PAUL SCHERRER INSTITUT

PSI

Florian Löhl :: Paul Scherrer Institut

Run coordinator report
July 6 – 12, 2020

SwissFEL Exchange Meeting, 13.7.2020

KW 28	Mo. 6.	Di. 7.	Mi. 8.	Do. 9.	Fr. 10.	Sa. 11.	So. 12.
Ganztägig							
00:00	Bernina commissioning	Set-up (Operation)	Bernina experiment (7.5 keV)	Bernina experiment (7.5 keV)	Bernina experiment (7.5 keV)	Bernina experiment (7.5 keV)	Bernina experiment (7.5 keV)
01:00							
02:00							
03:00							
04:00							
05:00							
06:00							
07:00	07:00 Set-up (Operation)	07:00 Bernina experiment (7.55 keV, 50 fs FWHM, 100 Hz)	07:00 Bernina experiment (7.5 keV)	07:00 Bernina experiment (7.5 keV)	07:00 Bernina experiment (7.5 keV)	07:00 Bernina experiment (7.5 keV)	07:00 Bernina experiment (7.5 keV)
08:00							
09:00							
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12:00							
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14:00							
15:00	15:00 Set-up (Operation)	15:00 Bernina experiment (7.5 keV)	15:00 Bernina experiment (7.5 keV)	15:00 Bernina experiment (7.5 keV)	15:00 Bernina experiment (7.5 keV)	15:00 Bernina experiment (7.5 keV)	15:00 Bernina experiment (7.5 keV)
16:00							
17:00							
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23:00	Set-up (Operati...	Bernina experi...	Bernina experi...	Bernina experi...	Bernina experi...	Bernina experi...	Bernina experi...
00:00							

A week of records

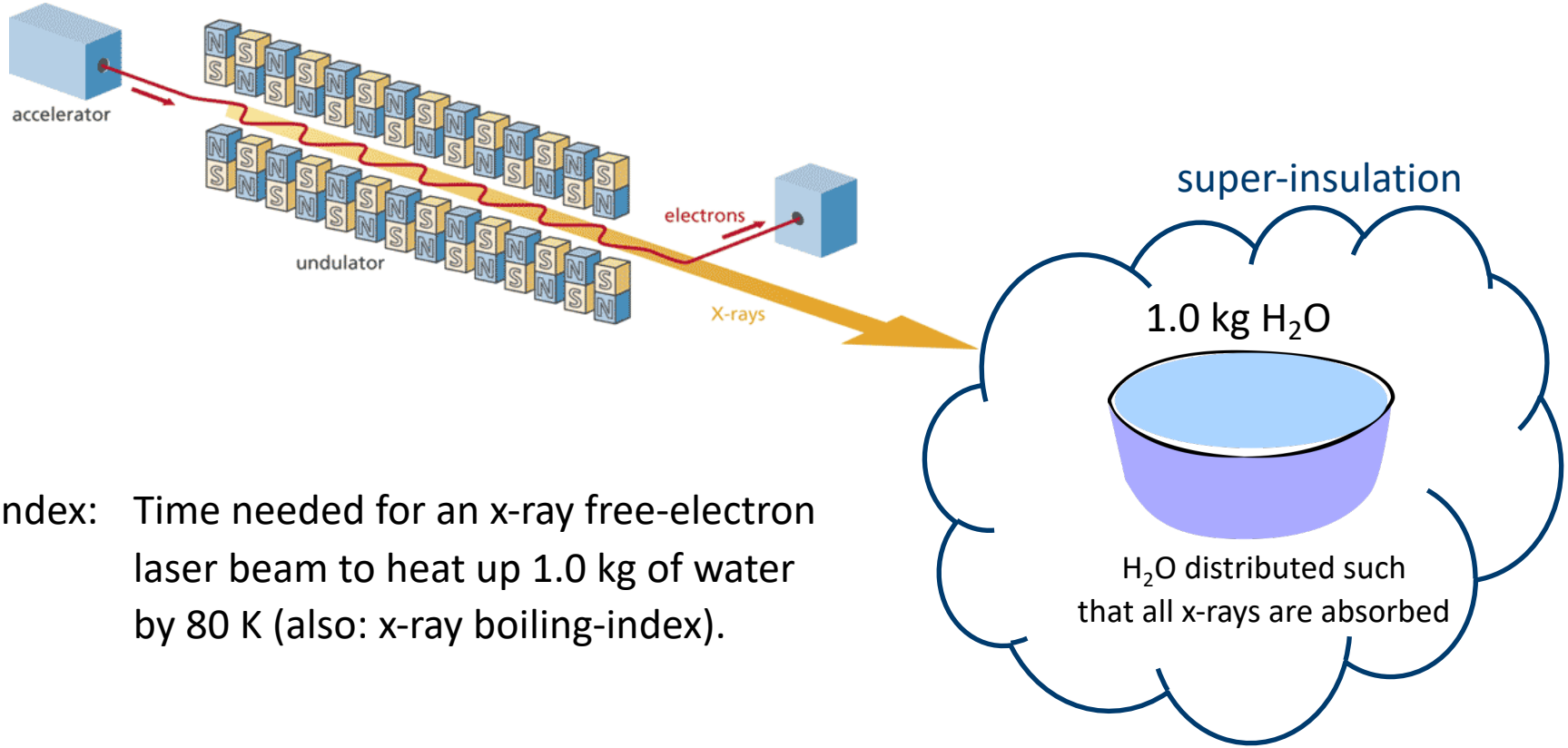
Aramis

- First user experiment at 100 Hz
- Narrowest spectrum ever generated in SwissFEL
  - FWHM BW < 0.10 %
- Highest average photon flux ever generated in SwissFEL (up to 560 µJ @ 100 Hz)
  - L-index = 69 d

