CERN

# Test of new BB Finemet controller

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***IPP MD Days***

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**Many thanks to PSB/PS operations team**

# Outline

- Previous work
- Synchronization scheme
- New features
- Change in the current setup
- Plans for 2025
- MD topics

# Previous work

- Barrier-bucket MTE scheme significantly reduces beam loss in PS extraction region
- Non-PPM barrier waveform
  - Lacked flexibility
- 2 consolidation boards
  - h16 measurement
  - h1 measurement

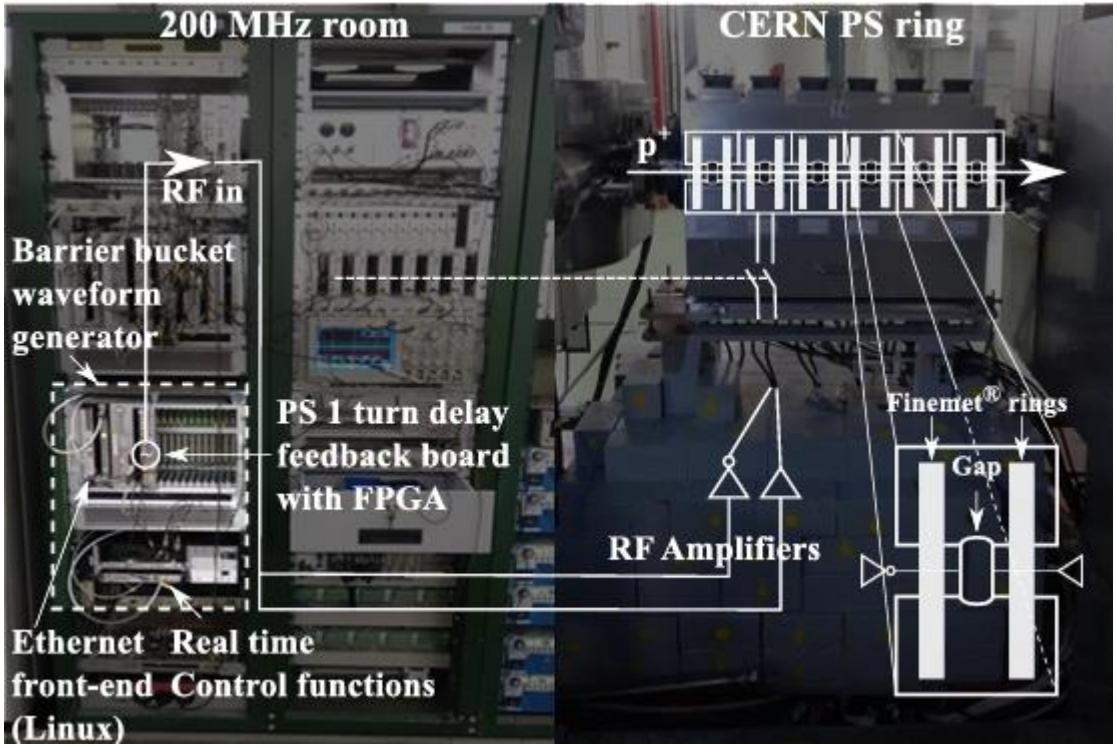
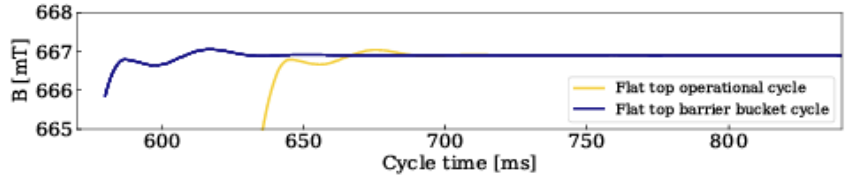


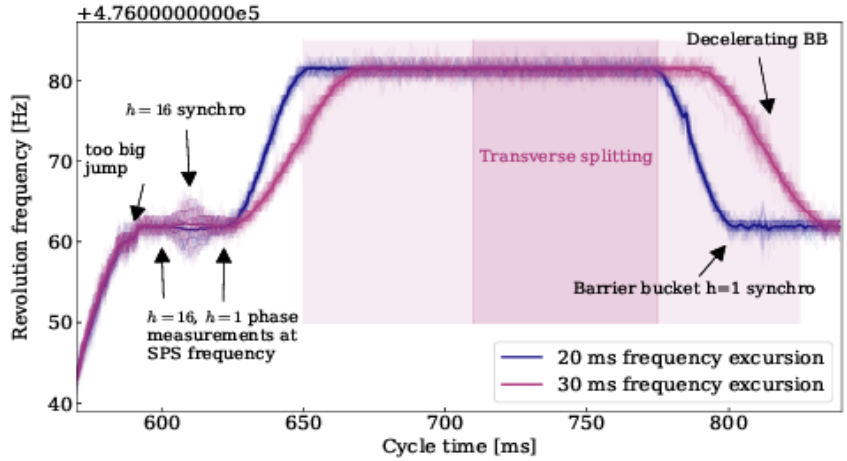

Diagram from M. Vadai, A. Alomainy, H. Damerau: Barrier Bucket Studies in the CERN PS (CC-BY 3.0) - https://doi.org/10.18429/JACoW-IPAC2019-MOPTS106

