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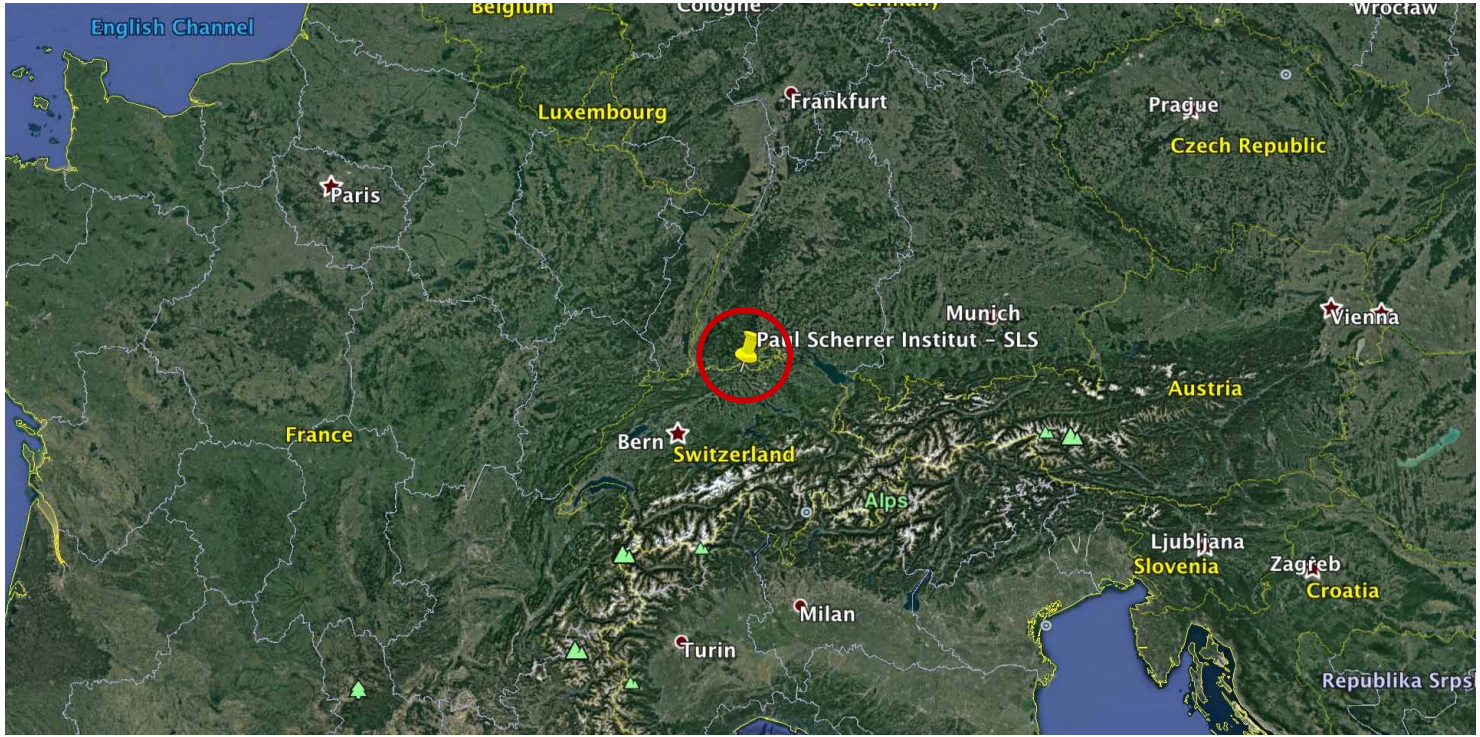
Klaus Wakonig :: Software Scientist :: Paul Scherrer Institute

A Beamline and Experiment Control System for SLS 2.0

October 9, 2023

The Paul Scherrer Institute



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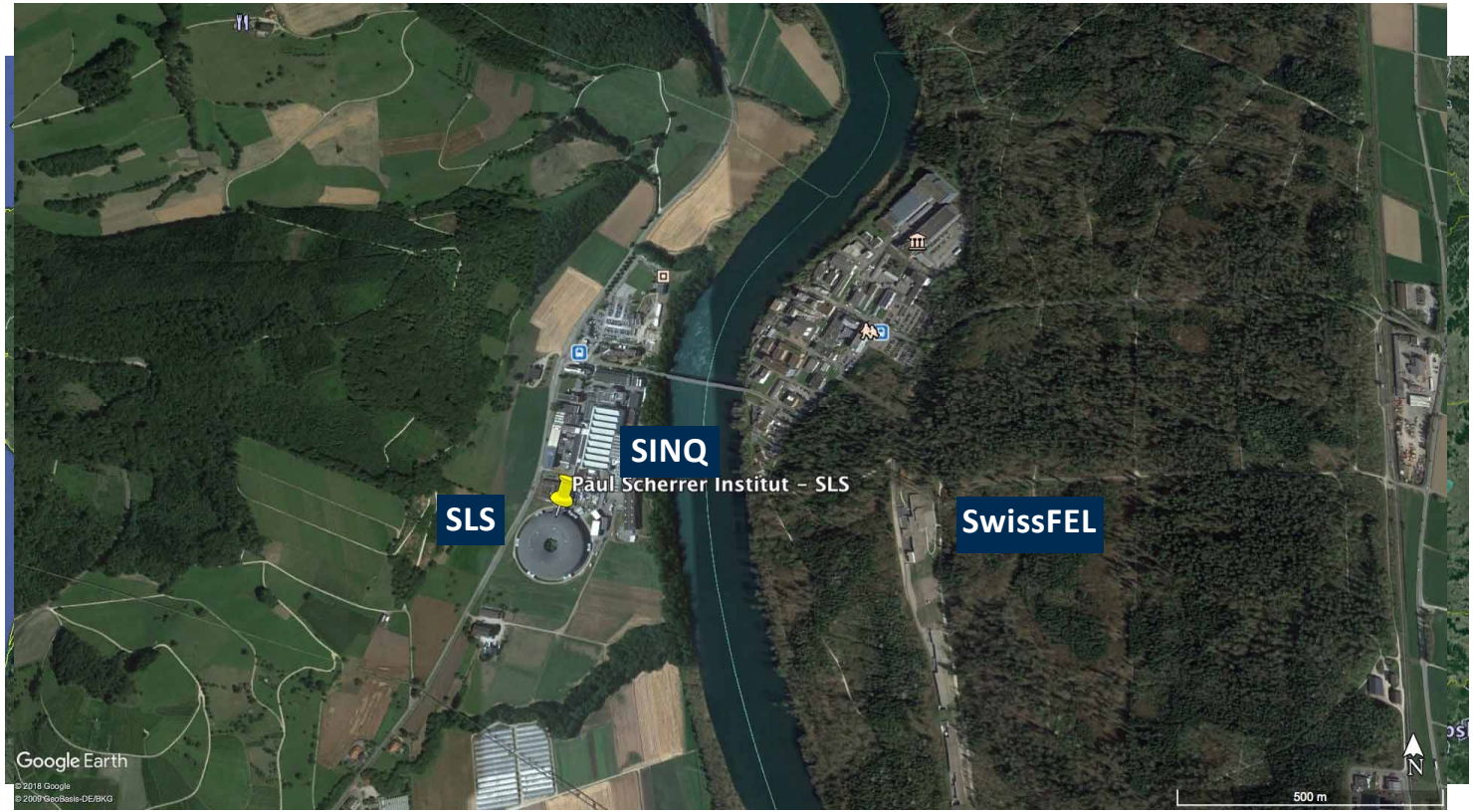

