

Bluesky at SIRIUS light source

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Control Software Group (SwC)

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Brazilian Center for Research in Energy and Materials (CNPEM)



Overview

- SIRIUS: overview and status
- Current status of beamlines acquisition
- Initiatives with Bluesky packages for SIRIUS beamlines
- Next steps

Overview

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SIRIUS: overview and status



Brazilian Center for Research in Energy and Materials (CNPEM)

- 4GSR in operation
- Green-field facility
- Construction: 2012 – 2020
- Cost: US\$ 500M (~85% spent in Brazil)
- 1st regular users call: Nov. 2022
- 100 mA in top-up mode, uniform fill



Campinas
Brazil

SIRIUS design parameters

Energy	3.0	GeV
Circumference	518.4	m
Emittance	250	pm.rad
Current (top-up)	350	mA

SIRIUS: overview and status

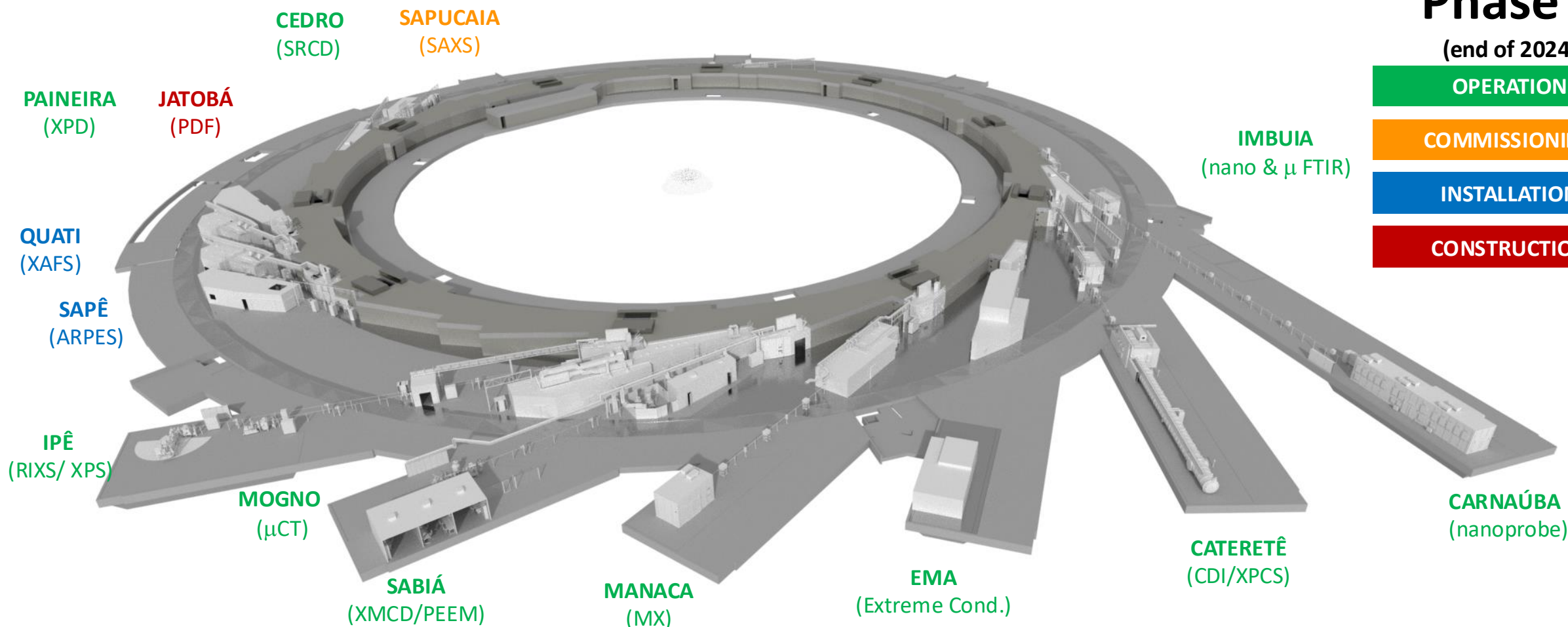
Currently on
Phase 1
(end of 2024)

