SwissFEL week 34

- **Schedule**
- **Cold checks**
- **Beam setup in steps**
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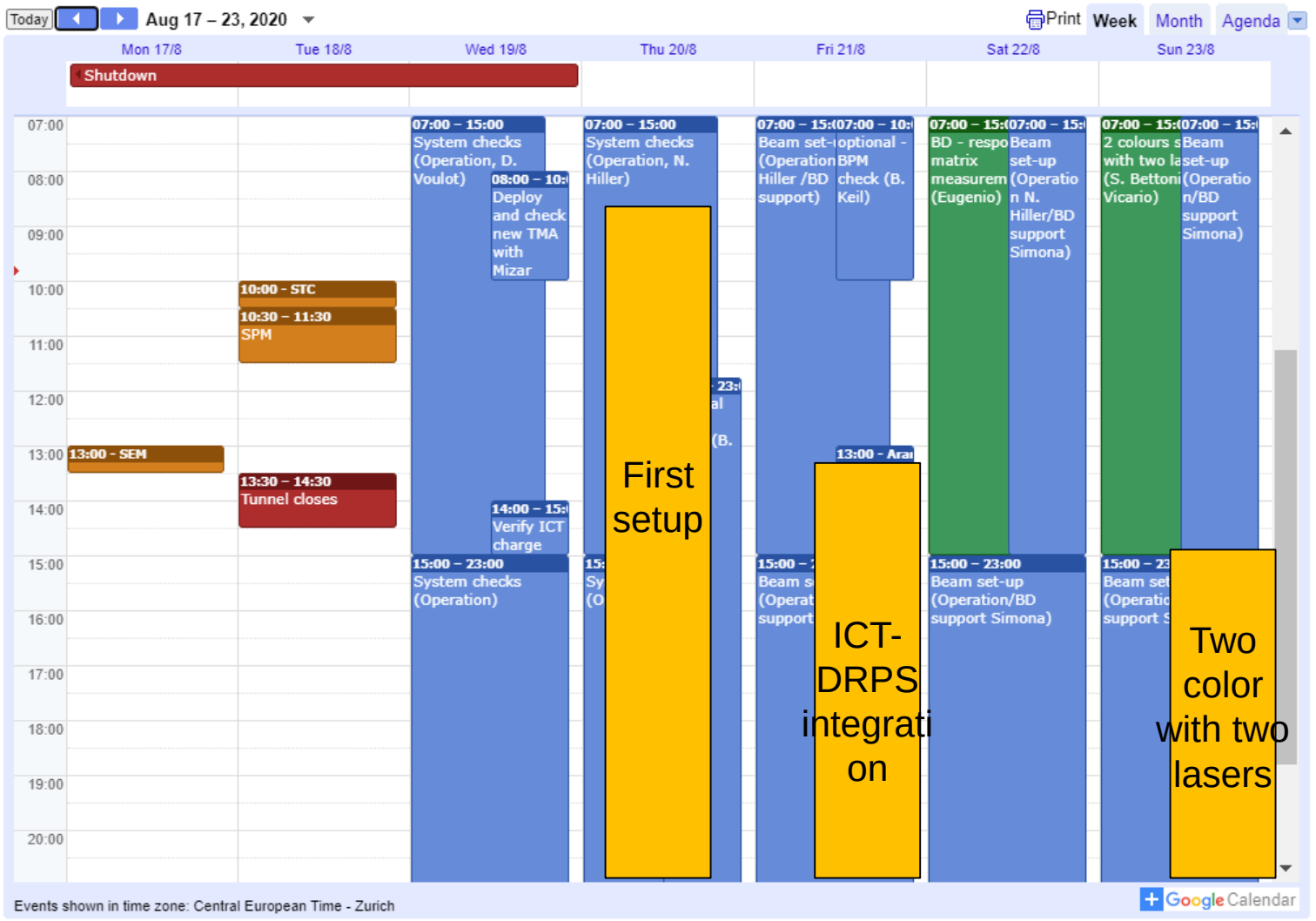
S. Bettoni, N. Hiller, D. Voulot
August 19-23 2020

