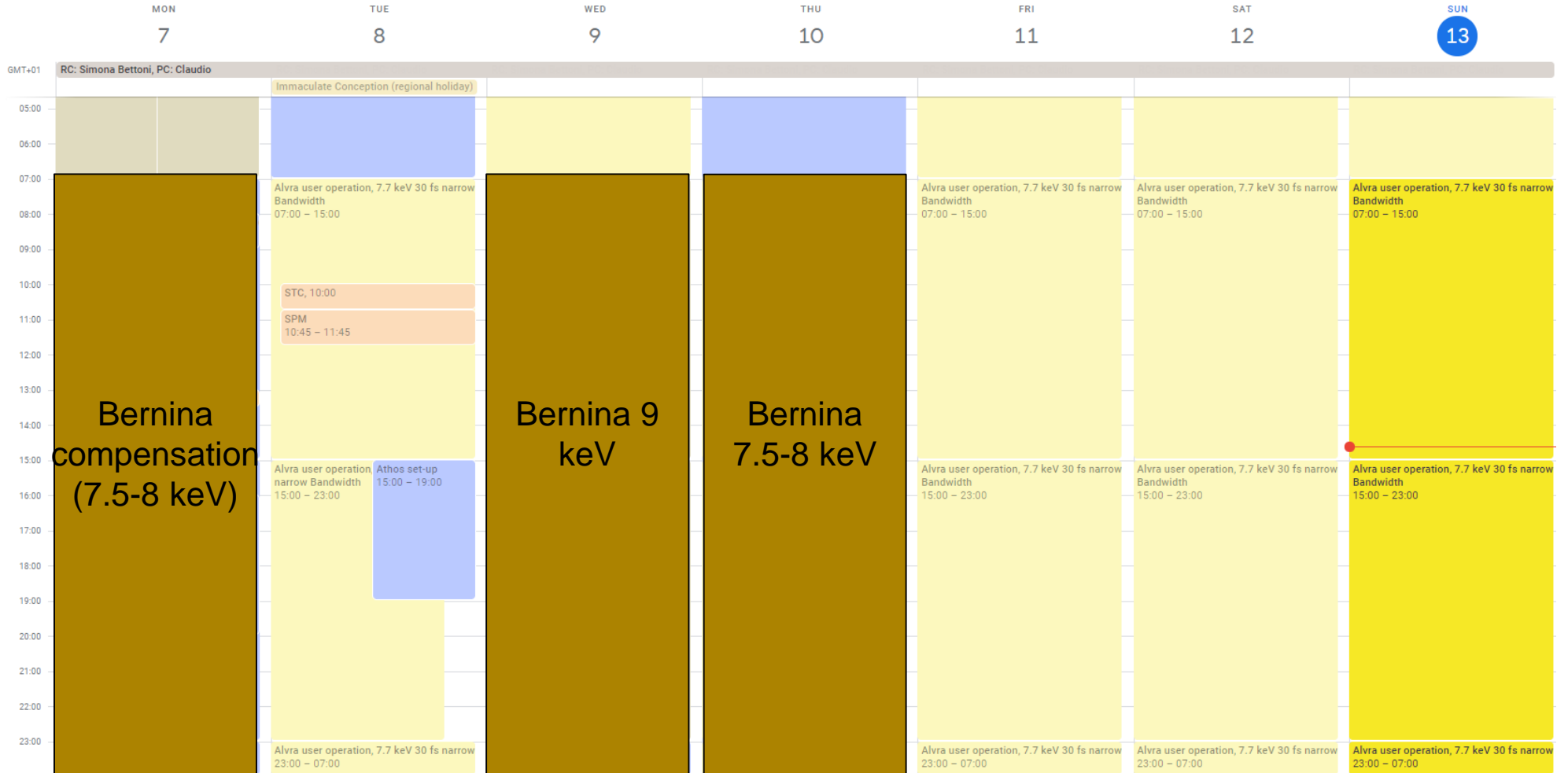


SwissFEL week 50

- **Schedule**
- **Aramis photon delivery**
- **Athos “photon delivery”**
- **Issues**
- **Considerations**
- **Conclusions**

Schedule



Athos → Beam setup Snail scans Line adjustment Half line setup Maloja meas

Changes in the schedule:

- ◆ Bernina accepted to give to Florian and myself time to study and do the Athos 2 bunch setup on Saturday. Both of us agreed to give back the time to Bernina. Thanks again!
- ◆ Due to the Alvra pump laser reparation, switched the Bernina and the Alvra day
- ◆ Bernina requested 9 keV instead of the initial scheduled 7.5-8 keV
- ◆ For Athos more discussions in the following

Machine stability

- Since last week (and one event in the past we realized) we suffer from jitter of the machine and jumps

Thanks to the laser and RF group, in particular to Qiao and Carlo for the excellent work!

As temporary cures:

- For the drift: we can compensate with the gun solenoid
- For the jumps: stringent limits in the feed-backs, at least to avoid that the machine is brought away during these events.

