



Data Analysis at the European XFEL

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Introduction

The European XFEL is a large-scale research facility that generates ultra-short and intense X-ray pulses. There are various experimental stations (instruments), where scientists from all over the world come to perform experiments. These experiments produce enormous amounts of data.

The Data Analysis groups main task is to provide all software tools to perform analysis and interpretation of the experimental data generated at EuXFEL..

Online data analysis

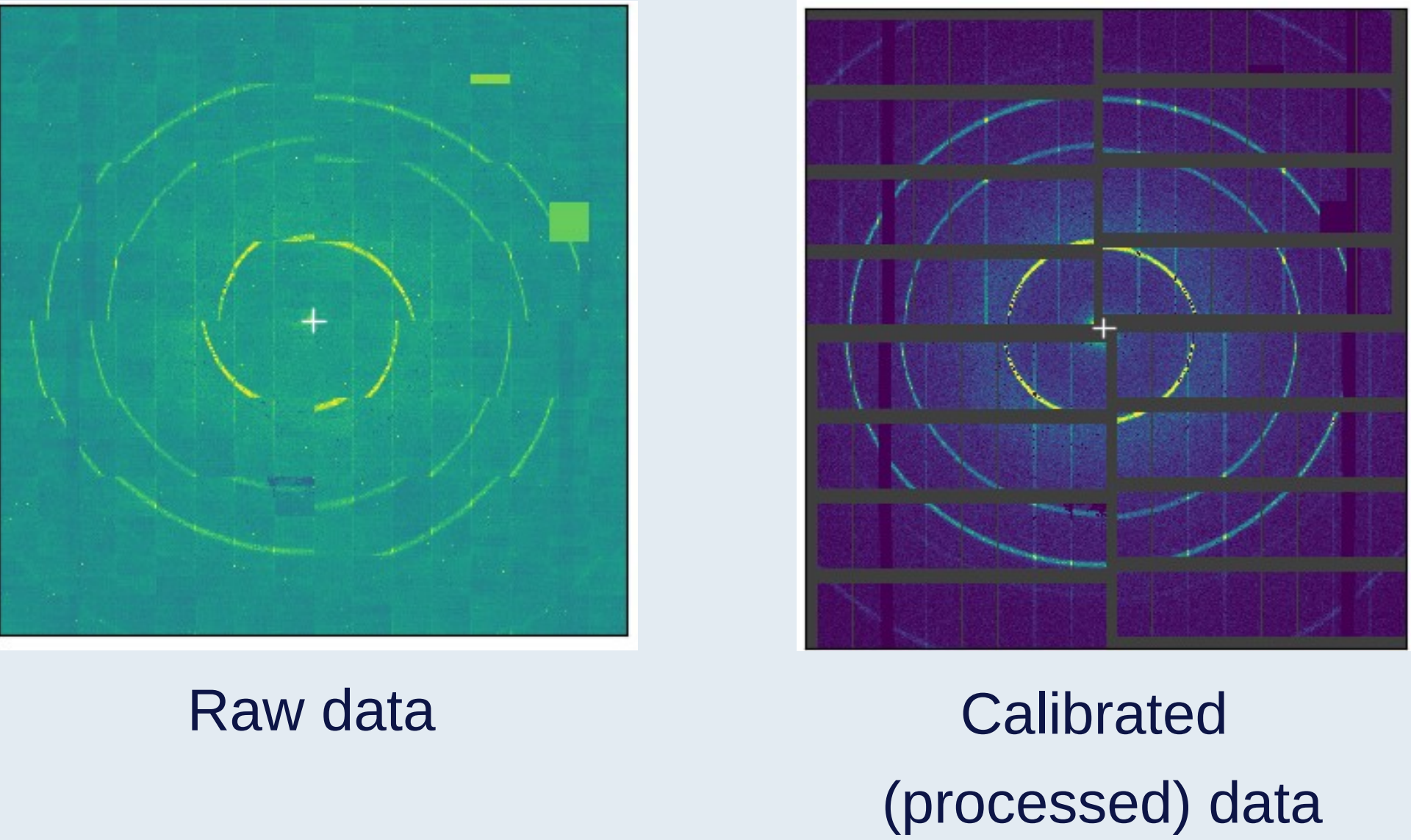
Low-latency data analysis that provides feedback to steer the experiment.