Schedule



Initial plan had to be re-adjusted:

- Tunnel closed 18th August
- Cold checks: 19th- and continuation in parallel to Aramis setup 20th-21st Aug
- Beam setup and machine studies: 20th Aug-23rd Aug

Cold checks

N. Hiller, D. Voulot, C. Kittel, all the groups

- DRPS alarm due to hard conditioning in S30CB13 during the night from Tuesday to Wednesday
  - Not a problem according to SU
  - Hard to detect when the machine is still in shutdown mode (many active alarms)
- Magnet control problems (control card, faulty 24V PS, wrong PSID)
- Diverse motion control problems (laser heater, BC1 chicane, vertical col., SARUN15, QFF, SATUN12…) Mostly ioc/epics related problems. 1 local reset required for the LH.
- New timing master deployed with Mizar support. Will be fully checked (with beam) on Monday.
- Tunnel access for vacuum pump repair in Athos FE

Issues

D. Voulot, F. Loehl, S. Bettoni

- The phase to gap calculation for the Aramis phase shifter is not working as expected
  - The phase should jump one full period when the gap is getting to a limit. It is jumping two periods instead of 1 (this problem was already known). But this is also happening when far away from gap limits.
  - Unfortunately the different working points are not equivalent. This is preventing the optimizer to work correctly.
  - Tuned only manually
- ICTs charge integration are not working as expected
  - The charge integral calculation is not correct for two bunch operation when one bunch has a non-integral rate (e.g. 2.5 Hz).
  - (BPMs and WCM could also provide charge integrals but this is still work in progress).
  - Charge integral limits have to be respected (BAG)
  - Allowed beam rates are limited since Friday to allow work to go on during the weekend (administrative measure). The problem needs to be urgently fixed.
- DRPS data archiving is not working
  - We have to rely on the EPICS archiver (which is also not extremely reliable). The shift crew are checking it periodically and documenting in the logbook.
  - This is also a BAG requirement. Needs to be fixed.

Setup strategy in steps

- Step 1 (Thu PM): try to recover from the last setup before the shut down to have a safe point:
  - Checks trying to stay close to the last references: LH emittance and optics, optics at SARCL, compression in BC1 and BC2 → 200 uJ at 11 keV pulse length shorter than in July
  - PSICO for a night → 270 uJ
- Possible to do all the checks needing photons from Fri AM
- Fri used for the ICT issue
- Step 2 (Sat PM): finer setup:
  - Emittance (slice and projected) at BC1 and BC2
  - Tilt correction at BC1 and BC2 (before just left, like in July to not loose lasing)
  - Dispersion along the undulator line (more optimized than on Thursday)
  - Some manual tweaking on that
  - PSICO on for half a night or so
- **Sat at 6 AM: 350 uJ at 11 keV**