As investigation (meeting laser and RF, Florian, Simona):

- Florian and myself backtracked the source of the instability, and we identified the source at the beginning of the machine: laser or gun
- Contacted laser group and RF. They did a great work to try to identify the possible source of the problem. Thanks to all, and in particular to Carlo and Qiao!
- From a meeting last week it seems that the drift is due to a change of the gun voltage due to a not optimal temperature regulation (good in July not in the last weeks)

As next steps:

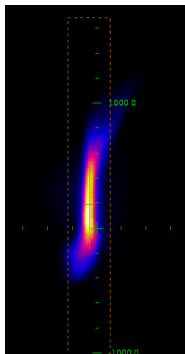
- Optimize gun rack cooling, study RF and T&S drifts, possibly implementing amplitude/phase drift for the gun

Sub-systems and other comments

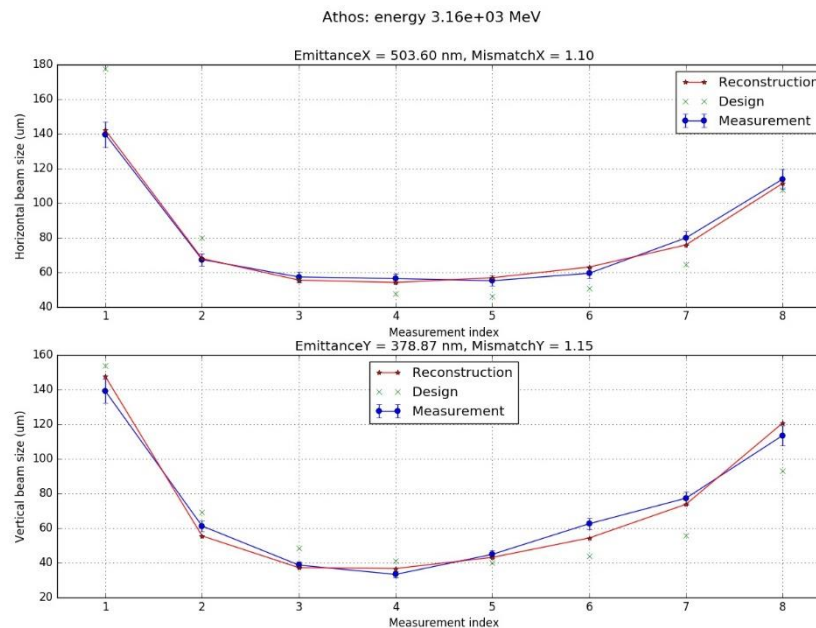
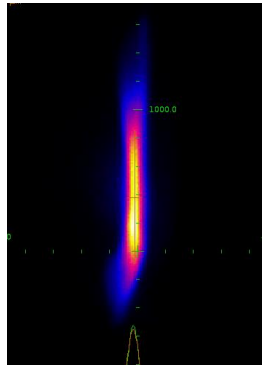
- Problems with the Athos gas detector, which required an access:
 - First time (Friday) nobody informed neither the run coordinator nor the users
 - Second time (on Sunday) I was informed, and the intervention was postponed to Monday (Athos not measuring on Sunday)
- A tunnel access was also necessary early morning on Saturday, but the users could not measure, so automatically granted by the control room, and users informed
- Compression monitor in BC2 (sensor for the compression feed-back) got stuck sometimes, but because of the jumps in the machine
- I received a call on Sunday morning at 3:30 AM, because of some losses in the machine, some servers down. Off and on seemed to help. Also observed that we were not symmetric anymore with respect to the working phase. Re-adjusted it. Not sure what helped the most, but after these two interventions, machine up
- All the other hardware perfectly working

Athos-electron beam setup

- Last week on Saturday Florian and myself (thanks for the time to Bernina) did the 2 bunch setup. Nice starting point was the standard procedure (by Qiao), but some improvements and possible issues identified (more discussions will follow):
 - Taken into account cross talk of bunch 1 and bunch 2: not before
 - More precise way to set the gun phase and amplitude: new procedure
 - Feed-back to stabilize the second bunch: implemented by Florian
 - Limitation of the phase and amplitude range: known to be addressed, temporary “fixed”



