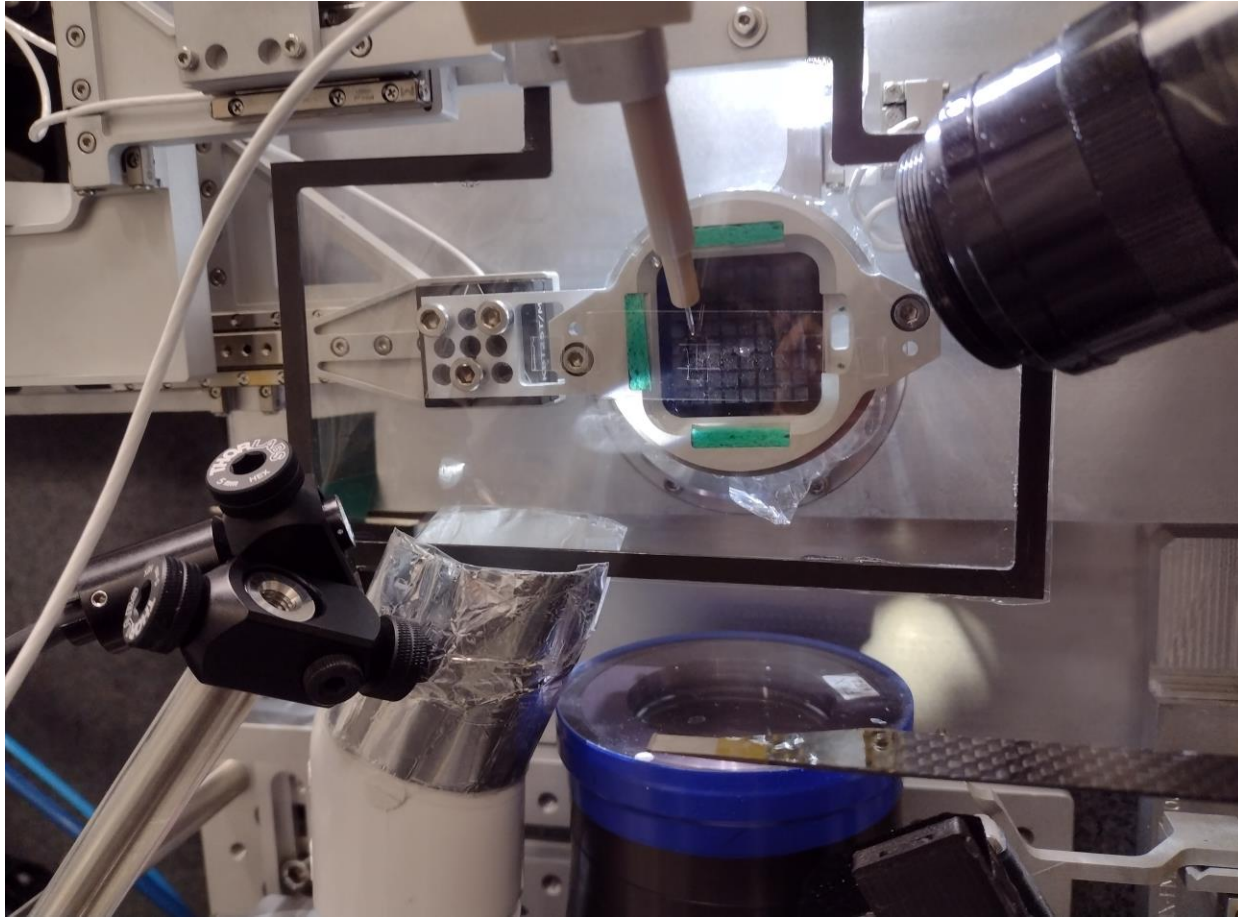


Integrated control of a chip scanner for time-resolved crystallography at the NSLS-II FMX beamline

