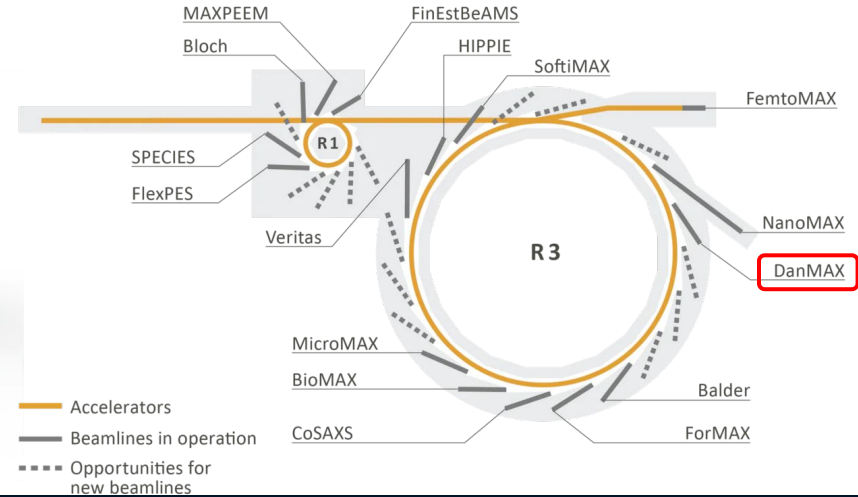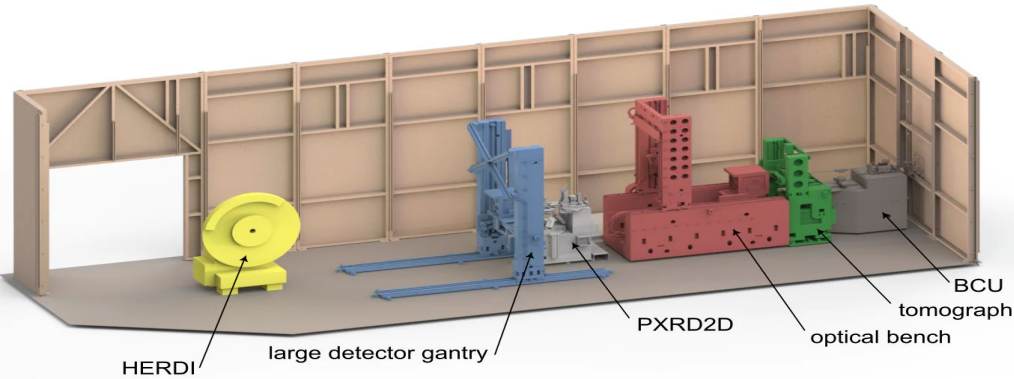# Full-field imaging at DanMAX

Yimeng Li | Software team

DANMAX

- A materials science beamline
- Operates in hard X-ray range 15-35 kev
- Three endstations: full-field imaging, versatile powder diffraction, and high-resolution powder diffraction.

HERDI

large detector gantry

PXRD2D

optical bench

BCU
tomograph

MAXPEEM
Bloch
FinEstBeAMS
HIPPIE
SoftiMAX
FemtoMAX
SPECIES
FlexPES
R1
Veritas
R 3
NanoMAX
DanMAX
MicroMAX
BioMAX
CoSAXS
Balder
ForMAX

Accelerators
Beamlines in operation
Opportunities for new beamlines

MAXIV

Background

Full field tomography experiment at DanMAX has been designed to offer maximum flexibility across a wide spectrum of experimental types and modalities, accommodating a diverse range of samples and sample environments.

Rotary stage: Controlled by an ACS system, the rotary stage serves a dual purpose: it not only supports the XY alignment stages mounted above it but also provides essential electrical connections for user-defined sample environments, including small motors, trigger signals, and high-voltage supplies.

