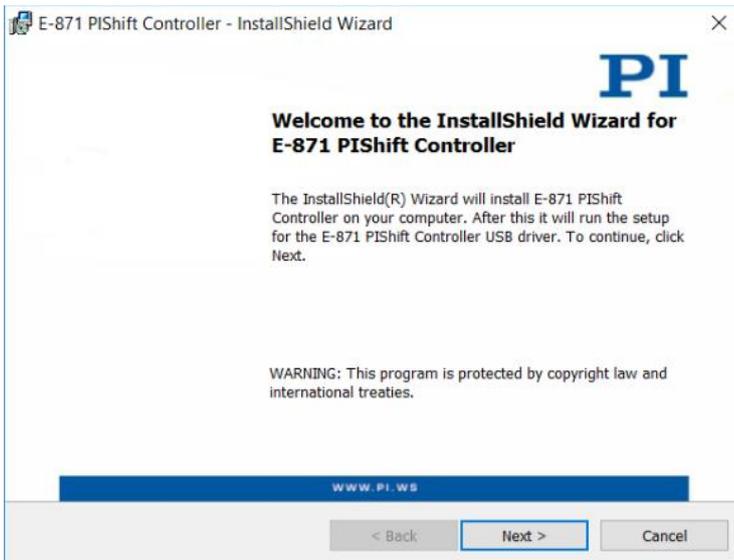
You can now connect your device to this computer. If your device came with instructions, please read them first.

Driver Name	Status
✓ Fastlite (WinUsb) visaUs...	Ready to use

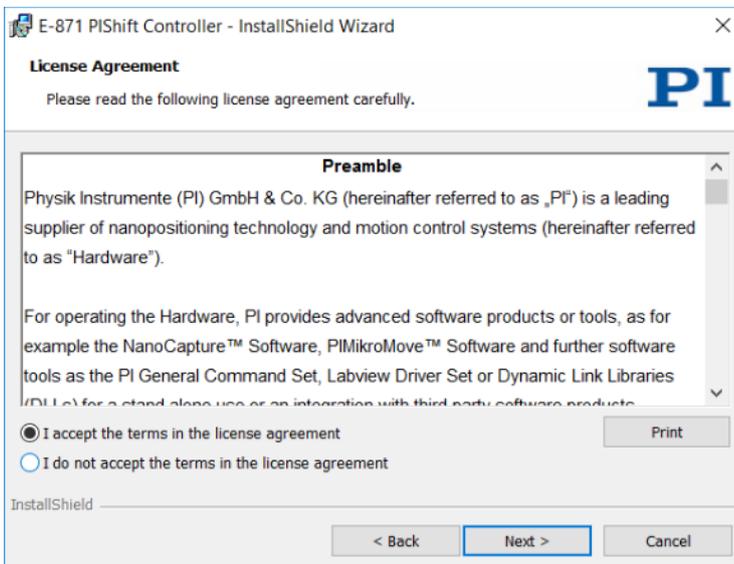
< Back   **Finish**   Cancel

-> Finish

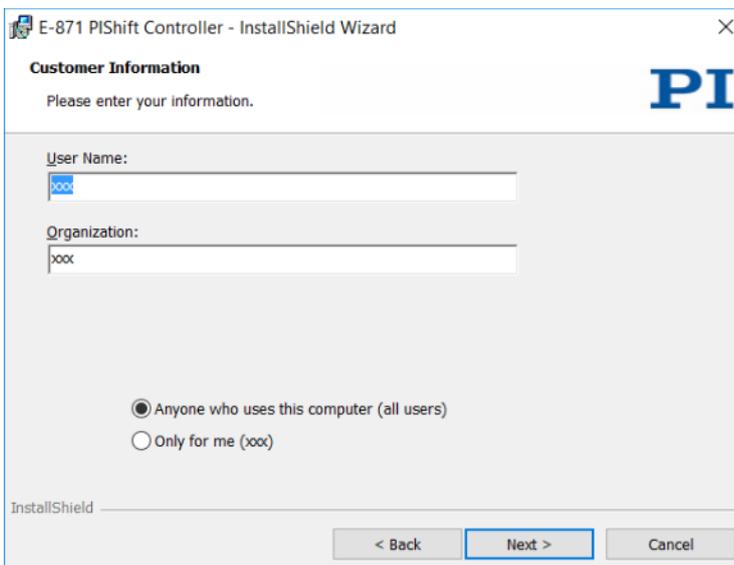
### 3.3.2 PI translation stage drivers installation