We offer a wide range of tools with different levels of flexibility and accessibility, from GUIs to raw data access.

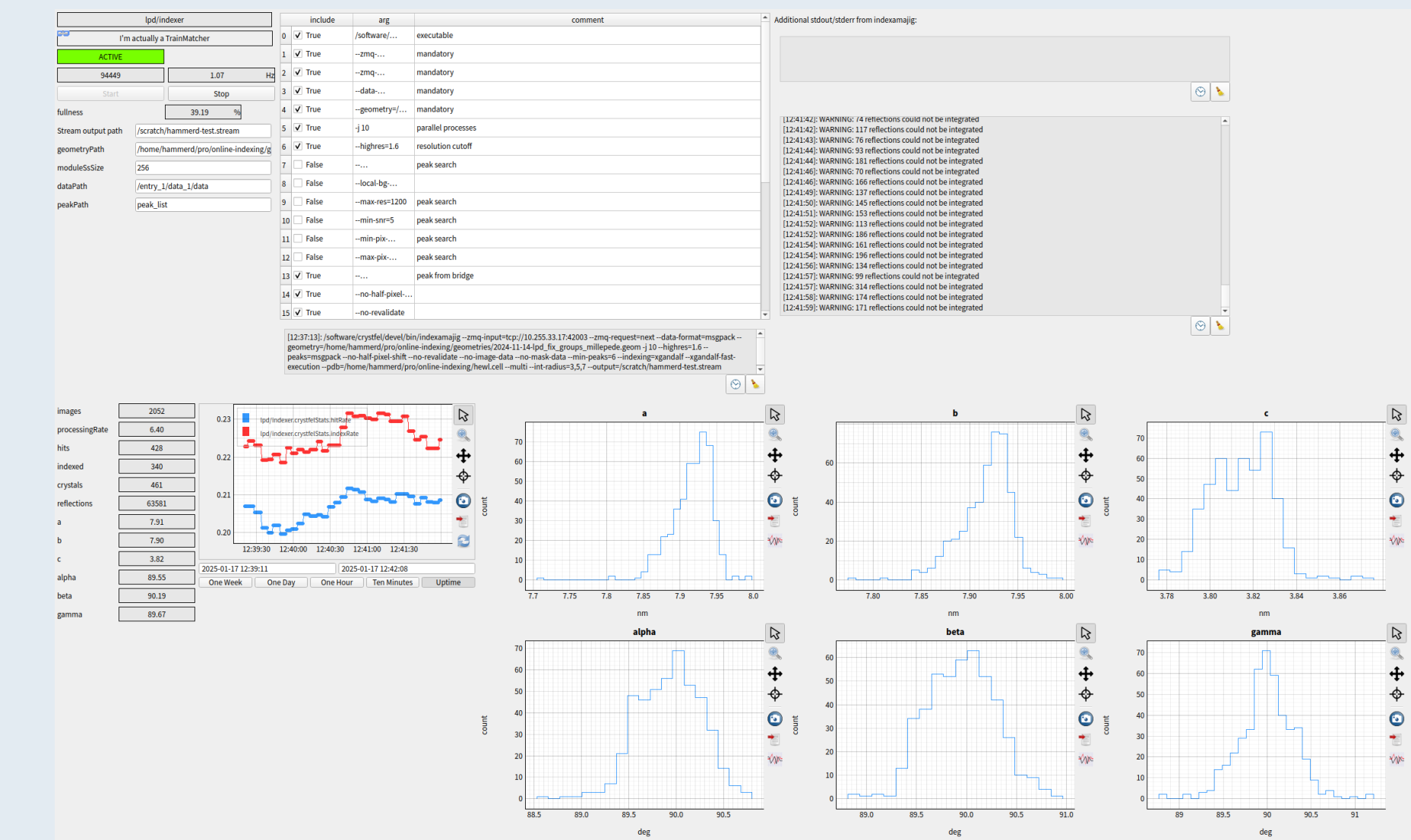
- Flexibility
- Karabo Scenes:** Allow quick and easy introspection into the control system data.
 - EXtra-foam:** Offers a rich GUI alongside with dedicated interfaces for specific types of analysis. It is mainly used with multi-module detectors' data.
 - Extra-metro:** framework for rapid development of Python-based online analysis code.
 - Karabo bridge:** protocol to stream real-time data with a client library in C++ and Python.

