MAX IV BPM and FOFB Status

Libera Workshop 2020-06-17

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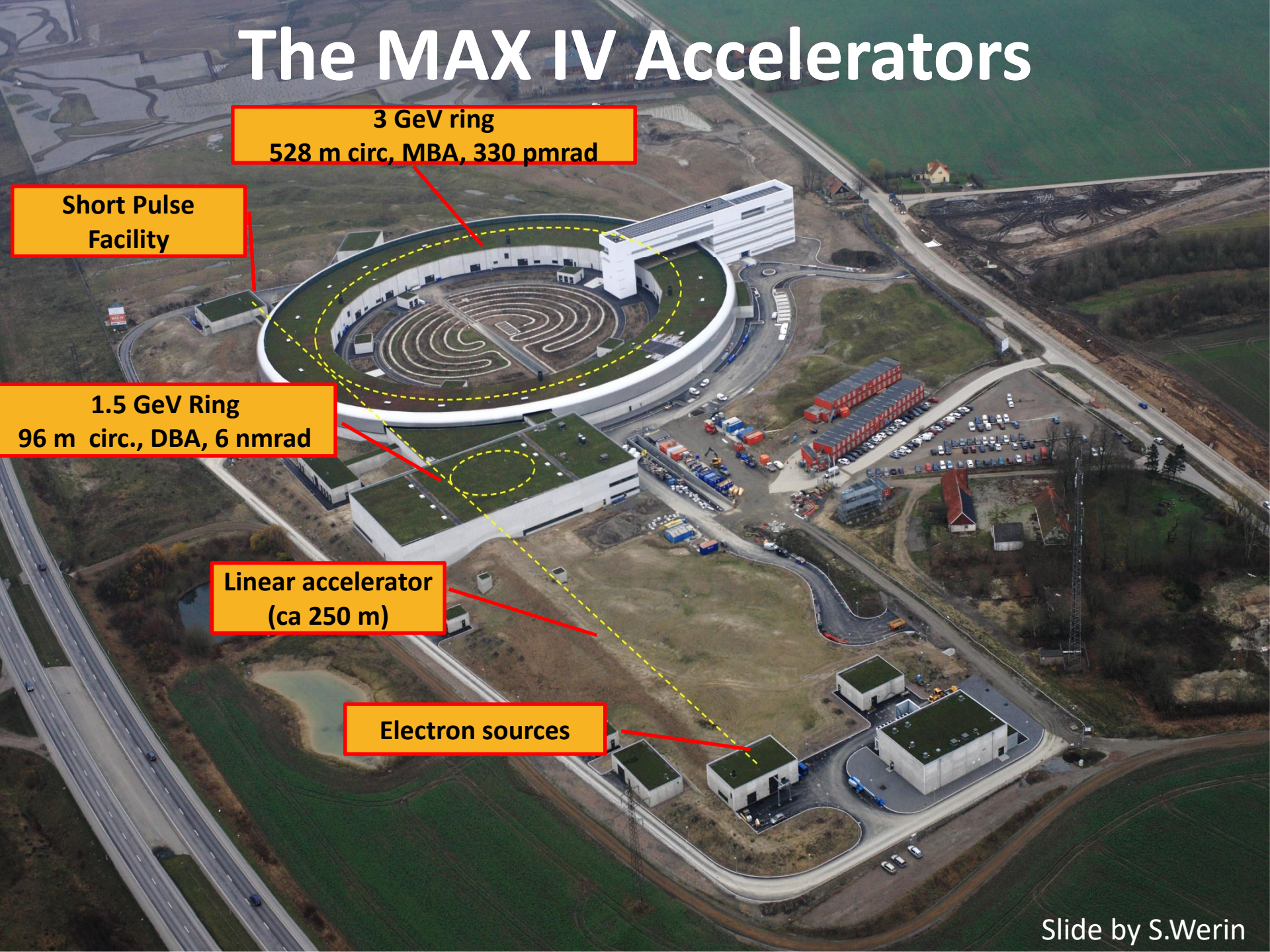
on behalf of the MAX IV Accelerator Division

Outline

- BPM Topology
- MAX IV Passive Stability
- FOFB
- Issues
- Summary

The MAX IV Accelerators



Slide by S.Werin

LINAC BPM Hardware

- 27 Libera Single Pass E modules with Stripline BPM's
  - Bare minimum was initially installed
  - BPM upgrade will be finished during the summer shutdown
  - Additional 20 Stripline BPM with electronics units will be installed
  - Seven out of the 20 new ones are for the TDC project

- Single module in most of the crates except for the Bunch Compressors, Short Pulse Facility and the Transfer Lines.

