Input/output

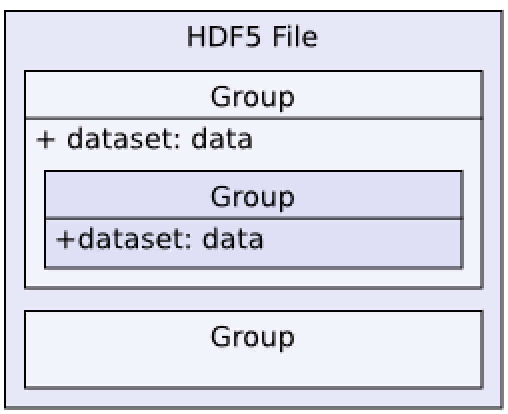
Silx IO

- Provides function to open file data
  - Accessible as HDF5-like objects
  - In read-only
  - Support HDF5 files, Spec files, EDF files (plus format supported by *FabIO*)
- In symbiosis with our widgets
  - HDF5 tree widget
  - DataViewer
- Also contains
  - Maintained *specfilewrapper* class
  - Maintained TIFF and EdfFile reader and writer
  - Spec to HDF5 converter
  - Dictionary dump

HDF5 introduction

HDF5 (for Hierarchical Data Format) is a file format to structure and store data.

- Standard exchange format for heterogeneous data
- Hierarchical collection of data (directory and file, UNIX-like path)
  - **File**: the root of the container
  - **Group**: a grouping structure containing groups or datasets
  - **Dataset**: a multidimensional array of data elements
  - And other features (links, attributes, datatypes)



HDF5 example

Here is an example of file generated by pyFAI.

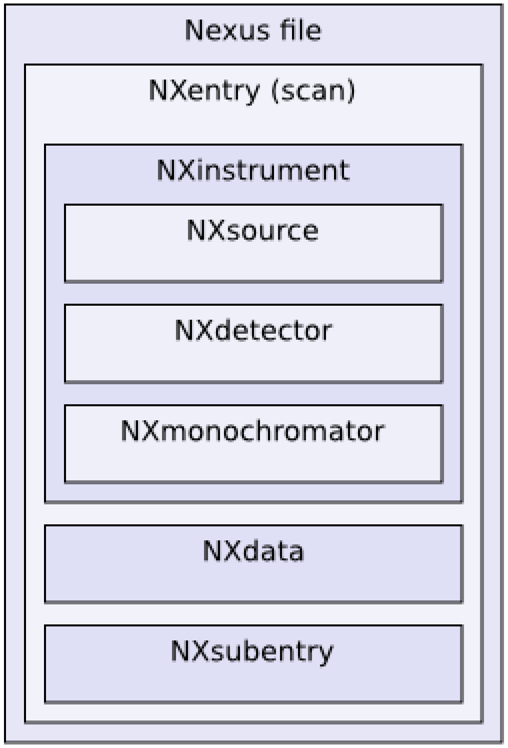
Name	Type	Shape	Value	Description	Node
test.h5					File
diff_map_0000					Group
data					Group
map	float32	29 × 78 × 100	...		Dataset
program_name	string		pyFAI		Dataset
pyFAI					Group
PONIfile	string		None		Dataset
date	string		2016-06-09T14:03:18+02:00		Dataset
detector	string		Pilatus1M		Dataset
dim0	int64		29		Dataset
dim1	int64		78		Dataset
dim2	int64		100		Dataset
dist	float64		1.63410088403		Dataset
inputfiles	string	2230	['/home/valls/workspace/data/diff_ma...		Dataset
pixel1	float64		5.197559e-05		Dataset
pixel2	float64		5.158538e-05		Dataset
poni1	float64		0.0312319583221		Dataset
poni2	float64		0.0141040323735		Dataset
program	string	1	['diff_map']		Dataset
rot1	float64		-0.0102999203254		Dataset
rot2	float64		0.00868154231655		Dataset

NeXus introduction

NeXus is a common data format for neutron, x-ray and muon science based on HDF5.

