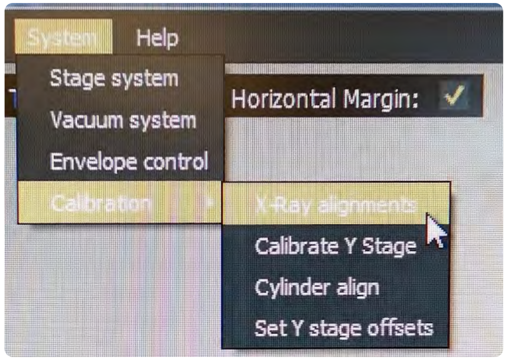
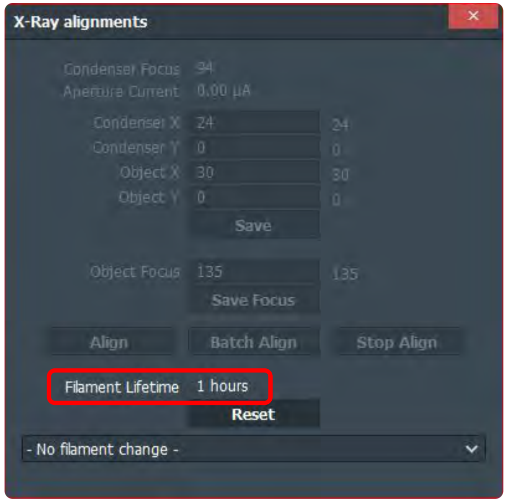
Heliscan MicroCT (Mark II) Basic Quick Guide

Starting up



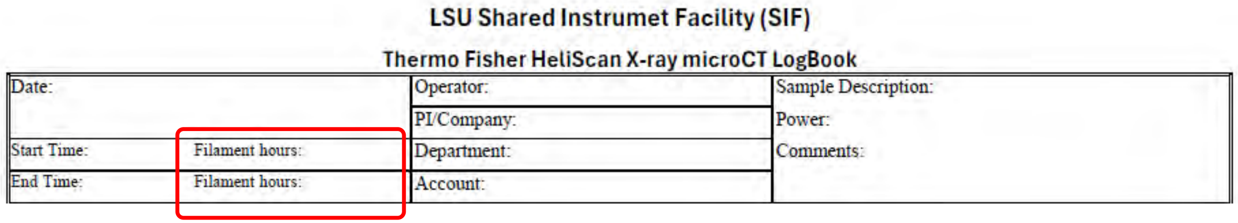


Condenser Focus 94
Aperture Current 0.00 µA
Condenser X 24 24
Condenser Y 0 0
Object X 30 30
Object Y 0 0
Object Focus 135 135
Filament Lifetime 1 hours
- No filament change -

!!!Before starting your scan!!!

1. On your computer your cell phone go to **FBS system** and **START** your session.
2. In FoxtrotUI navigate to **System > Calibration > X-Ray Alignments** .
3. In the popup window, locate the **"Filament Lifetime"**.
4. Record the **"Filament Lifetime"** in the logbook and close the popup window.
5. At the end of your scan, return to the **"Filament Lifetime"** and record it in the logbook again

   and **STOP** your session on the **FBS system**.



LSU Shared Instrumet Facility (SIF)

Thermo Fisher HeliScan X-ray microCT LogBook

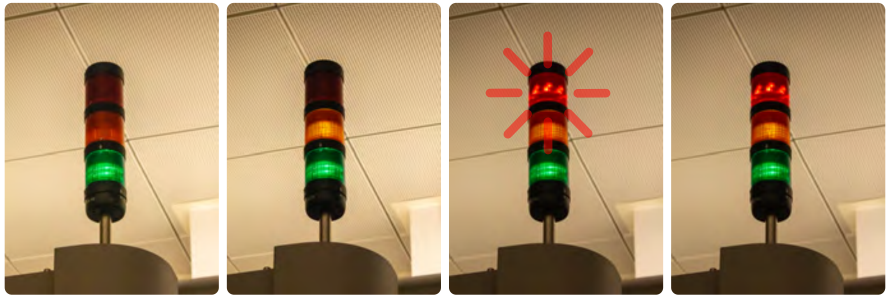
Date:		Operator:	Sample Description:
		PI/Company:	Power:
Start Time:	Filament hours:	Department:	Comments:
End Time:	Filament hours:	Account:	

X-ray generation and safety indicators

Enable and unable X-ray generation

To enable X-ray: close all system doors and press the X-ray Arm button

To unable X-ray: press the X-ray Disarm button and you can open the doors if needed.



