



# GUI Satellite Workshop

NOBUGS 2024 · ILL & ESRF · Grenoble, France

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**Monday 23<sup>rd</sup> September**

Letizia Sammut

*Senior Scientific Computing Software Engineer  
Australian Synchrotron, ANSTO*

Science. Ingenuity. Sustainability.

# The Scientific Computing Team



Scientific Computing since June 2017



Support Science and Users

- Experiment Control
- Data Acquisition
- Data Processing
- Data Analysis



Our Team

- 1 manager
- 17 members
  - 1 principal engineer
  - 10 PhDs
  - 47% gender split



Our Facility

- 18 beamlines
  - 10 original
  - 8 new BRIGHT beamlines (3 already operating)

## Beamline Groups

Imaging

Spectroscopy

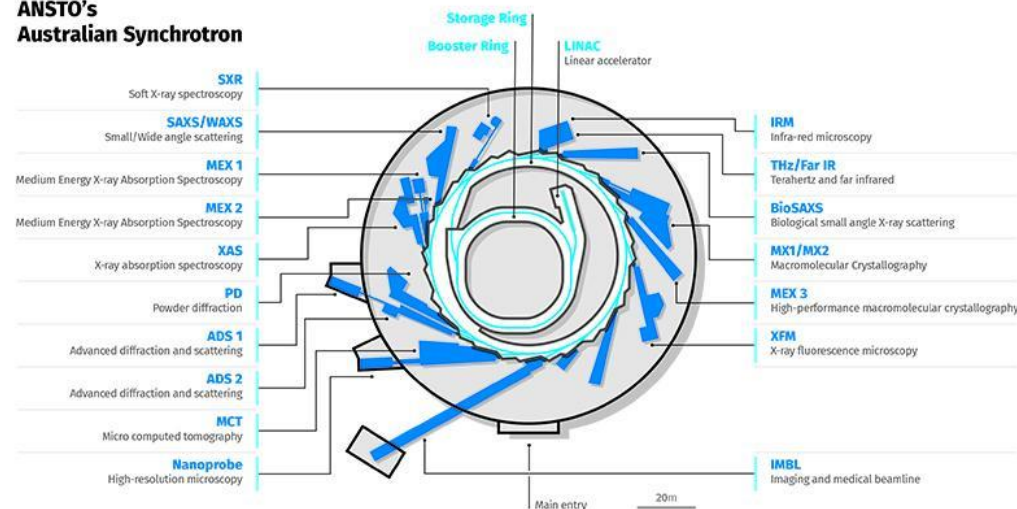
Microscopy

Scattering

Crystallography

Diffraction

## ANSTO's Australian Synchrotron



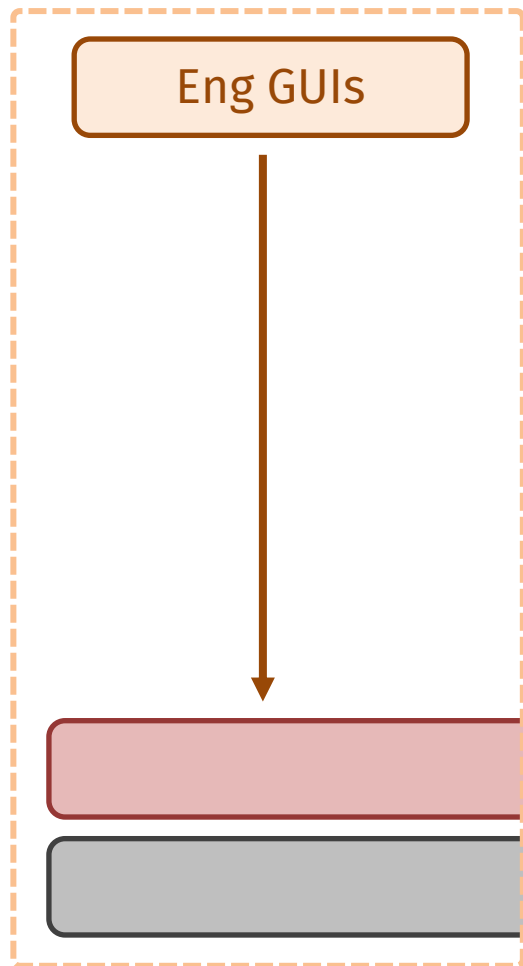
## Cross-functional teams

- Experiment Control
- Data Acquisition
- Processing
- GUI

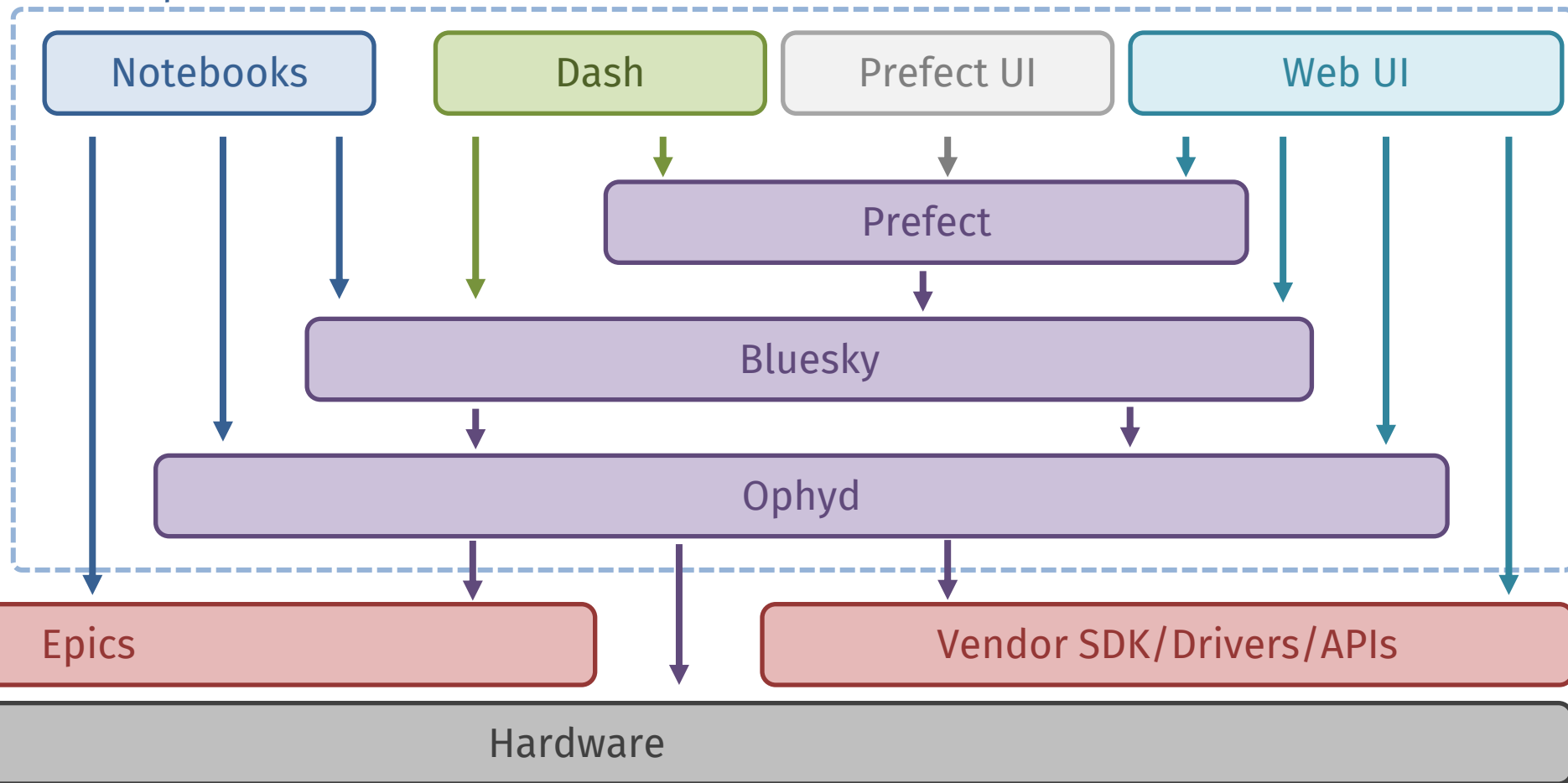
# GUI Overview



## Controls



## Sci Comp



# Engineering GUIs (Controls)

## Qt (QE Gui)

### ■ Direct Access to Devices

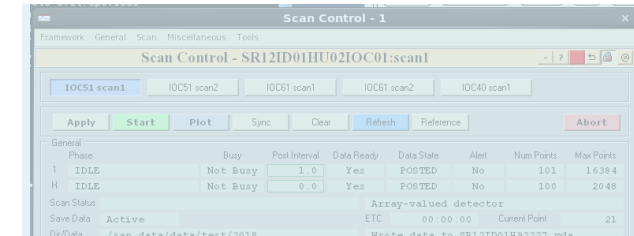
- 1:1 relationship between GUI element and device
- no additional layers, direct access to EPICS

