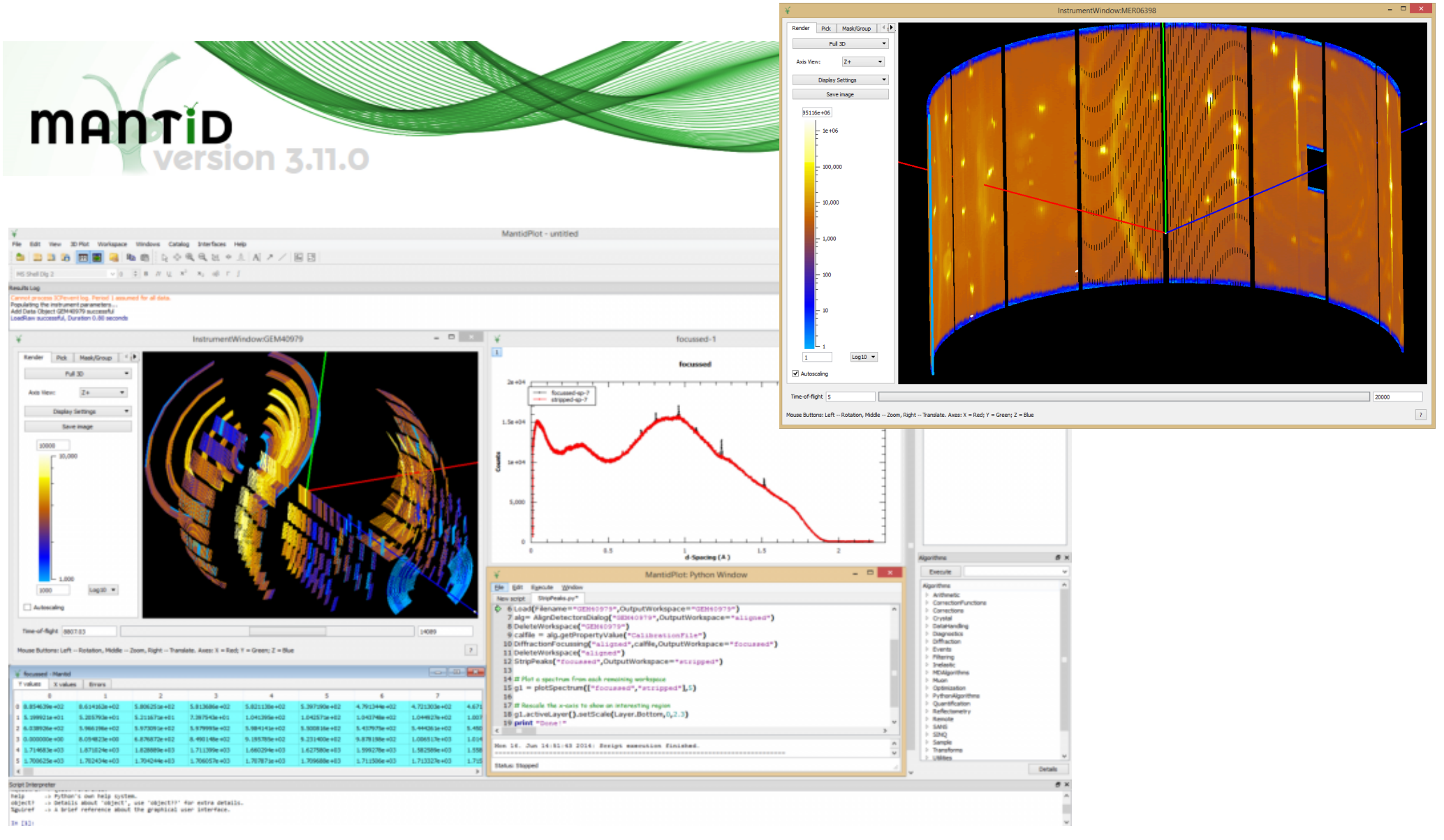
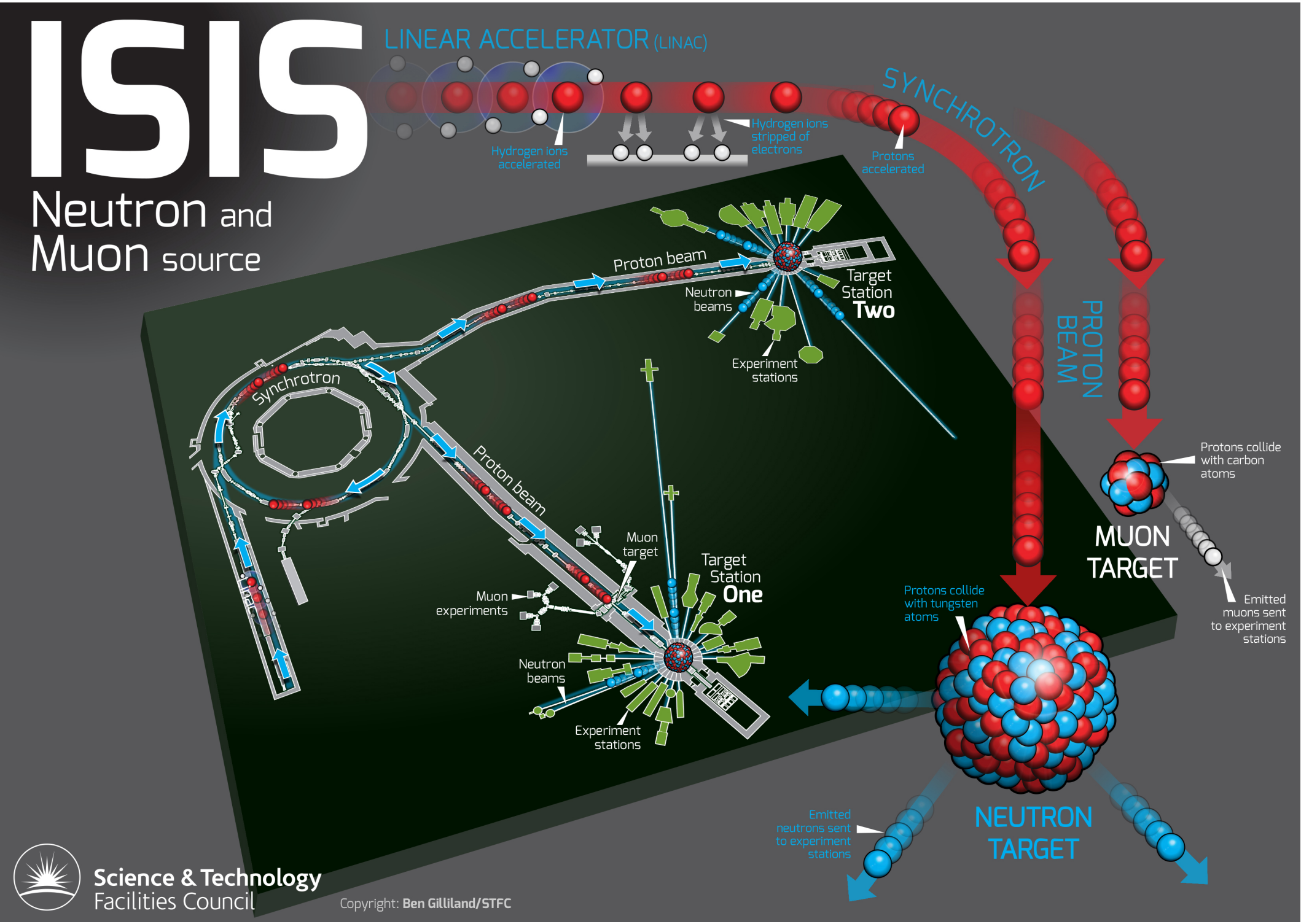
Introduction to neutrons

