

Frozzer

Startup guide



FASTLITE

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CONTENTS

1 Setup			p		. 2
	1.1	1	Com	ponents	. 2
	1.2	2	Opti	cal specifications	. 2
2		Optical configuration		onfiguration	. 3
3	Installation			on	. 3
	3.1	3.1 Mounting		inting	. 3
	3.2	3.2 Connections		nections	. 3
	3.3 Software installation		ware installation	. 4	
	 3.3.1 Install setup-frozzer-xx.exe. 3.3.2 PI translation stage drivers installation 3.3.3 NIRQuest spectrometer drivers installation 3.3.4 Translation stage calibration 3.4 Software settings 3.4.1 Spectrometer settings 		L	Install setup-frozzer-xx.exe	. 4
			2	PI translation stage drivers installation	. 7
			3	NIRQuest spectrometer drivers installation	11
			1	Translation stage calibration	14
			Soft	ware settings	21
			L	Spectrometer settings	22
		3.4.2	2	Translation stage settings	23
	3.5 Alignment		Aligr	nment	24
	3.6	5	SH-F	ROG Acquisition	27
	3.7 Data processing and pulse retrieval		processing and pulse retrieval	28	
		3.7.1 3.7.2		Autocorrelation mode	28
				FROG reconstruction mode	29
4		Real	ignm	ent	30
	4.1	1	Conf	iguration	30
	4.2	2	Fast	alignment	31
	4.3	3	Com	plete realignment	32
		4.3.1		Place the optical module	32
		4.3.2	2	Beam splitter adjustment	33
		4.3.3		Retroreflective mirrors alignment	34
		4.3.4	1	Parabola alignment	35
		4.3.5	5	SHG crystal alignment	36
		4.3.6	5	Collimating lens, pair of mirrors and optional fiber adapter	37

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 µJ (5 to 10 µJ 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_2 for Frozzer 1-9 μ m)



2 OPTICAL CONFIGURATION

3 INSTALLATION

3.1 MOUNTING

- a. Mount the feet under the optical module
- b. Mount the feet under the spectrometer

3.2 CONNECTIONS

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

3.3 SOFTWARE INSTALLATION

-> Insert the provided USB key

> FAS	STLITE (F:)		✓ Č Search I			LITE (F:)	Q
	Name	Date modified	Туре			Size	
*	😼 setup-frozzer-36.exe	2/14/2017 17:04	Application		ation	378,532 KB	

3.3.1 Install setup-frozzer-xx.exe

Setup - Frozzer —	×
Select Destination Location	
Where should Frozzer be installed?	
Setup will install Frozzer into the following folder.	
To continue, click wext. If you would like to select a different folder, click browse.	
C:\Program Files\Frozzer Browse	
At least 0,7 MB of free disk space is required.	
Next > Cance	-> Nevt
🔀 Setup - Frozzer 🦳 🗌	×
Select Components	
Which components should be installed?	JA.
Select the components you want to install; dear the components you do not want to install. Click Next when you are ready to continue.	
Full installation	
FROG Processing	
Avantes spectrometer driver	
✓ NIRQuest spectrometer driver 174.6 MB	
PIE8/1 driver (translation stage) 122.9 MB	
Current selection requires at least 298, 1 MB of disk space.	
< Back Next > Canc	-

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

Setup - Frozzer Setup - Stup - Frozzer Setup - Set
Select Start Menu Folder Where should Setup place the program's shortcuts? Image: Continue, click Next. If you would like to select a different folder, click Browse Image: Continue, click Next. If you would like to select a different folder, click Browse Image: Continue, click Next. If you would like to select a different folder, click Browse Image: Continue, click Next. If you would like to select a different folder, click Browse Image: Continue, click Next. If you would like to select a different folder, click Browse Image: Content
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Create a desktop shortcut for frog_processing.exe
< Back Next > Cancel
-> Ne
🚽 Setup - Frozzer — 🗌 🗙
Ready to Install
Setup is now ready to begin installing Prozzer on your computer.
Click Install to continue with the installation, or click Back if you want to review or
change any settings
change any settings.
Change any settings.
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Device Driver Installation Wizar	d	
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	< Back Next > Cancel	-> Next