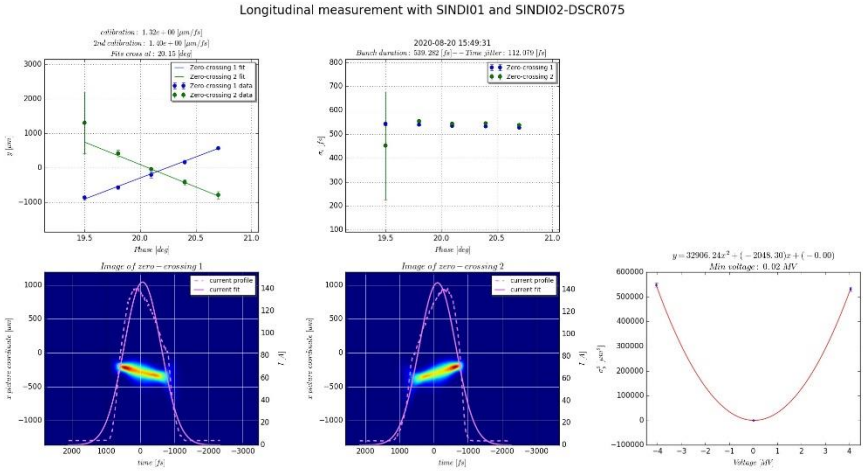
SOME MORE COMMENTS

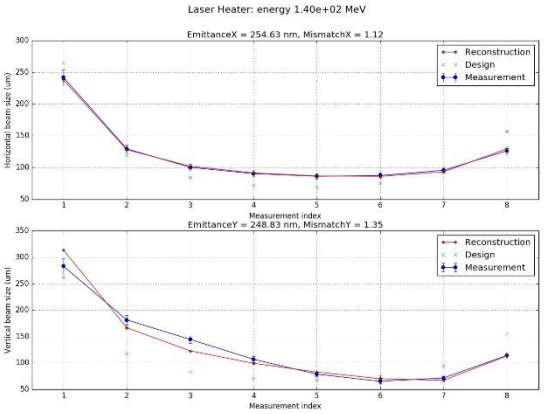
- Beam maintained short like before the shut-down, BW intermediate in prevision of the Sunday shift (relatively easy to re-optimize it)
- Photon energy selected to have the possibility to measure longitudinal parameters at SARCL without switching S30CB13-14. Maybe this should be the reference for the future setup. Maybe this may become the standard energy for the setup?
- “Human” setup done, PSICO run not for many hours yet, not all the parameters in it because of a new software issue

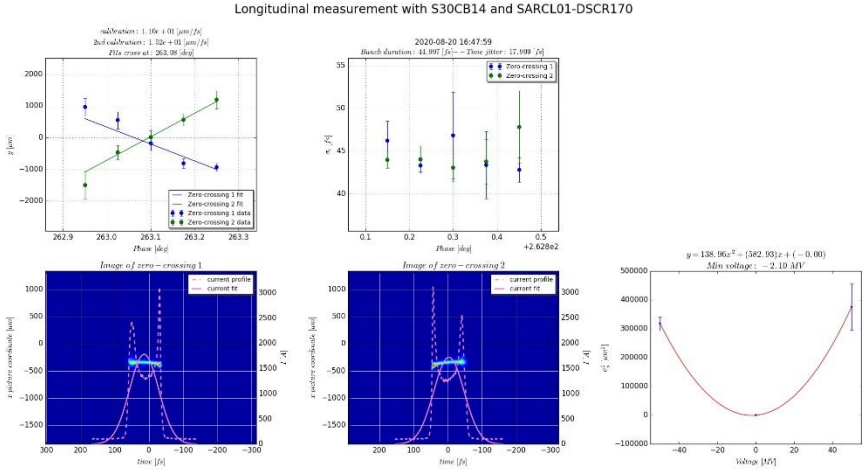
Aramis setup: step 1 (Thu)

S. Bettoni, D. Voulot, N. Hiller

- Thu: try to recover from the last setup before the shut down
- During the day several checks in parallel (ICT, BPM in Aramis, …)







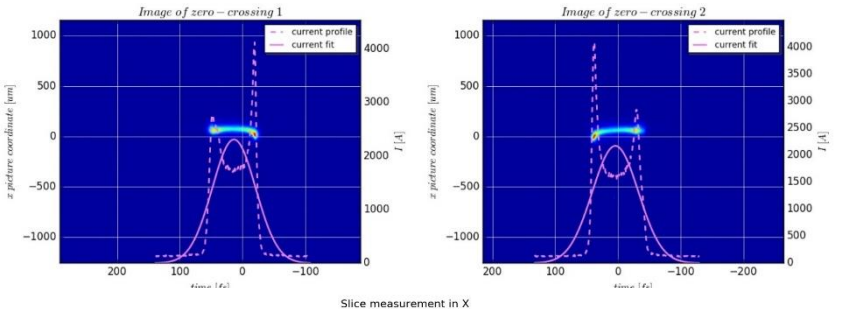
- Projected emittance at LH = 250 nm
- Basic checks, dispersion rough correction
- Short pulse at the end of the machine
- Left the tilt (no possible to softly correct it already in July)
- Possible all photonics diagnostics from the first evening of beam at more than **200 uJ at 11 keV short pulse** in the evening
- Started PSICO

