

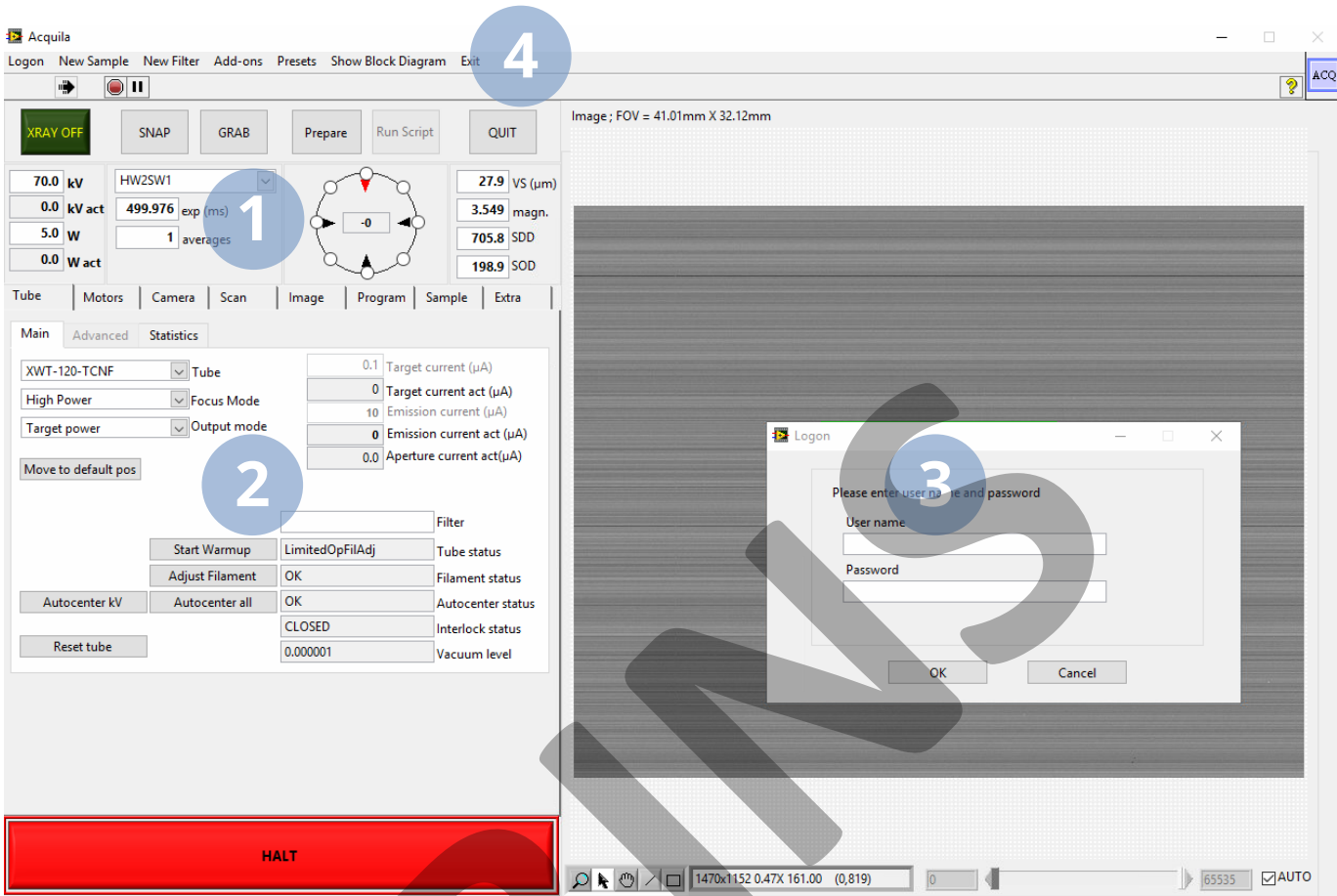


XRE Acquila software

Manual Q1 2017

1. Software overview
2. Getting started
 - Logon
 - X-ray Tube warm up
 - New sample
3. The Function area
 - X-ray tube
 - Detector
 - Motor positioning
 - Preparing and running the CT script
4. The Settings area
 - Tube
 - Motors
 - Camera
 - Scan
 - Image
 - Sample
5. Preparing and running a script

1. Software overview



Main software window

The main software window is divided into 4 parts:

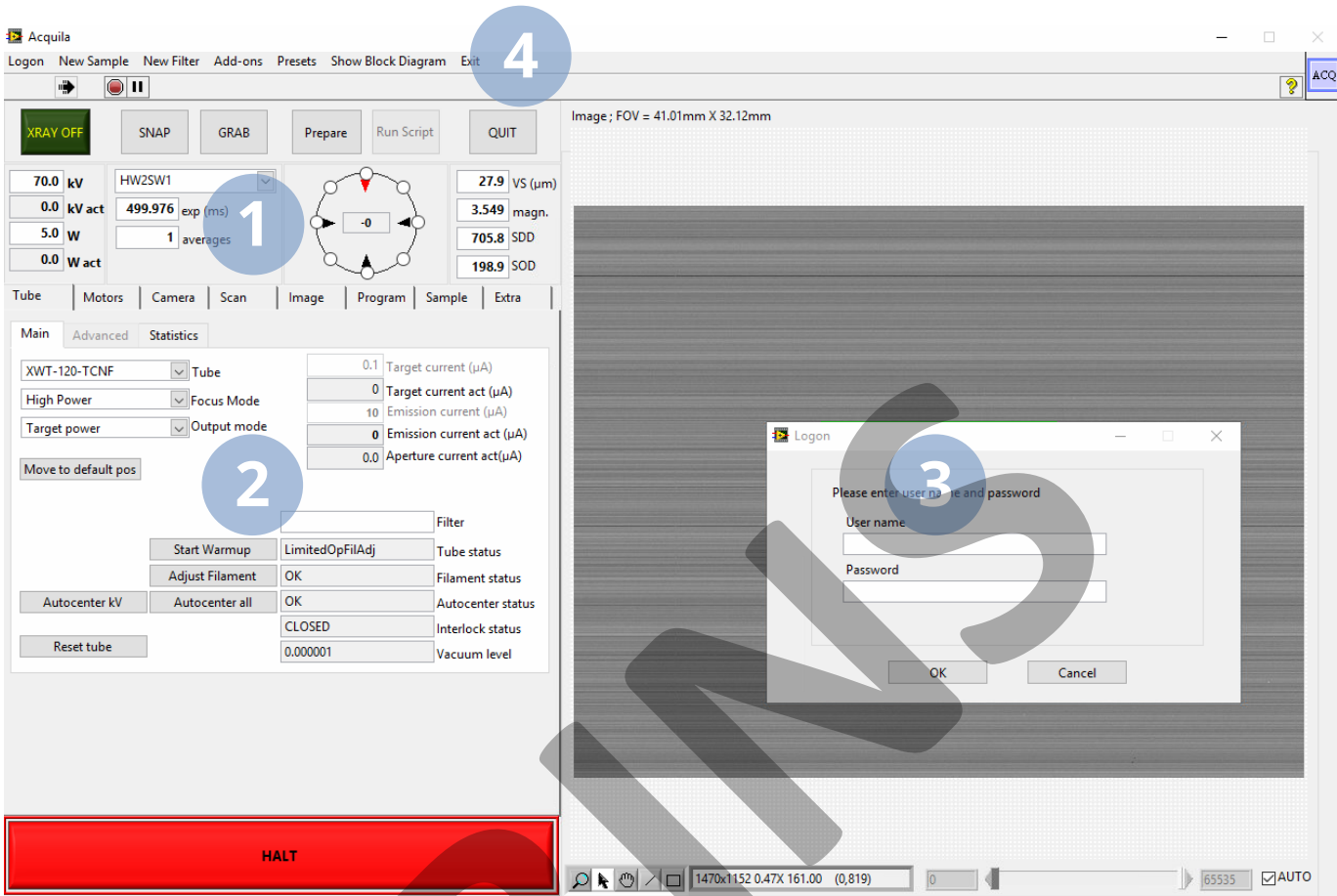
1 Function area

In the function area gives you easy access the most common scanner controls for the X-ray tube, detector and motor stages. It also enables you to prepare and execute scan scripts.

2 Setting area

The settings area contains the several tabs with more detailed settings for all components of the system (X-ray tube(s), detector(s) and motors) and additional functions for controlling the system.

1. Software overview



Main software window

The main software window is divided into 4 parts:

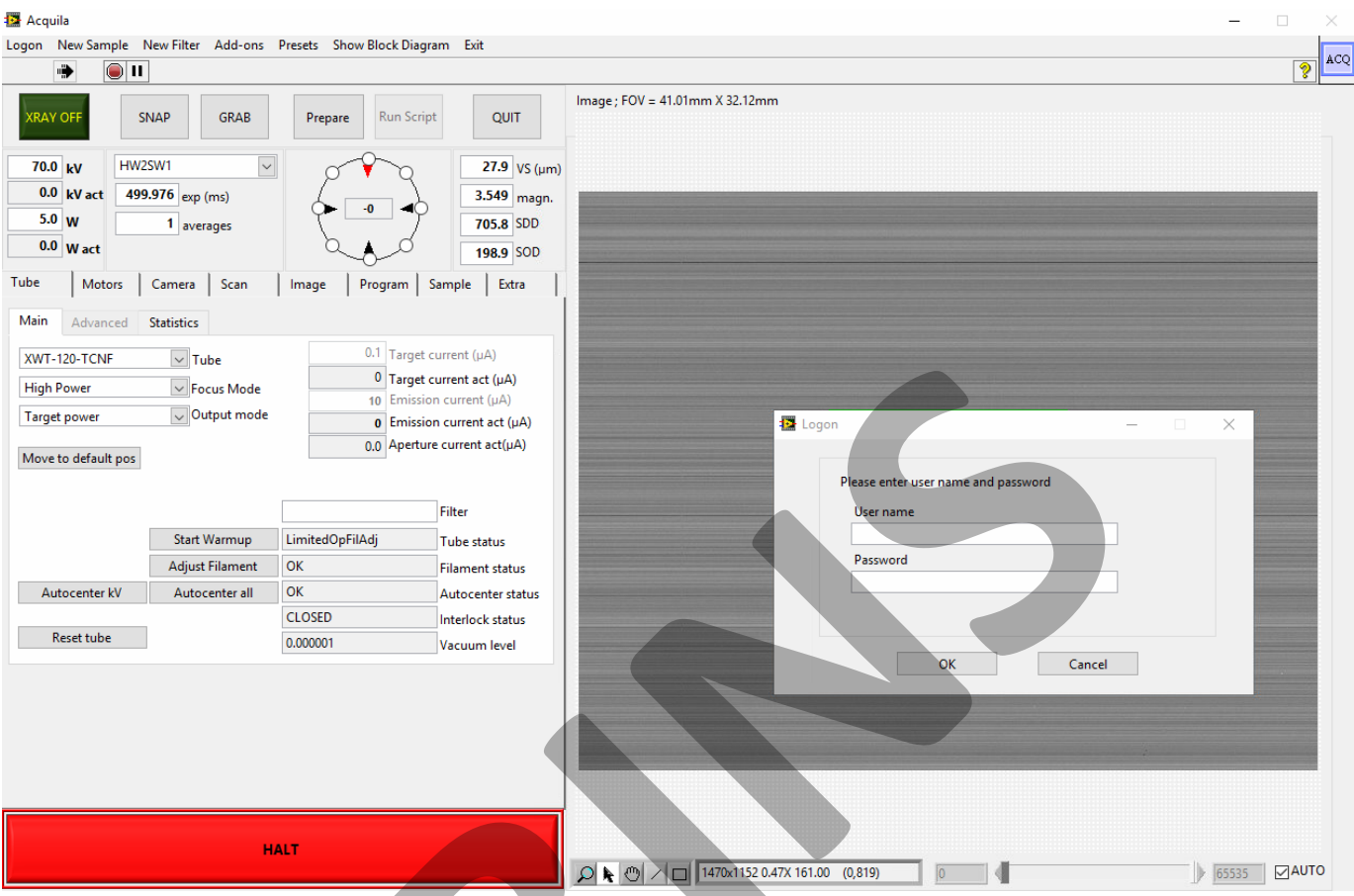
3 Image area

In the image area the data captured by the detector can be displayed and additional tools for image enhancement and positioning are available.

4 Toolbar

In the toolbar addition functions are available for login into the software, setting info about the sample or hardware filters that are placed in the system and system specific Add-on tools can be selected

2. Getting started



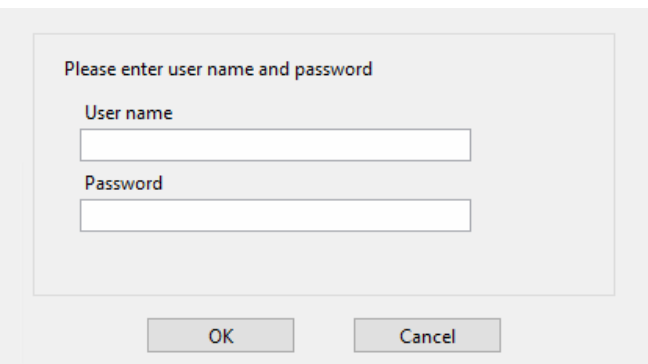
Logon

When the software is started, it will be necessary to logon. This is mainly to avoid unintended use of the system, but it also defines the level of the user.

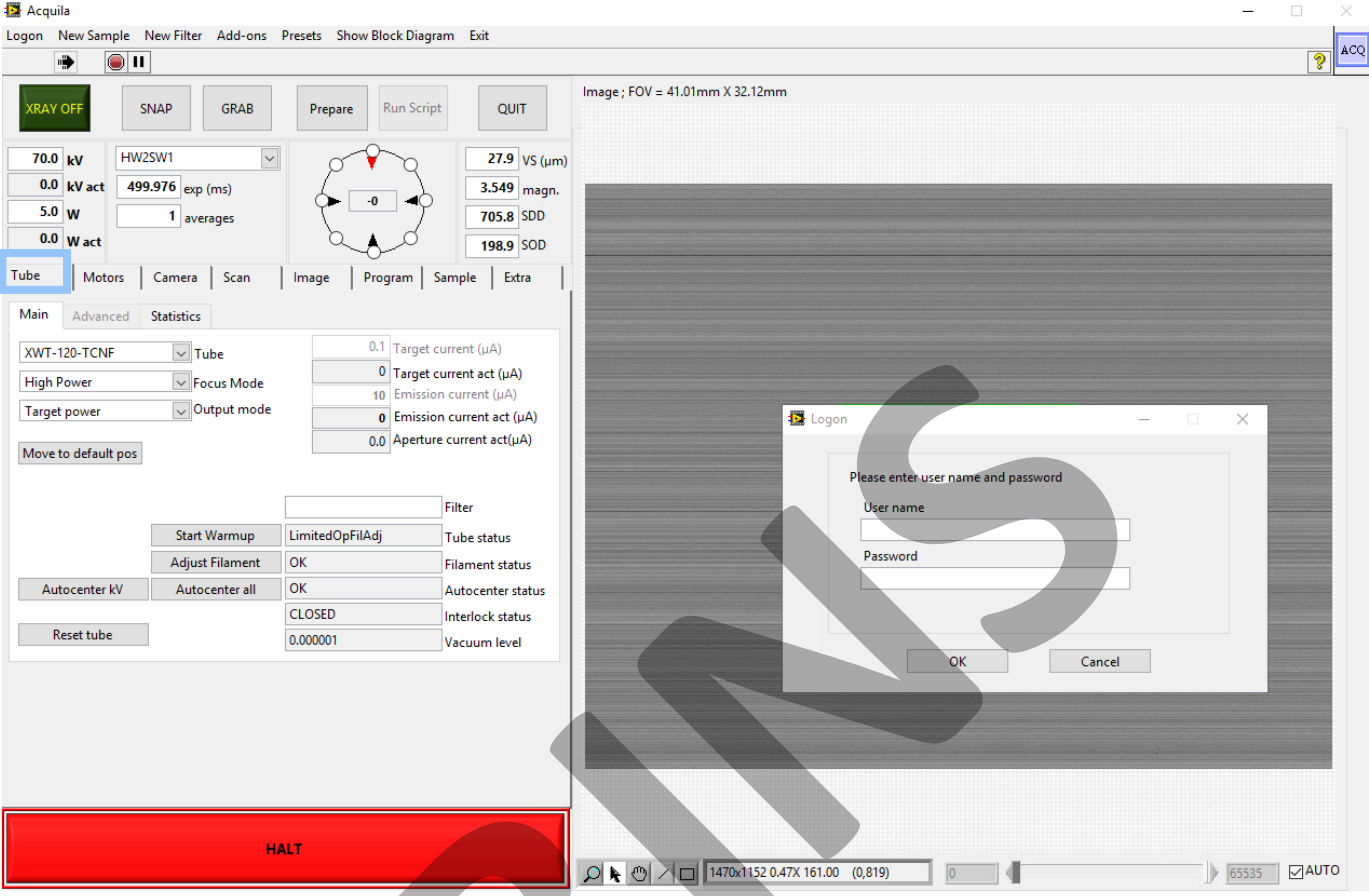
The software has different levels (from Developer to Operator) with different permission for each level.