OPERATION

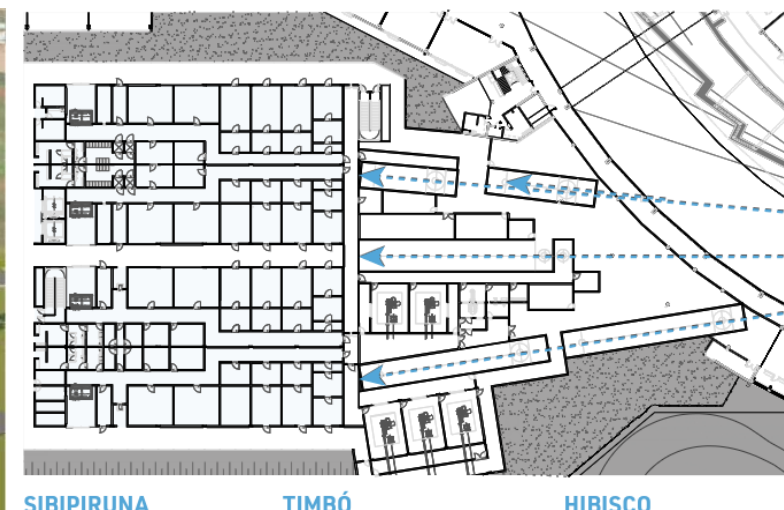
COMMISSIONING

INSTALLATION

CONSTRUCTION



SIRIUS: future beamlines



ORION

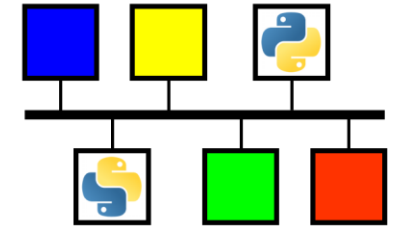
<https://cnpem.br/orion/>

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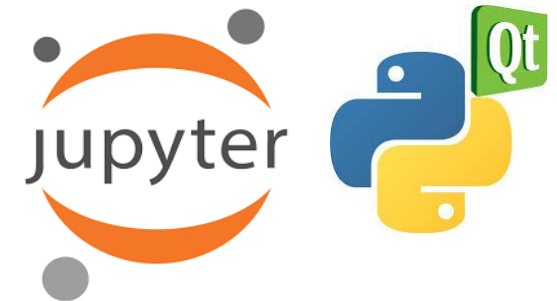
Current status

- EPICS framework based control system



- Beamlines in operation:

- Several tools implemented by beamline staff
- Mostly based on PyEpics library
- Jupyter notebooks
- PyQt5 + PyDM combined with some logic in the GUI
- Control and acquisition combined in desktop solutions

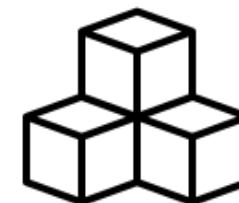


- These tools have made it possible for users to access our facilities so far, but there's plenty of room for improvement.

Current status

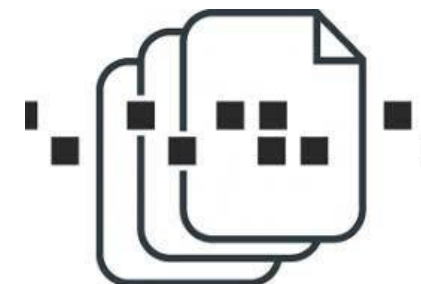
- Challenges:

- experiment downtime due to software issues



- lack of modular, standardized, and shared solutions between beamlines

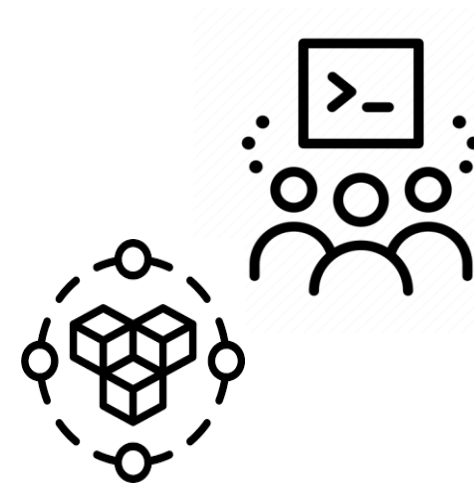
- difficulties in managing experiment metadata