Indicator statuses

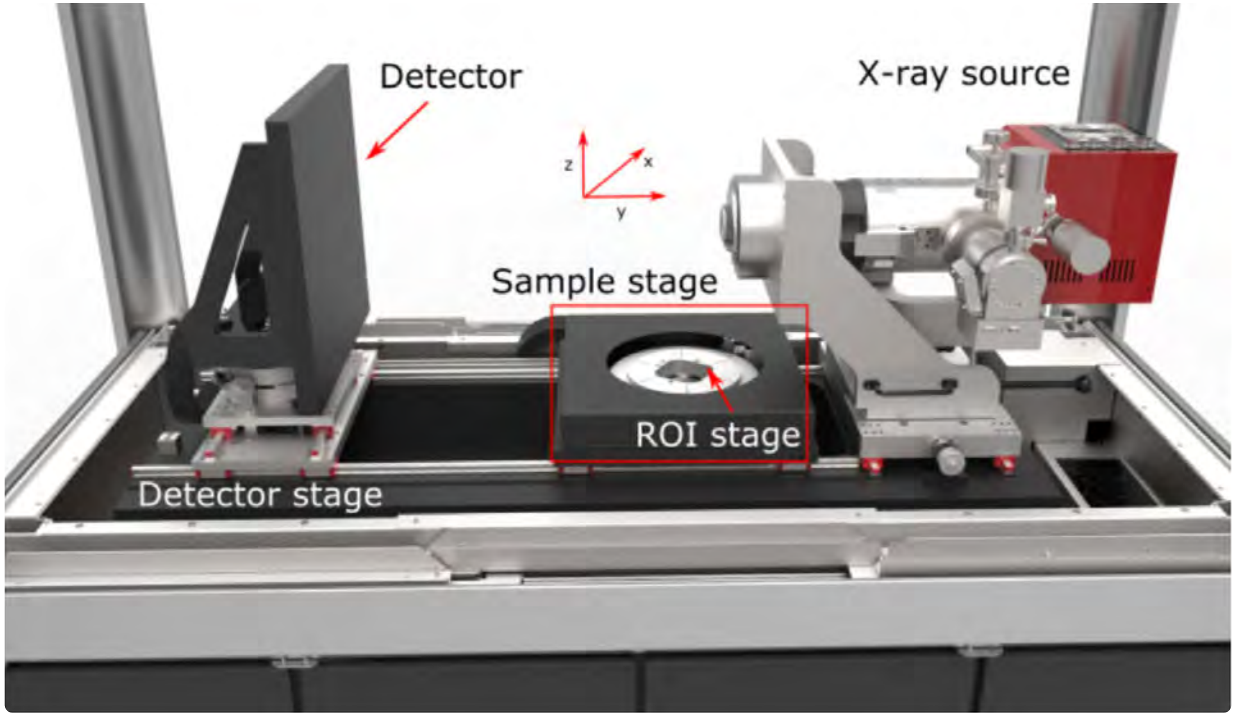
X-ray lamp statues

Signal	Description
Green 🟢	System is powered
Green and Yellow 🟢🟡	X-ray generation is enabled
Green, Yellow and Red blinking 🟢🟡🔴	X-ray is starting to be generated
Green, Yellow and Red 🟢🟡🔴	X-ray is generated

Control panel LED

Status	Meaning
LED is off	X-ray generation is enabled and doors are locked
LED is on	X-ray generation is disabled
LED is blinking	X-ray generation is disabled and doors are locked