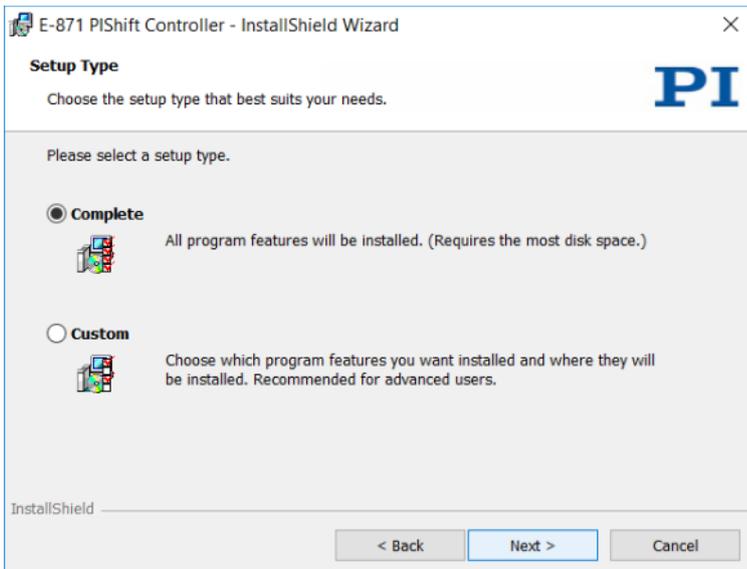
-> Next



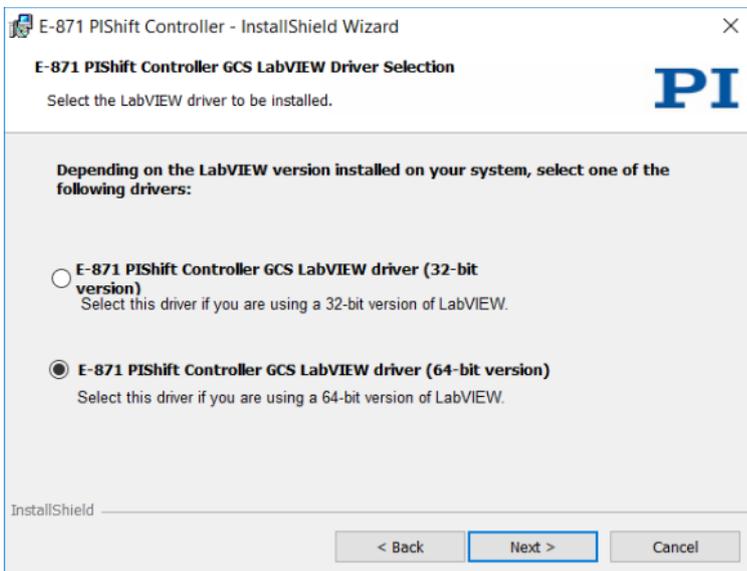
-> accept and next



-> complete your information and Next

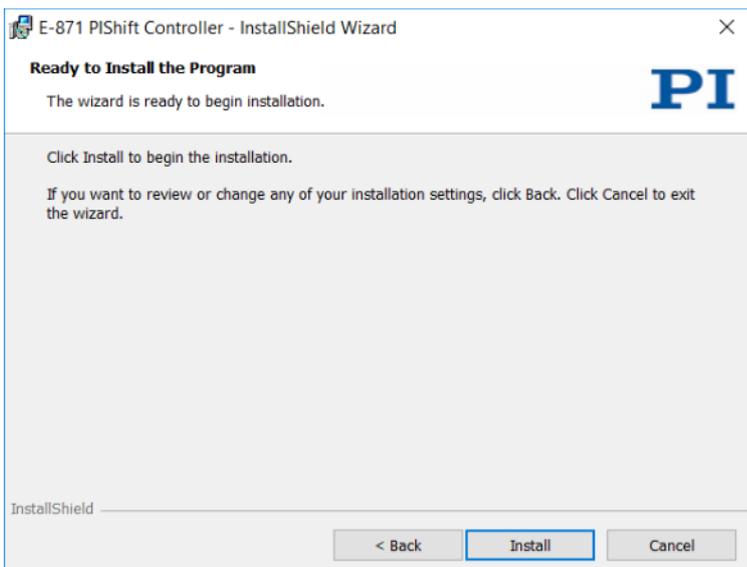


-> choose "Complete" and Next

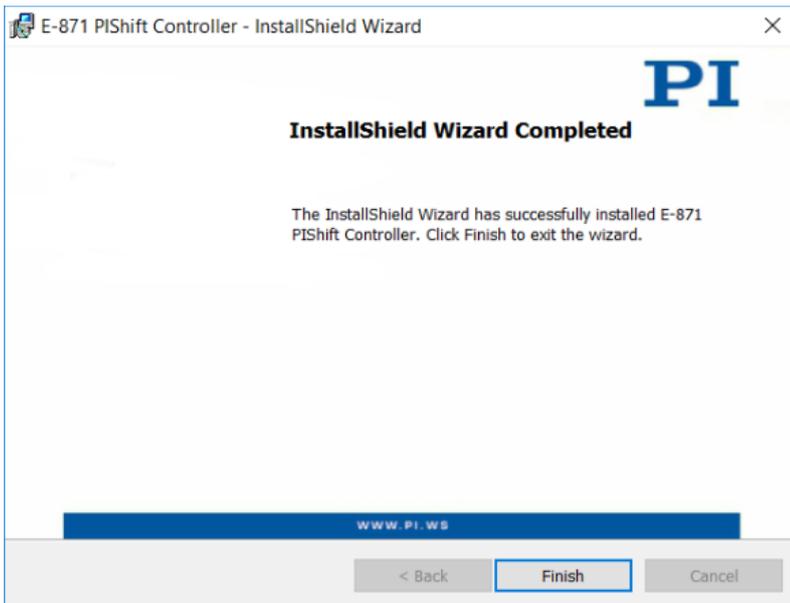


-> select option according to your system

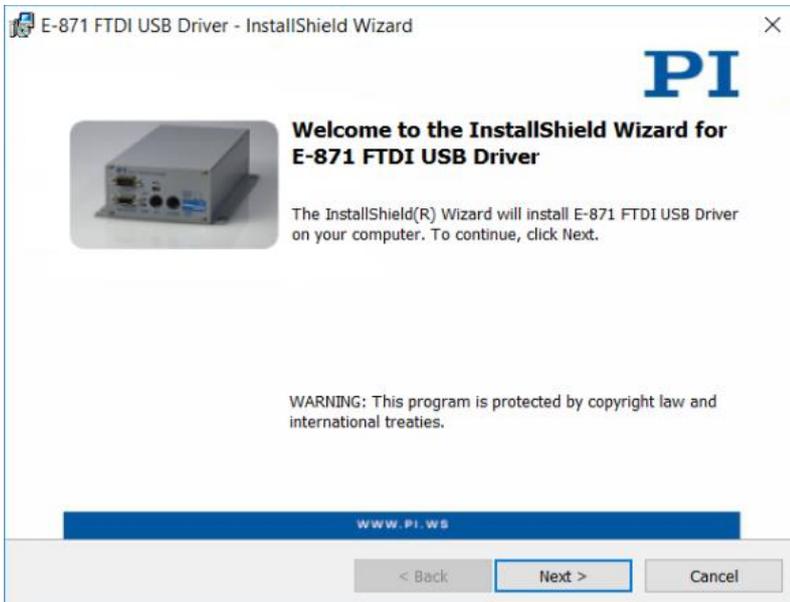
and Next



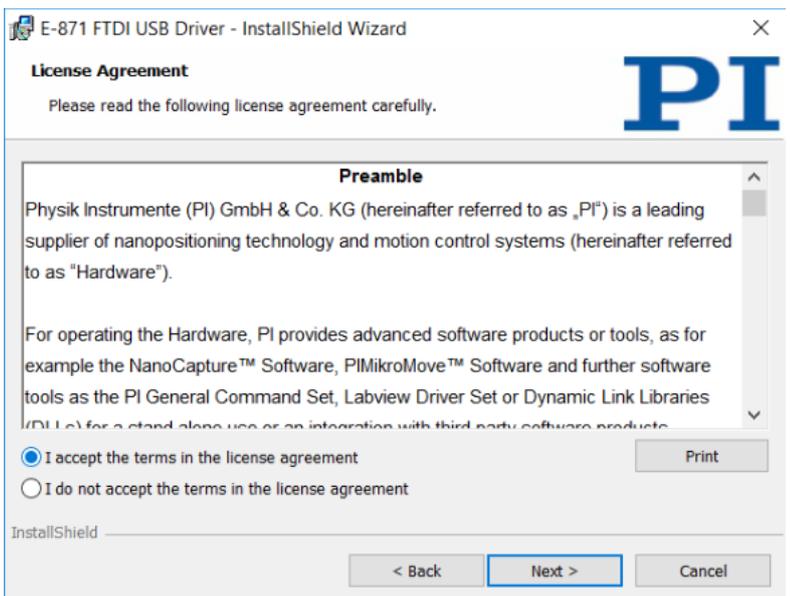
-> Install



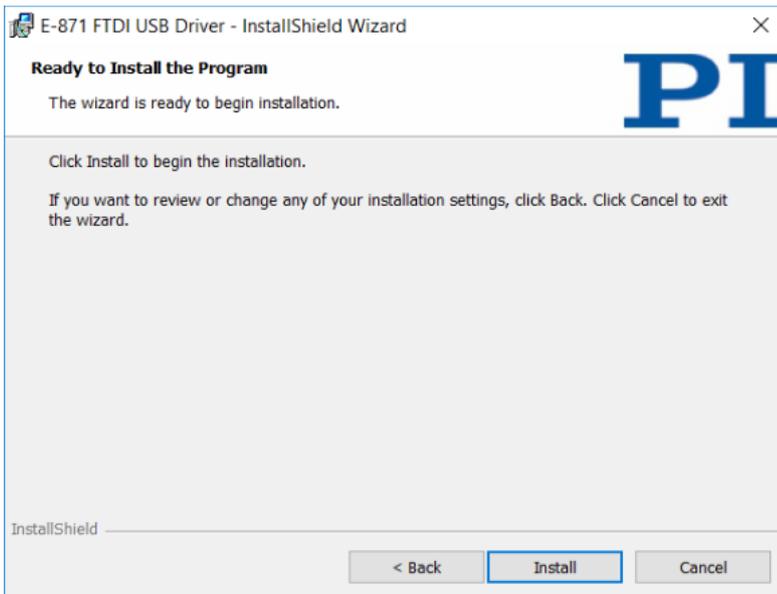
-> Finish



-> Next



-> Accept and Next

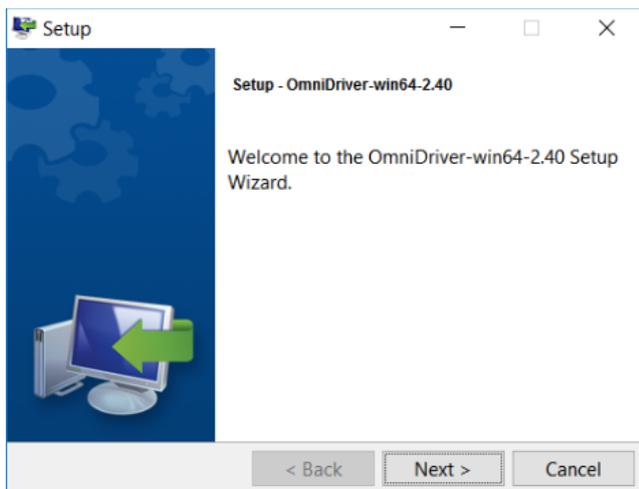


-> Install

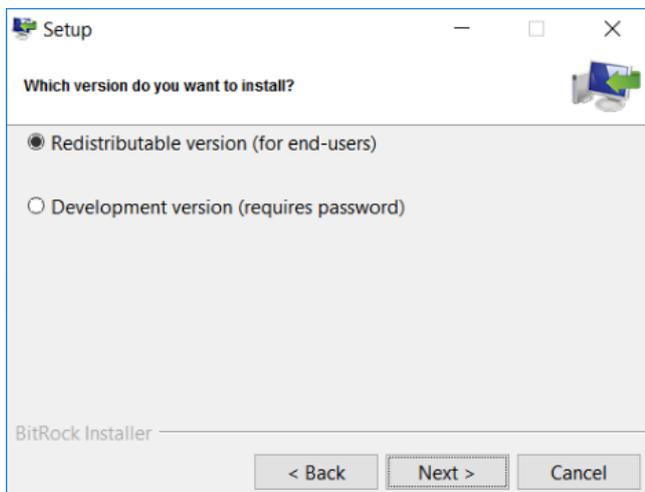


-> Finish

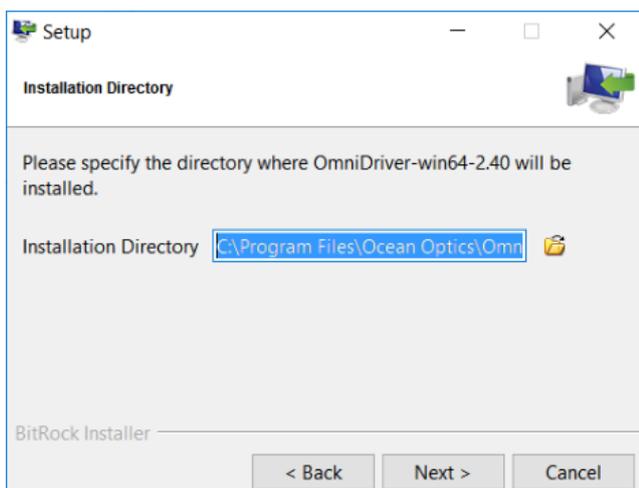
### 3.3.3 NIRQuest spectrometer drivers installation



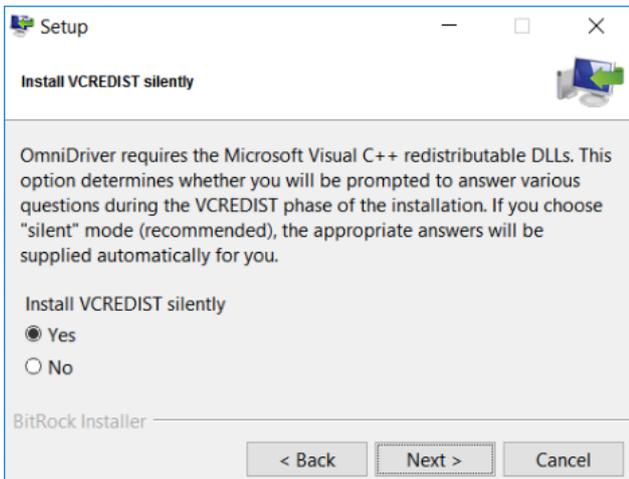
-> Next



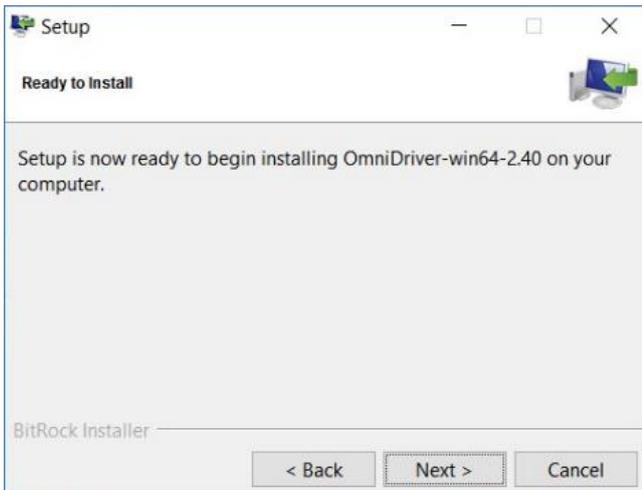
-> Select Redistributable version and Next



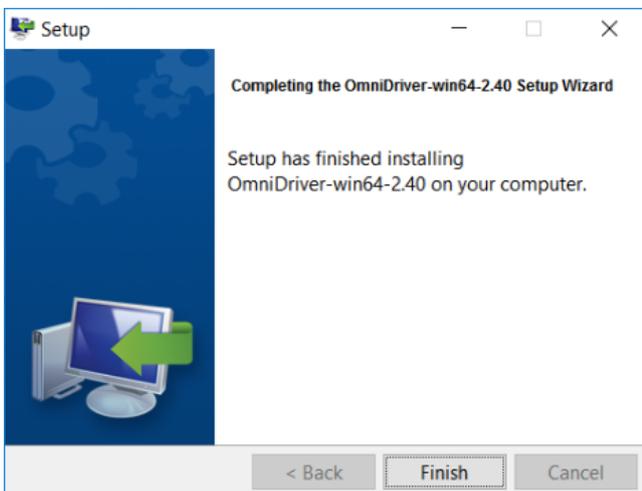
-> Next



-> Select Yes and Next

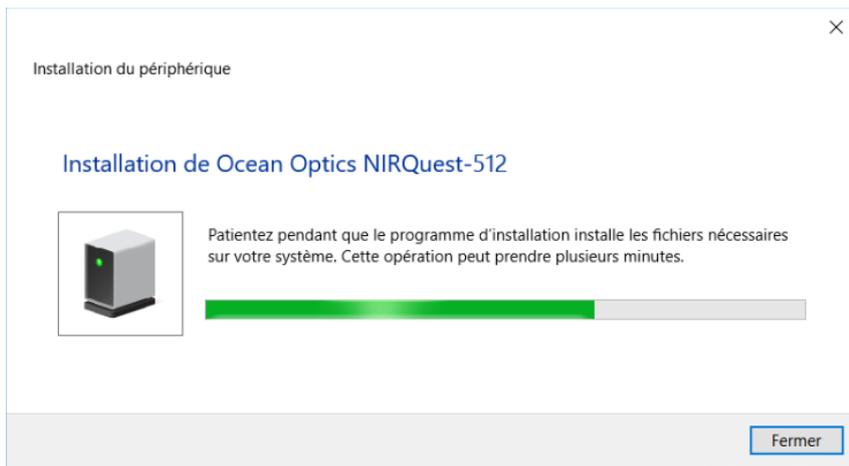


-> Next (installation)



-> Finish

-> Connect the USB cable from NIRQuest spectrometer to your computer

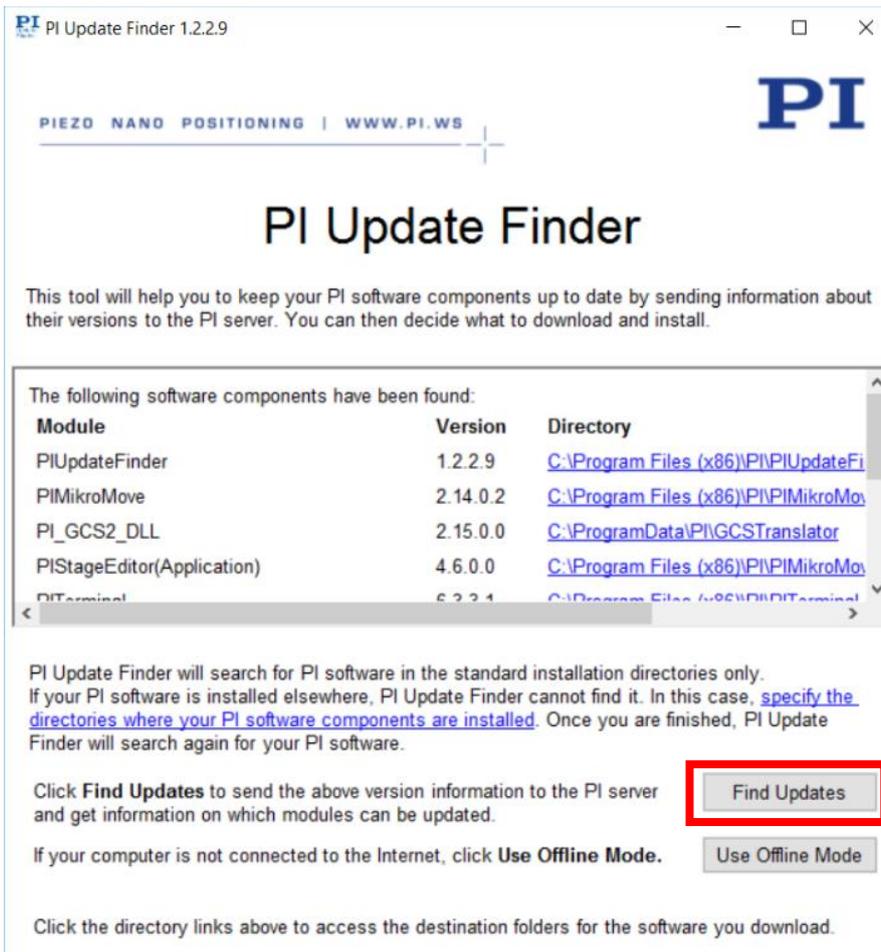
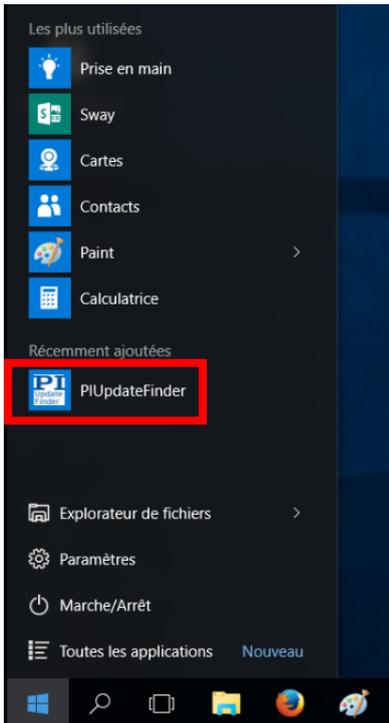


-> Drivers finish to be installed

-> Disconnect the USB cable from NIRQuest

### 3.3.4 Translation stage calibration

Open PIUpdateFinder



-> Find Updates

**PI Software Found on Your System**

Name	Installed Version	Version on PI Server	Release Notes	Download Link
PI LabVIEW Driver E-871	V6.3.0.0	V6.3.0.1	Release note	PI server
PIMikroMove	V2.14.0.2	V2.24.0.1	Release note	PI server
PIStageEditor (Application)	V4.6.0.0	V4.9.0.0	Release note	PI server
PITerminal	V6.3.3.1	V6.8.0.1	Release note	PI server
PIUpdateFinder	V1.2.2.9	V1.4.2.1	Release note	PI server
PI GCS Library PI_GCS2_DLL (ZIP file, please extract and run Install.bat)	V2.15.0.0	V3.9.0.1	Release note	PI server
PI LabVIEW Merge Tool	V6.3.0.9	V6.12.4.0	Release note	PI server
PI Stage Database PImiCosStages2	2013/01/11 10:56:09	2016/03/16 10:39:42		PI server

**Important note:**  
Before downloading and installing your update, read the corresponding release note to check if there are any known compatibility issues.

If you have any questions or problems please [contact us](#).

-> Download and install all PI server links (a ZIP extraction is needed for PI GCS Library\_GCS2\_DLL)

-> Close this page

-> Find Updates again

**PI Software Found on Your System**

Name	Installed Version	Version on PI Server	Release Notes	Download Link
PI GCS Library PI_GCS2_DLL (ZIP file, please extract and run Install.bat)	V3.9.0.1	V3.9.0.1		✓ Up to date
PI LabVIEW Driver E-871	V6.3.0.1	V6.3.0.1		✓ Up to date
PI LabVIEW Merge Tool	V6.12.4.0	V6.12.4.0		✓ Up to date
PI Stage Database PIStages2	2016/06/15 13:59:36	2016/06/15 12:59:36		✓ Up to date
PI Stage Database PImiCosStages2	2016/03/16 10:39:42	2016/03/16 10:39:42		✓ Up to date
PIFirmwareUpdater	V1.2.4.0	V1.4.2.3	Release note	PI server
PIMikroMove	V2.24.0.1	V2.24.0.1		✓ Up to date
PIStageEditor (Application)	V4.6.0.0	V4.9.0.0	Release note	PI server
PITerminal	V6.8.0.1	V6.8.0.1		✓ Up to date
PIUpdateFinder	V1.4.2.1	V1.4.2.1		✓ Up to date