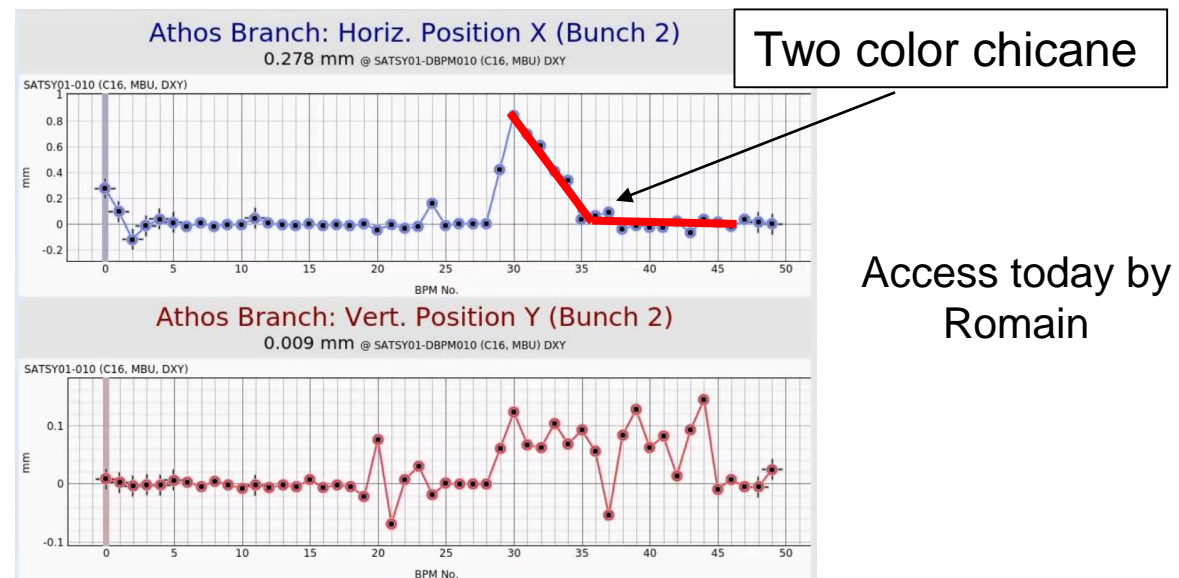
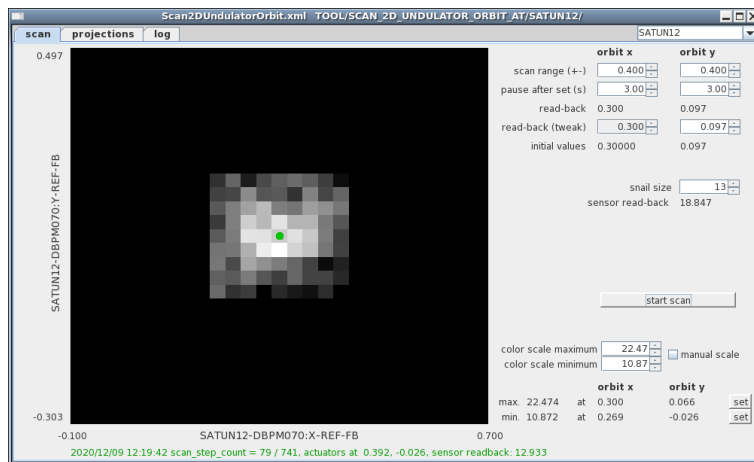
Examples of streaked beam in Athos



The beam quality seems to be ok both in transverse (for what can be measured) and transversally

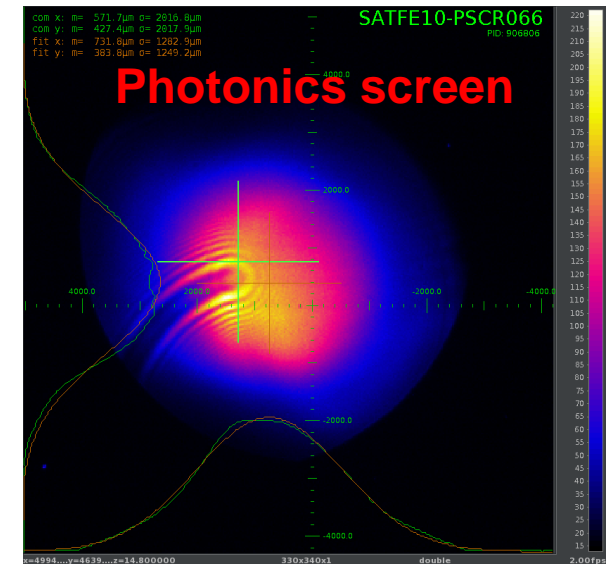
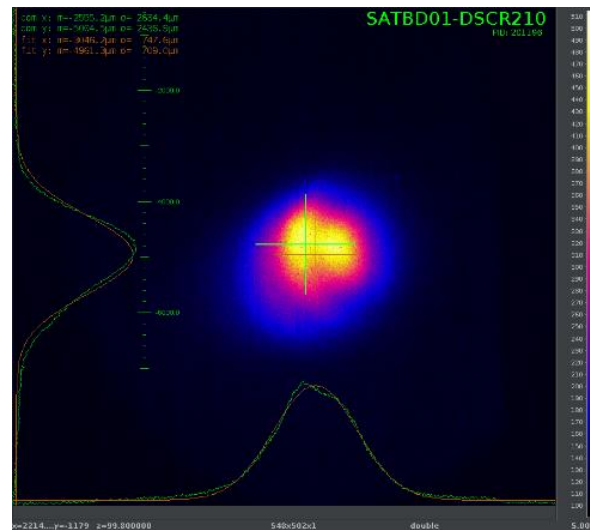
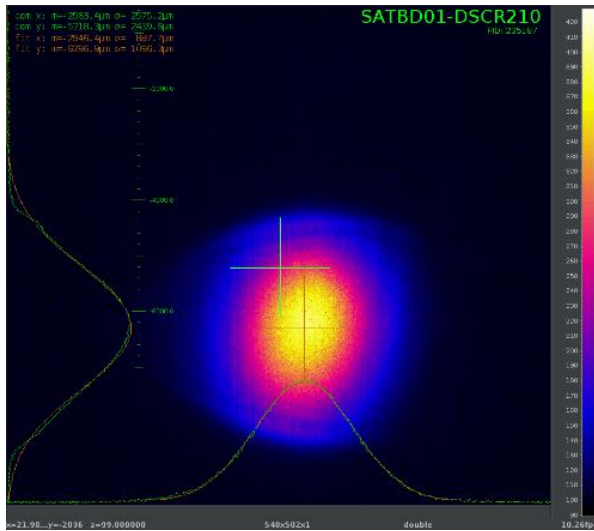
Athos-line setup

