

PAUL SCHERRER INSTITUT



Florian Löhl :: Paul Scherrer Institut

Run coordinator report November 30 – December 6, 2020

SwissFEL Exchange Meeting, 7.12.2020

I had no time for a complete summary. I only mention a few critical topics.

Program

	Mo. 30.	Di. 1.	Mi. 2.	Do. 3.	Fr. 4.	Sa. 5.	So. 6.
Ganztägig	RC: Florian Loehl, PC: Kirsten Schnorr, BD-support: Simona Bettoni						
	Laser neater studies 3 (E. Ferrari)	Set-up	Set-up	Aramis BD	Athos BD	Aramis BD	Athos BD
01:00							
02:00							
03:00							
04:00							
05:00							
06:00							
07:00	07:00 Set-up (Hiller)	07:00 Set-up (Hiller)	07:00 Aramis (Alvra) 7.7 keV 30 fs narrow BW	07:00 Athos (Maloja) 0.9-1.1 keV	07:00 Aramis (Alvra) 7.7 keV 30 fs narrow BW	07:00 Athos (Maloja) 0.9-1.1 keV	07:00 Aramis (Bernina) 8 keV 30 fs narrow BW
08:00	Migrat...	Cristali...					
09:00	Systematically inv...						
10:00	Cristalina installat...						
11:00							
12:00							
13:00							
14:00							
15:00	15:00 Set-up (Kittel)	15:00 Set-up (Kittel)	15:00 Aramis BD	15:00 Athos BD	15:00 Aramis BD	15:00 Athos BD	15:00 Aramis BD
16:00							
17:00							
18:00							
19:00							
20:00							
21:00							
22:00							
23:00	Set-up	Set-up	Aramis...	Athos BD	Aramis...	Athos BD	Aramis...
24:00							

KW 49

Mo. 30.

Di. 1.

Mi. 2.

Do. 3.

Fr. 4.

Sa. 5.

So. 6.

Ganztägig **RC: Florian Loehl, PC: Kirsten Schnorr, BD-support: Simona Bettoni**

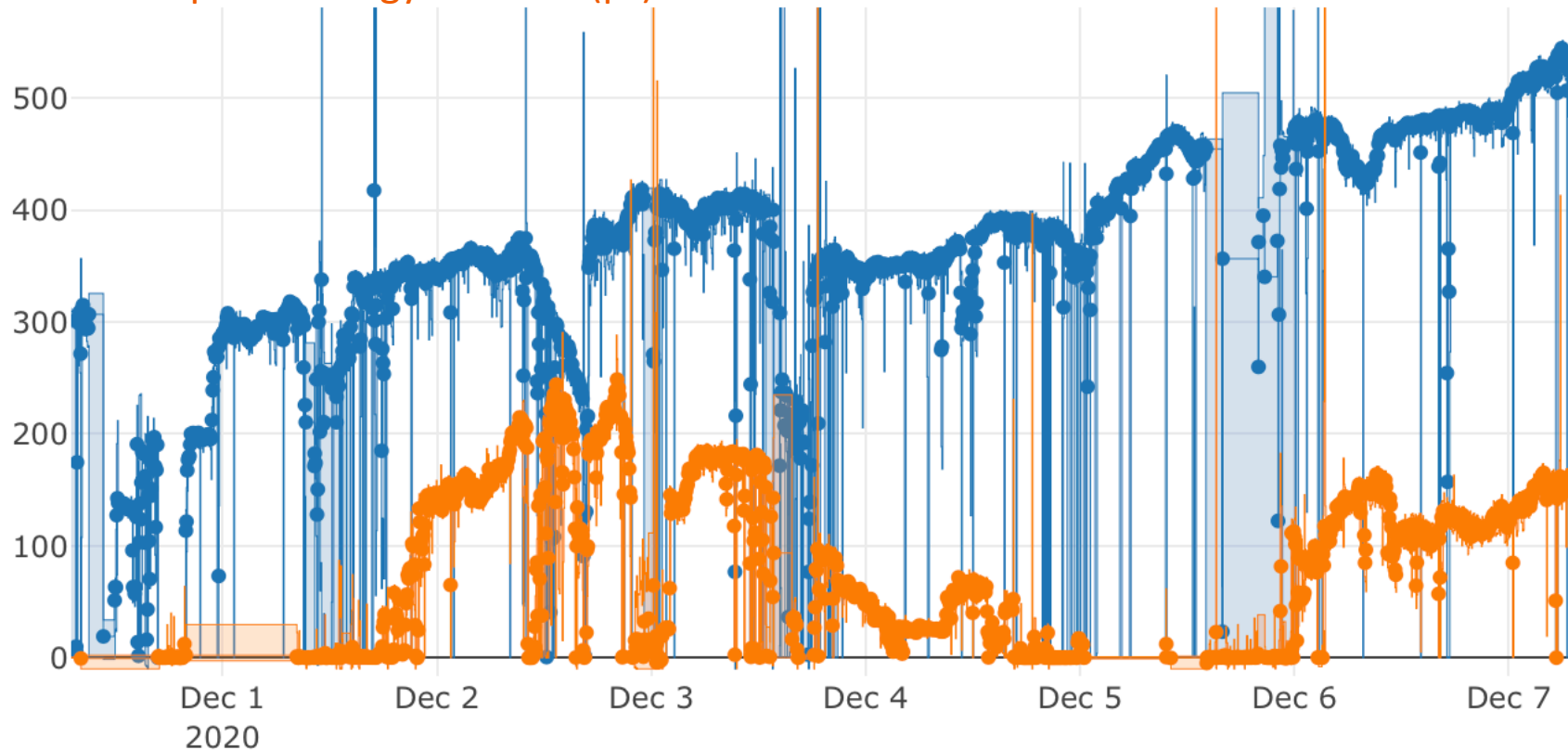
	Mo. 30.	Di. 1.	Mi. 2.	Do. 3.	Fr. 4.	Sa. 5.	So. 6.
01:00	Laser neater studies 3 (E. Ferrari)	Set-up	Athos first priority Set-up	Aramis BD	Athos BD	Aramis BD	Athos BD
02:00							
03:00							
04:00							
05:00							
06:00							
07:00							
08:00	07:00 Set-up (Hiller)	07:00 Set-up (Hiller)	07:00 Aramis (Alvra)	07:00 Athos (Maloja) 0.9-1.1 keV	07:00 Athos (Maloja)	07:00 Aramis (Bernina)	07:00 Athos (Maloja)
09:00	Migrat...	Cristali...					
10:00	Systematically inv...						
11:00	Cristalina installat...						
12:00							
13:00							
14:00							
15:00							
16:00	15:00 Set-up (Kittel)	15:00 Set-up (Kittel)	machine setup	15:00 Athos BD	15:00 Athos BD	15:00 Athos BD	15:00 Aramis BD
17:00				machine setup	machine setup	machine setup	
18:00							
19:00							
20:00							
21:00							
22:00							
23:00							
24:00	Set-up	Set-up		Athos BD	Athos BD	Athos BD	Aramis... Athos BD

We started with a machine performance significantly below our optimum settings.