Device Driver Installation Wize	rd 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	-> Finisł

3.3.2 PI translation stage drivers installation

🛃 E-871 PIShift Controller - In	stallShield Wizard	×	
		PI	
		<u> </u>	
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	E-8/1 PISHIC Controller		
	The InstallShield(R) Wizard will install E-871 PI	Shift	
	Controller on your computer. After this it will run for the E-871 PIShift Controller USB driver. To a	n the setup	
	Next.	continue, circk	
	international treaties.	ght law and	
	WWW.PI.WB		
	< Back Next >	Cancel	
	- and the -		> Next
0			
🕼 E-871 PIShift Controller - In	stallShield Wizard	×	
License Agreement		DI	
Please read the following licen	se agreement carefully.	PI	
	Preamble	^	
Physik Instrumente (PI) GmbH	I & Co. KG (hereinafter referred to as "PI") is	a leading	
supplier of nanopositioning tec	hnology and motion control systems (herein	after referred	
to as "Hardware").			
For operating the Hardware, P	I provides advanced software products or to	ols, as for	
example the NanoCapture™ S	Software, PlMikroMove™ Software and furthe	er software	
tools as the PI General Comm	and Set, Labview Driver Set or Dynamic Lin	k Libraries	
(DLLs) for a stand along use (or an integration with third narty coffware pro	ducto	
I accept the terms in the licens	e agreement	Print	
I do not accept the terms in the	license agreement		
InstallShield			
	< Back Next >	Cancel	
			-> accept and next
0			
E-871 PIShift Controller - In	stallShield Wizard	×	
Customer Information		DI	
Please enter your information.		PI	
User Name:			
pana -			
Organization:			
X0X			
Anyone who us	es this computer (all users)		
 Only for me (x 	ox)		
InstallShield			
	< Back Next >	Cancel	A second state of the formula for the second state of the second s

🖟 E-871 PIShift Controller - InstallShield	d Wizard		×	-
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Choose the setup type that best suits you	r needs.		FI	
Please select a setup type.				
Complete				
All program features wi	l be installed. (Requi	ires the most disk s	pace.)	
○ Custom				
Choose which program be installed. Recommen	leatures you want ins ded for advanced us	stalled and where t ers.	hey will	
InstallShield	< Pack	Next >	Cancel	
	DOCK	WEAL >	Cancer	-> choose "Complete" and Next
🕼 E-871 PIShift Controller - InstallShield	d Wizard		×	-
E-871 PIShift Controller GCS LabVIEW	Driver Selection		р	
Select the LabVIEW driver to be installed.			PI	
E-871 PIShift Controller GCS Lab Select this driver if you are using a 6 InstallShield	/IEW driver (64-bi 4-bit version of LabV	it version) IEW.	Cancel	
	< DOCK	Next >	Cancer	-> select option according to your system
and Next				_
E-871 PIShift Controller - InstallShield	l Wizard		×	
Ready to Install the Program The wizard is ready to begin installation.			\mathbf{PI}	
Click Install to begin the installation.				
If you want to review or change any of yo	our installation setting	gs, click Back. Click (Cancel to exit	
the wizard.				
InstallShield				
	< Back	Install	Cancel	-> Install



🛃 E-871 FTDI USB Driver - InstallShield Wizard	×
Ready to Install the Program	
The wizard is ready to begin installation.	
Click Install to begin the installation.	
If you want to review or change any of your installation settings, click Back. Click Cancel to exit	
the wizard.	
InstallShield	
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3.3.3 NIRQuest spectrometer drivers installation