What happens to data?



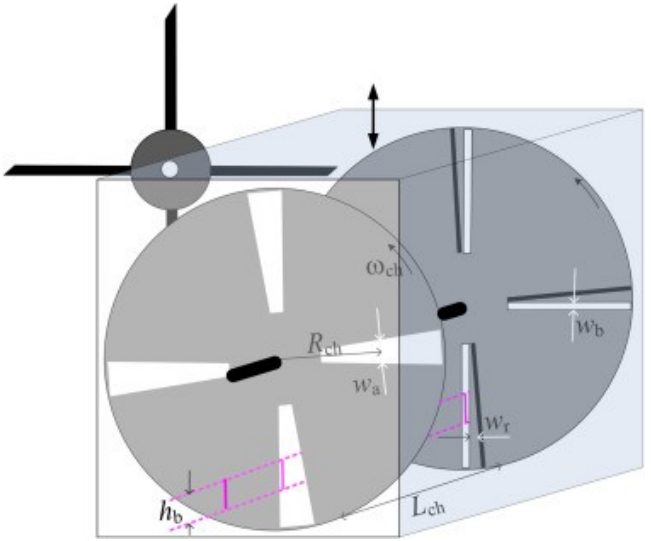
ISIS

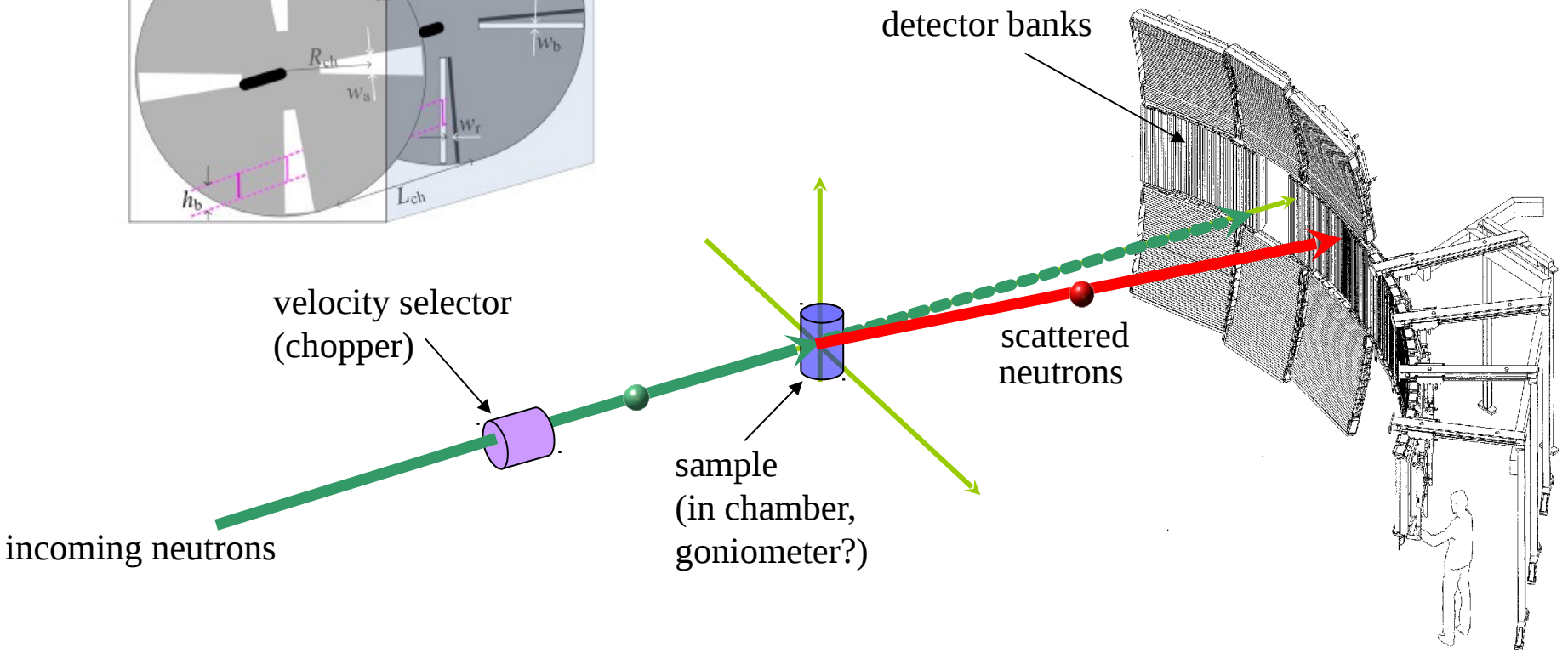
Neutron and Muon source



Science & Technology Facilities Council

Instrument


ω_{ch}
R_{ch}
w_a
w_b
w_r
h_b
L_{ch}


detector banks
velocity selector
(chopper)
scattered
neutrons
sample
(in chamber,
goniometer?)
incoming neutrons