Athos

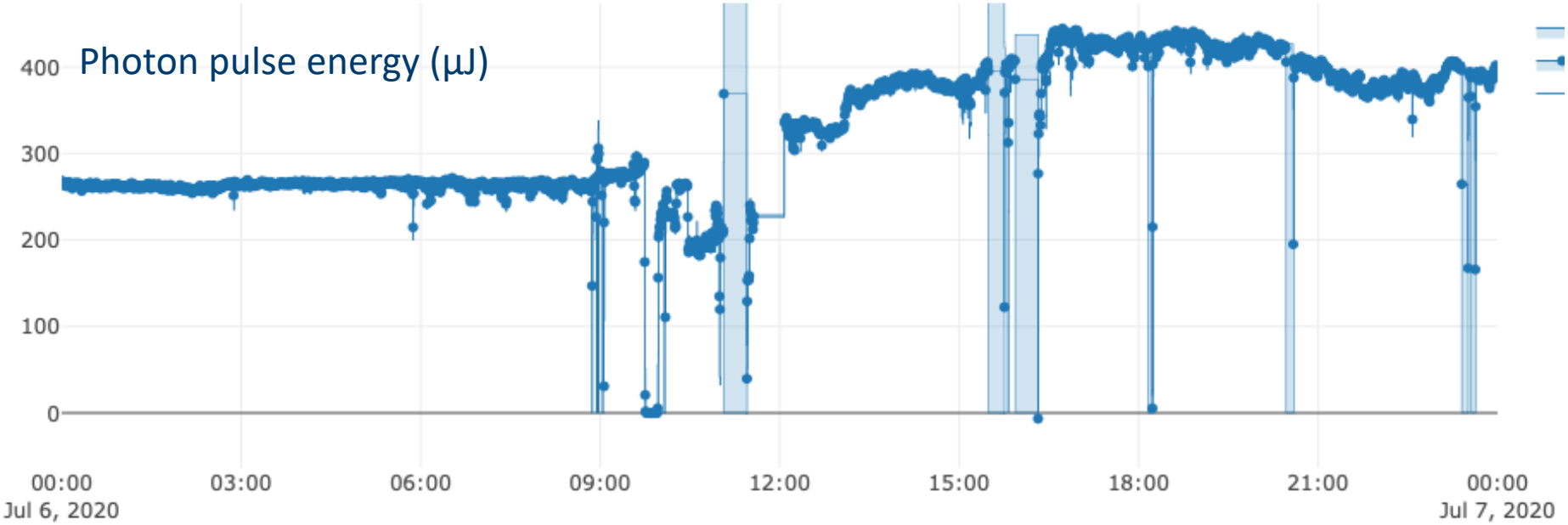
- First FEL beam at 10 Hz, no difficulties with losses (during one day)
  - Losses again after laser event on Thursday
- Pulse energy at 539 eV of 110 µJ, 10 Hz
  - There is now a new Athos PSICO – expect more to come
  - L-index = 9.6 a

L-index definition



L-index: Time needed for an x-ray free-electron laser beam to heat up 1.0 kg of water by 80 K (also: x-ray boiling-index).

Monday: **the** setup – S. Bettoni



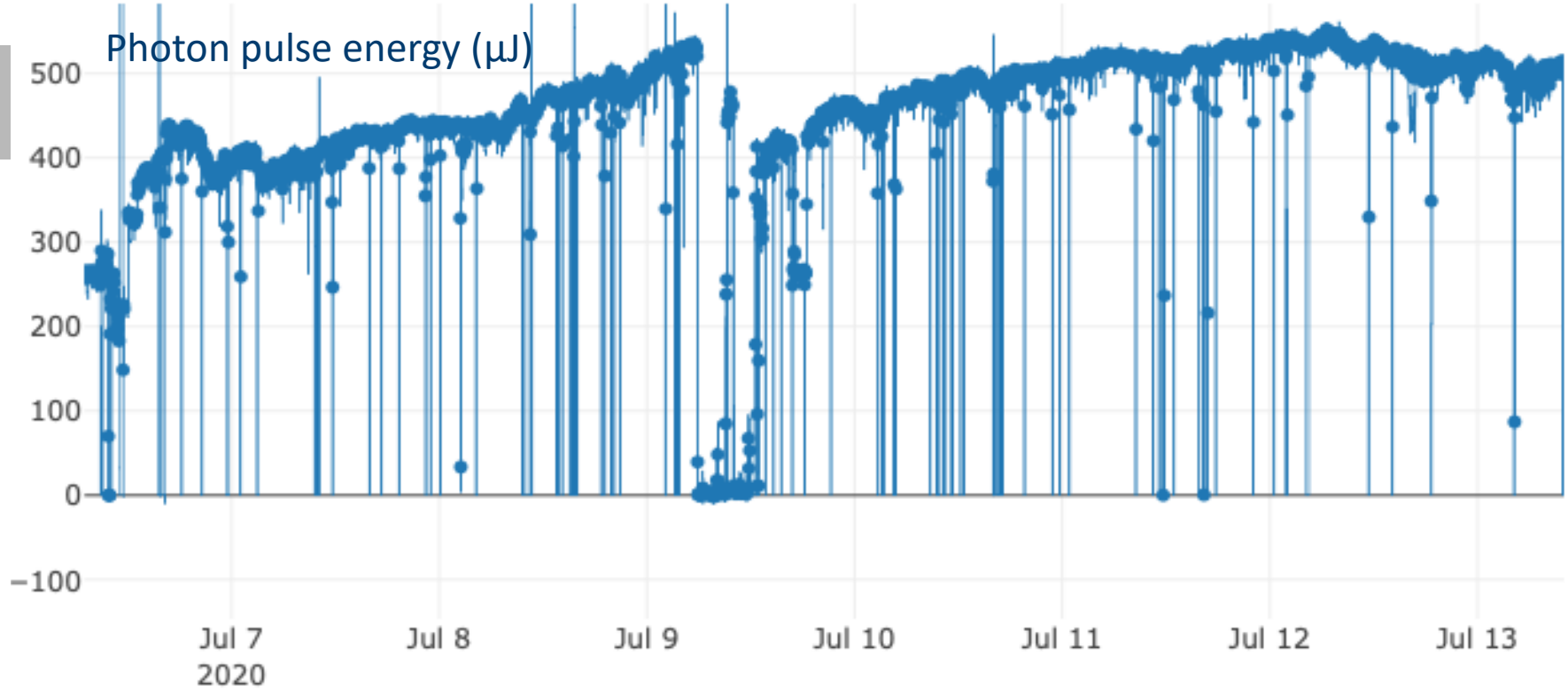
Simona setup the beam Monday morning and early afternoon (E_{ph} = 7.52 keV)