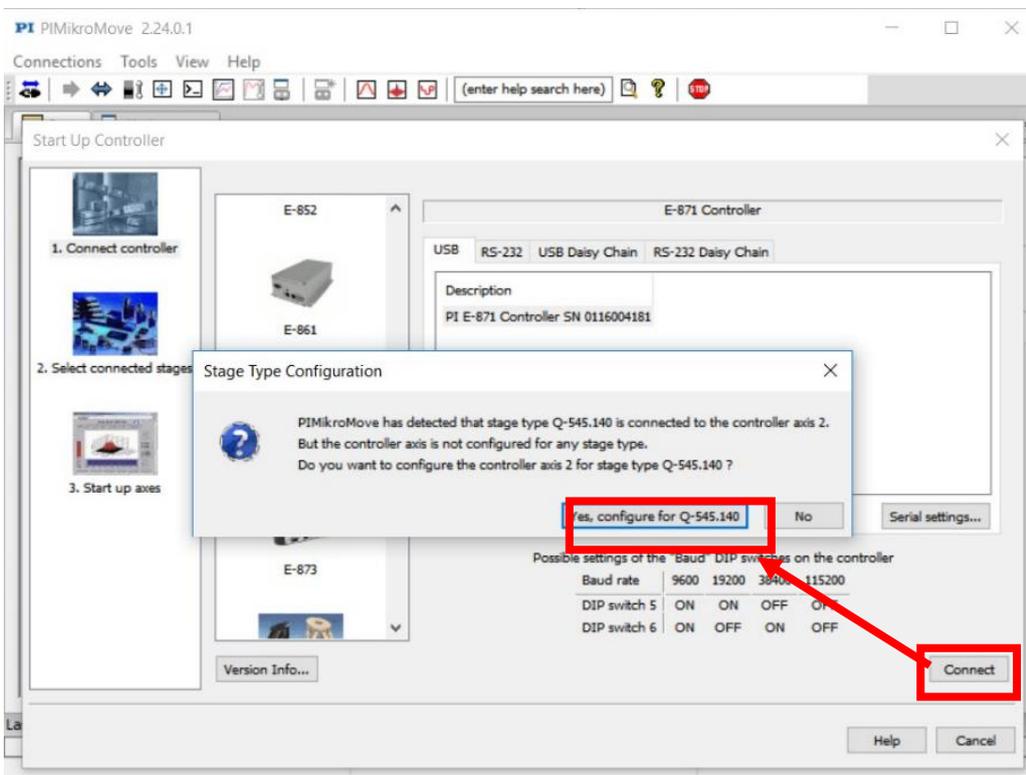
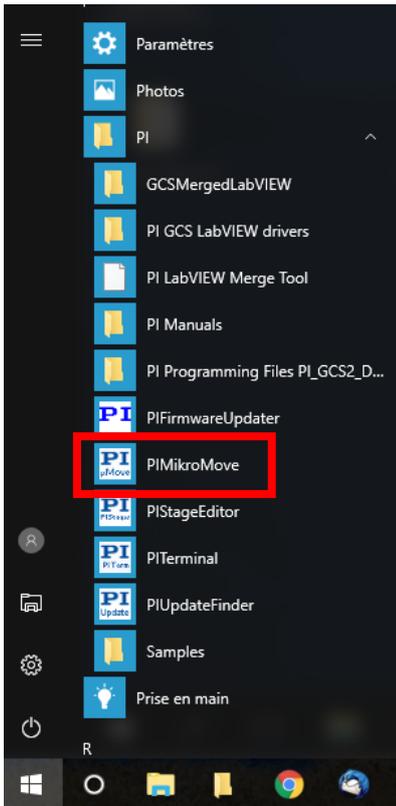
**Important note:**  
Before downloading and installing your update, read the corresponding release note to check if there are any known compatibility issues.

-> Check if all software are up to date (you can update the new installed software: "PIFirmwareUpdater" and "PIStageEditor (Application)").

-> Close PIUpdateFinder

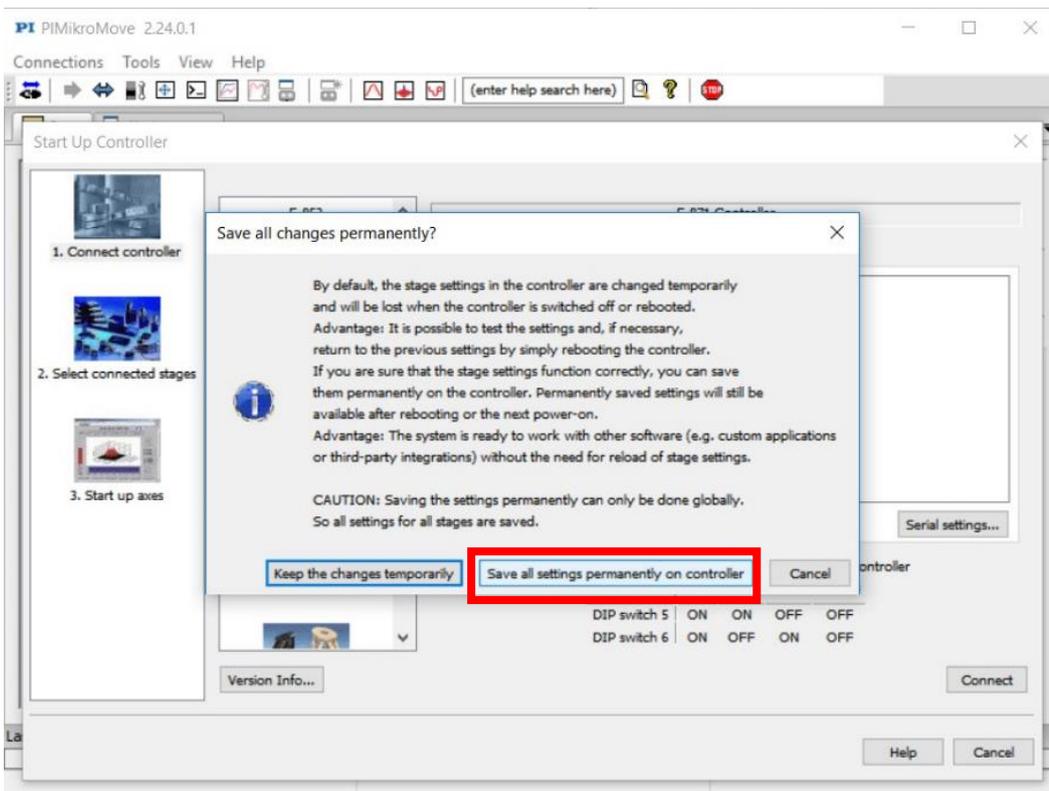
-> Connect the USB cable from the PI controller to your computer

-> Open PIMikroMove (calibration step)

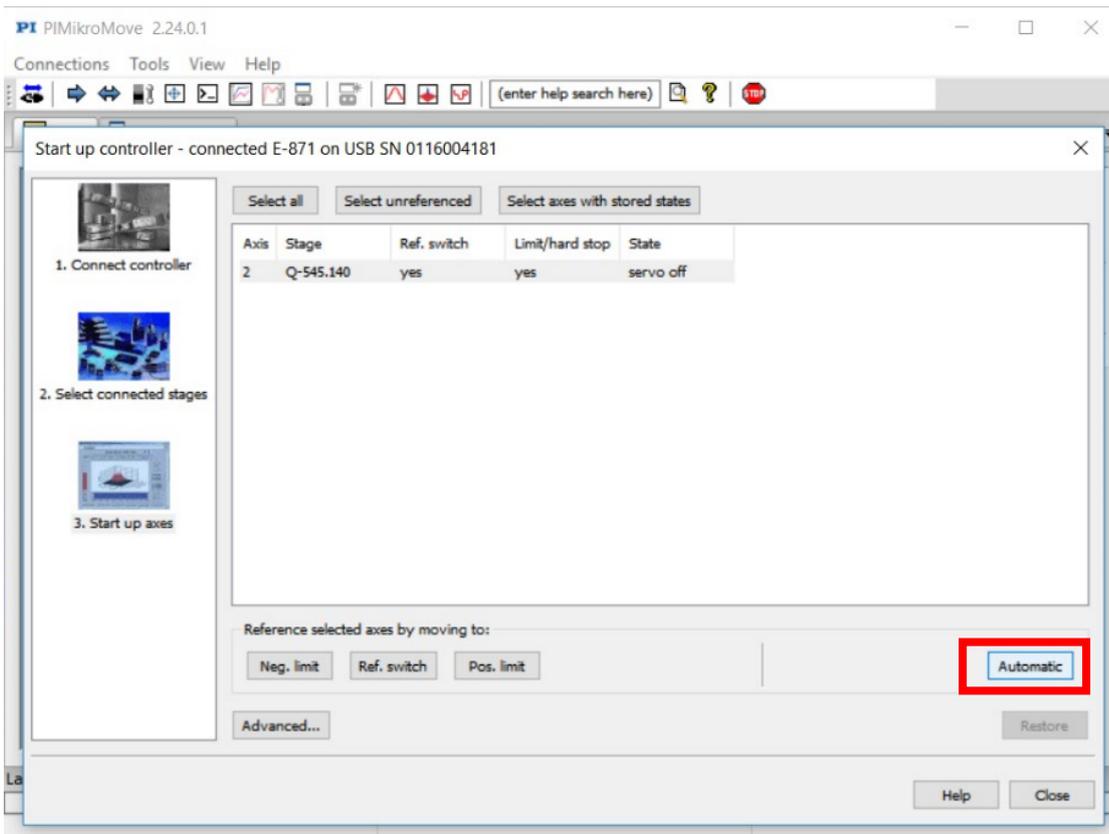


-> Choose E-871 (white controller) or E-873 (black controller, check on your packing list) in the list, Connect and click “Yes, configure for Q-545.140”

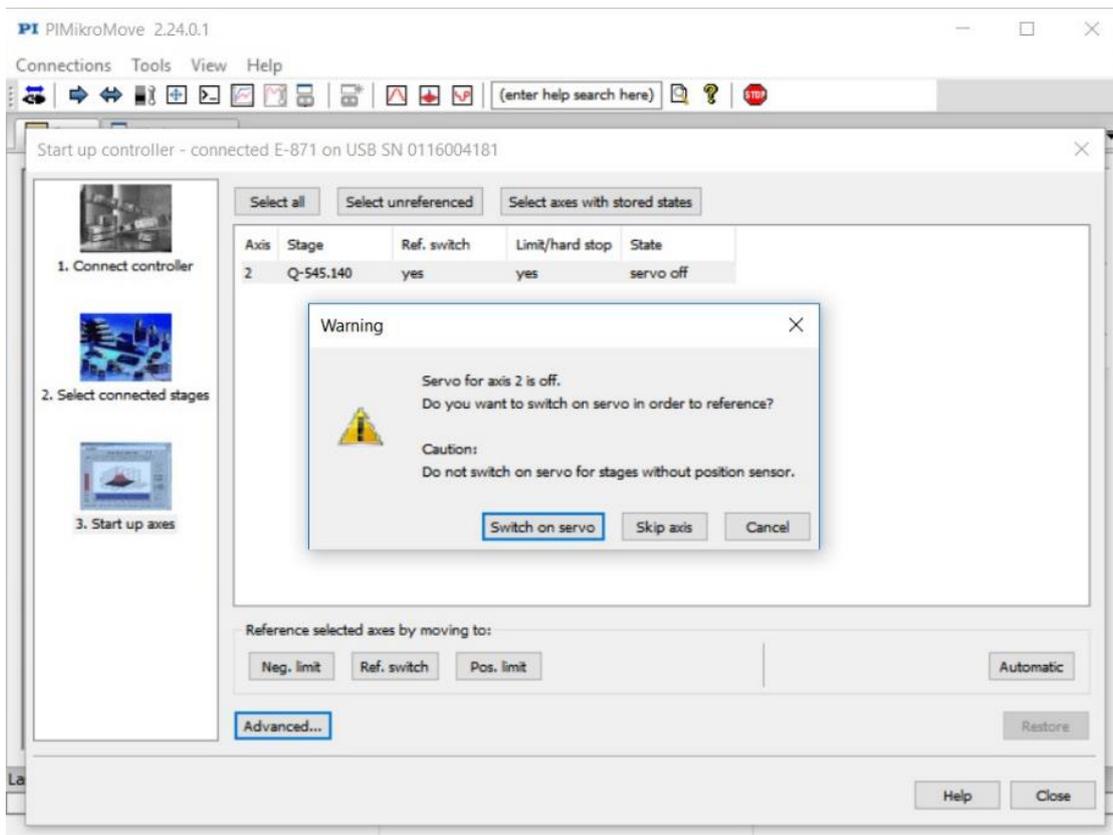
(If no controller is recognized, disconnect and reconnect the controller power cable to reboot it)



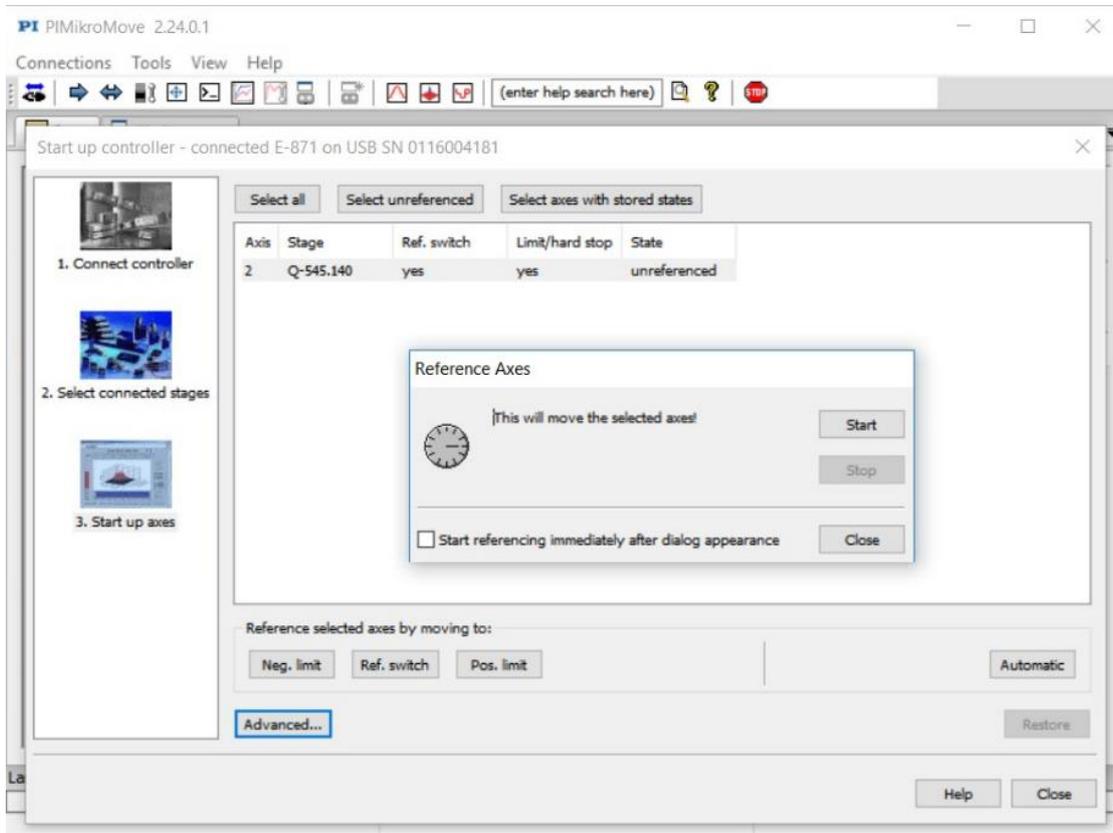
-> Click "Save all settings permanently on controller"



