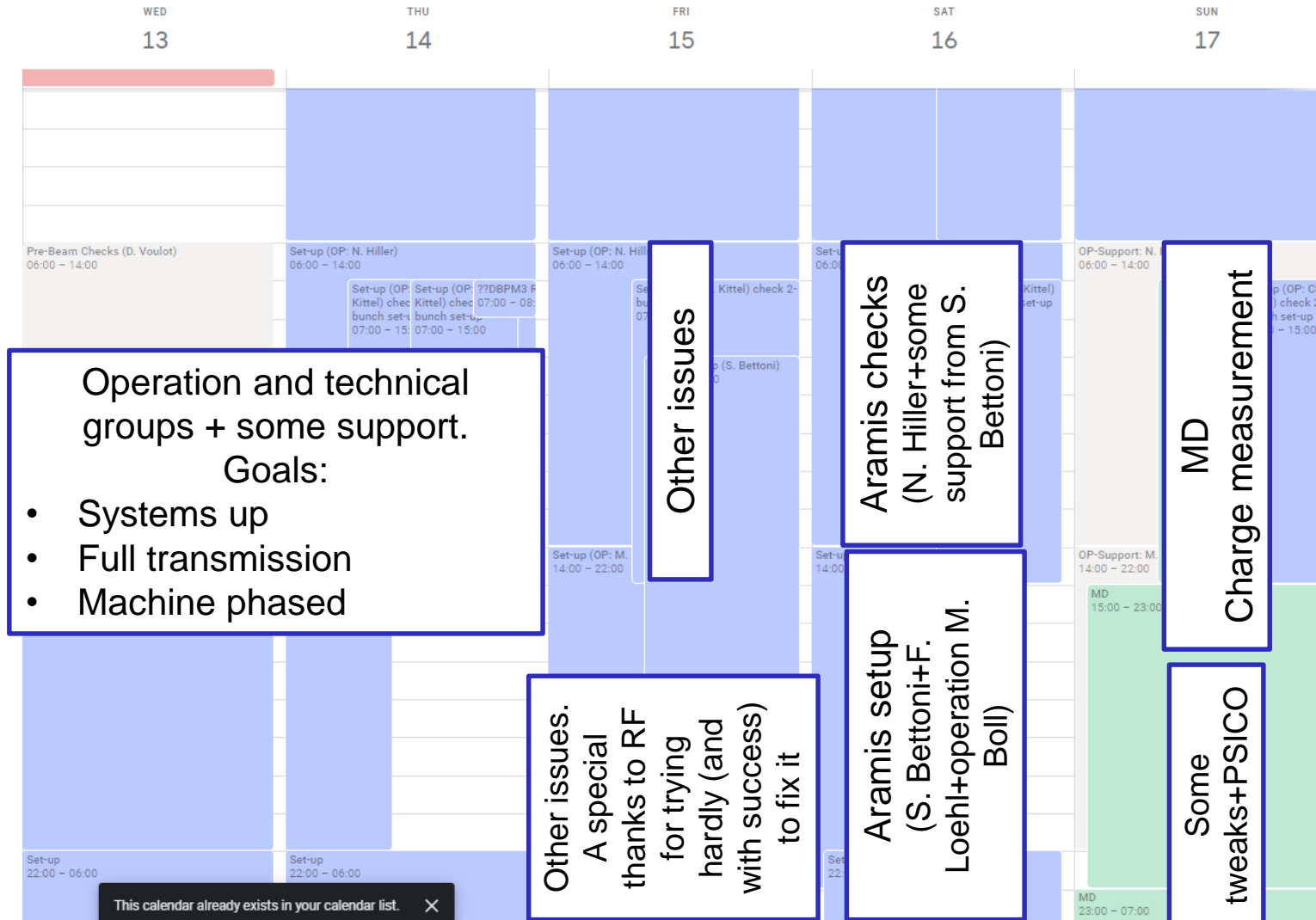


SwissFEL setup comments week 2

- **Schedule**
- **Systems issues and solutions: reported by operation**
- **Beam and FEL setup**
- **Considerations**
- **Conclusions**