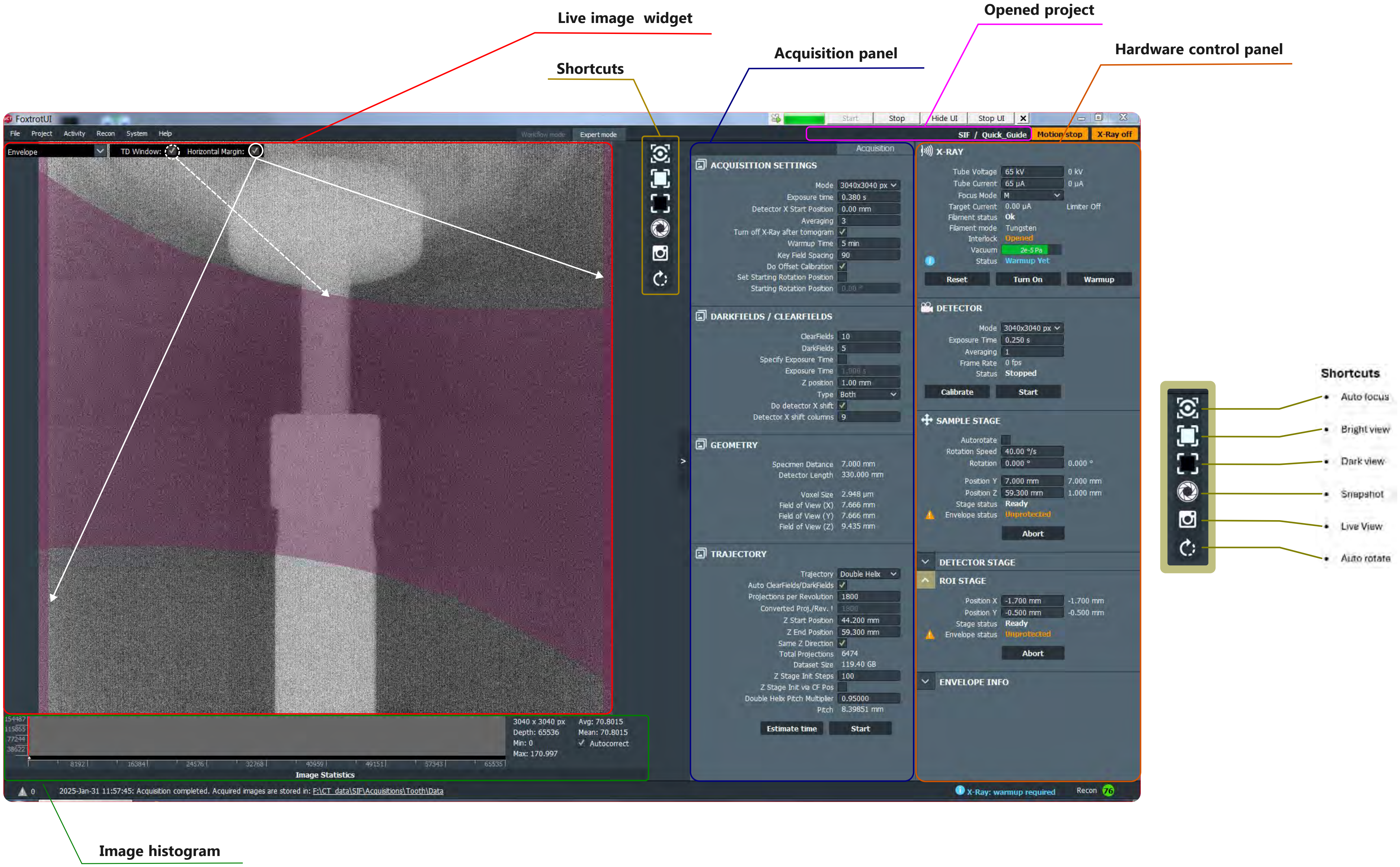
Motion System



Motion System

Max load	15 kg
Z axis travel	195 mm
R axis	360° continuous rotation
Y stage travel	400 mm
Y detector travel	830 mm
X detector travel	100 mm
ROI X travel	-20 mm – 20 mm
ROI Y travel	-20 mm – 20 mm

FoxtrotUI layout



ACQUISITION SETTINGS

Mode: 3040x3040 px
Exposure time: 0.380 s
Detector X Start Position: 0.00 mm
Averaging: 3
Turn off X-Ray after tomogram: ☑
Warmup Time: 5 min
Key Field Spacing: 90
Do Offset Calibration: ☑
Set Starting Rotation Position: ☐
Starting Rotation Position: 0.00 °

DARKFIELDS / CLEARFIELDS

ClearFields: 10
DarkFields: 5
Specify Exposure Time: ☐
Exposure Time: 1.000 s
Z position: 1.00 mm
Type: Both
Do detector X shift: ☑
Detector X shift columns: 9

GEOMETRY

Specimen Distance: 7.000 mm
Detector Length: 330.000 mm
Voxel Size: 2.948 µm
Field of View (X): 7.666 mm
Field of View (Y): 7.666 mm
Field of View (Z): 9.435 mm

TRAJECTORY

Trajectory: Double Helix
Auto ClearFields/DarkFields: ☑
Projections per Revolution: 1800
Converted Proj./Rev. !: 1800
Z Start Position: 44.200 mm
Z End Position: 59.300 mm
Same Z Direction: ☑
Total Projections: 6474
Dataset Size: 119.40 GB
Z Stage Init Steps: 100
Z Stage Init via CF Pos: ☐
Double Helix Pitch Multiplier: 0.95000
Pitch: 8.39851 mm

X-RAY

Tube Voltage: 65 kV — 0 kV
Tube Current: 65 µA — 0 µA
Focus Mode: M
Target Current: 0.00 µA — Limiter Off
Filament status: Ok
Filament mode: Tungsten
Interlock: Opened
Vacuum: 2e-5 Pa
Status: Warmup Yet

DETECTOR

Mode: 3040x3040 px
Exposure Time: 0.250 s
Averaging: 1
Frame Rate: 0 fps
Status: Stopped

SAMPLE STAGE

Autorotate: ☐
Rotation Speed: 40.00 °/s
Rotation: 0.000 ° — 0.000 °
Position Y: 7.000 mm — 7.000 mm
Position Z: 59.300 mm — 1.000 mm
Stage status: Ready
Envelope status: Unprotected

DETECTOR STAGE

ROI STAGE

Position X: -1.700 mm — -1.700 mm
Position Y: -0.500 mm — -0.500 mm
Stage status: Ready
Envelope status: Unprotected

ENVELOPE INFO

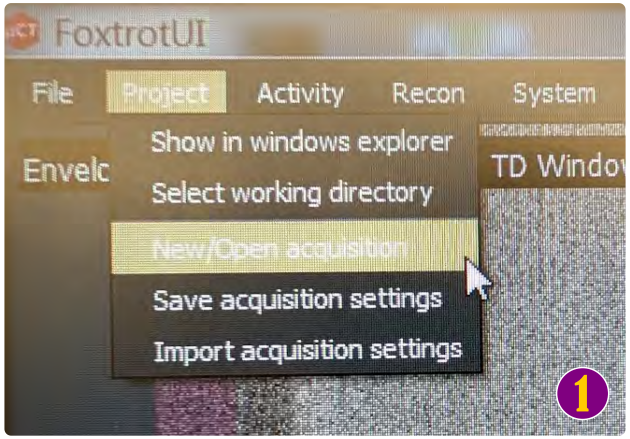
3040 x 3040 px
Depth: 65536
Min: 0
Max: 170.997
Avg: 70.8015
Mean: 70.8015
☑ Autocorrect

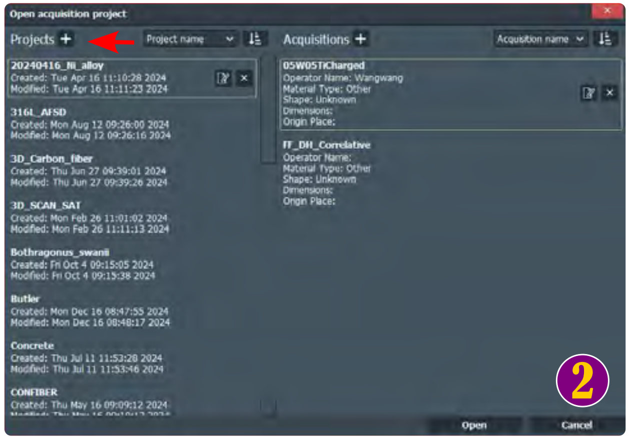
0 — 2025-Jan-31 11:57:45: Acquisition completed. Acquired images are stored in: F:\CT_data\SIF\Acquisitions\Tooth\Data

X-Ray: warmup required

Creating a new project/file

1. Go to **Project > New/Open acquisition.**
2. In the "Open acquisition project" window, click the **+** sign on the right side of "Projects".
3. In the "Create Project" window, enter your PI's name (laboratory), if it doesn't already exist, and click **Accept**.
4. Once the project is created, in the "Open acquisition project" window, select the project and click the **+** sign on the right side of "Acquisitions".
5. In the "Create acquisition" window, fill in the fields "Acquisition name", "Operator Name", and "Sample Filter Notes" and click **Accept**.
6. Your scan will then be ready to acquire and save within your laboratory's folder (project).