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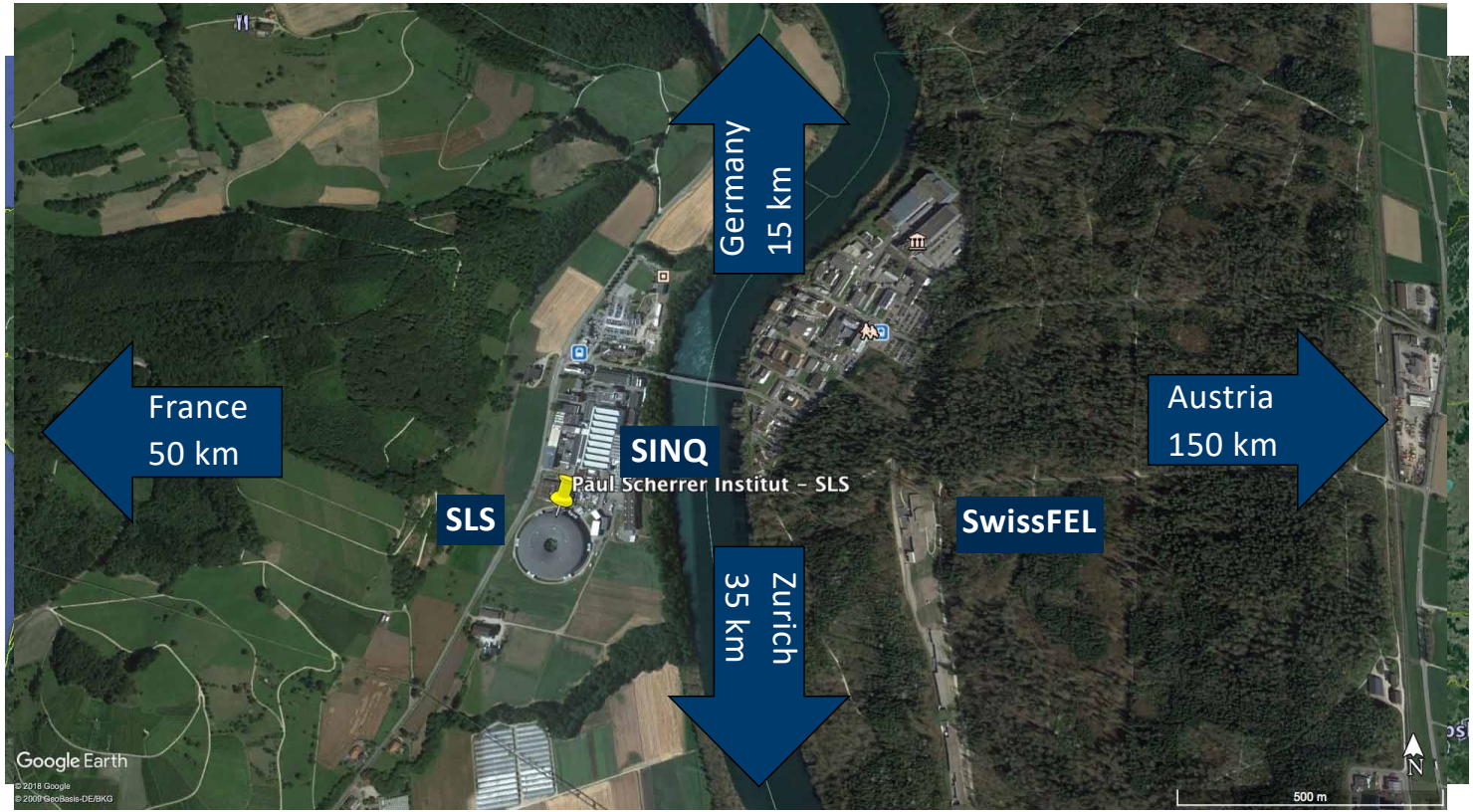
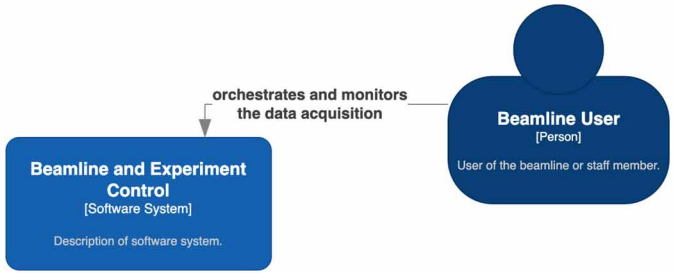


What's a BEC?