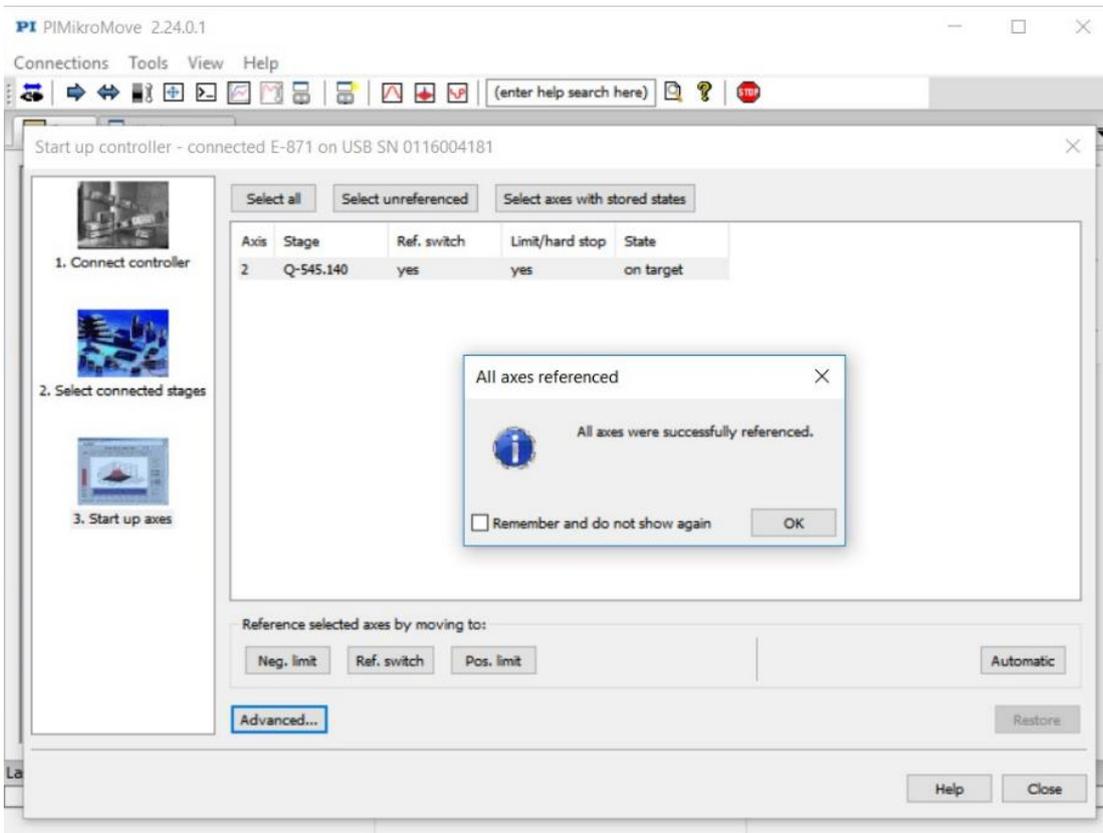
-> Click "Automatic" to calibrate the translation stage



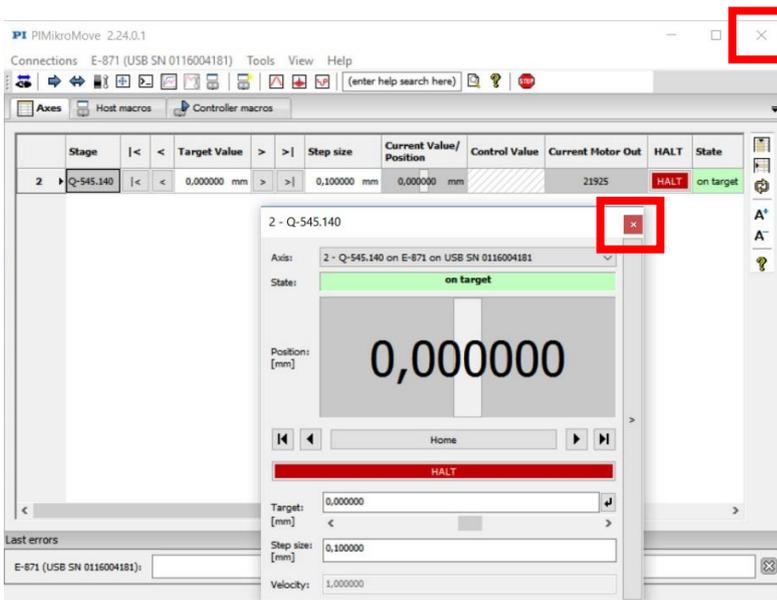
-> Switch on servo (check that no items is blocking the translation stage)



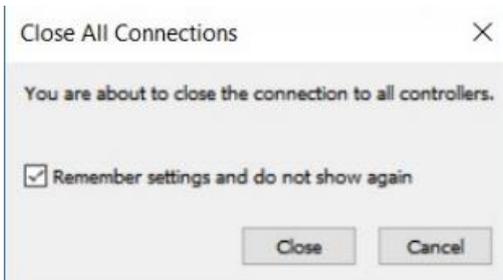
-> Start



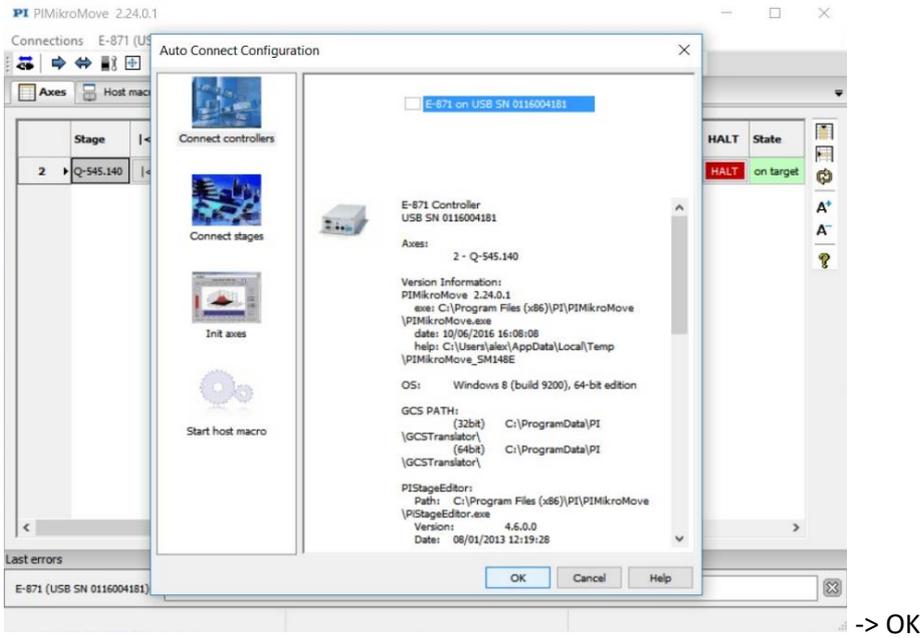
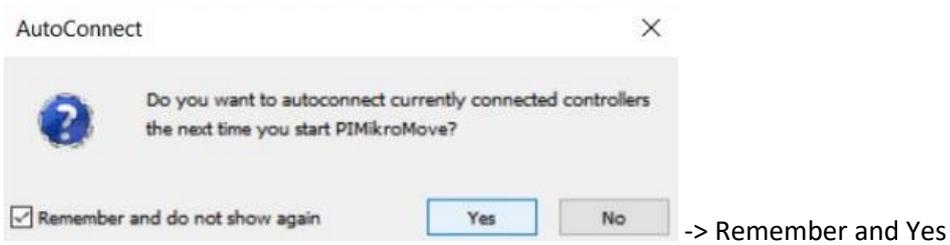
-> OK



-> Close PIMikroMove



-> Remember settings and Close



**For finishing the software installation -> Restart your computer**

### 3.4 SOFTWARE SETTINGS

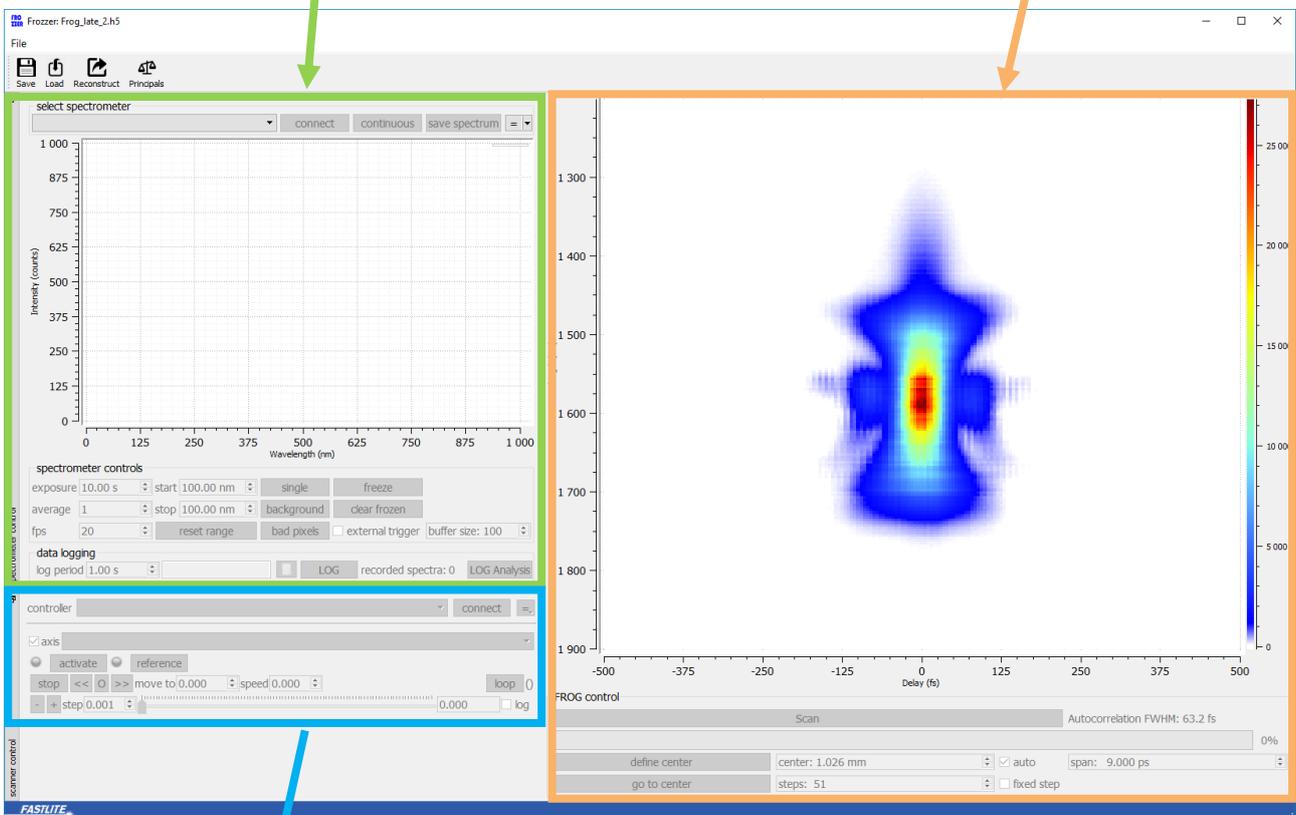
-> Connect USB cables from the spectrometer and from the controller

-> Run Frozzer software



Spectrometer settings

SH-FROG acquisition



Translation stage settings

#### File:

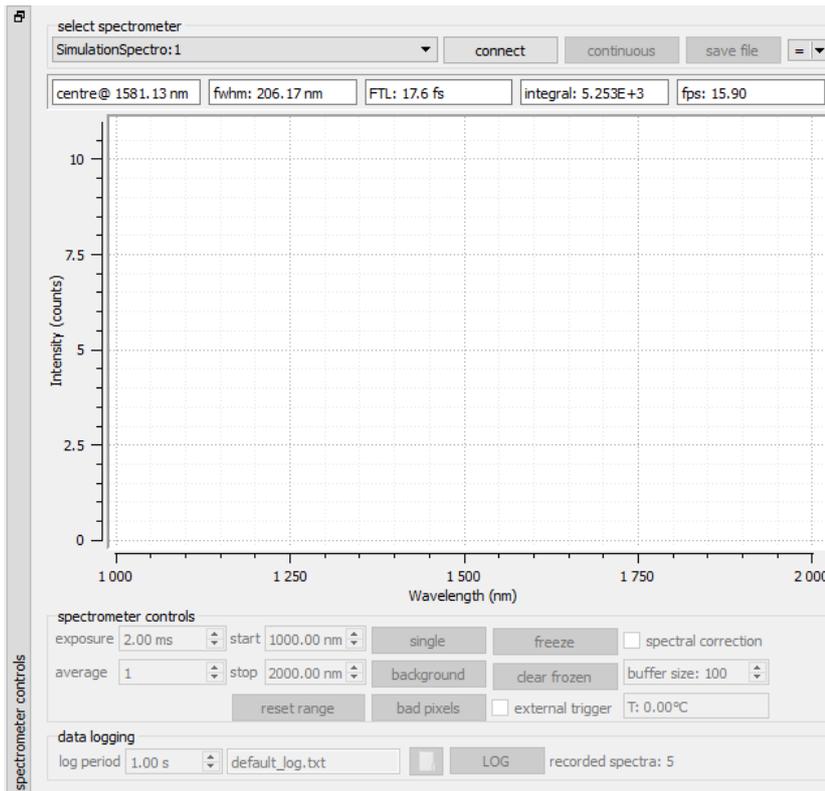
Save: save the current FROG acquisition in a .h5 or .txt file

Load: load a saved FROG acquisition

Save config as: save the current spectrometer and translation stage configuration

Load config: load a saved spectrometer and translation stage configuration

### 3.4.1 Spectrometer settings



- > Select the spectrometer in the list and Connect
  - > Click on the arrow (top right) and select "Show controls"
  - > Set the exposure time (here 2ms), click continuous
  - > Click background (no beam in the spectrometer), click acquire, wait a few seconds and click OK
  - > Double click on the Y axis or in the spectrometer window to rescale
- The spectrometer is ready.