- problems with acquisition robustness

Current status

- Strategies to address these issues:
 - Develop modular and standardized solutions
 - Use community shared solutions
- Good experiences with exploratory use of Bluesky packages in some beamlines through ad-hoc solutions
- Since early 2024 -> evaluating Bluesky project pieces and working on solutions that can be shared between the beamlines



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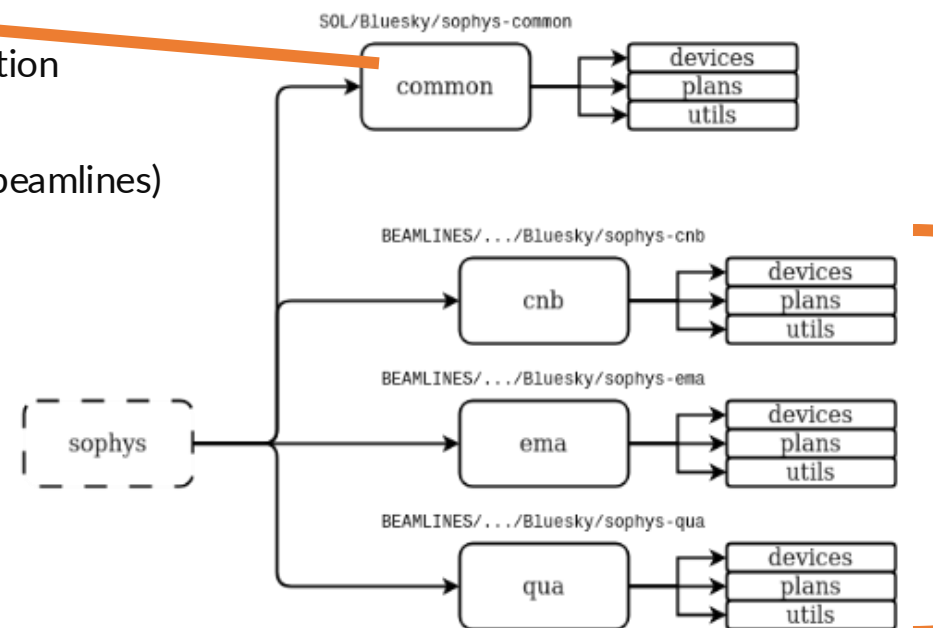
Bluesky at SIRIUS beamlines



sophys acronym to
SIRIUS ophyd and bluesky utilities

sophys - common

- Usage examples and documentation
- Common ophyd devices
(specific for SIRIUS, common for beamlines)
- Generic/annotated plans
- General utilities
 - Ophyd registry
 - Generic callbacks
 - Kafka interaction



sophys-(beamline abbreviation)