### ■ Fully Tested

- values in fields can be trusted
- under change management

### ■ Access Control via OS

- run natively on OPIs



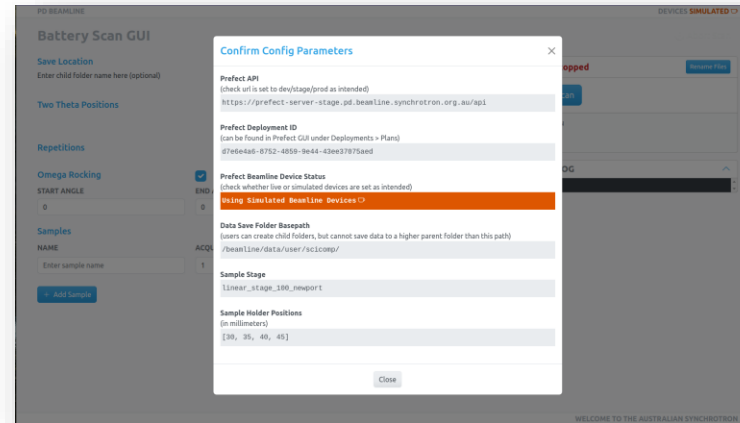
<https://github.com/qtqepics>



# Web Interfaces (Sci Comp)

- **Only needs a browser**

- No OPI installs, centrally updated
- Works on many device types
- Remote access enabled

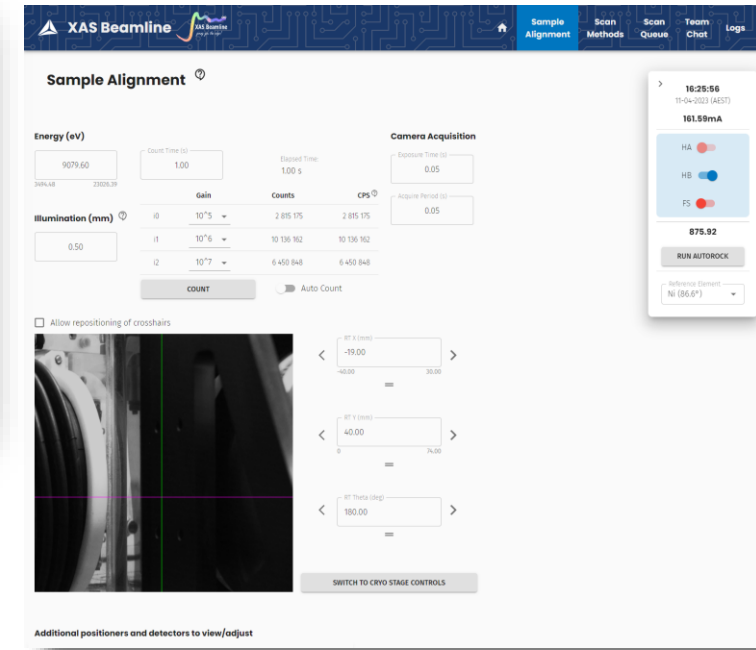


- **Cyber-security friendly**

- Securing websites is well understood
- User login easy to implement

- **User Experience**

- Users are very familiar with websites and their visual language
- Users know how to troubleshoot websites (refresh button, back button, etc.)