Several critical things were changes during the previous MD week

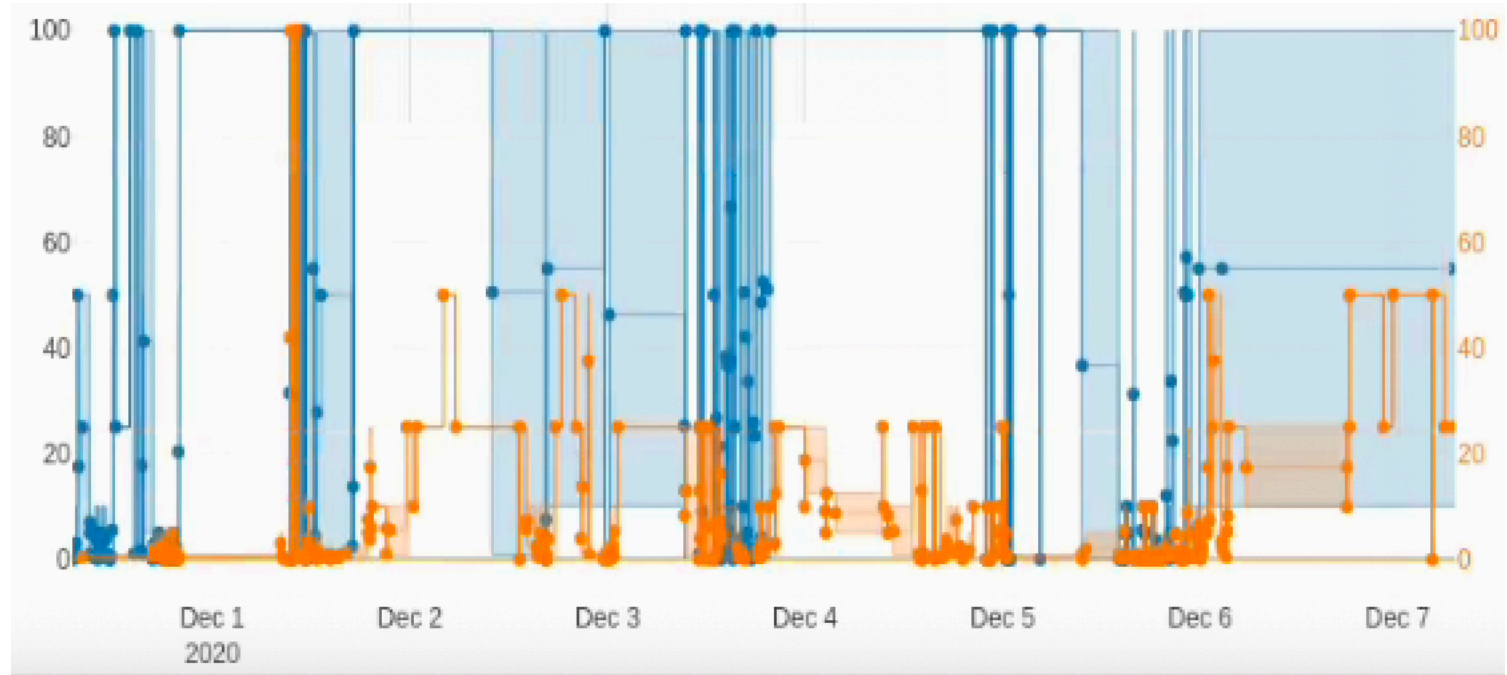
- New position of laser heater chicane (to reduce beam energy spread)
- New position of X-band structures (to reduce beam emittance)
- Machine set to design optics (requirement for Athos?)

Photon pulse energies during the week

Photon pulse energy in Aramis (μJ)Photon pulse energy in Athos (μJ)

Repetition rates during the week

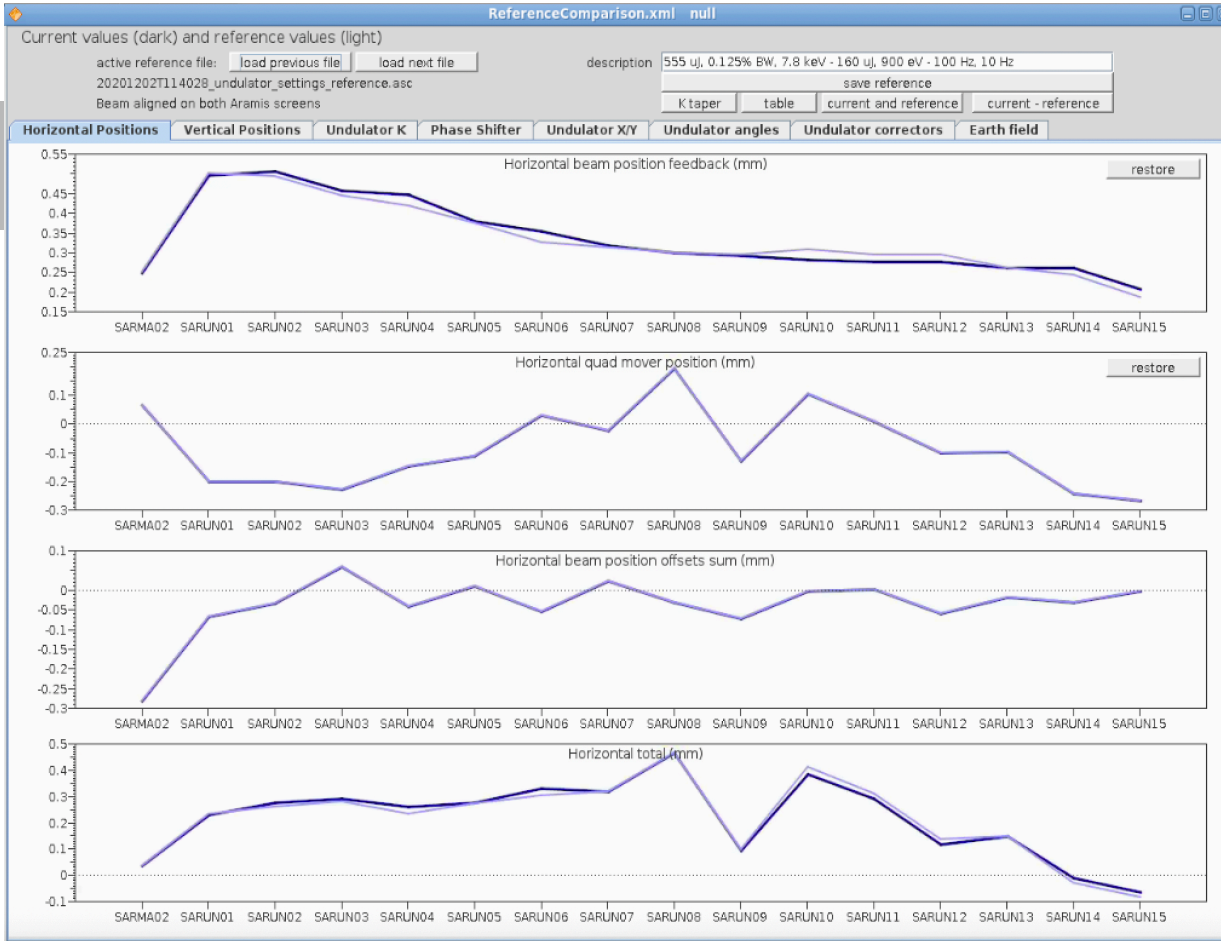
Aramis (Hz)
Athos (Hz)