- Tango trajectory feedback running for delivery to the Storage Rings and the SPF

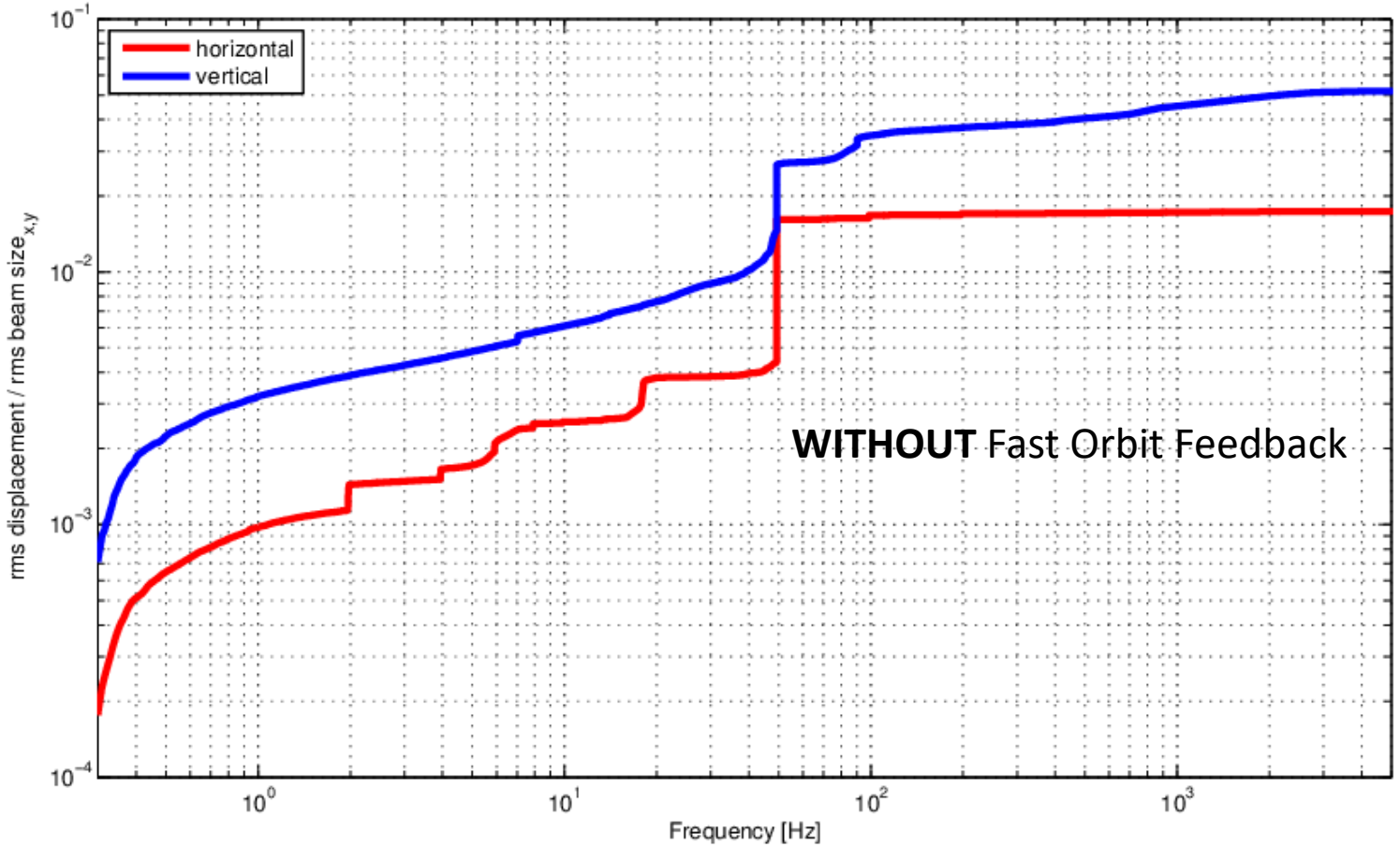
3GeV Storage Ring BPM Hardware

- 60 Libera Brilliance+ crates (3 in each achromat ps small room)
- 200 BPM modules (3+3+4)
- Slow correctors per achromat (h/v): 10/9
- Fast correctors per achromat (h/v): 4/4
- BPM heads per achromat (4 signals): 10
- Custom-ordered Brilliance+ SER-modules (RS485 interface) to output fast corrector set values, 18 µs latency
- GDX modules for global data exchange
- EvRx modules for timing
- itest Fast PSU BE549 installed for corrector magnets flanking the ID's.