#### Select spectrometer panel:

Spectrometer list

Connect or Disconnect the spectrometer

Continuous: display real time spectrum acquisition

Save file: save spectrum data

Arrow: show controls panel, show data panel or load a file

Stats panel: display different real time statistics according to the acquired spectrum

#### Spectrometer controls panel:

Exposure: set the spectrometer exposition time

Average: set the number of acquisitions that are averaged

Start & Stop: set the acquired wavelength range

Single: acquire a single acquisition (unclick continuous to use this option)

Background: subtract the background (click acquire, wait a few seconds and click OK)

Bad pixels: you can remove the acquisition made on bad pixels

Freeze: display a spectrum landmark (use clear frozen to remove landmarks)

External trigger: spectrometer will start the acquisition according to the trigger signal (trigger cable provided)

*Spectral correction: for software development*

Buffer size

T: spectrometer detector temperature (only with NIRQuest spectrometer)

Data logging panel: record spectrums

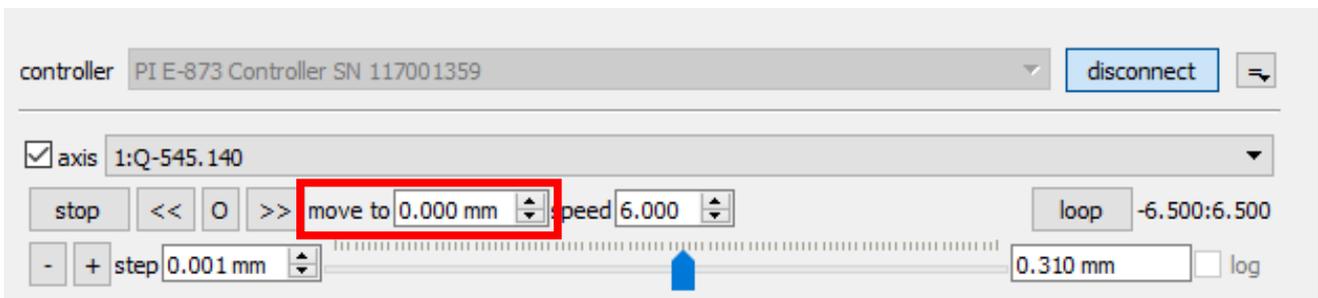
### 3.4.2 Translation stage settings



-> Select the controller in the list and Connect (if your translation stage isn't recognized, click Reload)  
(Controller reference: PI E-871 or E-873 / Translation stage reference: Q-545.140)

-> Click activate and reference if needed

-> Move the stage to the "time-zero" position defined during factory alignment and press Enter. (Noted on the Frozzer optical module) / here  $t_0 = 0.310$  mm



The translation stage is ready.

#### Translation stage controls:

Controller list

Connect or Disconnect the translation stage controller

Add axis: not available

Reload: reload the controller list

Translation stage list (Q-545.140)

Stop: stop the translation stage

<< 0 >>: Move to the limits and to the middle position of the translation stage (-6.5mm / 0mm / 6.5mm)

Move to: set the position of the translation stage

Speed: set the translation stage speed (recommended: 6.000)

+ - step: move the translation stage step by step / set the dimension of the step (here 0.001 mm)

*If you can't connect the translation stage, try to recalibrate the translation stage:*

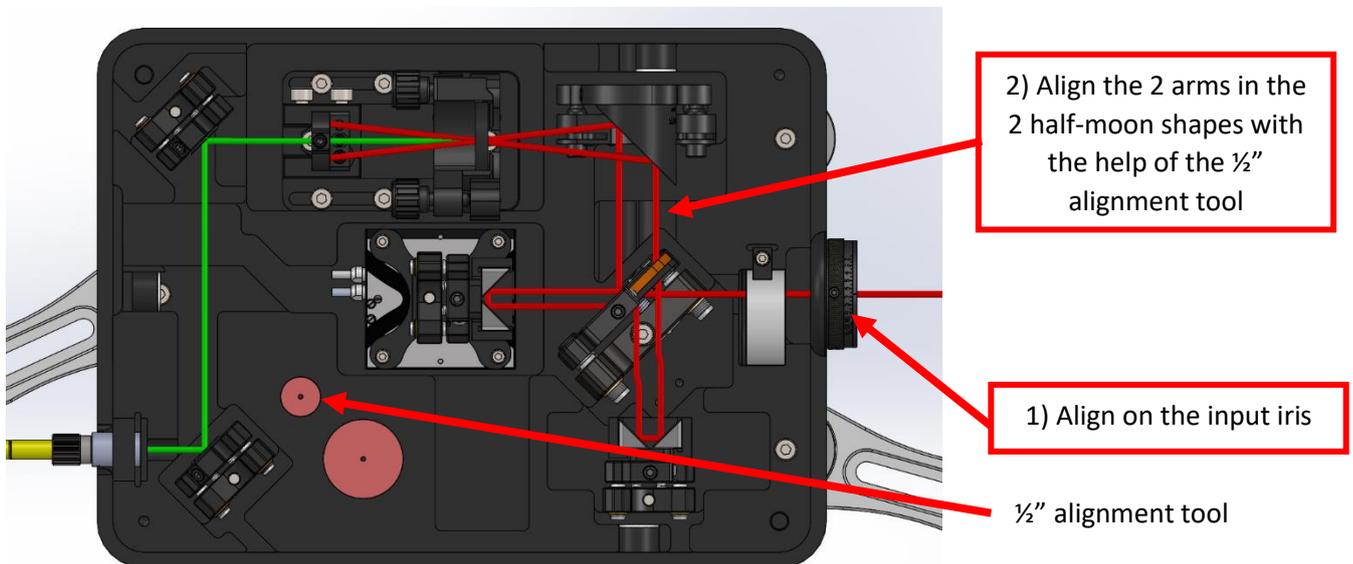
*(when you disconnect the power cable of the translation stage controller, the controller can lose the calibration of the stage)*

- a. check that the USB cable from the controller is plugged to the computer
- b. close the software
- c. unplug and replug the power cable of the translation stage controller
- d. open PI Mikromove software and follow the steps detailed pages 16 to 20 of this manual
- e. run Frozzer software

### 3.5 ALIGNMENT

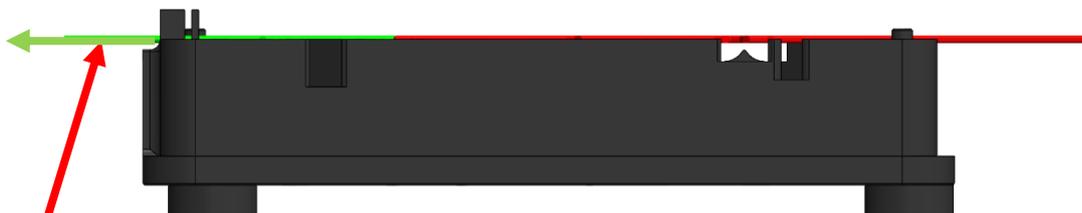
#### Your Frozzer optical module comes pre-aligned

- a. Adjust the input beam height and check that the beam propagated in a horizontal plane
- b. Adjust the energy (alignment is easier when the energy is between 5 and 10  $\mu\text{J}$ )
- c. Check that your optical configuration is corresponding to your wavelength (splitter, SHG crystal and spectrometer)
- d. Check that the input polarization (vertical) is corresponding to your SHG crystal orientation
- e. Align the input beam on the input iris and check that the beams after the beamsplitter and retroreflective mirrors are at the design position with the help of the  $\frac{1}{2}$ " inch alignment tool (half-moon shapes before the off-axis parabola) in moving all the optical module before to clamp it.



Red: measured beam / Green: sum-frequency beam

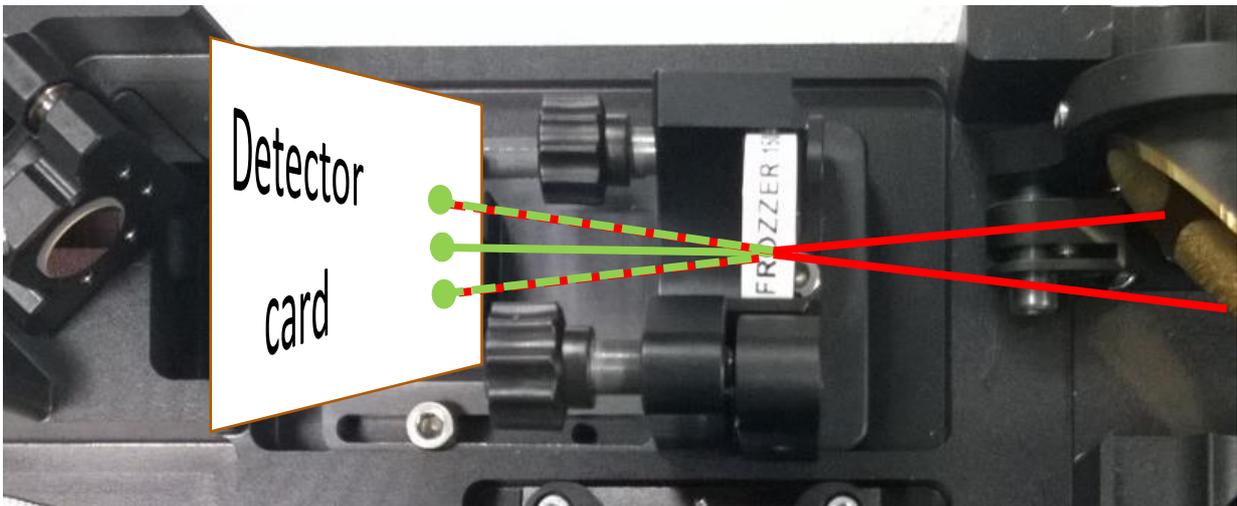
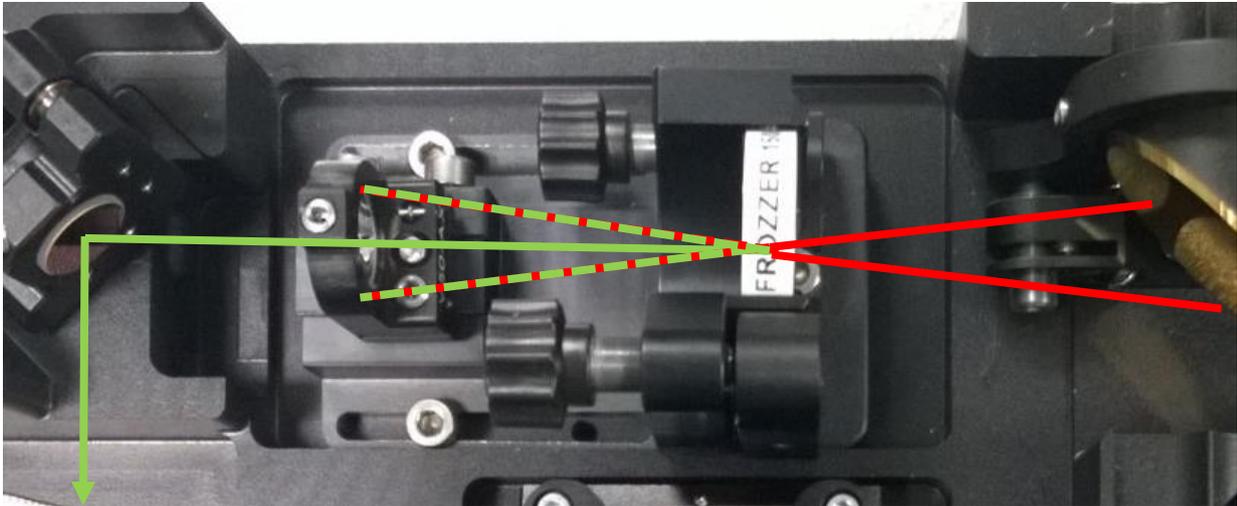
The beam must propagate in the top plane of the Frozzer base:



- 3) Orient the sum-frequency beam to the spectrometer (free space propagation or with optional fiber)

You can detect the sum-frequency beam with a detector card (white paper, photosensitive card or liquid crystal card depending of the wavelength):

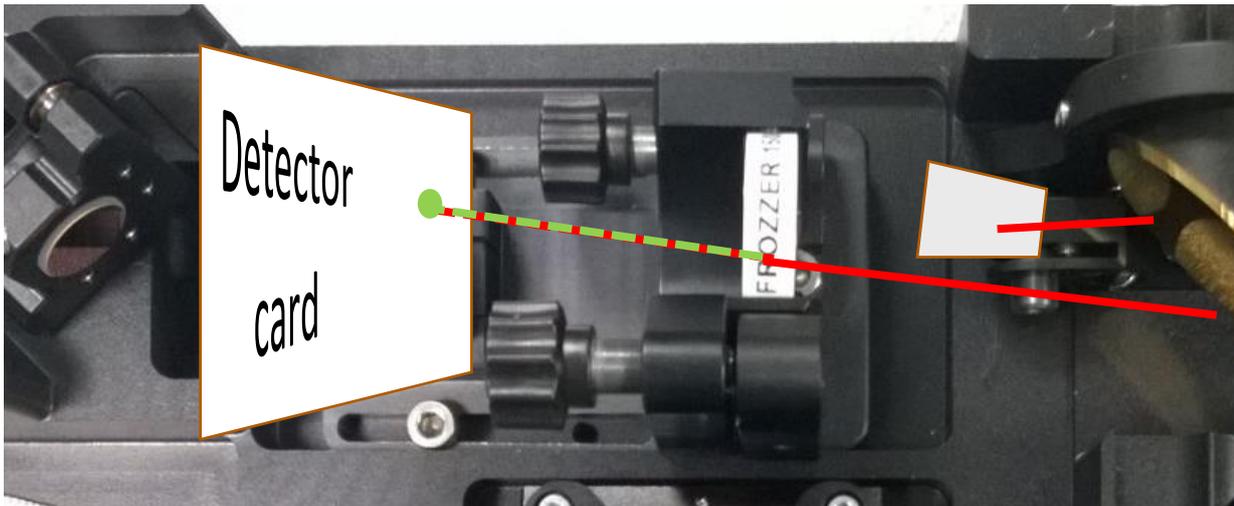
-> Place the detector card just after the crystal and you will observe the sum frequency beam in the middle of the second-harmonic beams of each arm:



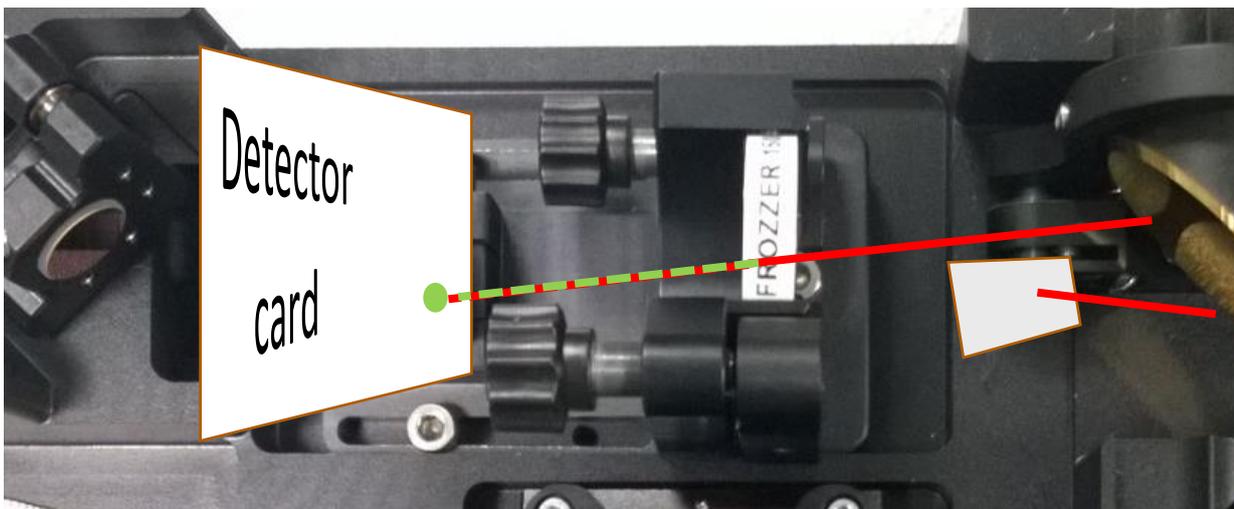
*Light intensity of the three spots on your detector card could be different.*