Selected activities during the week

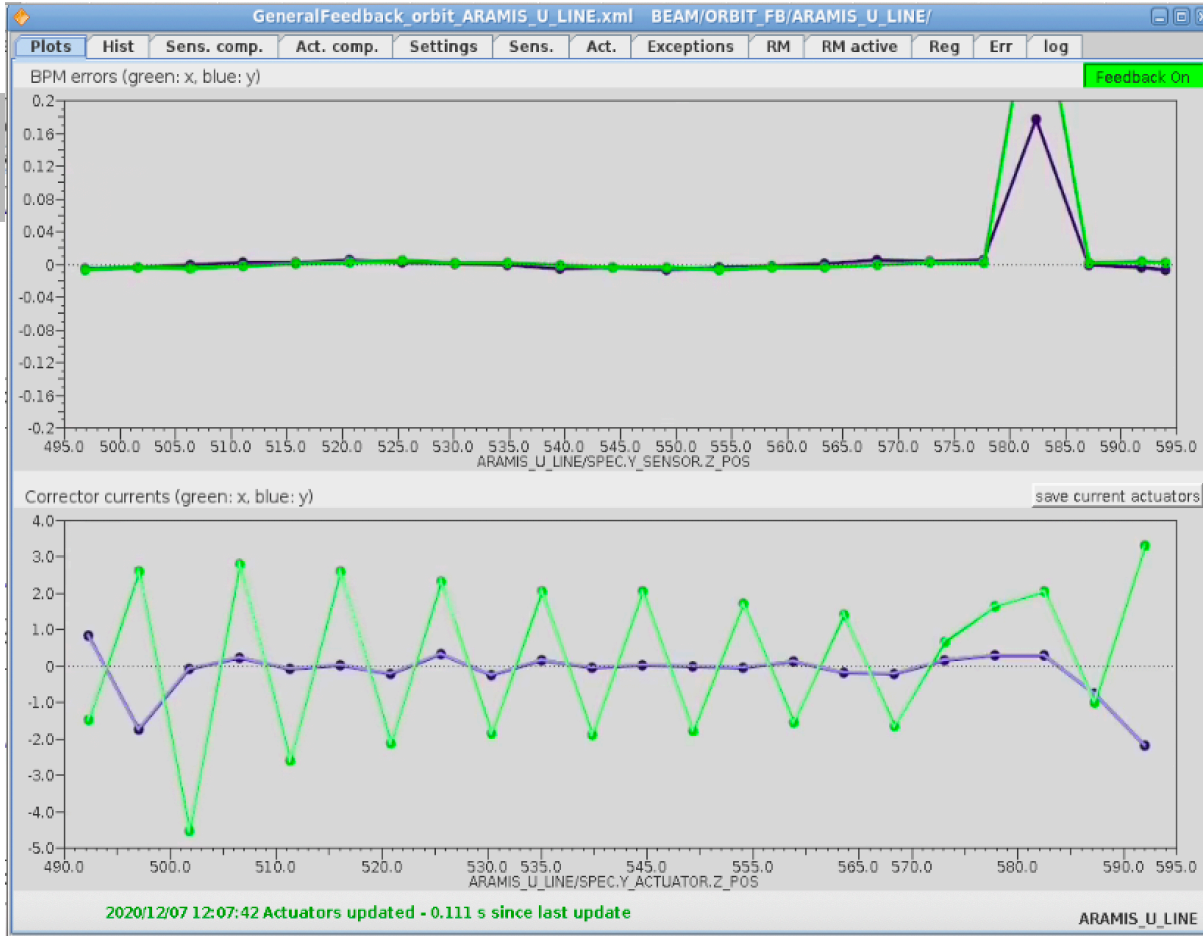
- Monday
 - Aramis beam setup (S. Bettoni, N. Hiller, C. Kittel, F. Loehl)
 - Qiao showed Florian & Simona how to do the two bunch setup. Eduard also wanted to learn and participated.
- Tuesday
 - Athos setup & tuning (S. Bettoni, E. Prat, E. Ferrari, F. Loehl)
- Wednesday
 - Tuning of Athos line alignment to remove FEL double spot (E. Ferrari, E. Prat)
 - Tuning, recovery from gas monitor failure
- Thursday, Friday
 - Tuning, trying to recover decent Athos performance. Failed. (S. Bettoni, E. Prat, E. Ferrari, F. Loehl)
 - Tuning to recover narrow spectrum in Aramis (S. Bettoni, F. Loehl)
- Saturday
 - Clean two bunch setup with a new procedure (S. Bettoni, F. Loehl)
 - Recovered stable performance in Athos and Aramis (S. Bettoni, F. Loehl)

Required hor. pointing correction in Aramis after BBA



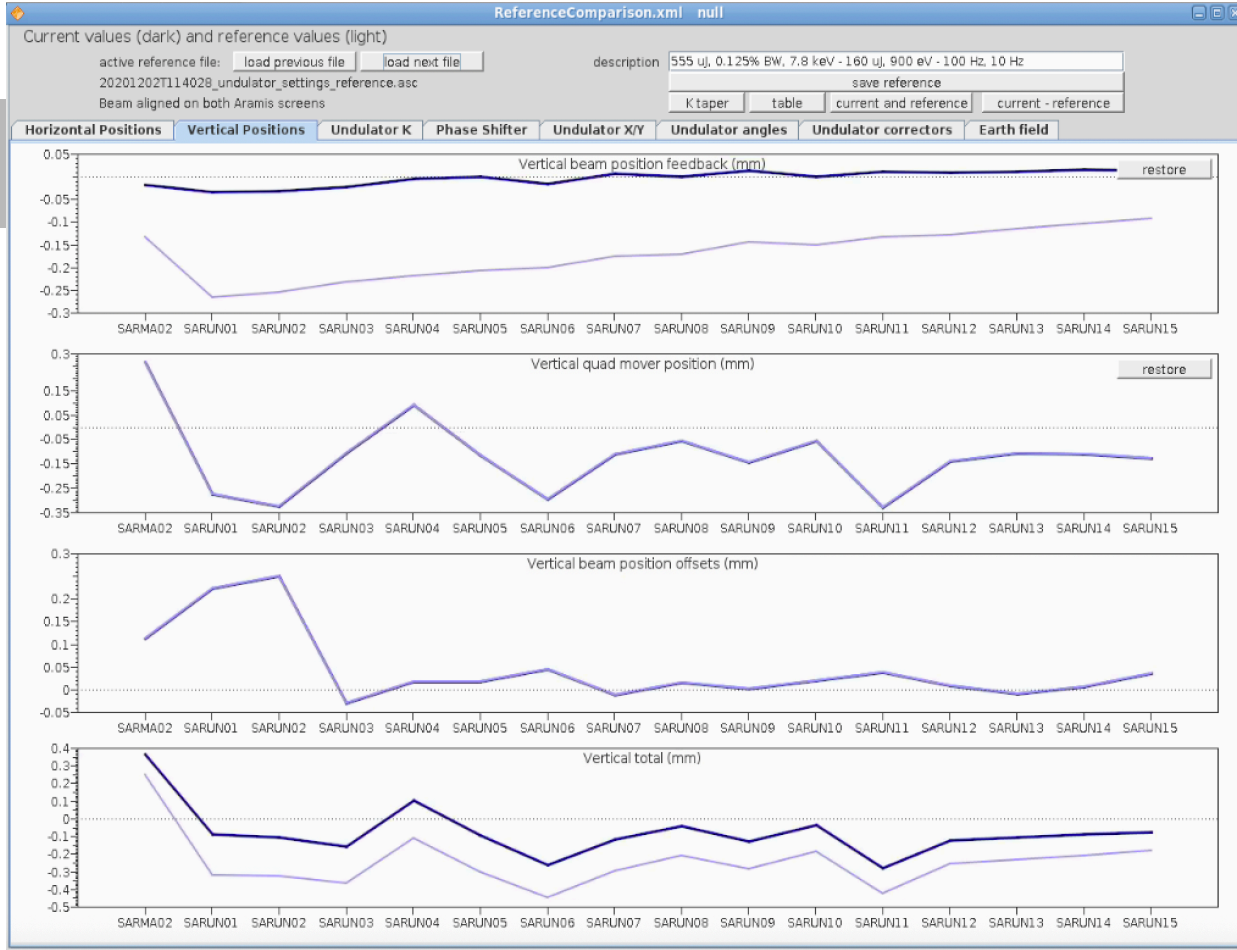
Need position offsets up to 500 μm on BPMs to align FEL beam on both apertures.