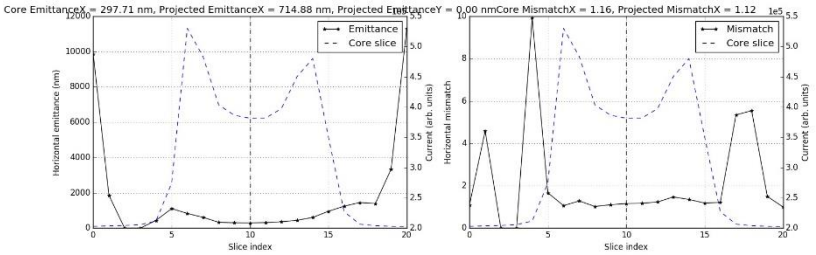
S. Bettoni, C. Kittel

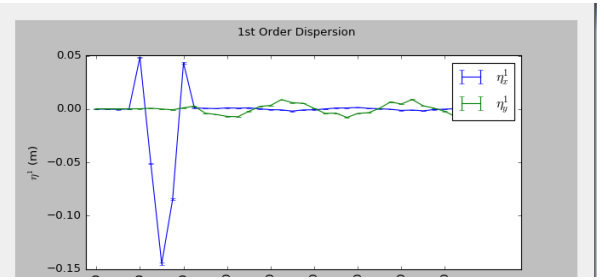
Aramis setup: step 2 (Sat PM)

Finer optimization all along the machine

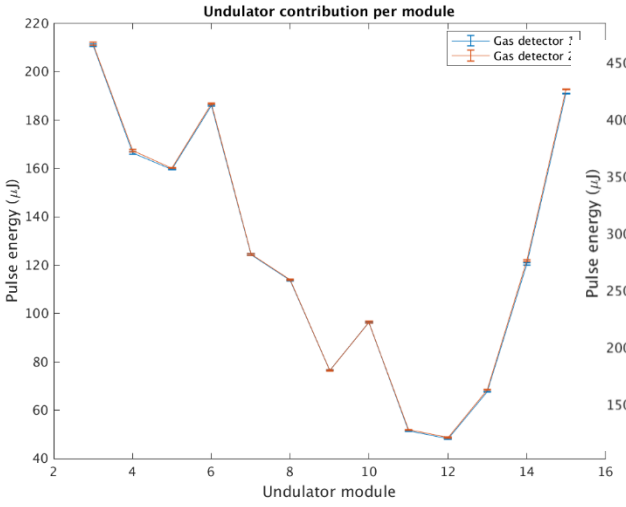
- **BC1 compression:**
  - Beam in injector is tilted. Corrected
  - Beam ok in x and compression: 26002
- **Tilt and slice emittance measurement at BC1:**
  - Tilt: 26005 parameter below 0.2: more than ok!
  - Vertical tilt corrected (2 0 X-ing)
  - Slice emittance-> solenoid scan-> slice emittance less than 300 nm
- **Tilt and slice emittance at SARCL:**
  - Bunch length: 26024 Tilt in y seems to be ok (at least for this point), beam: 26024
  - We changed the compression to stay at this point: 26026
  - Projected emittance: less than 300 nm, mismacth 1.16: 26029 ,beam short
  - Tilt also seems to be ok (vertical-for what we see and horizontal): 26030
- **Dispersion:**
  - starting point: 26032
  - SARCL02 quads: -0.2%: 26034 very good 1st order. We stay here.
  - Second order optimized: 26036
  - After all this retweaked some of the parameters->lasing to 290 uJ from 190 uJ