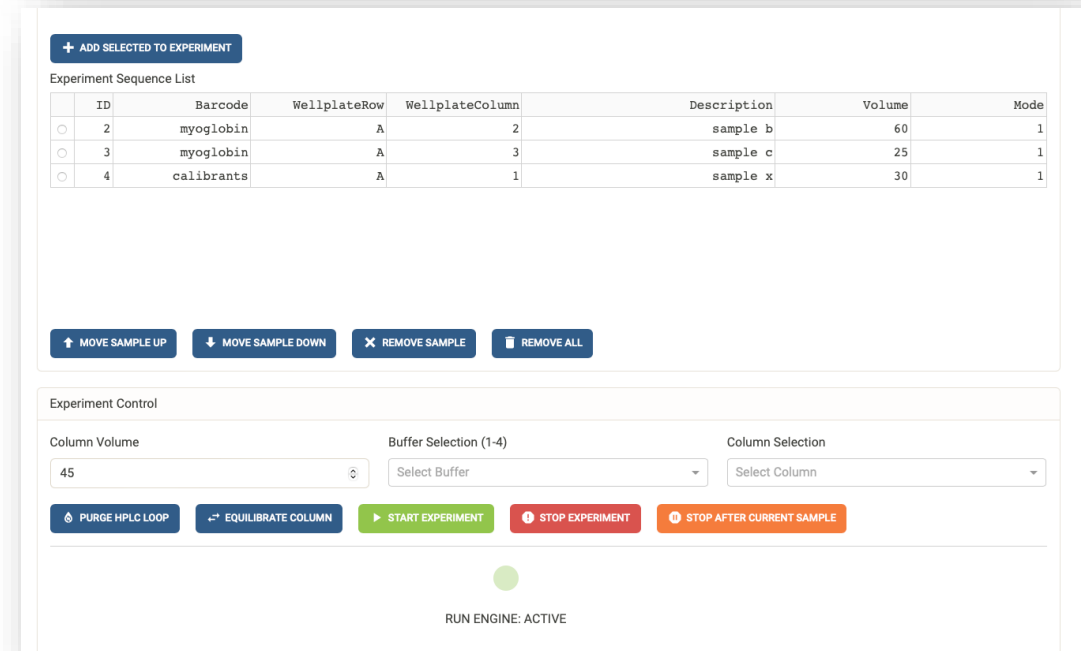
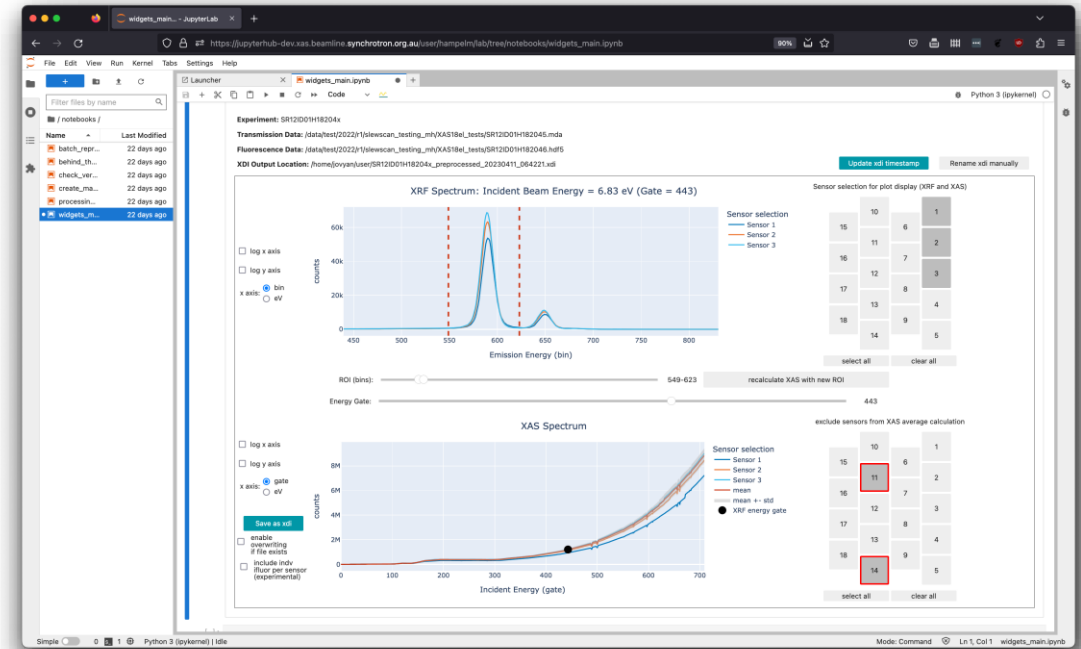
# Jupyter and Dash

## Jupyter Notebooks

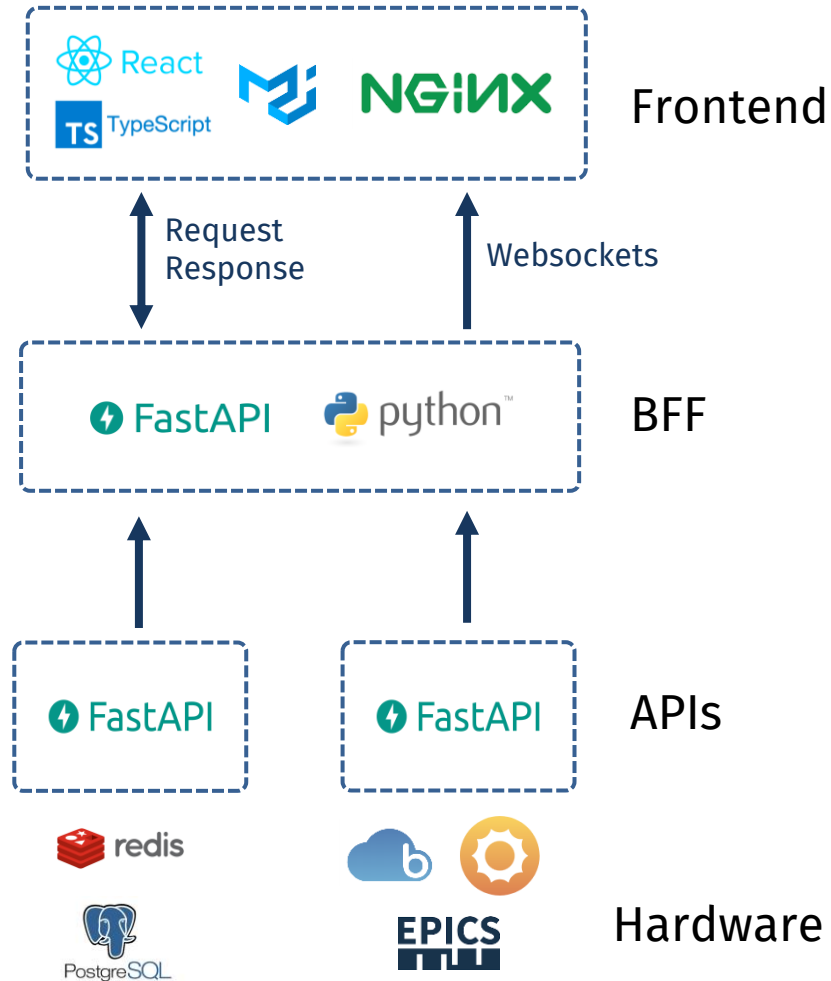
- Jupyter notebook employed as a first level playground to talk to Ophyd devices and run Bluesky plans
- Flexible, can support custom experiments
- Can also be useful for initial processing
- Still code based - widget functionality possible but limited
- Linear/sequential nature – difficult to make dynamic