3 GeV Ring: Passive Stability

Average of 13 long straight flanking BPMs
April 2019, 250 mA beam current

Plot By Jonas Breunlin



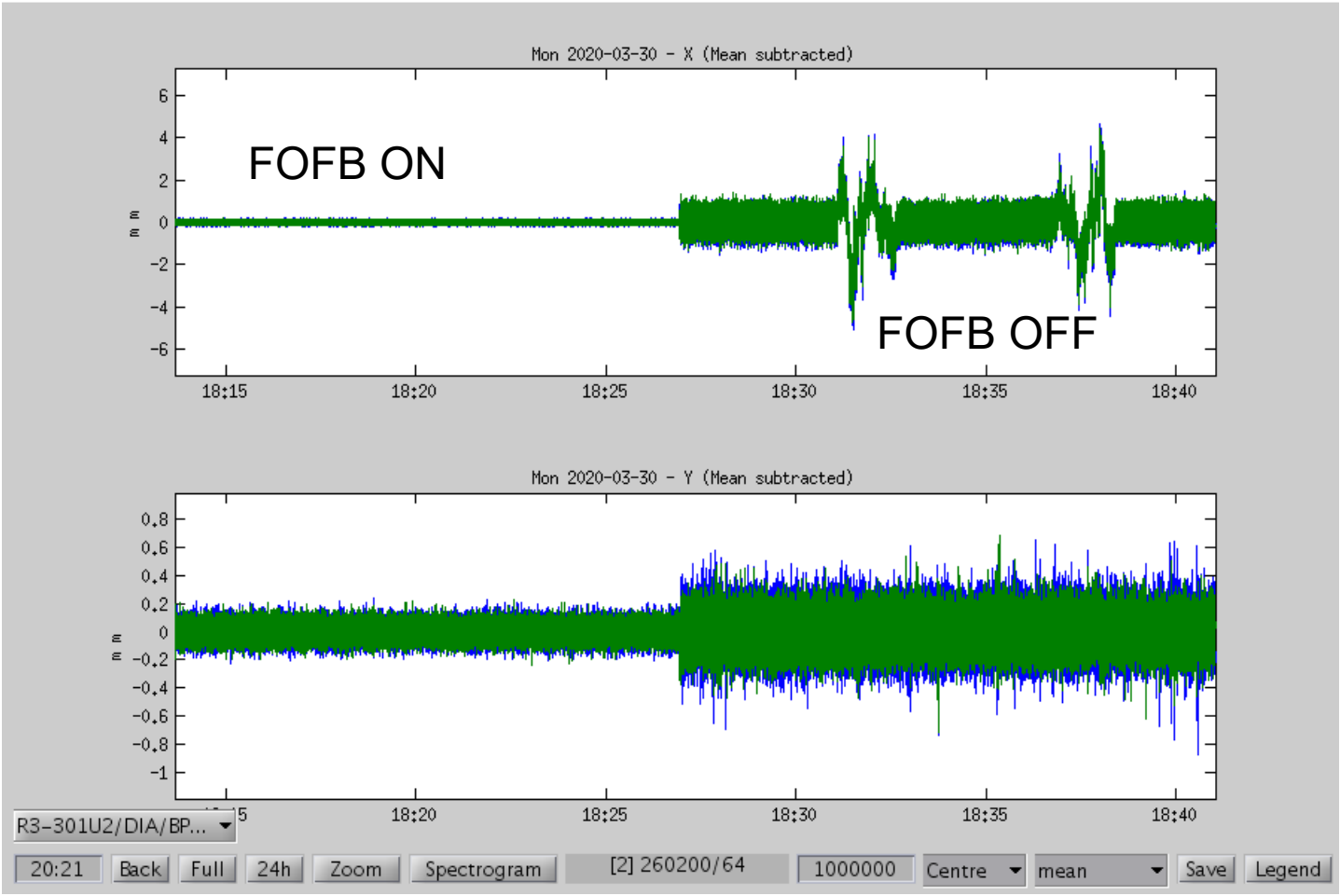
Integrated up to 5 kHz

- ❑ Horizontal RMS < 2.0 % of RMS beam size
- ❑ Vertical RMS < 5.0 % of RMS beam size

3GeV FOFB + SOFB

- SOFB Tango device running at approx 10Hz
- FOFB implemented in the GDX module by Instrumentation Technologies
- SOFB updates the FOFB reference orbit periodically.
- This off-loads the weaker but faster FOFB correctors
  - Fast correctors Max hor./ver. Kick: 10 µrad
  - Slew rate >5.64 µrad / 100µs