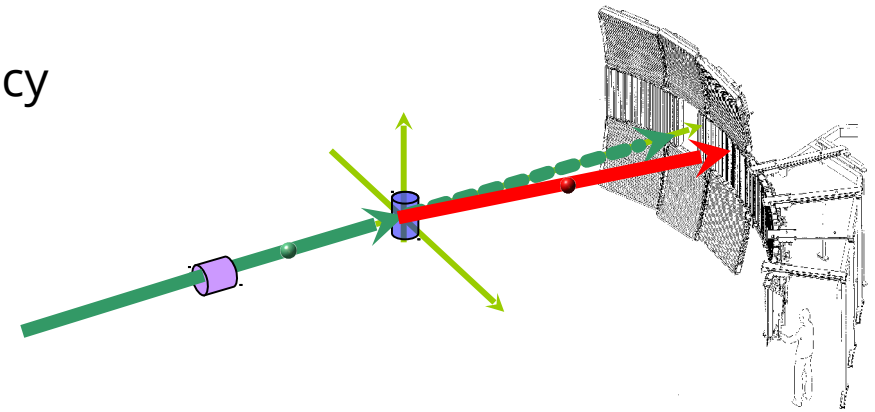
Data

Metadata
User, experiment title

Source
Proton charge
Veto?

Neutron detection events
Detector IDs, timestamps
Monitors

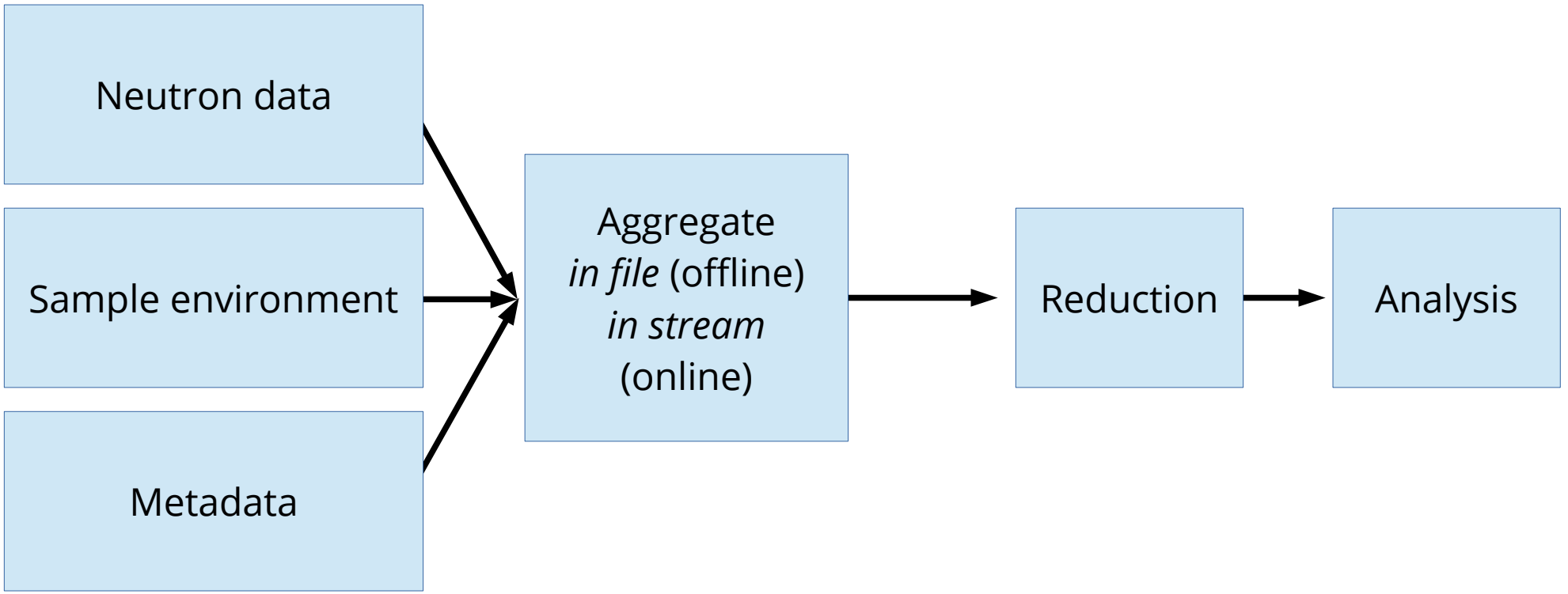
Chopper
Phase and frequency
Veto?



