Status of Bluesky deployment at BESSY II for machine commissioning

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Accelerator: devices

Magnets / Power converter

- Power converters
- Quadrupole multiplexer
- Steerers: multiplexer as Ophyd device

Devices

- master clock
- RF
- topup engine

Diagnostics

- Tune control: diagnostic or BBFB system
- Beam position monitors
- Bunch by bunch feefback (dimtel)
- Turn by turn (Libera with Diamond software)
- pin hole monitors
- double slit

Bluesky plans

- Mainly standard plans
- plan stubs e.g.: reinjection
  - BBA measurement
  - dynamic aperture scan
  - tune scans (under development)

Twin architecture

Software stack

- BESSY II / MLS: control system EPICS
- data transport EPICS
- optics calculation: TRACY as IOC Device
- Bluesky / Ophyd, basis of automatisation

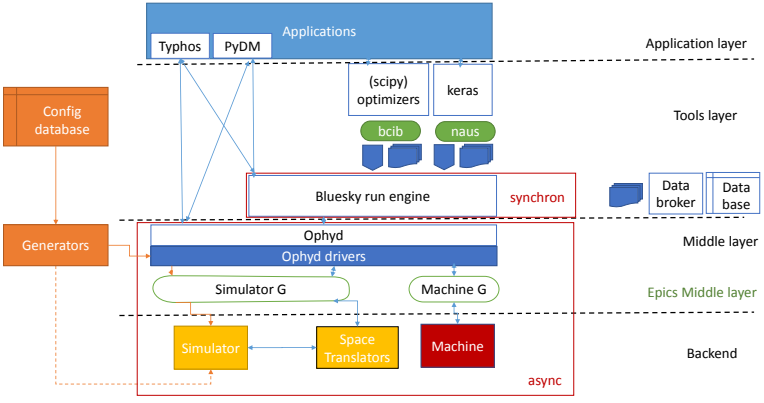
Ophyd	devices
Bluesky	plan stubs and plans
Databroker	pymongo as storage

Core

- Tracy: in IOC *thanks to Guobao Shen!*
- EPICS Variables, e.g
  - Lattice: names, position, misalignment
  - Beam: Twiss parameters, orbit, turn by turn
  - kicker start, angle
  - muxer: as PyDevice with peculiarities

```
record(waveform, "$(PREFIX):beam:orbit:x")
{
        field(INP,  "@getOrbitX,0")
        field(DTYP, "Tracy")
        field(SCAN, "Event")
        field(NELM, 2048)
        field(FTVL, 10)
        field(EVNT, "101")
}
record(waveform, "$(PREFIX):beam:ds")
{
        field(INP,  "@getSpos,0")
        field(DTYP, "Tracy")
        field(SCAN, "Event")
        field(NELM, 2048)
        field(FTVL, 10)
        field(EVNT, "101")
}
record(waveform, "$(PREFIX):beam:names")
{
        field(INP,  "@getCellNames,0")
        field(DTYP, "Tracy")
        field(SCAN, "Event")
        field(NELM, 2048)
        field(FTVL, 0)
        field(EVNT, "101")
}
```

Digital twin development



Similar implementations at other labs (e.g. ESRF, ALS-(U)),
Implementation started at BESSY II $\rightarrow$ tool for BESSY III
Interest on collaborations

Access

Packages

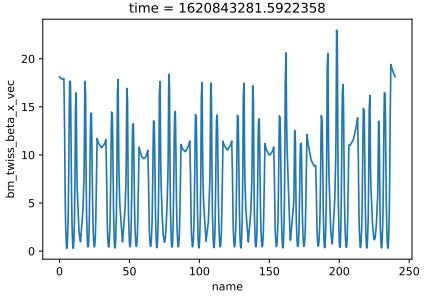
```
import xarray as xr
import matplotlib.pyplot as plt
from bact2.ophyd.devices.dt import tracy, beam
from bluesky import RunEngine
import bluesky.plans as bp
from databroker import Broker
```

Database

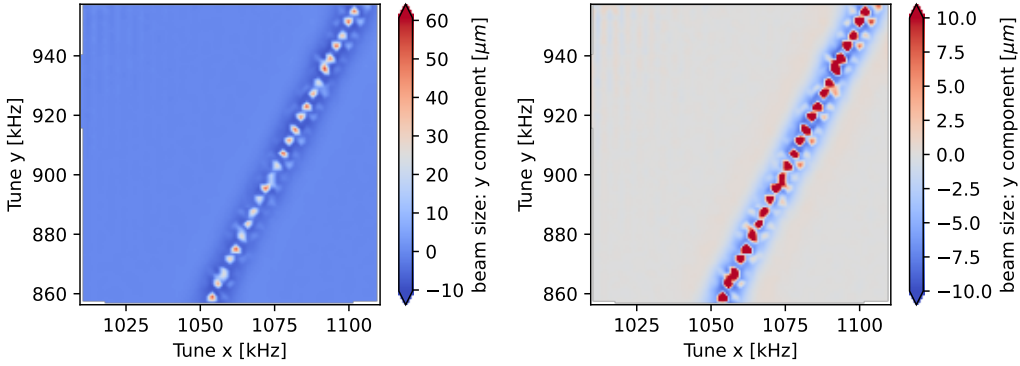
```
header = db[uid]

# Old style ..
conf = header['descriptors'][0]['configuration']
d = conf['bm']['data']
bm_names = list(d['bm_names'])
bm_ds = d['bm_ds']

bd_ = header.xarray_dask()
items = bd_.dims.items()
replace_dims = {name : 'name' for name, dim in items
                if dim == len(bm_names)}
beam_data = bd_.rename(replace_dims).assign_coords(name=bm_ds)

beam_data.bm_twiss_beta_x_vec.plot()
```

Retrieve data

```
bm = beam.Beam('Pierre:DT:beam', name='bm')

RE= RunEngine({})
db = Broker.named('temp')
RE.subscribe(db.insert);

uid, = RE(bp.count([bm], 1))
```



Example: tune scan



- Tune meas: bbfb
- Device: amplitue $\leftrightarrow$ frequency
- Raster: *bp.list_grid_scan*
- per step: reinjection if requested

- tune: bbfb $\leftrightarrow$ bpm: swap of device
- lifeplots: tune set, beam size
- databroker $\rightarrow$ analysis