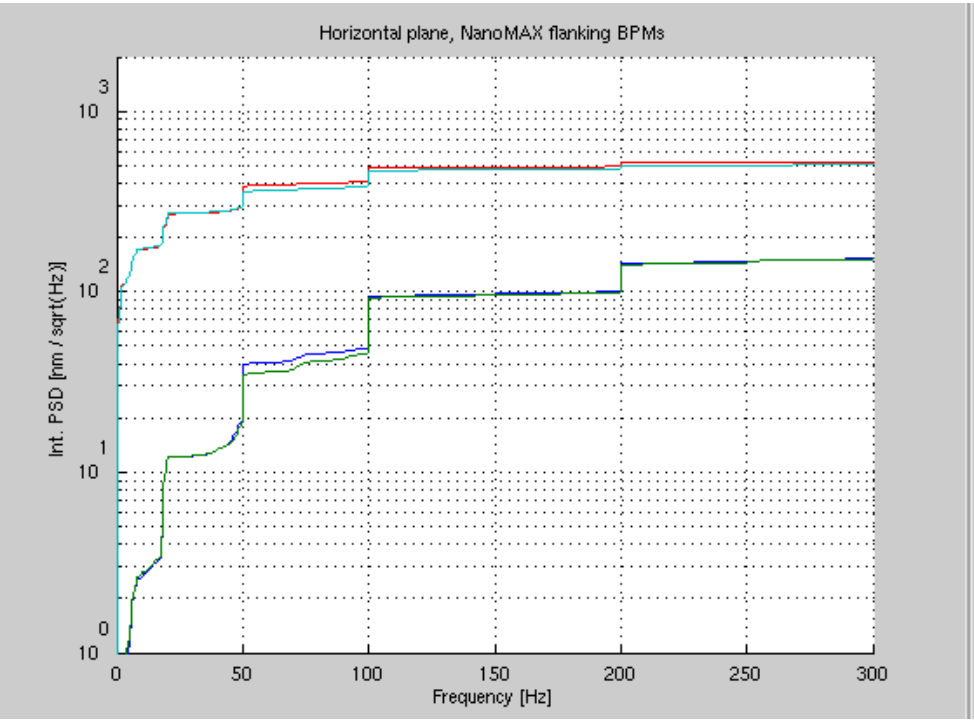
FOFB: NanoMAX Flanking BPM's

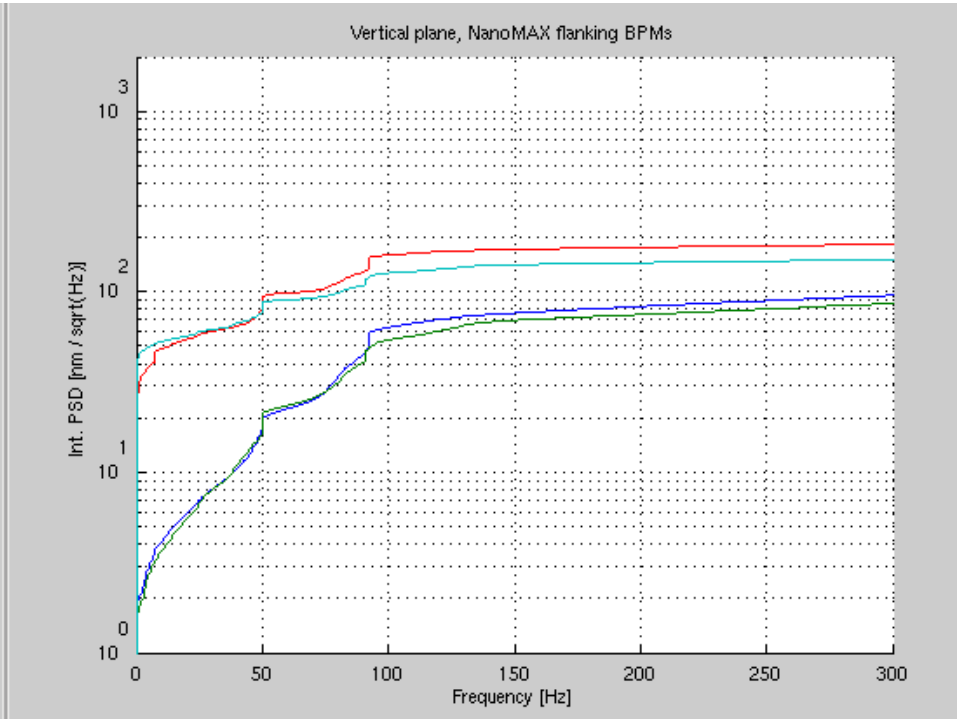


- *NanoMAX orbit position from flanking BPM's*
- *BALDER open/close gap (5 - 20 mm)*
- *Hardly any disturbance in the vertical plane even with FOFB off.*