The selected user also defines the default folders for storing the data

By entering the username and password you will be able to control the scanner and the function window will become accessible.



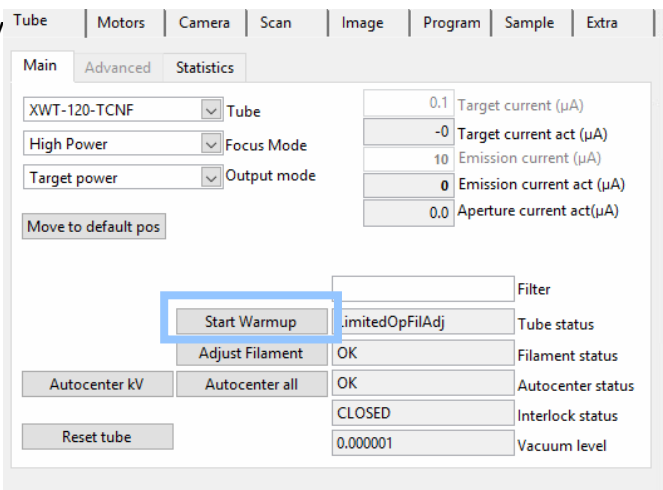
2. Getting started



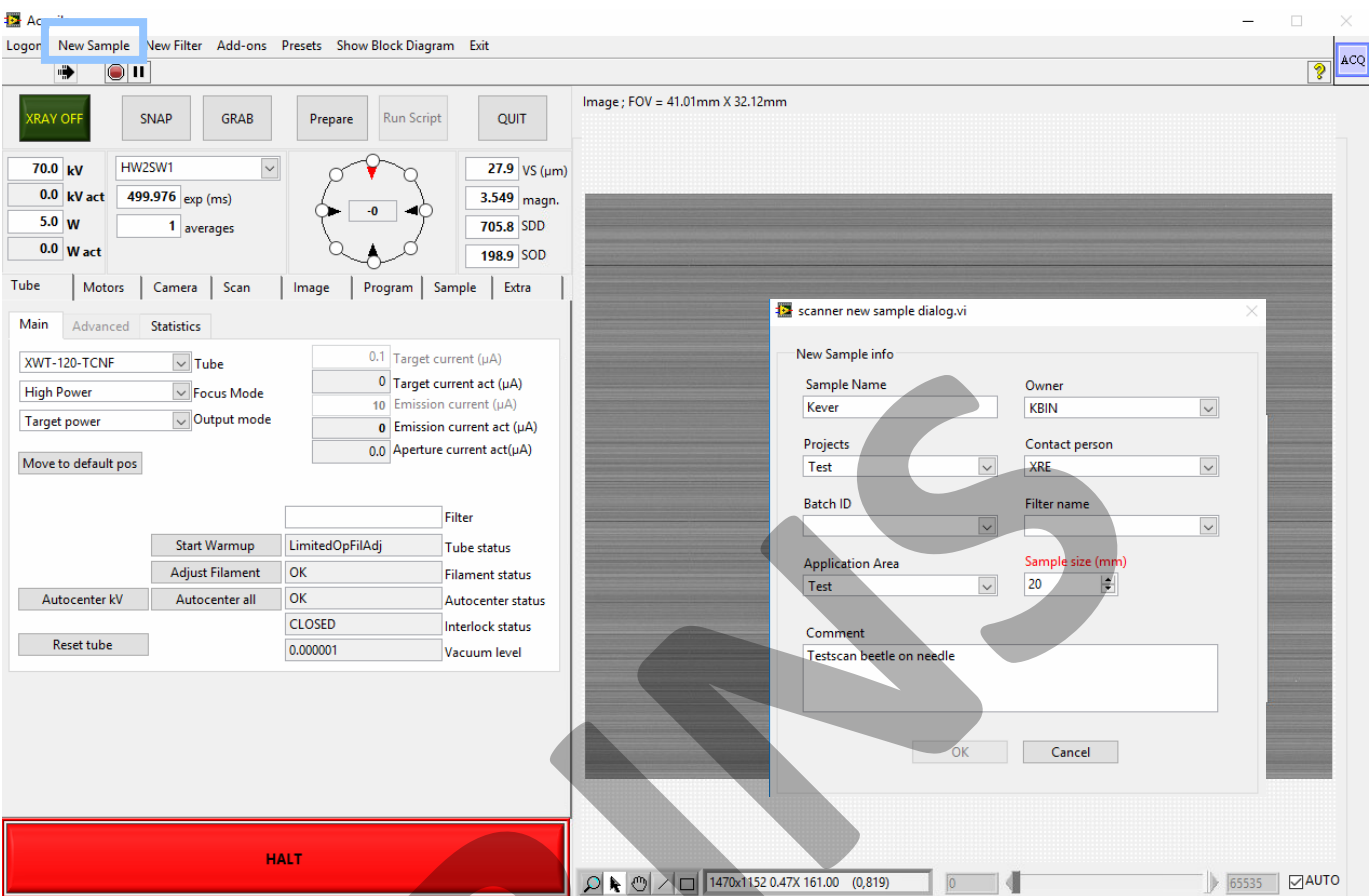
X-ray tube warmup

When the system has been inactive for more than 5 hours, a warmup of the X-ray tube is due. During warm-up the tube will gradually increase the kV and current to avoid arcing.

A warmup can be performed in the *Settings Area* in the *Tube* tab by clicking the *Start Warmup* button. A popup window lets you move the detector back to avoid damaging the detector. The warmup procedure automatically starts the X-ray tube and usually takes about half an hour.



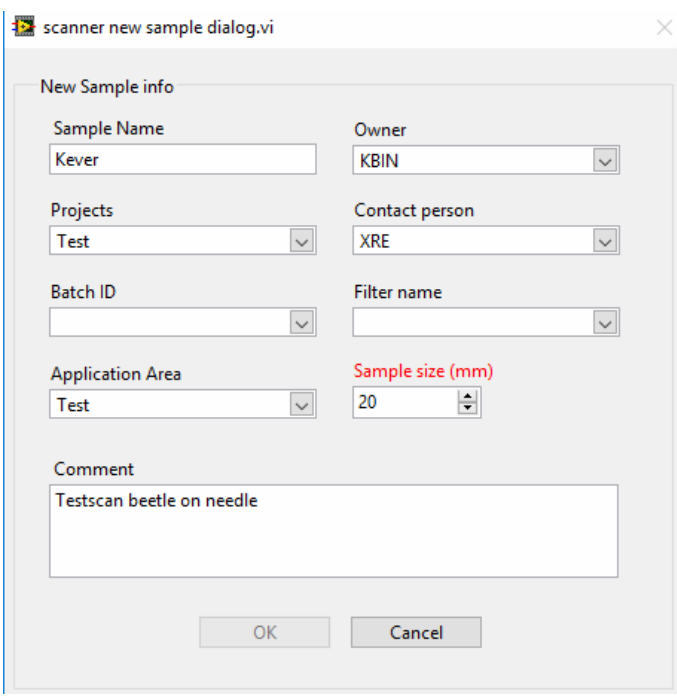
2. Getting started



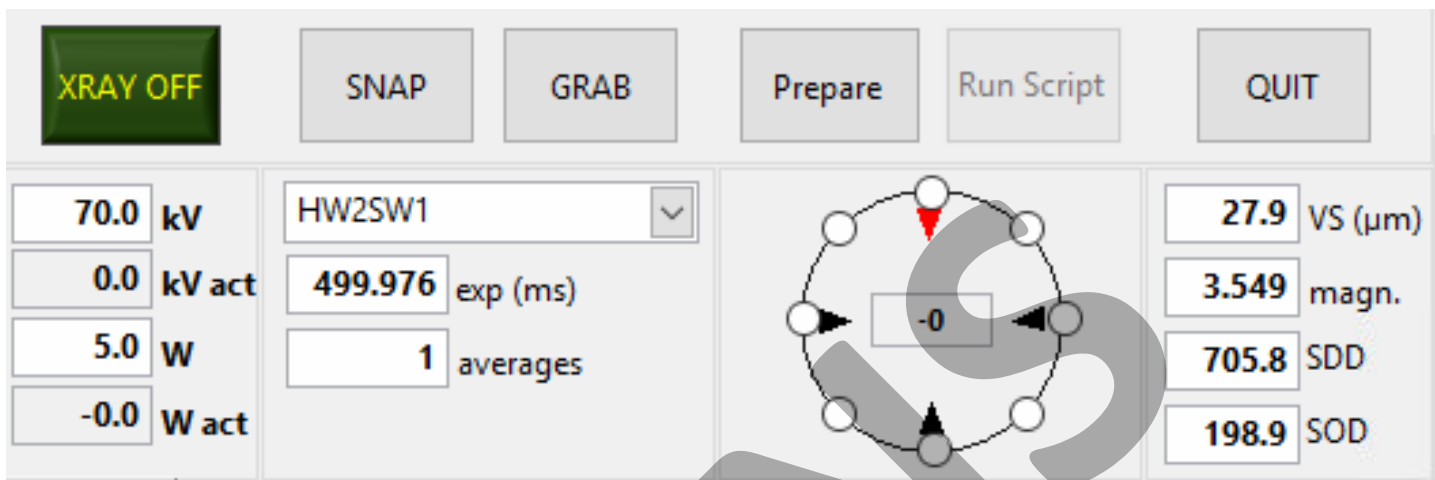
New sample

When a new sample is placed in the scanner it is advised to fill in the information about the sampled. By clicking the *New Sample* button in the toolbar a new window is displayed in which sample parameters can be added.

The *Sample size (mm)* parameter is shown in red and is the most important parameter, as it determines the safety limits of the motor stages in the system. This parameter refers to the total sample diameter: sample + anything that is around the sample (sample holder, cell, container, ...).



3. The Function area

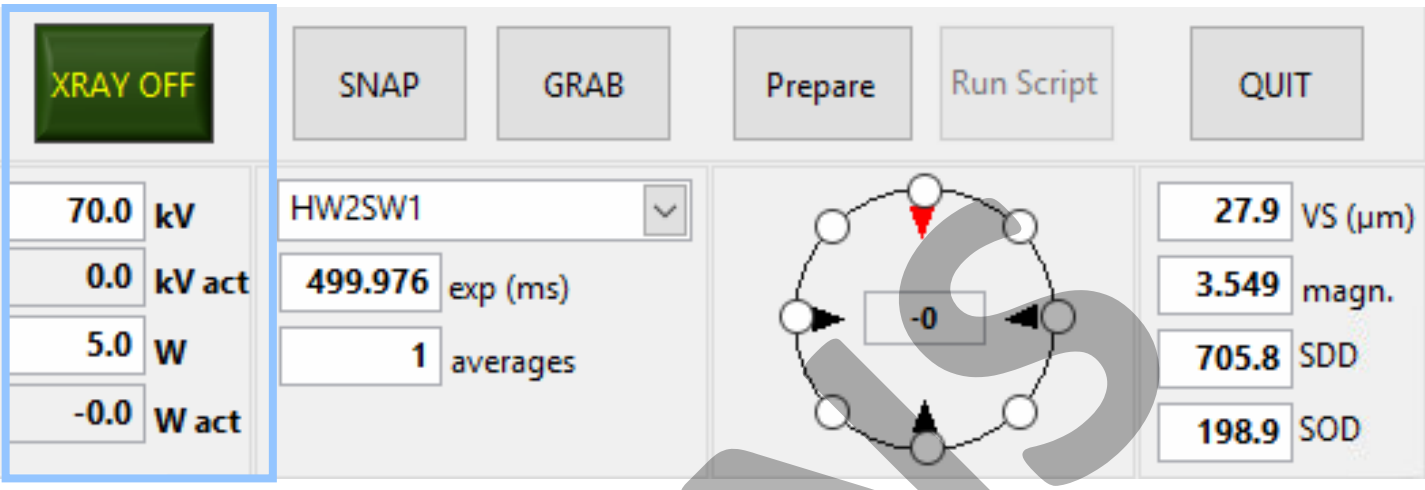


Function area:

In the function area you are able to:

- Directly switch on/off the X-rays and change the kV or Power
- Take one radiography or grab continuously and change the detector settings such as the binning mode, exposure time and averaging
- Rotate to a pre-defined set of angles (0°, 45°, 90°, ...) and move the sample with the micro-positioner
- View and alter the SDD (Source to Detector Distance), SOD (Source to Object Distance) and the voxel size (VS).
SDD and SOD are in mm, VS is in μm!
- Prepare and run a script
- Quit the software in a proper way

3. The Function area



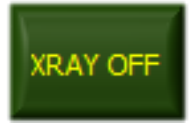
X-ray Tube

Directly switch on/off the X-rays

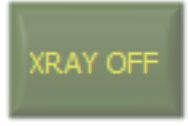
When the X-rays are ON, the button will blink red/yellow



When the X-rays are OFF, the button will be green

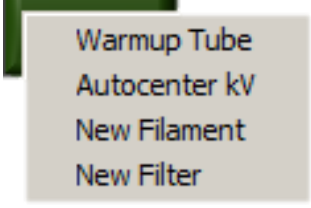


When it is not possible to switch on the X-rays, the button will be grey.