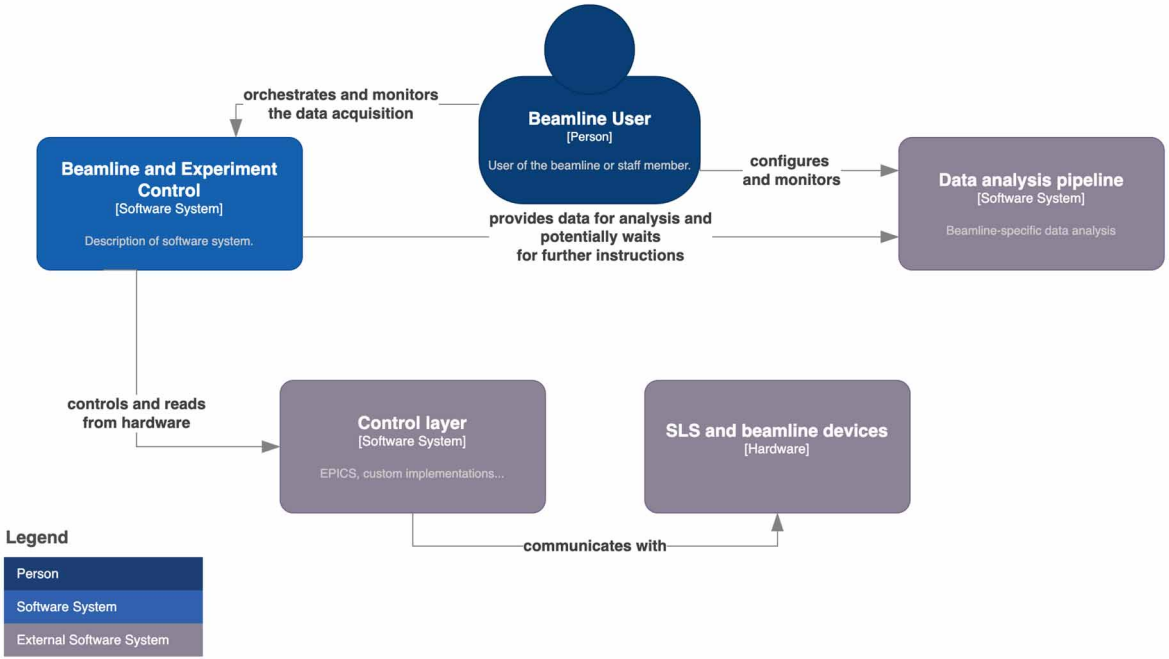
Beamline (and) **E**xperiment **C**ontrol

"… the layer above the control system tasked with the orchestration of the data acquisition."