20240416_Ni_alloy
Created: Tue Apr 16 11:10:28 2024
Modified: Tue Apr 16 11:11:23 2024

316L_AFSD
Created: Mon Aug 12 09:26:00 2024
Modified: Mon Aug 12 09:26:16 2024

3D_Carbon_fiber
Created: Thu Jun 27 09:39:01 2024
Modified: Thu Jun 27 09:39:26 2024

3D_SCAN_SAT
Created: Mon Feb 26 11:01:02 2024
Modified: Mon Feb 26 11:11:13 2024

Bothragonus_swanii
Created: Fri Oct 4 09:15:05 2024
Modified: Fri Oct 4 09:15:38 2024

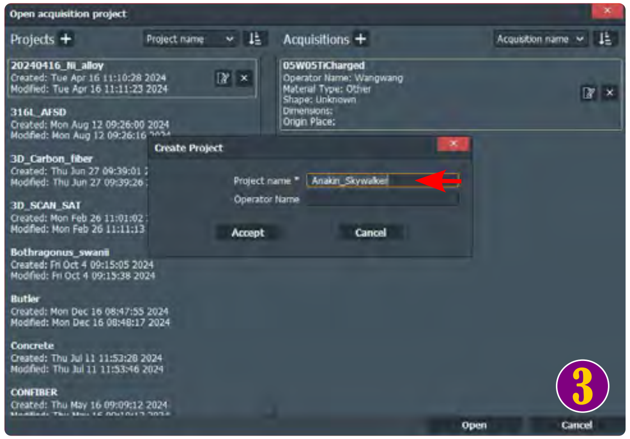
Butler
Created: Mon Dec 16 08:47:55 2024
Modified: Mon Dec 16 08:48:17 2024

Concrete
Created: Thu Jul 11 11:53:28 2024
Modified: Thu Jul 11 11:53:46 2024

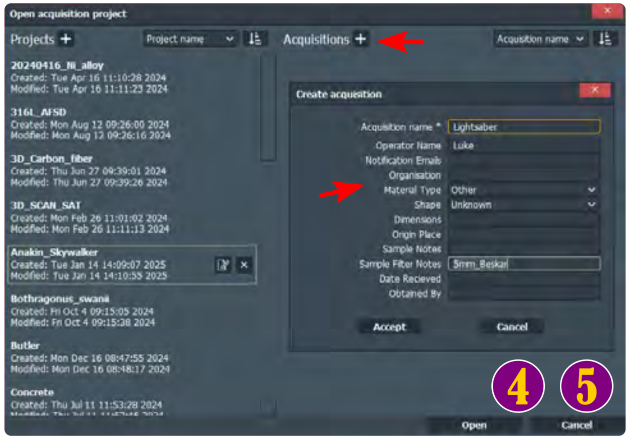
CONFIBER
Created: Thu May 16 09:09:12 2024

05W05TiCharged
Operator Name: Wangwang
Material Type: Other
Shape: Unknown
Dimensions:
Origin Place:

FF_DH_Correlative
Operator Name:
Material Type: Other
Shape: Unknown
Dimensions:
Origin Place:

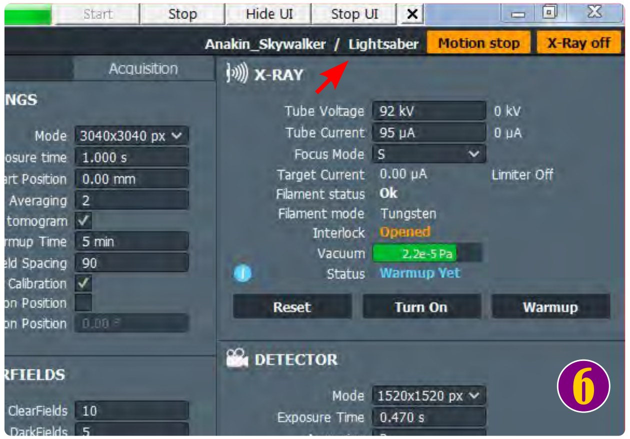


Project name * Anakin_Skywalker
Operator Name



Anakin_Skywalker
Created: Tue Jan 14 14:09:07 2025
Modified: Tue Jan 14 14:10:55 2025

Acquisition name * Lightsaber
Operator Name Luke
Notification Emails
Organisation
Material Type Other
Shape Unknown
Dimensions
Origin Place
Sample Notes
Sample Filter Notes 5mm_Beskar
Date Recieved
Obtained By