→ pulse energy increase from 270 µJ to > 400 µJ

→ reduction of spectral width from 0.0185 % to 0.011 %

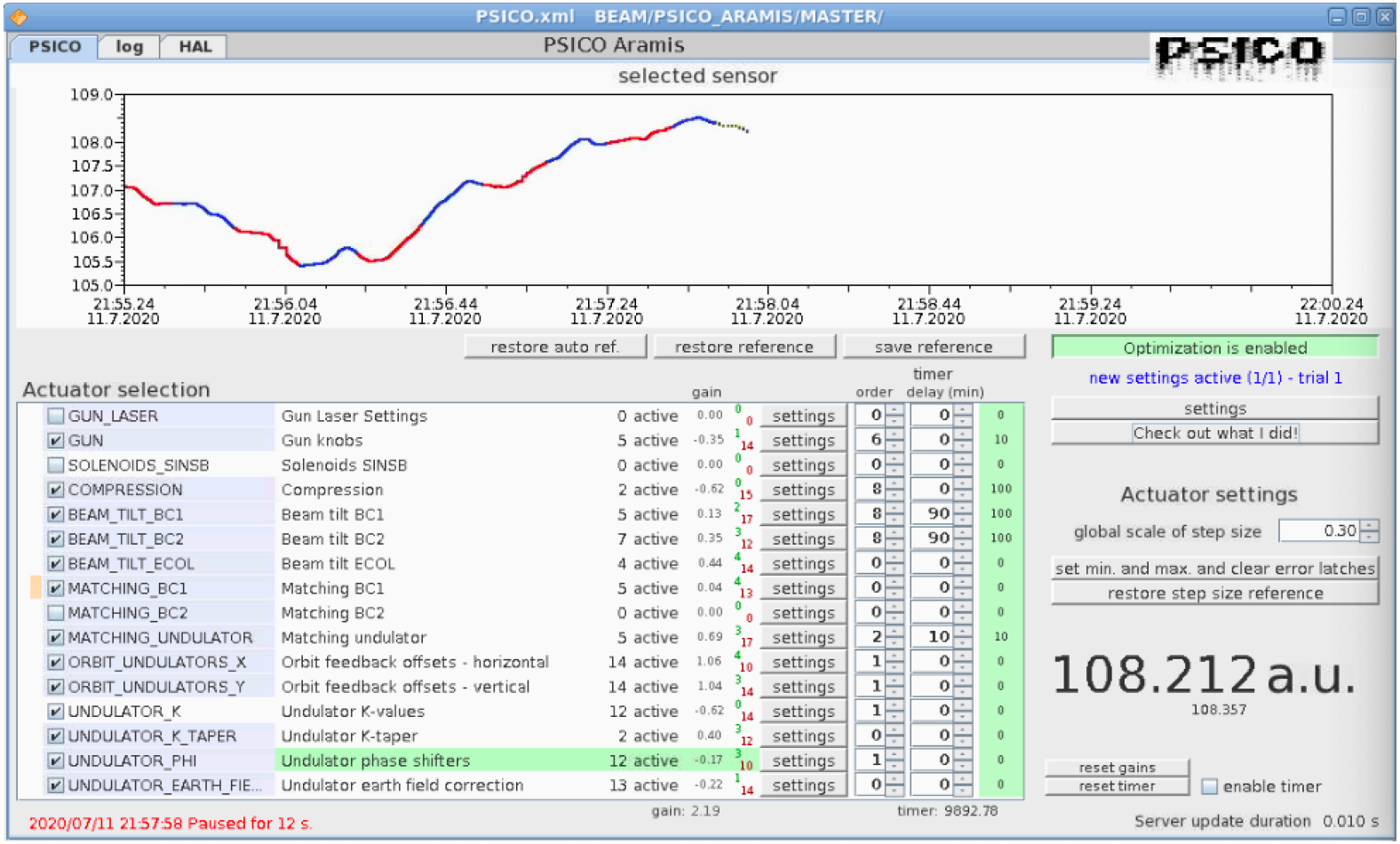
→ reduction of e-beam pulse duration (42 fs rms to 27 fs rms)

Pulse energy over the week

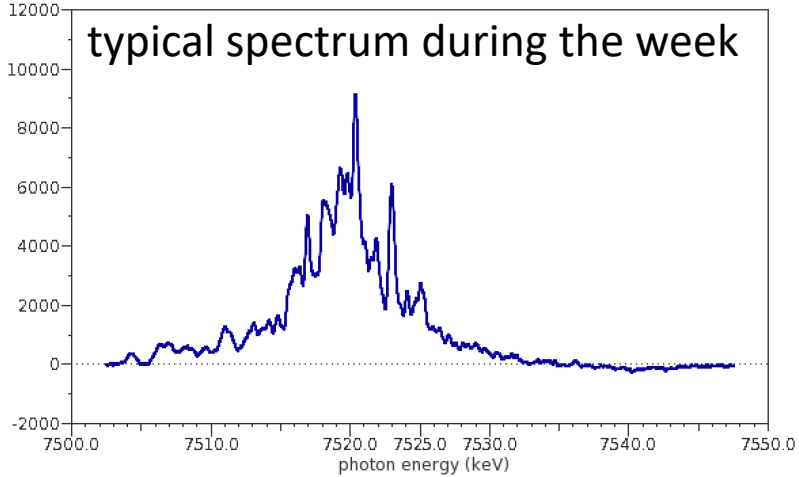


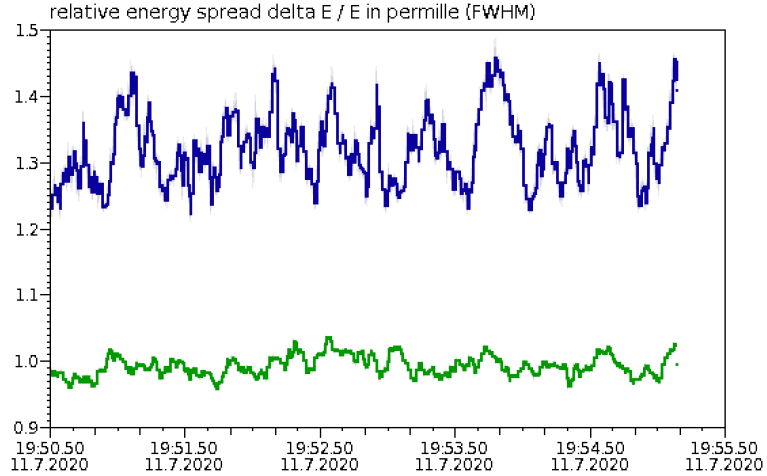
PSICO running all week, mostly optimizing on pulse energy / spectral width