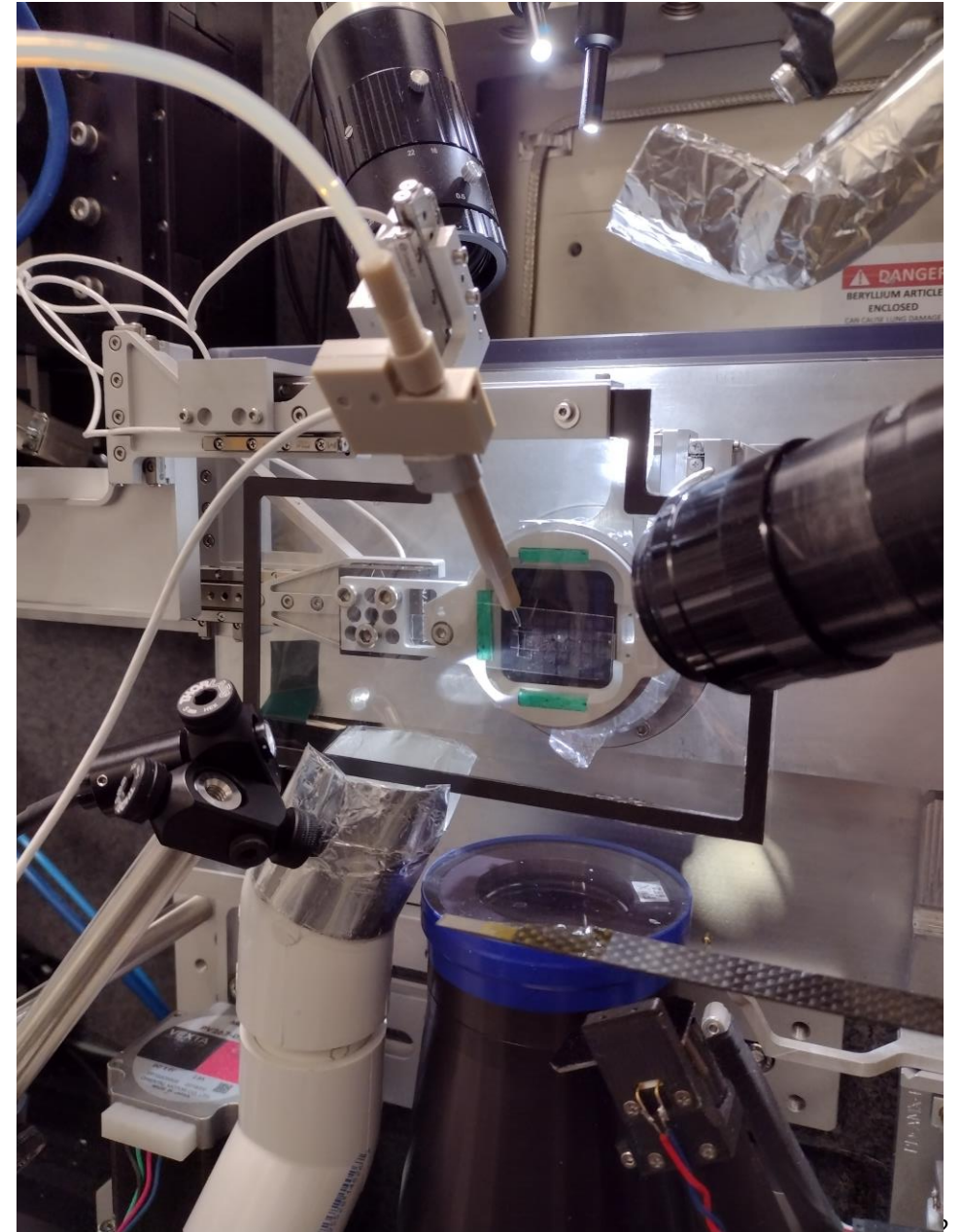
Robert Schaffer, Data Science and Systems Integration, NSLS2

Work done with Kevin Rollet, Shekar Venkateswaren, Wuxian Shi, Alexei Soares and Martin Fuchs

What is it?