Plots form FA archiver taken by Magnus Sjöström

FOFB: NanoMAX Flanking BPM's

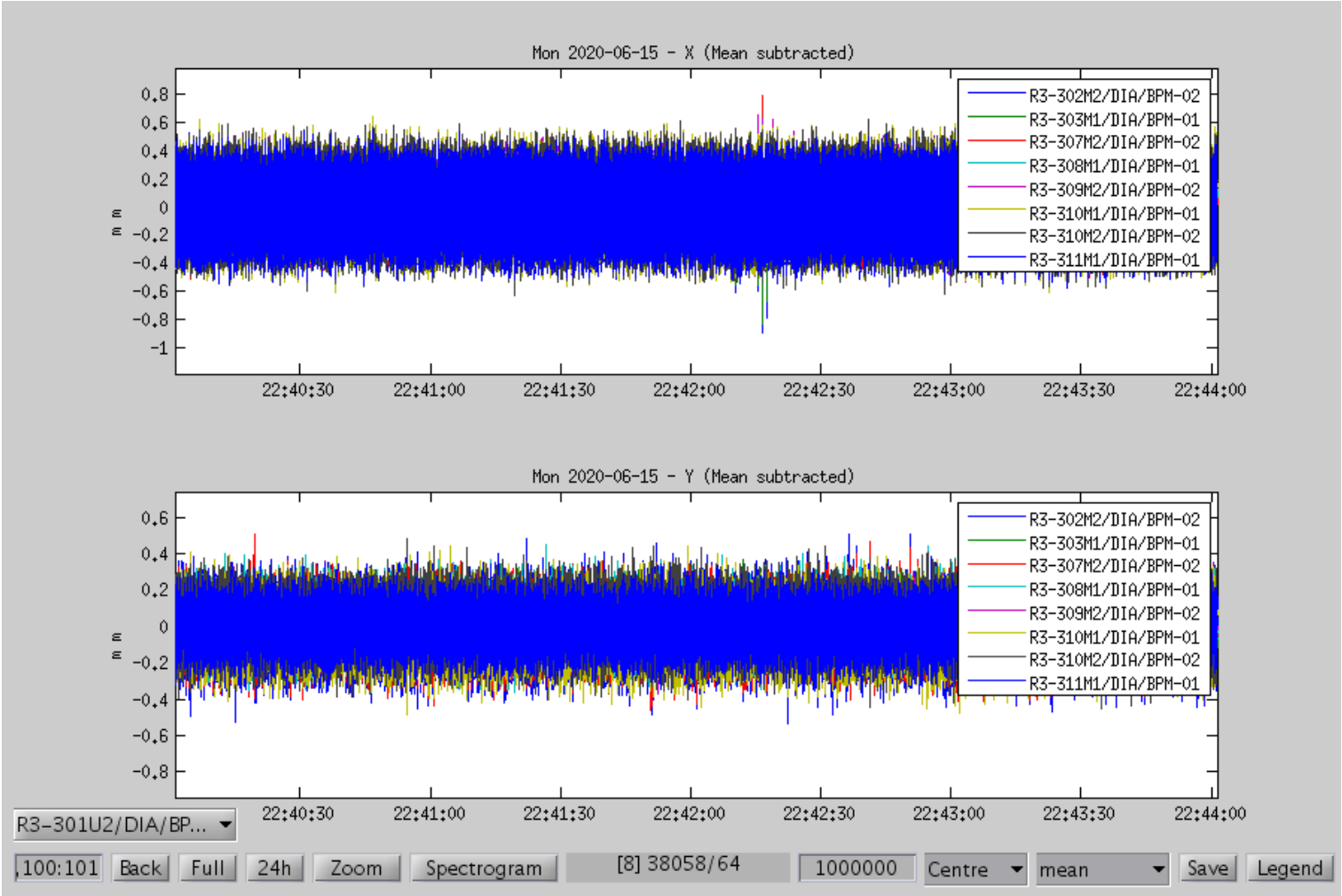




Plots by Magnus Sjöström

- Integrated PSD from 0 to 300 Hz for each of the two BPMs flanking NanoMAX
- With and without FOFB active.
- The heavy attenuation due to the feedbacks can clearly be seen

2020-06-15 FOFB + SOFB All ID's



- Closing BALDER from 15 mm down to 5 mm.
- Between 22:40 to 22:43.
- Distortion at 22:42:20 seems to be the off-loading from SOFB to FOFB

Plots form FA archiver taken by Magnus Sjöström

MAX IV FOFB

- First tests with two ID's were done late 2019
- Ongoing tests during spring
- Bit-cutting was adjusted for more gain
- A few bugs found
  - Events for the FOFB state machine randomly not received
  - Multiple events must be sent for all BPM's to enter the correct state.
  - Memory Leak in the ebpm daemon when updating the FOFB reference orbit at 5-10Hz, roughly two weeks before it crashes.
- Remote debugging session due to Covid-19
  - Microsoft Teams and I-Tech VPN access
  - Worked very well

Summary

- 2020-06-15 was the first time FOFB and SOFB was running on all ID's in the 3GeV Storage Ring.
- FOFB has been running routinely on select ID's for approx. 3 months
- MAX IV Passive stability is very good.
  - Everything at MAX IV has been designed with passive stability in mind.
  - Fans, pumps are located on springs
  - Ground stabilization
  - Stability Task Force was always involved for all installations
- FOFB does remove most perturbations from ID gap changes.
- More tuning of the parameters will be needed
- Feedforward logic to compensate for 50 Hz Harmonics to be implemented

Thank you for your attention

Questions?