Set of rules to structure a HDF5 file for interoperability of the data.

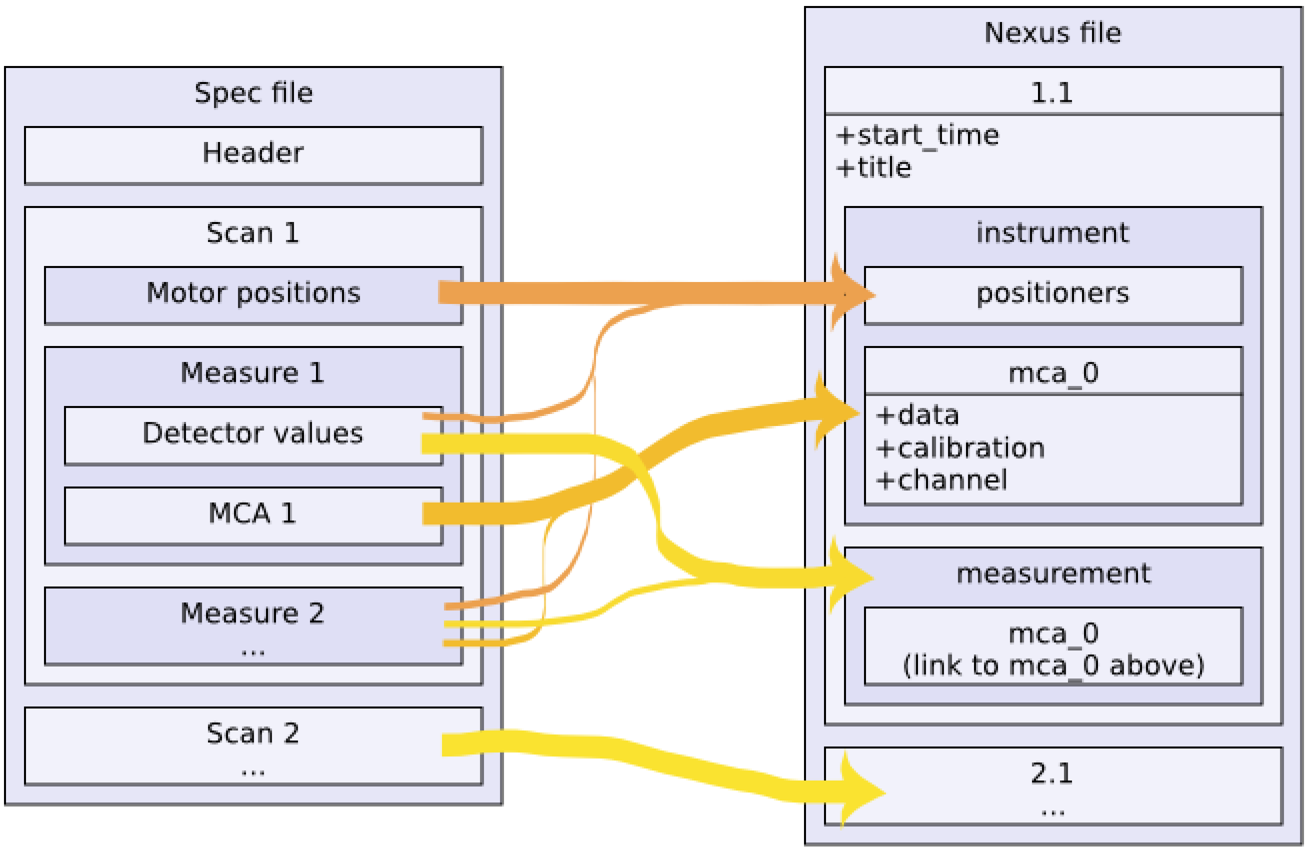
We tries to follow NeXus convention to display data or to expose data.