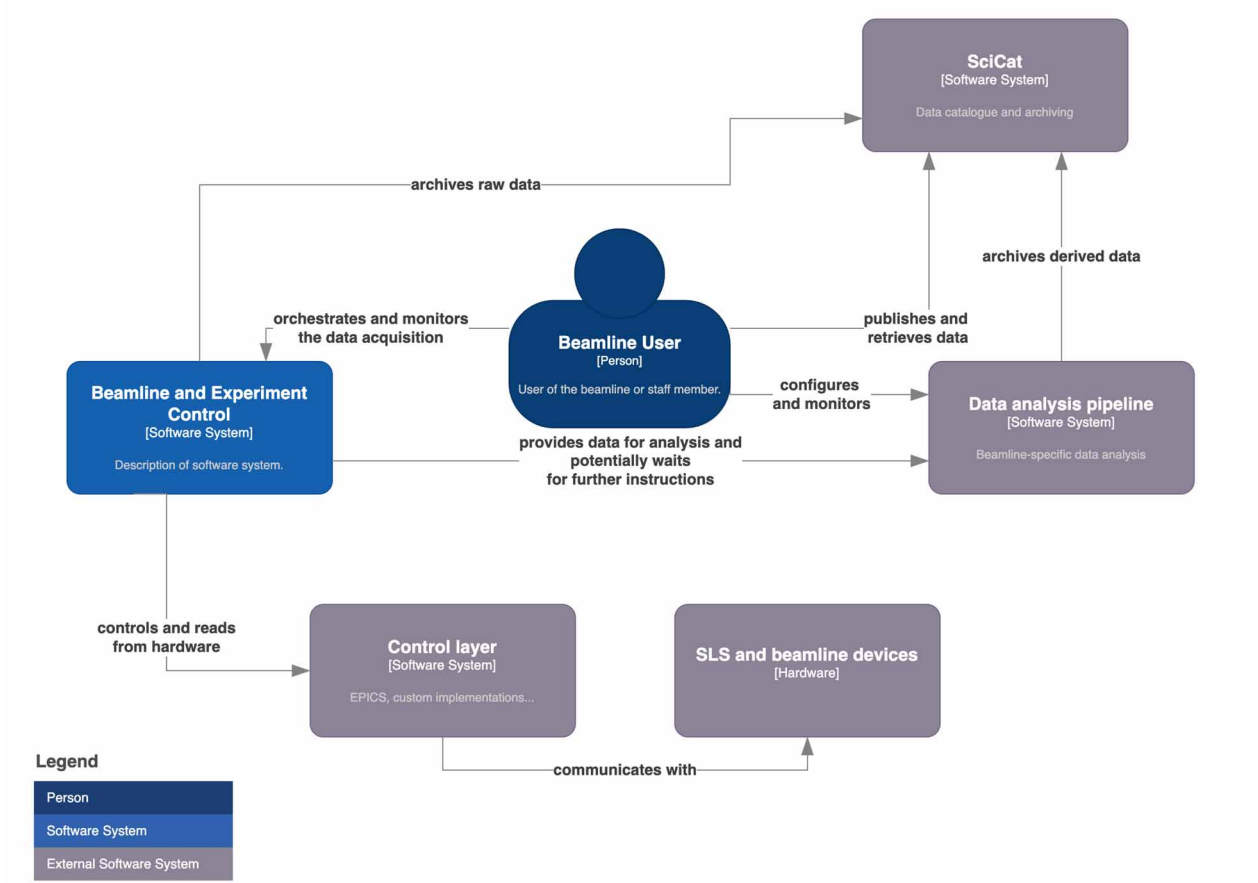
Beamline and Experiment Control



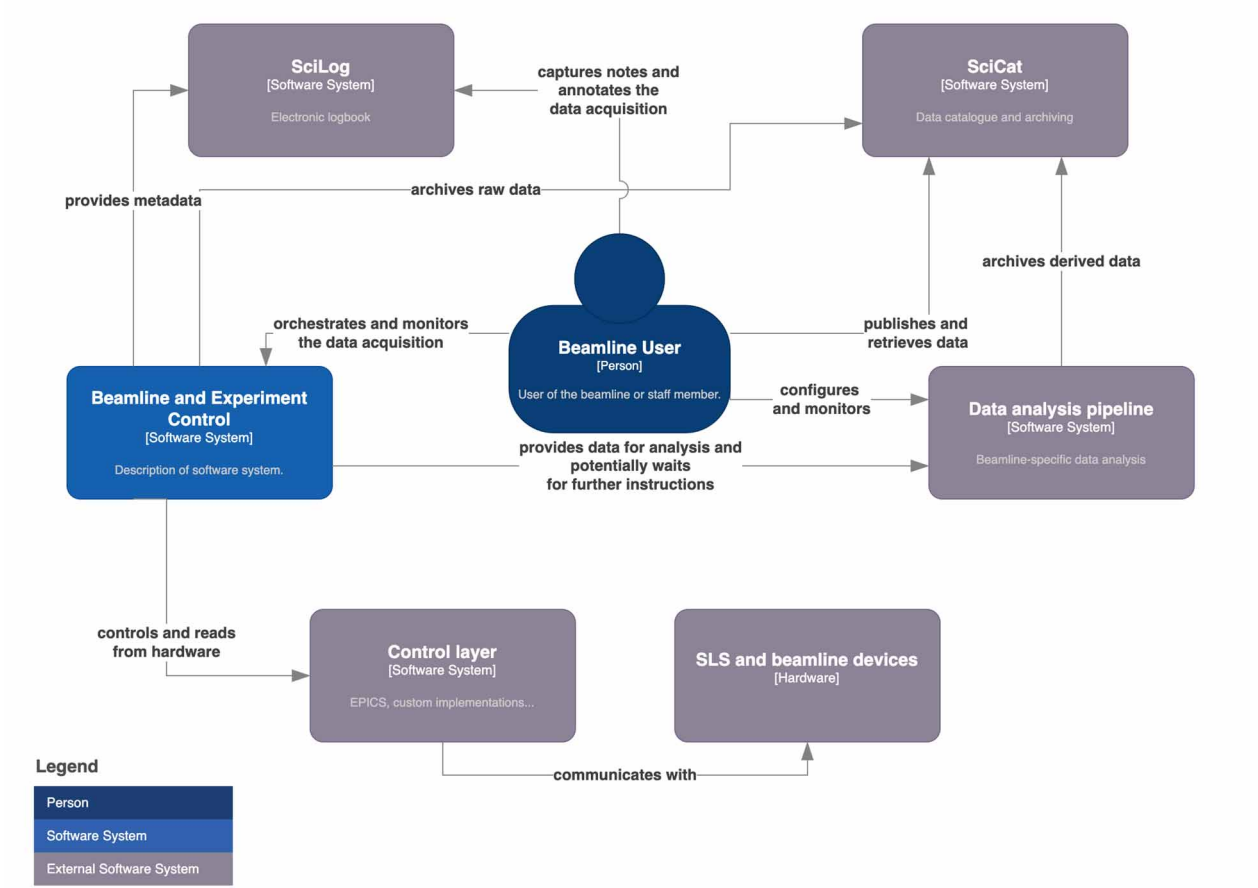
Beamline and Experiment Control



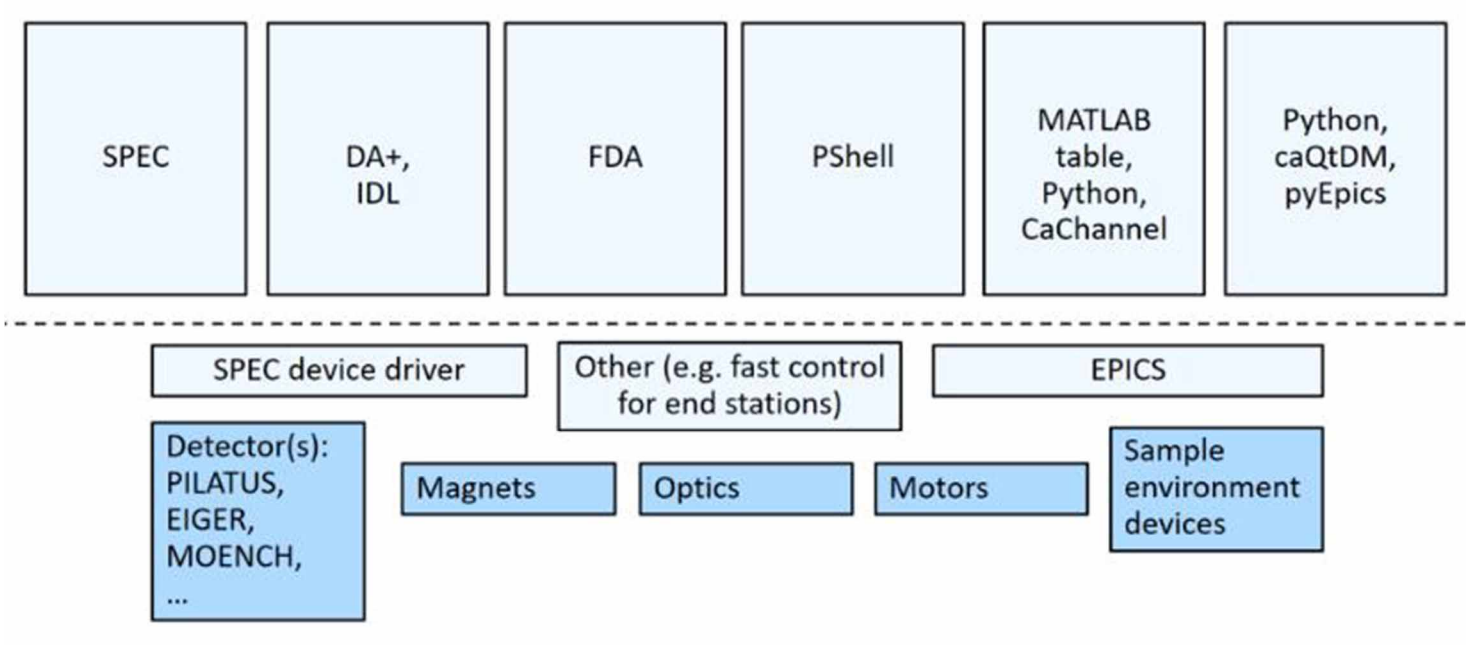
Beamline and Experiment Control



Beamline and Experiment Control



Current state at SLS

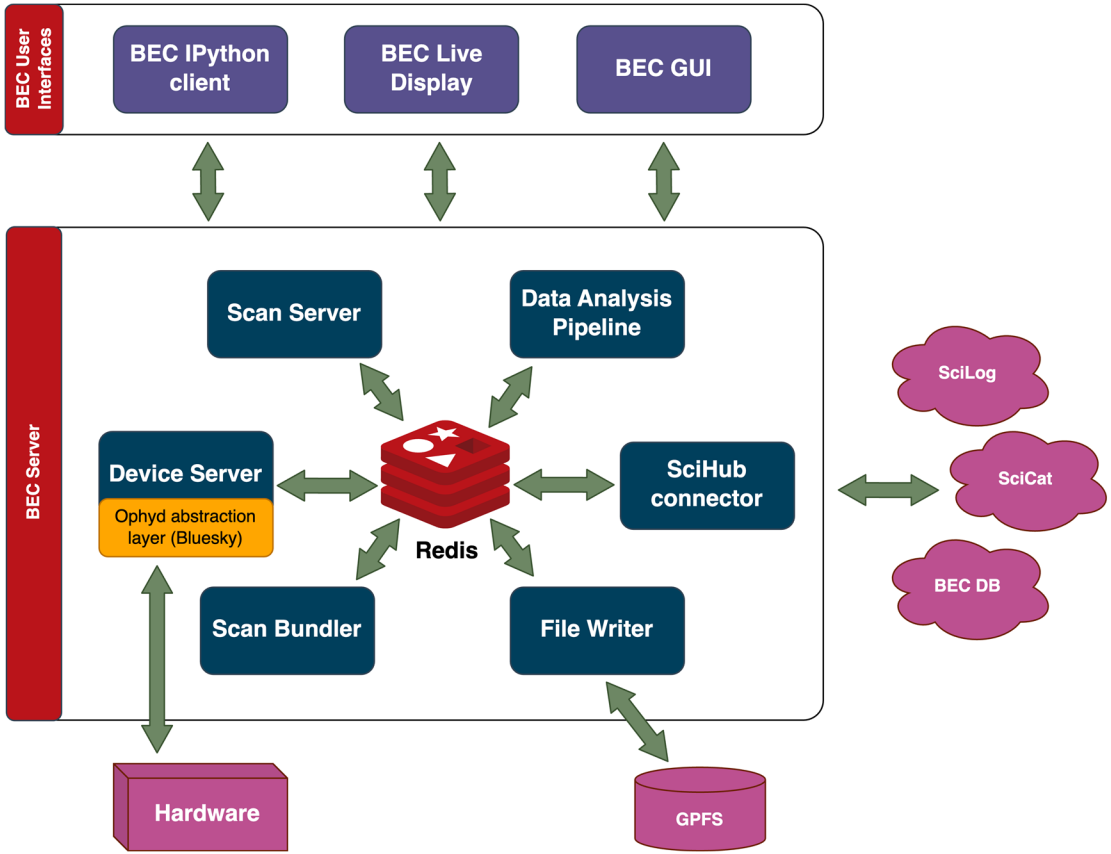


Source: CaSIT CDR


Bliss


bluesky

BEC Architecture

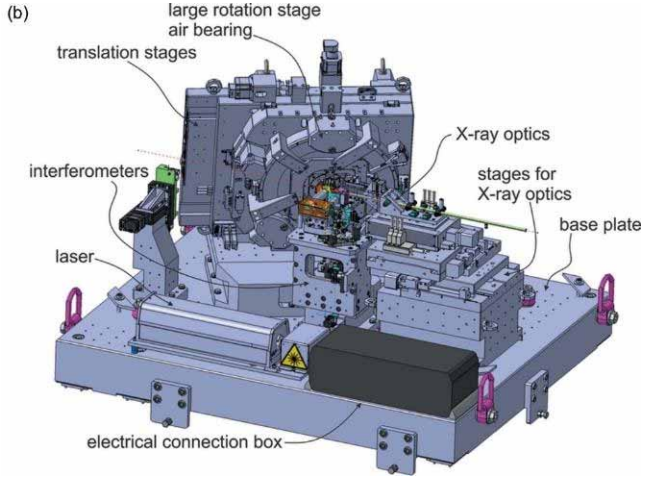