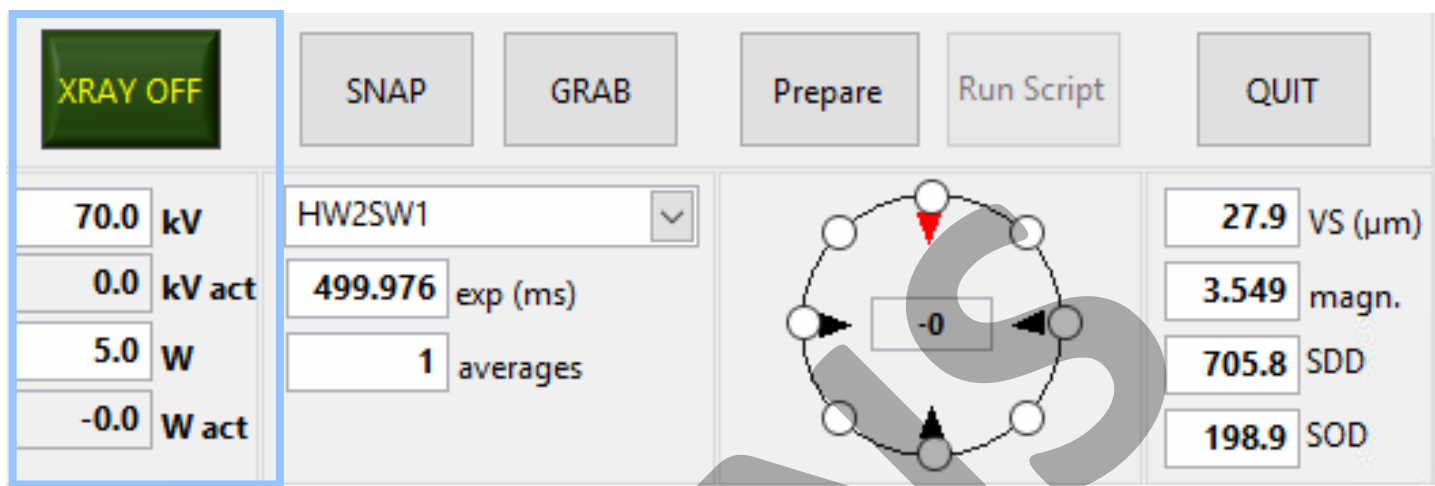


There are several possible reasons such as the doors that are open, the tube is not warmed-up, error,.... More information can be found in the Tube-Tab

With a right-mouse-click it is possible to access directly to several tube commands



3. The Function area



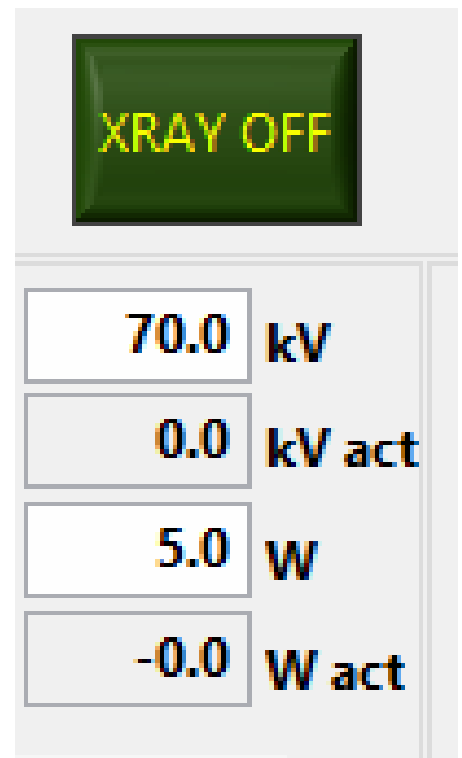
X-ray Tube

Change the kV or Power

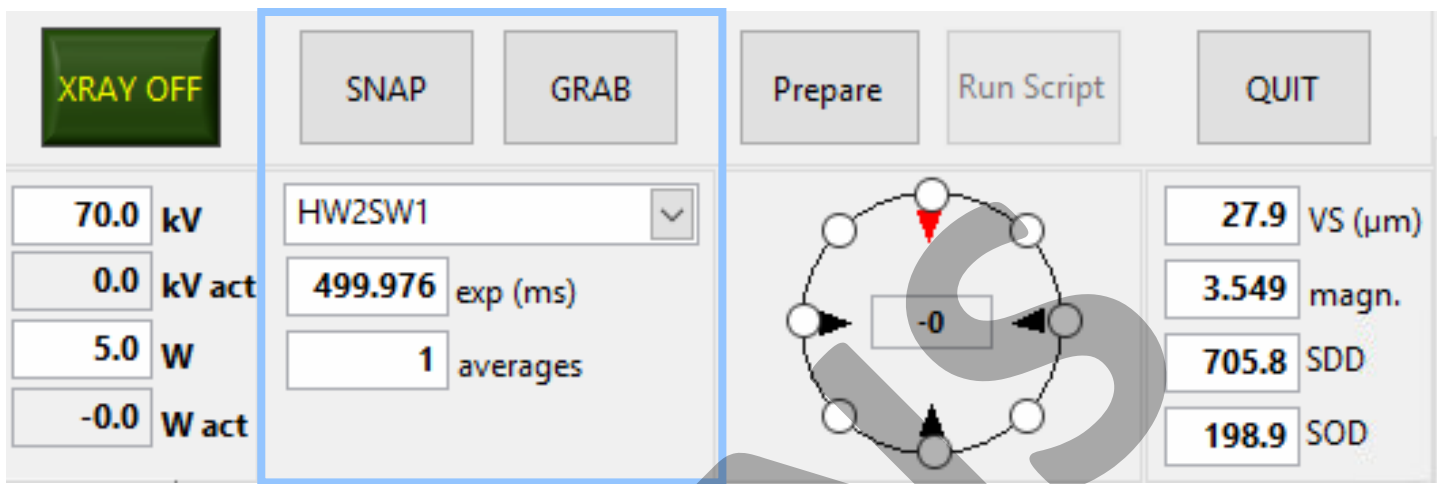
The source voltage can be changed using the *kV* indicator. The actual *kV* level of the source is shown in the *kV act* indicator.

The source power can be changed using the *W* indicator. The actual power level of the source is shown in the *W act* indicator.

More information can be found on the *Tube* Tab.



3. The Function area



Detector

SNAP

Takes one radiography.

GRAB

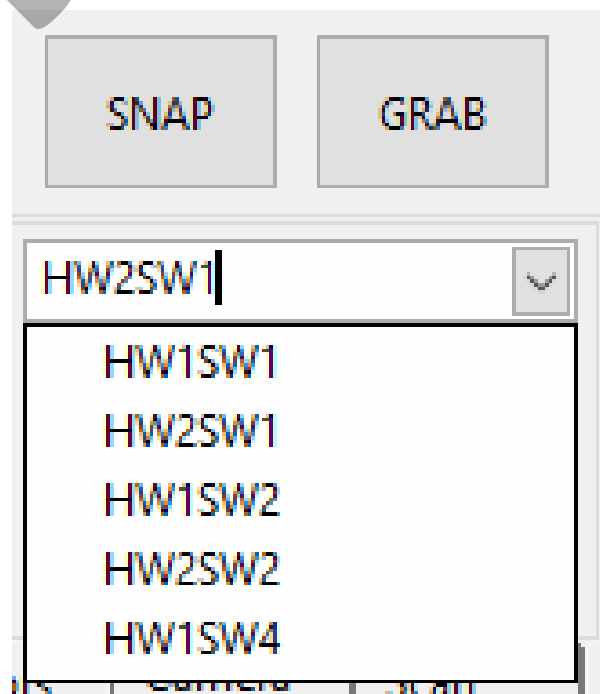
Continuously takes radiographs. With the right-mouse button it is possible to activate the auto-save function and set a delay between consecutive saved files.

Binning

In the drop-down menu it is possible to select the binning and mode of the detector.

Detector binning is used to limit the amount of data or increase the SNR-ratio of an image.

In binning, several pixels are grouped together as if they were one pixel, the value of the binned pixel is the average of the group.



A detector of for example 1000 x 1000 pixels can be binned by a factor of 2, resulting in a 500 x 500 image. Each pixel of this image is the average of four original pixels, which is a SNR of 4 times.

3. The Function area



Detector

Binning

The detector can be binned in hardware (HW), which will typically also result in a faster read-out, or in software (SW).

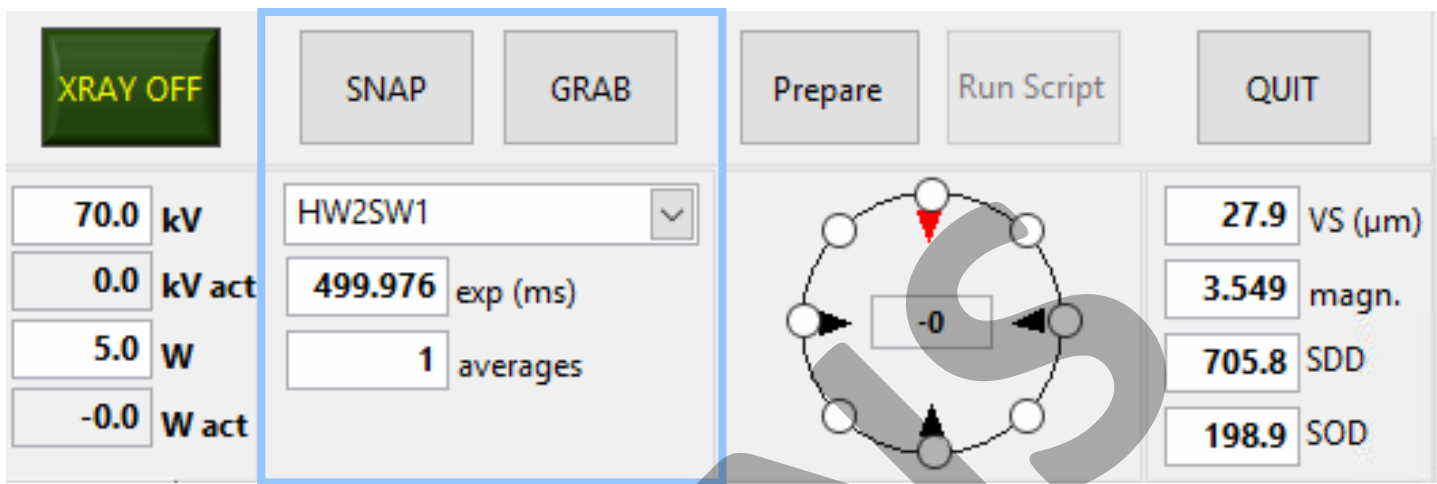
Combinations of both are also possible.

Examples:

Mode HW2SW1 is hardware binning 2 and software binning 1 which results in a final binning of 2.

Mode HW2SW2 is hardware binning 2 and software binning 2 which results in a final binning of 4.

3. The Function area



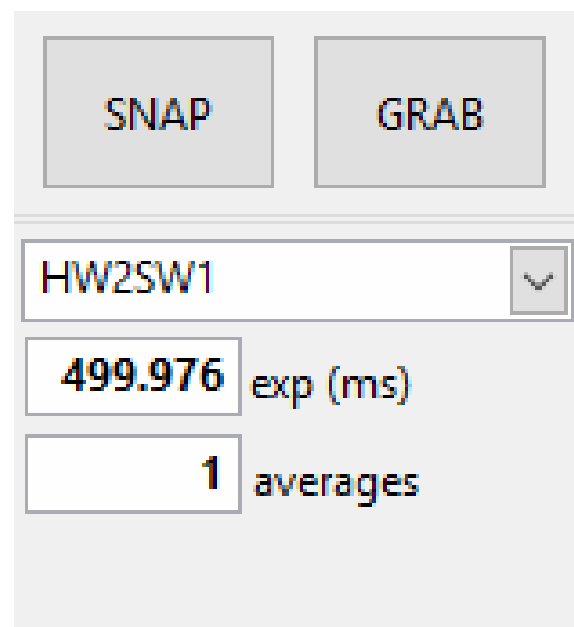
Detector

Exposure time

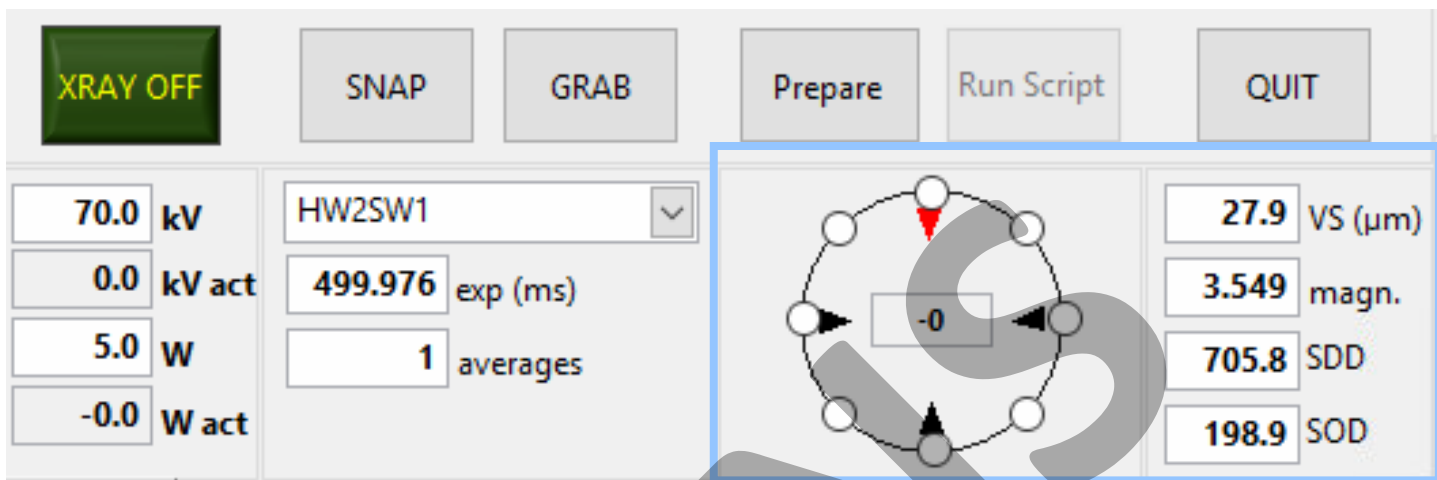
The exposure time will automatically limit itself to the smallest possible exposure time if a lower value is input. Higher exposure timings will result in a better SNR but it is important to make sure the detector is not saturated!

Averages

Averaging is another method to increase the SNR when the sensor becomes saturated. When the averaging number is higher than 1 and an image is taken, the subsequent improved images will be displayed and the last image is the result of the total number of averages.



3. The Function area



Motor Positioning

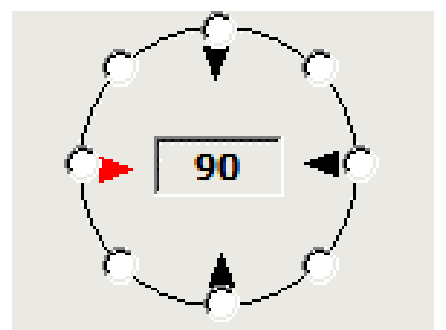
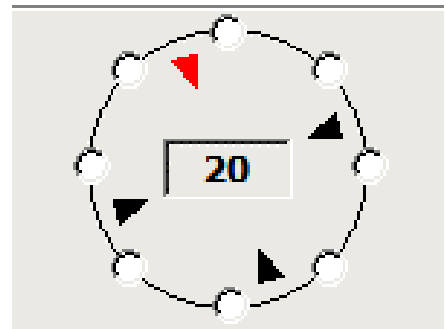
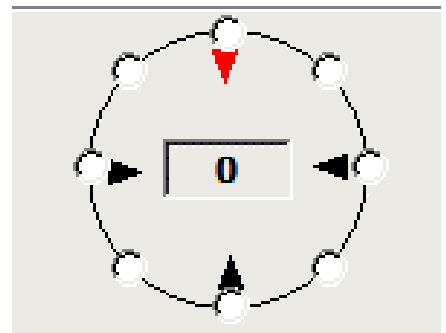
Rotation

The indicator in the middle of the circle reflects the actual angle of the rotation stage.