National Synchrotron Light Source II

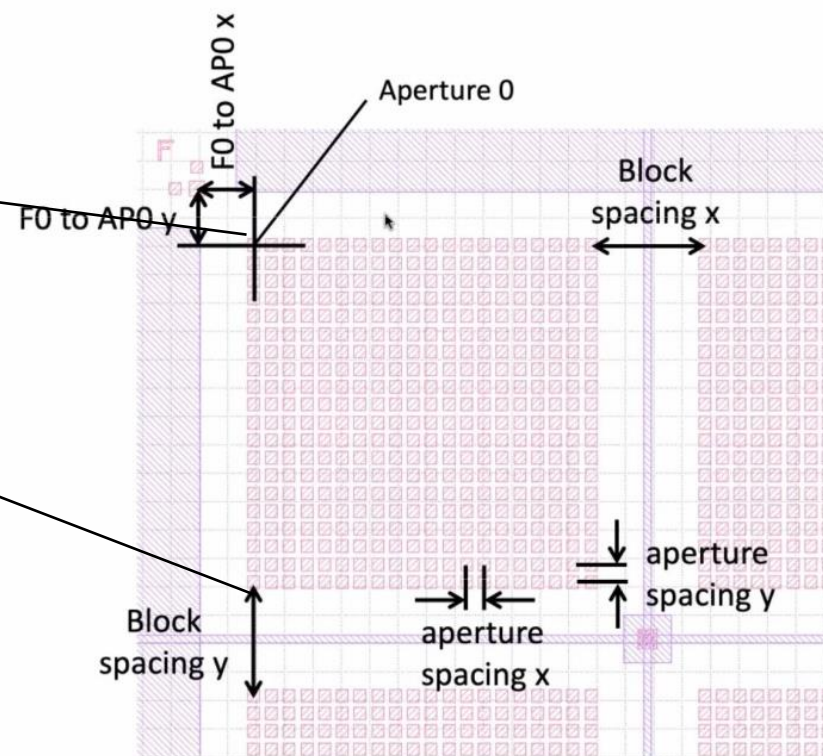
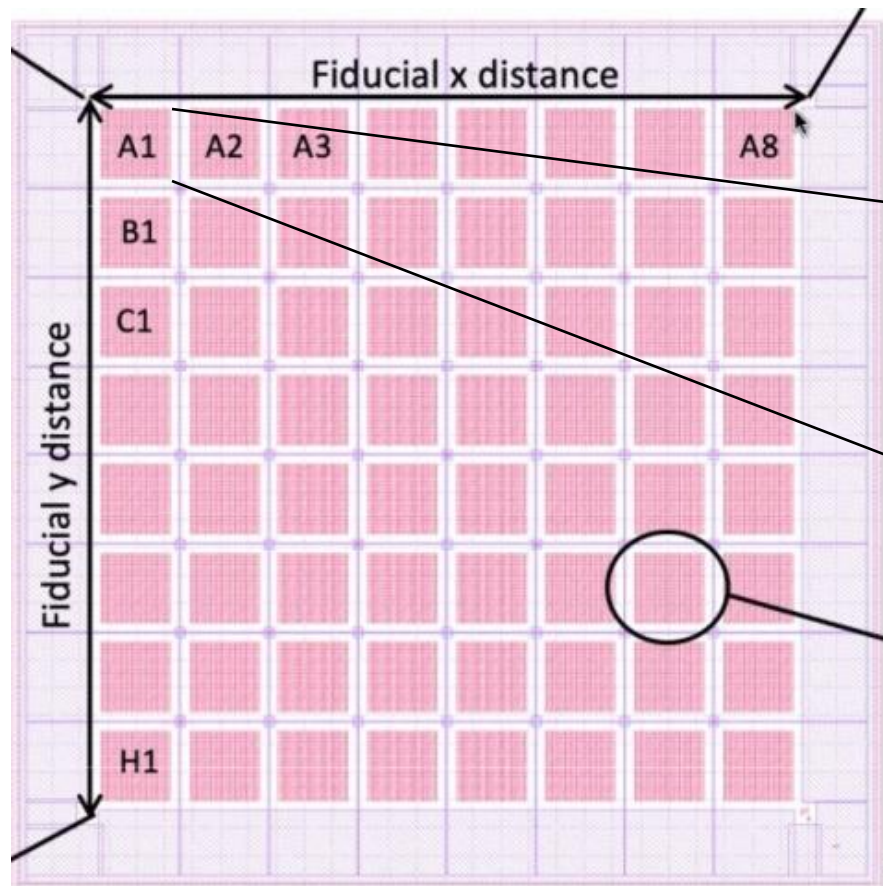


What is it?