## Dash

- Quick to make web UIs
- No JavaScript required
- Integrates into Jupyter
- Managing more than a handful of state becomes unwieldy



# Web UI Technology



## Industry Standard Technology

- Frontend
  - ReactJS / NextJS
  - TypeScript
- Backend to the Frontend (BFF)
  - FastAPI (Python)
- Backends
  - Hardware: FastAPI + ophyd/bluesky
  - Non hardware: FastAPI + database

# Example: MCT

https://mct-web-ui-prod.mct.beamline.synchrotron.org.au/acquisition

MCT

Acquisition

Service Status

Results

Setup ROI setup Acquisition Monitoring File viewer

### Acquisition Parameters

Scan name: FLY SCAN

Flyer speed mode: normal

Sample name\*: test\_scan

Description

Exposure time\*

Pre flats/darks  Post flats/darks

Number of flats/darks\*: 0

Scan range\*: 185 deg

Number of projections\*: 1851

Angle step: 0.1000 deg

Scan mode

Tiling motors  Horizontally(X)  Vertically(Y)

Number of steps along X\*: Step size along X\*: mm

Number of steps along Y\*: Step size along Y\*: mm

### Review parameters

Detector	mono taper
ROI shape (X * Y)	2560 * 2160
ROI origin (X, Y)	(0, 0)
Magnification	1.25
Effective pixel size (µm)	[5.2,5.2]
Sample to detector distance (m)	0.16
Beam mode	MONO
Energy (keV)	20.00
Source to sample distance (m)	10
Stage motor	x
Position mode	Relative
Sample out position (mm)	10
Shutter	beamline_shutter
CT stage	ct_stage_b1
Flyer parameters	normal
Trigger mode	position
Rotation velocity mode	optimal
Manual velocity factor	0.5
Rotation velocity max (deg/s)	50
Kickoff timeout (s)	60
Complete timeout factor	2
Trigger time min	0.01

BACK START ACQUISITION



# Example: XAS

**XAS Beamline** Use Dtaq

Sample Alignment Scan Methods Scan Queue Team Chat Logs

### Sample Alignment

Energy (eV) Illumination (mm) Count Time (s)

6440.14 0.25 0.10

3422.28 21020.98 0.01 10.00

	Gain	V	%	Live-%
10	10 <sup>-8</sup>	2.7722	27.722	0.140
11	10 <sup>-8</sup>	0.9169	9.169	0.180
12	10 <sup>-9</sup>	0.5905	5.905	0.140

COUNT Monitor

### Camera Acquisition

Allow repositioning of crosshairs

Exposure Time (s) 0.09

Acquire Period (s) 0.10

RT X (mm) -16.00

RT Y (mm) 12.00

RT Theta (deg) 120.00

TO CRYO STAGE

Additional positioners and detectors to view/adjust

Positioner Detector

> Count Scan Controls (Dummy scan)

> Alignment Scan Controls

14:23:15  
20-09-2024 (AEST)  
200.39mA

HA

HB

FS

226 065

RUN AUTOROCK

Reference Element  
V (122.6°)

### > Detector Controls

**Move Detector**

det x (mm) 200.00

146.00 435.00

**Setup Detector Test**

Count time 1

Sample Element Fe

Edge K (7112.0)

Set - ROI Low 6005 eV

Set - ROI High 6805 eV

RUN DETECTOR TEST

ROI 1 UPDATE ROIS

(Currently using Dtaq)

### Fluorescence Information

	Sum	Average
All events	1 504 660	83 592
All good events	1 475 580	81 977
ROI_1	481 970	26 776
ROI_2	50	3

### Detector Spectra

Element Selection To Plot

Display ROI 1 Display ROI 2

Low: 4550 eV High: 5350 eV

Low: 0 eV High: 0 eV

Cursor coords : x 0.000 y 0.000

Drawn distance : dx dy diagonal drawn distance

NORMALISE ABSOLUTE LOG 10 SCALE LOG E SCALE

RESET ZOOM ZOOM OUT

# Example: MEX

The screenshot displays the MEX Beamline web interface. The browser address bar shows the URL: `mex-web-ui-stage.mex.beamline.synchrotron.org.au/queue`. The sidebar on the left contains the following navigation items: Experiment Setup, Device Controls, Scan Recipe, Queue Builder, Queue (highlighted),  $\mu$ -Trajectory,  $\mu$ -SDD Oneshot,  $\mu$ -Camera Viewer, Scan Simulator, Ophyd Example, Plot Example, and Websocket.