Calibration

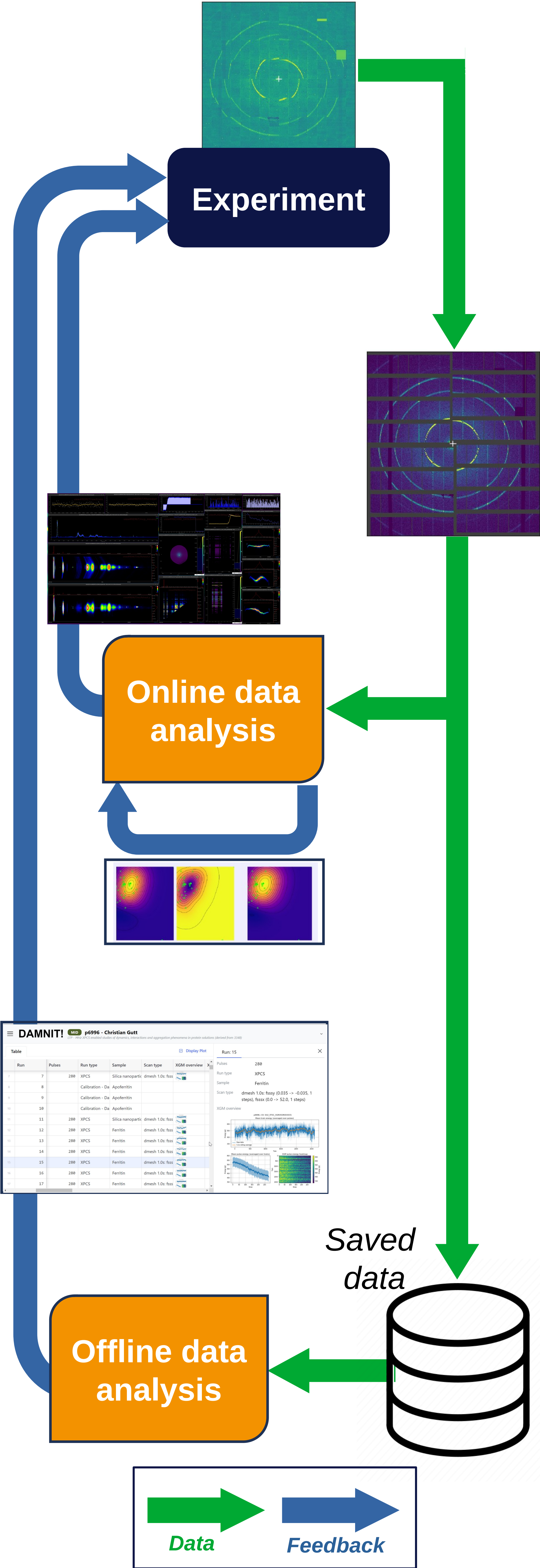
Robust, reproducible, low-latency pipeline developed to convert raw data into a more physics-sound view.



- Extensibility:** integrate your code towards a more complete online analysis.
- Example use case: SFX online indexing
- Applying user-defined mask.
 - Running peakfinding during correction step.
 - Two-way bridge to CrystFEL for indexing.



Recent integrations: Azimuthal integration, detector saturation monitoring, autocorrelation, ROI integration, AGIPD geometry with motor tracking.