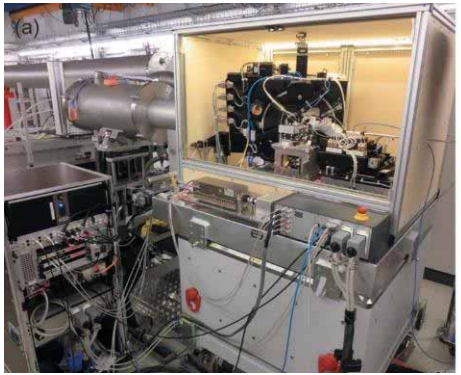
BEC development with LamNI

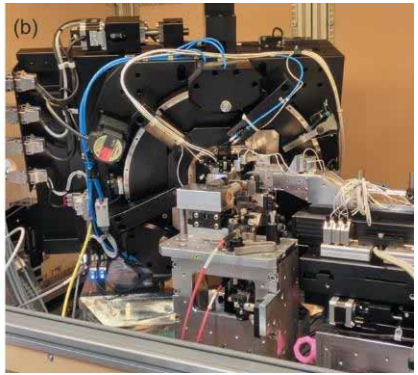
- LamNI hardware independent of beamline operation
- BEC prototyping in OMNY hutch
- Development without interference with user operation

Non-EPICS devices, direct interfacing to HW
- Galil motor controller
- Smaract motor controller
- RT linux based scanning system (interferometers, piezo stages, etc.)