Anakin_Skywalker / Lightsaber

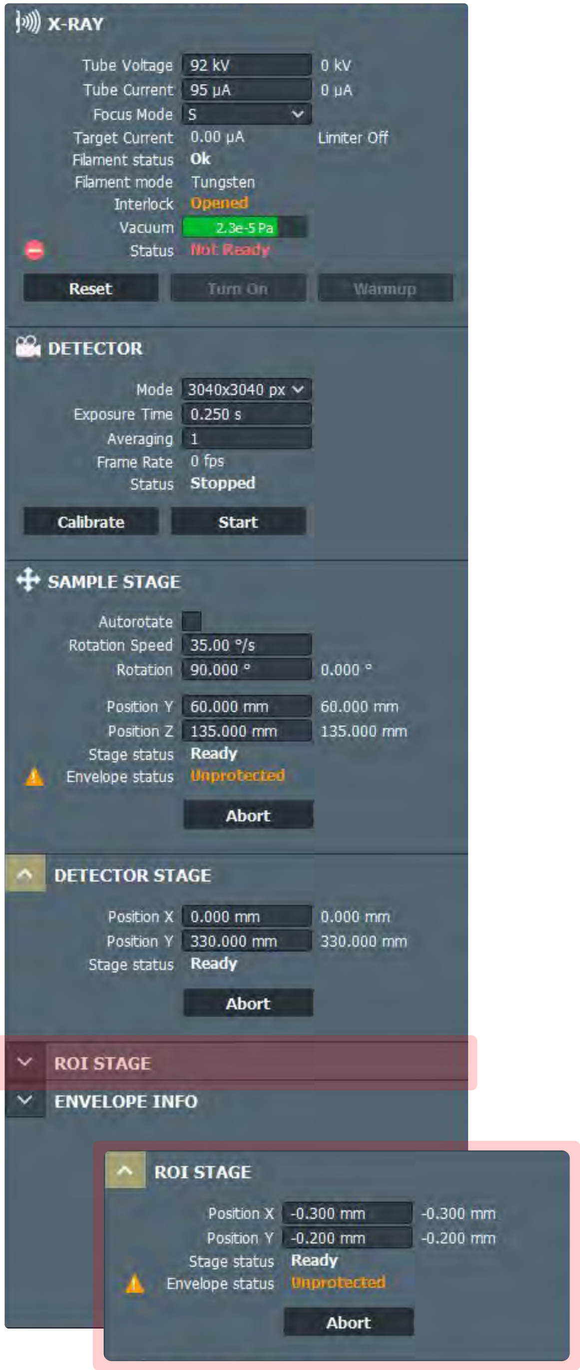
Mode 3040x3040 px
osure time 1.000 s
rt Position 0.00 mm
Averaging 2
tomogram ✓
rmup Time 5 min
ld Spacing 90
Calibration ✓
on Position ☐
on Position 0.00

Tube Voltage 92 kV 0 kV
Tube Current 95 µA 0 µA
Focus Mode S
Target Current 0.00 µA Limiter Off
Filament status Ok
Filament mode Tungsten
Interlock Opened
Vacuum 2.2e-5 Pa
Status Warmup Yet

Mode 1520x1520 px
Exposure Time 0.470 s

ClearFields 10
DarkFields 5

Setting acquisition



X-RAY

Tube Voltage	92 kV	0 kV
Tube Current	95 µA	0 µA
Focus Mode	S	
Target Current	0.00 µA	Limiter Off
Filament status	Ok	
Filament mode	Tungsten	
Interlock	Opened	
Vacuum	2.3e-5 Pa	
Status	Not Ready	

DETECTOR

Mode	3040x3040 px
Exposure Time	0.250 s
Averaging	1
Frame Rate	0 fps
Status	Stopped

SAMPLE STAGE

Autorotate	☐	
Rotation Speed	35.00 °/s	
Rotation	90.000 °	0.000 °
Position Y	60.000 mm	60.000 mm
Position Z	135.000 mm	135.000 mm
Stage status	Ready	
Envelope status	Unprotected	

DETECTOR STAGE

Position X	0.000 mm	0.000 mm
Position Y	330.000 mm	330.000 mm
Stage status	Ready	

ROI STAGE

ENVELOPE INFO

ROI STAGE

Position X	-0.300 mm	-0.300 mm
Position Y	-0.200 mm	-0.200 mm
Stage status	Ready	
Envelope status	Unprotected	

Acquisition panel

Scan Setup

X-ray

Select Tube Voltage and focus mode based on sample composition, thickness and desired voxel size

Adjust Tube current to optimize the target current

Detector

Select Mode (number of pixels on the detector)

Select Start to get a live view

Sample Stage

Lower position Z to 1 mm to get a Clearfield

Detector Stage

Move detector Y position to 330 mm (unless higher magnification is required)

Increase the exposure time to get the maximum number of counts at the detector without over-saturating it.

- Clearfield with Optimum Counts (~45,000 max)
- Oversaturated Clearfield (~>55,000)

Sample Stage

Move the sample closer to the source using **Position Y. Autorotate** the sample while adjusting Y stage and use the **Horizontal Margin** to ensure there is Clearfield all around the sample

Select **Z Start position** by moving the sample lower using **Position Z.** Use the **TD window** as a guide to ensure the sample will transition though the middle region.

ROI Stage

Centralize the sample by setting Position X and Y using the rotation on the **Sample Stage** settings.

- Position X: 0° and 180°
- Position Y: 90° and 270°

Sample Stage

- Autorotate
- Select Z End Position by moving the sample higher using Position Z. Use the TD window as a guide to ensure the sample will transition though the middle region.