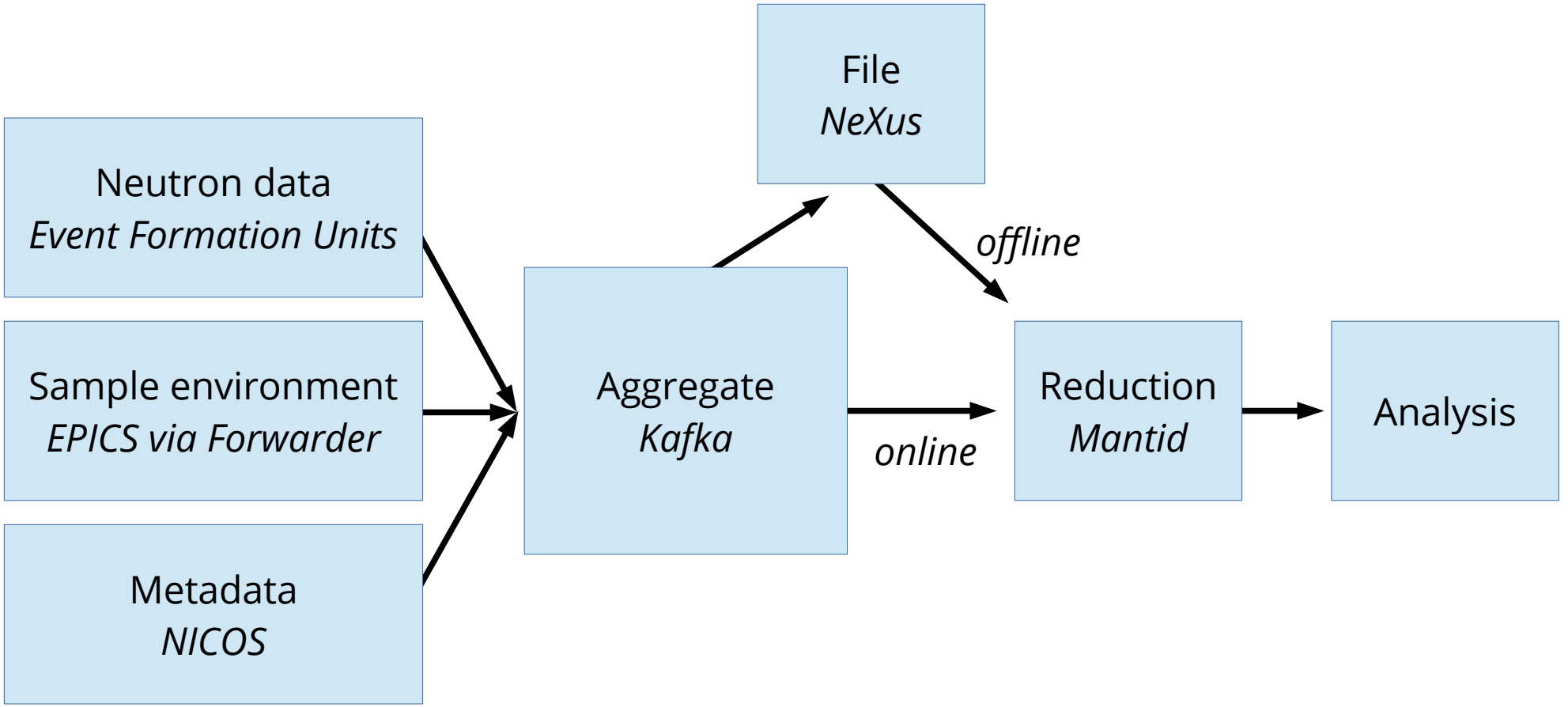
Geometry
Position (translation stages),
angle (goniometers)

Sample environment
Temperature, pressure, field?

