Performance Tracking across the Injector Complex

OP requirements' analysis and Technical Proposal.

LIU Meeting 27 September 2019

Marine Pace, for BE-CO.

Analysis study by Lukasz Burdzanowski, Mark Buttner and Greg Kruk.

Outline

- Reminder of OP request
- CO technical proposal and action plan

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OP Request: Input from LIU project

Verena’s courtesy

- Goals in terms of intensity and brightness are defined for each year
- The performance of the injectors will be measured with respect to performance goals

→ Peak performance

→Reproducibility

→ Performance needs to be tracked.

OP Request: 2 types of tracking required

Verena’s courtesy

- Machine specific data tracking
  - Two aspects / sources of data:
    1. Normal equipment data logging
    2. Online monitoring of certain parameters
- Performance tracking per beam type
  - Across complex.
  - Need to track beam through complex → unique SC number and beam ID

OP Request: Performance per beam type across complex

Verena’s courtesy

- Should be online and web based (also visible from outside)
- Plots to be continuously populated – no waiting for data from NXCALS
    - Background process to fill data in pickles?
    - Scripts with minor analysis for advanced plotting
    - Need interactive scientific plotting
    - Plots to be made by the “experts”. Use BOKEH?

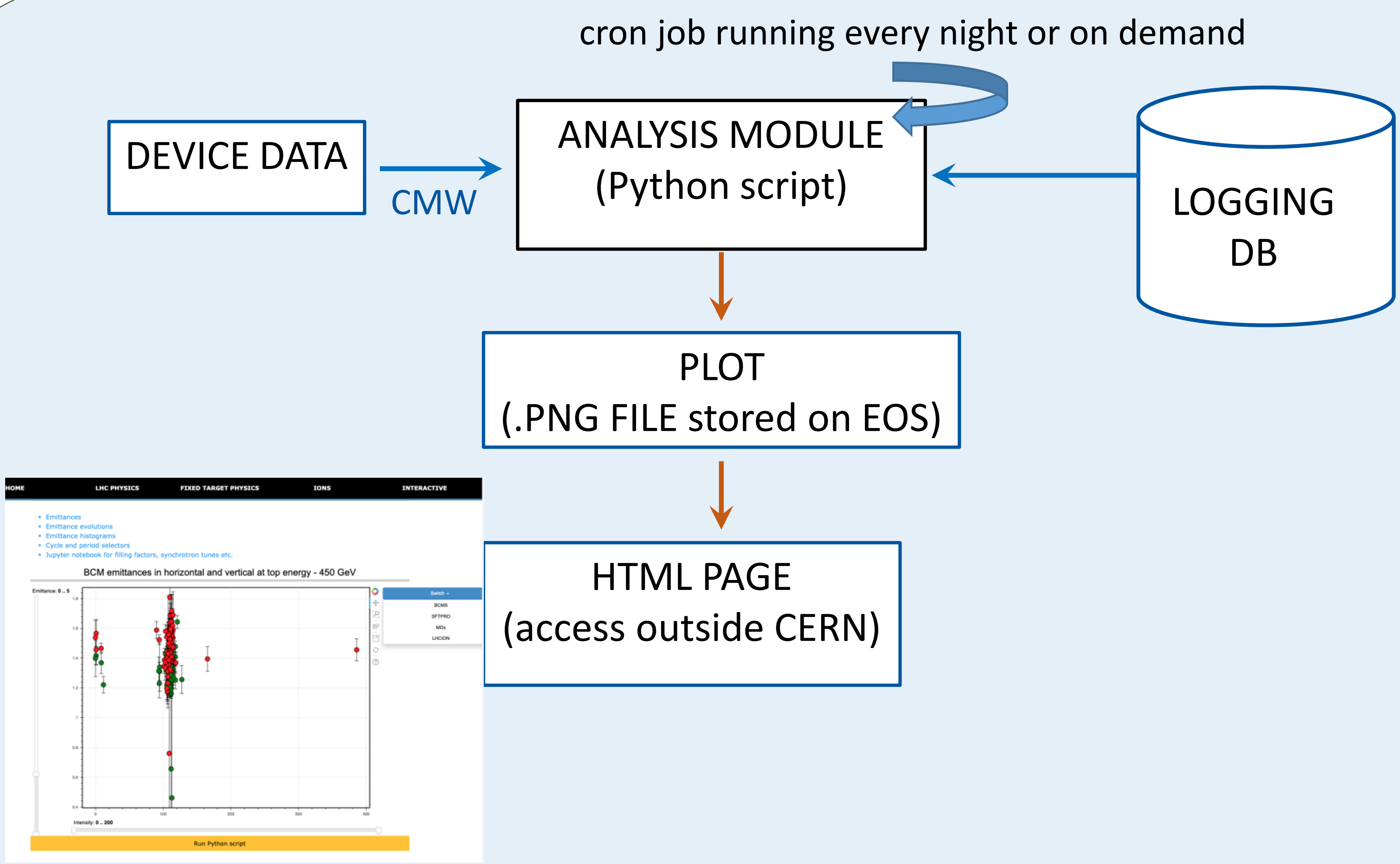
OP Request: Priorities, Deadlines

Verena’s courtesy

- First priority: performance tracking web pages for all beam types
  - Unique identifiers for SC number and beam
  - Background process to retrieve data ready for plotting
  - Plots ”prepared” by users, ideally in Python
  - Needs to be ready for start-up: mid 2020