- After the 2 bunch setup lasing up to 250 uJ at 0.9 keV, but:
 - Losses along the line still present, as in the past (dark current and nominal beam)
 - Indication that on the part of the line around the big chicane there is something not understood
 - Very strange position of all the elements (see last SEM)-and not known why
- Put the elements at 0 putting in the FB the offsets (E. Ferrari, S. Bettoni, E. Prat)
- Run 2D scans (x and y) to find overlap along the line: defined a straight line (F. Loehl, S. Bettoni, E. Prat, M. Boll, N. Hiller). Losses went down
- Two different spots reaching the end of the line**
- To try to overlap split the line in 2 parts and run scans and iteratively changing slope and offset in x and in y for the two halves. Losses increased (F. Loehl, S. Bettoni, C. Kittel)
- Very large offsets still present in the BPM, especially in horizontal, necessary to pass with the FEL spot through the chicane
- Some residual field of the bends? Some misalignment of the chicane elements?



Athos-lasing

- After the 2D scans and pointing adjustment of the first half of the line we may see a single spot of the first half of the line
- At the moment movers at 0 and undulators at the survey positions (provided by Romain). This makes possible to better identify the problem
- On Friday AM we agreed with Kirsten, Andr e, and Christoph B. that we deliver with one spot coming from the second part of the line, and they can do some measurements



First half of the line only 0.540 keV after the snail scans, and pointing adjustment

Full line 0.540 keV

Beam at 0.540 keV on Friday

Doubt on the cycling of the two color chicane bend

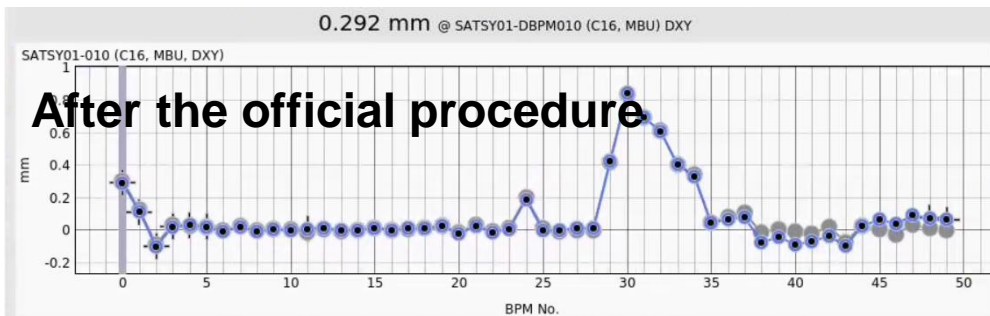
Suspicious on the cycling of the dipole of the two color chicane (Florian, Romain):

- +150 A, -150 A, +75 A, -75 A I think I saw (magnet group)
- I manually did +150, -150, +100, -100, +50, -50, +25, -25, +10, -5, +5, 0 A

I tried to check it:

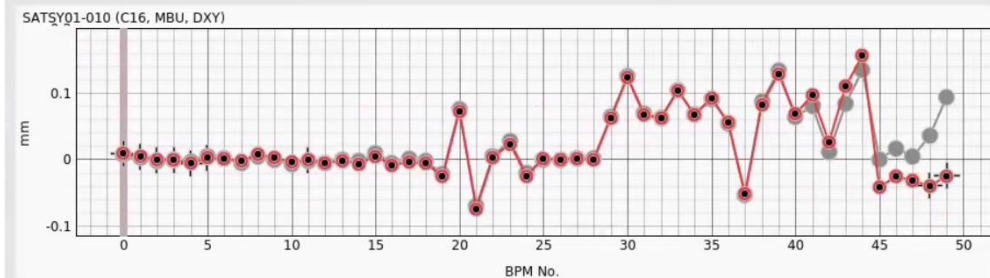
- Before cycling saved the reference orbit (grey line)
- Cycled using the cycling button
- Opened the orbit feed-back
- Read the orbit