Measurement time: A single-volume tomographic scan (~1 mm3) can be recorded in as little as 1 second. Generally, acquisition times for single volumes range between 10 and 300 seconds, depending on exposure, dynamic range, and the objective used.
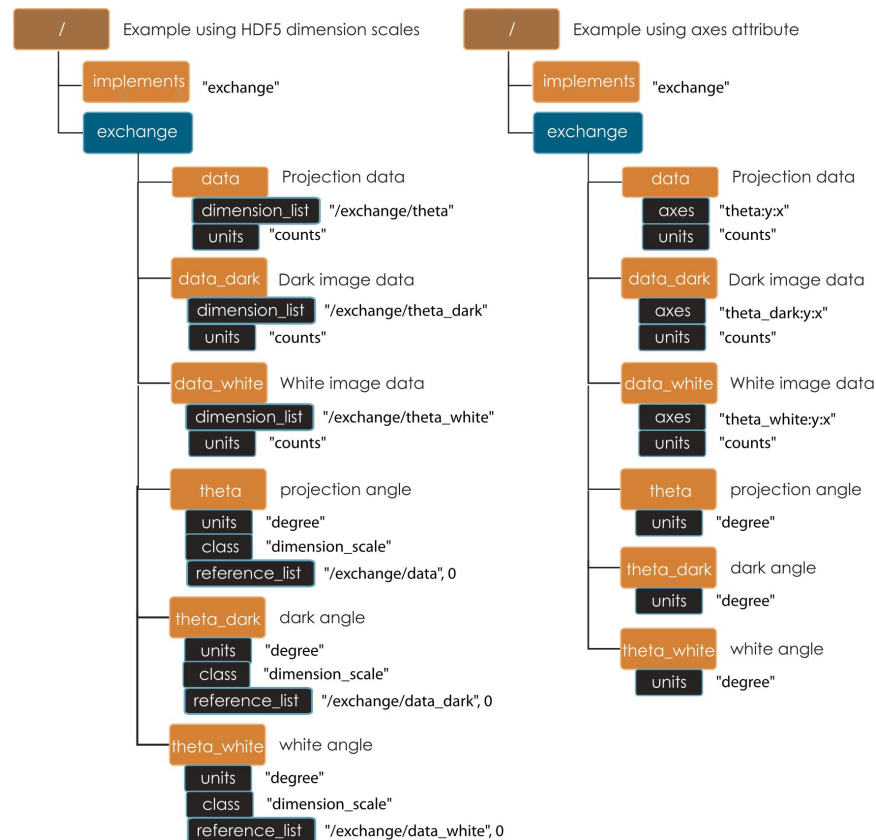
Detector Calibration:

- Detectors:

  a. Hamamatsu Orca
  b. Andor Zyla 5.5

- Dark-field correction: Record background signal with X-ray off.

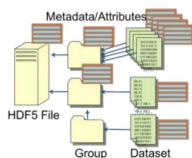- Flat-field correction: Record reference images without the sample.

File format

- `HDF5::DXchange`

Example using HDF5 dimension scales

/
├── implements "exchange"
└── exchange
    ├── data — Projection data
    │   ├── dimension_list "/exchange/theta"
    │   └── units "counts"
    ├── data_dark — Dark image data
    │   ├── dimension_list "/exchange/theta_dark"
    │   └── units "counts"
    ├── data_white — White image data
    │   ├── dimension_list "/exchange/theta_white"
    │   └── units "counts"
    ├── theta — projection angle
    │   ├── units "degree"
    │   ├── class "dimension_scale"
    │   └── reference_list "/exchange/data", 0
    ├── theta_dark — dark angle
    │   ├── units "degree"
    │   ├── class "dimension_scale"
    │   └── reference_list "/exchange/data_dark", 0
    └── theta_white — white angle
        ├── units "degree"
        ├── class "dimension_scale"
        └── reference_list "/exchange/data_white", 0

Example using axes attribute

/
├── implements "exchange"
└── exchange
    ├── data — Projection data
    │   ├── axes "theta:y:x"
    │   └── units "counts"
    ├── data_dark — Dark image data
    │   ├── axes "theta_dark:y:x"
    │   └── units "counts"
    ├── data_white — White image data
    │   ├── axes "theta_white:y:x"
    │   └── units "counts"
    ├── theta — projection angle
    │   └── units "degree"
    ├── theta_dark — dark angle
    │   └── units "degree"
    └── theta_white — white angle
        └── units "degree"