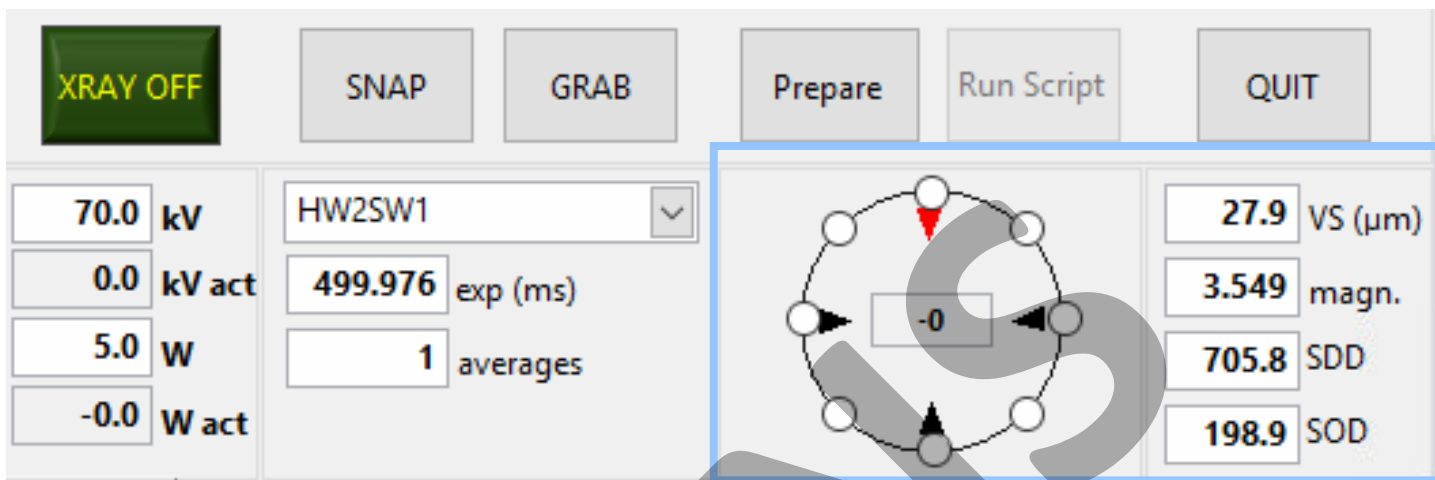
The red arrow shows with which position on the circle this corresponds.

The dots can be used to rotate to predefined positions (0°, 45°, 90°, 135°, 180°, 225°, 270°, 315°). This is mainly useful during alignment of the sample.

If a X-Y micro-positioner is installed, the black arrows can be used to move the sample in the indicated direction. Since the arrows also rotate, the direction of movement corresponds with the image in the image area.



3. The Function area



Motor Positioning

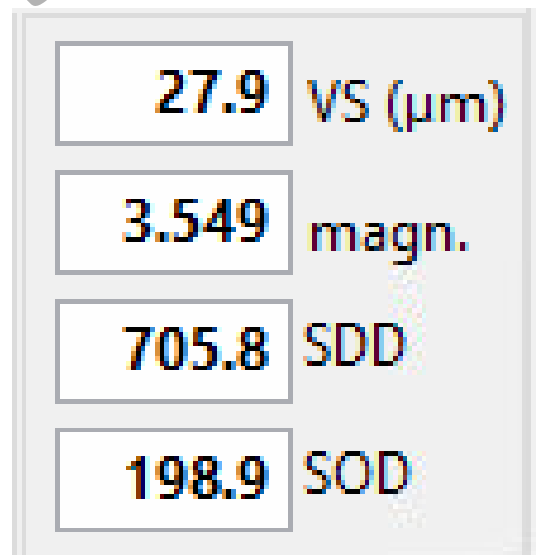
Magnification

The SOD (Source-to-Object-Distance) is the calibrated distance in mm between the spot of the X-ray source and the centre of the rotation stage.

The SDD (Source-to-Detector-Distance) is the calibrated distance in mm between the spot of the X-ray source and the centre of the detector.

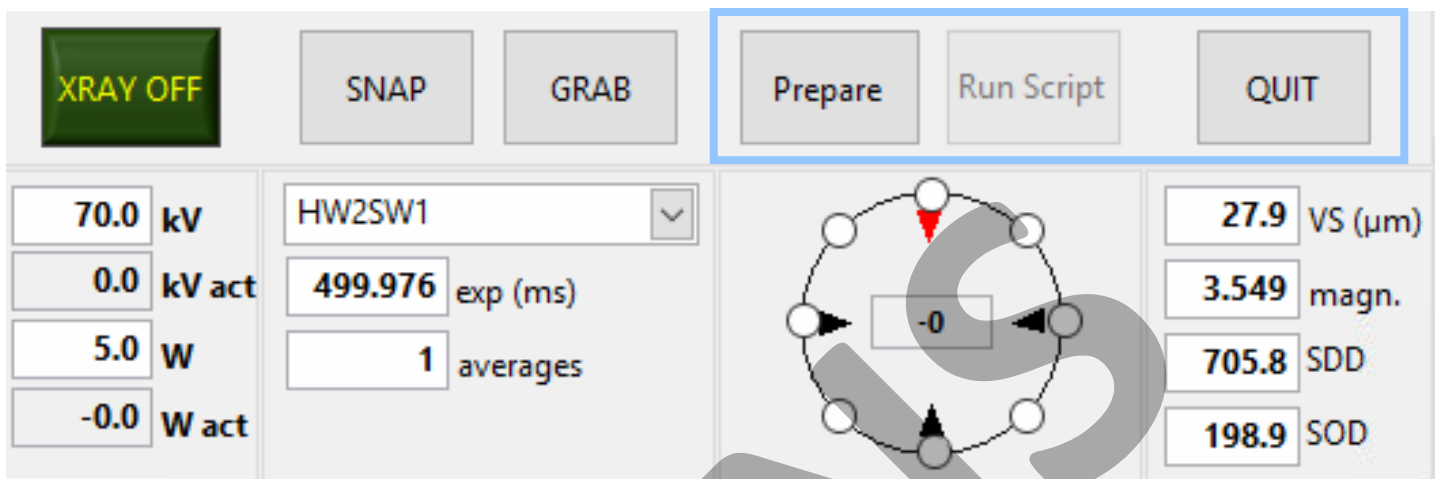
The magnification is the ratio between SDD/SOD.

The VS (voxel size) is the pixel size of the detector divided by the magnification in μm.



These indicators can also be used as an input and the system will be moved to change the positions accordingly. A warning message will be prompted to confirm the movement

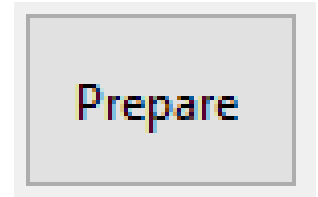
3. The Function area



Preparing and running the CT script

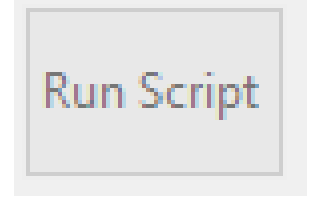
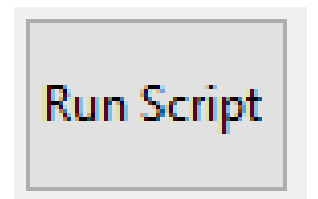
Prepare

When all settings are OK and you want to start a CT-scan, you can use the prepare button to generate a CT-script. More info in the prepare-script section (5). During a CT-scan the prepare button will change to a pause button that can be used to pause a script.



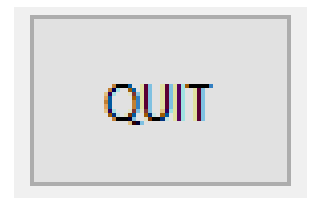
Run Script

When a script has been prepared, you can run the script using this button. When the script is running this button can also be used to stop a script. If there is no script available, the button will be greyed-out



QUIT

This button has to be used to properly stop the software.



4. The Settings area

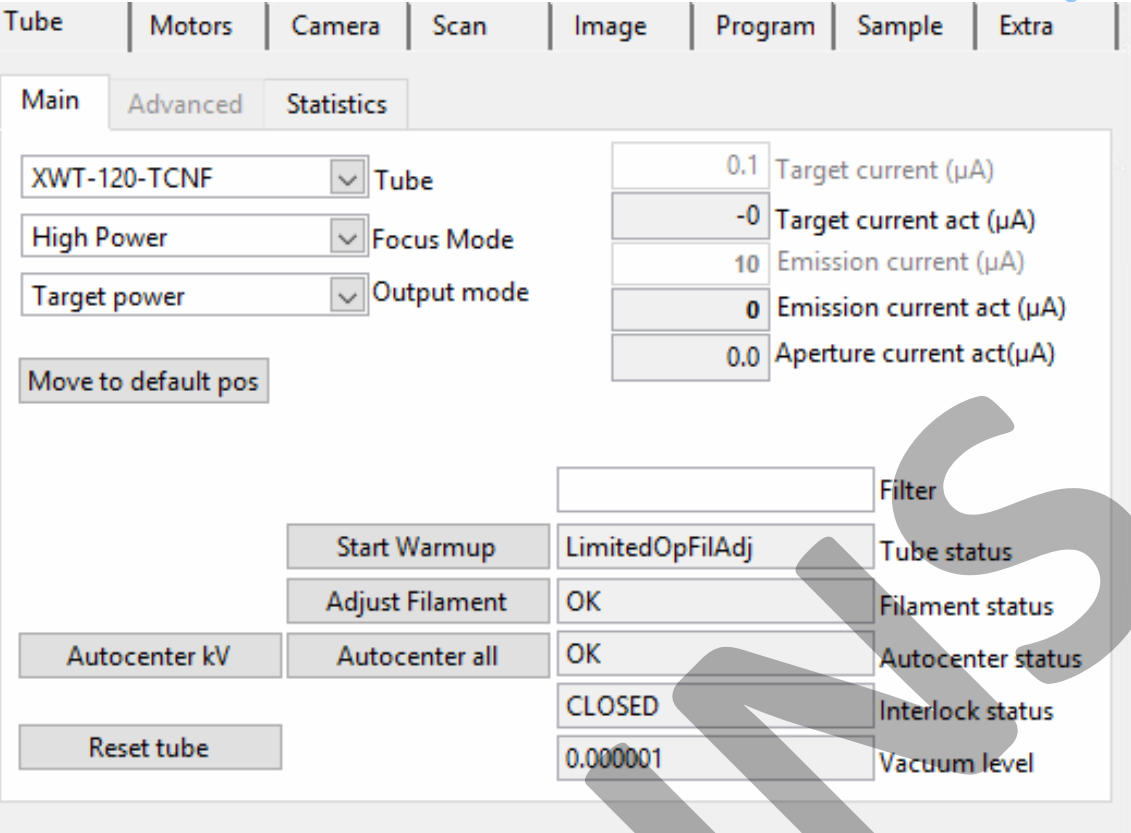
Tube

Depending on the selected output mode the corresponding input is enabled (emission current, target current or target power). The preferred output mode is **target power** and is displayed in the Function area.

Depending on the size of the sample and the desired resolution the focus mode can be selected.

Identical to the target power and KV, both the desired and the actual values are given and can be used as input if the mode is selected. The aperture current should be low

4. The Settings area



0.1	Target current (μA)
-0	Target current act (μA)
10	Emission current (μA)
0	Emission current act (μA)
0.0	Aperture current act(μA)

Filter	
Tube status	LimitedOpFilAdj
Filament status	OK
Autocenter status	OK
Interlock status	CLOSED
Vacuum level	0.000001

Tube

When a filter is changed, the according one should be selected from this list. In this way, the used filter will be logged or can be used as a preset. The filter can also be changed with a right-mouse-click on the X-RAY button. The available filters can be changed in the settings.ini file.

 Filter

Start Warmup

LimitedOpFilAdj

Tube status

The current status of the tube is shown here. The button on the left can be used to start a warm-up. During warm-up the tube will gradually increase the kV and current to avoid arcing. **This procedure should be repeated often and might be mandatory before the X-rays can be switched on.**

4. The Settings area

Tube | Motors | Camera | Scan | Image | Program | Sample | Extra

Main | Advanced | Statistics

XWT-120-TCNF	Tube	0.1	Target current (μA)
High Power	Focus Mode	-0	Target current act (μA)
Target power	Output mode	10	Emission current (μA)
		0	Emission current act (μA)
		0.0	Aperture current act(μA)

Move to default pos

	Filter		
Start Warmup	LimitedOpFilAdj	Tube status	
Adjust Filament	OK	Filament status	
Autocenter kV	Autocenter all	OK	Autocenter status
		CLOSED	Interlock status
Reset tube		0.000001	Vacuum level

Tube

Adjust Filament	OK	Filament status
-----------------	----	-----------------

The status of the filament is shown here and it is also possible to perform a filament adjust. During this procedure the tube will look for the optimal filament settings to avoid unnecessary usage of the filament. **Especially when a new filament is installed it is important to perform filament adjust very frequently (every 4h is advised).**

Autocenter kV	Autocenter all	OK	Autocenter status
---------------	----------------	----	-------------------

The centering of the focusing is important to get good resolution images. Centering should be performed regularly. It is possible to autocentre at a specific kV or to centre for all kV.

The status of the interlock and the vacuum can be inspected here

CLOSED	Interlock status
0.000001	Vacuum level

If arcing has occurred, it is possible to reset the tube

Reset tube

4. The Settings area



Tube | Motors | Camera | Scan | Image | Program | Sample | Extra

Main | Advanced | Statistics

XWT-120-TCNF	Tube	0.1	Target current (µA)
High Power	Focus Mode	-0	Target current act (µA)
Target power	Output mode	10	Emission current (µA)
		0	Emission current act (µA)
		0.0	Aperture current act (µA)

Move to default pos

	Filter		
Start Warmup	LimitedOpFilAdj	Tube status	
Adjust Filament	OK	Filament status	
Autocenter kV	Autocenter all	OK	Autocenter status
		CLOSED	Interlock status
Reset tube		0.000001	Vacuum level

Tube

Adjust Filament	OK	Filament status
-----------------	----	-----------------

The status of the filament is shown here and it is also possible to perform a filament adjust. During this procedure the tube will look for the optimal filament settings to avoid unnecessary usage of the filament. **Especially when a new filament is installed it is important to perform filament adjust very frequently (every 4h is advised).**

Autocenter kV	Autocenter all	OK	Autocenter status
---------------	----------------	----	-------------------

The centering of the focusing is important to get good resolution images. Centering should be performed regularly. It is possible to autocentre at a specific kV or to centre for all kV.