Required horizontal corrector currents after BBA



Huge corrector currents
required as a consequence
(up to 4.5 A @ 4.94 GeV)

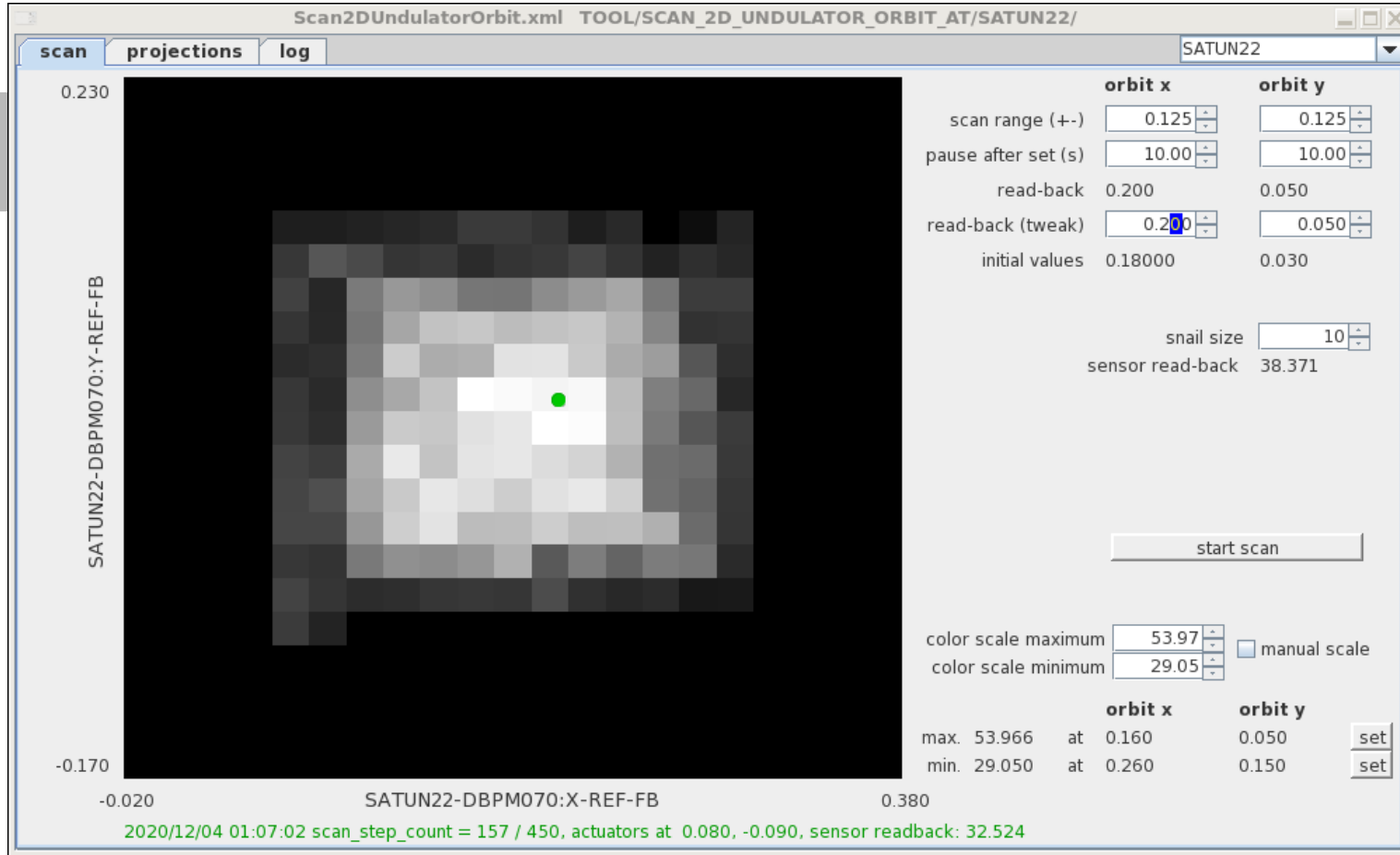
Required vert. pointing correction in Aramis after BBA



Need position offsets of > 250 μm on BPMs to align FEL beam on both apertures.

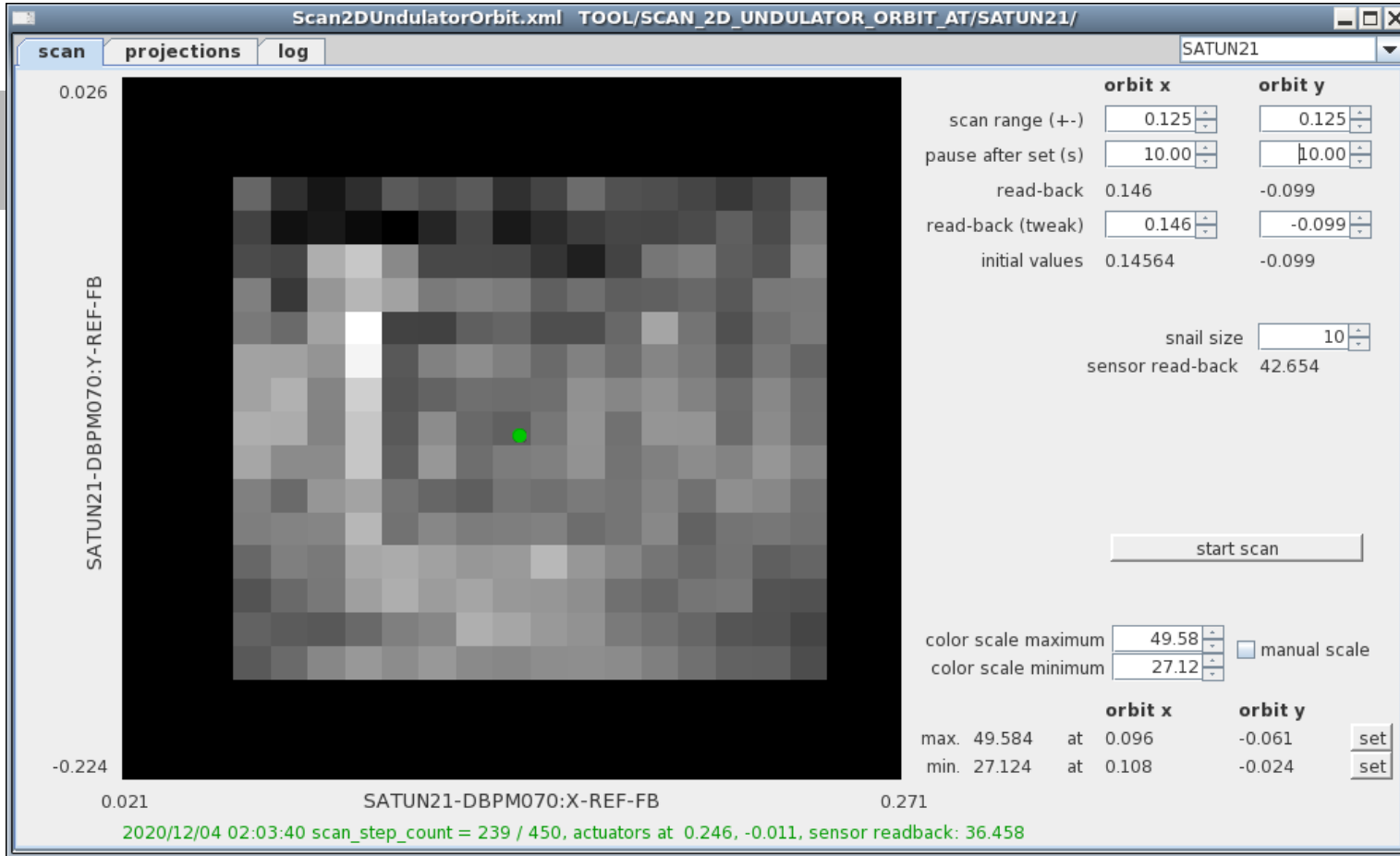
This had a large impact on FEL pulse energy. Decided together with Alvra and Bernina to only align beam horizontally. Alignment in both planes is desired by the beam lines.