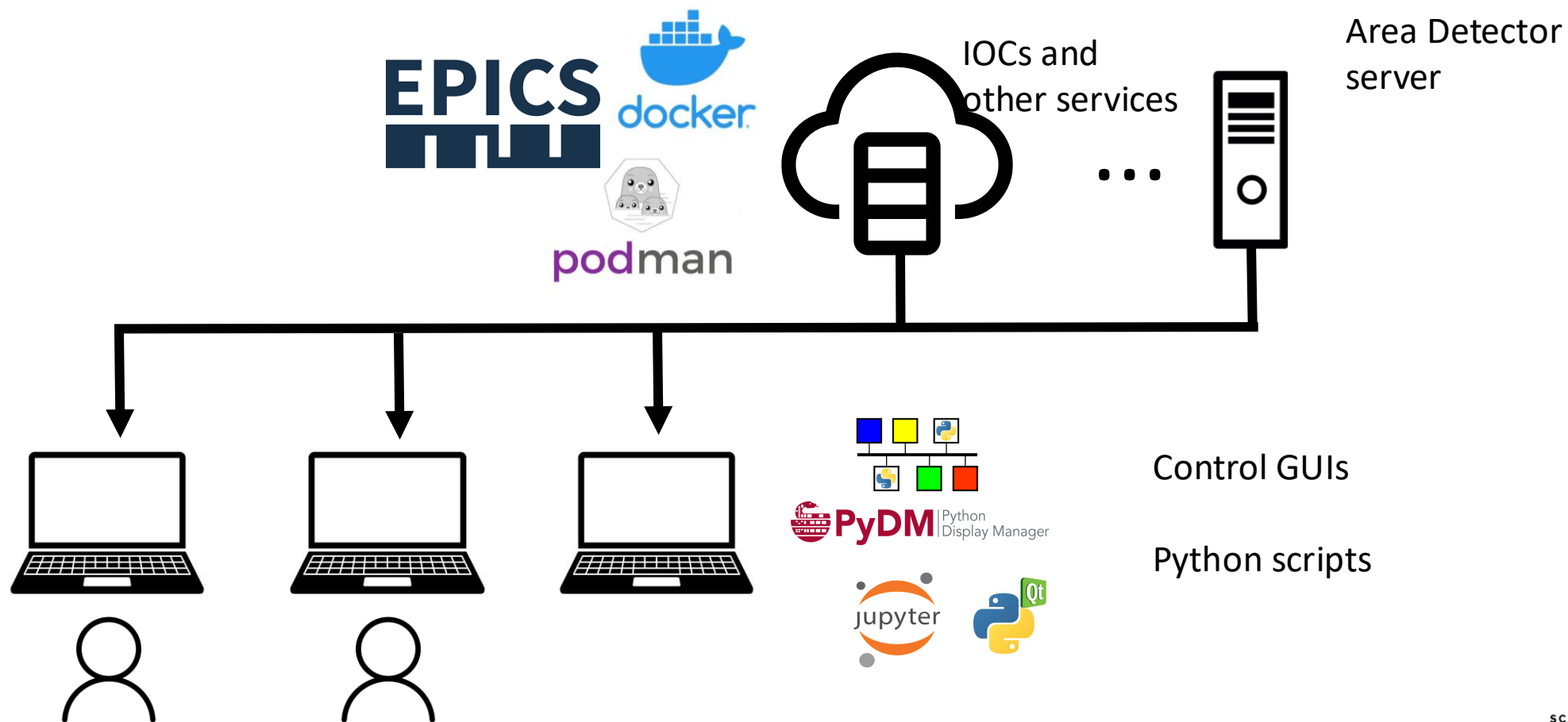
- Specific devices
- Dedicated plans
- Devices instantiation

Examples:

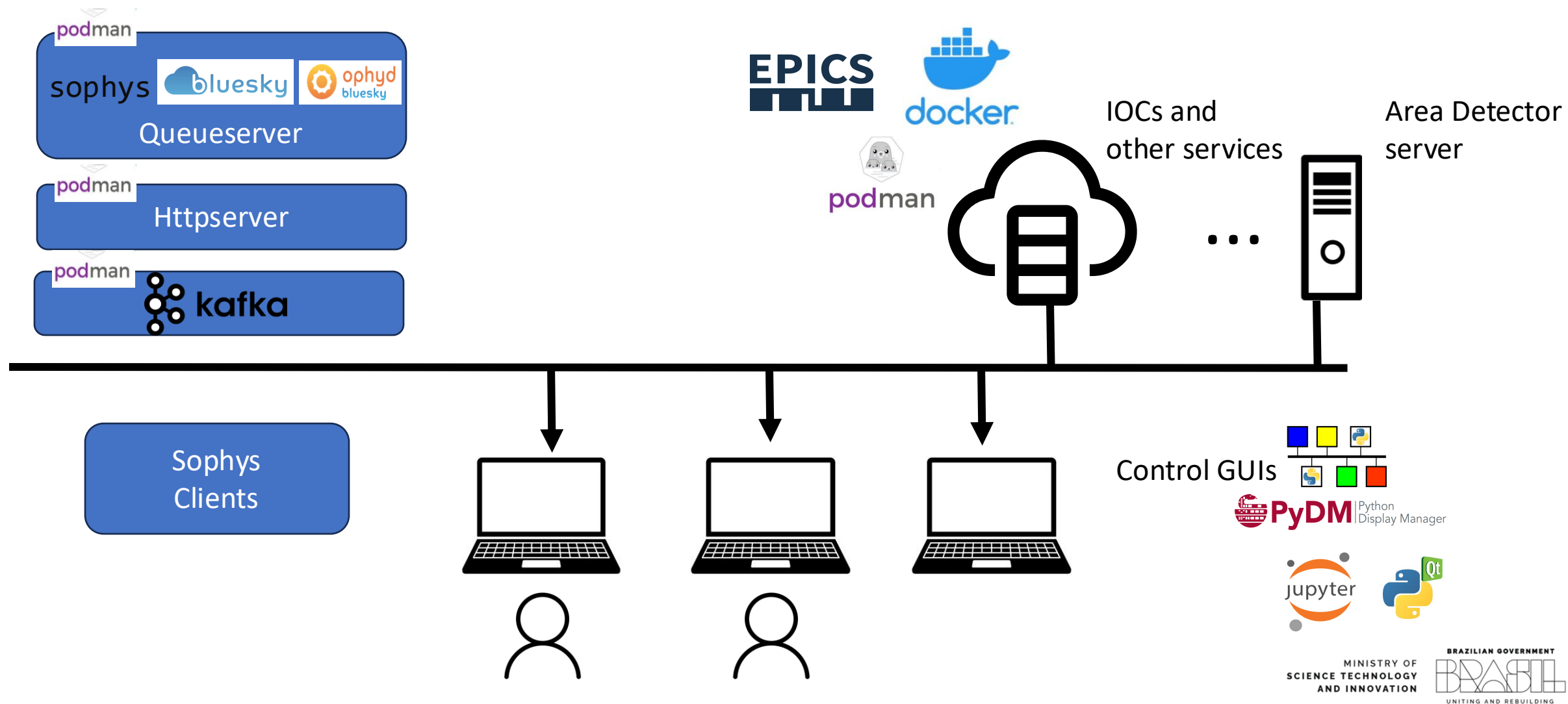
```
from sophys common utils import set_debug_mode
from sophys ema plans import MobipixEnergyScan
from sophys qua devices import HVPS
```