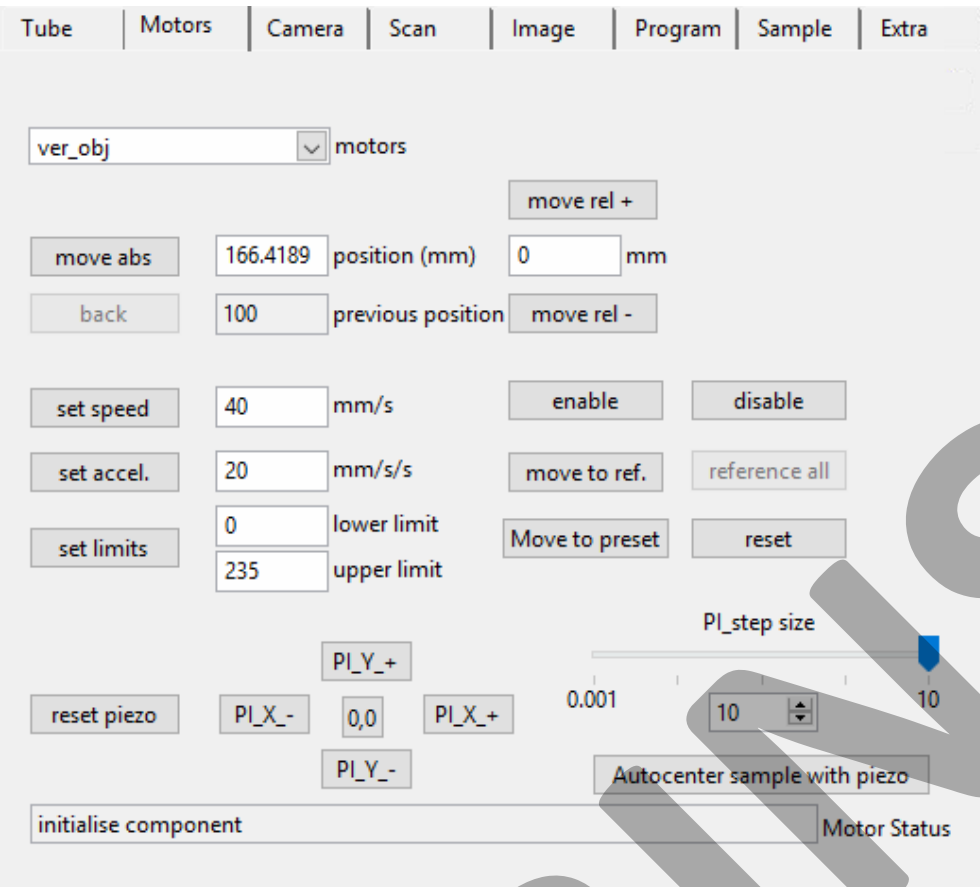
The status of the interlock and the vacuum can be inspected here

CLOSED	Interlock status
0.000001	Vacuum level

If arcing has occurred, it is possible to reset the tube

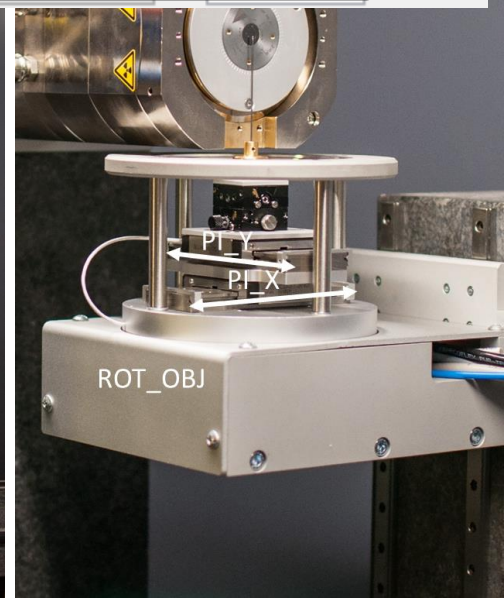
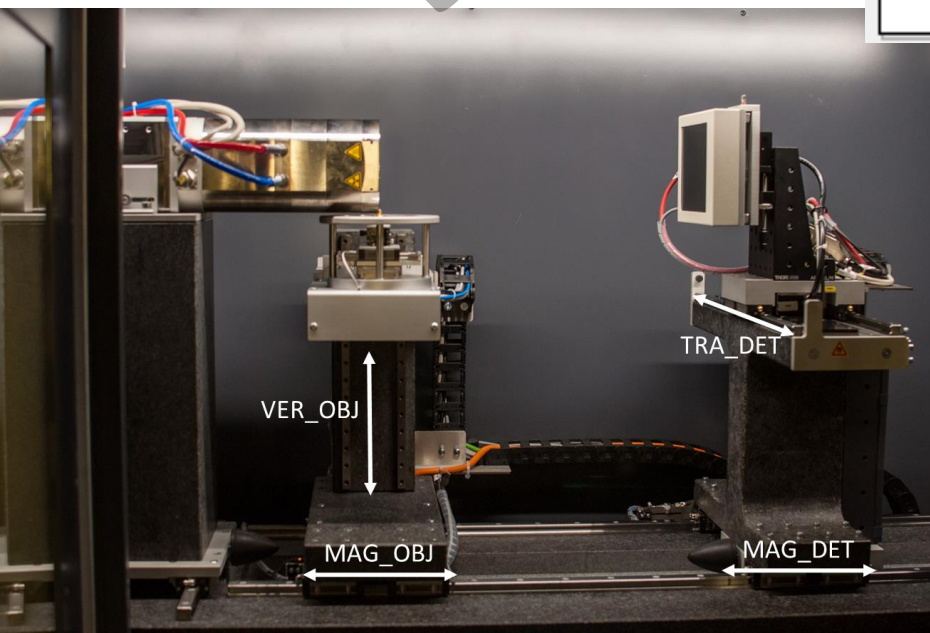
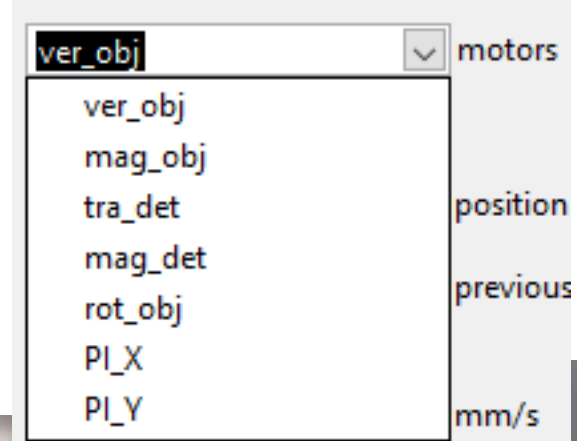
Reset tube

4. The Settings area

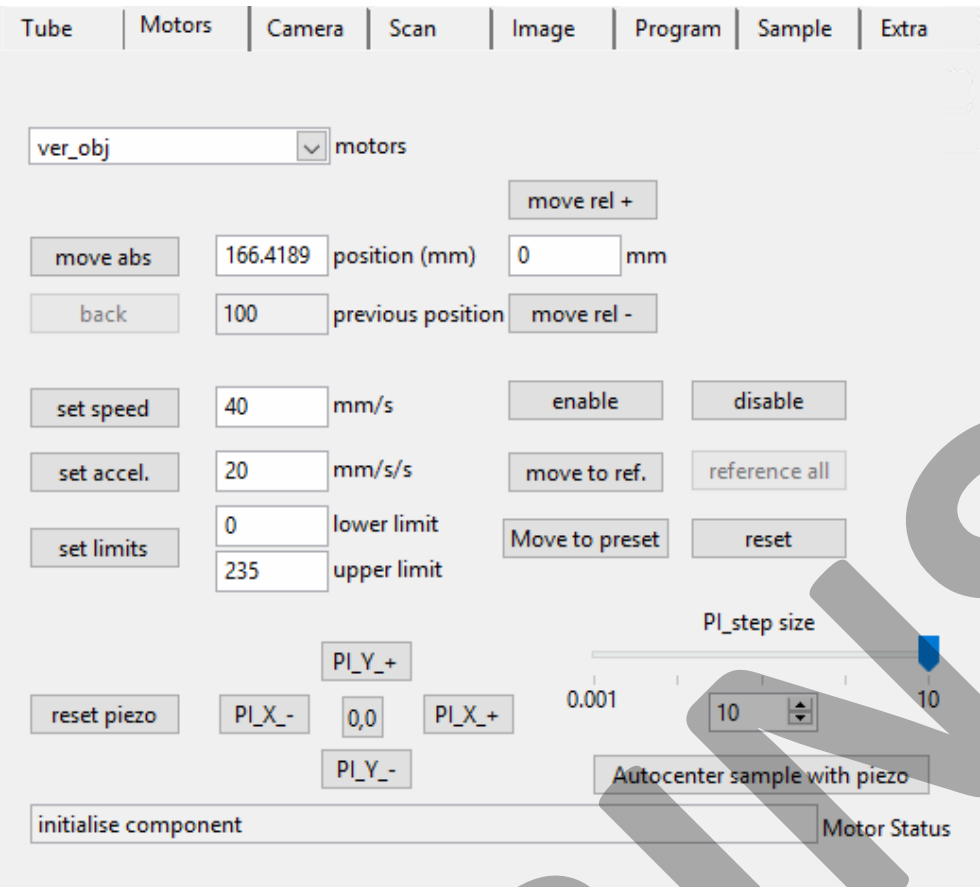


Motors

Each available axis can be selected from this drop-down menu. When the axis is selected, the current settings are refreshed.



4. The Settings area

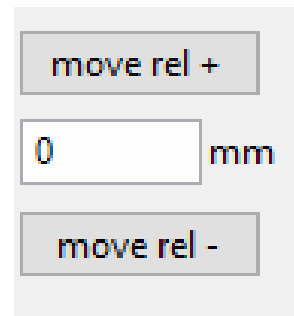
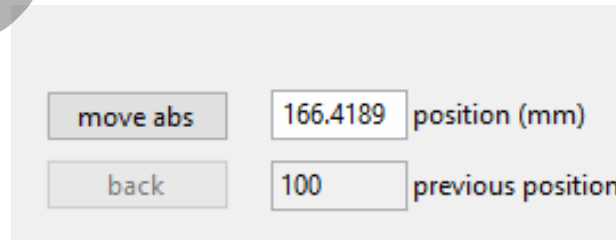


Motors

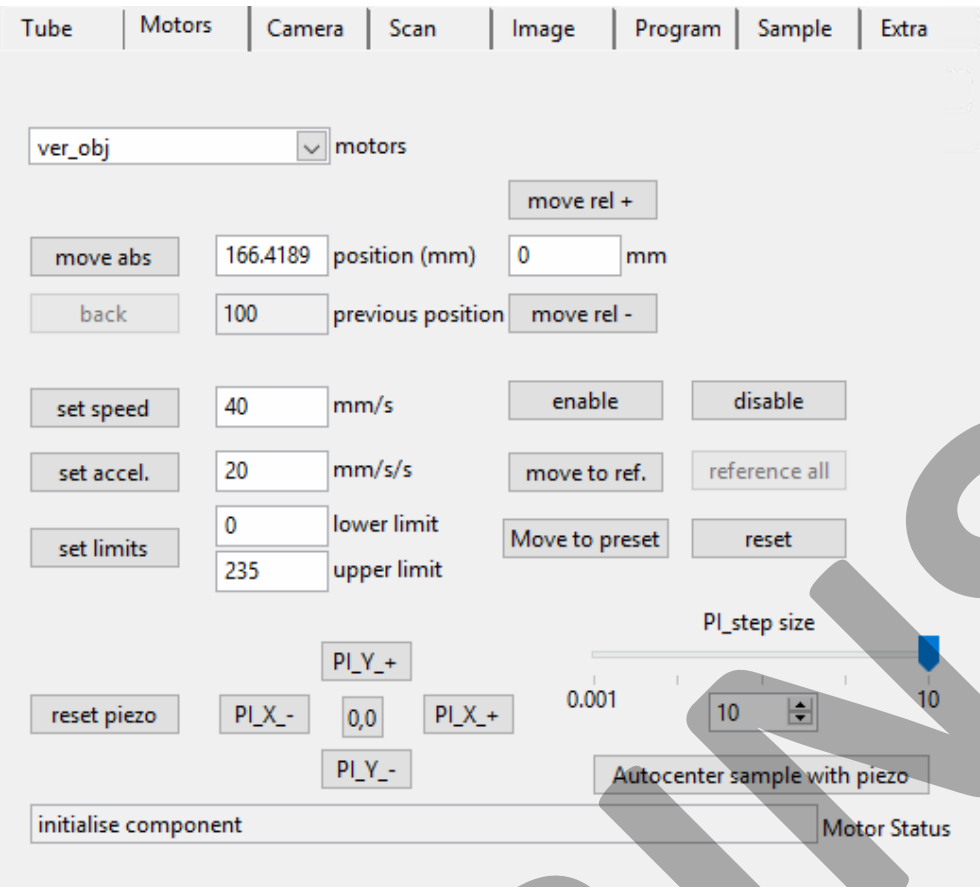
In the position indicator, a new motor position value can be inserted, with the 'move absolute' button, the selected axis will move to the new position. For safety reasons, the current value will be refreshed if the move absolute button is not pressed after a new position is inserted.

In the relative movement input window a value can be inserted and with the 'move relative' buttons a relative movement is performed in either pos. or neg. direction.

The motor position shown here are actual motor position and not the calibrated SOD, SDD or other.



4. The Settings area

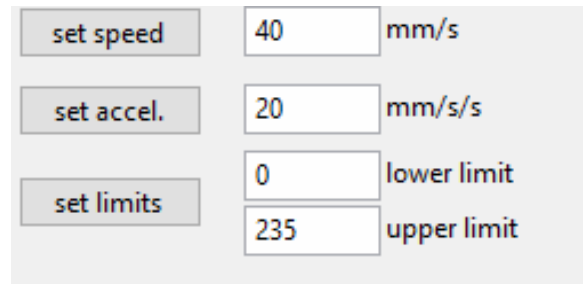


Motors

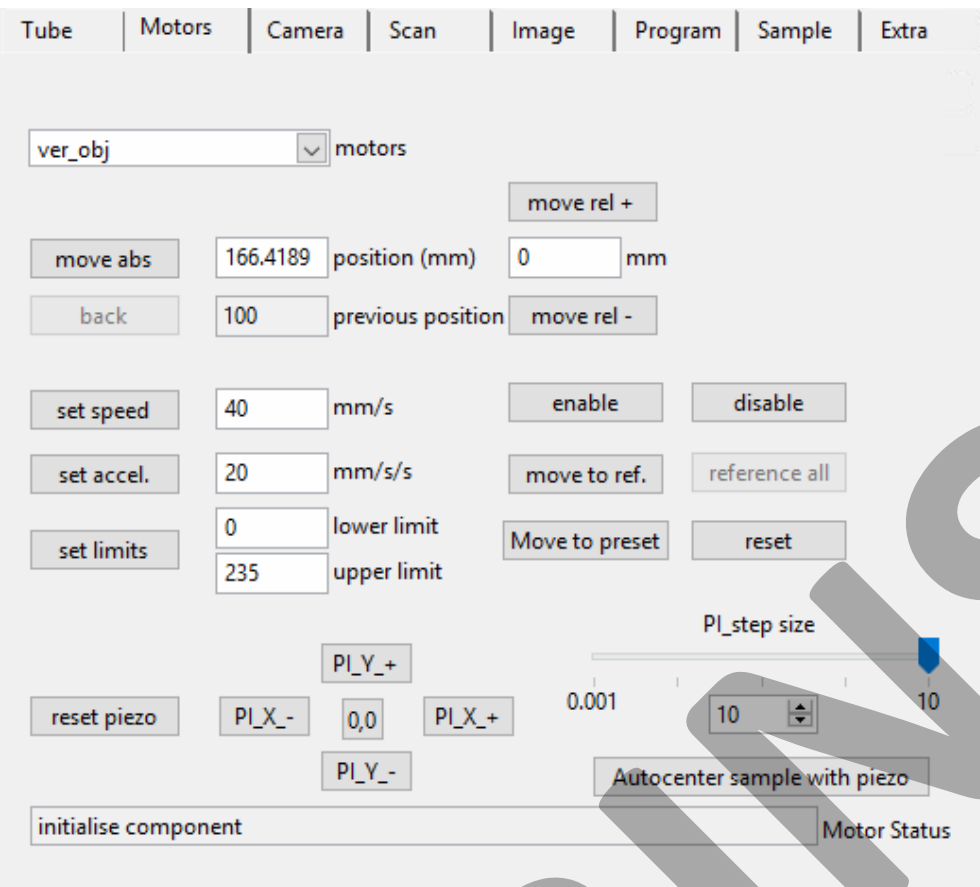
Speed and acceleration can be changed here.