Examples for alignment and beam sizes from 4.12.



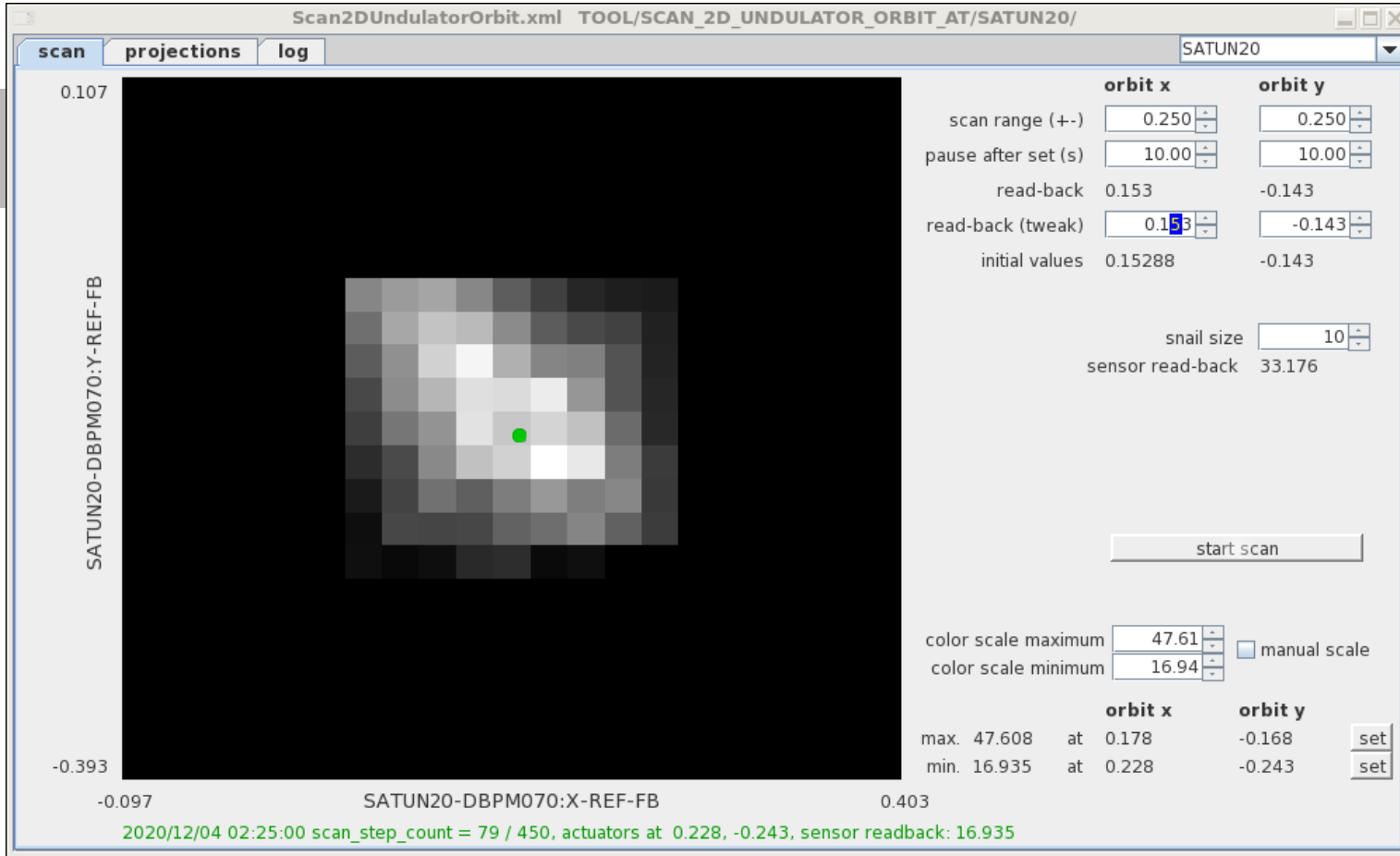
Scans performed
by shift crew:
Faccetti, Haller,
Parsa

Examples for alignment and beam sizes from 4.12.



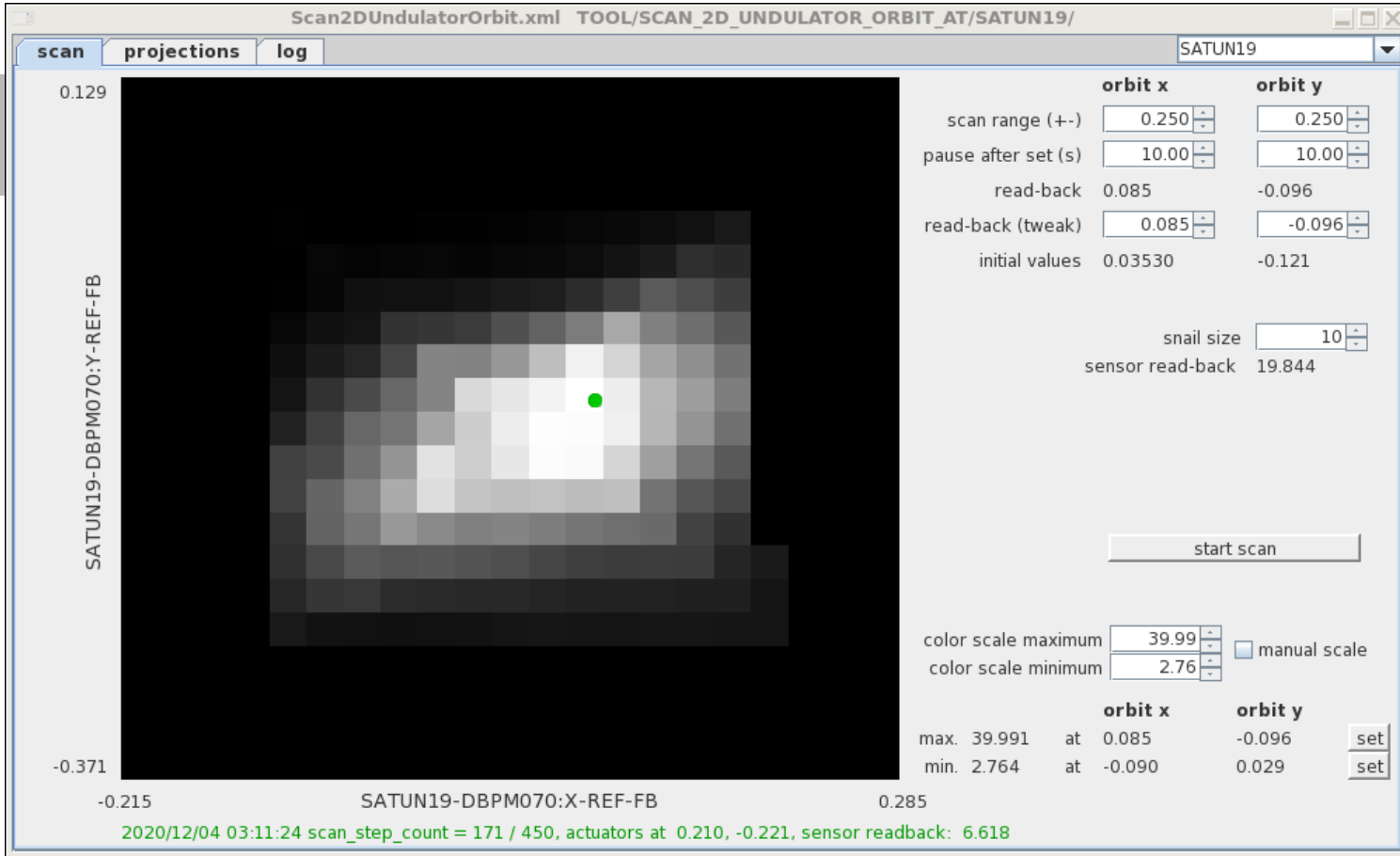
Scans performed by shift crew:
Faccetti, Haller, Parsa

Examples for alignment and beam sizes from 4.12.