Chips from DLS

Fiducial distances = 2.54cm

Aperture spacings = 125 μ m



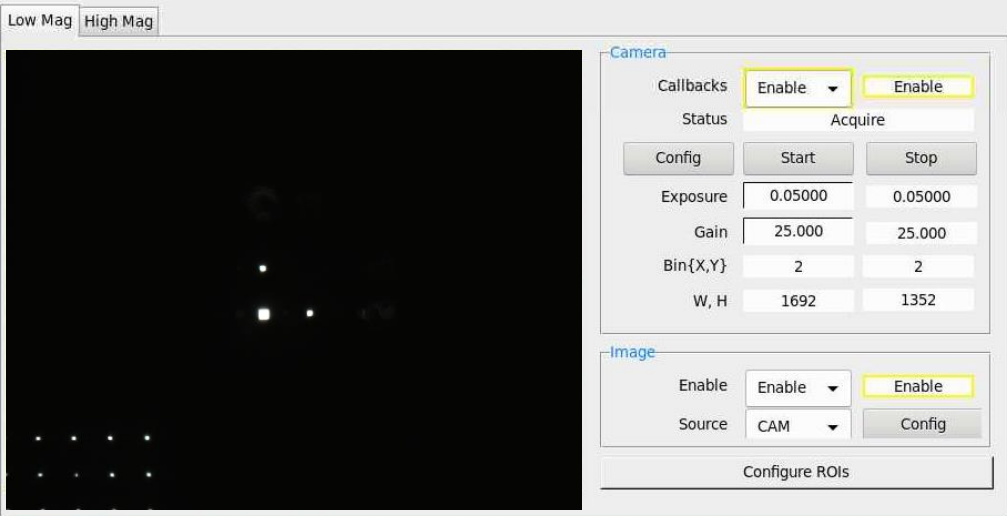
25600 apertures

distances are from the centre of a feature to the centre of a feature not edge to edge

Uses

- Room temperature crystals
- Can get simple crystal measurements
 - With enough, can solve structures
 - Need lots of samples (~10000)
- Pump probe (with laser elsewhere, chemical injection here currently)
 - With varying delay times, ~10ms – 2s