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	< Back Next > Cancel -> Next	
🐓 Setup	- 🗆 X	
Which version do you wan	nt to install?	
Redistributable vers	rsion (for end-users)	
O Development version	ion (requires password)	
BitRock Installer	< Back Next > Cancel	
		ext
🐓 Setup	- · ×	
Installation Directory		
Please specify the direct installed.	ctory where OmniDriver-win64-2.40 will be	
Installation Directory	C:\Program Files\Ocean Optics\Omn 🛛 📸	
BitRock Installer		
	< Back Next > Cancel -> Next	

😻 Setup		_		×	
Install VCREDIST silently			U.		
OmniDriver requires th option determines whe questions during the V "silent" mode (recomm supplied automatically	e Microsoft Visual C+ ther you will be pron CREDIST phase of the tended), the appropr for you.	+ redistributa npted to answ installation. If iate answers w	ble DLLs. Ti er various you choos ill be	his ;e	
Install VCREDIST silent	ly				
Yes	-				
○ No					
BitRock Installer					
	< Back	Next >	Cancel		-> Select Yes and Next
Setup		2 <u>1.</u>		×	l
Ready to Install				8	
BitRock Installer	< Back	Next >	Cance	el	-> Next (installation)
👺 Setup		_		×]
	Completing the Omni	Driver-win64-2.4	0 Setup Wiza	ard	
	Setup has finished	installing			
	OmniDriver-win64	-2.40 on your	computer.		
	< Back	Finish	Cance	el	-> 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

Les plus utilisées					
Prise en main					
Sway					
Q Cartes					
Contacts					
🧭 Paint >					
Calculatrice					
Récemment ajoutées					
PIUpdateFinder					
Explorateur de fichiers					
袋 Paramètres					
🖒 Marche/Arrêt					
Toutes les applications Nouveau					
E 🖉 🗆 🧮 🥹 🧧	A)				
PI Update Finder 1.2.2.9		- 0	×		
PIEZO NANO POSITIONING 1	WWW.PI.WS	P	Ι		
PI Update Finder					
This tool will help you to keep your PI their versions to the PI server. You can	I software components up to an then decide what to downlo	date by sending information bad and install.	about		

The following software components ha	ave been found:		^
Module	Version	Directory	
PlUpdateFinder	1.2.2.9	C:\Program Files (x86)\PI\PIUpdateFi	
PIMikroMove	2.14.0.2	C:\Program Files (x86)\PI\PIMikroMo	
PI_GCS2_DLL	2.15.0.0	C:\ProgramData\PI\GCSTranslator	
PIStageEditor(Application)	4.6.0.0	C:\Program Files (x86)\PI\PIMikroMo\	
Diterminal	6334		~

PI Update Finder will search for PI software in the standard installation directories only. If your PI software is installed elsewhere, PI Update Finder cannot find it. In this case, <u>specify the</u> <u>directories where your PI software components are installed</u>. Once you are finished, PI Update Finder will search again for your PI software.

Click Find Updates to send the above version information to the PI server and get information on which modules can be updated.



If your computer is not connected to the Internet, click Use Offline Mode.

Click the directory links above to access the destination folders for the software you download.