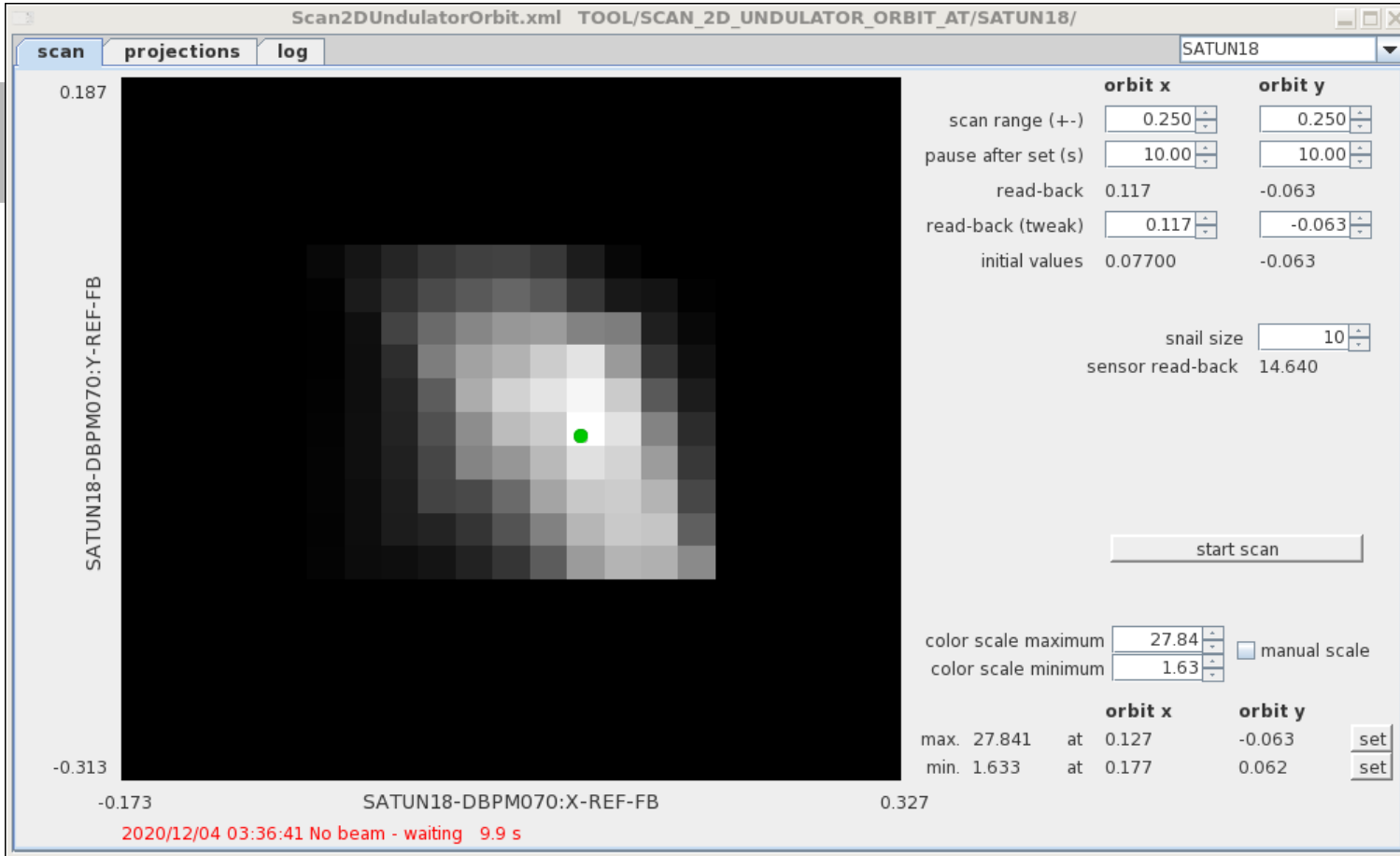
Scans performed
by shift crew:
Faccetti, Haller,
Parsa

Examples for alignment and beam sizes from 4.12.



Scans performed
by shift crew:
Faccetti, Haller,
Parsa

Examples for alignment and beam sizes from 4.12.



Scans performed
by shift crew:
Faccetti, Haller,
Parsa

Examples for alignment and beam sizes from 4.12.