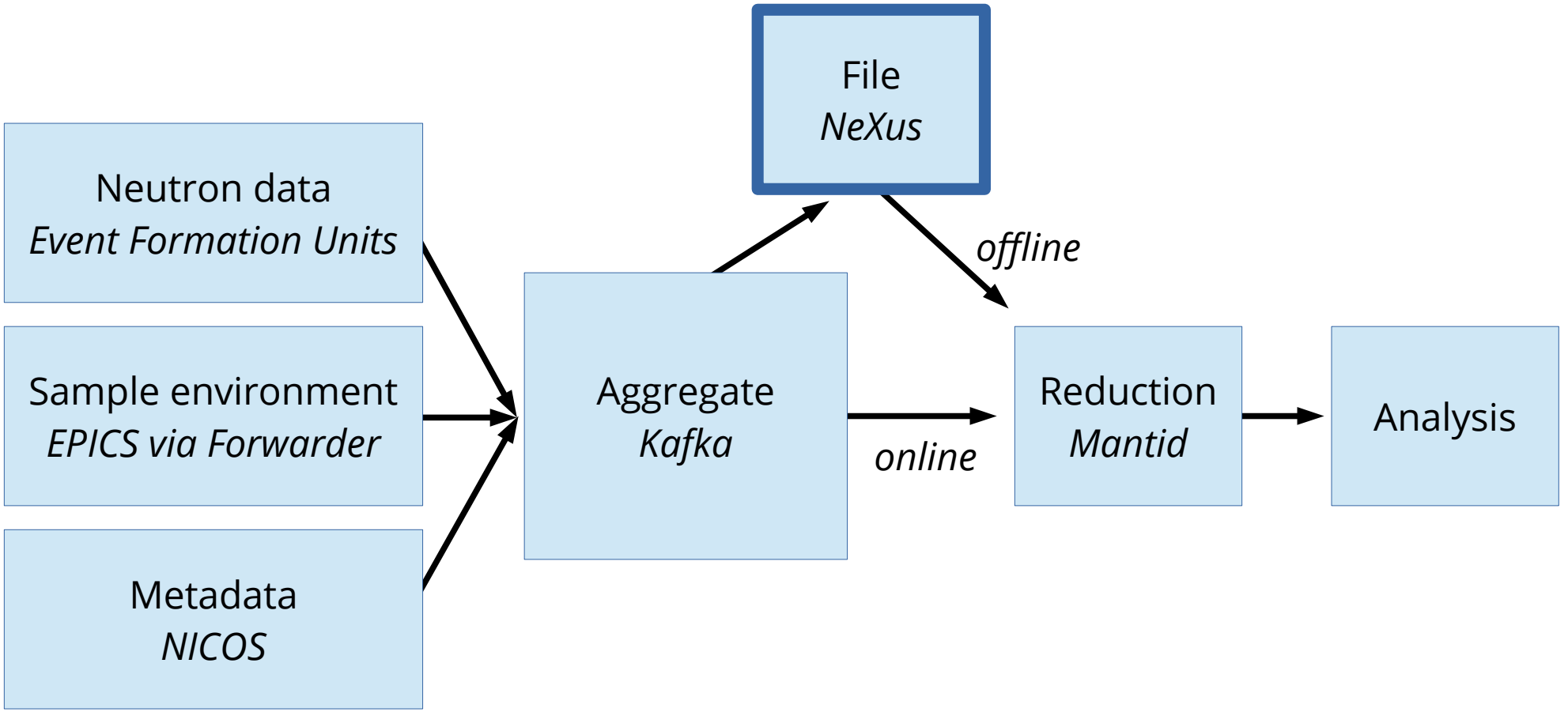
Data Pipeline



Data Pipeline - ESS

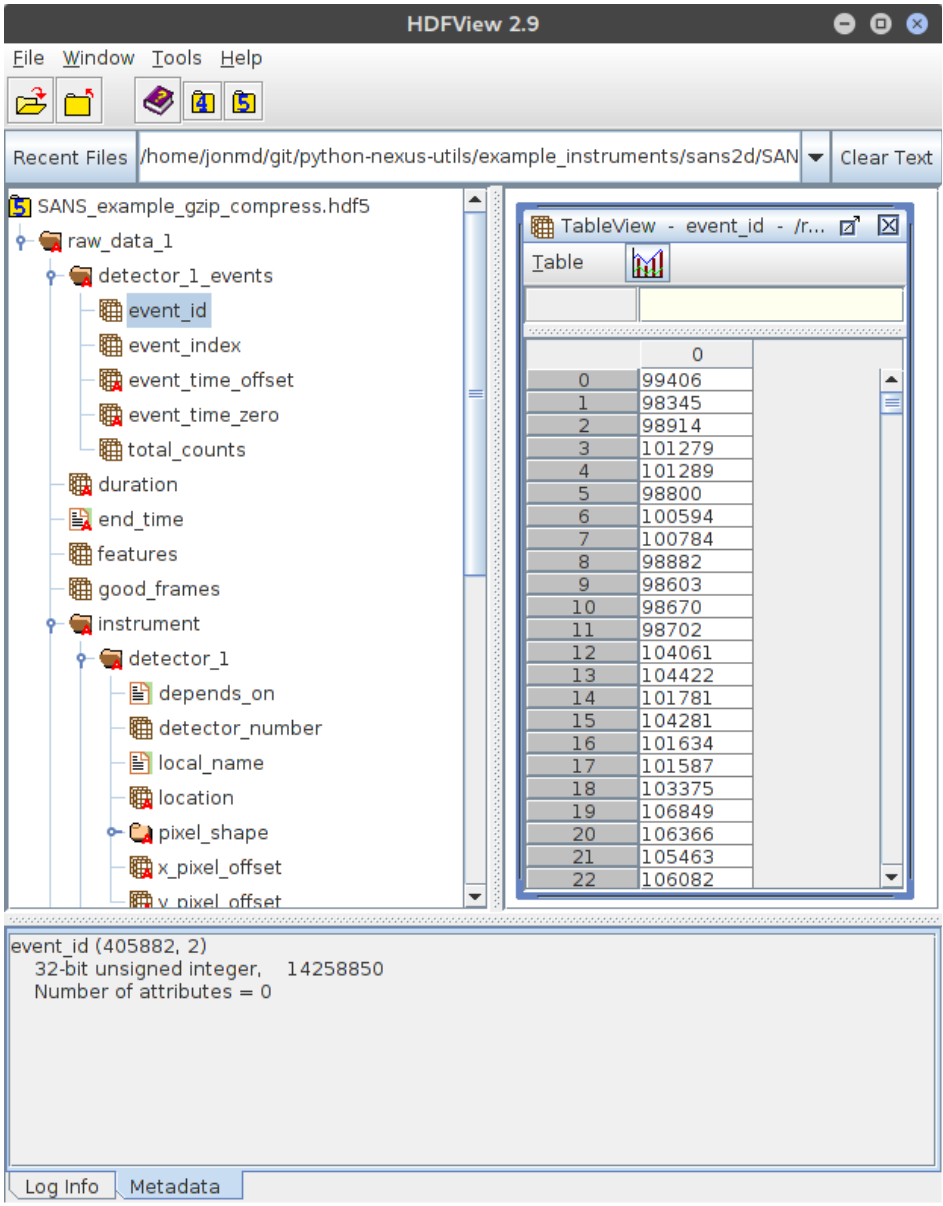


Data Pipeline - ESS



NeXus

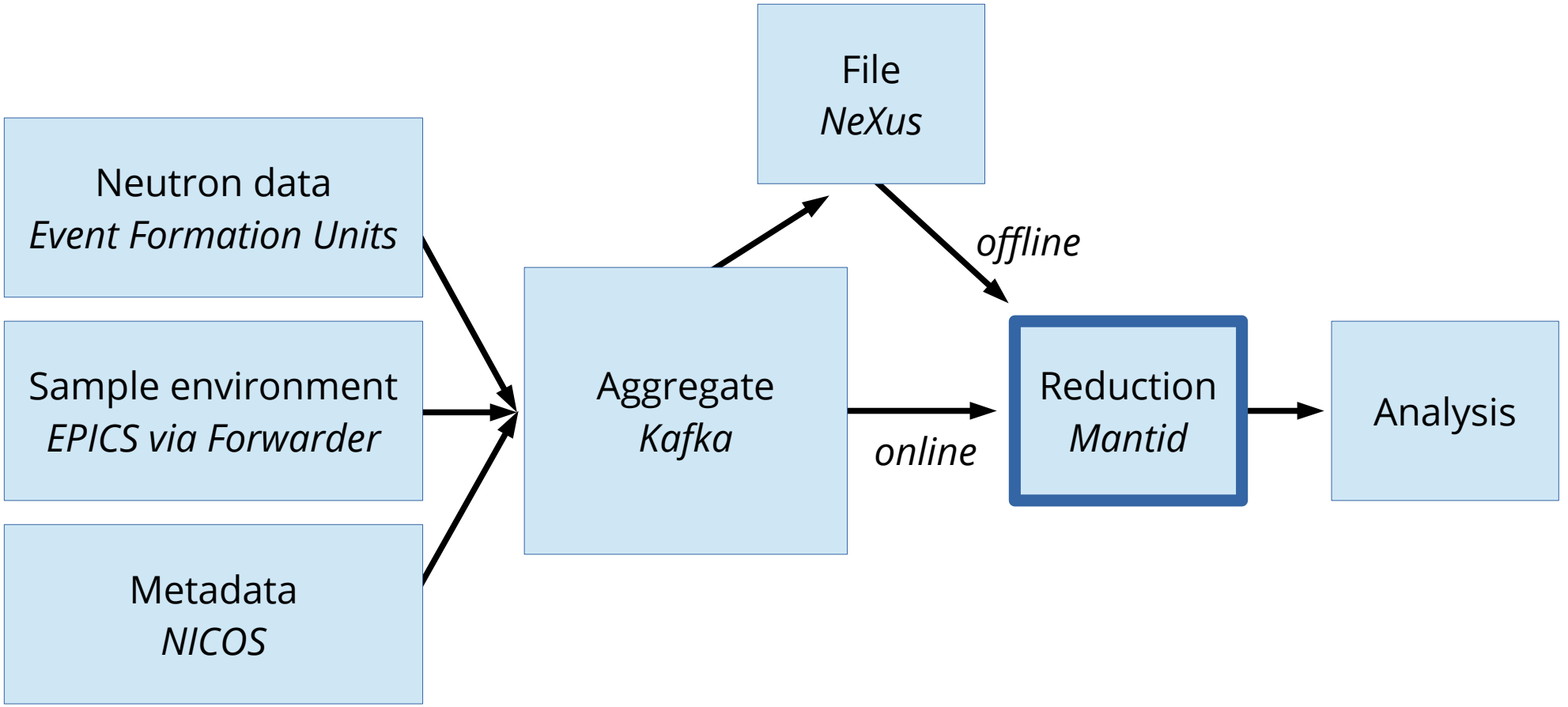
- **H**ierarchical **D**ata **F**ormat
  - Groups + datasets : directories + files
  - Datasets can have attributes
  - Compression
- NeXus classes for all data: geometry, events, sample env logs, metadata, etc

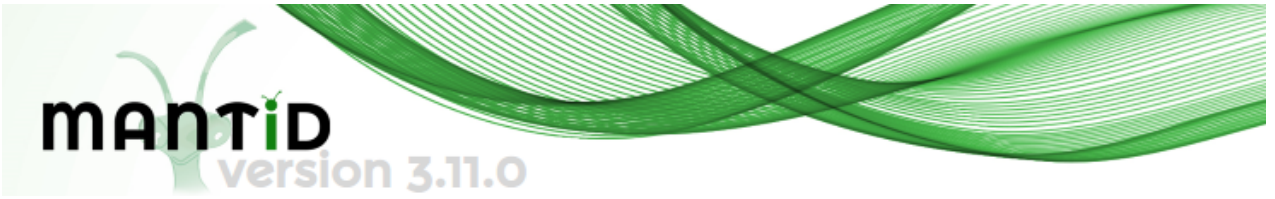


NeXus

- Documentation: http://download.nexusformat.org/sphinx/classes/base_classes/
- Tools (https://github.com/nexusformat):
  - Features (example code)
  - Validator
  - API (Python - https://github.com/nexpy)