For safety reasons, the range of absolute movement is limited with an upper and lower value. If necessary, the range can be adjusted. If a permanent change has to be performed, the limits can be found in the .ini file of the component.

Movement of a certain axis can be enabled or disabled with these buttons. When the software is restarted, the axis will be enable again.

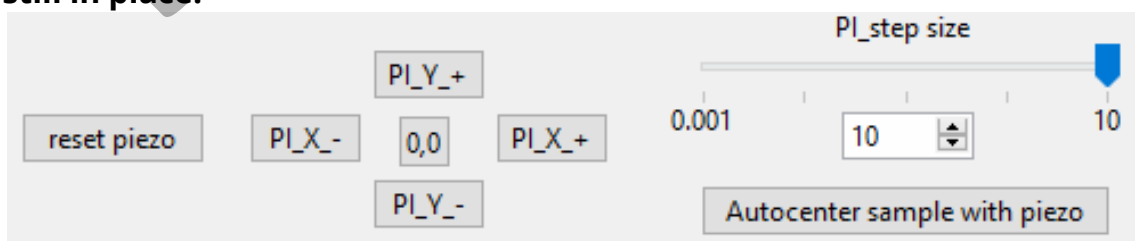
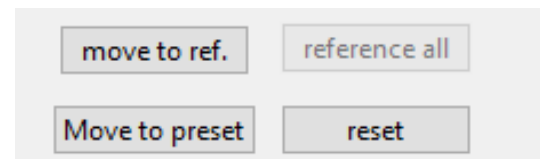


4. The Settings area



Motors

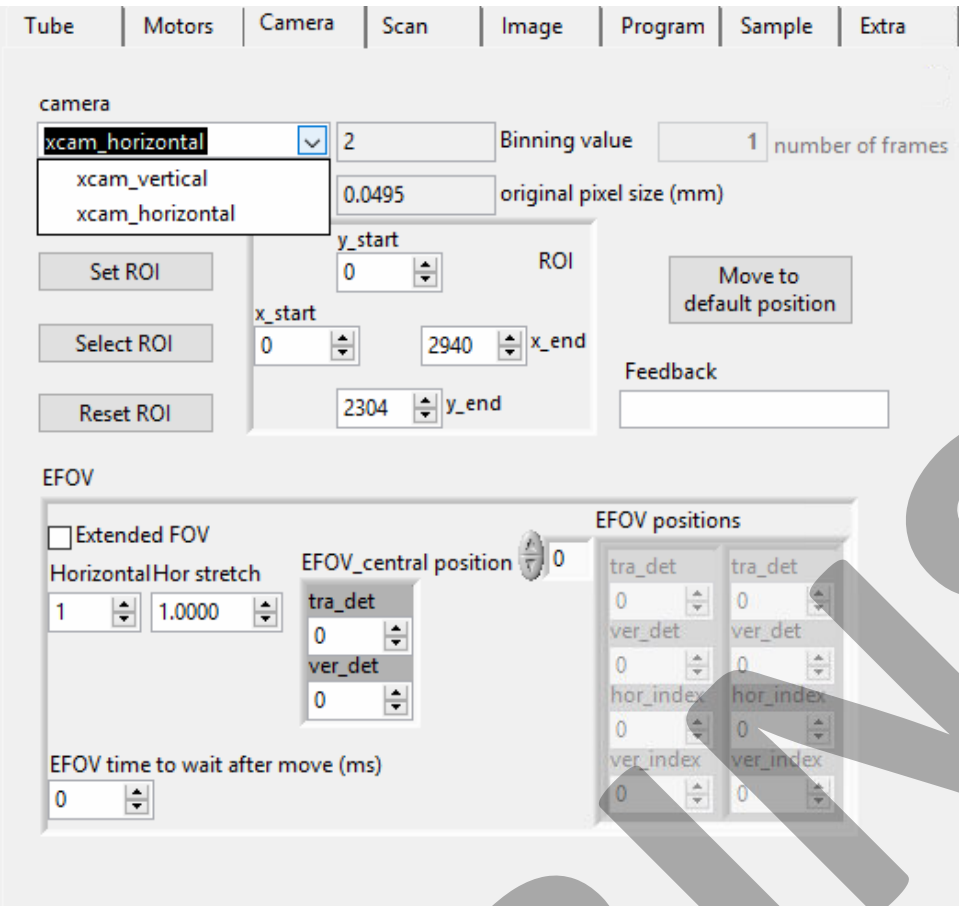
After a power failure or when estimated necessary, it is possible to perform a referencing of the motor stages. Either one or all stages at once can be referenced. **Be very careful to follow the instructions as referencing is potentially dangerous if an object is still in place.**



Movements and travel ranges of the X-Y micro-positioner on the rotation stage can be adjusted here.

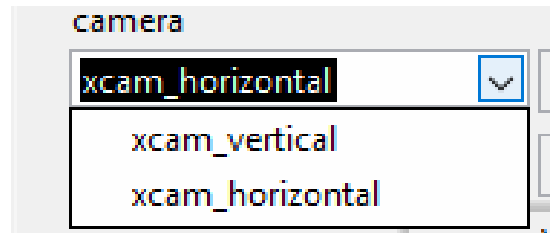
It is preferred to use the arrows in the function area to move the micro-positioning stage.

4. The Settings area



Camera

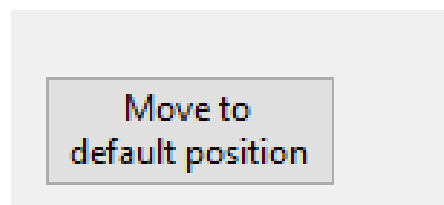
The desired camera or camera-orientation can be selected from this drop-down list.



The binning and mode of the camera can be selected in the function area. With the chosen mode, the total binning value, the effective pixel size and the original pixel size are indicated here.



The camera can be moved to it's default position (if applicable when several detectors or detector X-Z is available) using this button.



4. The Settings area

Tube | Motors | Camera | Scan | Image | Program | Sample | Extra

V:\scans\marijn output path

start 00:00:00 time busy remaining expected

progress (1 of 1)

component	command	arguments	FDB	wait?
scanner	set output path	V:\scans\marijn		ACK
scanner	set sample info	@4 <input type="checkbox"/> Kever <input type="checkbox"/> Test <input type="checkbox"/> KBIN <input type="checkbox"/> Te		ACK
camera	set mode	mode1		ACK
camera	set exposure	499.976135		ACK
camera	set number of fra	1		ACK
camera	set number of ave	1		ACK
camera	set ROI	0 0 2940 2304		ACK
ver_obj	move absolute	0.000000		ACK
tube	xrayoff			ACK
scanner	pause	2000.000000		ACK
camera	take image			ACK
camera	set number of ave	22		ACK
camera	take image			ACK
camera	save image	V:\scans\marijn\di0000.tif		ACK
camera	set number of ave	1		ACK
tube	xrayon			ACK
tube	REPEAT UNTIL TR			ACK
scanner	pause	5000.000000		ACK
ver_obj	move absolute	0.000000		ACK
camera	take image			ACK
camera	set number of ave	44		ACK

Scan

In the scan tab, the script and information about the script is displayed. Once a script has been prepared and accepted, a copy of the script is present in this tab.

It is subdivided into several columns:

‘component’ for which component the command is addressed to

‘command’ which command is send

‘argument’ for the parameter of the command

‘FDB’ for the type of feedback that is requested

‘wait’ for explicit longer wait-times before time-out.

When the script is running, in the column next to ‘wait’, the exact execution time of that command is shown. Once the script is finished it will save a copy (script_executed.txt) of the executed script with the execution timings. It is possible to make changes to the script but these changes will not be saved in the original script, only in the executed script.

4. The Settings area

Tube | Motors | Camera | Scan | Image | Program | Sample | Extra

V:\scans\marijn output path

start 00:00:00 time busy remaining expected

progress (1 of 1)

component	command	arguments	FDB	wait?
scanner	set output path	V:\scans\marijn		ACK
scanner	set sample info	@4 <input type="checkbox"/> Kever <input type="checkbox"/> Test <input type="checkbox"/> KBIN <input type="checkbox"/> Te		ACK
camera	set mode	mode1		ACK
camera	set exposure	499.976135		ACK
camera	set number of fra	1		ACK
camera	set number of ave	1		ACK
camera	set ROI	0 0 2940 2304		ACK
ver_obj	move absolute	0.000000		ACK
tube	xrayoff			ACK
scanner	pause	2000.000000		ACK
camera	take image			ACK
camera	set number of ave	22		ACK
camera	take image			ACK
camera	save image	V:\scans\marijn\di0000.tif		ACK
camera	set number of ave	1		ACK
tube	xrayon			ACK
tube	REPEAT UNTIL TR			ACK
scanner	pause	5000.000000		ACK
ver_obj	move absolute	0.000000		ACK
camera	take image			ACK
camera	set number of ave	44		ACK

Scan

The output path is the folder into which all data is saved

V:\scans\marijn output path

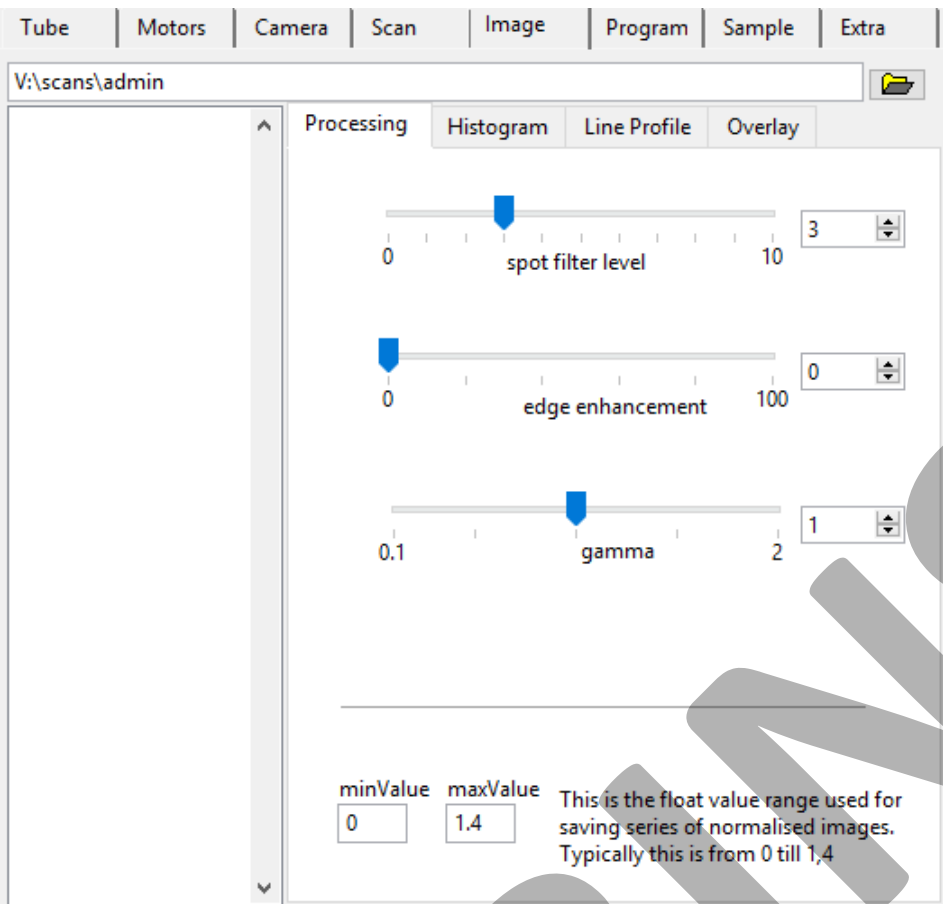
start 00:00:00 time busy remaining expected

progress (1 of 1)

The progress of the current script can be followed here.

If there are multiple scripts, the status of that progress is indicated with numbers next to the progress bar.

4. The Settings area



Image

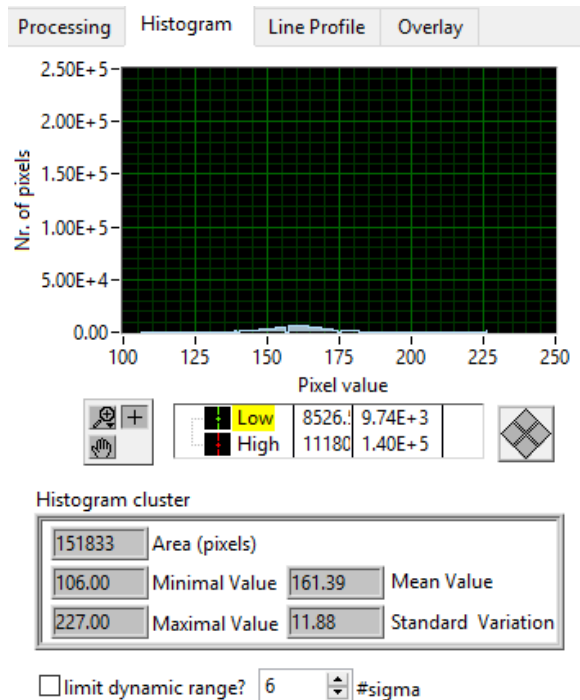
The image tab is for image processing and image optimization.

