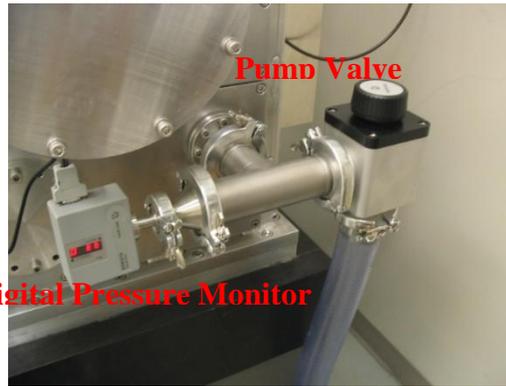
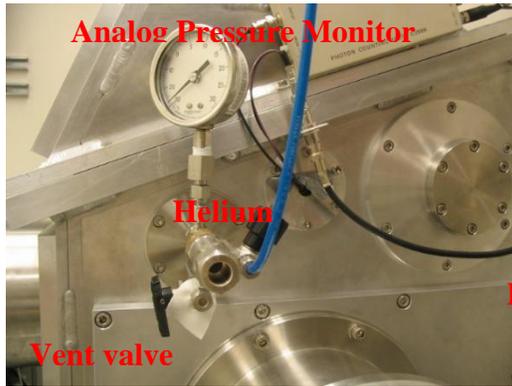


# SM beamline control window

# STXM control window



## 1. Getting started and Loading sample

- 1.1 Close SM-PSH and BSH – SM beamline control, if they are open.
- 1.2 Close pump valve and turn off pump, if they are open.
- 1.3 Open the vent valve on STXM tank to break the vacuum.
- 1.4 Turn off Detector.
- 1.5 Move coarseZ to 5000 um.
- 1.6 Open the STXM tank. Check there is no sample inside. If there is a sample, remove it by gently lifting it straight up. Be careful not to touch OSA or any other components inside STXM.
- 1.7 Load your sample. Write down the sample information, sample position and the empty hole position in own logbook.
- 1.8 Change ZP to static mode.
- 1.9 Select the right polarization (if your sample is not polarization sensitive, use Circular Right/Left), grating, harmonic number.

Energy Range (ev)	Grating	Harmonic	Polarization
<320 up to 390	LEG 250 l/mm	1 <sup>st</sup> (use it for only C 1s & below)	LH, CR, CL
330 to 1000	MEG 500 l/mm	1st	LH, CR, CL
1000 to 1800	MEG 500 l/mm	3rd	Only LH
1800 to 2500	MEG 500 l/mm	5th	Only LH
>2200	HEG 1250 l/mm	5 <sup>th</sup> or 7 <sup>th</sup> (not well characterized)	Only LH

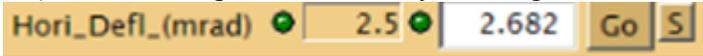
LH: Linear Horizontal; CR: Circular Right; CL: Circular Left

- 1.10 Change to the desired energy. Choose a proper A0 as recommended by the software (click the “S” above A0 line ).
- 1.11 Set ZP to auto mode, and click ‘Go’ besides energy again.
- 1.12 Check the gap between ZP and OSA to make sure they do not touch each other.
- 1.13 Move Coarse Z to 3000 um.
- 1.14 Change energy to 395 ev with Harmonic = 1.
- 1.15 Close STXM tank.
- 1.16 Close vent valve.
- 1.17 Start pump and open pump valve slowly until it is completely open.

- 1.18 IF NOT A WET CELL, pump until Pressure ~0.1 torr (~5 minutes), close the valve, and stop pump.
- 1.19 Backfill with He to 1/3rd atmosphere or 20inch.Hg in the analog gauge.