Data Pipeline - ESS





Mantid is a freely redistributable, open source, cross-platform, data reduction and analysis framework for neutron scattering and muon experiments.

Partners:

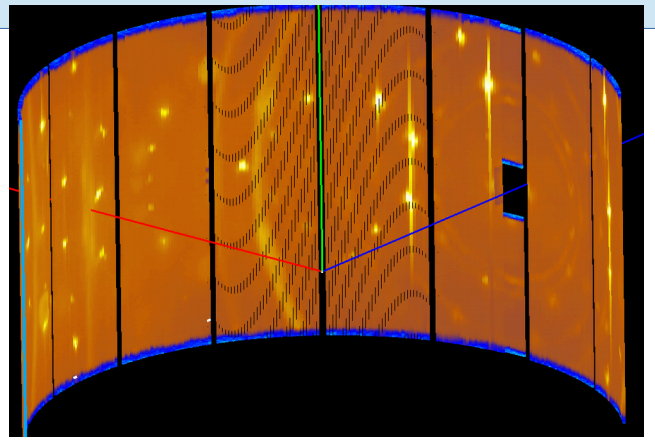
Contractor:

Contributors:

Reduction

Raw data

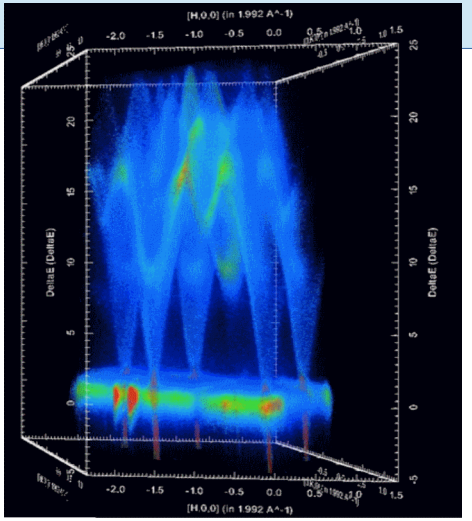
- Neutron events (detector IDs and timestamps)
- Sample environment logs
- Metadata
- *Measurement artefacts*



MANTID

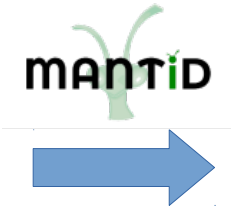
Reduced data

- Parameters space of interest, for example momentum transfer, reciprocal space, etc
- Scientific units
- Cropped to region of interest
- Measurement artefacts removed