The main content area is titled "Worker Env" and includes a "State" section with a person icon and the text "No scan running". Below this are three buttons: "START QUEUE" (blue), "STOP QUEUE" (grey), and "ABORT SCAN" (grey).

The "Queue Contents" section features a table with the following columns: Scan Type, Label, Positioners, Repeats, Autorock, Comment, Filename prefix, and Added at. It contains two rows of data:

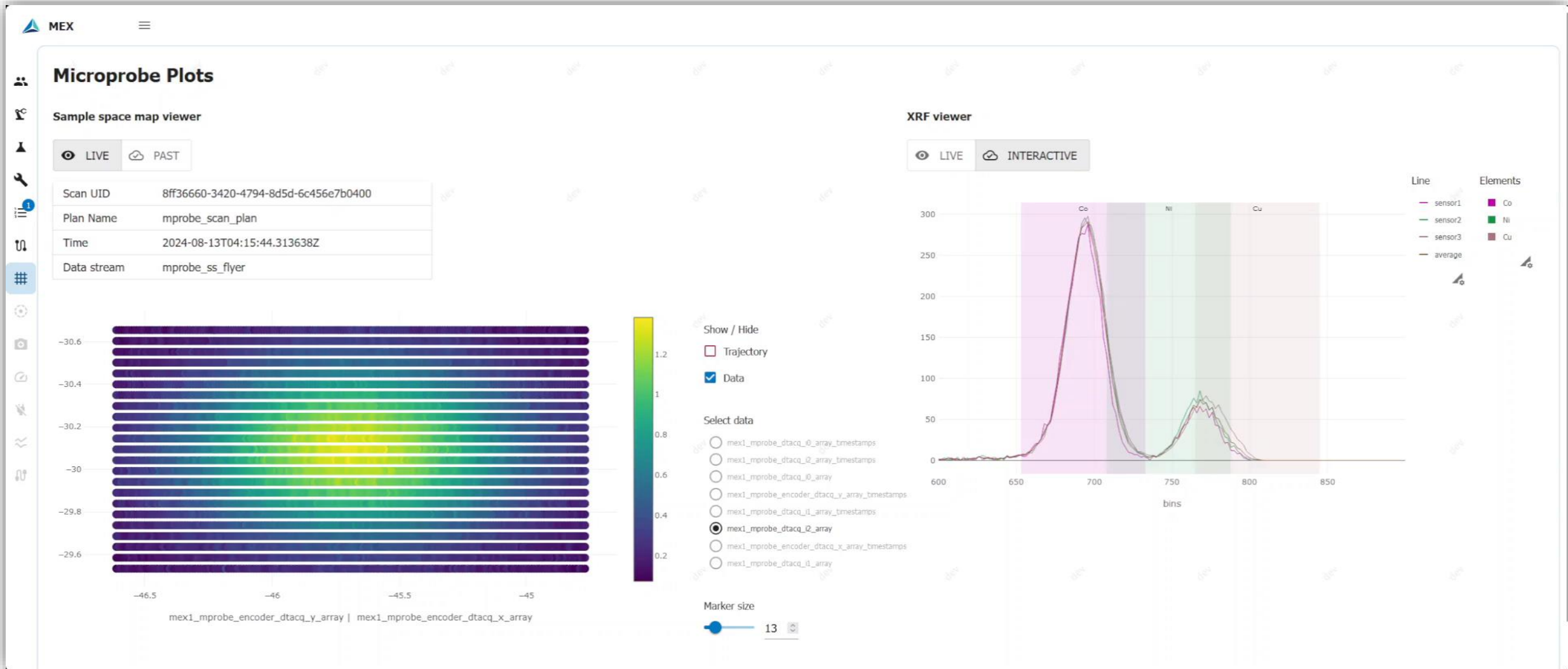
Scan Type	Label	Positioners	Repeats	Autorock	Comment	Filename prefix	Added at
⋮	scan_wrapper						21:10:01 2024-02-29
⋮	scan_wrapper						21:10:05 2024-02-29

Below the table, it indicates "Rows per page: 10" and "1-2 of 2".