Scan2DUndulatorOrbit.xml TOOL/SCAN_2D_UNDULATOR_ORBIT_AT/SATUN17/ SATUN17

scan projections log

0.233

SATUN17-DBPM070:Y-REF-FB

0.267

SATUN17-DBPM070:X-REF-FB 0.172

orbit x orbit y

scan range (+-) 0.250 0.250

pause after set (s) 10.00 10.00

read-back -0.078 -0.017

read-back (tweak) -0.078 -0.017

initial values -0.07756 -0.017

snail size 10

sensor read-back 0.844

start scan

color scale maximum 31.37 manual scale

color scale minimum 0.45

max. 31.372 at -0.053 0.008 set

min. 0.451 at -0.178 0.108 set

2020/12/04 04:11:59 No beam at measurement location - waiting at least 90.0 s

Scans performed
by shift crew:
Faccetti, Haller,
Parsa

Mover positions in Athos line, overall pointing



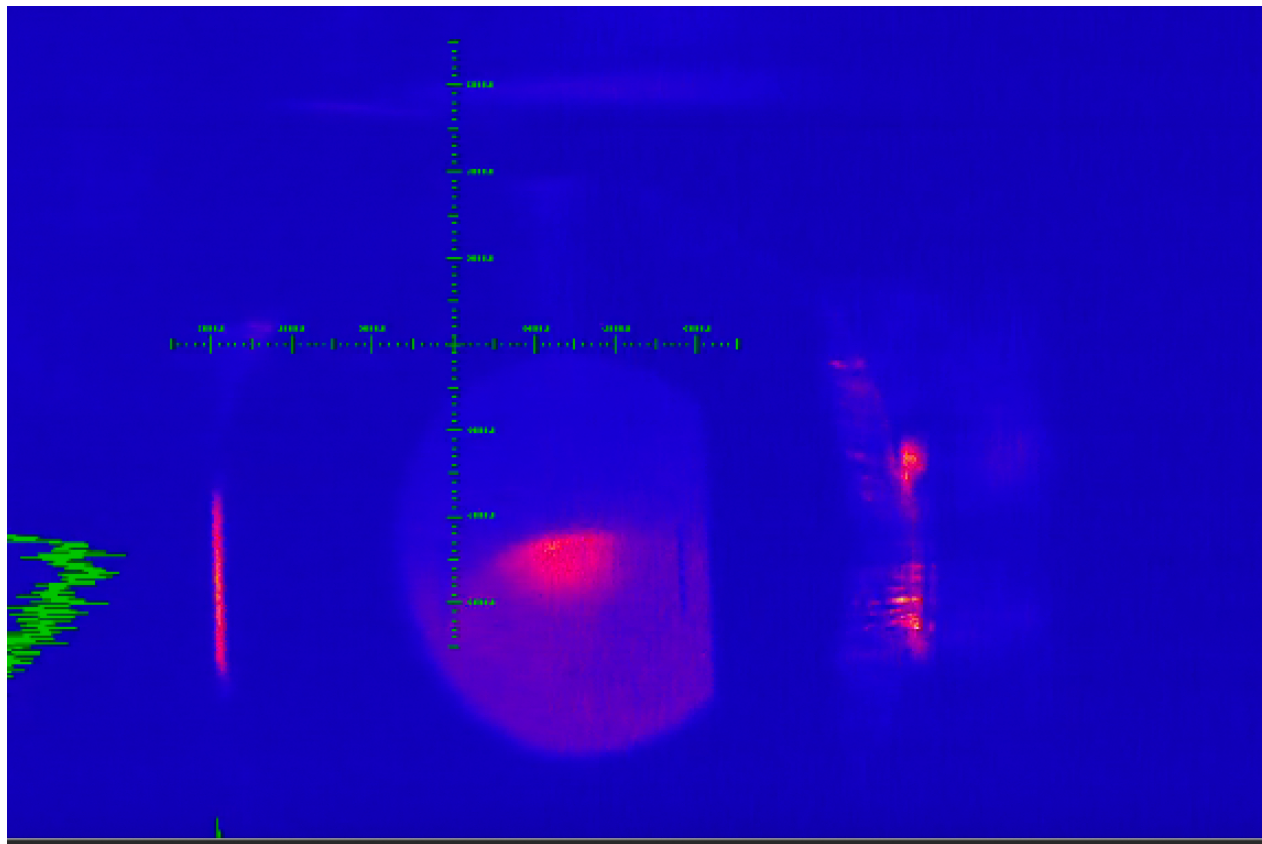
The movers seem vastly off in position. The line appears to be not straight.

Mover positions in Athos line, overall pointing



The movers seem vastly off in position. The line appears to be not straight.

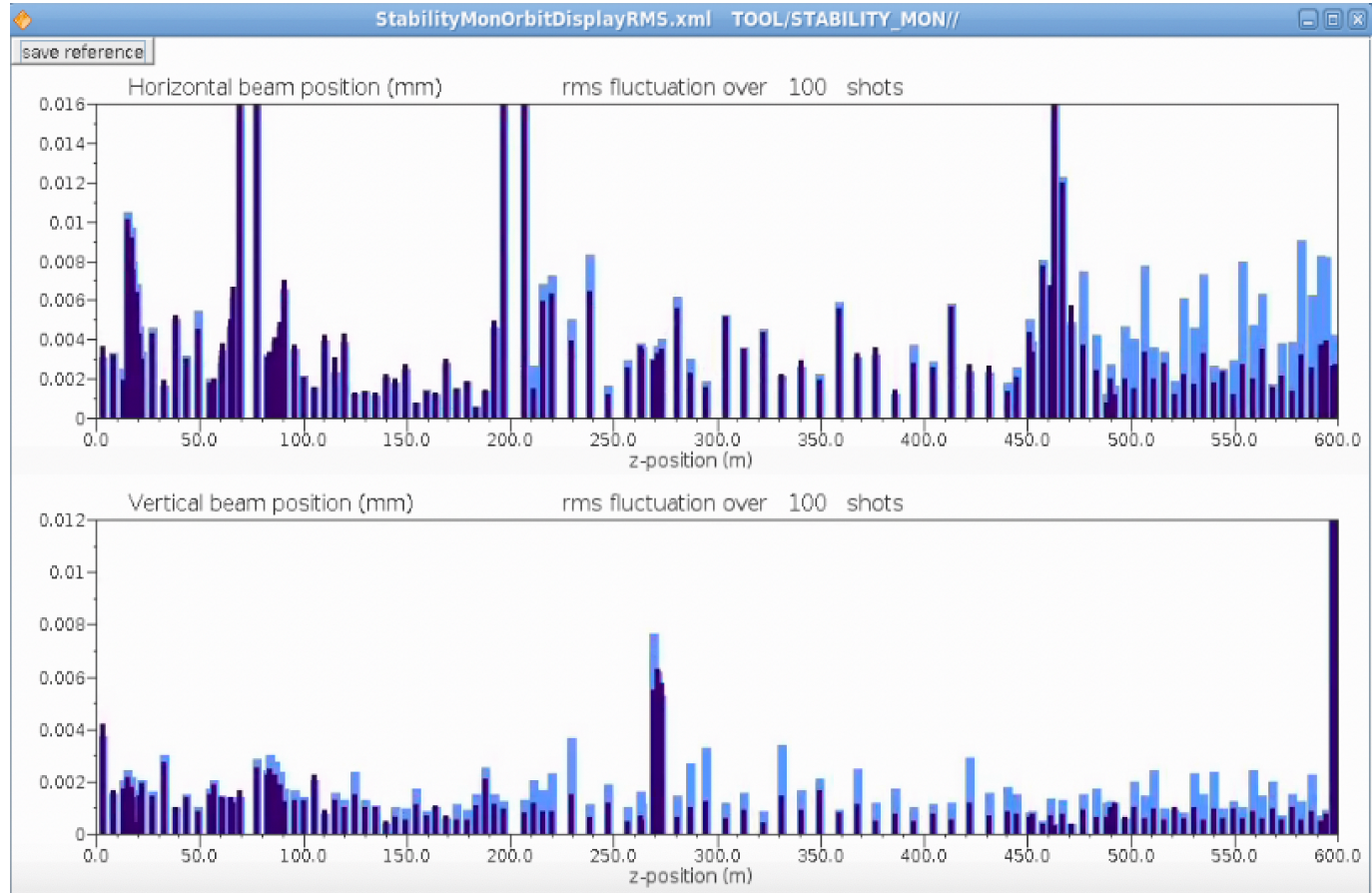
Observed limitation in aperture (E. Ferrari)