Offline development and testing during summer 2022





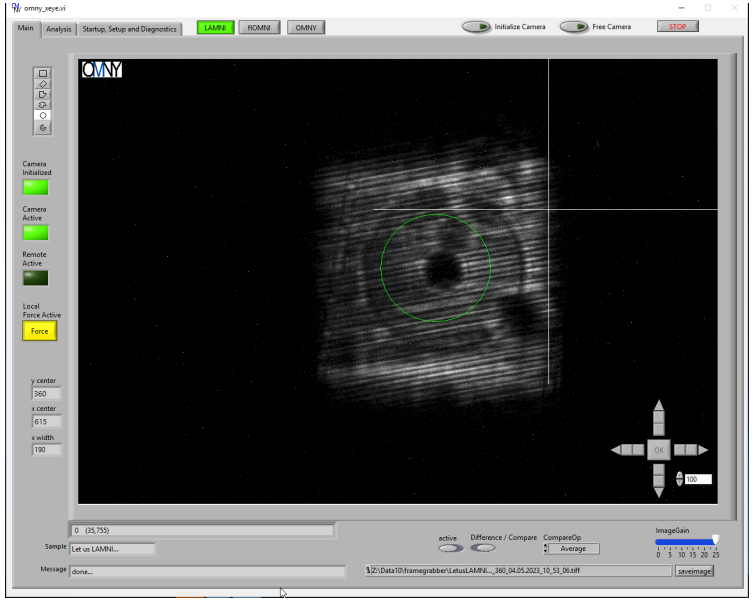


J. Synchrotron Rad. (2020). 27, 730–736

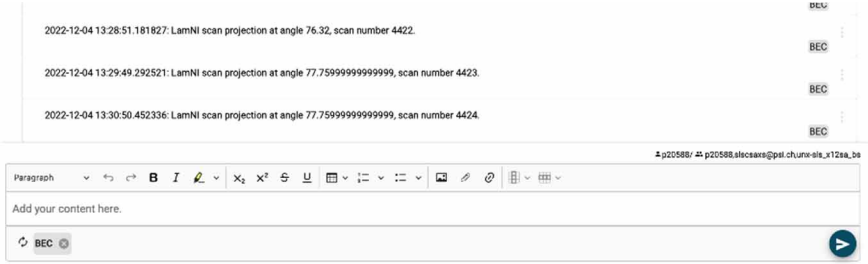
Slide courtesy: Mirko Holler, Photon Science Division (PSD)

Interoperability

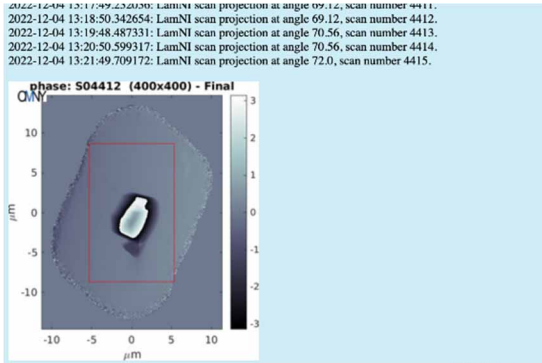
- File writer writes NeXus-compatible files, defined through plugins
  - currently NXsas
- BEC-internal dataset ID for automated data archiving using SciCat.
- Connected to alignment GUI

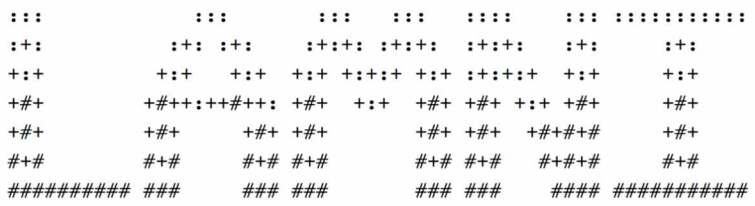


- Connected to cSAXS's automated data processing and archiving pipeline
  - cSAXS code (Matlab) subscribes to BEC events (from Redis)
- Connected to SciLog



- Connected to legacy web log.





Sample Name: Y350c_L1
Measurement ID: 1160
Dataset ID: 20054
Sample Info: Sample Info
e-account: e20632
Number of projections: 752
First scan number: 20055
Last scan number approx.: 20817
Current photon energy: 6.2027
Exposure time: 0.10
Fermat spiral step size: 0.50
Piezo range (FOV sample plane): 79.00/79.00
Restriction to circular FOV: 27.00
Stitching: 0.00/0.00
Number of individual sub-tomograms: 8
Angular step within sub-tomogram: 3.83

Y350c_L1 LamNI dataset_id_20054 tomo_parameters BEC

Beam checks

Starting subtomo: 1. First scan number: 20055.

BEC tomo_id_1160 Y350c_L1 BEC_subtomo

Beamline checks failed at 2023-05-02 22:12:54.842205: Check beam failed: Light not available.

beam_check BEC

Operation resumed at 2023-05-02 22:38:43.103098.

beam_check BEC

Starting subtomo: 2. First scan number: 20151.

BEC tomo_id_1160 Y350c_L1 BEC_subtomo

Starting subtomo: 3. First scan number: 20245.

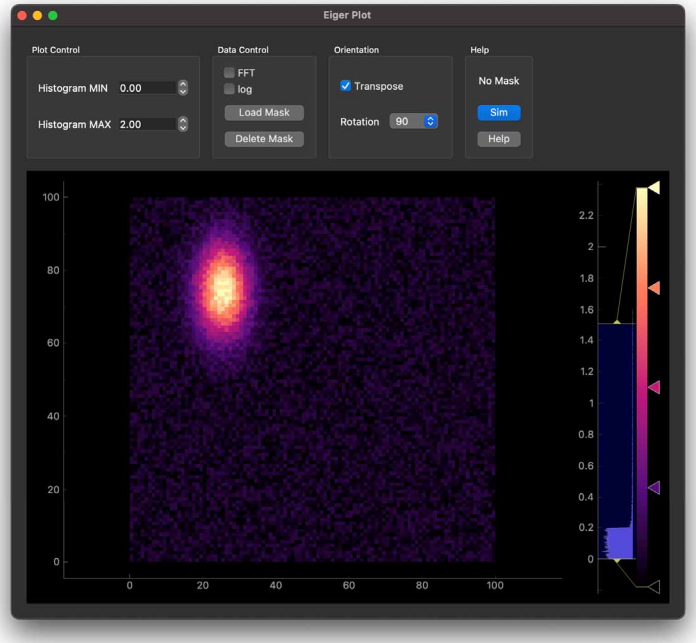
BEC tomo_id_1160 Y350c_L1 BEC_subtomo

Starting subtomo: 4. First scan number: 20339.