If you stop 1 arm of the Frozzer, you stop this arm and the sum-frequency beam:

Arm 1 stopped:



Arm 2 stopped:



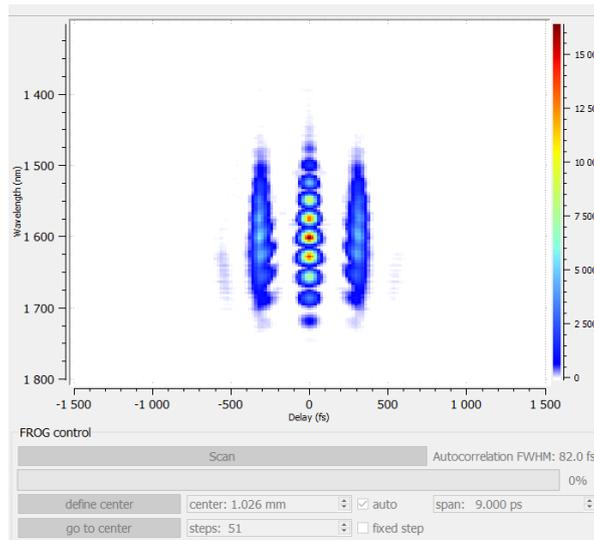
- f. Set the spectrometer at the proper height
- g. Direct the sum-frequency beam to the spectrometer: open-space or via a fiber (with optional fiber collimator).
- h. Close the cover to increase components lifetime

The complete realignment of the optical module is easy but a bit long so if you are unable to generate the sum-frequency beam with the pre-aligned optical module, before touching the alignment, first check:



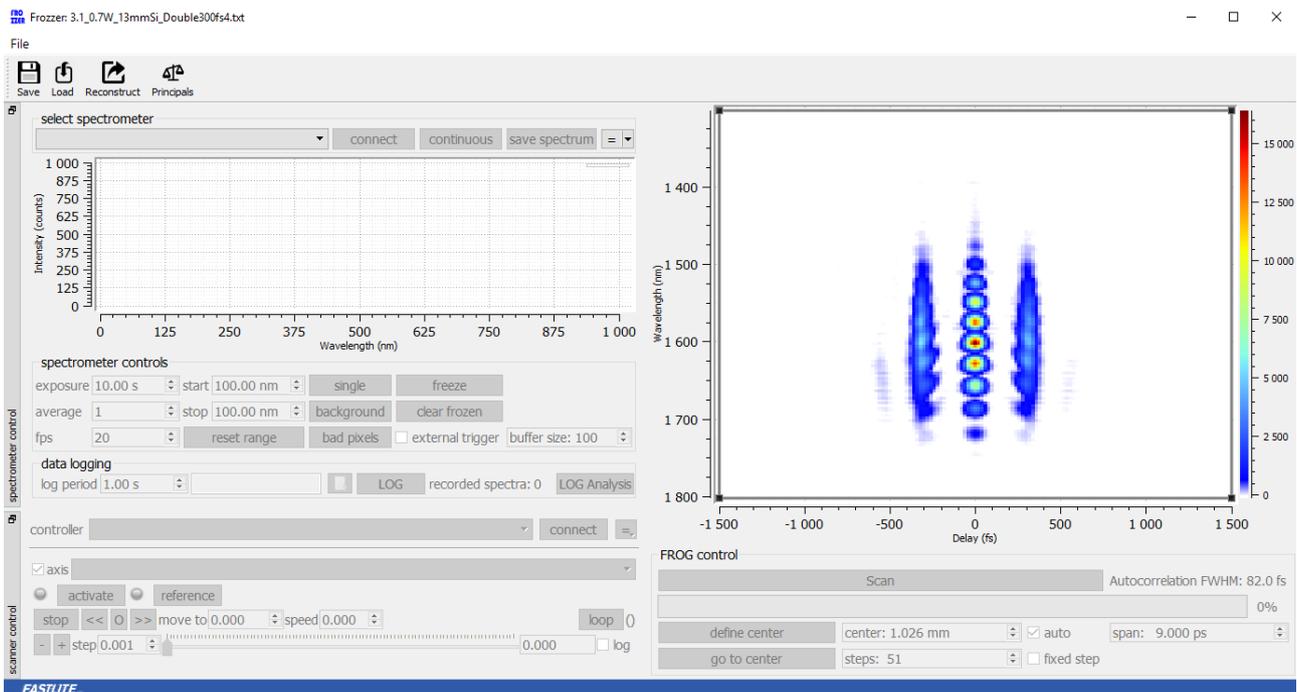
- 1) If the translation stage is at the "time-zero" position?
- 2) If the 2 separated arms are well aligned in the 2 half-moon shapes before the off-axis parabola?
- 3) If the 2 arms crossover is in the SHG crystal?
- 4) If the SHG crystal orientation corresponds to your vertical polarization?
- 5) If the sum-frequency beam is well oriented to the spectrometer in using the pair of mirrors at the exit?
- 6) If you can increase the input energy? (max 10-15  $\mu$ J)

### 3.6 SH-FROG ACQUISITION



- Improve the sum-frequency signal in the spectrometer (see chapter 4.2. Fast alignment)
- Click “define center” to set the actual position as the central position (reference position of the translation stage / “time-zero” position)
- Center the spectrum with “start” and “stop” (in spectrometer controls panel)
- Set the time span and the length of the step (you can define the number of points of the acquisition in unchecking “fixed step” (for fast acquisitions you can use 30 to 50 points / measurement duration < 10 sec, for better acquisitions increase the number of points)
- Use “Scan” to start a SH-FROG acquisition

Even complex FROG traces can be acquired and processed:

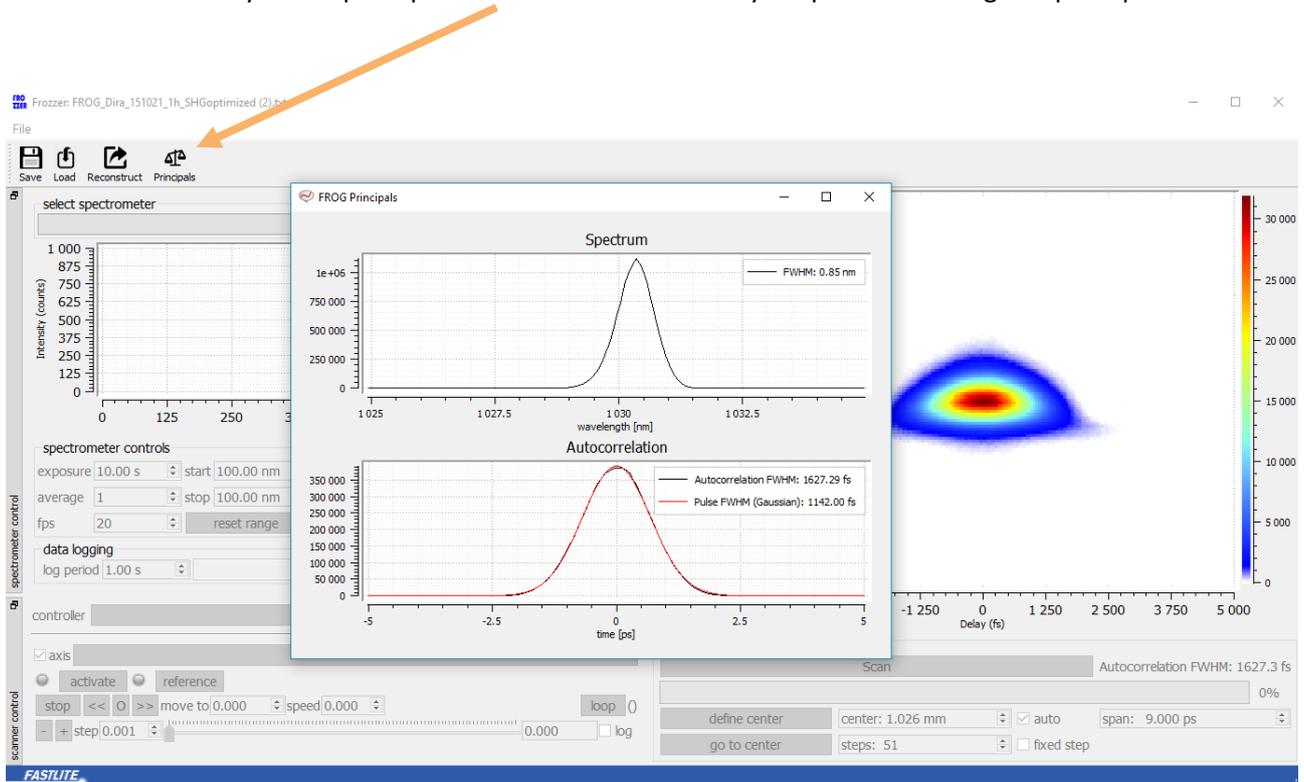


Example of a complex SH-FROG acquisition (double pulse)

## 3.7 DATA PROCESSING AND PULSE RETRIEVAL

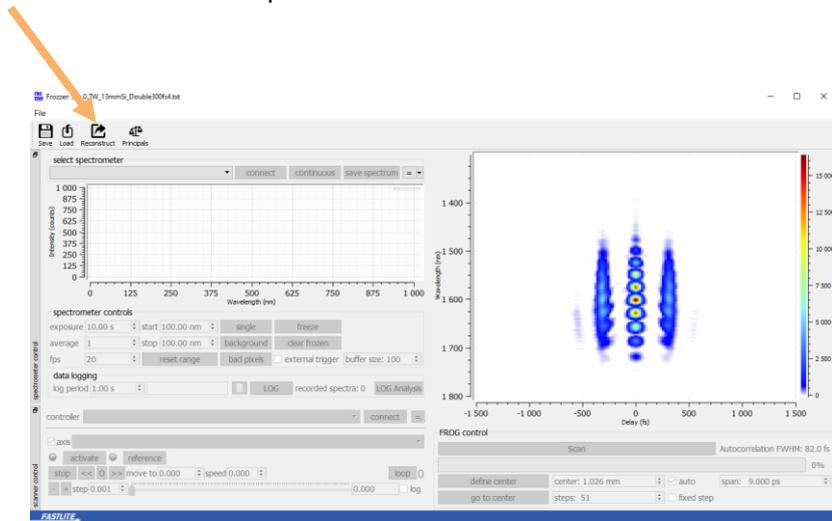
### 3.7.1 Autocorrelation mode

You can access easily to the principal coarse characteristics of your pulse in clicking on “principals”.

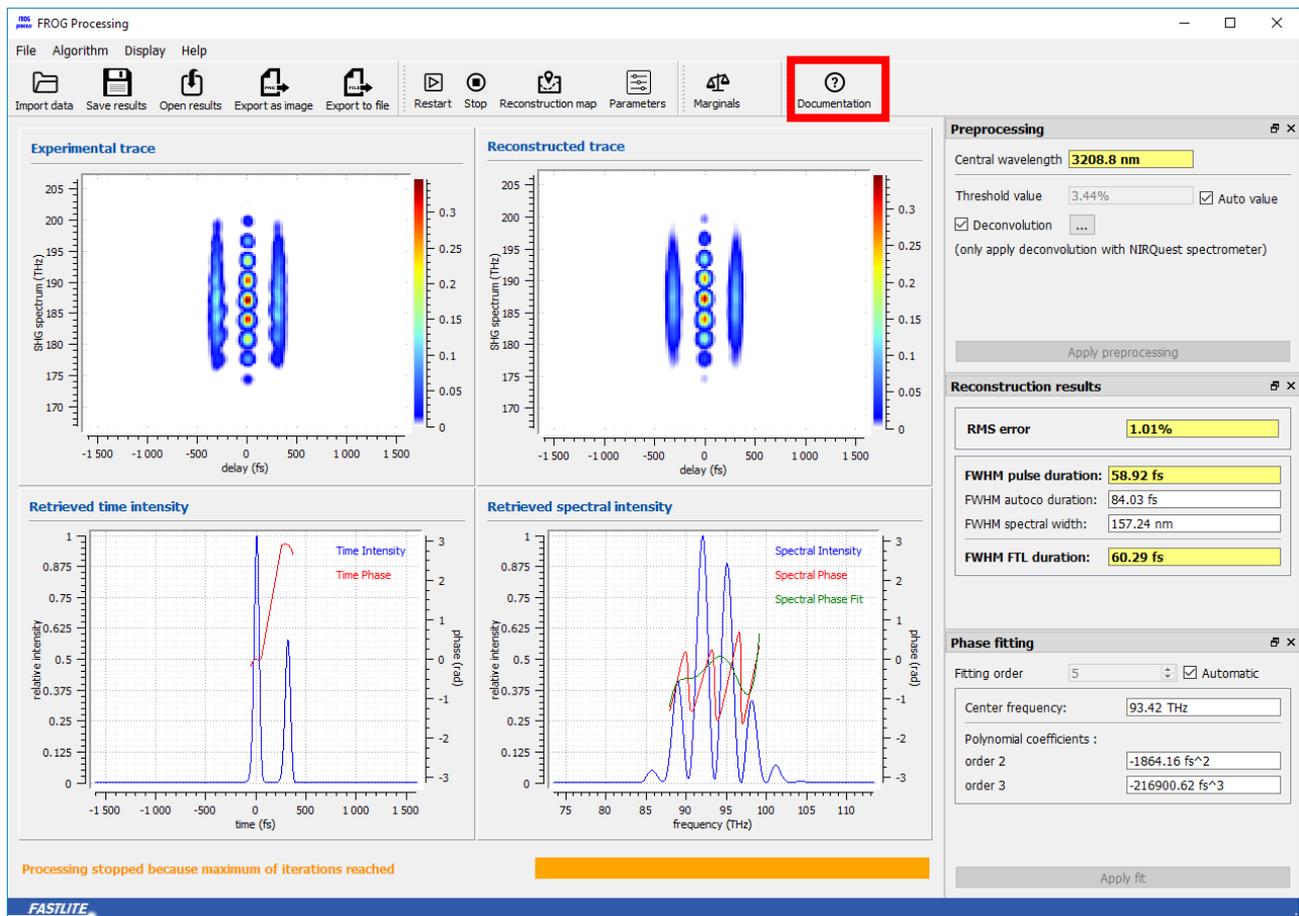


### 3.7.2 FROG reconstruction mode

Click on “Reconstruct” in the Frozzer acquisition software



Your data are sent to the reconstruction software “Frog\_Processing” and automatically processed.