Schedule



Foreseen schedule:

- ◆ Machine up for Thursday night
- ◆ Aramis setup on Friday from 9 AM, and some tweaks and PSICO on Saturday

Real schedule:

- ◆ Beam usable for more than few hours continuously from 11 PM on Friday
- ◆ Setup on Saturday, and some tweaks and PSICO on Sunday

Changes to feedbacks and other servers

F. Loehl

The 'virtual' feedback computer running all my servers was heavily overloaded since the machine was operated at higher rates.

Ordered a new, much faster computer dedicated to feedbacks. Arrived in December.
(128 cores, 256 GB of memory)

- René: setup of the computer in December / January (RHEL7 instead of SL6)
- Florian:
 - Re-compiled all libraries and servers for RHEL7 in January
 - Transferred all time-critical servers to new system
 - Calculation times, latency, and load is significantly lower on the new computer
 - In addition: implemented several additional checks and features to the feedbacks:
 - Checks that remote systems received new data
 - Feedbacks can now handle actuators that reached their limit
 - ...
 - Realized in December that several IOCs (e.g. magnets) were overloaded or had memory leaks. Things got partially improved meanwhile.

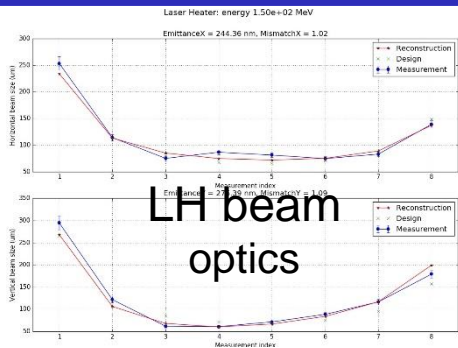
Beam setup

S. Bettoni, F. Loehl, operation (M. Boll)

Real time available

- Waiting from 9 AM on Friday, but only few hours beam on Friday PM and with some interruptions
- Saturday AM Nicole tried to look at the reference file and we started some measurements
- Real beam optimization on Saturday from 2 PM to Sunday 2 AM