**2. Optimizing signal and collecting data**

- 2.1 Turn on Detector.
- 2.2 Open SM-PSH and BSH. Open SM-PSH and BSH – SM beamline control, if they are close). Note: after storage ring is refilled, one should manually open the safety shutter on ACIS panel and PSH - SM beamline control as well.
- 2.3 Move to an empty hole on sample holder by changing Coarse X and Coarse Y.
- 2.4 Open shutter and some level of counts should be observed.
- 2.5 Optimize the Hori\_Defl\_(mrad) for maximum photon counts by clicking the “S” besides



- 2.6 Optimize EPU offset for maximum photon counts by input a value (starting with 0)



- 2.7 Adjust dispersive and non-dispersive slit size to have counts lower than  $2 \times 10^6$  (PMT/10).

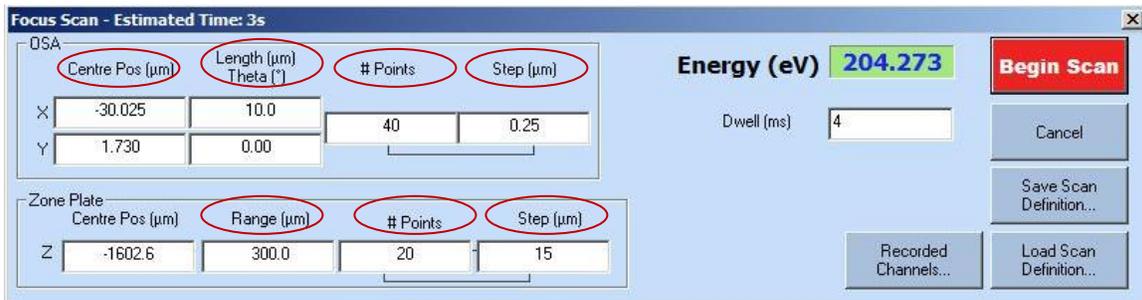
- 2.8 Table with recommended slit sizes :

	C 1s	N 1s	O 1s	Fe 2p
Dispersive	35	30	25	10
Non-Dispersive	35	30	25	10

- 2.9 Close shutter to avoid unnecessary photo exposure to detector.
- 2.10 Perform an OSA scan to find OSA center, set OSA (0,0) to center of the ZP.



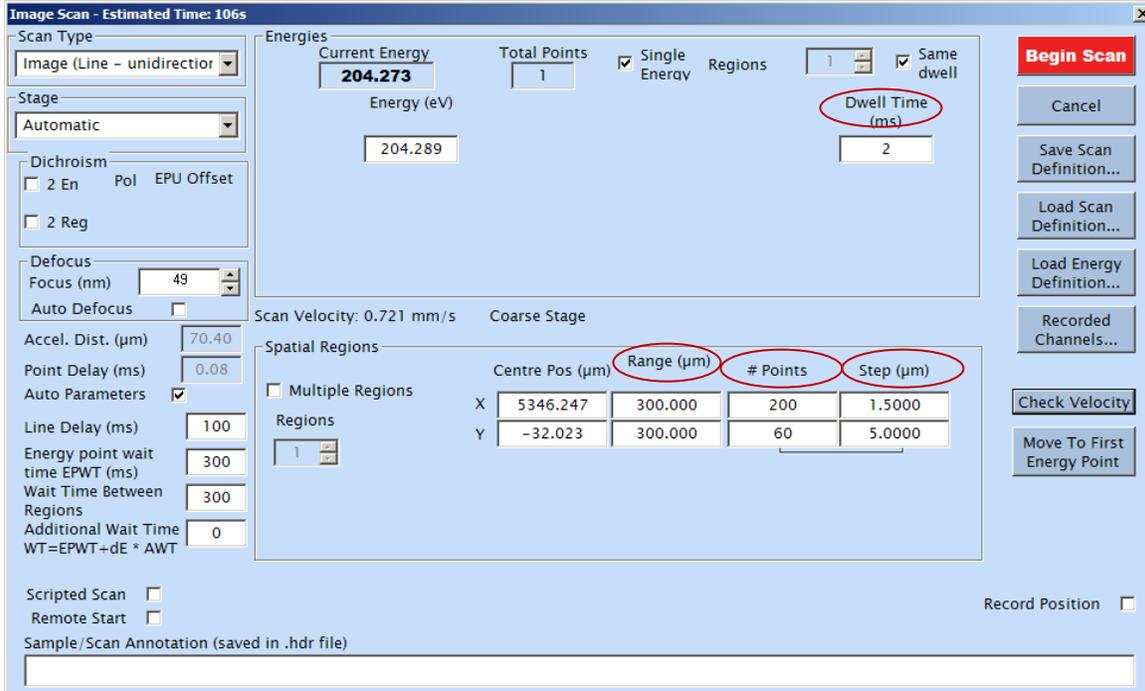
- 2.11 Perform an OSA focus scan and set the ZP scale.
- 2.12