BEC tomo_id_1160 Y350c_L1 BEC_subtomo

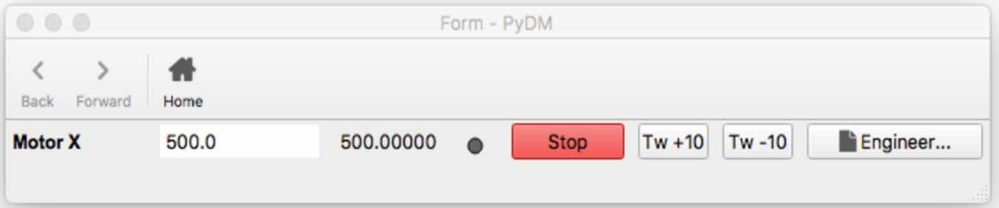
Visualization

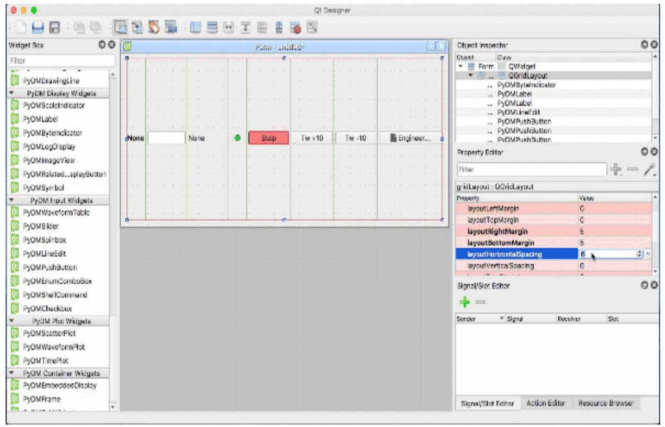
- PyDM (based on QtDesigner, PyQt5 and pyqtgraph) datasource plugins for BEC
- Additional BEC-specific plugins with fast feedback loops from PSD scientists.
  - Long-term goal: Collection of modular plugins for beamline scientist to build the desired interface themselves



Visualization using PyDM

PyDM datasource plugins for moving devices using BEC (EPICS and non-EPICS)



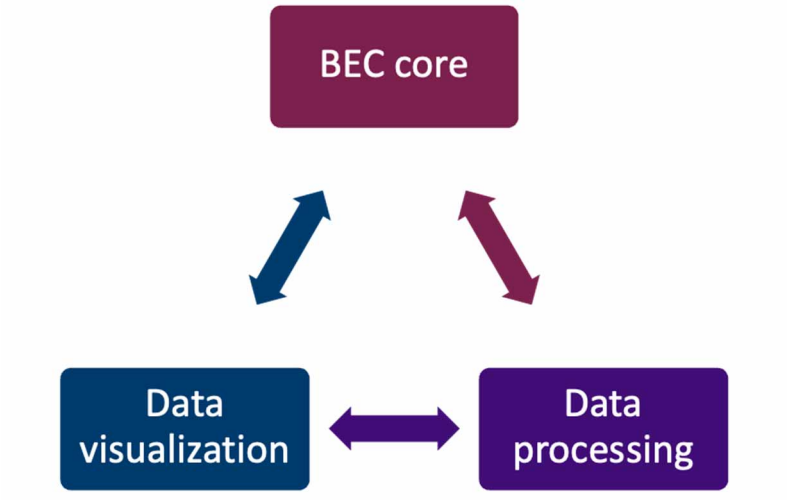


Drag and drop widgets to compose new user interfaces

Visualization using BEC-specific widgets

Extending the functionality of PyDM with BEC-specific QtDesigner plugins

BEC's event-based architecture facilitates fast development cycles.



https://gitlab.psi.ch/bec/bec-widgets

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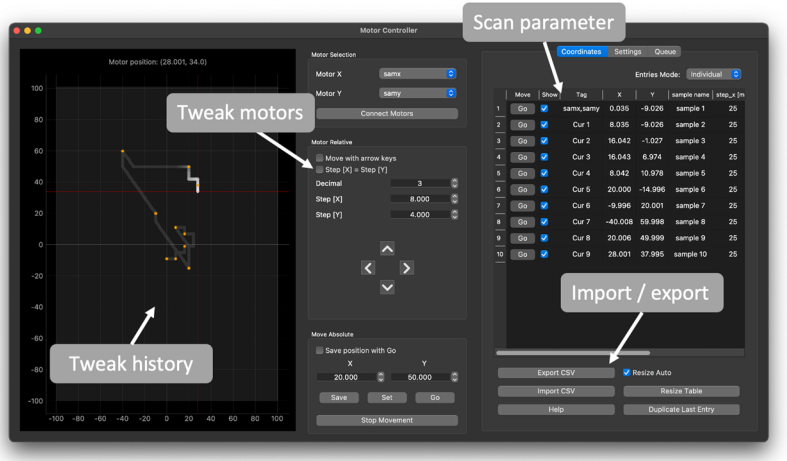
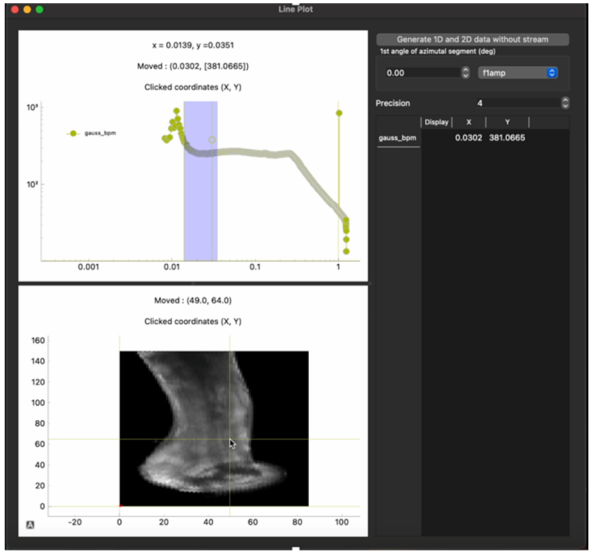
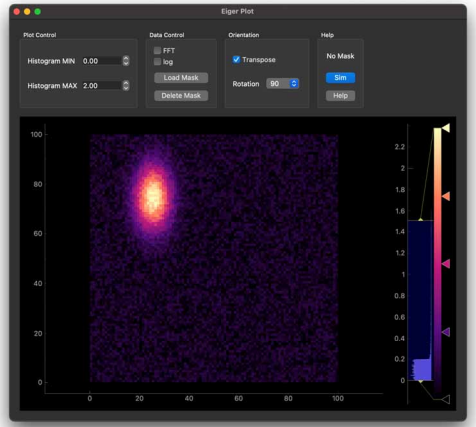
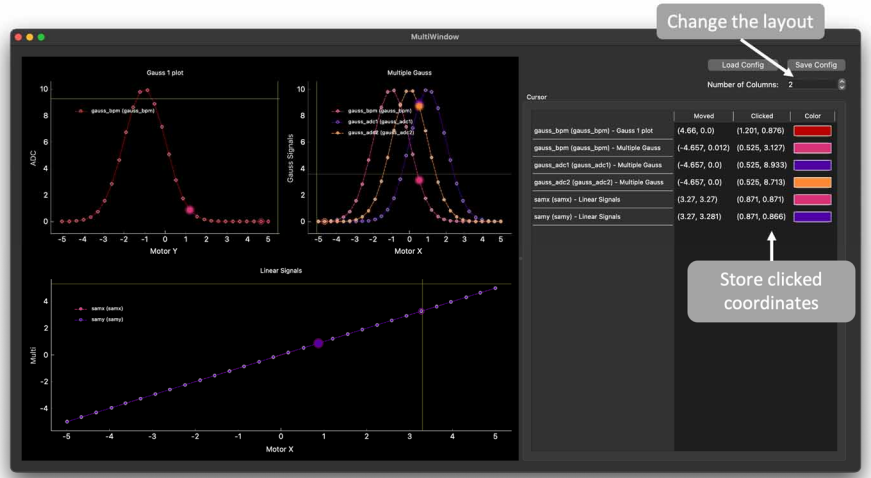
User interfaces using BEC widgets