Fresh from yesterday evening



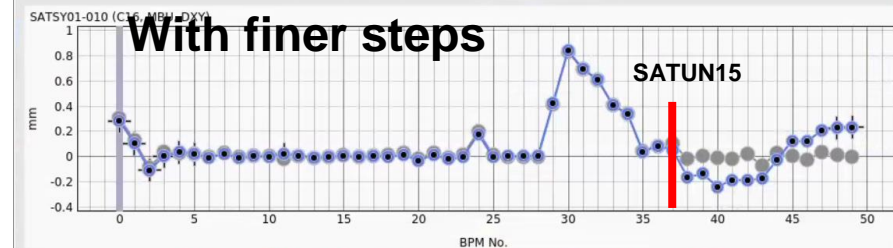
Athos Branch: Vert. Position Y (Bunch 2)

0.010 mm @ SATSY01-DBPM010 (C16, MBU, DXY)



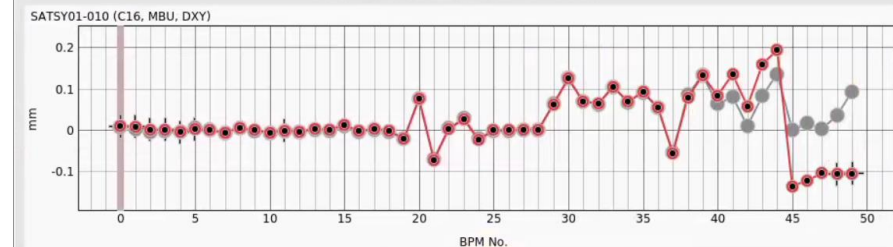
Athos Branch: Horiz. Position X (Bunch 2)

0.284 mm @ SATSY01-DBPM010 (C16, MBU, DXY)



Athos Branch: Vert. Position Y (Bunch 2)

0.010 mm @ SATSY01-DBPM010 (C16, MBU, DXY)

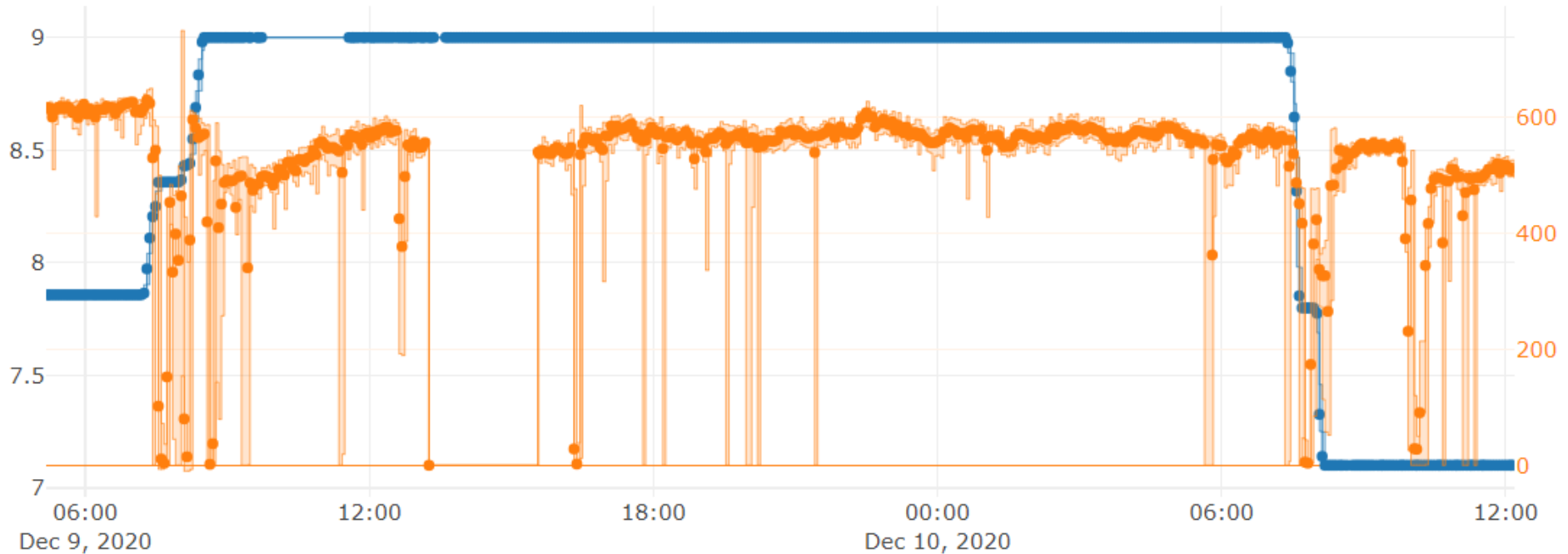


Considerations

- Also if it was Aramis first priority week(s), the largest fraction of the time (day and night) was spent to try to understand the Athos line, which should not happen during a photon delivery week
- Probably was too early to go in photon delivery in Athos. At the moment:
 - 2 bunch setup optimized on Saturday of the previous week
 - Not known if the beam can be well transported with a given peak current to the end of the line (BD will simulate it in January next year)
 - Not clear why some elements were in some “strange” positions
 - Losses (dark current/main beam) not under control at the beginning of the week, better after the 2D scans, and worse when we adjusted the FEL pointing
 - Some tools ready to be used by all (emittance/matching for example), others not yet (line alignment for example, and responsible in vacation)
 - Discovered that some key parameters are not saved in the snapshot
- More discussions at the project level happened/will happen, and probably the SEM is not the right place, but it was clear that massive studies are necessary to make Athos to reliably operate.