Control setup at DanMAX

Data acquisition

- Sardana based scan schema
- Separate tomo configurator tango device to store the detector calibration data
- PandaBOX integrated hardware trigger synchronization

Syntax:

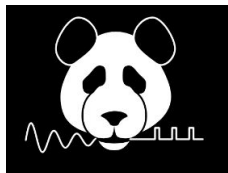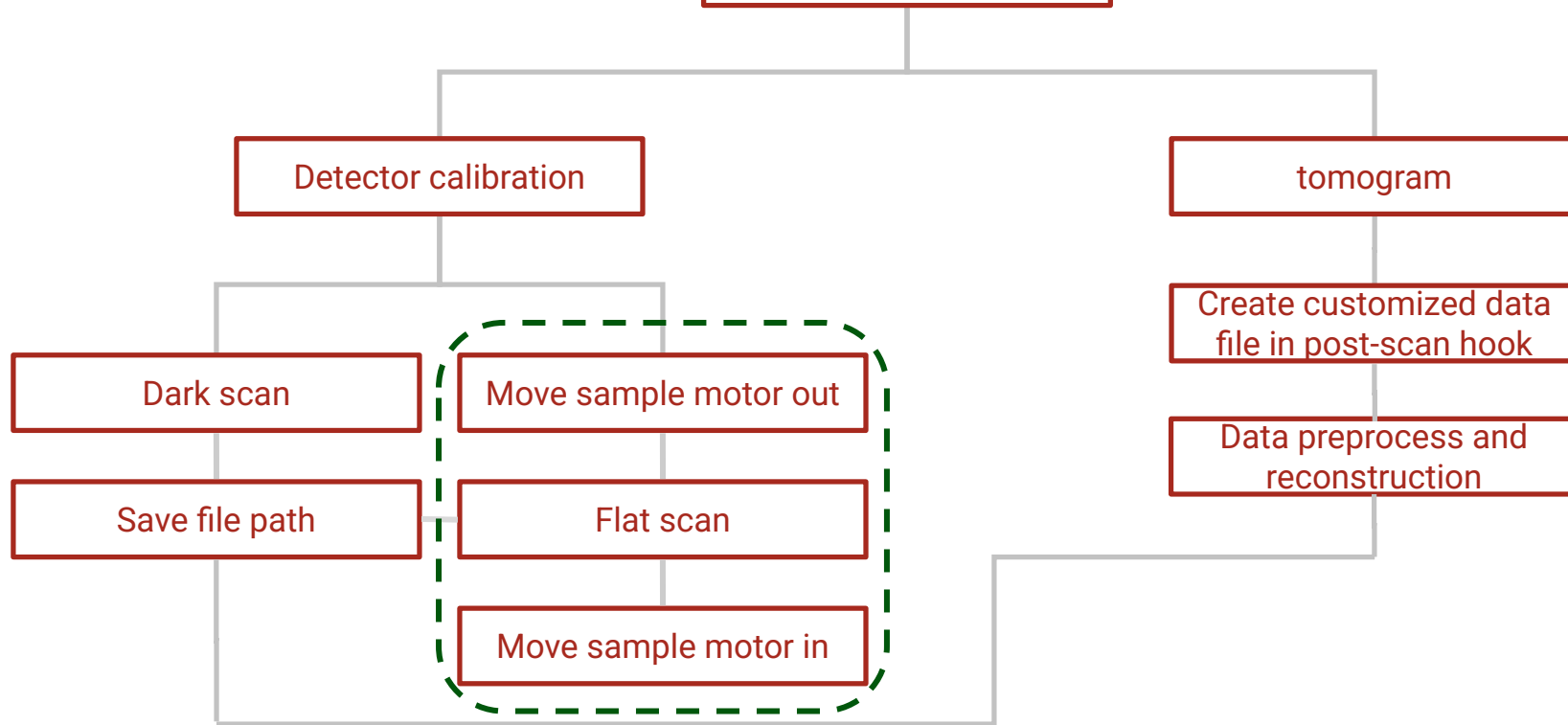   tomoscan <collect_dark> <collect_white> <nb_points_flat> <tomo_scan_type> <rotational_motor> <start_pos> <end_pos> <nb_points_tomo> <integ_time> <tomo_detector> <white_pos> <latency_time>

tomoscan macro runs scanning for tomography experiment. It consists of a darkscan, a whitescan
and a tomo scan which supports both step scan and continuous scan.