- Second priority: event based analysis: cycle-by-cycle
  - Centralized analysis, reuse analysis results as input to other analysis
  - Republish results → show in GUI, use for performance tracking
    - Results need to be ready before end of next cycle: latency requirements to be defined for small machines
  - Store grouped as event for playback
  - Needs to be developed 2021/22 for machines other than SPS

OP Request: What exists today



cron job running every night or on demand

DEVICE DATA

CMW

ANALYSIS MODULE
(Python script)

LOGGING
DB

PLOT
(.PNG FILE stored on EOS)

HTML PAGE
(access outside CERN)

- Emittances
- Emittance evolutions
- Emittance histograms
- Cycle and period selectors
- Jupyter notebook for filling factors, synchrotron tunes etc.

BCM emittances in horizontal and vertical at top energy - 450 GeV

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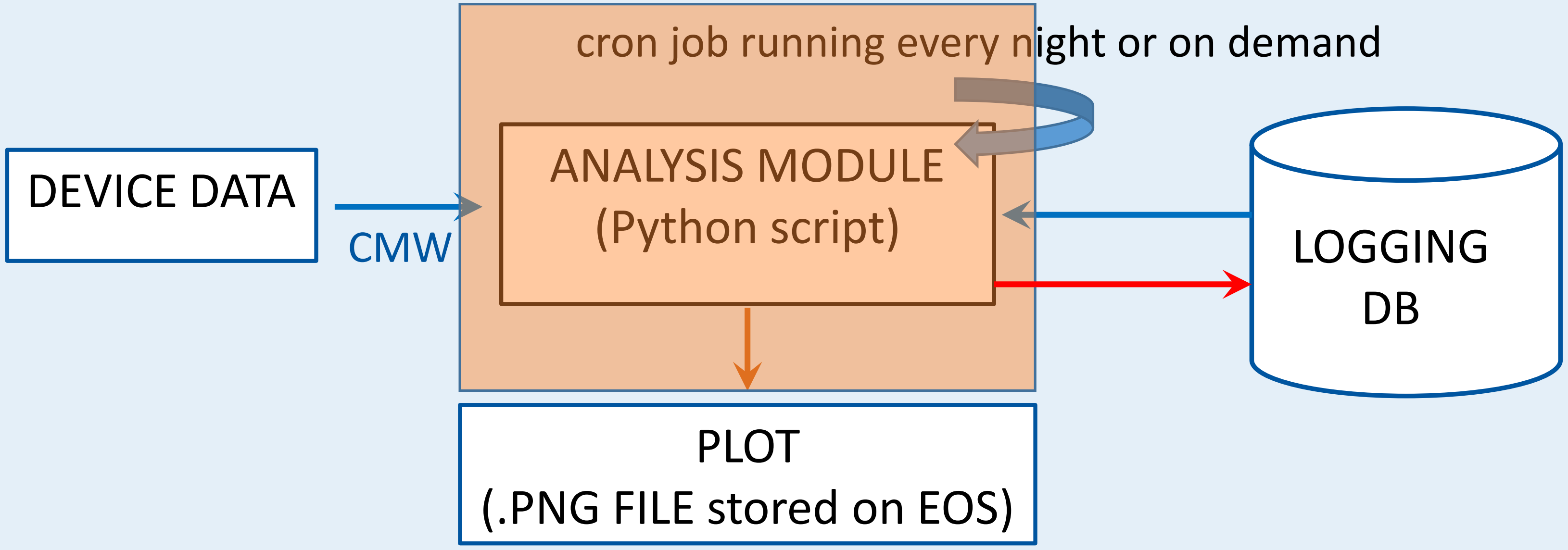
- Reminder of OP request
- CO technical proposal and action plan
  - for priority 1 : start-up mid 2020
  - for priority 2: 2021/22

CO proposal for start-up mid 2020 (P1)

1. CO-standard infrastructure to manage Python scripts
2. New Web TIMBER
3. Access to Beam Instance ID to group data by beam