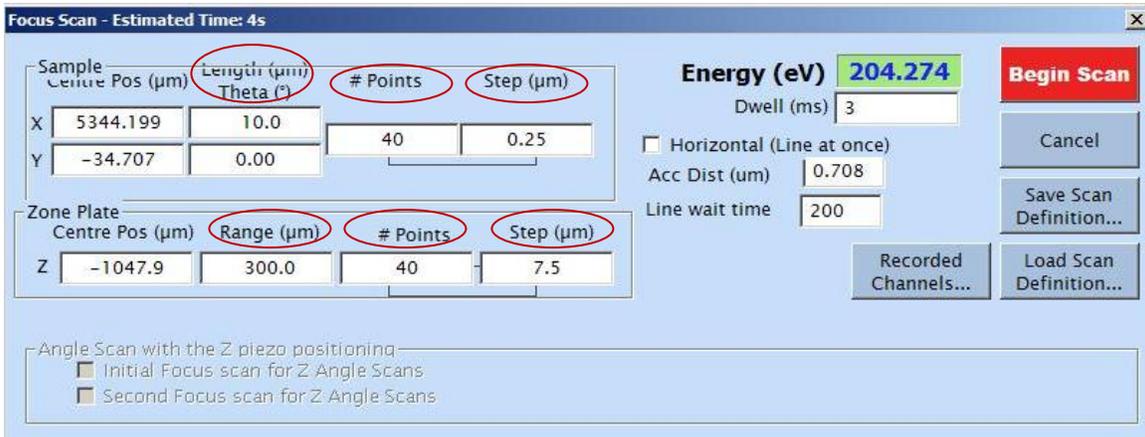
- 2.13 Move to your sample by changing coarse X and coarse Y.
- 2.14 Repeat steps 1.9, 1.10 and 1.11 to set the desired energy.
- 2.15 Move the coarse Z towards the expected position (Ao+sample thickness) CAUTIOUSLY while checking the sample does not make contact with the OSA. The following is the recommendation. Move first Coarse Z to the expected +300 um and after checking move to the desired position.

	C 1s			N 1s			O 1s		
	Sample coarse Z			Sample coarse Z			Sample coarse Z		
	A0	grids	200 um window	A0	grids	200 um window	A0	grids	200 um window
25 nm ZP	320	450	600	400	530	680	500	630	780

2.16 Perform a sample scan with a big scan range (coarse scan), for example 300 um × 300 um, to find the sample.



2.17 Choose a sample region or an object with good white/black contrast. Perform a focus scan with the line drawn on this region to cover sufficient white/black contrast. The ZP scan range can't be too big, usually smaller than 300 µm, otherwise ZP might hit OSA. After focus scan, select the focal point or most close to the focal point region, set 'Focus to cursor + set for autofocus'.



2.18 When an interested small area is chosen, focus scan should be performed again. If the scan range is within 30 um, use 'set Ao for focus'.

2.19 Perform necessary point scan, line scan, or image scan.

## Point scan:

Point Scan - Estimated Time: 5m 33s

Scan Type: **Point**

Stage: **Automatic**

Dichroism:  2 En Pol EPU Offset  
 2 Reg

Defocus: Focus (nm) **49**  
Auto Defocus

Accel. Dist. (µm) **3.568**  
Point Delay (ms) **1**  
Auto Parameters   
Line Delay (ms) **100**  
Energy point wait time EPWT (ms) **300**  
Wait Time Between Regions **300**  
Additional Wait Time WT=EPWT+dE \* AWT **0**

Scripted Scan   
Remote Start

Sample/Scan Annotation (saved in .hdr file)