Bluesky at SIRIUS beamlines

- Computational infrastructure for beamlines operation

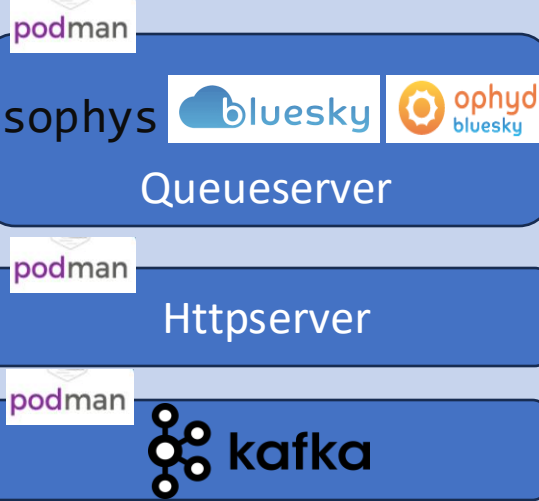


Bluesky at SIRIUS beamlines



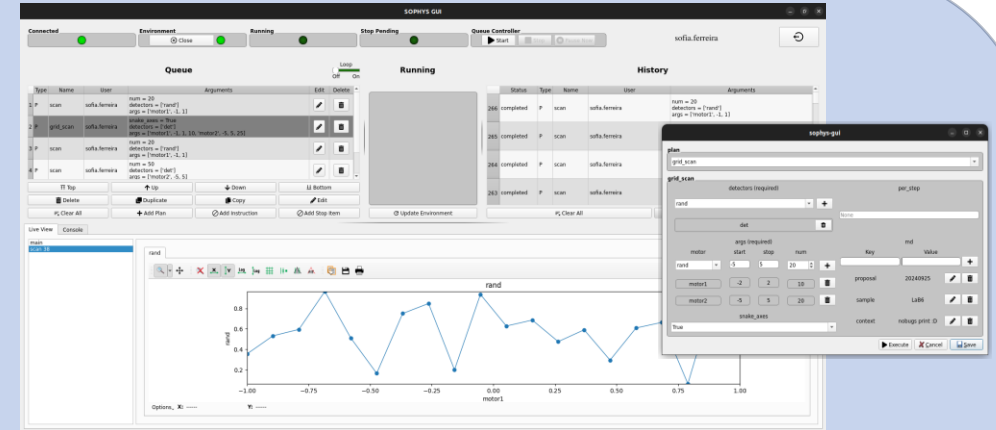
Bluesky at SIRIUS beamlines

Sophys Server



Sophys Clients

- sophys-gui
- Bluesky-widgets
 - Kafka consumer



- sophys-cli
- "spec-like"
 - Queueserverapi through httpserver
 - Ipython magics
 - Kafka consumer

```
(bluesky) sofia.ferreira@swc09-l ~/D/S/sophys-cli> sophys-cli test
Python 3.12.4 | packaged by conda-forge | (main, Jun 17 2024, 10:23:07) [GCC 12.3.0]
Type 'copyright', 'credits' or 'license' for more information
IPython 8.26.0 -- An Enhanced Interactive Python. Type '?' for help.

The custom available variables are:
BEAMLINE : The currently configured beamline.
BEC       : The BestEffortCallback instance hooked up to the run data.
D         : The list of available devices (to the current user).
DB        : A databroker instance containing the most recent runs data and metadata.
LAST      : The last run data, as a Pandas Dataframe.
P         : The list of available plans (to the current user).

The custom available modules are:
bp        : bluesky_plans
bps       : bluesky_plan_stubs

The custom available commands are:
kbl       : Open kafka-bluesky-live
reload_devices : Reload the available devices list (D).
reload_plans   : Reload the available plans list (P).
query_state   : Query the current server state.
reload_environment : Reload currently active environment. Open a new one if the current

Authentication is required to proceed! Please enter your credentials. [Ctrl-C to cancel]
Username:

In [1]: scan -d rand -m motor1 -2.2 -num 25
Out [1]: 'Plan has been submitted successfully!'

Transient Scan ID: 51      Time: 2024-09-24 17:24:20
Persistent Unique Scan ID: '4886bd9-bb68-4744-8084-7ad3bce444f'
New stream: 'primary'
-----
seq num | time | motor1 | rand |
-----|-----|-----|-----|
1 | 17:24:20.4 | -2.800 | 0.563 |
2 | 17:24:20.4 | -1.833 | 0.040 |
3 | 17:24:20.4 | -1.667 | 0.791 |
4 | 17:24:20.4 | -1.500 | 0.255 |
5 | 17:24:20.4 | -1.333 | 0.001 |
6 | 17:24:20.4 | -1.167 | 0.998 |
7 | 17:24:20.4 | -1.000 | 0.127 |
8 | 17:24:20.4 | -0.833 | 0.107 |
9 | 17:24:20.4 | -0.667 | 0.670 |
10 | 17:24:20.4 | -0.500 | 0.684 |
11 | 17:24:20.4 | -0.333 | 0.195 |
12 | 17:24:20.4 | -0.167 | 0.526 |
13 | 17:24:20.4 | 0.000 | 0.255 |
14 | 17:24:20.4 | 0.167 | 0.361 |
15 | 17:24:20.4 | 0.333 | 0.026 |
16 | 17:24:20.4 | 0.500 | 0.276 |
17 | 17:24:20.4 | 0.667 | 0.714 |
18 | 17:24:20.4 | 0.833 | 0.971 |
19 | 17:24:20.4 | 1.000 | 0.973 |
20 | 17:24:20.4 | 1.167 | 0.490 |
21 | 17:24:20.4 | 1.333 | 0.600 |
22 | 17:24:20.4 | 1.500 | 0.443 |
23 | 17:24:20.4 | 1.667 | 0.610 |
24 | 17:24:20.4 | 1.833 | 0.936 |
25 | 17:24:20.4 | 2.000 | 0.994 |
-----
generator scan [ 4886bd9 ] (scan num: 51)

In [2]:
```