Parameters:

    collect_dark : (Boolean) collect dark field scan if it is true
    collect_white : (Boolean) collect white field scan if it is true
    nb_points_flat : (Integer) number of points for the flat field scan
    tomo_scan_type : (String) the type of scan used for the tomography
    rotational_motor : (Moveable) moveable for tomography scan
    start_pos : (Float) scan start position
    end_pos : (Float) scan end position
    nb_points_tomo : (Integer) number of points for the tomo scan
    integ_time : (Float) integration time
    tomo_detector : (String) the detector used for tomo scan
    white_pos : (String) the saved position to move a predefined motor for flat field scan
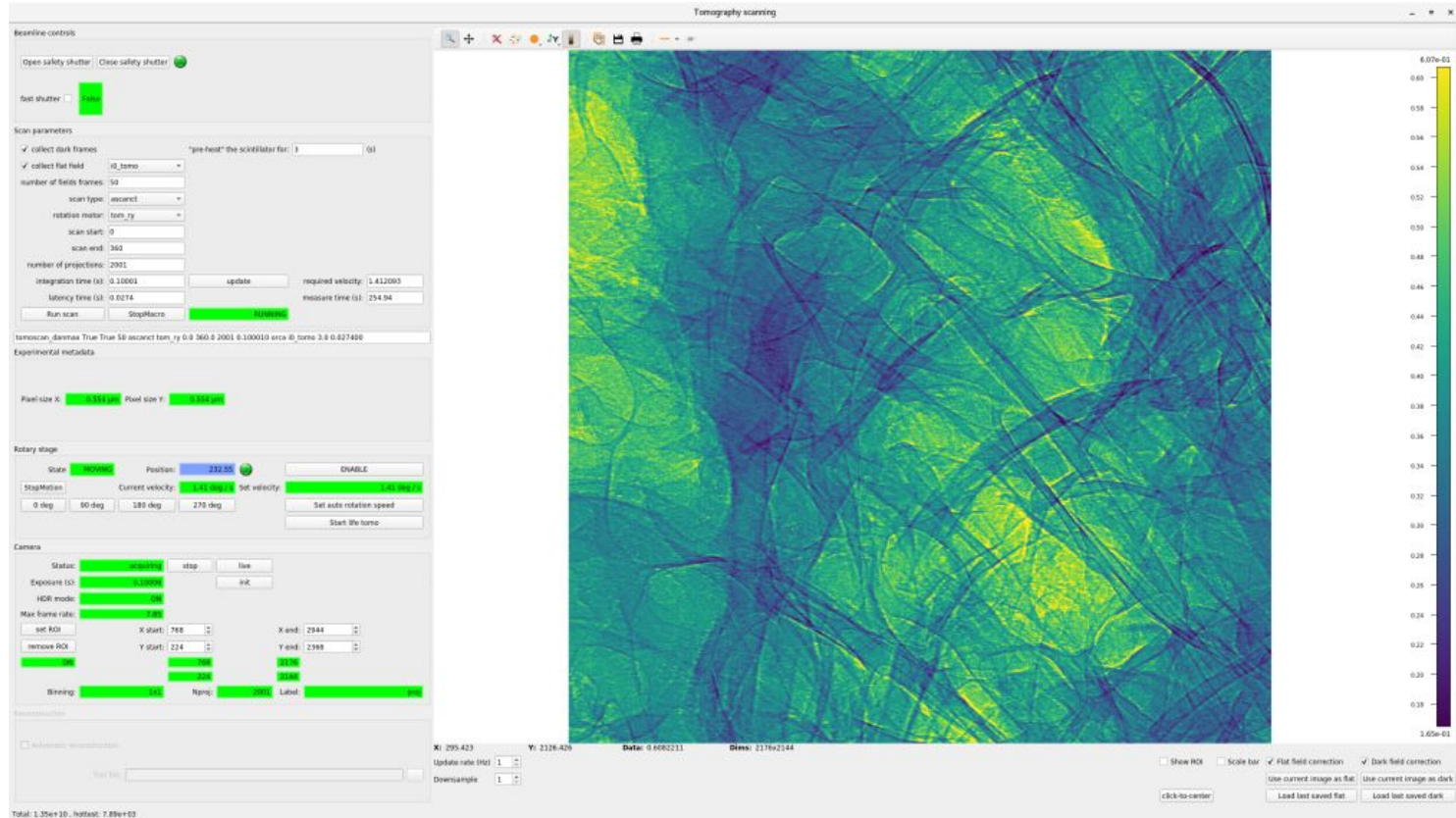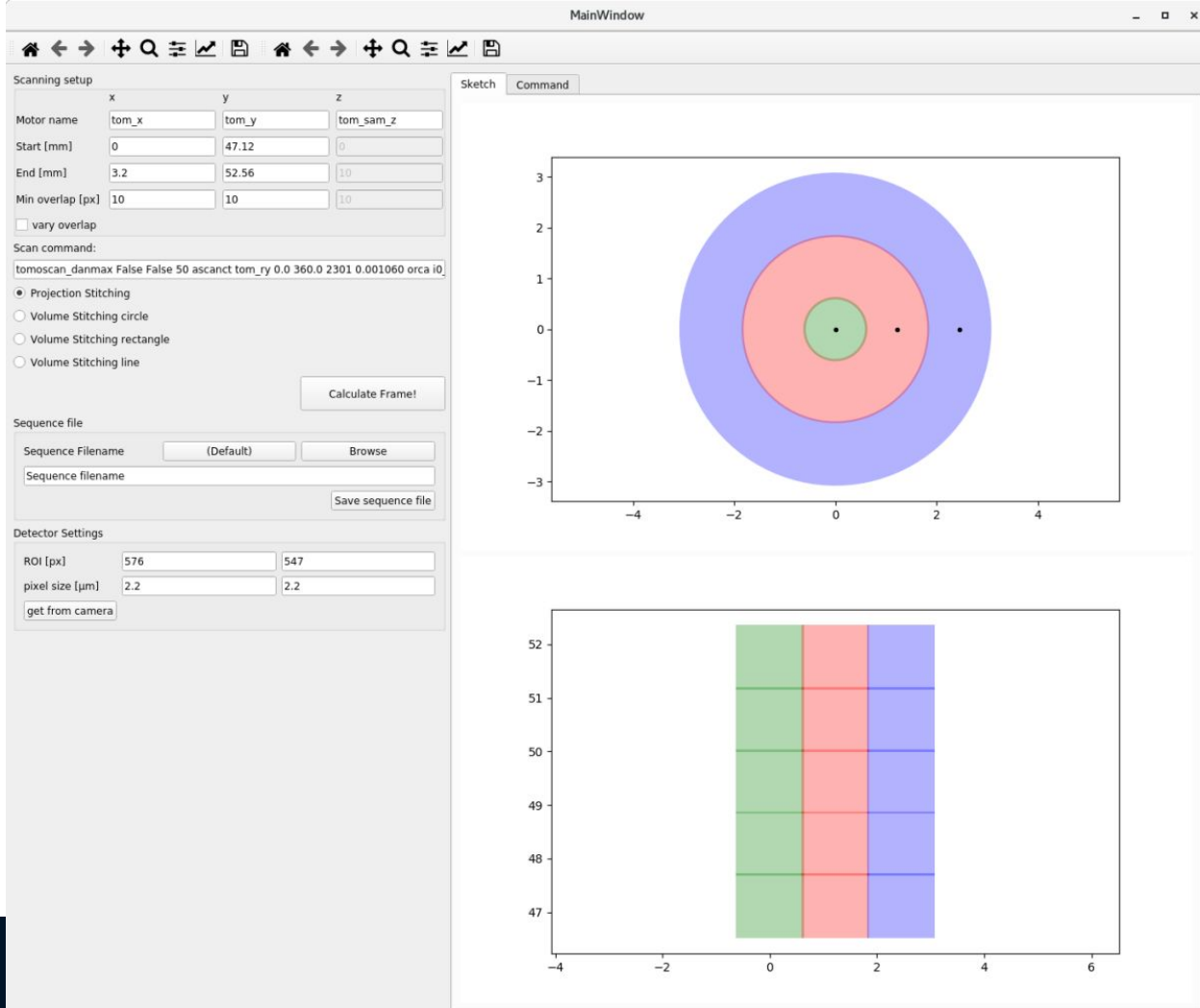   latency_time : (Float) latency time for the tomo scan
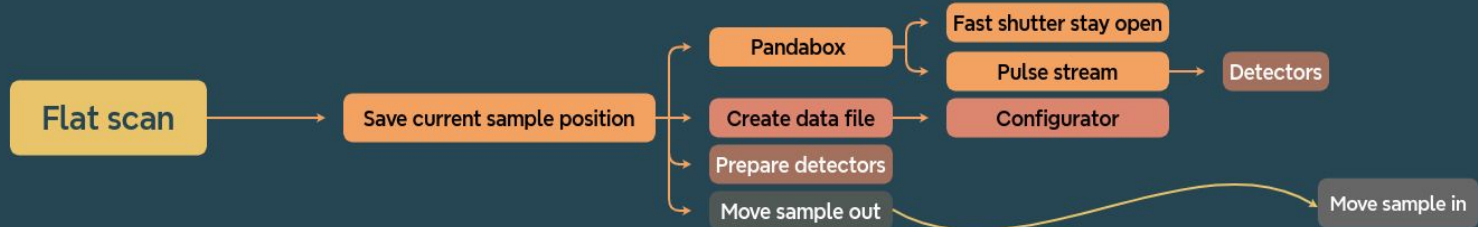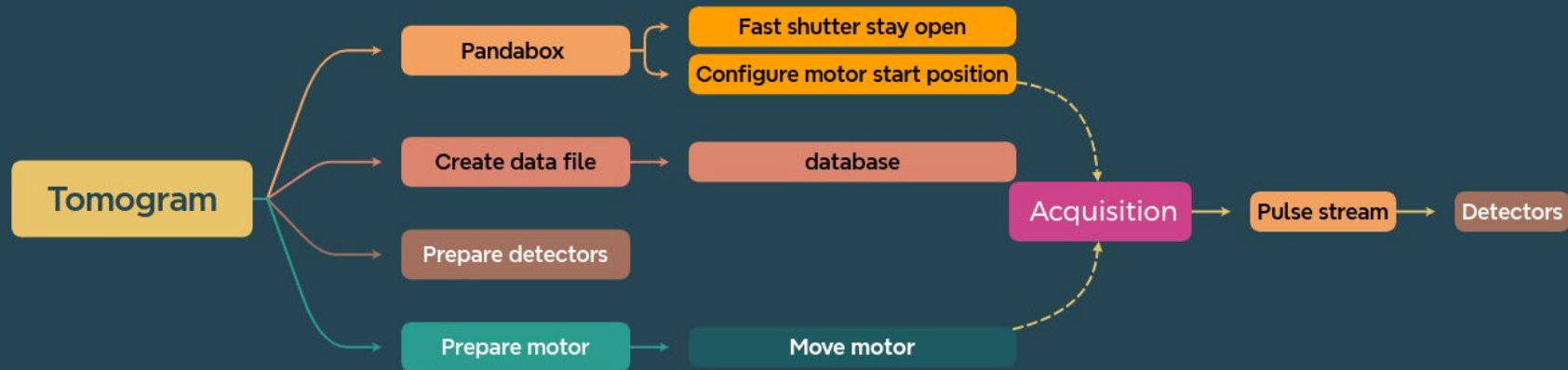
TomoScan GUI