Energies

Current Energy **204.274** Total Points **185** Regions **3**  Same dwell

Region	Start Energy (eV)	End Energy (eV)	Range (eV)	# Points	Step (eV)	Dwell Time (ms)
1	695	706	11	29	0.393	600
2	706.2	730	23.8	120	0.2	600
3	731	745	14	36	0.4	600

Scan Velocity: 0.017 mm/s Fine Stage

Spatial Regions

Multiple Regions

Region	Pos (µm)
1	X <b>419.196</b>
	Y <b>4478.902</b>
2	X <b>0.000</b>
	Y <b>0.000</b>

Record Position

Buttons: **Begin Scan**, Cancel, Save Scan Definition..., Load Scan Definition..., Load Energy Definition..., Recorded Channels..., Check Velocity, Move To First Energy Point

## Line scan:

Line Scan - Estimated Time: 5m 17s

Scan Type: **Line (Full Horiz. Line)**

Stage: **Automatic**

Dichroism:  2 En Pol EPU Offset  
 2 Reg

Defocus: Focus (nm) **49**  
Auto Defocus

Accel. Dist. (µm) **4.545**  
Point Delay (ms) **0.44**  
Auto Parameters   
Line Delay (ms) **500**  
Energy point wait time EPWT (ms) **300**  
Wait Time Between Regions **300**  
Additional Wait Time WT=EPWT+dE \* AWT **0**

Scripted Scan   
Remote Start

Sample/Scan Annotation (saved in .hdr file)

Energies

Current Energy **204.273** Total Points **136** Regions **3**  Same dwell

Region	Start Energy (eV)	End Energy (eV)	Range (eV)	# Points	Step (eV)	Dwell Time (ms)
1	524	528	4	11	0.4	11.211
2	528.2	546	17.8	90	0.2	11.211
3	546	560	14	35	0.412	11.211

Scan Velocity: 0.017 mm/s Fine Stage

Spatial Regions

Regions	Centre Pos (µm)	Length (µm)	Theta (°)	# Points	Step (µm)
1	X <b>419.185</b>	<b>20.000</b>	<b>0.00</b>	<b>100</b>	<b>0.2000</b>
	Y <b>4478.943</b>				

Record Position

Buttons: **Begin Scan**, Cancel, Save Scan Definition..., Load Scan Definition..., Load Energy Definition..., Recorded Channels..., Check Velocity, Move To First Energy Point

## Fine image:

Image Scan - Estimated Time: 234s

Scan Type: Image (Point by Point)

Stage: Automatic

Dichroism:  2 En Pol EPU Offset  
 2 Reg

Defocus: Focus (nm) 49  
Auto Defocus

Accel. Dist. (µm) 0.454  
Point Delay (ms) 1  
Auto Parameters

Line Delay (ms) 100  
Energy point wait time EPWT (ms) 300  
Wait Time Between Regions 300  
Additional Wait Time WT=EPWT+dE \* AWT 0

Scripted Scan   
Remote Start

Sample/Scan Annotation (saved in .hdr file)

Energies: Current Energy 204.273  
Energy (eV) 204.289  
Total Points 1  
Single Energy   
Regions 1  
Same dwell   
Dwell Time (ms) 1

Scan Velocity: 0.004 mm/s  
Fine Stage

Spatial Regions:  Multiple Regions

Regions	Centre Pos (µm)	Range (µm)	# Points	Step (µm)
X	5346.247	2.000	200	0.0100
Y	-32.023	2.000	200	0.0100

Buttons: Begin Scan, Cancel, Save Scan Definition..., Load Scan Definition..., Load Energy Definition..., Recorded Channels..., Check Velocity, Move To First Energy Point, Record Position

## Stack:

Image Scan - Estimated Time: 26m 3s

Scan Type: Image (Line - unidirectional)

Stage: Automatic

Dichroism:  2 En Pol EPU Offset  
 2 Reg

Defocus: Focus (nm) 49  
Auto Defocus

Accel. Dist. (µm) 1.181  
Point Delay (ms) 0.04  
Auto Parameters

Line Delay (ms) 10  
Energy point wait time EPWT (ms) 300  
Wait Time Between Regions 300  
Additional Wait Time WT=EPWT+dE \* AWT 0