Setting acquisition

ACQUISITION SETTINGS

Mode	3040x3040 px
Exposure time	1.000 s
Detector X Start Position	0.00 mm
Averaging	2
Turn off X-Ray after tomogram	☑
Warmup Time	5 min
Key Field Spacing	90
Do Offset Calibration	☑
Set Starting Rotation Position	☐
Starting Rotation Position	0.00 °

DARKFIELDS / CLEARFIELDS

ClearFields	10
DarkFields	5
Specify Exposure Time	☐
Exposure Time	1.000 s
Z position	1.00 mm
Type	Both
Do detector X shift	☐
Detector X shift columns	9

GEOMETRY

Specimen Distance	60.000 mm
Detector Length	330.000 mm
Voxel Size	25.273 µm
Field of View (X)	65.709 mm
Field of View (Y)	65.709 mm
Field of View (Z)	-25.273 mm

TRAJECTORY

Trajectory	Double Helix
Auto ClearFields/DarkFields	☑
Projections per Revolution	1800
Converted Proj./Rev. !	1800
Z Start Position	138.000 mm
Z End Position	160.000 mm
Same Z Direction	☑
Total Projections	1102
Dataset Size	19.71 GB
Z Stage Init Steps	100
Z Stage Init via CF Pos	☐
Double Helix Pitch Multiplier	0.95000
Pitch	71.98727 mm

Review of all Acquisition Settings

ACQUISITION SETTINGS

- Detector Mode: matching the one selected during live view
- Exposure time: matching the one selected during clearfield live view
- Averaging: Increasing the number of projections to average will reduce noise in the image while spending more time acquiring the tomogram
- Turn off X-ray after tomogram: Selected in most cases to prolong the filament lifetime acquiring images rather than remaining idle
- Warmup Time: Recommended if the source has been off for a while

DARKFIELDS / CLEARFIELDS

- Clearfields: 10 (Recommended)
- Darkfields: 5 (Recommended)
- Exposure time: Matching the projection acquisition exposure time, unless a different exposure time want to be acquired to avoid oversaturating the detector (application specific)
- Z Position: 1 mm usually
- Type: Both (Recommended)
- Do detector X-shift: Yes, to avoid helical/circular artifacts
- Detector X-Shift Columns: 9 (recommended)

TRAJECTORY

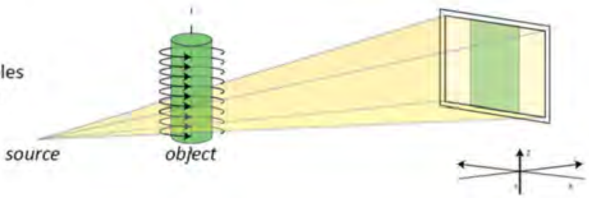
- Select Trajectory
- Auto Clearfields/Darkfields: Yes, unless the sample does not allow it

Review **Estimate Time** and **Start** Acquisition

Trajectories

Trajectories:

Circular trajectory
scanning of tall samples
At a <10 ° conebeam



Circular scanning mode: This trajectory is based on rotating the sample through 360 degrees of projections at fixed vertical position with respect to the X-ray source.

Benefit: a small number of projections are required.

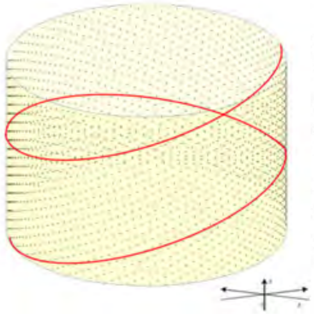
Drawback: the reconstruction algorithm to work, an assumption that all the X-ray paths from the source that reach the detector are parallel must hold true.

Helical trajectory
scanning of tall samples
at a <110° conebeam

Double Helix scanning mode: During helical scan the sample is simultaneously rotated and moved up to the next position at which the projection image of the X-rays passing through the sample is acquired. This allows to image a longer object – with diameter vs height aspect ratio up to 10 (AR:10) – within a single scan or to scan several objects, mounted on top of each other, without a need for re-mounting the samples between every scan.

Benefit: (1) It allows the detector to be moved very close utilizing as much X-ray flux as possible (i.e. better signal to noise ratio); (2) all reconstructed points have travelled through the mid-plane of the detector allowing for a theoretically exact reconstruction of the data and (3) very tall sample can be scanned resulting in tall tomograms.

Drawback: requires a much more precise knowledge of system geometry for the reconstruction to work and has 6 degrees of freedom that need to be known accurately. A helical trajectory also required more projections for the same final tomogram volume as a single circular scan.



Schematic visualization of the X-ray beam trajectory with respect to the scanned sample (yellow cylinder) during:

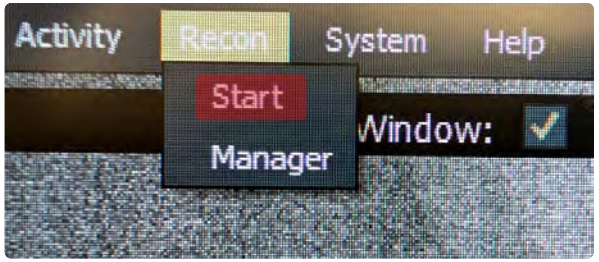
- **Helical scan** (red line) – projections are acquired in a continuous trajectory curve with a progressive increment of the rotation angle and vertical travel
- **Space-Filling scan** (dark dotes) – acquisition of the mutually independent projections is evenly spread with respect to the sample volume across whole vertical travel

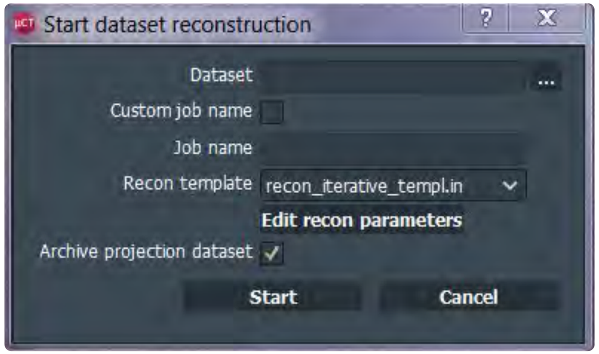
Space-filling mode: This allows generating high-quality images with reduced amount of the acquired projections.