- Calculate the tomo scan parameters
- Set scan ranges from 0 to 360 and an even number of projections

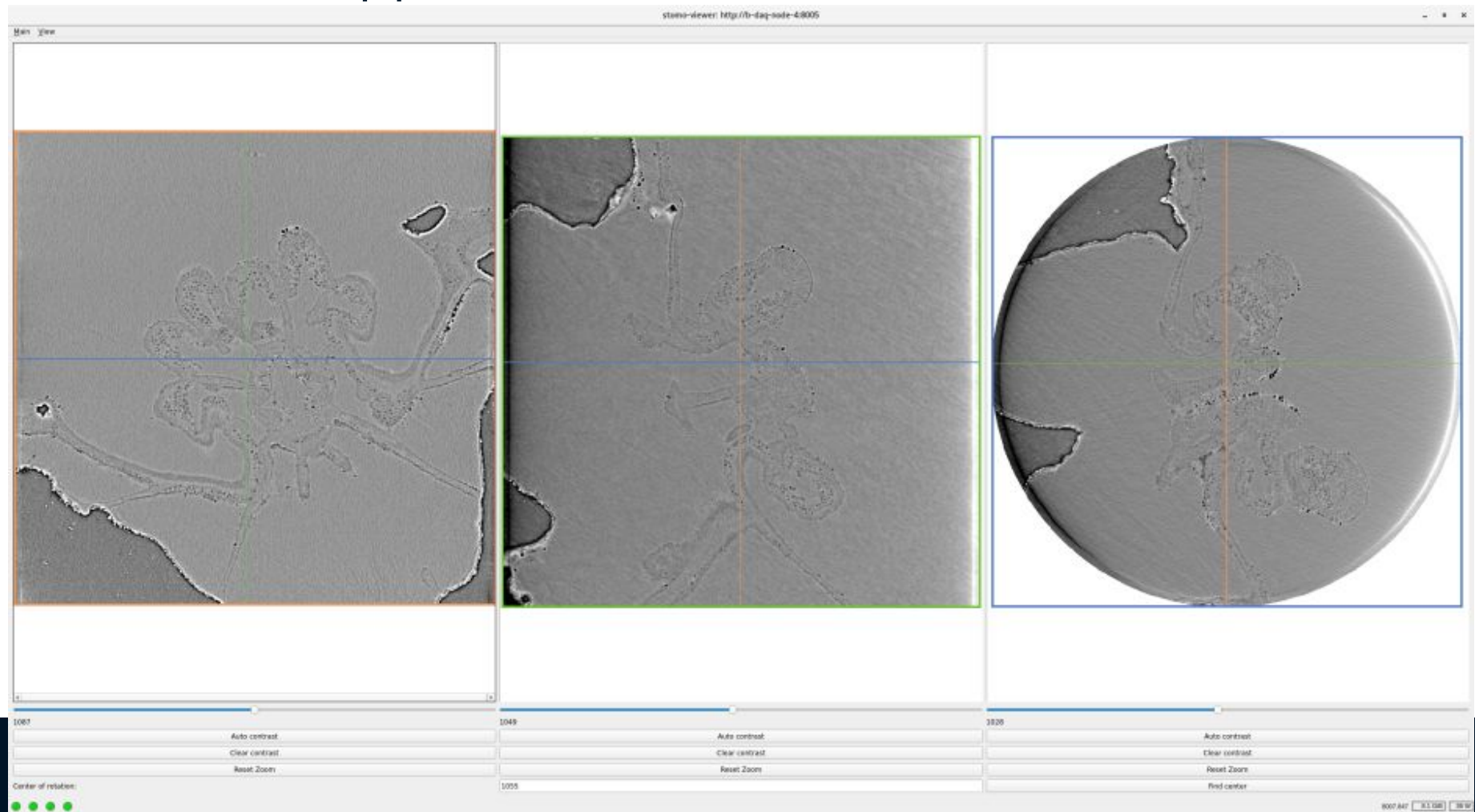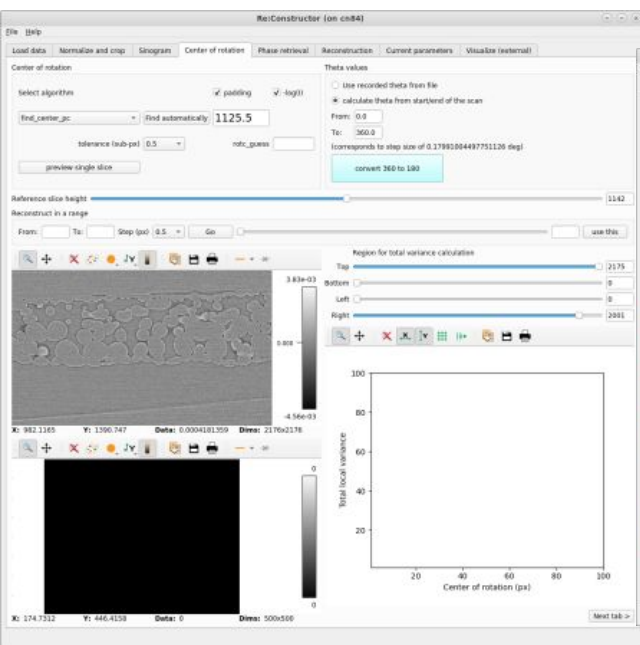# Tomo mapper GUI