Offline data analysis

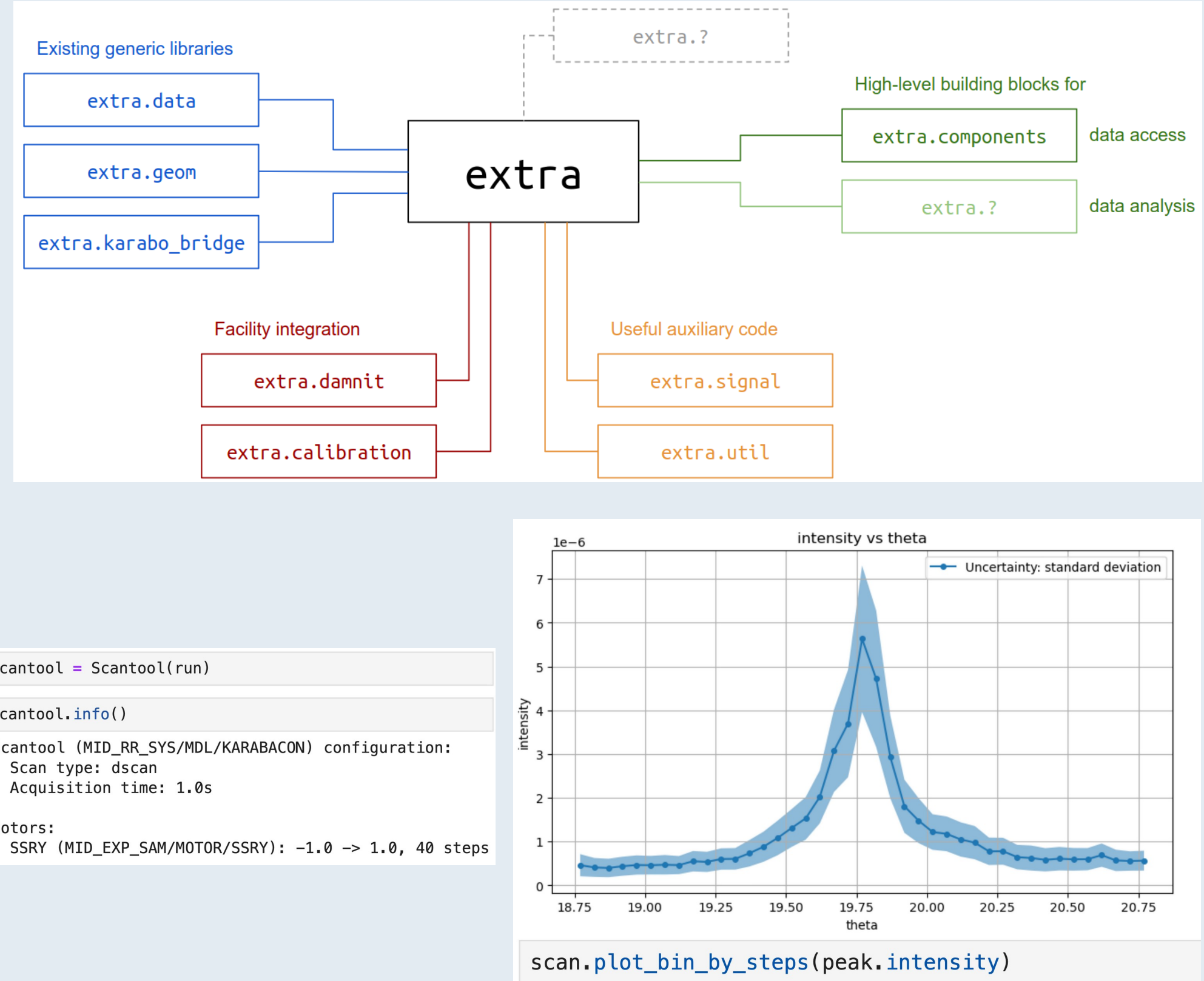
Scientific data at EuXFEL is saved in HDF5 files in a specific format (EXDF) and can be analyzed on the Maxwell computing cluster.

We provide a number of tools, as well as some software environments set up with commonly used packages.

EXTRA: European XFEL Toolkit for Research and Analysis.

<https://extra.rtfid.io>

This project aims to group a series of tools (in the form of packages) that make the analysis of data simpler. The tools range from **accessing** and working with EXDF data, implementations of specific **analysis techniques** to **high-level components** that abstract low-level Karabo devices. Most libraries are written in Python.



Experimental technique oriented documentation

- Documentation based on the analysis steps of an experimental technique.
- Explanation of useful concepts from a data analysis perspective.
- Jupyter notebook with all the analysis steps for each technique.