Benefit: (1) High cone-angle imaging; (2) entire detector area is fully utilized; (3) half the overscan required in comparison with Double Helix; (4) More uniform sampling of the object reducing the artifacts e.g., non-uniform magnification, helical filtering, streaking around high-density inclusions and secondary source.

Drawback: (1) May result in a lower signal-to-noise ratio (SNR) and (2) increased computational complexity for reconstruction.

Reconstruction





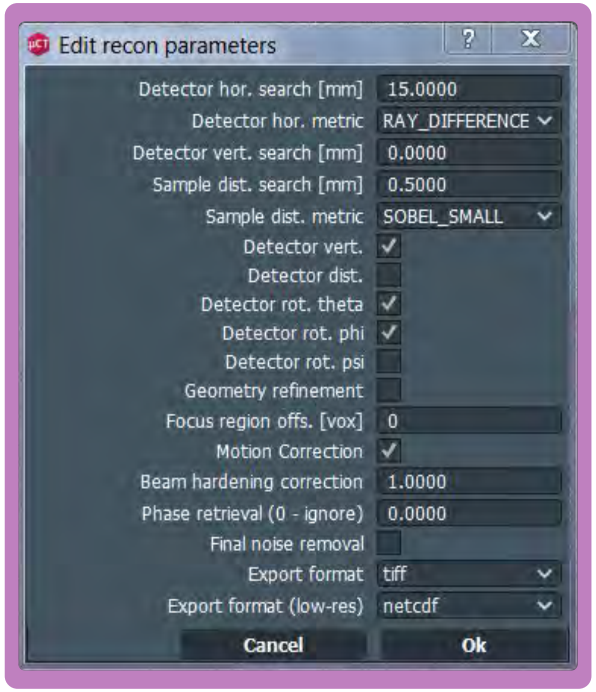
Dataset ...

Custom job name ☐

Job name

Recon template recon_iterative_templ.in

Archive projection dataset ☑



Detector hor. search [mm] 15.0000

Detector hor. metric RAY_DIFFERENCE

Detector vert. search [mm] 0.0000

Sample dist. search [mm] 0.5000

Sample dist. metric SOBEL_SMALL

Detector vert. ☑

Detector dist. ☐

Detector rot. theta ☑

Detector rot. phi ☑

Detector rot. psi ☐

Geometry refinement ☐

Focus region offs. [vox] 0

Motion Correction ☑

Beam hardening correction 1.0000

Phase retrieval (0 - ignore) 0.0000

Final noise removal ☐

Export format tiff

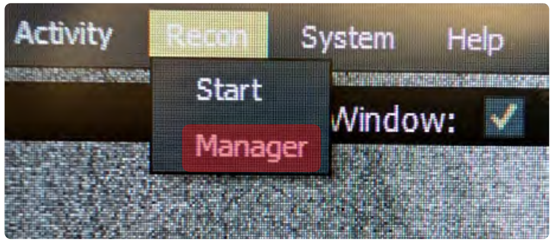
Export format (low-res) netcdf

Reconstruction

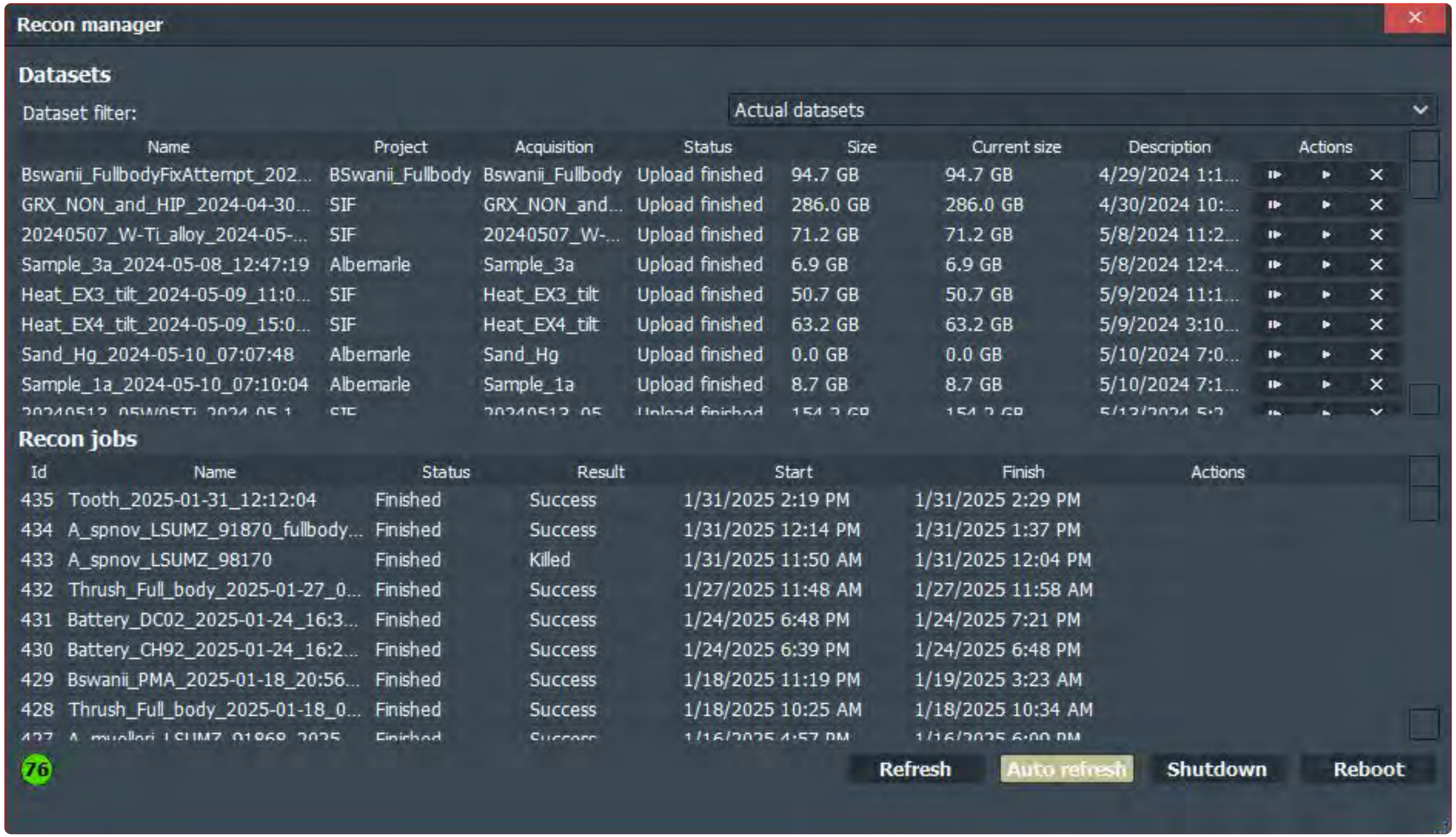
1. Once the scan is complete, navigate to **Recon > Start** and select the full-frame dataset that was just acquired.
2. Choose the appropriate reconstruction template:
   - **Space filling** → recon_iterative_templ.in
   - **Double Helix** → recon_FBP_templ.in
   - **Circular** → recon_FBP_circular.in