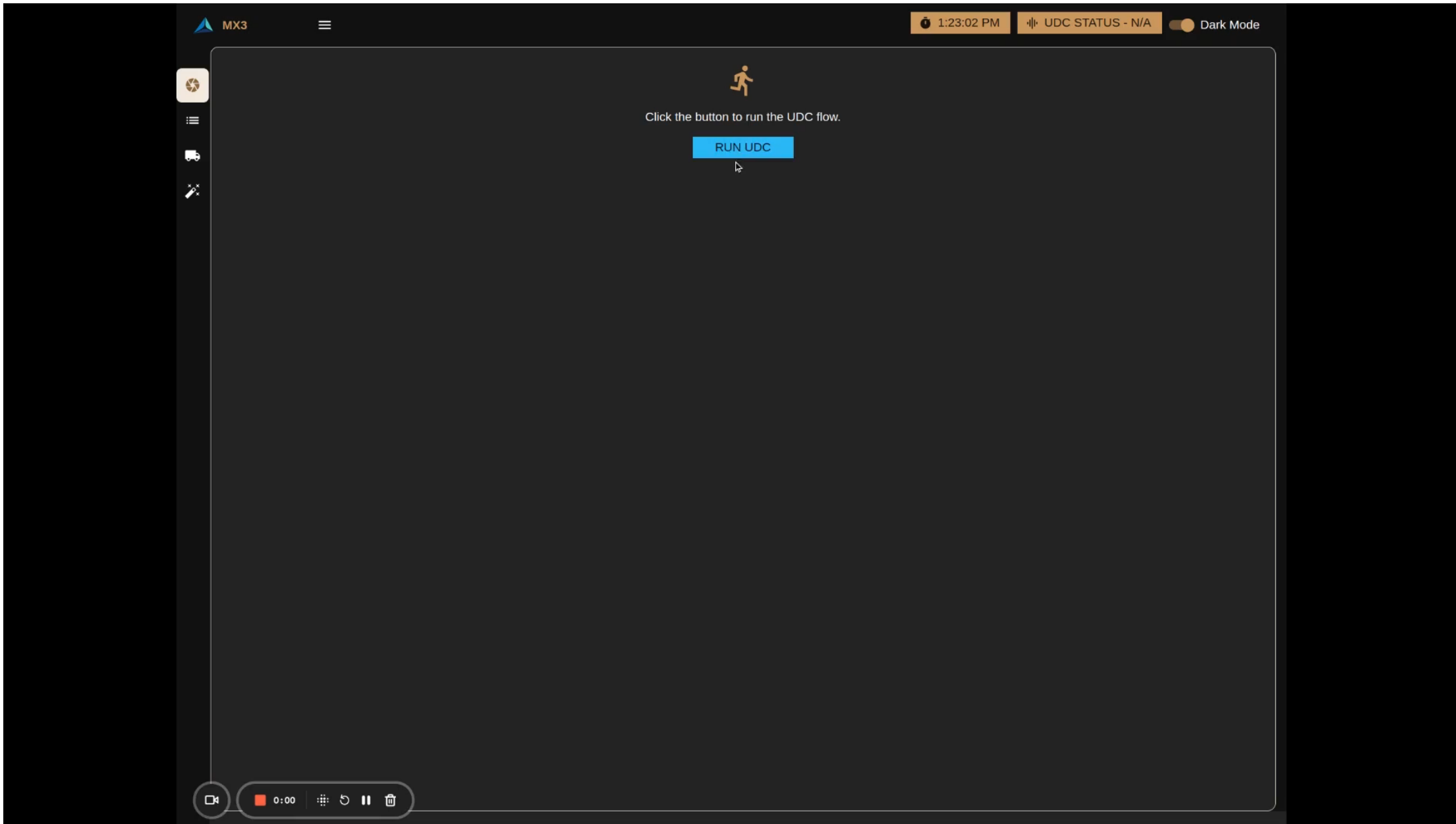
The "Queue History" section features a table with the following columns: Status, Scan Type, Label, Positioners, Repeats, Autorock, Comment, Filename prefix, and Finished at. It contains two rows of data:

Status	Scan Type	Label	Positioners	Repeats	Autorock	Comment	Filename prefix	Finished at
✓	scan_wrapper							21:01:22 2024-02-29
✓	scan_wrapper							21:00:45 2024-02-29