Scripted Scan   
Remote Start

Sample/Scan Annotation (saved in .hdr file)

Energies: Current Energy 204.275  
Total Points 81  
Single Energy   
Regions 3  
Same dwell   
Dwell Time (ms) 1

Region	Start Energy (eV)	End Energy (eV)	Range (eV)	# Points	Step (eV)	Dwell Time (ms)
1	281	284	3	10	0.333	1
2	284.1	292	7.9	54	0.149	1
3	292.3	298	5.7	17	0.356	1

Scan Velocity: 0.048 mm/s  
Fine Stage

Spatial Regions:  Multiple Regions

Regions	Centre Pos (µm)	Range (µm)	# Points	Step (µm)
X	-4988.990	5.000	100	0.0500
Y	142.180	5.000	100	0.0500

Buttons: Begin Scan, Cancel, Save Scan Definition..., Load Scan Definition..., Load Energy Definition..., Recorded Channels..., Check Velocity, Move To First Energy Point, Record Position

### 3. Moving between samples on the same sample holder

- 3.1. Write down the current Coarse Z reading (for example, 400  $\mu\text{m}$ ).
- 3.2. Move Coarse Z by 1000  $\mu\text{m}$  from the current position ( $400 + 1000 = 1400 \mu\text{m}$ ).
- 3.3. Move to your next sample by changing coarse X and coarse Y.
- 3.4. If you are going to use the same energy, move coarse Z to 500  $\mu\text{m}$  ( $400 + 100 = 500 \mu\text{m}$ ). If you are going to use a different energy, refer to step 4.
- 3.5. Repeat steps from 2.12 to 2.15.

### 4. Change to a different energy

- 4.1 Write down the current coarse Z reading (for example, 400  $\mu\text{m}$ ).
- 4.2 Write down the current A0 reading (for example, 390  $\mu\text{m}$ ).
- 4.3 Change ZP to static mode.
- 4.4 Select the right polarization (if your sample is not polarization sensitive, use Circular Right/Left), grating, harmonic number.

Energy Range (ev)	Grating	Harmonic	Polarization
<320 up to 390	LEG 250 l/mm	1 <sup>st</sup> (use it for only C 1s & below)	LH, CR, CL
330 to 1000	MEG 500 l/mm	1st	LH, CR, CL
1000 to 1800	MEG 500 l/mm	3rd	Only LH
1800 to 2500	MEG 500 l/mm	5th	Only LH
>2200	HEG 1250 l/mm	5 <sup>th</sup> or 7 <sup>th</sup> (not well characterized)	Only LH

- 4.5 Change to the desired energy. Choose a proper A0 (for example, 690  $\mu\text{m}$ ) as recommended by the software (click the “S” above A0 line ).
- 4.6 Calculate the difference of the two A0 ( $\Delta$ :  $690 \mu\text{m} - 390 \mu\text{m} = 300 \mu\text{m}$ ).
- 4.7 Move coarse Z to the position of the current reading plus the difference of A0 (in this case, the new position is  $700 \mu\text{m} = 400 \mu\text{m} + 300 \mu\text{m}$ ).
- 4.8 Set ZP to auto mode, and click ‘Go’ besides energy again.
- 4.9 Repeat steps from 2.12 to 2.15.

### 5. Unloading Sample

- 5.1 Close SM-PSH and BSH – SM beamline control.
- 5.2 Move coarse Z to 5000  $\mu\text{m}$ .
- 5.3 Detector off.
- 5.4 Pump valve closed and pump off and (if you were pumping).
- 5.5 Vent the STXM tank.
- 5.6 Remove top flange to access sample.
- 5.7 Take sample out, being careful NOT to touch the OSA – lift straight up.
- 5.8 If no more sample to run during the shift, click ‘Close BM’.
- 5.9 Pump STXM tank and fill with He if it is the end of your beam time and there is no user after you (if instructed by the beamline staff).