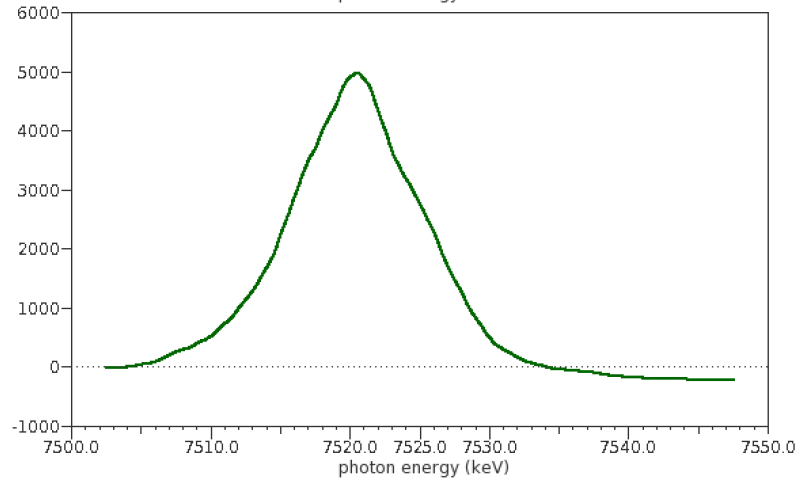
PSICO was active with most parameters

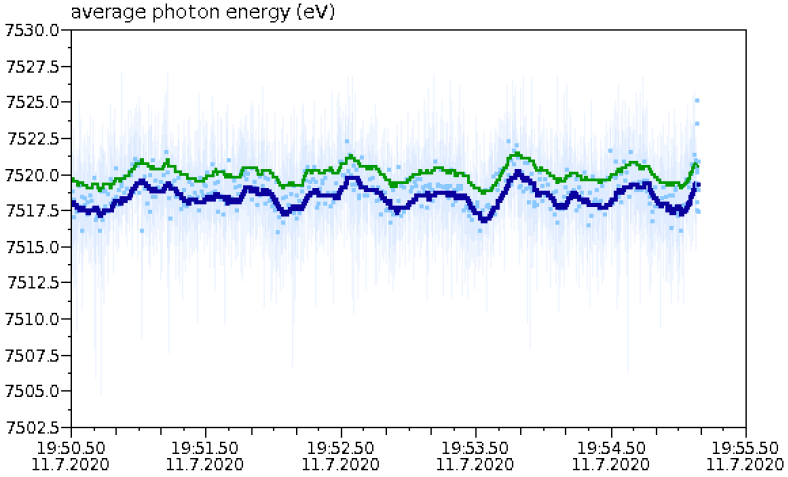


PSSS.xml









set background | substract background | E_ph from machine (eV) 7631.0 | send to gas monitor

pulse energy | FWHM 10.62 eV | GMD / (delta E/E + d) 106.06 | d 4.00

530.9 uJ

update duration 0.033

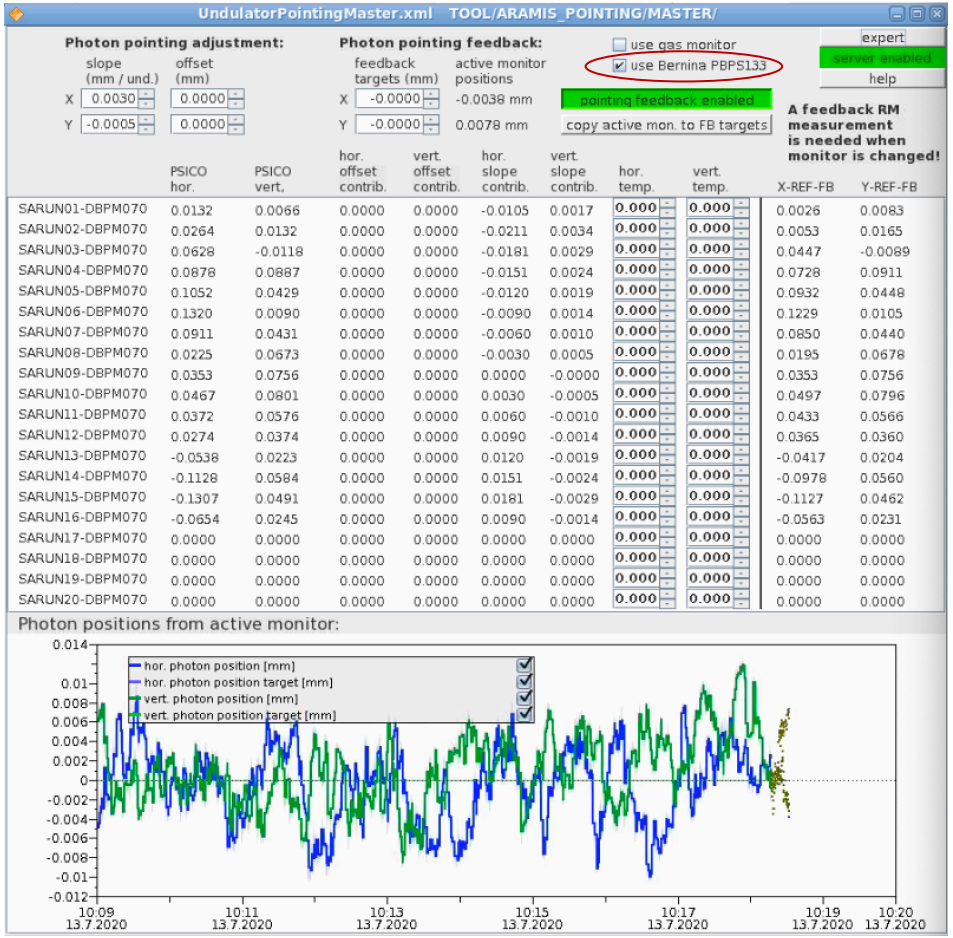
Machine stability

- Optimized beam-based feedback loops for current machine state
  - Helped a lot in improving the overall stability
  - Some feedback now running with much faster rates

- Added option to feedback on position detector PBPS133 close to Bernina experiment
  - Used from Tuesday on to stabilize FEL pointing

- Added new feedback for the photon energy
  - Thanks a lot to Didier for making new PVs available on such a short time-scale
  - Users adjusted the wavelength themselves to what they needed

New sensor option in FEL pointing feedback



Feedback now on a signal much closer to the experiment.