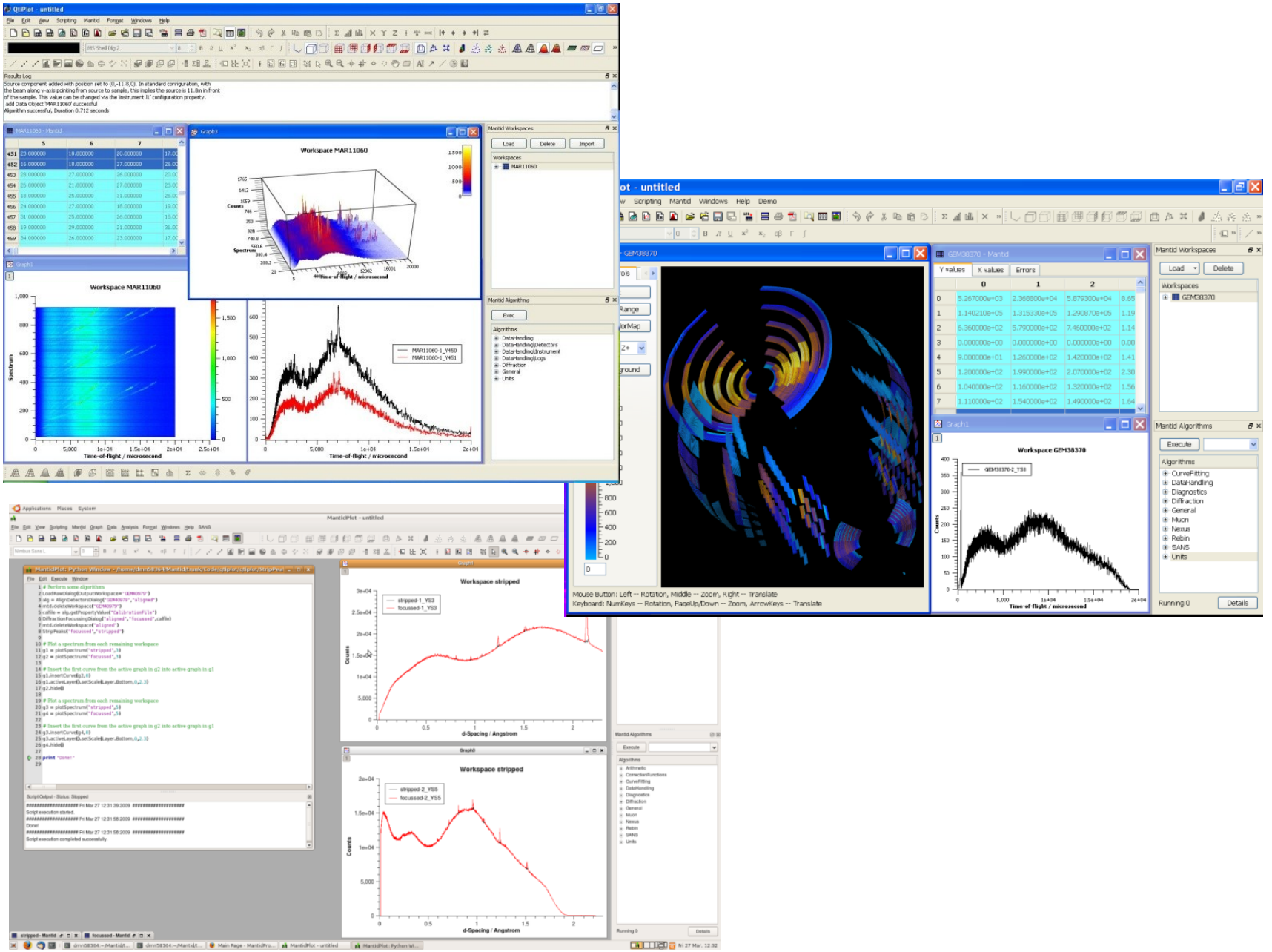


Measurement artefacts

- Normalisation – based on charge or monitor
- Remove background
- Ignore (mask) noisy or dead pixels
- Detector efficiency vs wavelength
- Incident beam vs wavelength

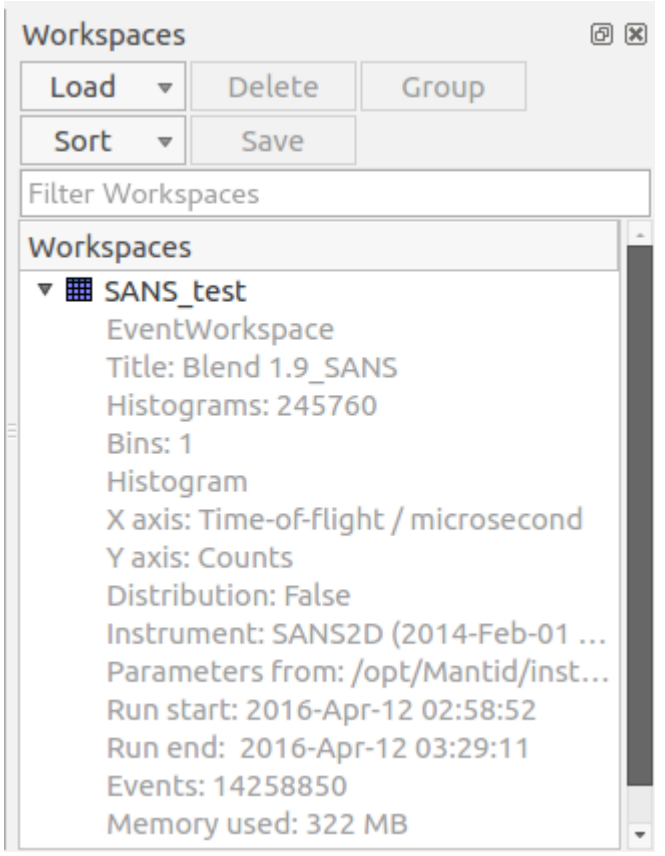


MantidPlot


QtiPlot - untitled
Workspace MAR11060
Time-of-flight / microsecond
Spectrum
Counts
Mantid Workspaces
Load
Delete
Import
Mantid Algorithms
Exec
MAR11060-1_Y450
MAR11060-1_Y451
Workspace GEM38370
Mouse Button: Left -- Rotation, Middle -- Zoom, Right -- Translate
Keyboard: NumKeys -- Rotation, PageUp/Down -- Zoom, ArrowKeys -- Translate
Workspace stripped
stripped-1_YS3
focussed-1_YS3
stripped-2_YS5
focussed-2_YS5
d-Spacing / Angstrom