LH beam optics

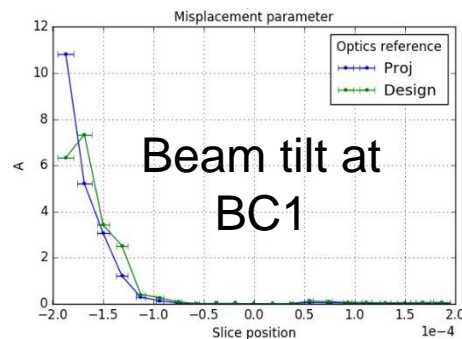


EmittanceX = 244.36 nm, MismatchX = 1.02

EmittanceY = 275.39 nm, MismatchY = 1.09

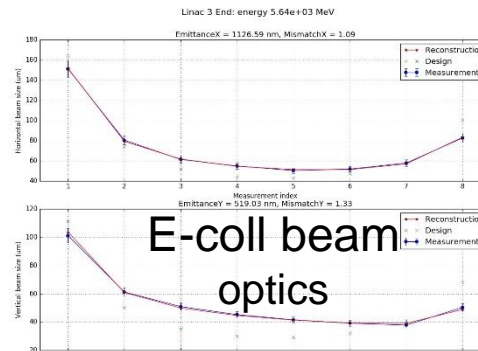
Between good and very good

Beam tilt at BC1



Corrected

E-coll beam optics

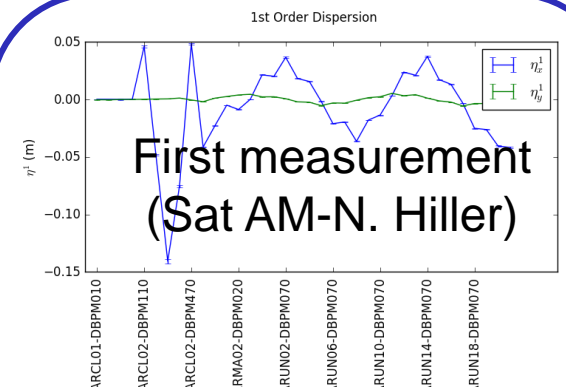


EmittanceX = 1126.59 nm, MismatchX = 1.09

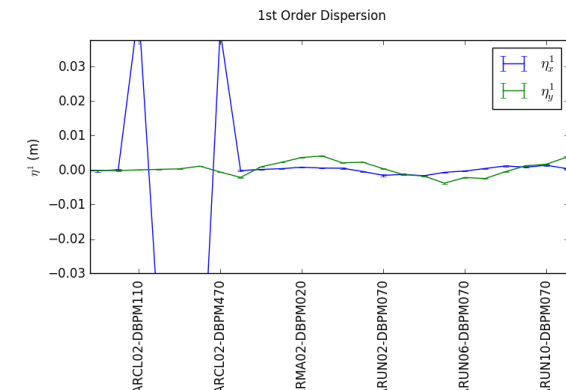
Measurement index
EmittanceY = 519.03 nm, MismatchY = 1.33

C-shape still present in X. DRPS limit stopped from optimizing looking at the beam (something done on Sunday)

First measurement (Sat AM-N. Hiller)



E-coll dispersion



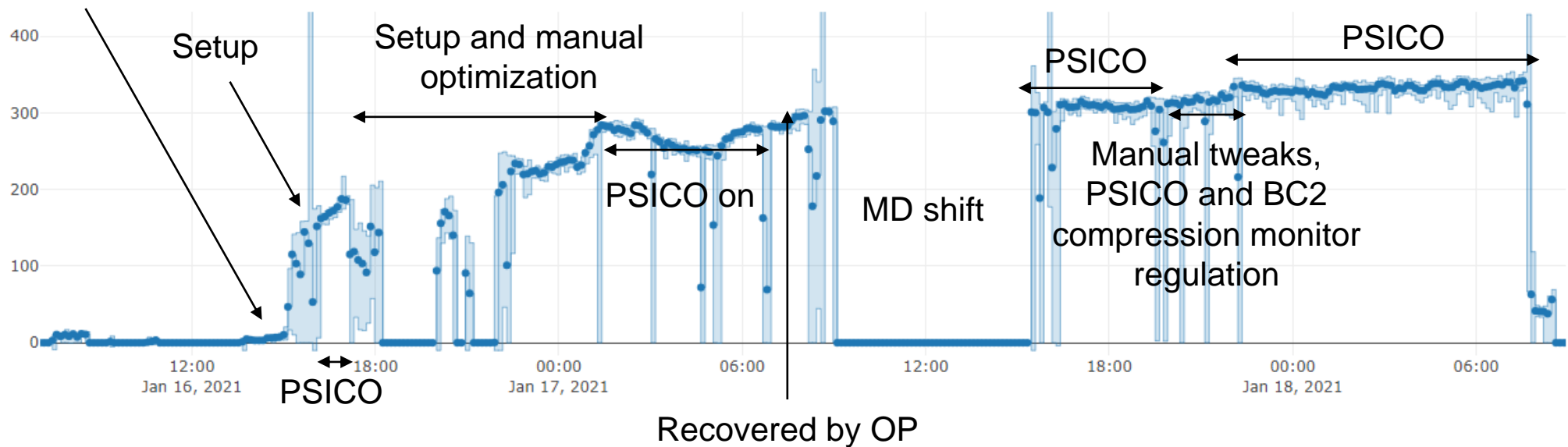
Large dispersion at the beginning (see next slides)