Specfile with silx

`Silx` provides access to spec files using an HDF5-like mapping. It uses a subset of the HDF5 model, based on NeXus.

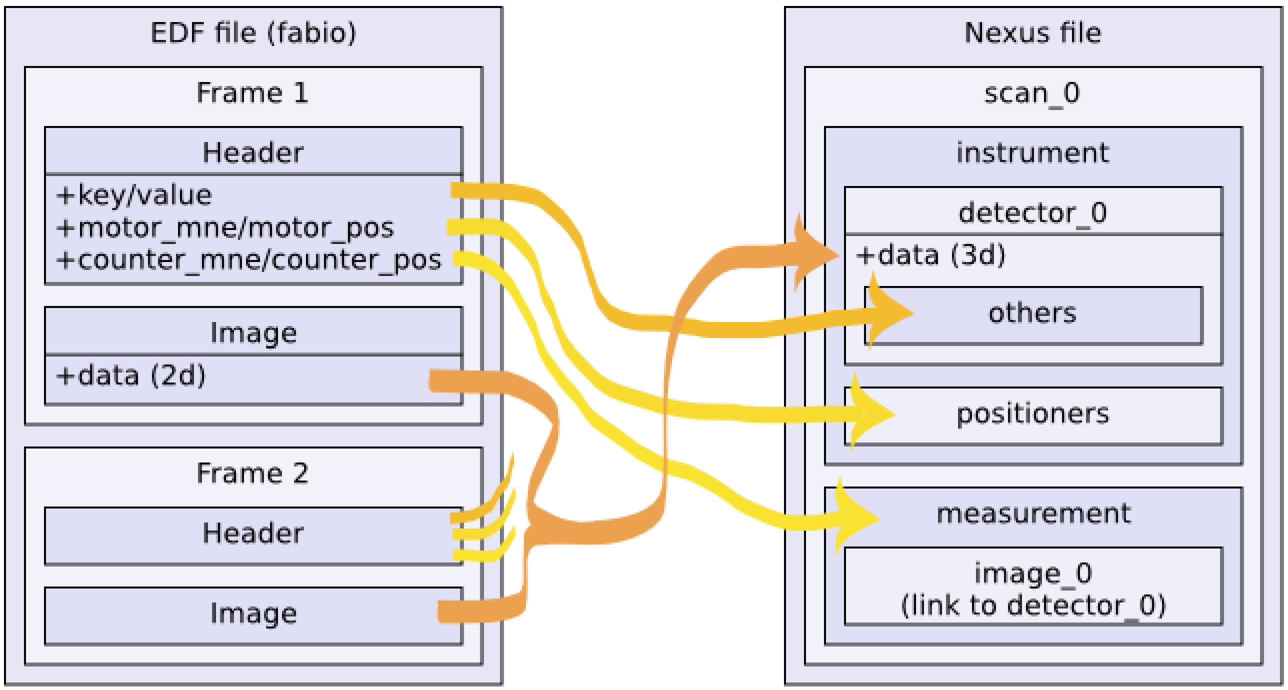
HDF5-like mapping



EDF with silx

`Silx` provides access to EDF files (and other format supported by *FabIO*) using an HDF5-like mapping. It is a subset of the HDF5 model, based on NeXus.

HDF5-like mapping



Silx IO API

Based on HDF5 and *h5py* module API.

Open a file

```
import silx.io

# open
obj = silx.io.open(filename)
# do your stuff here
obj.close()


# or using context manager
with silx.io.open(filename) as obj:
   # do your stuff here
   # the close is called for you at the end of the with
```

Silx IO API

Based on HDF5 and *h5py* module API.

Common properties

```
obj.name   # the path name
obj.parent # the direct container of the object
obj.file   # the file container of the object

# test object type
if silx.io.is_file(obj):
   print("this is a root file")

   # path of the file from the file system
   obj.filename

if silx.io.is_group(obj):
   # BTW a file is a group
   print("this is a group")

if silx.io.is_dataset(obj):
   print("this is a dataset")
```

Silx IO API

Based on HDF5 and *h5py* module API.