-> Find Updates

Update Finder × +					-		×
(i) update.pi-portal.ws/index.php?ver=1≤	=82&info=3C0603000001020E0002090406000027060303010001020	C Q Recherch	ner	☆	自 🖡 🏠	◙	=
					рт		
PI Update Finder							
	PI Software	Found on Yo	ur 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		PI server		
	PIUpdateFinder	V1.2.2.9	V1.4.2.1	Release note	PI server		
5	PI GCS Library PL_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 Update Finder PI Software Found on Your System Name Installed Version Version on PI Server Releat Note PI GCS Library PI_GCS2_DLL (ZIP file, please extract and run install.bat) V3.9.0.1 V3.9.0.1 V3.9.0.1 PI LabVIEW Driver E-871 V6.3.0.1 V6.3.0.1 V6.3.0.1 V6.3.0.1	PI
PI Software Found on Your System Name Installed Version Version on PI Server Relea Note PI GCS Library PI GCS2_DLL (ZIP file, please extract and run Install.bat) V3.9.0.1 V3.9.0.1 V3.9.0.1 PI LabVIEW Driver E-871 V6.3.0.1 V6.3.0.1 V6.3.0.1 V6.3.0.1	se Download
Name Installed Version Version on PI Server Relex Note PI GCS Library PI_GCS2_DLL (ZIP file, please extract and run Install.bat) V3.9.0.1 V3.9.0.1 PI LabVIEW Driver E-871 V6.3.0.1 V6.3.0.1 V6.3.0.1	e Download
PI GCS Library PI_GCS2_DLL (ZIP file, please extract and run install.bat) V3.9.0.1 V3.9.0.1 PI LabVIEW Driver E-871 V6.3.0.1 V6.3.0.1	s Link
PI LabVIEW Driver E-871 V6.3.0.1 V6.3.0.1	✓ Up to date
	✓ 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 2016/06/15 13:59:36 12:59:36	✓ Up to date
PI Stage Database PImiCosStages2 2016/03/16 2016/03/16 10:39:42 10:39:42	✓ Up to date
PIFirmwareUpdater V1.2.4.0 V1.4.2.3 Relea	PI server
PIMikroMove V2.24.0.1 V2.24.0.1	Vp to date
PIStageEditor (Application) V4.6.0.0 V4.9.0.0 Release not	PI server
PITerminal V6.8.0.1 V6.8.0.1	🚩 Up to date
	¥

-> 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)

		Paramètres
		Photos
		GCSMergedLabVIEW
		PI GCS LabVIEW drivers
		PI LabVIEW Merge Tool
		Pi Manuals
		PI Programming Files PI_GCS2_D
	PI	PlFirmwareUpdater
	PI µMoue	PIMikroMove
	PI	PIStageEditor
8	PITorn	PITerminal
Ģ	PI	PlUpdateFinder
ŝ		Samples
4	Ý.	Prise en main
Ö	R	
E	0	
PI	PIMikroMove	2240.1 – 🗆 🗙
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S	itart Up Contr	ols View Help
S	tart Up Contr Connect co Connect co Con	ols View Help
2	1. Connect co	ols View Help I Description Held RS-232 USB Daisy Chain Description PI E-851 Controller SN 0116004181 Stage Type Configuration X
2	1. Connect co	ols View Help
2	1. Connect co 2. Select connec 3. Start up	ols View Help We Defended the search here) Controller We Defended the search here Controller and S. But the controller axis S not configure the controller axis 2 for stage type Q-545.140 ? We Defended the search here Controller axis S to stage type Q-545.140 ? We Defended the search here Controller axis S to stage type Q-545.140 ? We Defended the search here Controller axis S to stage type Q-545.140 ?
22	1. Connect co 2. Select connect 3. Start up	ols View Help We Constrained to the controller axis 2 for stage type Q-545.140 ? No Serial settings
22	1. Connect co 2. Select connect 3. Start up	ols View Help Image: Stage Type Configuration Image: Stage Type Configuration Image: Stage Type Configurating
22	1. Connect co	ols View Help We Construct the search here) (Construction of there) (Cons
2	1. Connect co 2. Select connect 3. Start up	ols View Help Aller Controller C
	1. Connect co 2. Select connect 3. Start up	ols View Help R Die Connect Help Cancel

-> 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)

PI PIMikroMove 2.24.0.1 Connections Tools View	v Help		(enter help search here)	Ø 🖱		-		×
Start Up Controller	Save all cha	anges permanently?	(enser neip search nere)	5 674 Control				×
2. Select connected stages	0	By default, the stage setti and will be lost when the Advantage: It is possible return to the previous set If you are sure that the st them permanently on the available after rebooting of Advantage: The system is or third-party integration CAUTION: Saving the se So all settings for all stage	ngs in the controller are changed controller is switched off or rebo to test the settings and, if necess tings by simply rebooting the co age settings function correctly, is controller. Permanently saved s or the next power-on. Is ready to work with other softw s) without the need for reload of ttings permanently can only be (is are saved.	d temporarily soted. ary, ontroller. you can save ettings will still be vare (e.g. custom f stage settings. done globally.	a applications	Serial	settings	
	Keep	p the changes temporarily	Save all settings permanently DIP switch DIP switch	5 ON ON 6 ON OFF	Cancel OFF OFF ON OFF	ontroller	Conne	ect
						Help	Cane	cel