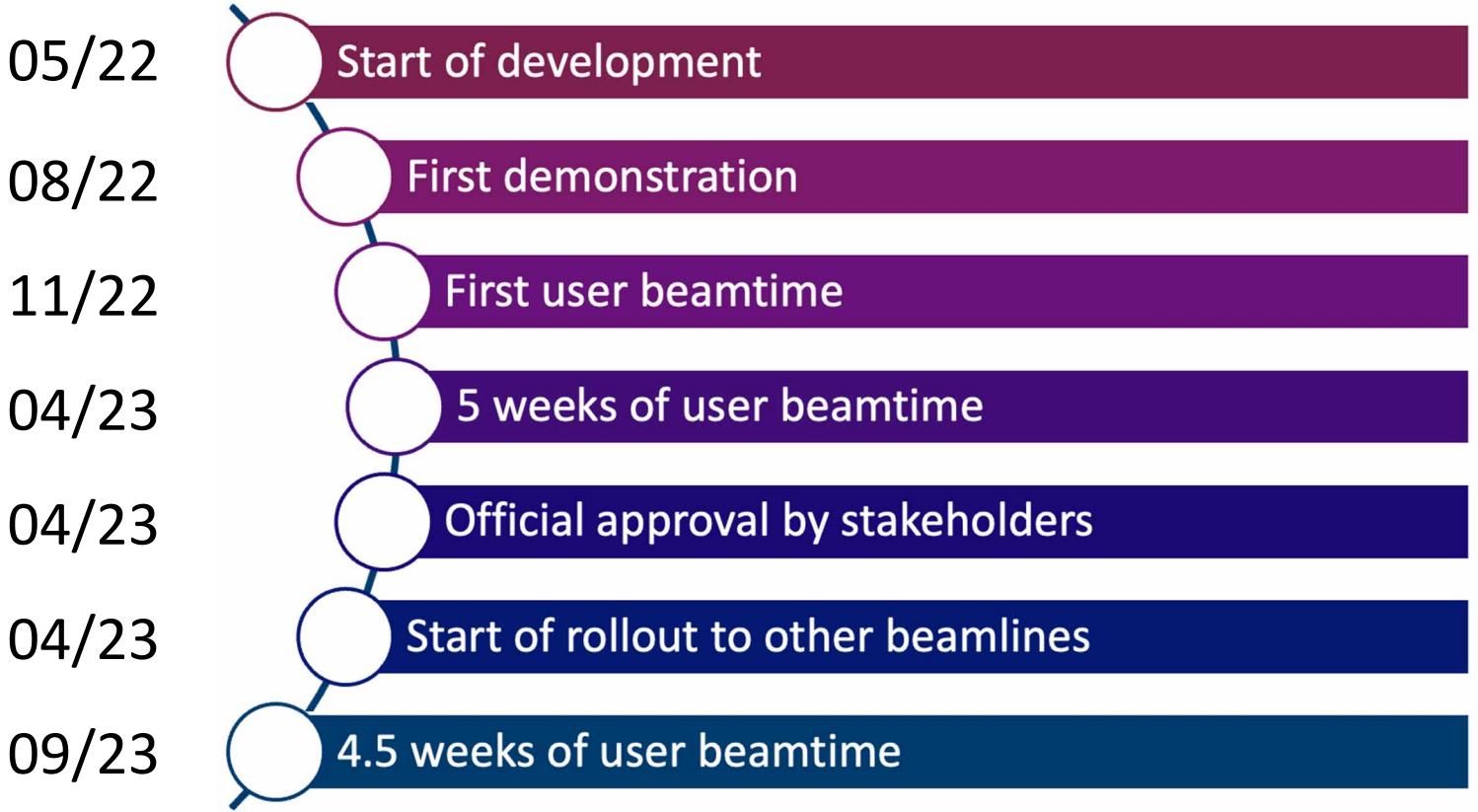








Milestones / Summary



Outlook

SLS 2.0 upgrade program (18 months)

- Transition most phase 0 / phase 1 beamlines to BEC
- Further explore the data processing pipelines
- BEC DB (under development)
  - Hosted on external cloud service provider (similar to SciLog and SciCat)
- Web interfaces for monitoring (and control)
  - Daiquiri
  - …

Thanks!

- **Christian Appel**
- **Ivan Usov**
- **Jan Wyzula**

- **Science IT**
- **Photon Science Division**
- **Controls**

Everyone who contributed and facilitated the swift prototype development!