Aramis photon delivery (9 keV)

Initial scaling done by Didier with the shift crew (thanks!) from 7 AM. I tuned a bit more the dispersion and other small things during the day.

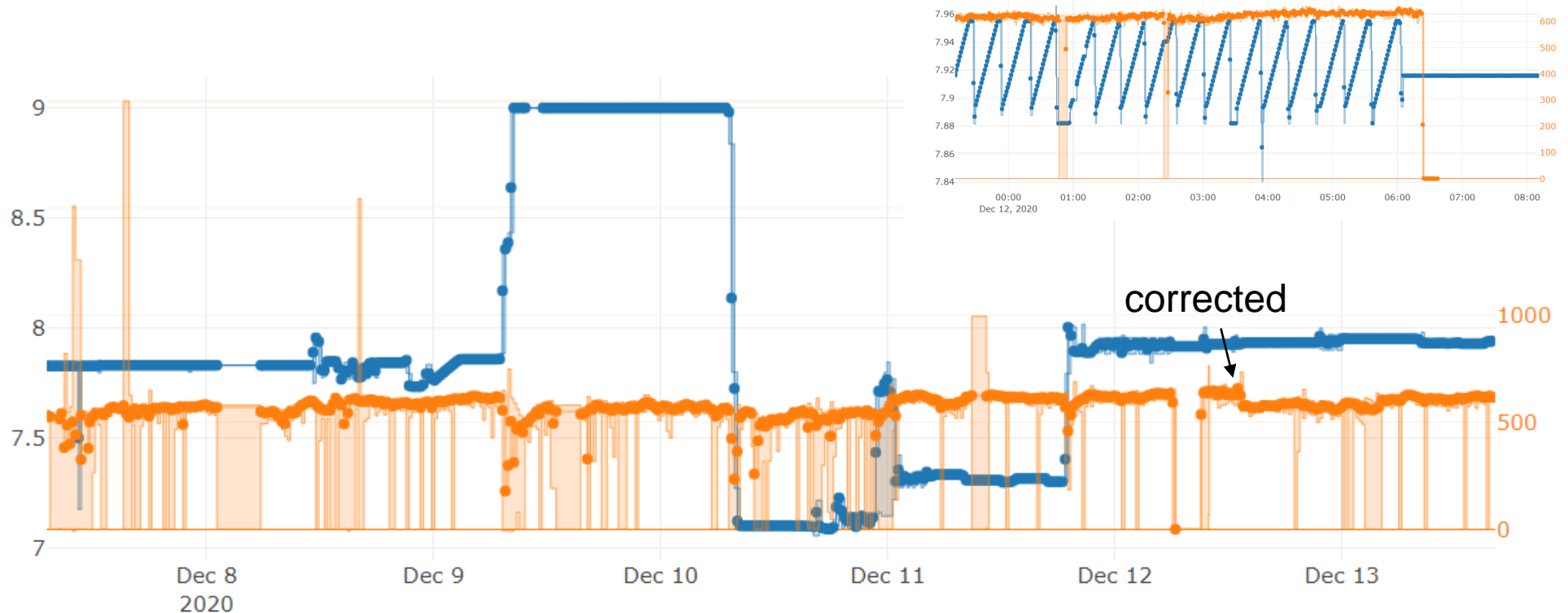


- SARUN03-UIND030:FELPHOTENE\$max
- SARUN03-UIND030:FELPHOTENE\$mean
- SARUN03-UIND030:FELPHOTENE\$min
- SARFE10-PBPG050:PHOTON-ENERGY-PER-PULSE-AVG\$max
- SARFE10-PBPG050:PHOTON-ENERGY-PER-PULSE-AVG\$mean
- SARFE10-PBPG050:PHOTON-ENERGY-PER-PULSE-AVG\$min

Peak at about 620 uJ during the day

Aramis photon delivery

On despite of the drifts and jumps lasing for the entire week in the range of 550-630 uJ from 7.1 to 9 keV with several energy scans and frequent (☺) energy change requests by Alvra



Some comments:

- ◆ We could keep PSICO on for the drift compensation also during the Alvra energy scans
- ◆ Better for the next big energy jump to cycle the bend at the energy collimator. Corrected the pulse energy reading on Saturday, but mismatch between the PSSS at the photon energy calculated

Conclusions

Machine in general:

- Stability and jump issues, which affect both lines
- Temporary cures implemented, which makes more demanding to operate the machine
- Source probably identified
- Long term solutions under study/implementation

Aramis:

- Lasing around 550-600 uJ, with a peak above 620 uJ with energy variation from 7.1 up to 9 keV
- Short (around 25 fs), small (0.12%) bandwidth bunch

Athos:

- Lasing in the past in some weeks, but not in a reproducible way and never back to the September mJ level
- Losses better under control after the 2D scan, but worse after the FEL pointing
- Orbit FB are pointing to an angle error in horizontal to the 2 color chicane (element misaligned or residual field). With only BPM offsets and the rest at 0 we are sure the problem is there. Not a guess, and something systematically may be done
- Some basic measurements done only by Maloja using the second half of the line
- Long term plan to be discussed at the project level