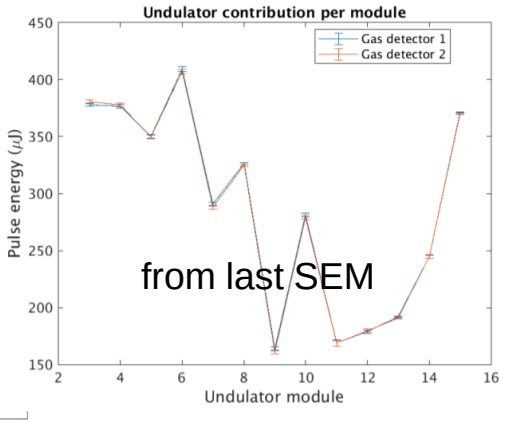






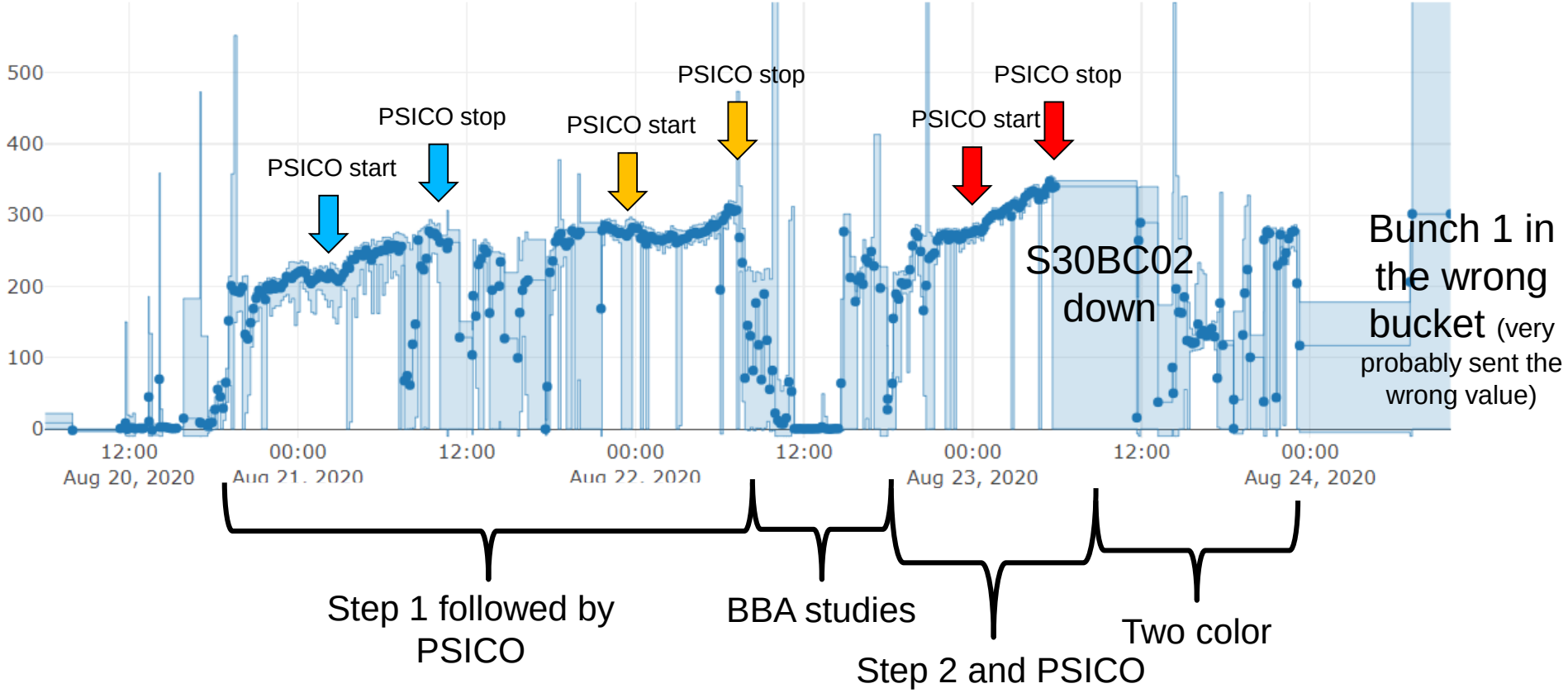
- Slice emittance below 300 nm at the undulator entrance with relatively short pulse
- Tilt corrected
- Dispersion corrected
- Enlarged the BW for the Sunday shift
- Monochromator and PSSS setup: many thanks to Claudio, Christopher, and Pavle