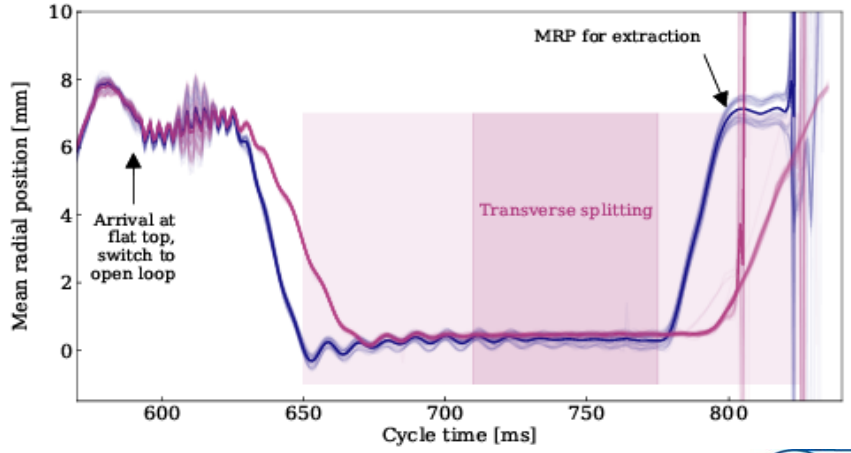
# Synchronization scheme

- Conventional synchronisation not possible
  - RF voltage of the wide-band cavity generating the BB would be too low for a conventional synchronisation

- Synchronisation concept in use:
  - Synchronising in h16 using feed-forward cogging
  - Lower accuracy sufficient for barrier buckets
  - Synchronisation in h1: phase measurement and communicating phase information within a cycle to set the correct barrier position

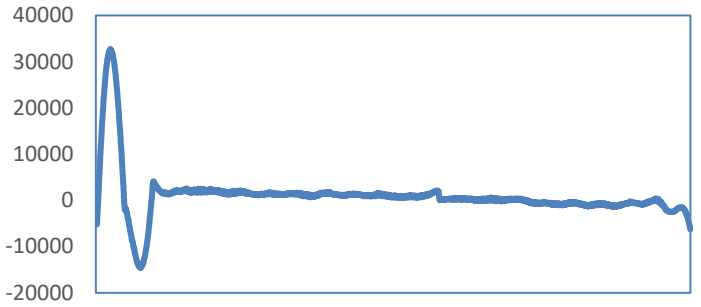


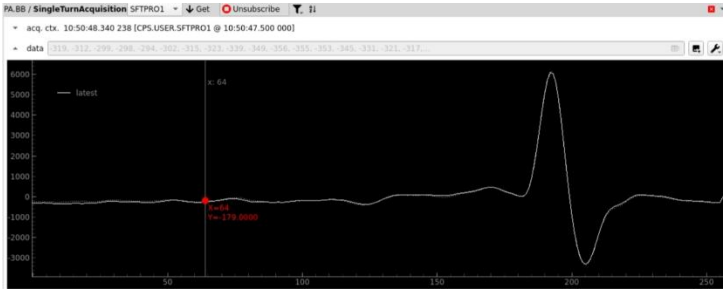



# New features (1)

- Full control of RF drive voltage
  - PPM
  - Arbitrary waveform
  - 16-bit waveform memory




- Acquisition of gap voltage
  - Single turn
  - Hard trigger (from CTRV through backplane)
    - PAX.SACQ-ALLRFM