Bluesky at SIRIUS beamlines

Sophys Server

podman

sophys



Queueserver

podman

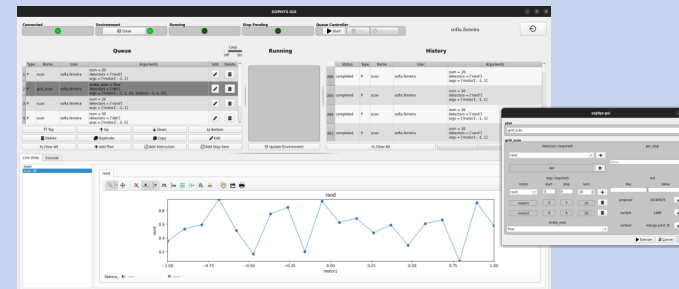
Httpserver

podman



Sophys Clients

sophys-gui



sophys-cli

```
(bluesky) sofia.ferreira@bc-wc09-1 ~/D/S/sophys-cli$ sophys-cli test
Python 3.12.4 | packaged by conda-forge | (main, Jun 17 2024, 10:23:07) [GCC 12.3.0]
Type "copyright", "credits" or "license()" for more information.
Python 8.26.0 -- An enhanced Interactive Python. Type "?" for help.

The custom available variables are:
BEAMLINE : The currently configured beamline.
BECK      : The BesiForFullback instance hooked up to the run data.
D         : The list of available devices (to the current user).
DB        : A databroker instance containing the most recent runs and metadata.
LAST      : The last run data, as a Pandas Dataframe.
P         : The list of available plans (to the current user).

The custom available modules are:
top       : bluesky plans
lps       : bluesky plan stubs

The custom available commands are:
open_kafka_bluesky_live : Open kafka-bluesky-live
reload_devices           : Reload the available devices list (D).
reload_plans             : Reload the available plans list (P).
query_state             : Query the current server state.