# Example: MEX



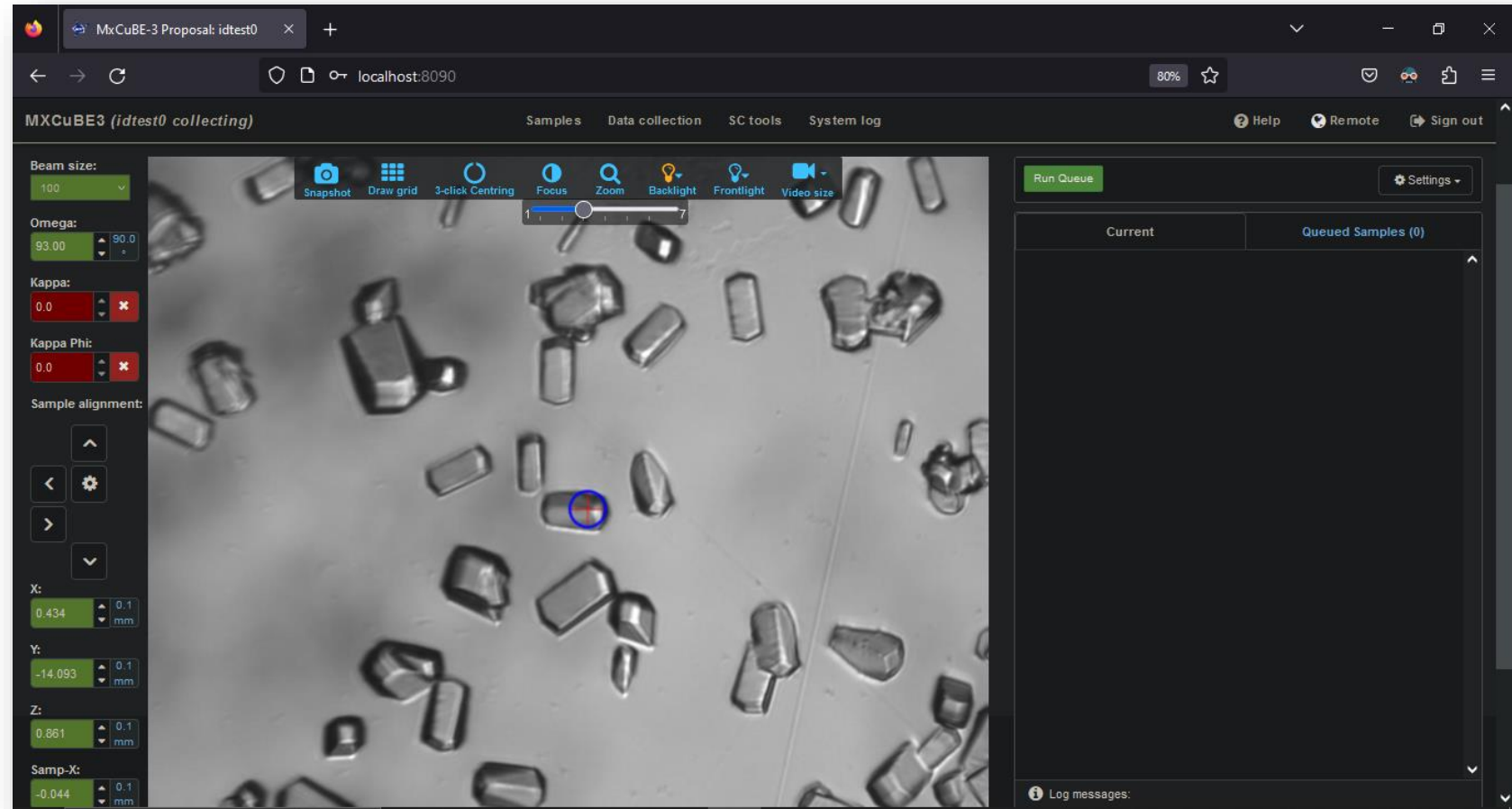
# Example: MX3



# MXCuBE at MX3

## MXCuBE Web

- Currently used at MX3
  - Tech stack is perfect match
- Member of Collaboration
  - Contribute to code
  - Integrated Bluesky



# Strategies and Challenges

## Strategies

- Industry standards and off-the-shelf tools
  - Large eco-system and training material
  - Standard protocols (http), cyber secure

## Challenges

- Web frontend very specific tech stack
  - Needs specialised skillset
  - Fast paced upstream development of frameworks
- Web frontend for “industrial control “
  - Real-time data transfer (e.g. array data)
  - UX challenge

The screenshot displays the MEX web interface. On the left is a navigation menu with the following items: Experiment Setup, Device Controls, Scan Recipe, Queue Builder, Queue, **μ-Trajectory** (highlighted), μ-SDD Oneshot, μ-Camera Viewer, Scan Simulator, Ophyd Example, Plot Example, and Websocket. The main content area is titled "Trajectory Preview" and contains "Input Parameters" for a "Snake PVT" trajectory type. The parameters are: Start X: -46, End X: -45, Pix X: 1, Feed Rate X: 10, Start Y: 0, End Y: 1, Pix Y: 0.2, and Step Time Y: 10. A blue "GENERATE" button is located to the right of these parameters. Below the input fields is a "Preview" section showing a grayscale image of a rocky surface with a red trajectory line overlaid. At the bottom of the preview are "RESET" and "FOCUS" buttons.

# Thank you

Any questions?