Epics controls

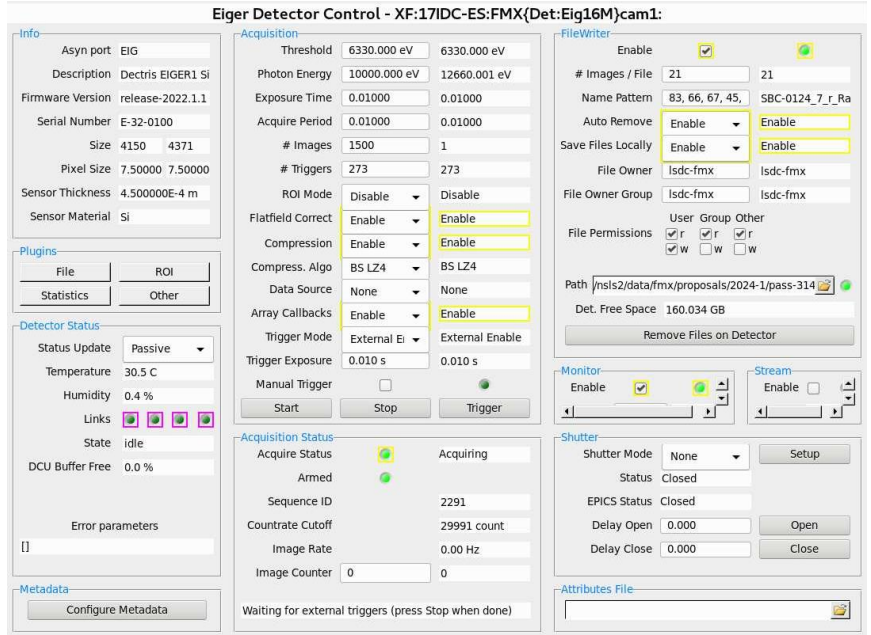


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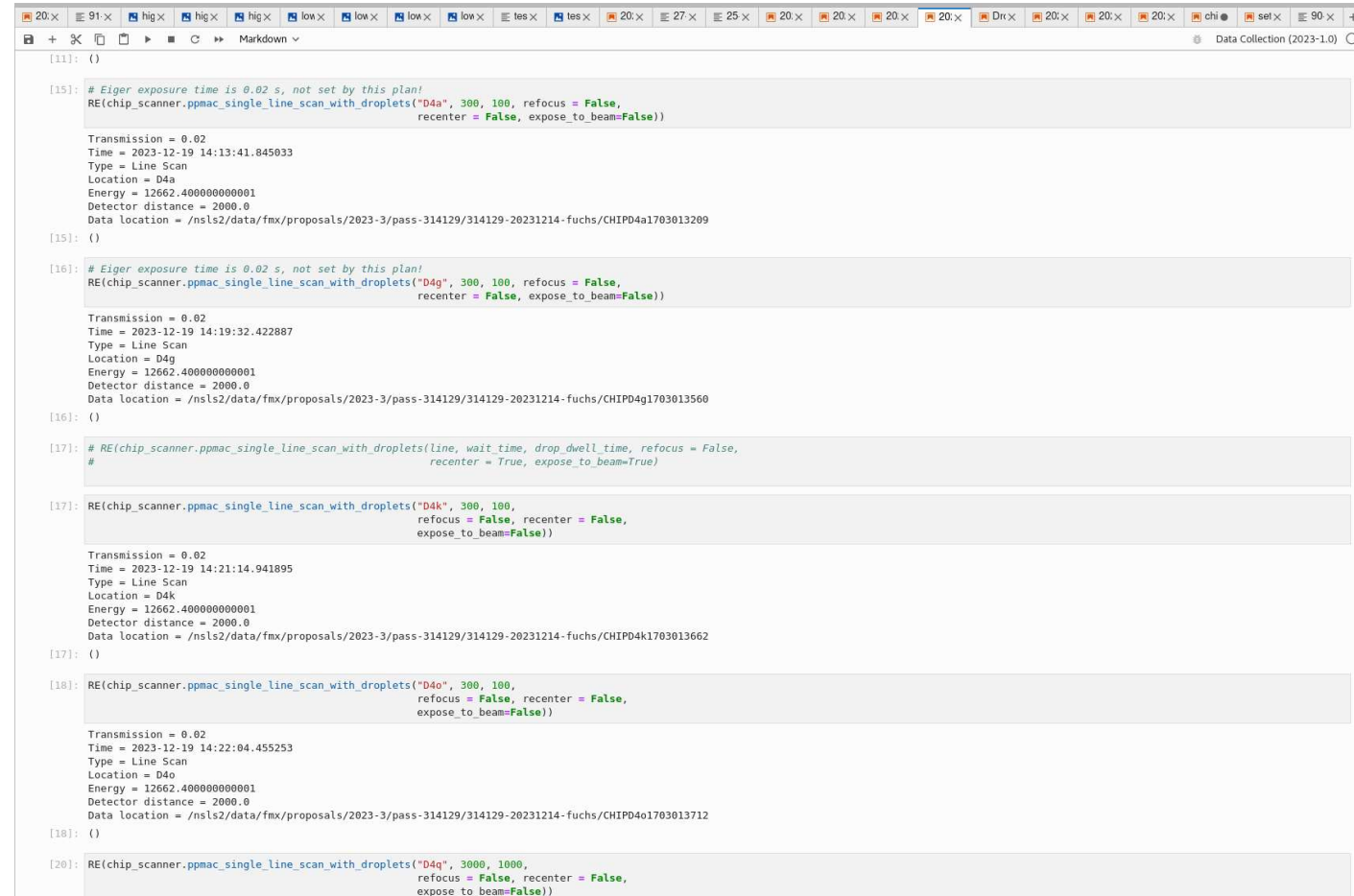
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...