Aramis lasing

350 uJ @ 11 keV
One shift to stay as close as possible to references, and one for finer tuning seems to be ok
Athos setup scheduled, but at the end cancelled because of the ICT problem, and it makes more sense to do it with the Mizar today hopefully (E. Prat will support this)



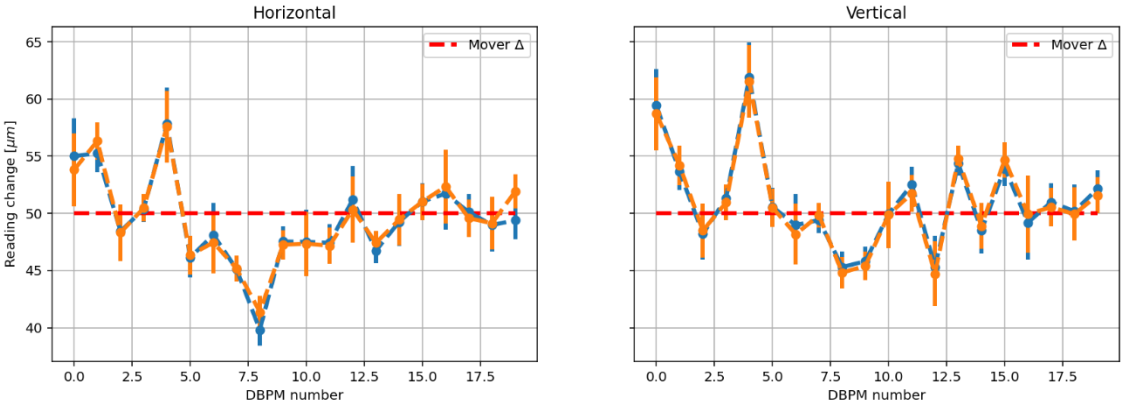
More and issues:

- S20CB03 failure in the night when PSICO was running. Q. Geng (piquet) and J. Alex fixed the issue on Sunday late morning
- Sent bunch 1 to wrong bucket on Sunday night. No beam until this morning
- BPM calibration by Boris
- Beam time for ICT interface

The UV non-contamination

Pavle installed the foil to intercept the UV light, but in this setup ,and in that of July no UV contribution present. We could generate it to test the filter, if necessary.

DBPM calibration check (26.07.2020)



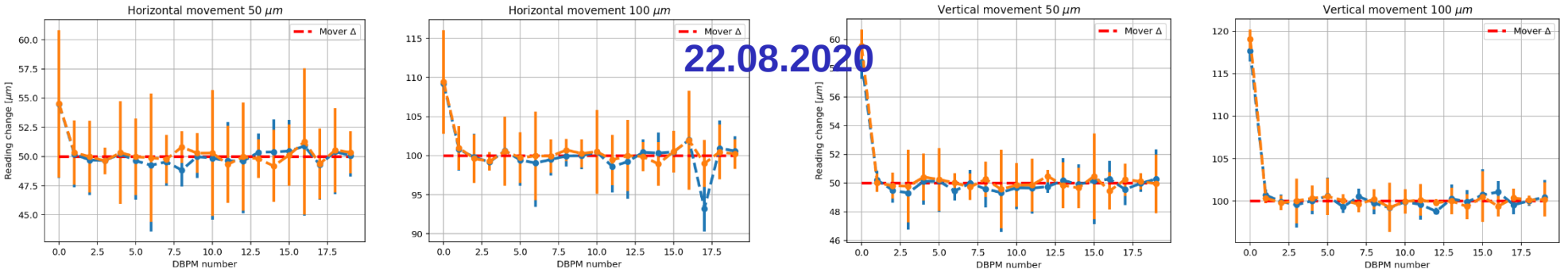
E. Ferrari

26.07.2020

DBPM reading of the same break section of the MQUA being moved: calibration verification.
50 um movement of the quadrupole movers, both in horizontal and vertical
The two curves correspond to plus (orange) and minus movements (blue).
Error bars are the rms of the acquisition for each DBPM (300 shots).