reload_environment      : Reload currently active environment. Open a new one if the current env is closer.

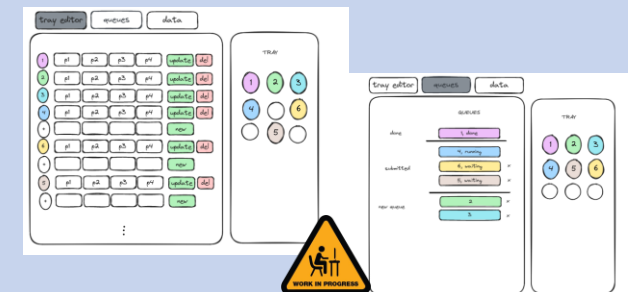
Authentication is required to proceed! Please enter your credentials. [Ctrl-C to cancel]
Username: 
```

```

Time: 2024-09-24 17:24:28
-----
Max stream: primary
-----
Time: 2024-09-24 17:24:28
-----
generator id: 408880c5 | scan num: 511
-----

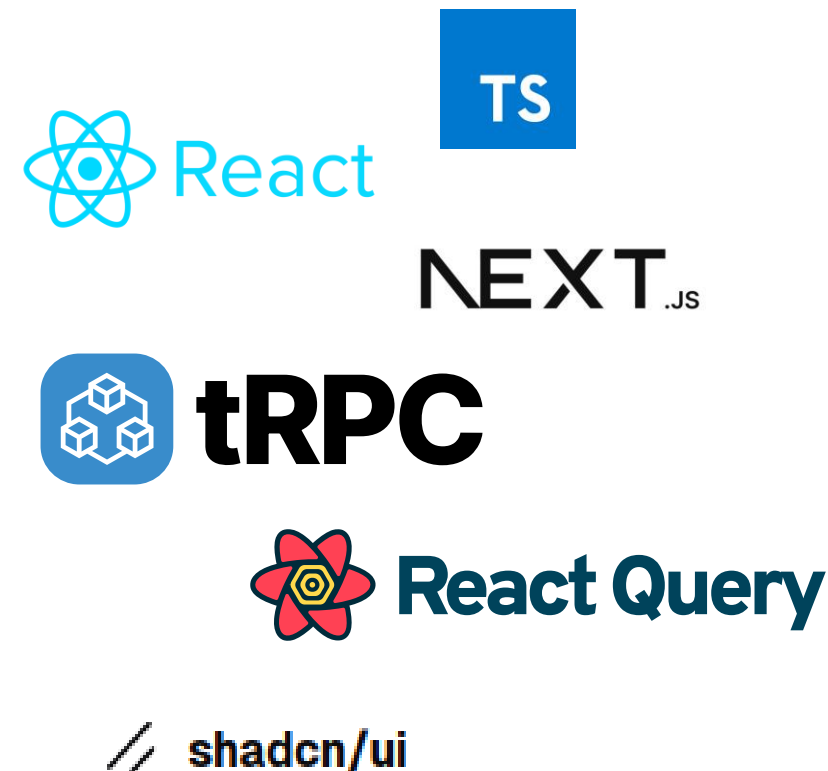
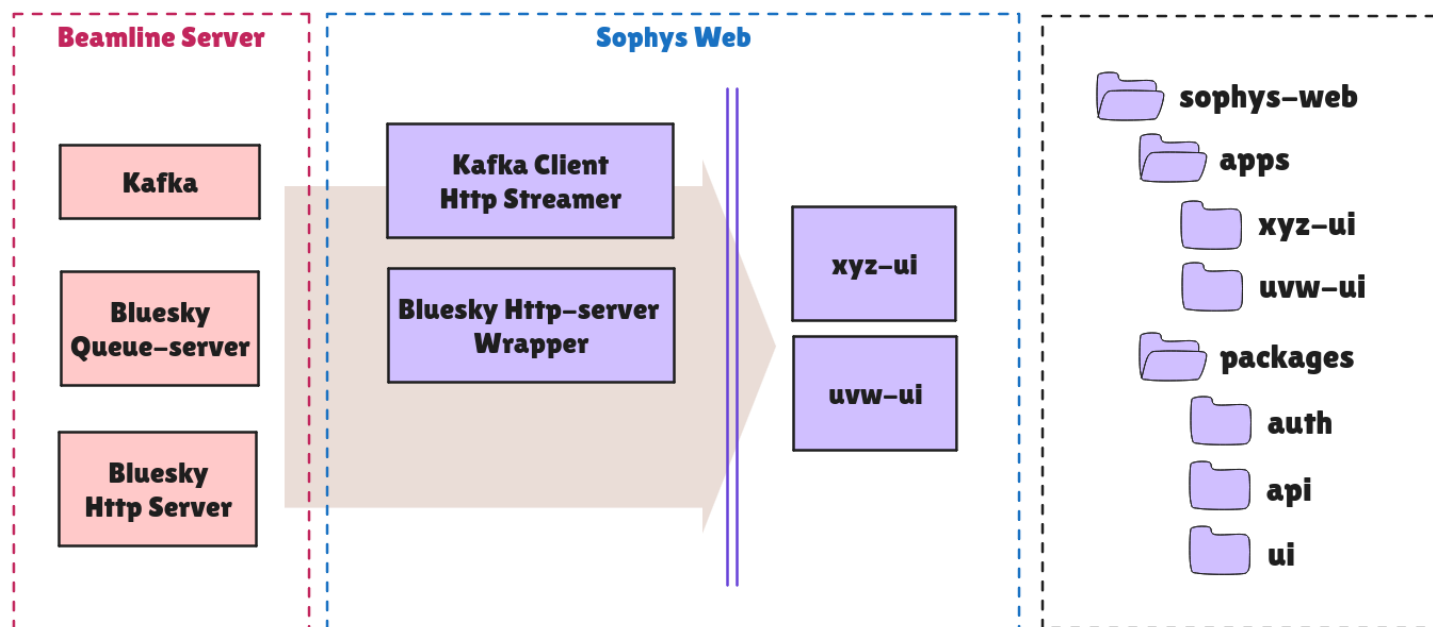
```

sophys-web



Bluesky at SIRIUS beamlines

sophys-web



Server-Sent Events

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Next steps

- We've just started this initiative and are working closely with the beamlines; we have a long road ahead, with improvements needed for all these packages and clients
- We are working with the data management and science group, discussing ways to integrate the NeXus converter (Assonant) with Bluesky documents

Acknowledgments

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Control Software Group (SwC)

Data Management and Science Group (GCD)

Data Acquisition and Processing Division (DAP)

Thank you

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CNPem
Brazilian Center for Research
in Energy and Materials

MINISTRY OF
SCIENCE TECHNOLOGY
AND INNOVATION