Note:
Sign of response is inverted with respect to gas monitor signal. To be checked if this is due to the mirrors or if they are different.

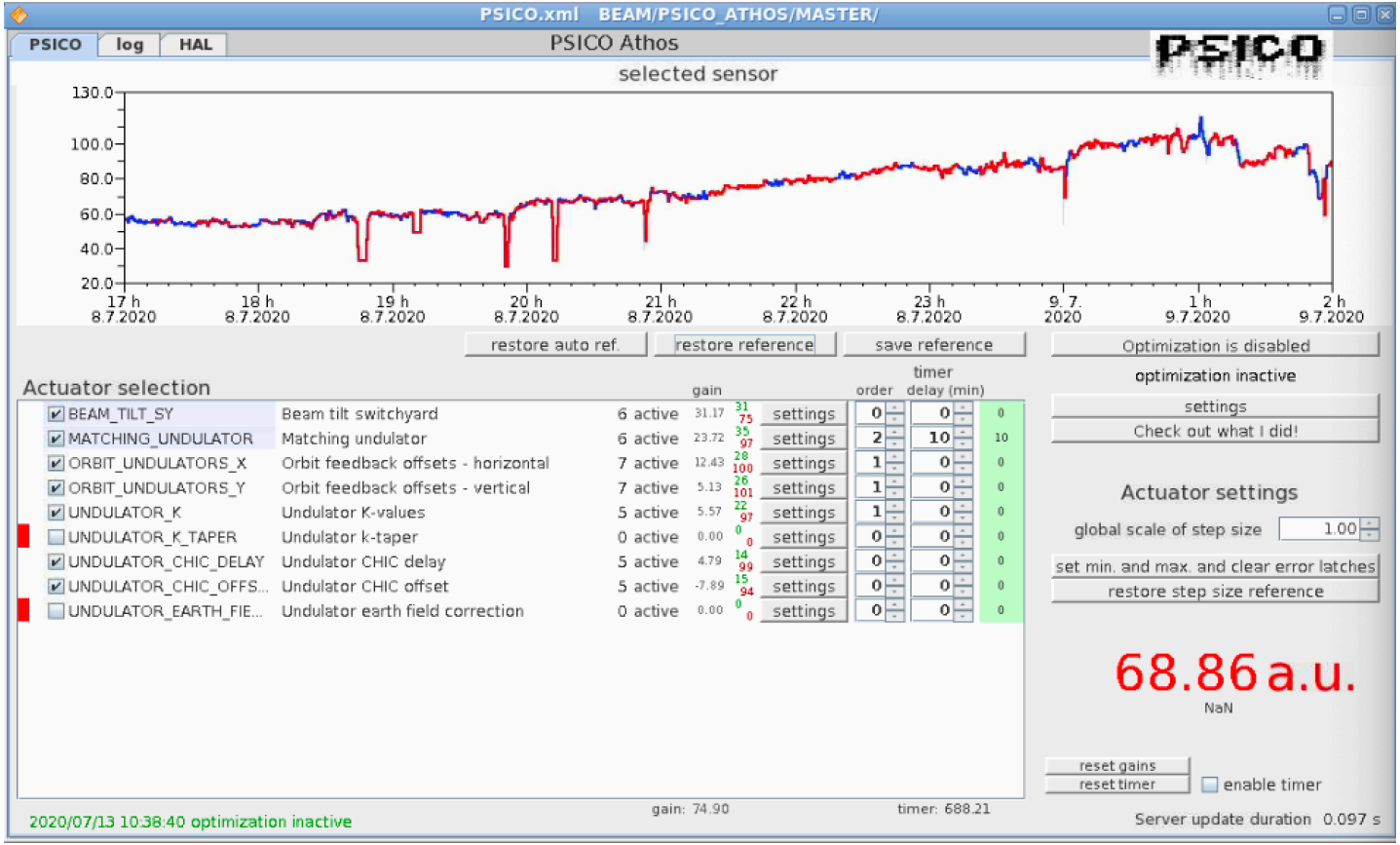
Athos setup

- Activated many BPMs again that had been disabled in the Athos orbit feedbacks
- Performed orbit correction in the entire Athos line
  - The orbit was terrible before this (it is still not perfect)
- Running feedbacks allow for a more reproducible state and for automatic tuning

→ After these changes running Athos at 10 Hz beam rate was possible
→ Losses were at around 10% of our allowed daily dose in the undulators, so in principle also 100 Hz would have been possible (limited by laser)