1. CO-standard infrastructure for Python scripts



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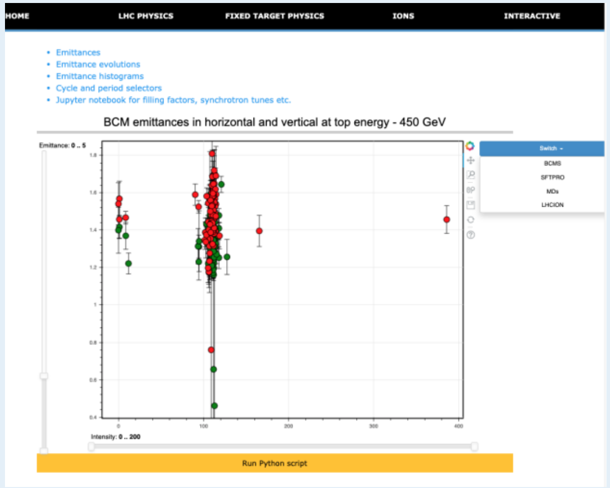

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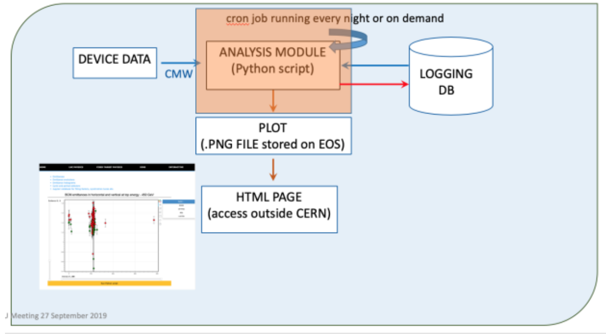
1. CO-standard infrastructure for Python scripts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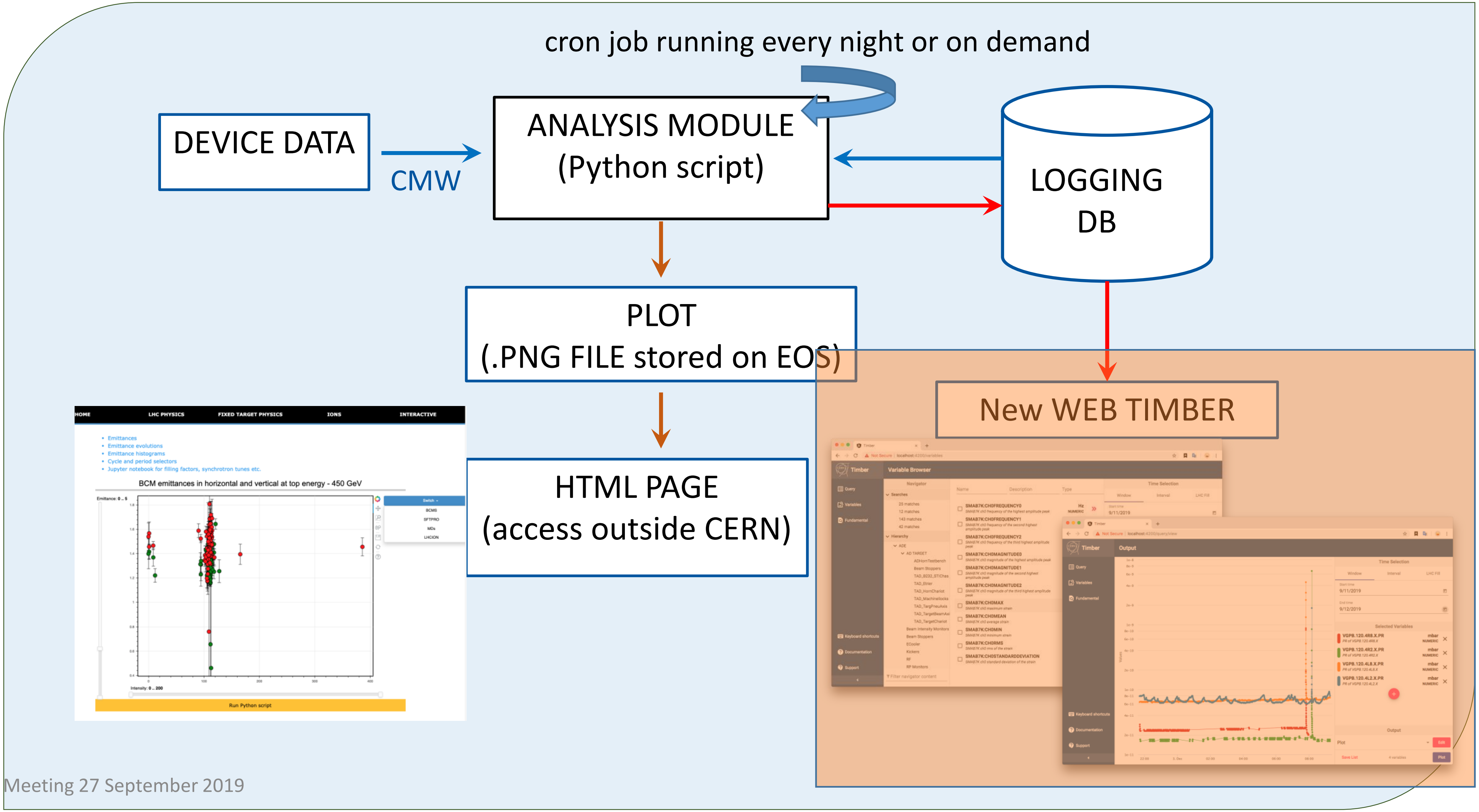
- Configure GitLab to store, version and track changes in Python analysis scripts.
- Mechanism to automate the deployment of scripts for testing / trigger the PRO deployment to suitable CO infrastructure from where it will be scheduled for execution.
- Facility to monitor the execution of scripts.
- Also aim for a mechanism to publish Python analysis results into NXCALS via UCAP.