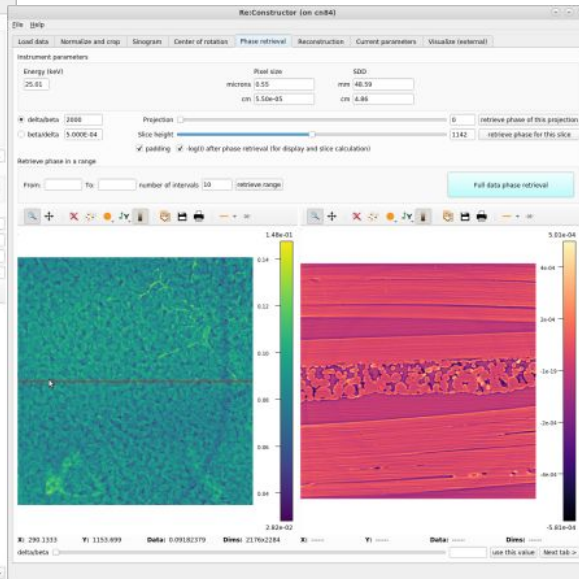Set up for coarse overview scan and projections stitching
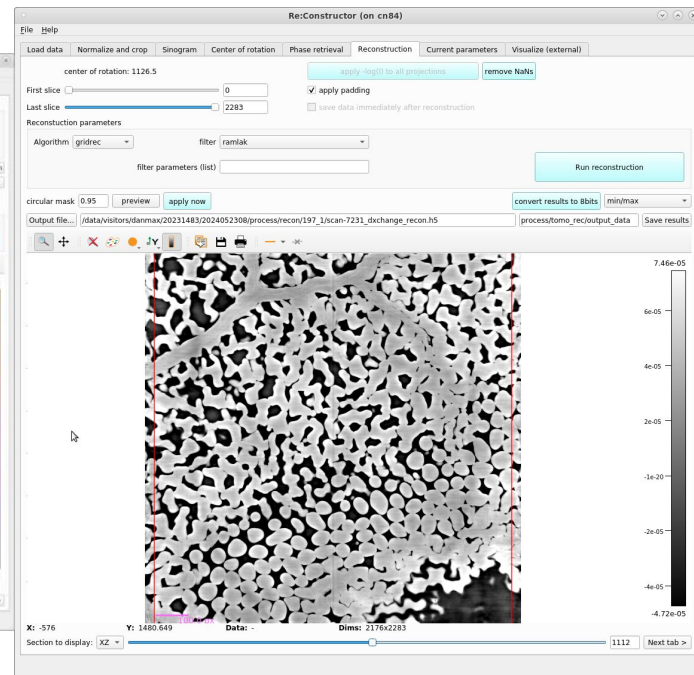
Live reconstruction pipeline

Reconstructor

Center of rotation

Phase retrieval

Reconstruction