-> Click "Save all settings permanently on controller"

PI PIMikroMove 2.24.0.1							×
Connections Tools Vie	w Help		(enter help search	here) 🖓 🥐 💼			
			(units help search		-		
Start up controller - con	nected E-871 on USB	SN 011600418	1				\times
	Select all Select	ct unreferenced	Select axes with s	tored states			
Pa -	Axis Stage	Ref. switch	Limit/hard stop	State			
1. Connect controller	2 Q-545.140	yes	yes	servo off			
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Constant of							
3. Start up axes							
	Reference selected as	xes by moving to:					_
	Neg. limit Re	f. switch Pos	, limit			Automatic	-
				1			
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-> Click "Automatic" to calibrate the translation stage

t up controller - con	nected E-87	1 on USB	SN 011600418	31			
1	Select all	Selec	t unreferenced	Select axes with	stored states		
. Connect controller	Axis Sta 2 Q-5	ge 545.140	Ref. switch	Limit/hard stop yes	State servo off		
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elect connected stages		<u> </u>	Do you w Caution: Do not sw	ant to switch on serv itch on servo for sta	yo in order to re ges without pos	eference? ition sensor.	
	Reference	selected as	ces by moving to	4			

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

art up controller - conn	nected E-871 on USB	SN 011600418	1				
and and	Select all Select	t unreferenced	Select axes with s	tored states			
1. Connect controller	Axis Stage 2 Q-545.140	Ref. switch yes	Limit/hard stop yes	State unreferenced			
Select connected stages		Reference	Axes This will move the s	elected axes!	Start		
3. Start up axes		Start ref	erencing immediately	y after dialog appearance	Close		
	Reference selected a	kes by moving to: f. switch Po	s. limit			1	Automatic

-> Start

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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



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

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3.4.2 Translation stage settings

axis					
activ	ate	reference	POSITIVE END 🔫		
stop	<< 0	>> move to	0.000 🚖 speed	4 0.00 ·	

-> 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 t0 = 0.310 mm

controller PI E-873 Controller SN 117001359	✓ disconnect 🔫
✓ axis 1:Q-545.140	•
stop << 0 >> move to 0.000 mm + peed 6.000 +	loop -6.500:6.500
- + step 0.001 mm ≑	0.310 mm log

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 μ 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 ½" 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:



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 μJ)

3.6 SH-FROG ACQUISITION



- a. Improve the sum-frequency signal in the spectrometer (see chapter 4.2. Fast alignment)
- b. Click "define center" to set the actual position as the central position (reference position of the translation stage / "time-zero" position)
- c. Center the spectrum with "start" and "stop" (in spectrometer controls panel)
- d. 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)
- e. 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".



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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



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

- a. Unscrew carefully the screw on the top of the mount which is on the motorized translation stage (don't force on the motorized stage)
- b. Remove carefully the mirrors
- c. Place the $\frac{1}{2}$ " alignment tool in the left slot
- d. Check if the beam is well centered on the alignment tool (propagate through the alignment tool hole)
- e. If not, move the optical module or the beam in order to center the beam on the input iris and on the alignment tool
- f. Put back carefully the mirrors in the mount



4.3.2 Beam splitter adjustment

Same method as the 1st step: remove carefully the fixes 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 $\frac{1}{2}$ " 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).

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



Vertical 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
- 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



b (horizontal)

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 (<u>do not exceed the maximum energy! You will damage optics!</u>). You can also move the motorized translation stage (<u>be careful because you add a temporal condition to the spatial crossover condition to obtain a sum-frequency beam</u>).

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.