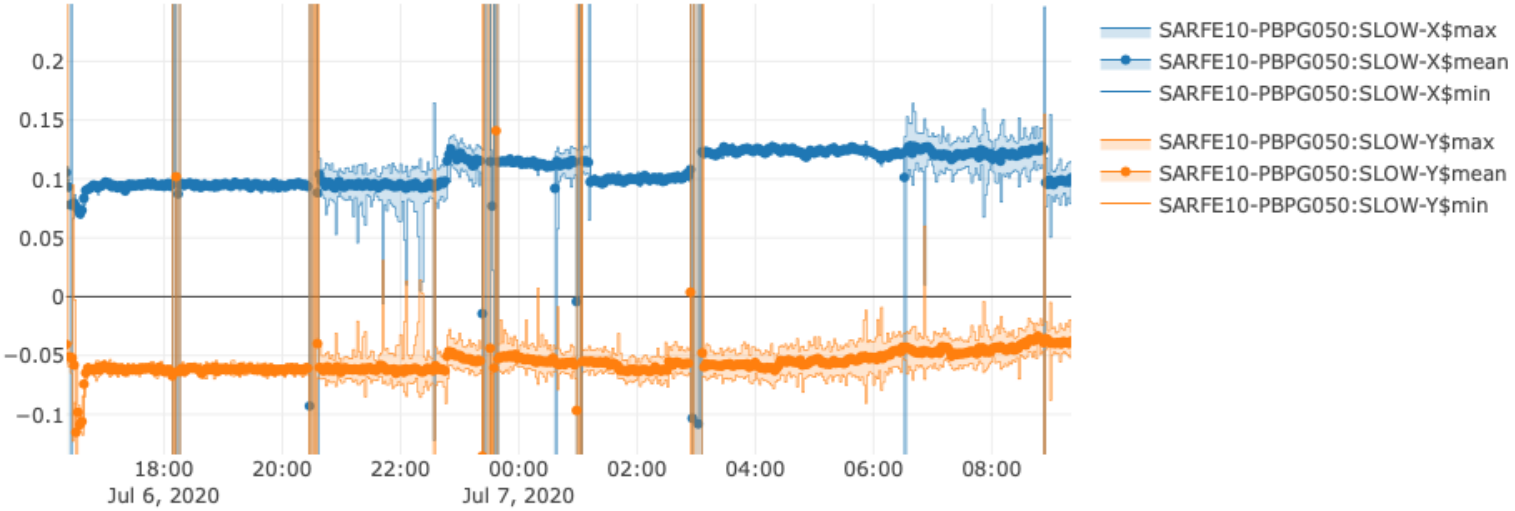
- Losses were again high after laser event on Thursday

New Athos PSICO – still in the setup



Brought up pulse energy from 58 µJ to 110 µJ on Wednesday / Thursday

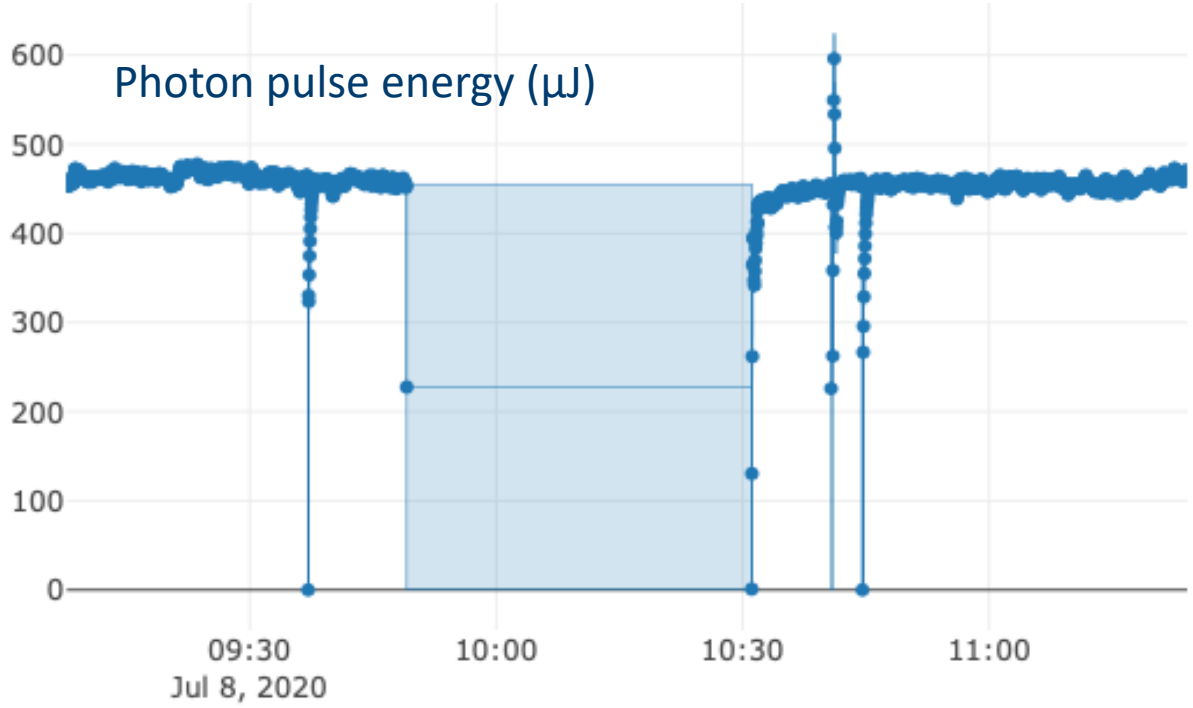
Difficulties 1 – Instabilities in gas monitor position reading



- Sudden strong noise on gas monitor position signals
- Brief investigation on Tuesday indicates that this is dues to stray-radiation from the slits

→ Reason to implement PBPS133 position sensor instead into the feedback

Difficulties 2 – Reboot of DRPS MPS soft-IOC



A soft-IOC was rebooted which writes to the timing system IOC.

