[Basic procedure]

1. Scan generator → Aztec
    - ✓ Use the “TEM center” to find a region of interest while viewing the STEM image
    - ✓ STEM imaging on GMS will not work anymore
2. Use the Aztec PC and run Aztec
    - ✓ Running ‘Tidy Up’ first recommended
    - ✓ Cool down the EDX detector and insert it
3. Open a new project in AZTEC on a local drive and save it
    - ✓ Now whether AZTEC is running or not does not matter
    - ✓ Memorise the name of the project
4. Run Anaconda Prompt, type ‘conda activate vjem38’ and ‘spyder’
5. Run the acquisition program (‘merlin_acquisition_pyJEM_AZTEC_EDX.py’)
    - ✓ The Merlin acquisition software on the Merlin PC must be running
    - ✓ Note that the first run always fails
6. Input the acquisition parameters on the GUI (Please see below for the details)
    - ✓ If ‘Simultaneous EDX’ is unchecked, it will work just like the normal Merlin acquisition program
    - ✓ In this case, the scan generator should be JEOL scan generator
7. Scan

[GUI input parameters]

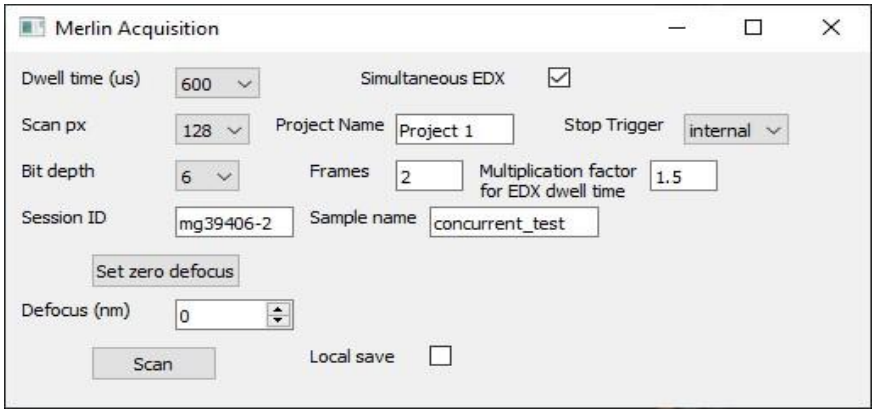


Figure 1 Acquisition program

1. Simultaneous EDX:

    If checked, 4DSTEM and EDX will be obtained simultaneously for the same scan area

2. Project Name:

    It must be the same as the name specified previously in Aztec

3. Stop Trigger:

Stop Trigger

Internal – The frame or sequence will stop when it reaches the frame time set on the main panel.

Rising/Falling Edge (LVDS) – The frame or sequence will stop when a rising or falling edge is detected on the selected line (TTL In, or LVDS In).

If the stop trigger is 'internal', the dwell time for EDX must be larger than that for Merlin. In other words, 'Multiplication factor for EDX dwell time' should be larger than 1 (≧1.5 recommended). Also, 'Scan px' is recommended to be only 128. If 'Scan px' is larger than 128, the scan result will be as shown in Figure 2.

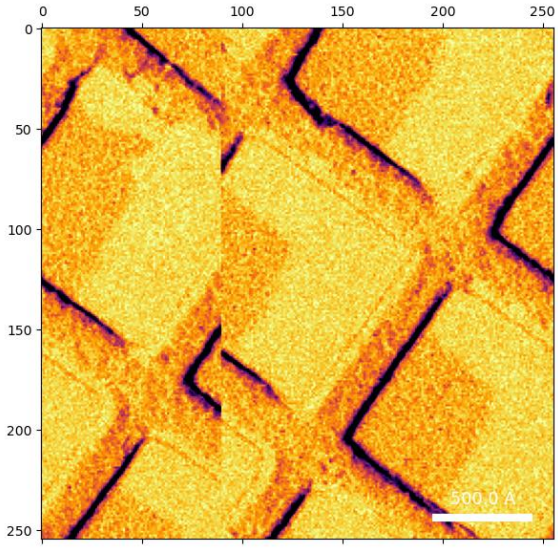


Figure 2 Unexpectable scan behaviour when 'Stop Trigger' is 'internal' and 'Scan px' is 256