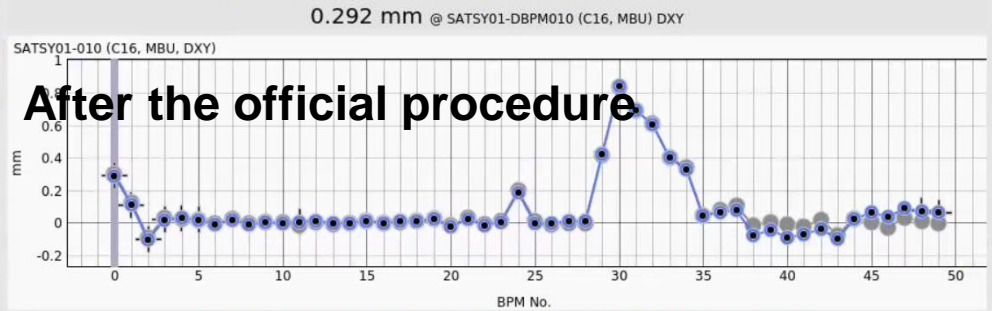
Some acknowledgments

Thanks to **operation**, which tried to support the machine at least during the working time, to the **laser** and the **RF** section, and in particular Carlo and Qiao for the stability issue analysis, to **beam dynamics** for trying to help for Athos in some occasions during the week

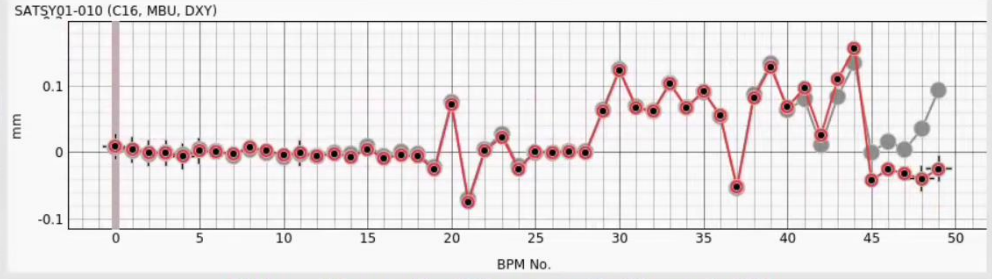
Thanks to the **Maloja** team for their patience, for continuously adapting their schedule, and for being always ready to check the beam upon any request from our side

A huge thanks to **Florian**, who, after his last super busy week as run coordinator, was continuing to help and support everybody during day and night

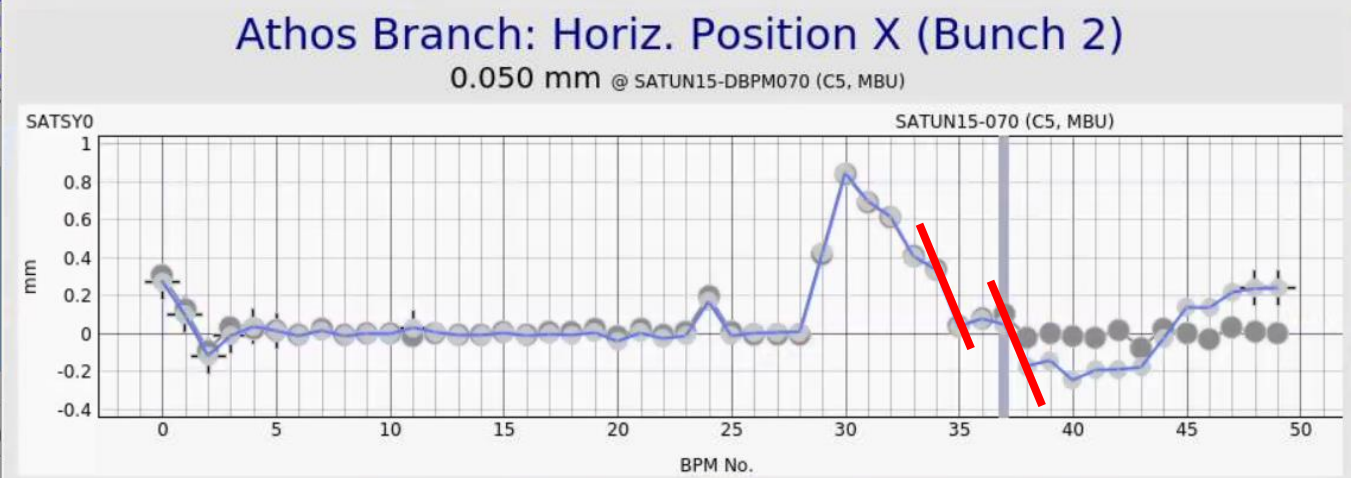
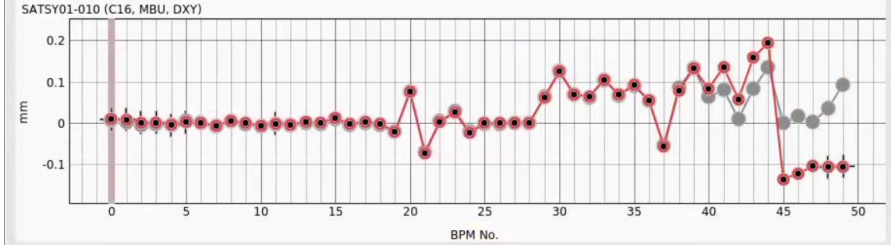
Doubt on the cycling of the two color chicane bend