Lasing optimization

SARFE10-PBPG050:PHOTON-ENERGY-PER-PULSE-AVG\$max
SARFE10-PBPG050:PHOTON-ENERGY-PER-PULSE-AVG\$mean
SARFE10-PBPG050:PHOTON-ENERGY-PER-PULSE-AVG\$min

$E_{ph} = 9.8 \text{ keV}$

Something not properly set? Starting from few uJ on Sat at 2 PM



Setup: when and what:

- ◆ Started the real optimization with **few uJ** at 2 PM on Sat, and at 2 AM Sun **300 uJ**
- ◆ PSICO on between Sat and Sun: **FEL up and down**. A feed-back sensor not working? Other?
- ◆ On Sunday (not in shift) I tried to optimize the beam tilt with some tweaks (to be checked and properly done), and to catch up the central part of the beam. I modified the PSICO step sizes with these settings, and I regulated in a different way the BC2 compression feed-back

Considerations: energy collimator

Facts:

- Some years ago we were running with natural R56 in the energy collimator (no quadrupoles and sextupoles on)
- Now we run with $R56 = 0$ optics (quad and sext on)
- This latter configuration gives several advantages, because we are independent on the incoming energy chirp: we can measure the e-bunch of the undulator line, and therefore we can tune it using the E-coll screen, we can do LBW mode, ...

Concerns:

- At each photon energy change we may have a different orbit along the chicane
- Dispersion may be generated, and needs to be corrected. By this optics and beam tilts are modified

Consequences:

- More tricky to scale the photon energy
- This is at the moment done only by run coordinator(s), some few operators, but not by the users

Proposal:

- Go back to the natural R56 setup, so that all the operation crews or also the users themselves may do the energy scaling, like in the past
- Do BBA in the chicane
- Come back to $R56 = 0$ setting as the standard setting only after that is done

Considerations: LH chicane

Facts:

- Beam dynamics reported that in this setting (angle smaller than the design which we used until last November) we have less energy spread:
 - Initial DE spread measured in a shift at the design position: 15 keV
 - Initial DE spread at another shift at the same design position: 11.5 keV
 - Moving the chicane to the BD optimized position: from 11.5 keV to 8.5 keV
- This is beneficial for the final lasing intensity

Concerns and status:

- The chicane is not designed to work at several positions: not all the systems are working at the best. Operation with controls, BPM experts, laser group discussed and tested the reproducibility and reliability of the readings
- It seems that the smaller energy spread makes beneficial for the horns to lase at the beginning of the optimization. This makes tedious the initial FEL intensity ramp up
- At the moment we tried to unbalance more the peak current to make more disadvantageous the lasing from the horns, but tuning is necessary after the central part is lasing well. In alternative we need the LH operational, and this must be tuned

Proposal for the next start up:

- We come back to the design settings
- We optimize the FEL intensity
- When the intensity is high enough we change the chicane position (measuring the TOF to shift the RF phases downstream)

Conclusions

One of the most difficult systems startup ever at SwissFEL:

- Huge work done by operation and all the involved technical groups!
- Many thanks to all of them, and specially to RF (P. Craievich, R. Menzel, and C. Beard), which made possible to run during the week-end!

Beam and FEL setup:

- Due to all the issues delayed
- Something went wrong in the preliminary part (we do not know what), because we started from few uJ lasing only. Not a lot of time left, so we start the optimization
- We reached 350 uJ at 9.8 keV in 12 hours + some tweaks and regulations outside of the scheduled time
- Very efficient support by the operation Saturday shift crew (we had M. Boll as a contact person) and many thanks to Florian

Machine setup possible improvements:

- Several mails going around about some settings of the machine. All a bit difficult to follow in a proper way especially during the setup and in this case
- Some proposals presented for the two main topics
- Proposed by Florian (myself and operation fully agree) to set up a meeting between run coordinators and beam dynamics to determine the best settings to optimize the machine performances, reliability and reproducibility