Bluesky controls

- Ophyd Object
- Bluesky Plans
- Run through notebook, IPython (BSUI), Queueserver



The screenshot displays a Jupyter Notebook interface with multiple tabs at the top. The active tab shows a series of code cells and their corresponding output. The code cells contain Bluesky plans, specifically using the `RE(chip_scanner.ppmac_single_line_scan_with_droplets)` function. The output for each cell shows the execution details, including transmission, time, type, location, energy, detector distance, and data location. The plans are executed sequentially, with the first three cells showing successful execution and the last two cells showing an error.

```
[11]: ()

[15]: # Eiger exposure time is 0.02 s, not set by this plan!
RE(chip_scanner.ppmac_single_line_scan_with_droplets("D4a", 300, 100, refocus = False,
recenter = False, expose_to_beam=False))

Transmission = 0.02
Time = 2023-12-19 14:13:41.845033
Type = Line Scan
Location = D4a
Energy = 12662.400000000001
Detector distance = 2000.0
Data location = /nsls2/data/fmx/proposals/2023-3/pass-314129/314129-20231214-fuchs/CHIPD4a1703013209

[15]: ()

[16]: # Eiger exposure time is 0.02 s, not set by this plan!
RE(chip_scanner.ppmac_single_line_scan_with_droplets("D4g", 300, 100, refocus = False,
recenter = False, expose_to_beam=False))

Transmission = 0.02
Time = 2023-12-19 14:19:32.422887
Type = Line Scan
Location = D4g
Energy = 12662.400000000001
Detector distance = 2000.0
Data location = /nsls2/data/fmx/proposals/2023-3/pass-314129/314129-20231214-fuchs/CHIPD4g1703013560

[16]: ()

[17]: # RE(chip_scanner.ppmac_single_line_scan_with_droplets(line, wait time, drop dwell time, refocus = False,
# recenter = True, expose_to_beam=True)

[17]: RE(chip_scanner.ppmac_single_line_scan_with_droplets("D4k", 300, 100,
refocus = False, recenter = False,
expose_to_beam=False))

Transmission = 0.02
Time = 2023-12-19 14:21:14.941895
Type = Line Scan
Location = D4k
Energy = 12662.400000000001
Detector distance = 2000.0
Data location = /nsls2/data/fmx/proposals/2023-3/pass-314129/314129-20231214-fuchs/CHIPD4k1703013662

[17]: ()

[18]: RE(chip_scanner.ppmac_single_line_scan_with_droplets("D4o", 300, 100,
refocus = False, recenter = False,
expose_to_beam=False))

Transmission = 0.02
Time = 2023-12-19 14:22:04.455253
Type = Line Scan
Location = D4o
Energy = 12662.400000000001
Detector distance = 2000.0
Data location = /nsls2/data/fmx/proposals/2023-3/pass-314129/314129-20231214-fuchs/CHIPD4o1703013712

[18]: ()

[20]: RE(chip_scanner.ppmac_single_line_scan_with_droplets("D4q", 3000, 1000,
refocus = False, recenter = False,
expose_to_beam=False))
```

Hardware Challenges

- Well locations slightly off
- Droplet injector clogging
- Motors freezing in the "moving" state