Athos Branch: Vert. Position Y (Bunch 2)
0.010 mm @ SATSY01-DBPM010 (C16, MBU) DXY

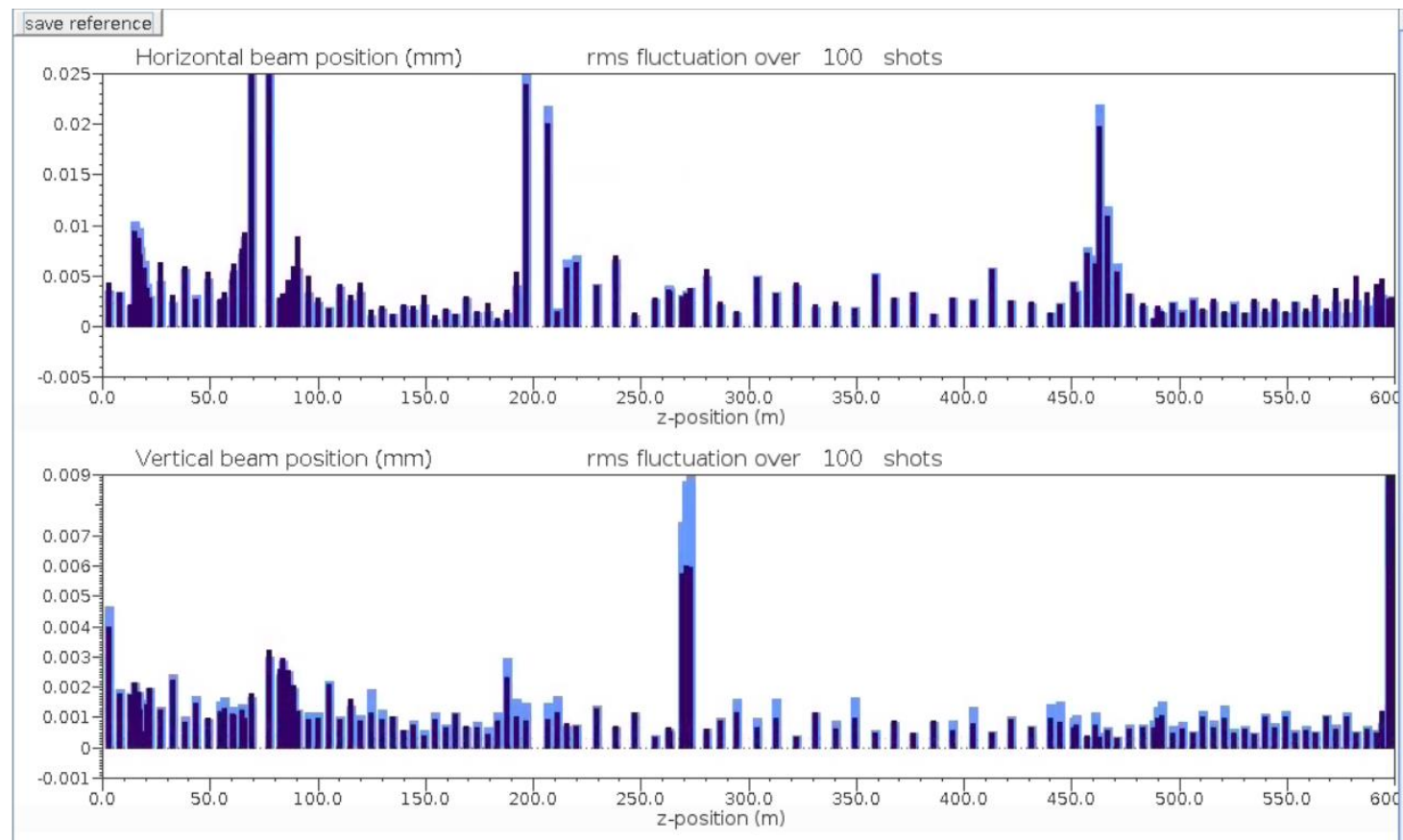


Athos Branch: Vert. Position Y (Bunch 2)
0.010 mm @ SATSY01-DBPM010 (C16, MBU) DXY



Aramis performance

- All the time we scale the photon energy, and we modify the dispersion in the energy collimator (known problem)
- This week particular attention cared to fine (below 1 mm) correct it in case of big energy changes, and fine tune with the dispersion group
- This is what we delivered in average during the week (plot on Sunday, reference-light blue at the beginning of the week)



More FEL images