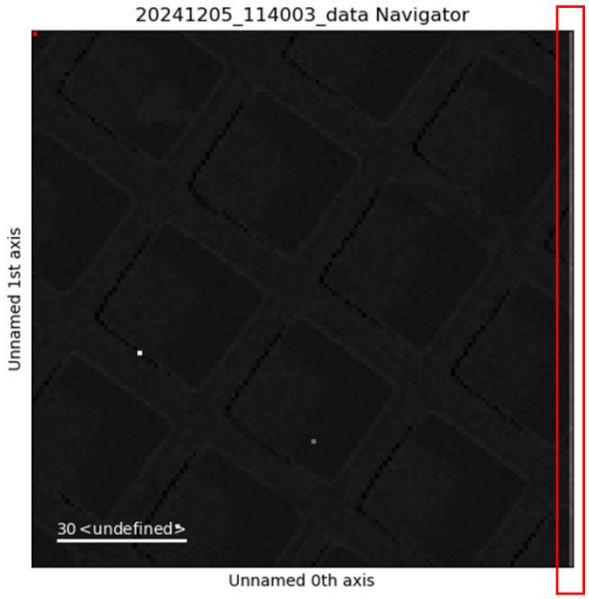


Figure 3 Weird last column (flyback) when 'Stop Trigger' is 'rising edge'

If the stop trigger is 'rising edge', the dwell times for Merlin and EDX must be the same. In other words, 'Multiplication factor for EDX dwell time' must be 1. In this case, one of the columns of the 2D scan

region must be removed manually by post-processing the data (Figure 3). Furthermore, this condition can cause abnormal spike signals (white pixels in Figure 3) in 2D diffraction data because the EDX system can incur a longer dwell time on Merlin.

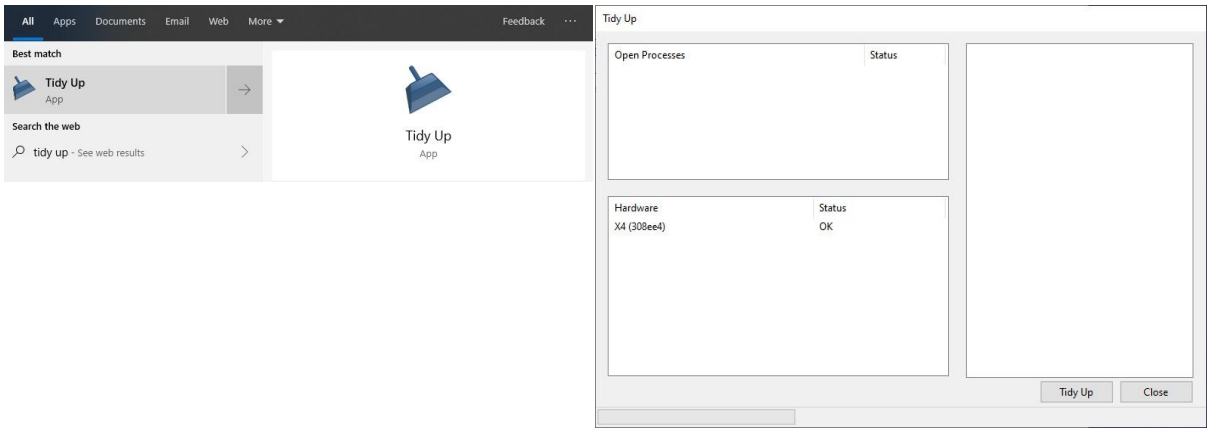
4. Frames:

If greater than 1, the acquisition will be repeated for the number of frames, and the 4DSTEM and EDX data will be saved individually for each frame. This also works when “Simultaneous EDX” is unchecked.

[Important Note]

0. Troubleshooting

When the acquisition is not working properly, it is recommended to reboot Merlin software on the Merlin PC or running ‘Tidy Up’ on the Aztec PC. ‘Tidy up’ will make the EDX system the default. Therefore, you should cool down and insert the EDX detector again.