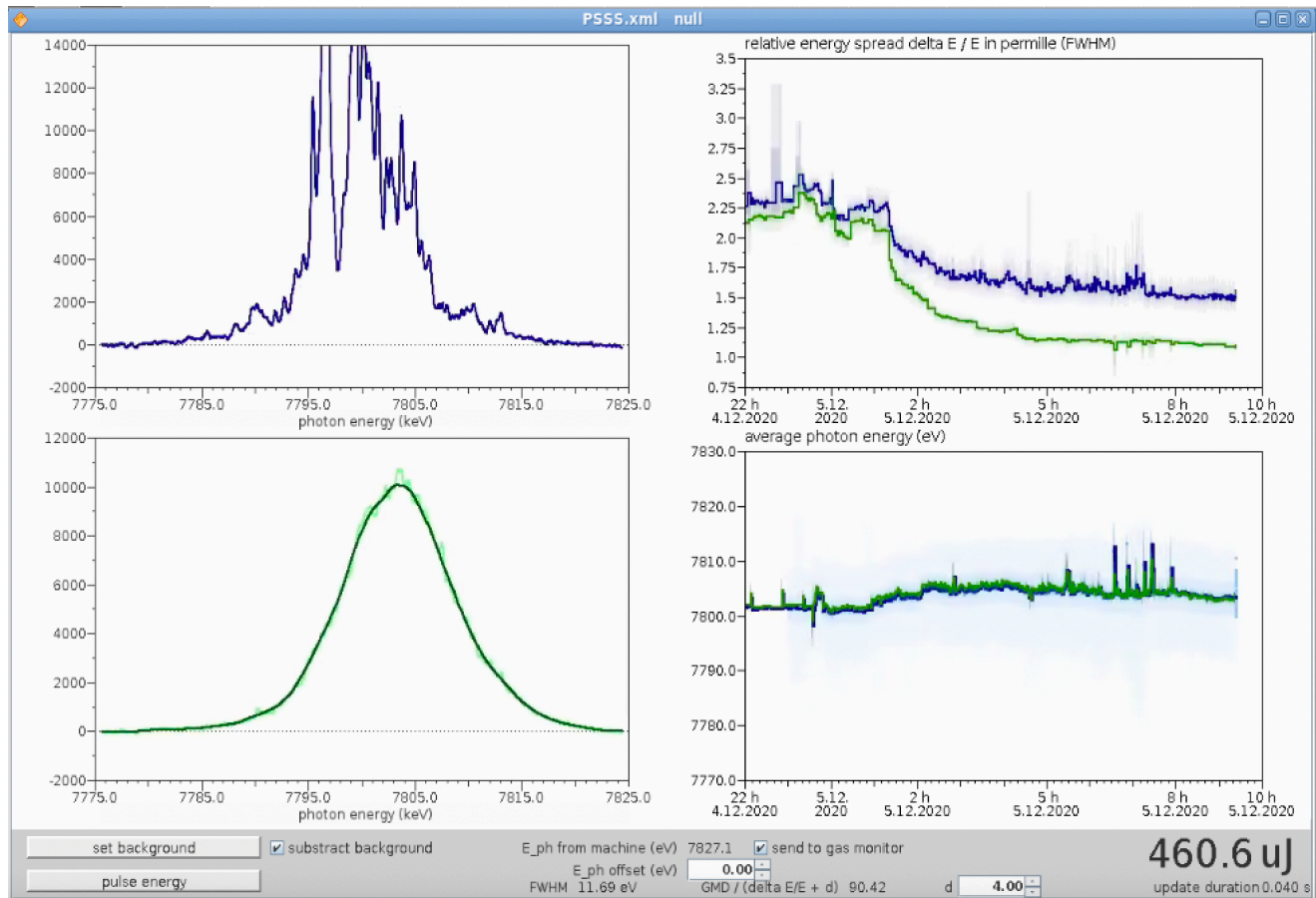
A few things that were setup last week

- 2D orbit scans in Athos ('snail scans')
- Feedbacks are automatically stopped if bunch charge is out of range
- Feedbacks corrections limited due to jumps
- Server to 'push button' for two bunch steps
- Two feedbacks for two bunch steps
 - Laser heater: active
 - BC1: not yet active, LLRF step generation crashes when using it
- Two bunch setup (Simona, Florian): established a new procedure to setup the second bunch
 - Currently, the available step size does not allow full control
 - Established method to deal with limited step sizes
- Orbit overview in Athos
- PSICO Athos: extended parameter configuration
- Orbit feedbacks Athos: extended feedbacks by additional BPMs & correctors
- BPM scaling factor calibrations in Athos (Boris)

Position jitter reduction after one night of PSICO common path optimization



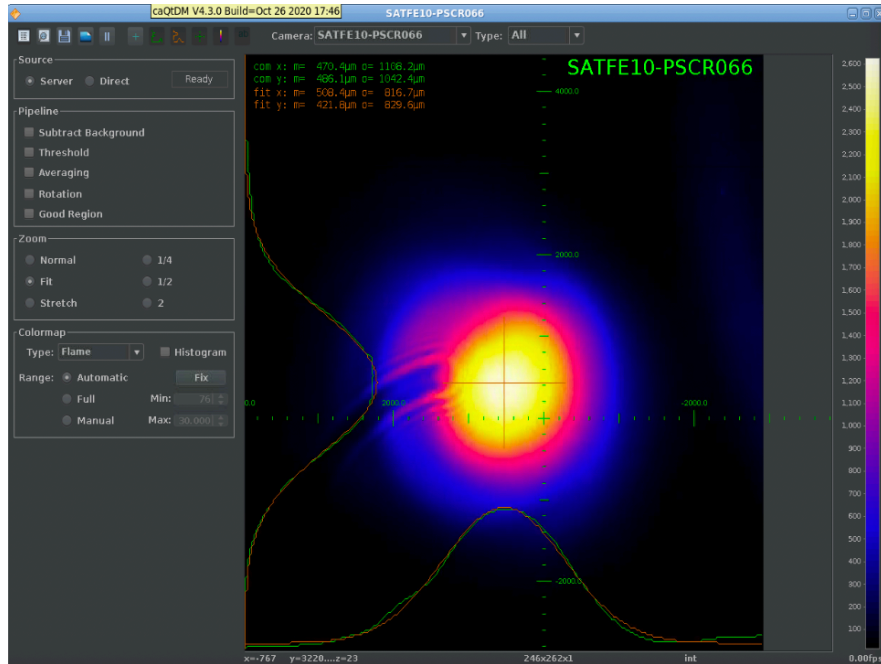
Aramis bandwidth optimization



Selected difficulties

- Frequent jumps and instabilities
 - Charge jumps lead to feedbacks drive the machine crazy
 - High losses in Aramis & Athos beam dumps had the same effect
 - Had to change beam optics to mitigate this
- Gas monitor in Athos failed. Needed tunnel access (electricians, vacuum)
 - Lost lasing in Athos after it. Found after hours of debugging that critical parameters were missing in snapshot files.
 - Lost S30CB05 after restart (IOC failure)
 - Had to bridge S30CB05 in MPS and virtual RF to be able to continue
- Athos line not well aligned
 - Not all undulator contributing
 - Losses
 - Double spots on FEL beam
 - Beam not matched in Athos

- Good beam in Aramis at the end of the week (up to 550 uJ, 27 fs, narrow BW)
- Up to 250 uJ @ 900 eV in Athos for a short time
 - Usable beam up to 170 uJ @ 50 Hz last night



Athos FEL beam on Sunday morning

Run coordination not maintainable like this

I worked > 100 h last week, sometimes day & night

Without the great support of Simona I would not have managed at all

We need to address critical points on the machine side to make the run coordination maintainable. As it is now, I will not be able to continue doing it.

Current RC pool:

- Simona
- Thomas
- Nicole
- Christoph
- Didier
- Florian

Some proposals, needs separate discussions

Machine settings should be changed only if this is really required and gives a proven and measured benefit

- One indicator should be the lasing performance at max. performance and not a change in FEL signal at lower power
- Other critical indicators
 - Losses
 - Stability
 - Compatibility with existing systems
 - Ease of use for Operations

Machine development weeks should focus more on improving FEL performance

- In addition: fewer beam dynamics studies that can have a negative impact on the performance?
- Additional recovery days in MD weeks after BD studies?
- Fridays used for recovery and weekends for optimization?

Proposal of Simona for Athos setup today

- Dispersion check and optimization in the switchyard (possible that we changed it when optimizing for Aramis)
- Check the effect of sending back undulator area positions. To be evaluated the risk
- Match in front of SATUN
 - No touches upstream the switchyard and not tweaking of the RF steps for the moment. We leave this for the second step of the optimization
 - Stop the Athos optimization on Monday at 19 at the latest, because I would like to monitor the two PSICO together for some time, and go to bed at a decent time tomorrow. In alternative we stop to optimize at 18, I check for a couple of hours, and if you want, continue to optimize, and after activate both PSICO