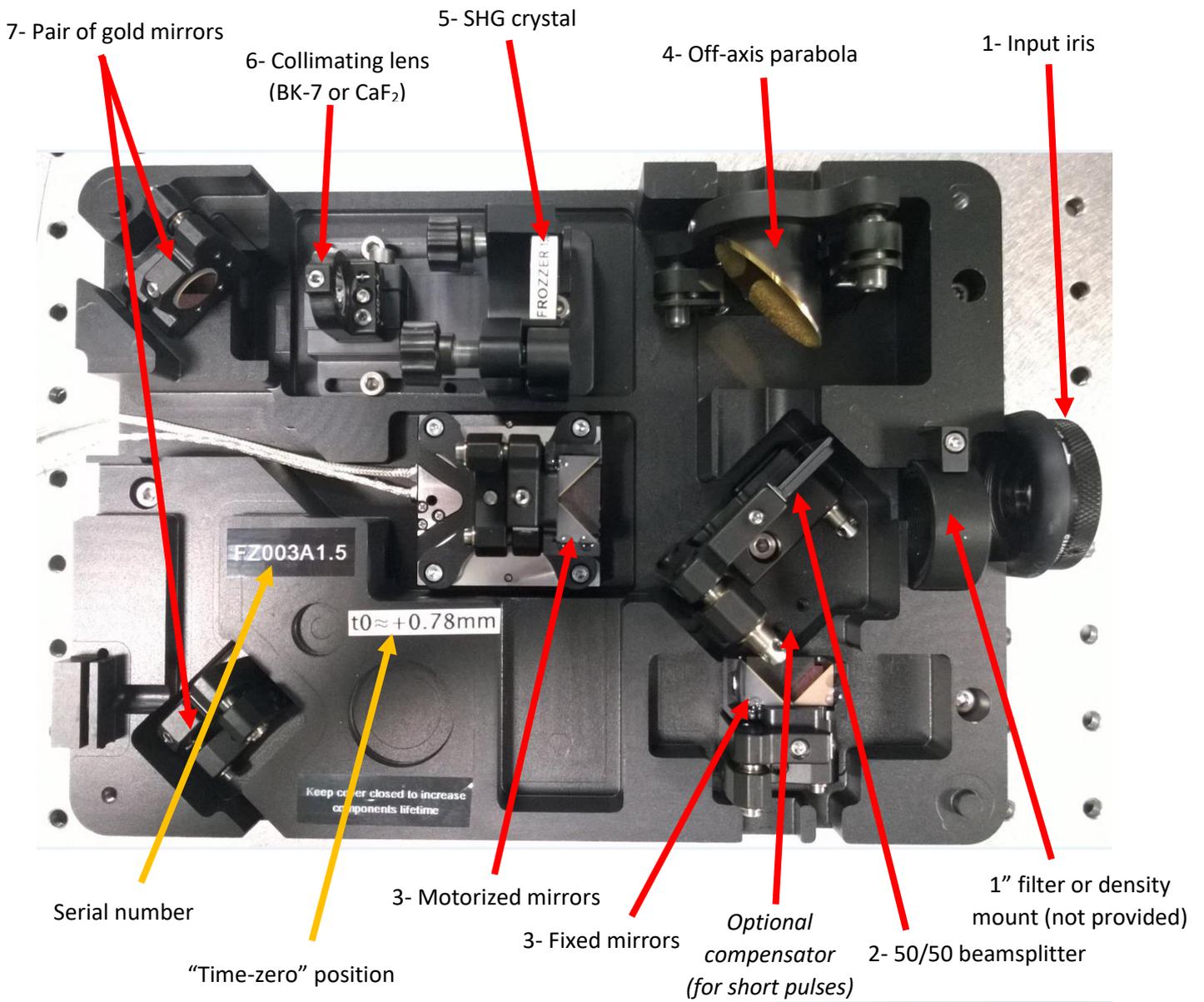


Example of a complex SH-FROG trace processing

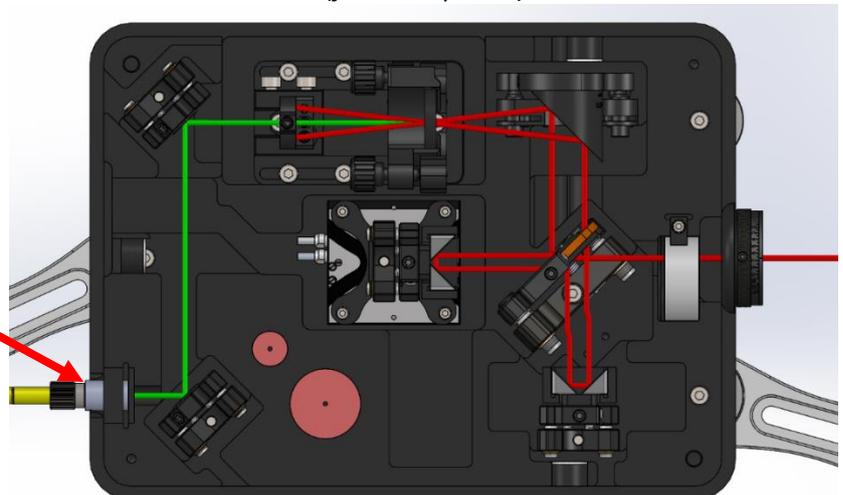
All documentation about Frozzer alignment, Frozzer software and Frog\_Processing software is accessible in clicking on “Documentation”.

# 4 REALIGNMENT

## 4.1 CONFIGURATION



8- Optional fiber connector  
(depending on your wavelength  
and spectrometer)



## 4.2 FAST ALIGNMENT

The complete realignment of the optical module is easy but a bit long so if you are unable to generate the sum-frequency beam with the pre-aligned optical module, before touching the alignment, first check:

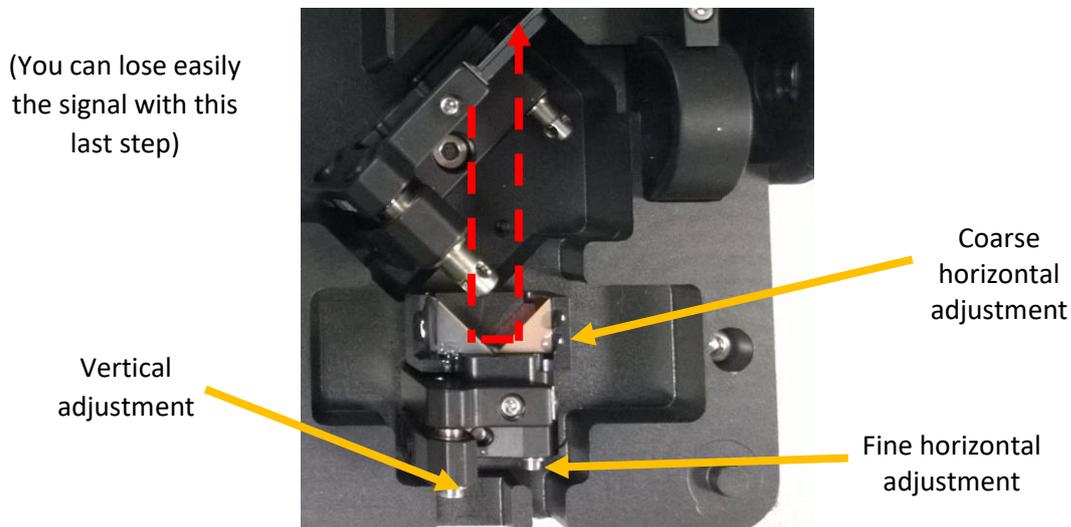
- 1) If the translation stage is at the "time-zero" position?
- 2) If the 2 separated arms are well aligned in the 2 half-moon shapes before the off-axis parabola?
- 3) If the 2 arms crossover is in the SHG crystal?
- 4) If the SHG crystal orientation corresponds to your vertical polarization?
- 5) If the sum-frequency beam is well oriented to the spectrometer?
- 6) If you can increase the input energy?



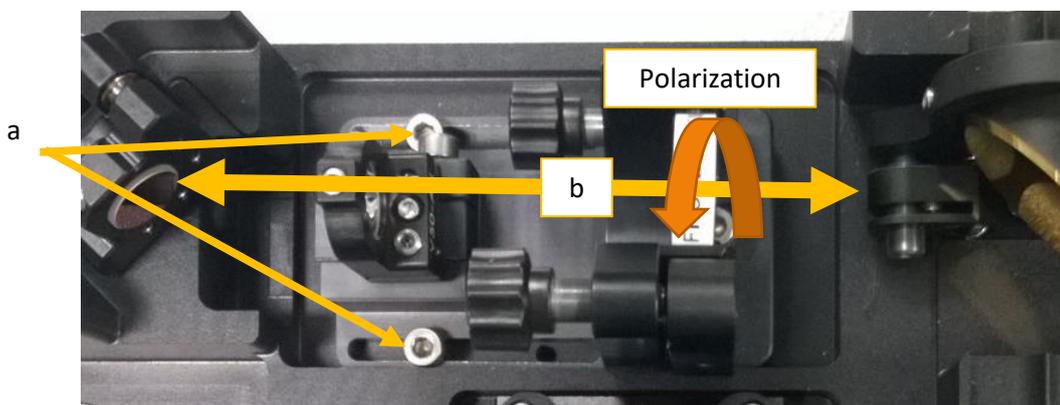
- don't change the beamsplitter and the parabola alignment!
- don't change the motorized mirrors alignment!
- move the translation stage to the "time-zero" position defined during factory alignment

In order to improve the signal of the sum-frequency beam, you can:

1. move step by step the position of the motorized stage with the software
2. rotate the SHG crystal (axial -> polarization / vertical or horizontal -> phase matching)
3. move carefully the precision screws of the fixed retroreflective mirrors



4. scan manually the position of the SHG crystal in moving slowly the baseplate or in moving the precision screws of the mount:
  - a. unscrew the 2 M4 screws
  - b. scan manually the SHG crystal position to improve the signal
  - c. screw the 2 M4 screws



## 4.3 COMPLETE REALIGNMENT

If a complete realignment is necessary (despite good protection, optics can move during transportation), first:

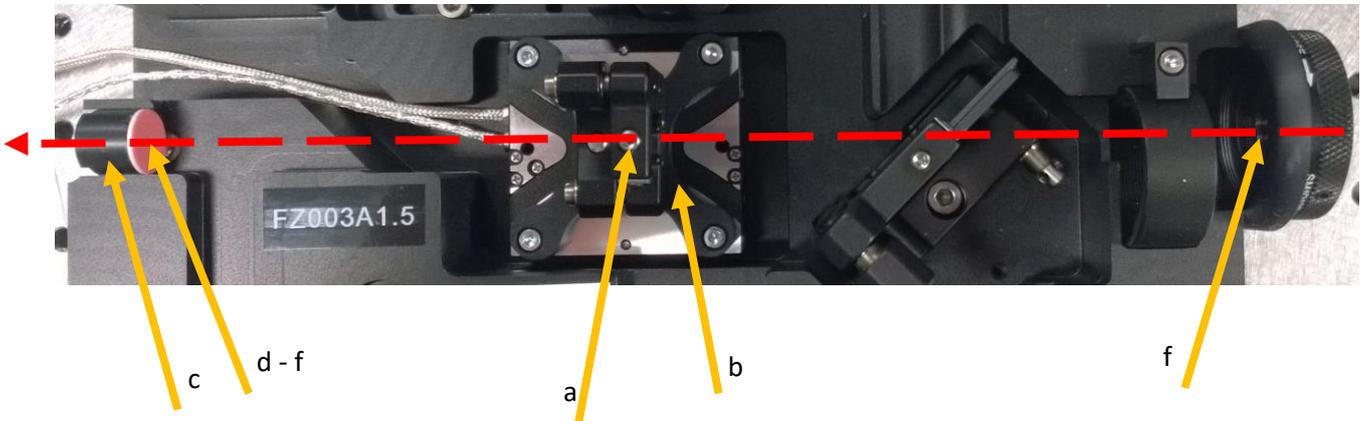


- move the translation stage to the “time-zero” position defined during factory alignment

### 4.3.1 Place the optical module

Remove carefully the retroreflective mirrors on the motorized translation stage and check if the beam propagate in the good direction through the Frozzer optical module

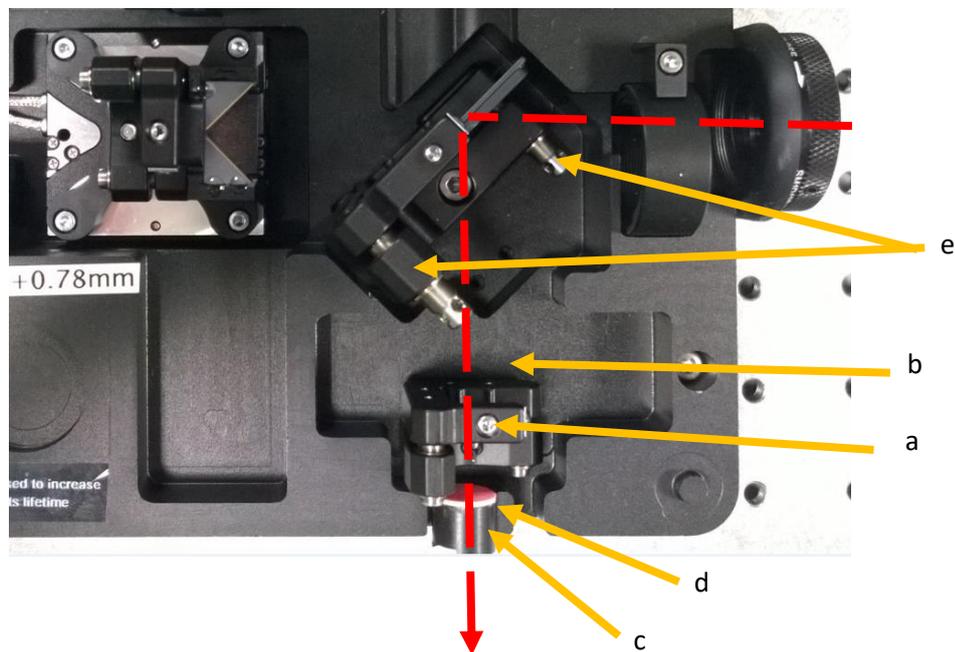
- Unscrew carefully the screw on the top of the mount which is on the motorized translation stage (don't force on the motorized stage)
- Remove carefully the mirrors
- Place the ½" alignment tool in the left slot
- Check if the beam is well centered on the alignment tool (propagate through the alignment tool hole)
- If not, move the optical module or the beam in order to center the beam on the input iris and on the alignment tool
- Put back carefully the mirrors in the mount



### 4.3.2 Beam splitter adjustment

Same method as the 1<sup>st</sup> step: remove carefully the fixed retroreflective mirrors and check if the beam propagate in the good direction.