2. Web TIMBER



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New WEB TIMBER

HOME LHC PHYSICS FIXED TARGET PHYSICS IONS INTERACTIVE

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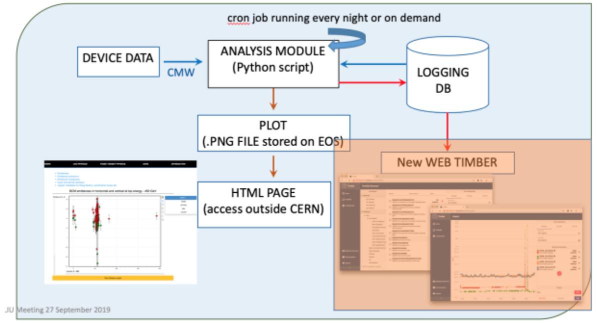
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New WEB TIMBER
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- First version of new TIMBER (Web), connected with NXCALS is foreseen for end of this year. Iterative development will continue throughout next year.
- TIMBER will include <u>user configurable</u> charts → in parallel to maintaining the existing OP Web publications to EOS, validate:
  - Suitability of Charts available in TIMBER
  - Performance of extraction of analysis results from NXCALS

3. Access to Beam Instance ID to group data by beam

- Extension of Timing beam metadata publications to include Beam Instance id.
- Timing will publish a device property that will links each cycle Stamp with Beam ID, Beam Instance ID and bcd Stamp (=Supercycle ID).
  - One device per machine
- All this metadata will be logged in NXCALS.
- Python analysis scripts (OP) can use this metadata from NXCALS to fetch all data related to a specific beam type and/or beam instance.

CO proposal for 2021-22 (P2)

- OP requirements
  - Cycle by Cycle analysis - Results ready before end of next cycle
  - Re-publication of results, play back analysis…
- Outcome of preliminary CO analysis
  - OP needs are aligned with the CO technical direction (including our vision for UCAP in the controls system) in the coming years.
- No commitment for 2021-22 can be given now as strongly dependent on available HR.
- Our proposal will be presented mid 2020.

Work organization

- The OP requests for start up mid 2020 will be fulfilled by CO.
  - Some CO activity will be reshuffled to give priority to this request.
- CO group commitment
  - APS: integrated environment for Python scripts. Aim to also publish analysis results to be stored in NXCALS.
  - DS: new TIMBER (Web) with user configurable charts.
  - SRC: publication of beam instance ID to correlate beam data across machines.
- Vito Baggiolini will coordinate this activity.
  - Follow-up of CO deliverables
  - Main interface with OP/ABP. Reporter to LIU.

Beam Instance ID

- OP needs to identify each beam type (BeamID) as well as instance of that beam within the BCD (beamInstanceID)
  - If there are two TOF beams within the BCD, they should have the same BEAMID (that's the case today) but distinct beamInstanceIDs
  - As long the same BCD is played in a loop, the beamInstanceID of all beams within this BCD should remain unchanged
  - Once OP edits the played BCD or changes LSA Cycle-USER mapping (to be confirmed) – all beamInstanceIDs should be regenerated
- OP needs to identify uniquely the BCD
  - This could be achieved e.g. by using a bcdStamp (cycleStamp of the first cycle in the BCD – usually the PSB one)
  - Note that in case SPS or LEIR are in standalone mode, their bcdStamp would be different from PSB/PS

Beam Instance ID

- Before playing a cycle in each machine, the Timing system could publish all the related information in a single property (one device per machine):
  - Header:
    - cycleStamp
    - cycleName (user)
  - bcdStamp
  - beamInstanceId
  - beamId
  - beamName
- With the information above logged to NXCALS, OP would be able to:
  - For a given time window, find all **bcdStamp**s, **beamId**s, **beamInstanceID**s and **beam names**
  - Then using **beamInstanceID**s and **cycleStamp**s , find all other beam-related data for all machines