Horizontal

Vertical



22.08.2020

Boris prepared a new calibration table for the DBPM SARUN01-->SARUN19

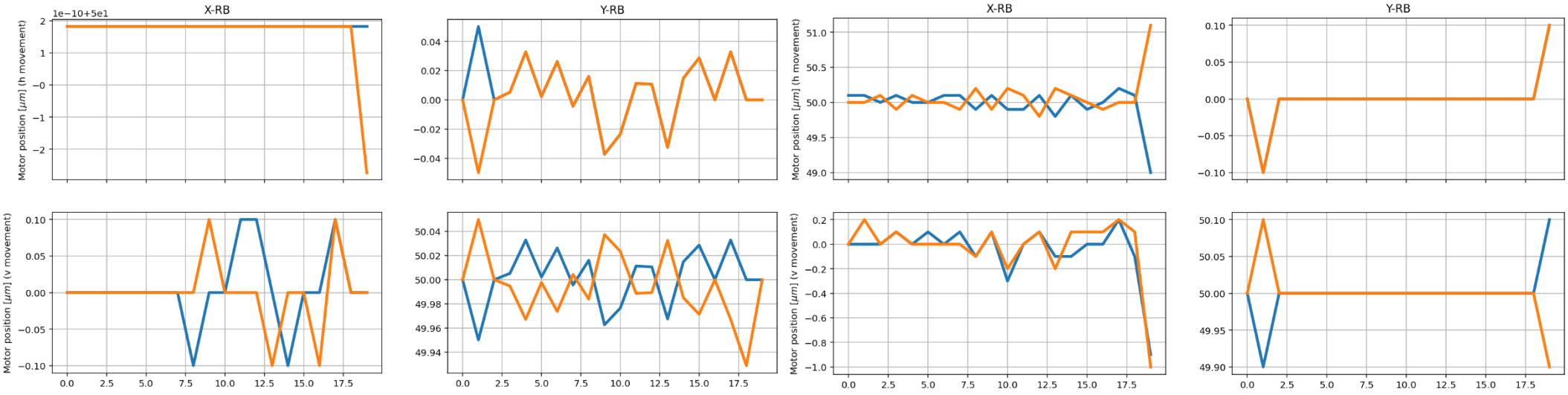
Check with -100, -50, 50, 100 um movements, in the same direction. (for SARUN16, one movement was 95 um, mover limit. Calibration is very good)

Way better calibration! **Thanks Boris!**
Let's please implement it. Also please check SARMA02-DBPM110.

Coupling analysis in progress
Hysteresis analysis in progress
Calibration analysis at another energy in progress

Quadrupole movers (22.08.2020)

E. Ferrari



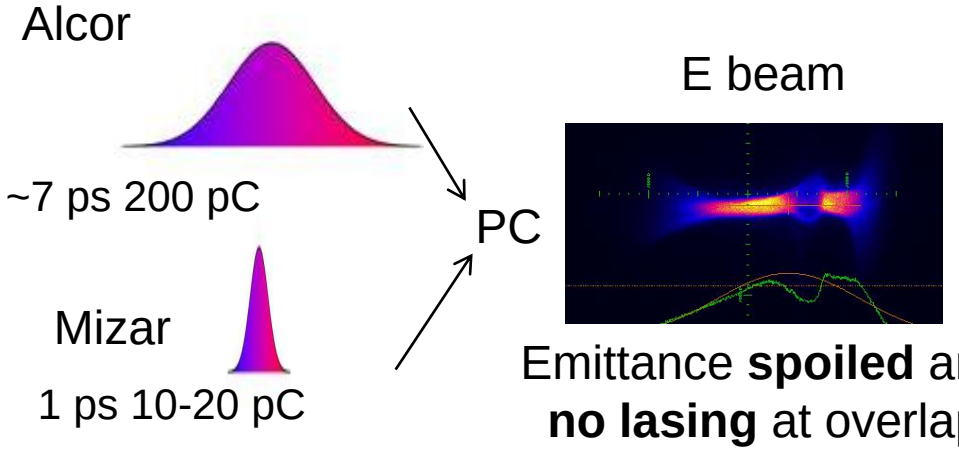
SARUN19 moves 49 um horizontally and 1 um vertically when required to move 50 um horizontally.
SARUN18 has a large discrepancy between set and read values in horizontal ~4um (but no alarm).