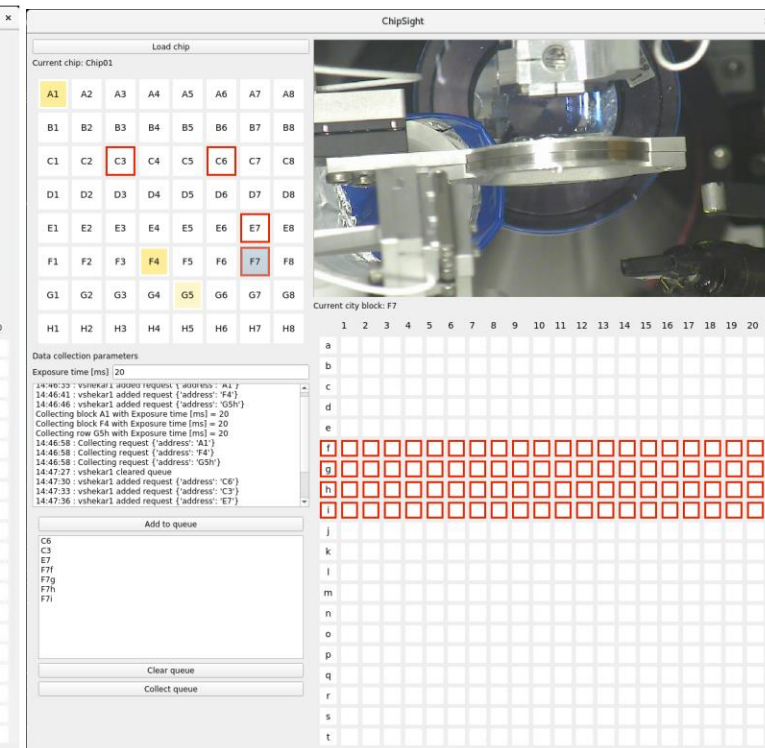
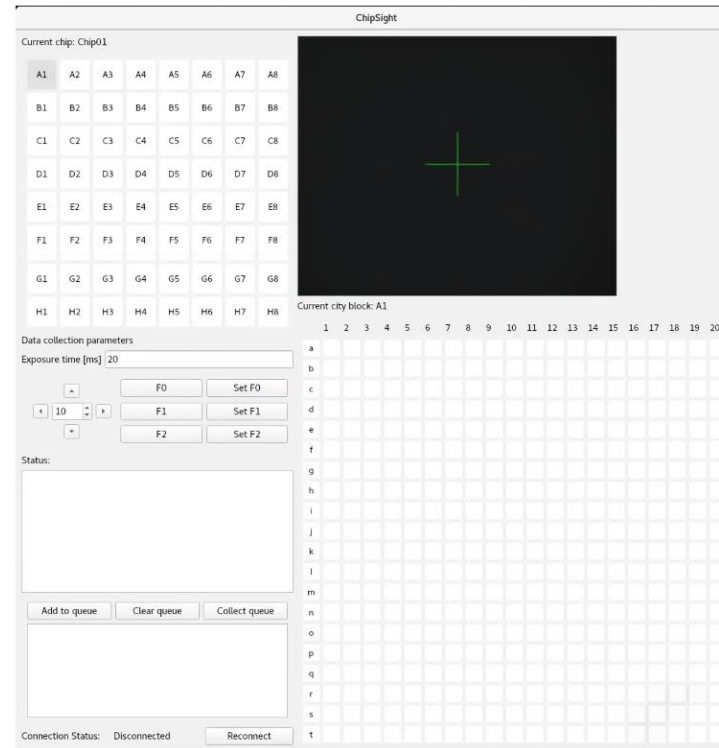
Hardware Solutions

- Well locations slightly off
 - Take additional fiducials
- Droplet injector clogging
 - Check before and after scans
- Motors freezing in the "moving" state
 - "Sentinel" IOC watches for this, resolves, and emits metadata for user processing about the scan points



User facing controls

- Ophyd Object
- Bluesky Plans
- Run through notebook
- Also through GUI
 - Ongoing Development
 - Credit to Shekar
 - Runs through Webserver



Lessons learned

- Don't reinvent the wheel
 - Ask for help
- Prepare for things to break or bend
 - Harden software as best as possible against strange hardware issues
 - Make sure to have lots of spares
 - Lots of time for testing and refactoring is required