Processing

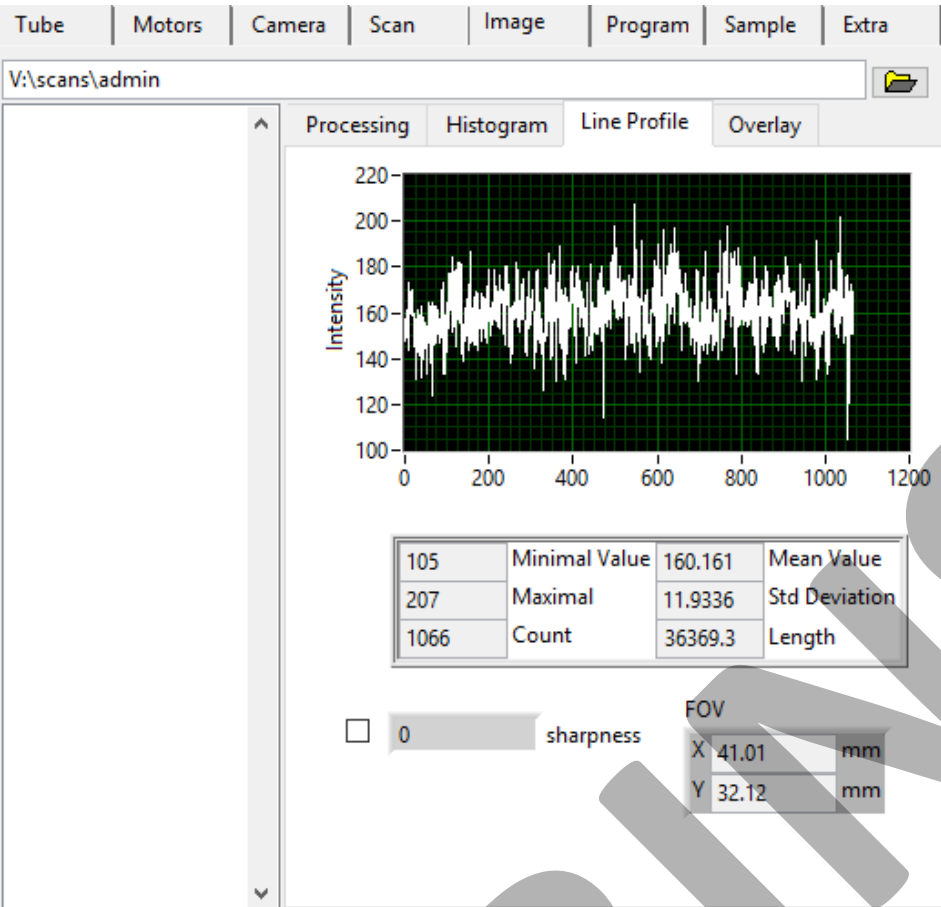
In the processing tab the displayed image can be optimized by removing spots in the image, enhancing edges and changing the gamma.

Histogram

The histogram tab displays the histogram of the current image. Numerical details of the grey value distribution in the image is also provided.



4. The Settings area



Image

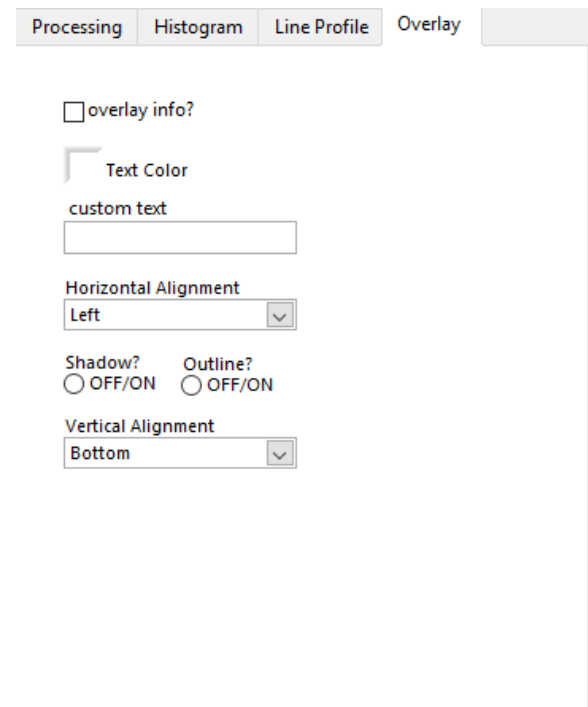
The image tab is for image processing and image optimization.

Line Profile

If a line is drawn on the displayed image, the grey values along that line are shown in the line profile tab. Further details about the grey values and the length of the line are provided below the profile.

Overlay

Text can be overlaid on the radiographs using the overlay tab



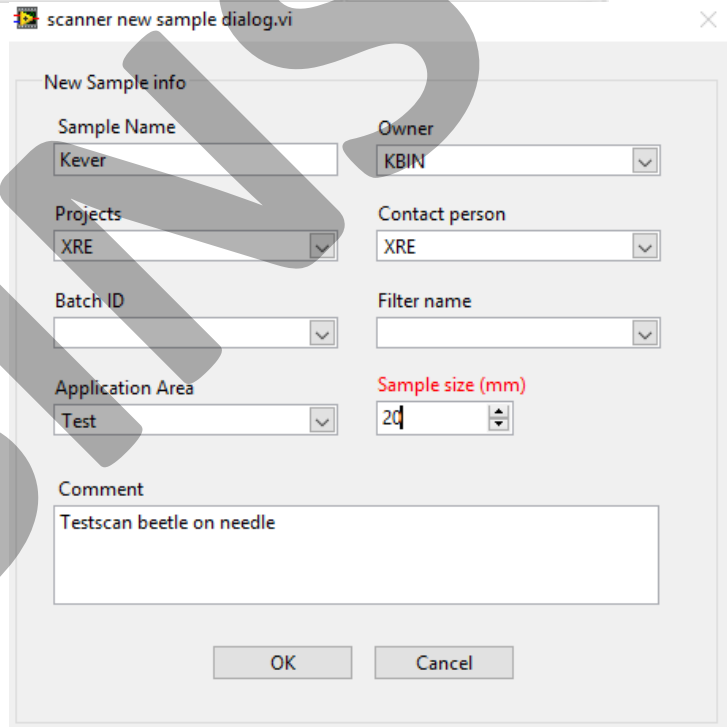
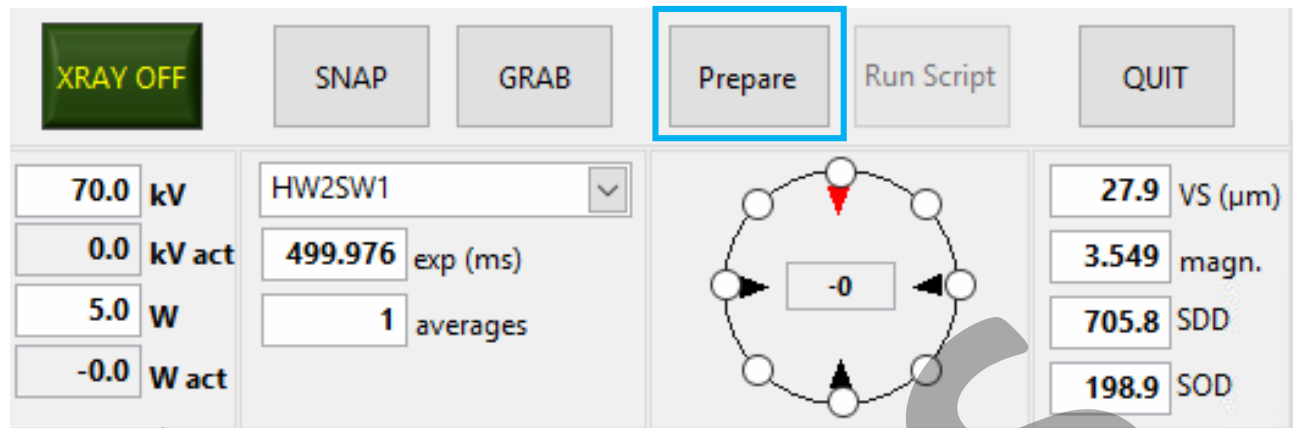
4. The Settings area

Tube	Motors	Camera	Scan	Image	Program	Sample	Extra
Sample							
Kever				Sample Name			
Test				Application Area			
KBIN				Owner			
Testscan beetle on needle				Comment			
20				Size (mm)			
XRE				Contact person			
				Scan ID			
				Batch ID			
Test				Project			

Sample

When the sample information is filled in using the New Sample button in the toolbar, this information is displayed in the Sample tab.

5. Preparing and running a script



Prepare

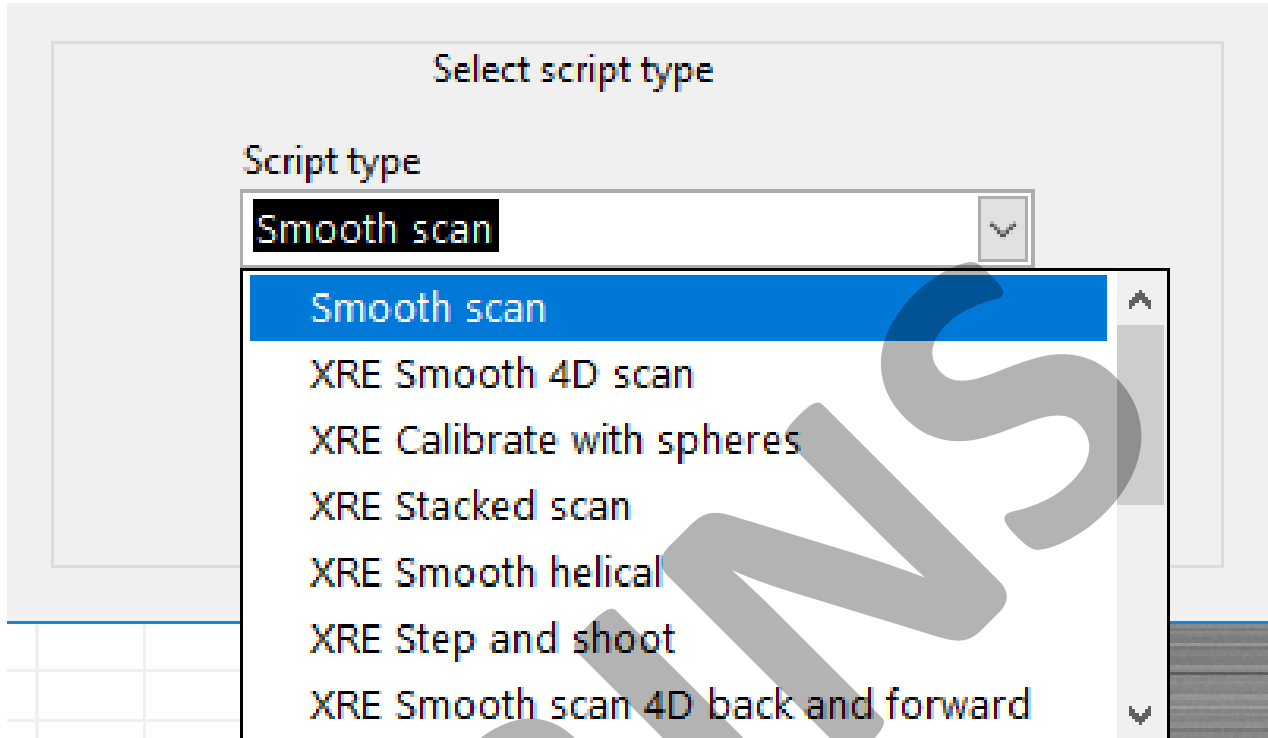
A scan script can be generated by clicking the prepare button in the function area.

When prepare is clicked, the new sample dialog is displayed, in which the sample information like sample name, owner and project can be altered or edited.

The OK button is greyed out and only becomes active when the sample name and sample size are entered.

5. Preparing and running a script

script_generator_selection_dialog.vi



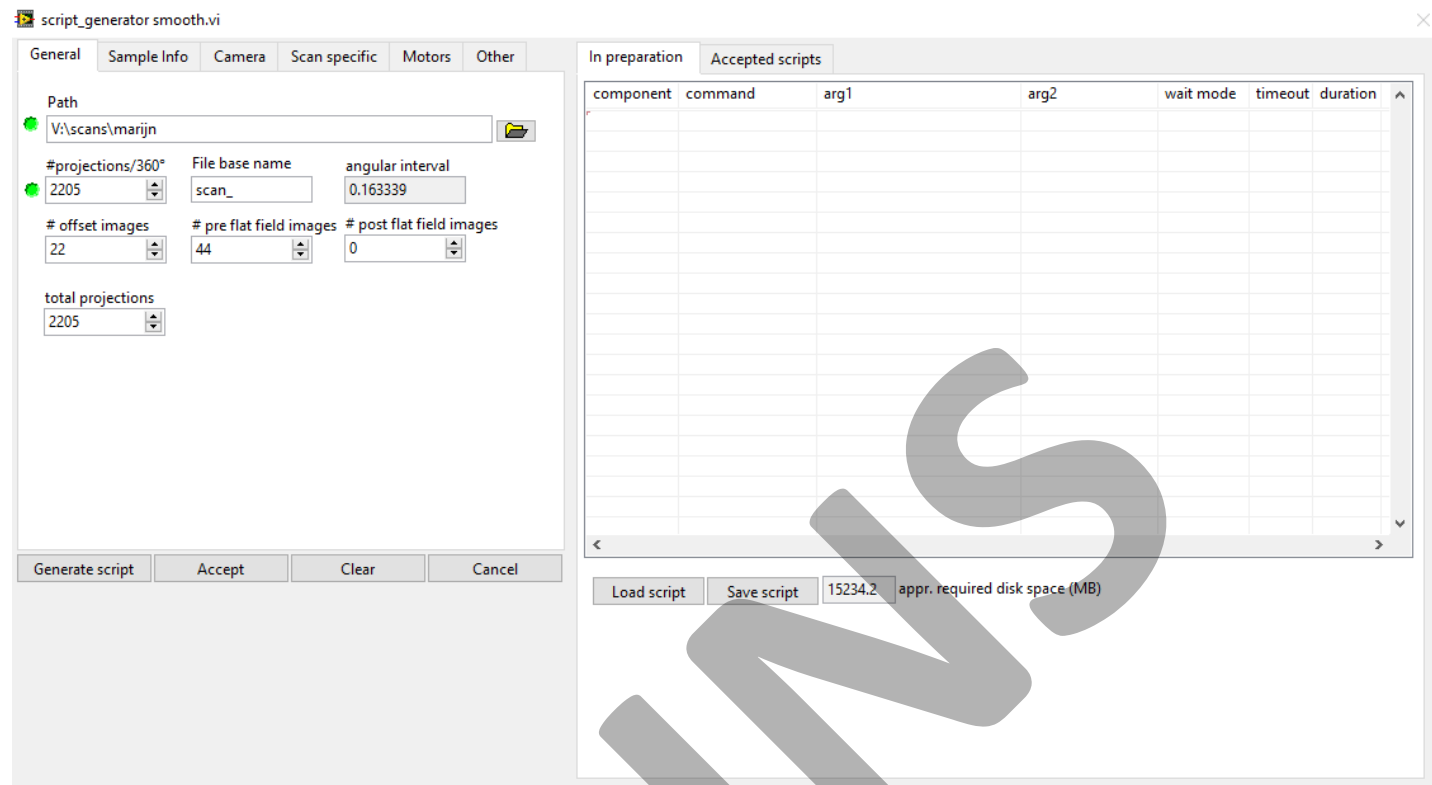
Prepare

When the sample information is entered, the Script type needs to be selected. Numerous acquisition scripts are available.

The standard acquisition scripts are Smooth scan and Step and shoot, in which Smooth scan is the fastest option.

More advanced scripts for scanning elongated samples, dynamic acquisitions and calibration scans can also be selected.

5. Preparing and running a script



Prepare

After selecting the Script type, the script generator window for that type is shown

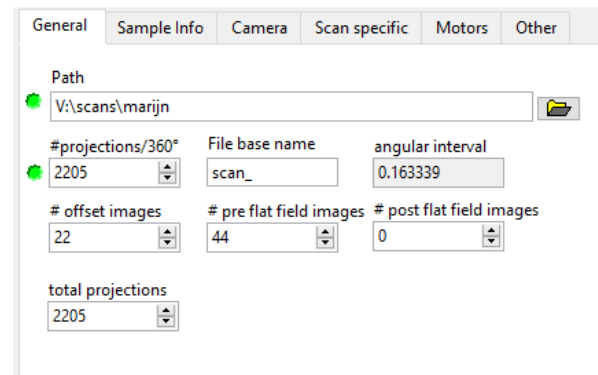
General

In the general tab the path where the images will be stored can be selected and the File basename chosen.