- a. Unscrew the screw on the top of the fixed mirror mount
- b. Remove carefully the mirrors
- c. Place the ½" alignment tool in the lateral slot
- d. Check if the beam is well centered on the alignment tool (propagate through the alignment tool hole)
- e. If not, adjust the beamsplitter mount tip/tilt adjustment in order to center the beam
- f. Put back carefully the mirrors in the mount

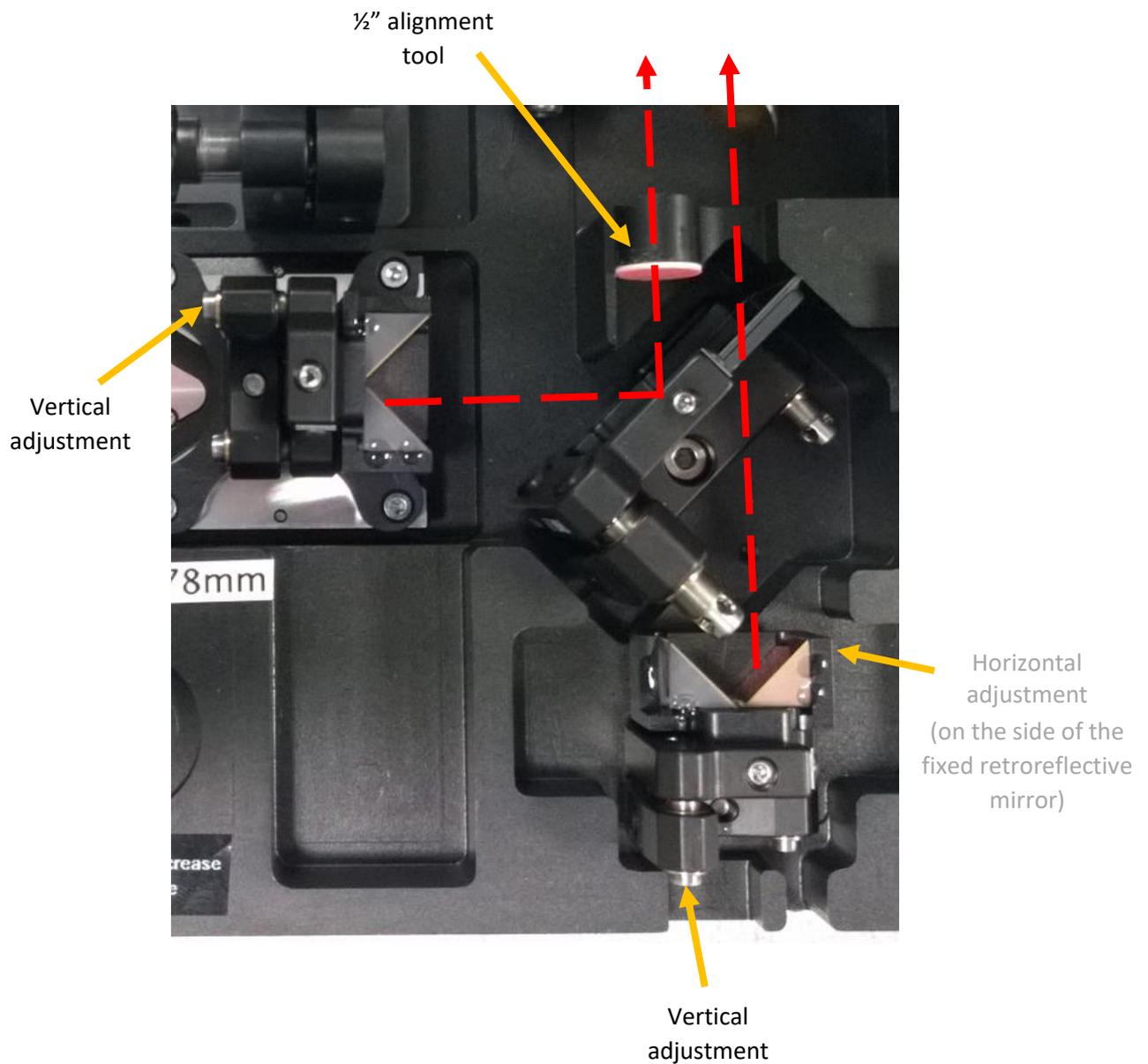


### 4.3.3 Retroreflective mirrors alignment

Each retroreflective mirror is composed of 2 hypotenuse coated right angle prism mirrors. The 2 retroreflective mirrors can adjust the vertical direction of the beams. Only the fixed retroreflective mirror can adjust the horizontal direction of one arm.

With the help of these adjustment possibilities, adjust the 2 arms to center them onto the alignment tool placed in the 2 half-moon shapes before the parabola (one half-moon shape for each arm).

Retroreflective mirrors are 90° prealigned, so if the 2 first steps have been well realized, you don't need to touch the horizontal adjustment.



#### 4.3.4 Parabola alignment

If the first 3 steps have been well realized, the 2 arms are parallel and go through the alignment tool placed in the 2 half-moon shapes before the parabola.

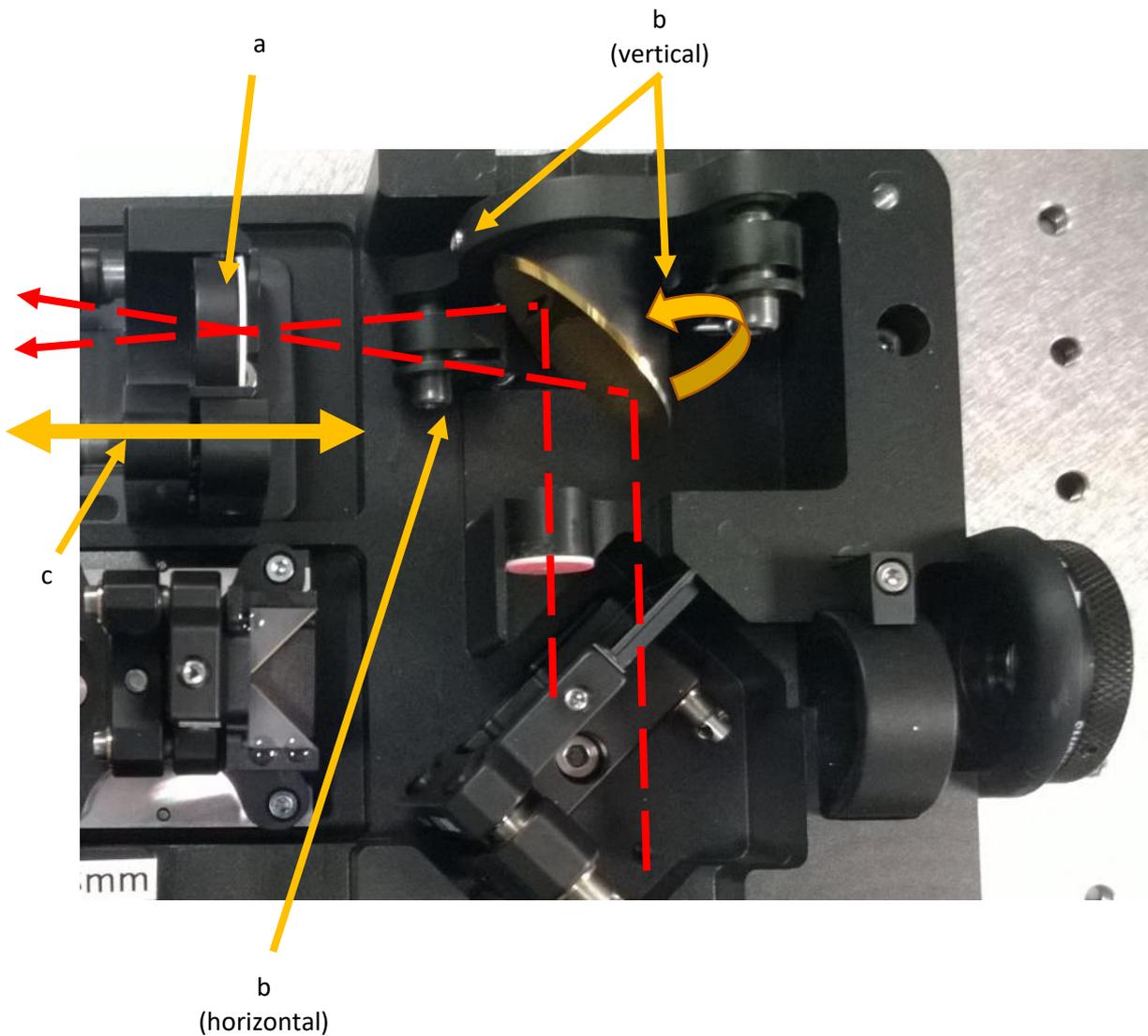
To prealign the 2 arms crossover, replace carefully the SHG crystal by the 1" alignment tool.

The 2 arms must go through the hole in the 1" alignment tool.

If not, adjust the parabola to orient the 2 arms in the good direction.

To adjust the position of the 1" alignment tool, you can follow the step 1 of the chapter "5.2 Fast alignment".

- a. Remember the orientation of the SHG crystal and replace it by the 1" alignment tool
- b. Adjust the parabola to orient the beam  
(for vertical adjustment: unscrew the screw on the side of the parabola mount and rotate the parabola carefully by hand / don't touch the gold coated surface)
- c. Move the SHG base to put the beams crossover in the hole of the 1" alignment tool  
(follow the step 1 of the chapter "5.2 Fast alignment")
- d. Replace the 1" alignment tool by the SHG crystal

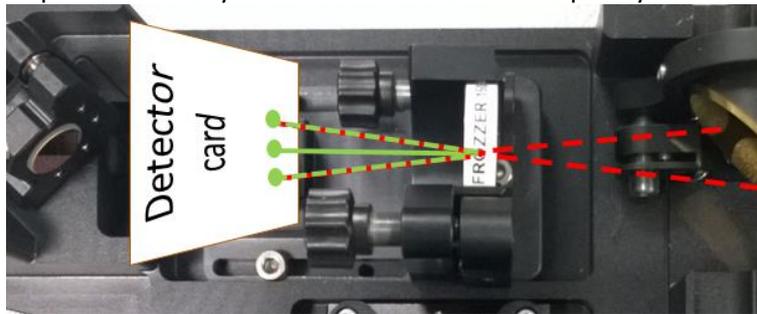


### 4.3.5 SHG crystal alignment

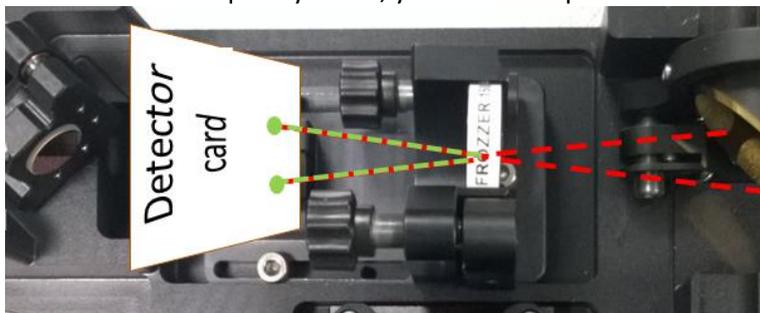
During this step, you will have to align precisely the 2 beams in order to place the crossover of the 2 beams at their focusing points in the SHG crystal.

- a. Verify that the motorized translation stage is at the “time-zero” position on the software
- b. Place a detector card (corresponding to the wavelength of the second harmonic of the measured beam: white paper, photosensitive card or liquid crystal card) just behind the SHG crystal.
- c. Check if the crossover of the 2 arms is at the focusing point of each arm  
Check if the crossover of the 2 arms is in the SHG crystal  
Check if the SHG crystal orientation is corresponding to your vertical polarization
- d. If yes, you must see the sum-frequency beam in the middle of the second harmonic beams of each arm  
If not, you can adjust different parameters to meet these 2 conditions:
  - a. Move finely the crystal base as the step 1 of the chapter “5.2 Fast alignment”
  - b. Adjust finely the crossover with the help of the fixed retroreflective mirror adjustment possibilities (horizontally and vertically)
- e. When you obtain a weak sum-frequency signal, orient it into the spectrometer with the last pair of mirrors. It will help you to increase the signal with redoing the last 2 steps and in finely adjusting the orientation of the SHG crystal (tip/tilt with the mount, fine axial rotation by hand). You can also move by little steps the motorized translation stage on the software.

Well aligned Frozzer optical module: you can observe the sum-frequency beam on your detector card:



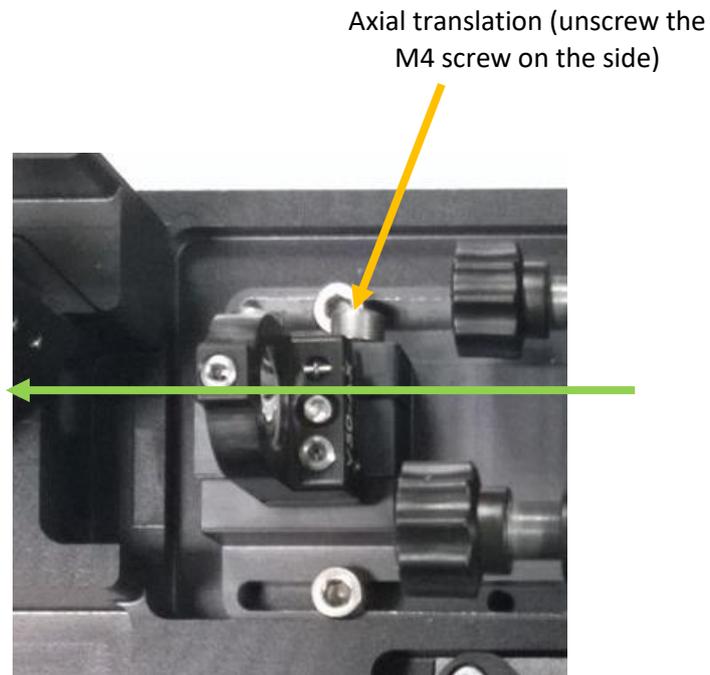
If you can't observe the sum-frequency beam, your Frozzer optical module isn't well aligned:



If you can't manage to obtain a sum-frequency signal, one option (if possible) is to increase energy at the input of the Frozzer optical module (do not exceed the maximum energy! You will damage optics!). You can also move the motorized translation stage (be careful because you add a temporal condition to the spatial crossover condition to obtain a sum-frequency beam).

#### 4.3.6 Collimating lens, pair of mirrors and optional fiber adapter

You can adjust manually the position of the collimating lens to improve the collimation of the sum-frequency beam.



Adjust finely the sum-frequency beam direction into the spectrometer with the help of the last pair of mirrors. You can also use the optional fiber adapter to transmit the sum-frequency beam to the spectrometer through a fiber.