0.1 Code 5060 (on Merlin)

Clearing the error log may solve the problem.

0.2 Sleep mode?

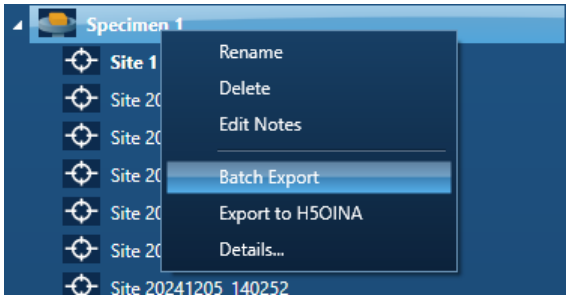
If acquisition is paused for a while (e.g., while swapping the sample), a disconnection is highly likely to occur (resulting in "RuntimeError: Could not start acquisition" in Python). This might be because the EDX system switches to sleep mode, which causes a disconnection between the Aztec REST API and the hardware.

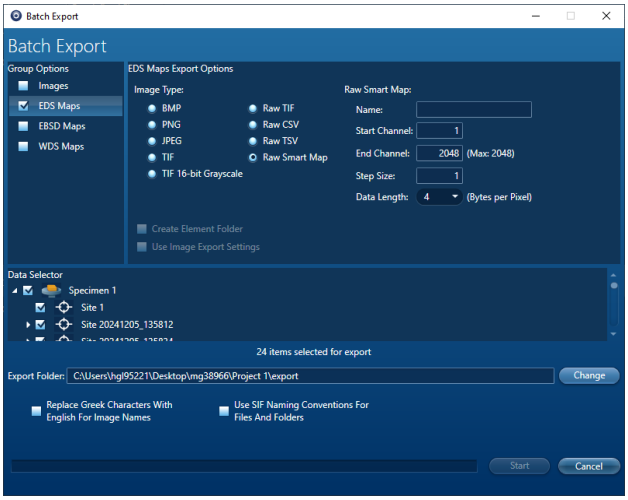
1. MIB conversion

When converting the MIB files obtained concurrently with EDX, ‘flyback’ option cannot be used. Therefore, ‘Auto reshape’ option is recommended. Or the exact scan shape must be specified by the user (‘Known_shape’), and the possible [‘Scan_X’, ‘Scan_Y’] options are [128, 127] and [256, 255].

2. Export the EDX files

Many EDX map data can be exported using ‘Batch Export’ (by right-clicking on any data name). If EDX map data is saved as a ‘raw’ file (‘Raw Smart Map’), it can be read using ‘HyperSpy’ in Python. If you want to export multiple data, the 'Name' field in the 'Batch Export' window must be empty.





3. Example acquisition parameters

Please note that the acquisition of 256×256 scan shape data is unstable and may result in disconnection from Aztec or Merlin. This is under investigation.

Test Number	Parameters	Observations/Errors/Notes
test 1	600, 128, rising, 1 frame	spikes observed
test 2	600, 128, rising, 1 frame	spikes observed
test 3	600, 128, rising, 20 frames	spikes observed
test 4	600, 128, internal (1.5), 1 frame	
test 5	600, 128, internal (1.5), 10 frames	
test 6	600, 128, internal (2.0), 10 frames	
test 7	600, 256, internal (1.5), 1 frame	
test 8	600, 512, internal (1.5), 1 frame	
test 9	600, 256, internal (1.5), 10 frame	error on Merlin after acquiring the first frame Code 5060 - Timeout in STEM Analysis. Not enough images available from the source. **After clearing the error log, it started acquisition again**
test 10	600, 256, rising, 1 frame	spikes observed
test 11	600, 256, rising, 10 frames	spikes observed
test 12	600, 256, internal (3.0), 10 frames	
test 13	600, 256, internal (1.5), 1 frame	
test 14	600, 128, internal (1.5), 1 frame	error on Merlin Code 5060 - Timeout in STEM Analysis. Not enough images available from the source. The error log was cleared
test 15	600, 128, internal (1.5), 1 frame	