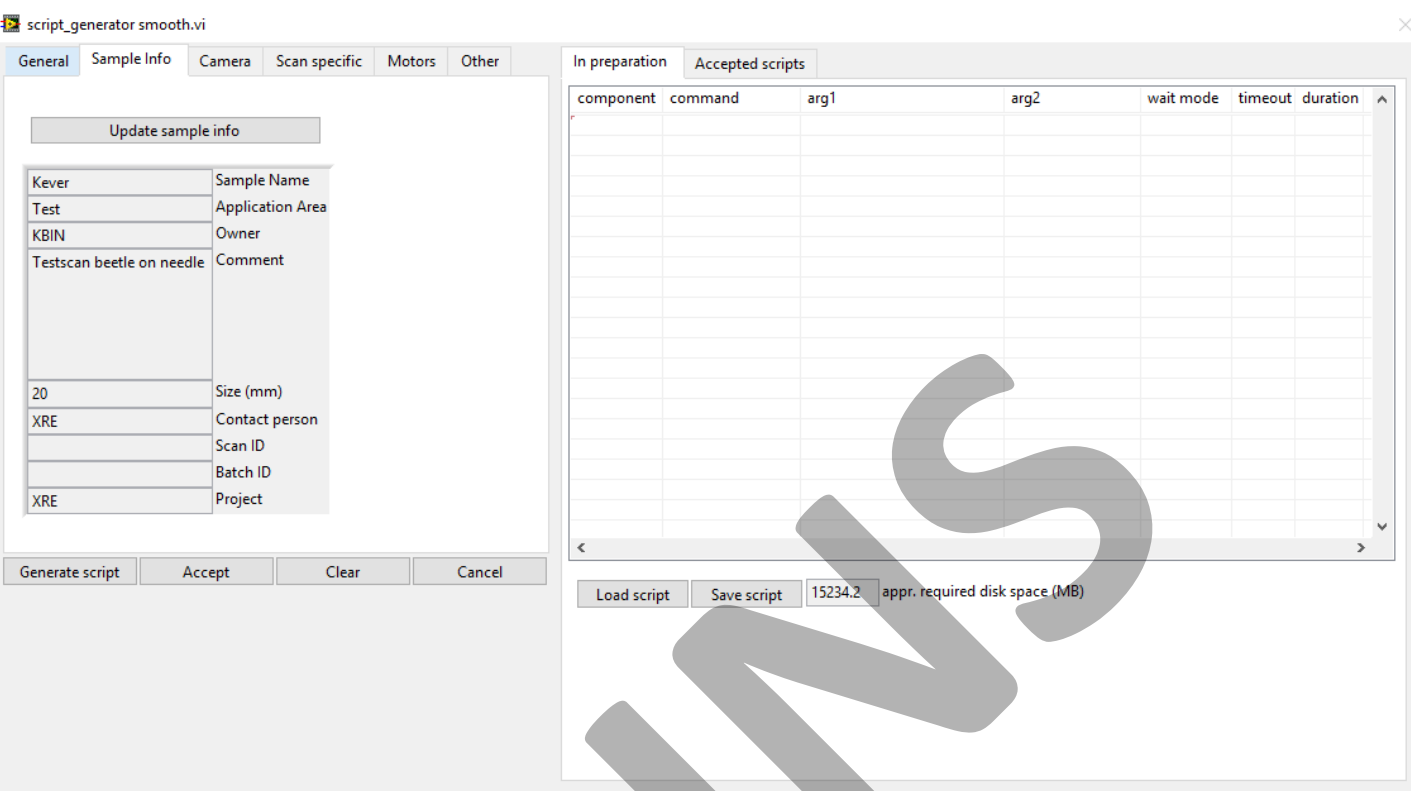
The number of projections for a full rotation can be entered and the minimum amount of projections is equal to the amount of pixels in the horizontal direction of the projection.

A number of correction images can be selected before and /or after the scan.

The total number of projections is also shown and the can differ from the #projections/360° if the rotation angle is altered.



5. Preparing and running a script

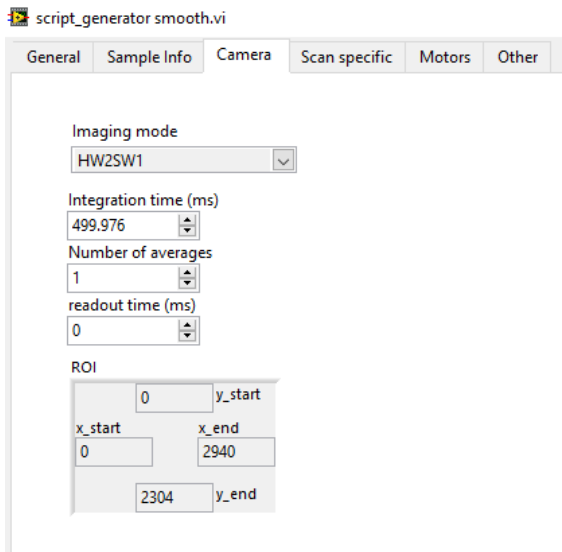


Prepare Sample Info

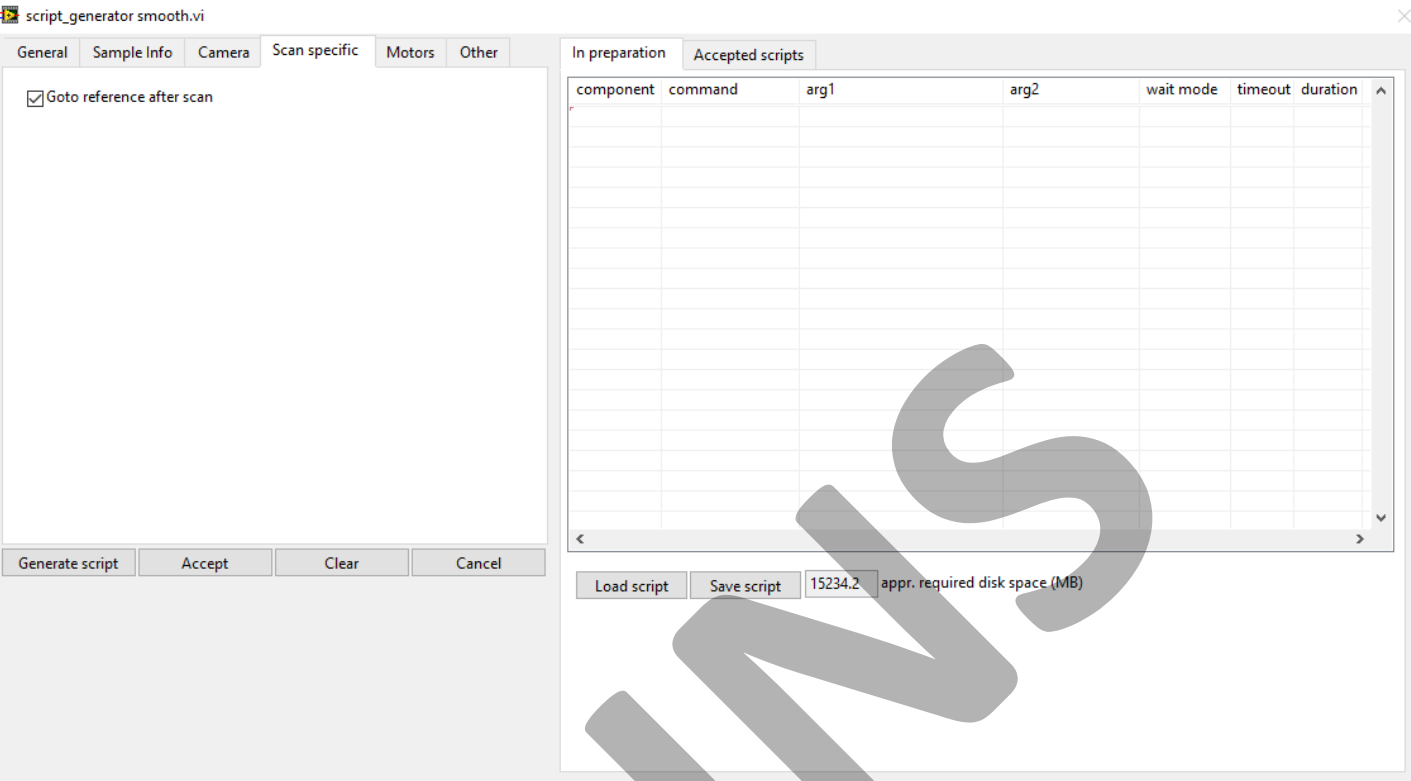
The information about the sample is shown in the Sample Info tab and this data can be updated.

Camera

In the camera tab the detector settings like binning and ROI are shown and the integration time and number of averages can still be optimized.



5. Preparing and running a script



Prepare Scan specific

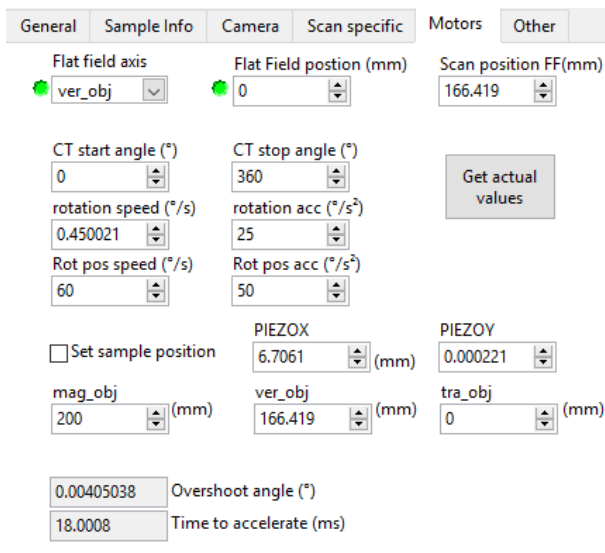
The scan specific tab shows specific options depending on the selected scan script.

Motors

In the motors tab the flat field position or the calibration image without the sample in the beam, can be optimized.

The start and stop angle can be altered and the rotation speed and accelerations can be changed is desired.

Set sample position makes it possible to enter specific positions of the sample for the scan .



5. Preparing and running a script



component	command	arg1	arg2	wait mode	timeout	duration
scanner	set output path	V:\scans\marijin		ACK		
scanner	set sample info	@4 <input type="checkbox"/> Kever <input type="checkbox"/> Test <input type="checkbox"/> KBI		ACK		
camera	set mode	mode1		ACK		
camera	set exposure	499.976135		ACK		
camera	set number of fram	1		ACK		
camera	set number of aver:	1		ACK		
camera	set ROI	0 0 2940 2304		ACK		
ver_obj	move absolute	0.000000		ACK		
tube	xrayoff			ACK		
scanner	pause	2000.000000		ACK		
camera	take image			ACK		
camera	set number of aver:	22		ACK		
camera	take image			ACK		
camera	save image	V:\scans\marijin\di0000.tif		ACK		
camera	set number of aver:	1		ACK		
tube	xrayon			ACK		
tube	REPEAT UNTIL TRU			ACK		
scanner	pause	5000.000000		ACK		
ver_obj	move absolute	0.000000		ACK		
camera	take image			ACK		
camera	set number of aver:	44		ACK		

Prepare

Other

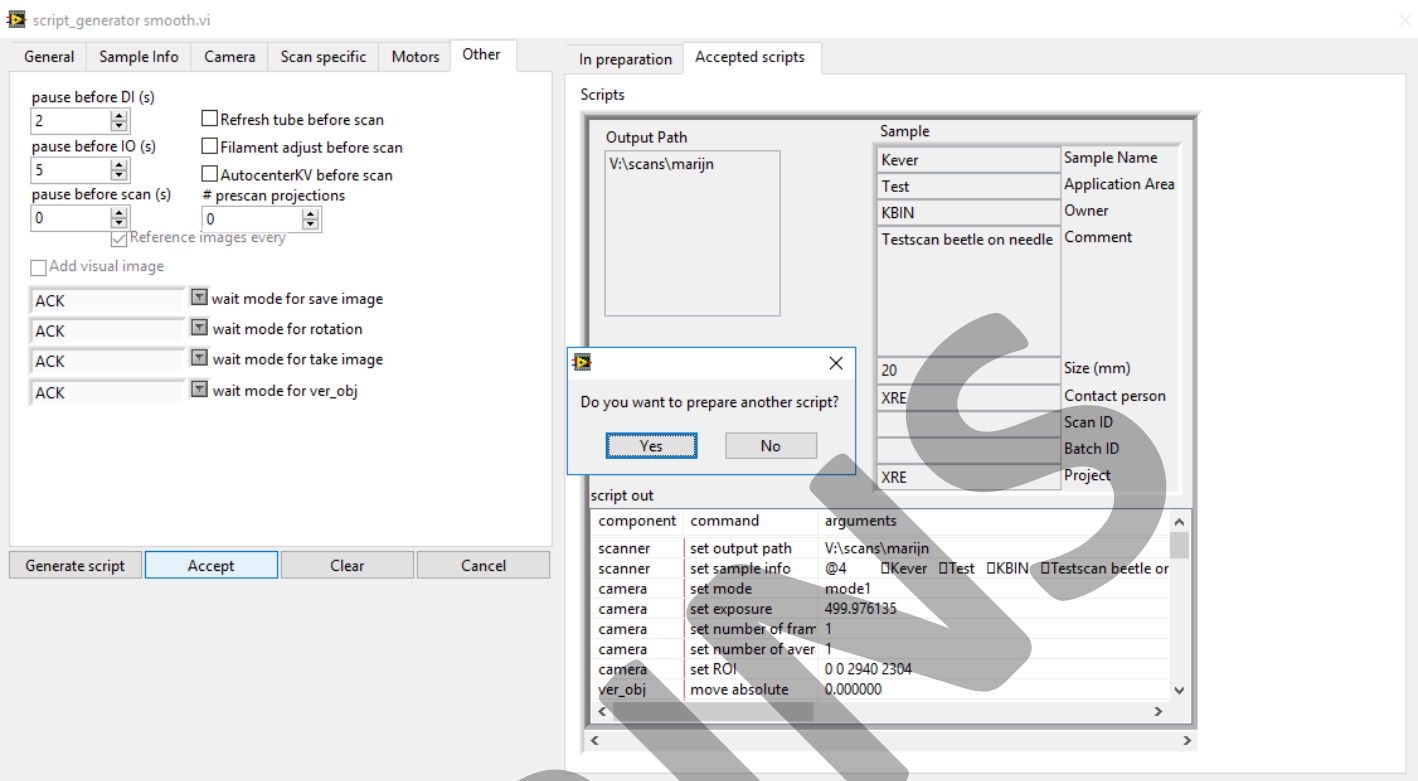
In the other tab the tube can be refreshed and focused, the pause between specific steps in the script can be altered and prescan projections can be acquired.

Generate script

If all parameters are selected the script can be generated. Clicking *Generate script* displays all the steps of the script. This scan script can be cleared or even canceled, but can also be saved.

Existing scripts can also be loaded using the *Load script* button.

5. Preparing and running a script



Prepare

Accept

When clicking the accept button, the script is stored and the options window *Do you want to prepare another script?* Is shown.

When selecting *Yes*, you are redirected to the main software window.

When selecting *No*, an additional script can be generated with other settings or with another sample position.

Run Script

The Run script button in the function area of the main window is no longer greyed out and clicking this button starts the scan. The progress of the scan can be monitored in the Scan tab of the settings area.