Node traversal

```
if silx.io.is_group(obj):
   # it can contains child

   # number of child
   len(obj)

   # iterator on child names
   obj.keys()

   # access to a child
   child = obj["child_name"]

   # access to a child using a path
   child = obj["path/to/a/child"]

   # the path can be absolute
   child = obj["/absolute/path/to/a/child"]
```

Silx IO API

The content of a dataset is a *numpy* data.

Data access

```
if silx.io.is_dataset(obj):
   # it contains data

   # a dataset provides information to the data
   obj.shape    # multidimentional shape
   obj.size     # amount of items
   obj.dtype    # type of the array

   # copy the full data as numpy array
   data = obj[...]

   # or a part of it (using numpy selector)
   data = obj[1:2, ::3, 7]

   # special case to access to the value of a scalar
   # i.e. a single integer, a single string...
   data = obj[()]
```

Silx IO API

Specfile example

```
import silx.io

h5like = silx.io.open('data/oleg.dat')

# print available scans
print(h5like['/'].keys())

# print available measurements from the scan 94.1
print(h5like['/94.1/measurement'].keys())

# get data from measurement
time = h5like['/94.1/measurement/Epoch']
bpm = h5like['/94.1/measurement/bpmi']
mca = h5like['/94.1/measurement/mca_0/data']
```

Silx IO API

EDF example

```
import silx.io.utils

h5like = silx.io.open("data/medipix.edf")

# here is the data as a cube using numpy array
# it's a cube of images * number of frames
data = h5like["/scan_0/instrument/detector_0/data"]
# here is the first image
data[0]

# groups containing datasets of motors, counters
# and others metadata from the EDF header
motors   = h5like["/scan_0/instrument/positioners"]
counters = h5like["/scan_0/instrument/measurement"]
others   = h5like["/scan_0/instrument/detector_0/others"]

# reach a monitor named 'mon'
# it's a vector of values * number of frames
monitor = counters["mon"]
# here is the monitor value at the first frame
monitor[0]
```

HDF5 tree

Tree view which allow to browse HDF5 file content.

Provides:

- Mouse click event
- Customable content menu
- Customable columns

HDF5 tree

Example

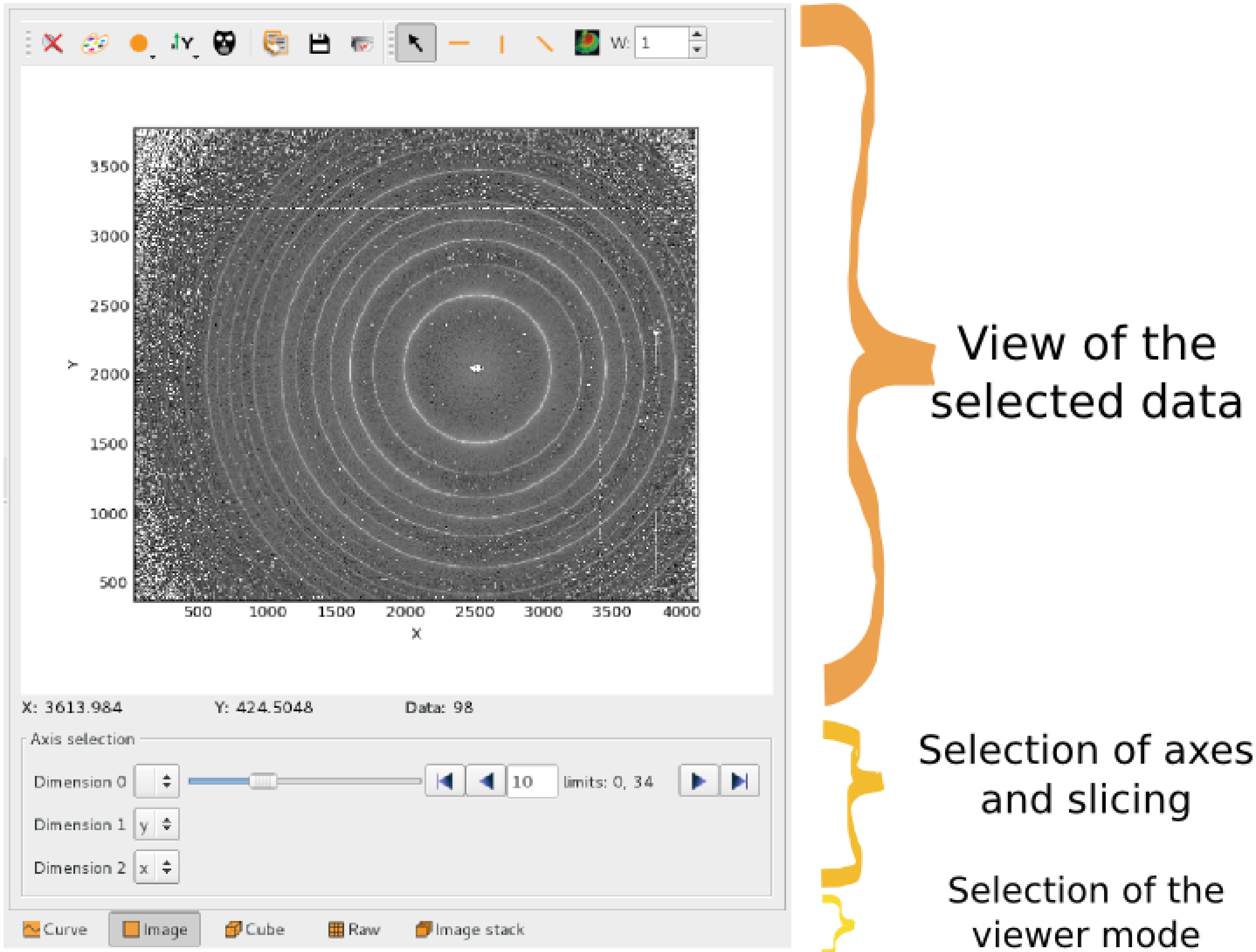
Tree view which allow to browse HDF5 file content.

```
import silx.gui.hdf5
tree = silx.gui.hdf5.Hdf5TreeView()
model = tree.findHdf5TreeModel()

# Insert a filename
model.insertFile("data/test.h5")

# Insert an HDF5 node
h5 = silx.io.open("data/test.h5")
model.insertH5pyObject(h5)
```

DataViewer


W: 1
3500
3000
2500
2000
1500
1000
500
Y
500
1000
1500
2000
2500
3000
3500
4000
X
X: 3613.984
Y: 424.5048
Data: 98
Axis selection
Dimension 0
10
limits: 0, 34
Dimension 1
y
Dimension 2
x
Curve
Image
Cube
Raw
Image stack
View of the selected data
Selection of axes and slicing
Selection of the viewer mode

DataViewer

Example

```
import silx.gui.data.DataViewerFrame
viewer = silx.gui.data.DataViewerFrame.DataViewerFrame()
viewer.setVisible(True)


# Let's display a random cube
import numpy
data = numpy.random.rand(100, 100, 100)
viewer.setData(data)


# Let's display an HDF5 dataset
import silx.io
h5like = silx.io.open("data/ID16B_diatomee.h5")
dataset = h5like["/data/0299"]
viewer.setData(dataset)
```

Exercises

This exercises are based on phase contrast acquisition data.

You can find it as notebook, or as Python files.

- **Exercise 1:**
  - Browse the data file
- **Exercise 2:**
  - Compute the correction
- **Exercise 3:**
  - Create a viewer
- **Exercise 4:**
  - Custom the viewer to display corrected images