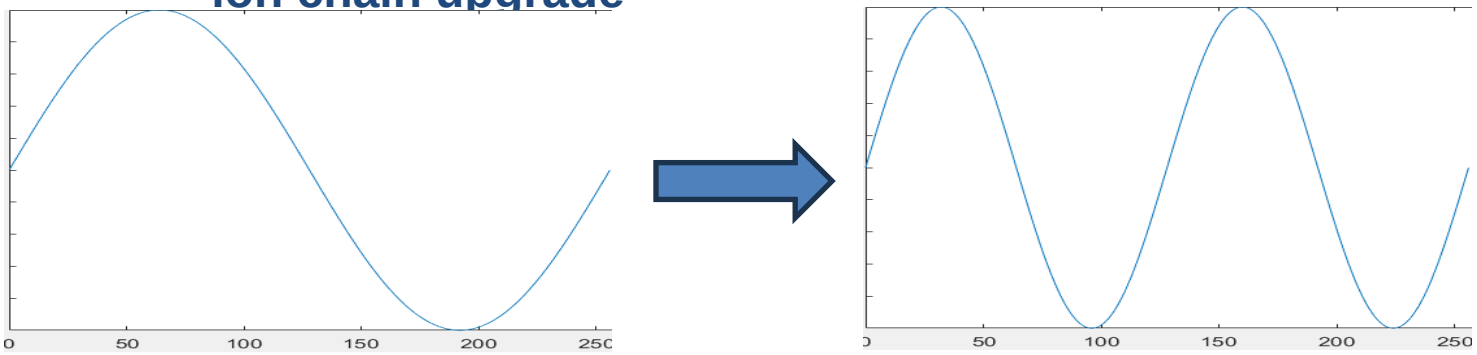


- Arbitrary gain function of the waveform
  - FGC: Internal function generator – new preferred option (makerule from old function)
  - CVORB

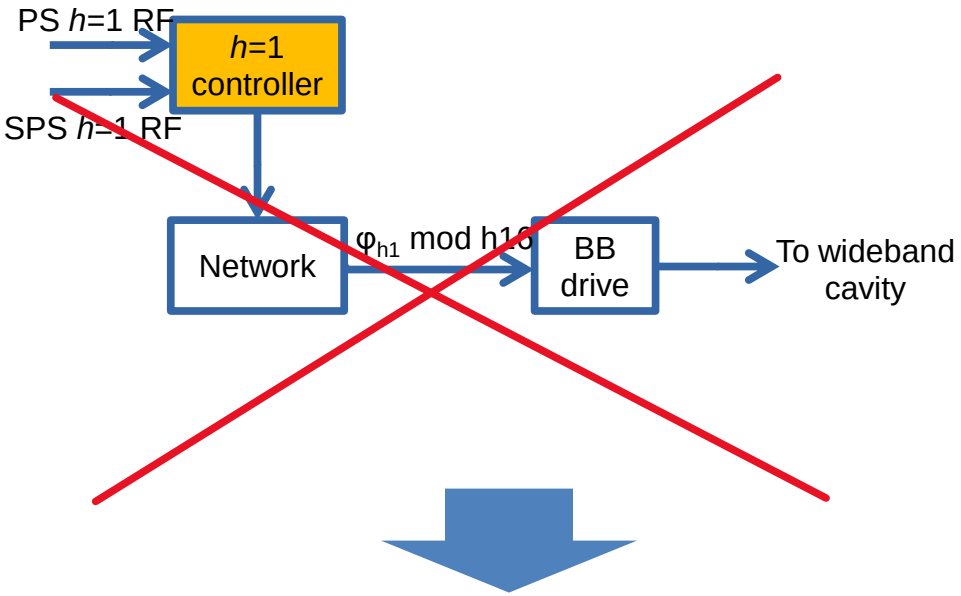
# New features (2)

**Following features are yet to be tested with the beam:**

- **New extraction synchro for PS: h1 measurement w.r.t. SPS derived h1**
  - **Updates BB azimuth during the cycle (C620 ms)**
- **PS acquisition core**
  - **Gain function**
  - **h1 measurement – phase between SPS derived h1 and PS h1**
- **Accordion sweep of the waveform**
  - **Time in which sweep happens can be set**
    - **Used for smooth batch compression – interesting for possible ion chain upgrade**

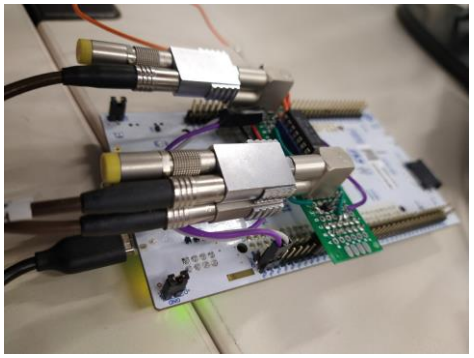


# Change in h1 measurement




New Finemet cavity controller

- *h*=1 controller measures the phase w.r.t. SPS and sends it real-time via C programs on front-ends to the barrier bucket drive



- Non-standardized hardware removed
- Enables remote intervention

h=1 diagram: M. Vadai, H. Damerau, M. Giovannozzi, A. Huschauer, A. Lasheen:
IMPLEMENTATION OF SYNCHRONISED PS-SPS TRANSFER WITH BARRIER BUCKET (CC-BY 4.0)
https://arxiv.org/abs/2210.05416

# Plans for 2025

- Deploy new firmware during commissioning period
- Deploy operational FESA class for the new cavity controller during 24/25 YETS
- Increase number of turns acquired – up to 16 turns
- Test new features with the beam
- Add relay for remote interventions on NIM crate powering h16 controller??
- Develop BB IP as a part of new digital PS beam control
  - Removes remaining controller used for h16 measurement

# MD topics

- **Explore the benefits of Finement cavity with new software and firmware beyond barrier buckets**
  - **Transient beam loading compensation**
  - **Smooth batch compression (h21 → h42) for Oxygen ion run**

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