Undulator movers have quite some discrepancies between set and read. Can we do something for those?

Two color two lasers shift (Sun)

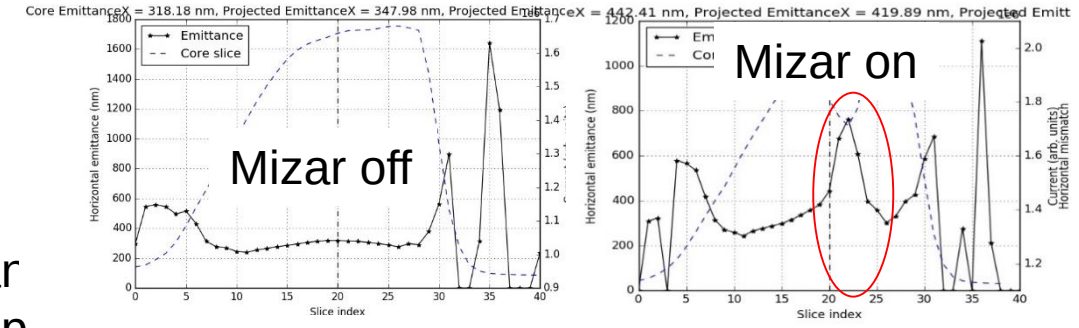
On shift C. Vicario, A. Dax, S. Bettoni

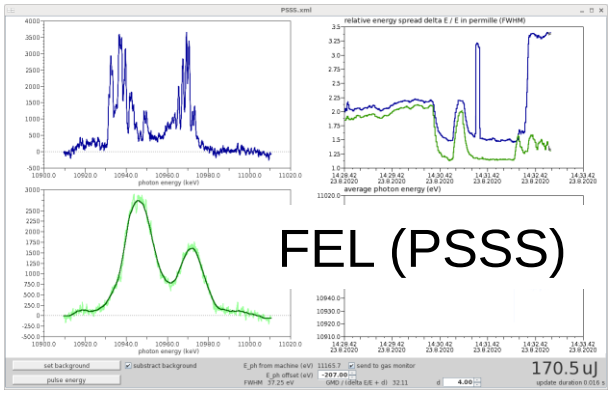
By overlapping Alcor and Mizar, we can control the portion of beam which is (not) lasing



Emittance **spoiled** ar
no lasing at overlap

Slice emittance at the injector





+ Easy and extremely fast and robust method to setup

+ Same quality of the beam optimized for the nominal lasing: up to 170 uJ measured

+ 100% of the shots are two color

+ Scan the ratio among the peak height (both using SINXB and Mizar delay)

+ Very easy to switch on and off one or the other color (adjusting the Mizar delay)

+ Jitter among the two pulses very good (more analysis), and it may be further improved using a different laser configuration

- Tunability range and the moment in the bunch length (common to other methods)

Two color two lasers shift (Sun)

On shift C. Vicario, A. Dax, S. Bettoni

Conclusions

- Cold check went quite smoothly, BUT unexpected issue with ICT-DRPS interface, and new undulator software. ICT seems to be ok thanks to D. Llorente! Undulator software under investigation.
- Electron beam setup (phase 1):
  - First two days (with many other system checks): 100 Hz, 200 uJ at 11 keV, 270 uJ morning later
  - Possible the setup and checks of the photon diagnostics
  - Energy selected to free station S30CB13 so that we can easily streak at SARCL
- Electron beam setup (phase 2):
  - Finer tuning of the electron beam all along the machine
  - Lasing up to 350 uJ at 11 keV short pulse after one very short night started late and interrupted by RF failure (stacked at 250 uJ the other night after the phase 1 setup)
- At the moment we are lasing with an empirically optimized orbit, but BBA studies ongoing and very promising (E. Ferrari)
- Athos setup scheduled for today (E. Prat)

Many thanks to all the people involved and especially to D. Llorente, C. Cirelli, C. Arrell, C. Milne, J. Alex, for helping also outside of the normal working time