→ Timing system dropped a pulse

→ All RF stations went to standby

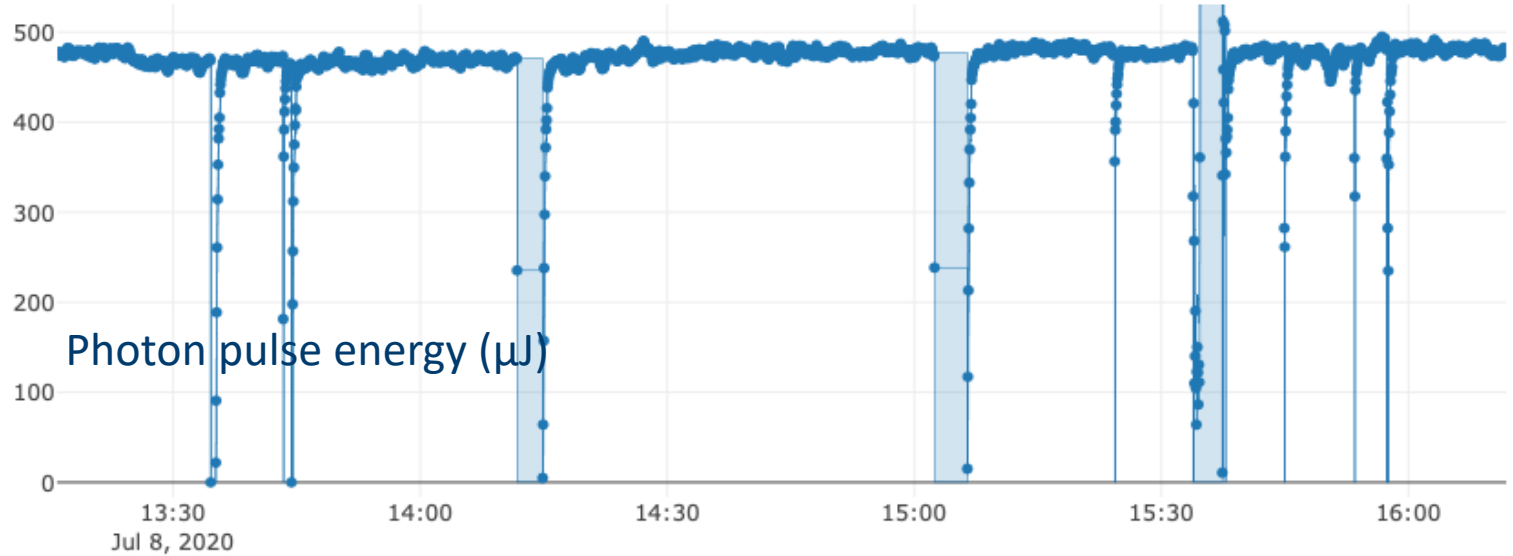
→ Restart of the stations took a while

Difficulties 3 – SINDI01 deflector set on beam

The deflector SINDI01 was set on beam multiple times on Wednesday afternoon

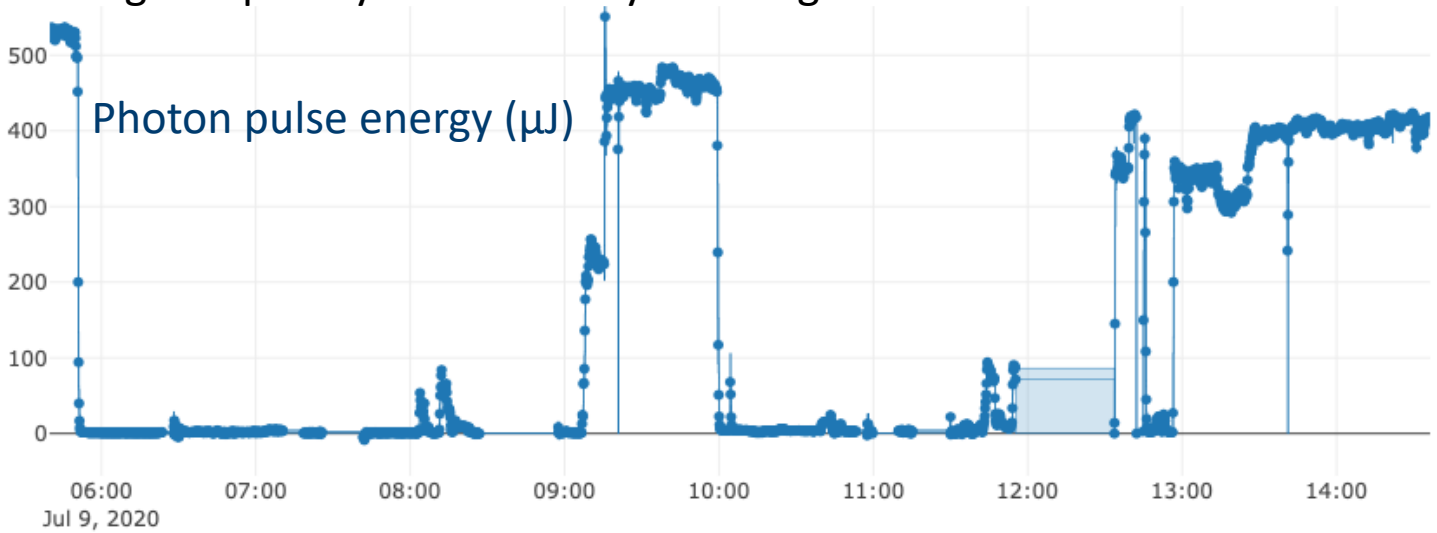
- Drop in pulse energy
- Beam losses in Aramis & Athos

This turned out to be an unintended action during software tests.



Difficulties 4 – Jump in gun laser

Lasing completely lost Thursday morning



- Recovered by itself around 9:05. Happened again around 10:00.
- At around 12:30, Simona found that lasing can be mostly recovered by adjusting the solenoid.
  - → Alexandre changed centering of laser beam in capillary. Very sensitive.
  - → Could not recover lasing with previous settings, but after this the laser remained stable
  - → It would be nice to have a permanent optimization (I successfully tested a PSICO long time ago, would be nice if we were allowed to use it)