   Note: If necessary, click on **“Edit recon parameters”** and adjust the **“Beam hardening correction”** value. The range is **0.7 to 2.0,** with recommended starting values at **1.4**, increasing in increments of **0.2** until you achieve a satisfactory result.
3. Ensure that the **“Archive projection dataset”** box is checked to automatically save the reconstruction once completed.
4. Click **Start** to begin the reconstruction.

Reconstruction



5. Navigate to **Recon > Manager**.
6. The **top half** of the window will display the dataset as it uploads to the cluster. Once the upload is complete, a new job number will appear in the **bottom half** of the window. Enabling **Auto Refresh** will periodically update the status, showing the **start time, finish time, and current status** of the reconstruction.
7. Once finished, the reconstructed data will be available in the **project folder on the SIF server.**



Datasets

Dataset filter: Actual datasets

Name	Project	Acquisition	Status	Size	Current size	Description	Actions
Bswanii_FullbodyFixAttempt_202...	BSwanii_Fullbody	Bswanii_Fullbody	Upload finished	94.7 GB	94.7 GB	4/29/2024 1:1...	⏭ ▶ ✕
GRX_NON_and_HIP_2024-04-30...	SIF	GRX_NON_and...	Upload finished	286.0 GB	286.0 GB	4/30/2024 10:...	⏭ ▶ ✕
20240507_W-Ti_alloy_2024-05-...	SIF	20240507_W-...	Upload finished	71.2 GB	71.2 GB	5/8/2024 11:2...	⏭ ▶ ✕
Sample_3a_2024-05-08_12:47:19	Albemarle	Sample_3a	Upload finished	6.9 GB	6.9 GB	5/8/2024 12:4...	⏭ ▶ ✕
Heat_EX3_tilt_2024-05-09_11:0...	SIF	Heat_EX3_tilt	Upload finished	50.7 GB	50.7 GB	5/9/2024 11:1...	⏭ ▶ ✕
Heat_EX4_tilt_2024-05-09_15:0...	SIF	Heat_EX4_tilt	Upload finished	63.2 GB	63.2 GB	5/9/2024 3:10...	⏭ ▶ ✕
Sand_Hg_2024-05-10_07:07:48	Albemarle	Sand_Hg	Upload finished	0.0 GB	0.0 GB	5/10/2024 7:0...	⏭ ▶ ✕
Sample_1a_2024-05-10_07:10:04	Albemarle	Sample_1a	Upload finished	8.7 GB	8.7 GB	5/10/2024 7:1...	⏭ ▶ ✕

Recon jobs

Id	Name	Status	Result	Start	Finish	Actions
435	Tooth_2025-01-31_12:12:04	Finished	Success	1/31/2025 2:19 PM	1/31/2025 2:29 PM	
434	A_spnov_LSUMZ_91870_fullbody...	Finished	Success	1/31/2025 12:14 PM	1/31/2025 1:37 PM	
433	A_spnov_LSUMZ_98170	Finished	Killed	1/31/2025 11:50 AM	1/31/2025 12:04 PM	
432	Thrush_Full_body_2025-01-27_0...	Finished	Success	1/27/2025 11:48 AM	1/27/2025 11:58 AM	
431	Battery_DC02_2025-01-24_16:3...	Finished	Success	1/24/2025 6:48 PM	1/24/2025 7:21 PM	
430	Battery_CH92_2025-01-24_16:2...	Finished	Success	1/24/2025 6:39 PM	1/24/2025 6:48 PM	
429	Bswanii_PMA_2025-01-18_20:56...	Finished	Success	1/18/2025 11:19 PM	1/19/2025 3:23 AM	
428	Thrush_Full_body_2025-01-18_0...	Finished	Success	1/18/2025 10:25 AM	1/18/2025 10:34 AM	