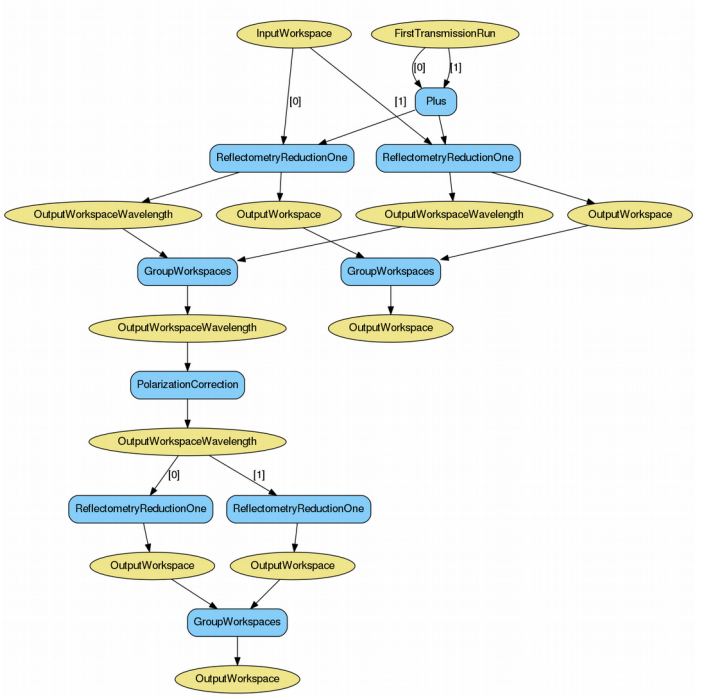
Workspaces

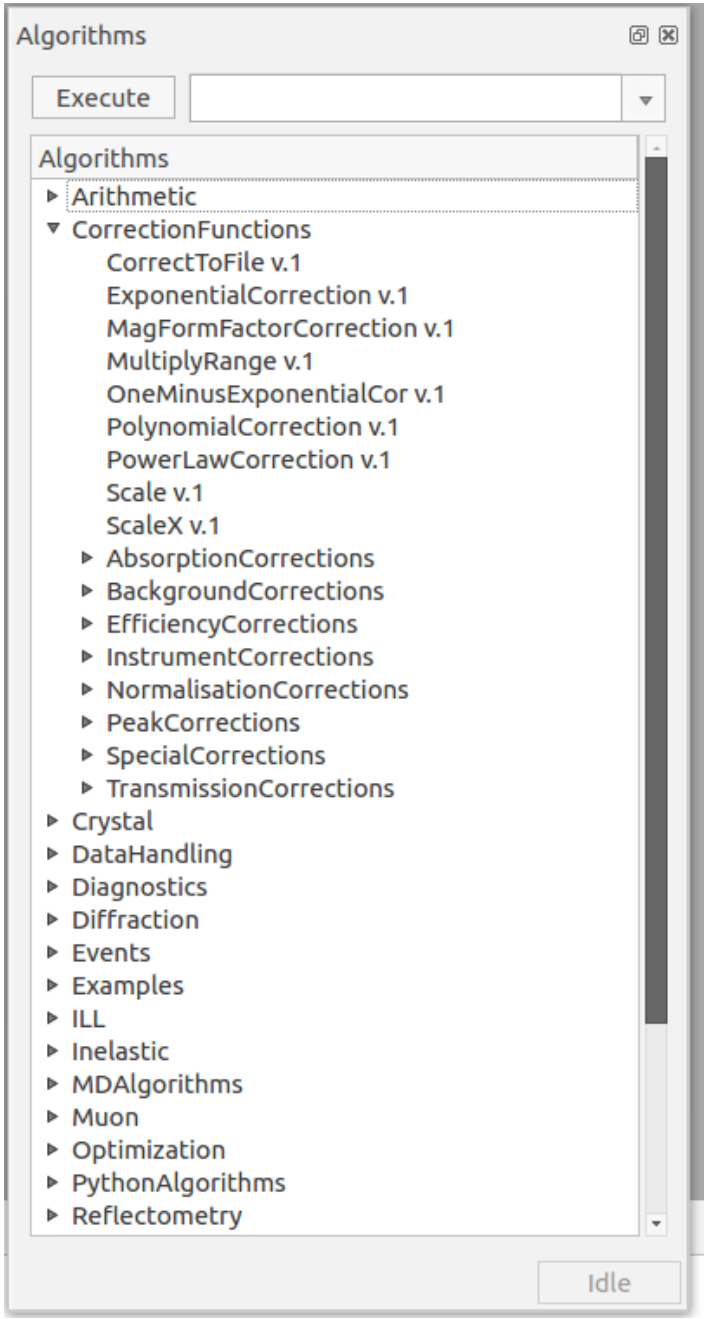
- Data structure for all data required to carry out reduction and analysis
- Different types, for example EventWorkspace
- Workspaces created by:
  - loading data from file,
  - accumulating data from network stream,
  - programmatically, for example from NumPy arrays, algorithms…



Algorithms

- Input workspace -> output new workspace or in-place
- Workflow algorithms – complete reduction workflow





Python API

- Implemented in C++ with Python interface

- IPython and script editor windows in MantidPlot