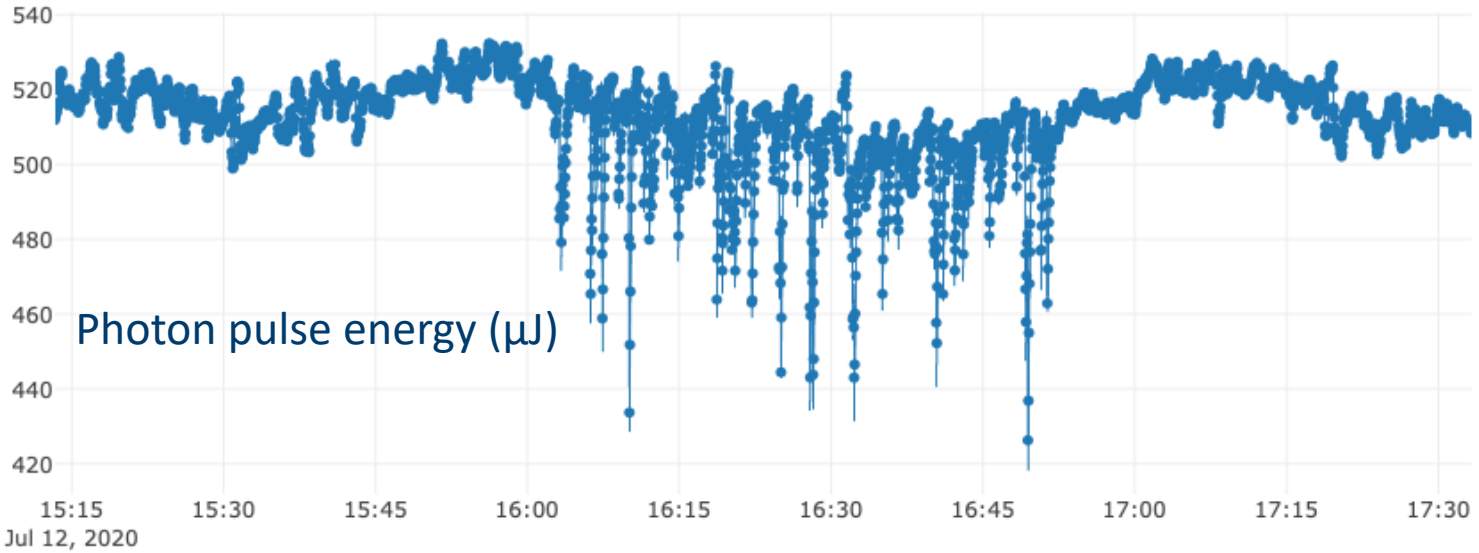
Difficulties 5 – losses in Athos
BLMs not setup properly

- After the gun laser event, we could not recover the beam in Athos with low losses
- During the investigration, I realized that most BLMs in Athos do not measure the beam losses properly. The DRPS detectors were much more sensitive than the BLMs.
- Started Friday afternoon to setup BLMs together with Gian-Luca. Has to be continued this week.

Goals

- Sensitive and well functioning BLMs for loss tuning in Athos
- Add option in PSICO Athos to minimize losses in Athos line (similar to what exists in Aramis)

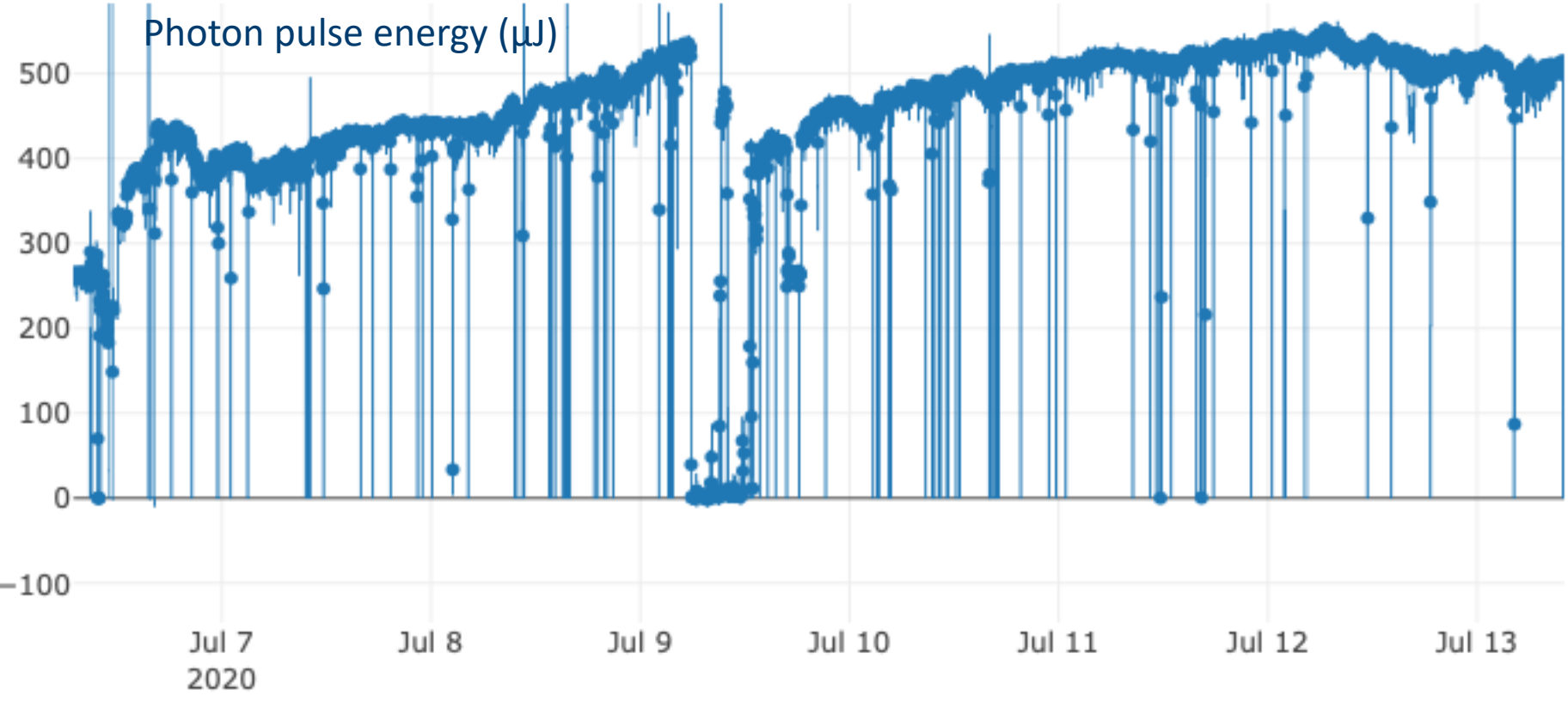
Difficulties 6 – Jump undulator orbit feedback



- Observed drops in pulse energy
- These were correlated with large orbit jumps in the undulator line
- The feedback applied some very large corrections which caused the jump – the position offsets were then regulated away by the feedback
  - → Network problems? Maybe this caused a large latency at some times?
  - → Temporarily fixed by not allowing the feedback to do large corrections.

Overall a great week!

Questions?



Outlook

Many thanks to Simona for her help last week!

Simona’s goal for this week:
alzare l’asticella