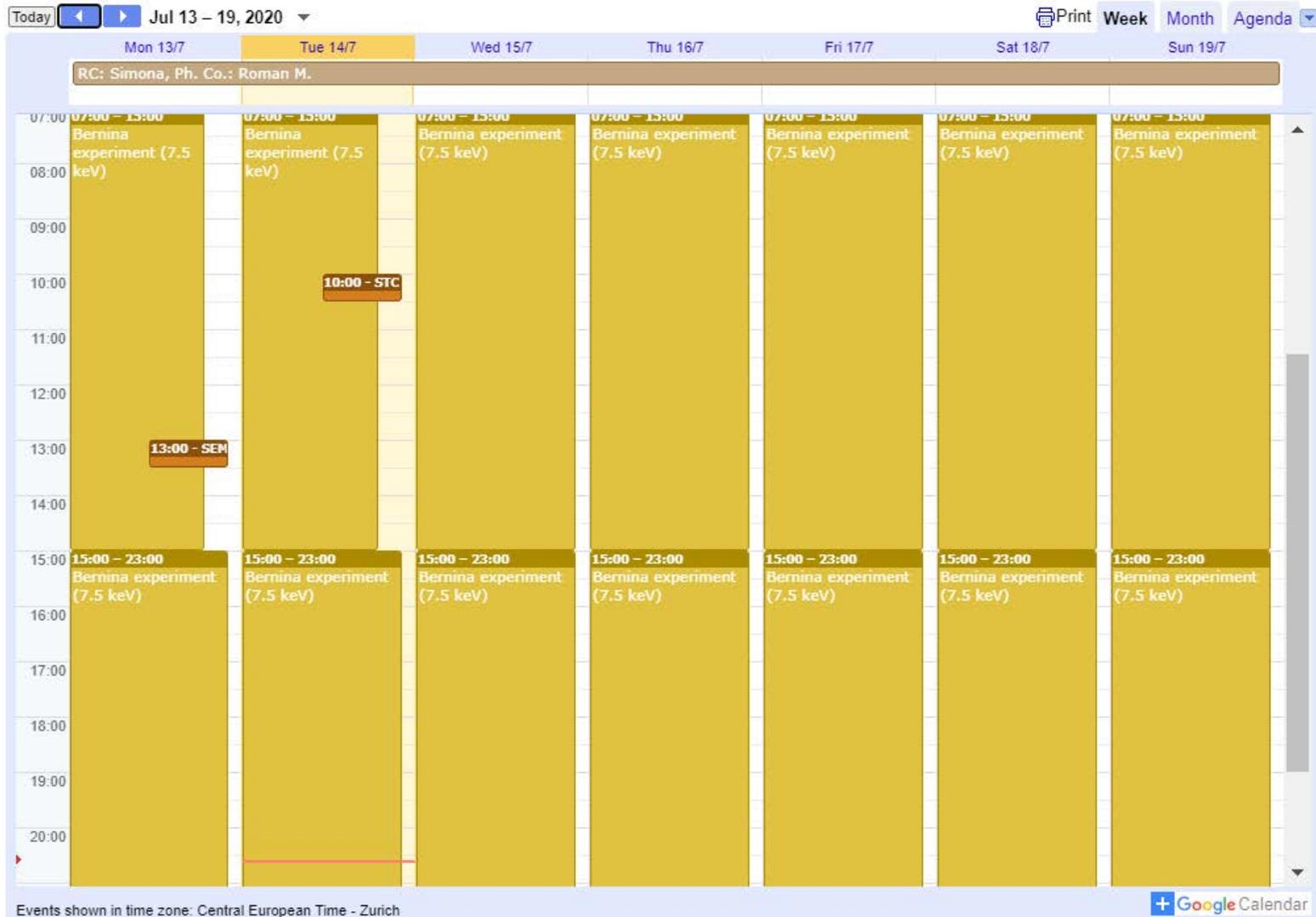


SwissFEL week 29

- **Schedule**
- **Issues**
- **Achievements**
- **Conclusions**
- **Message from Bernina**

S. Bettoni
July 13-19 2020

Schedule



No setup time scheduled:

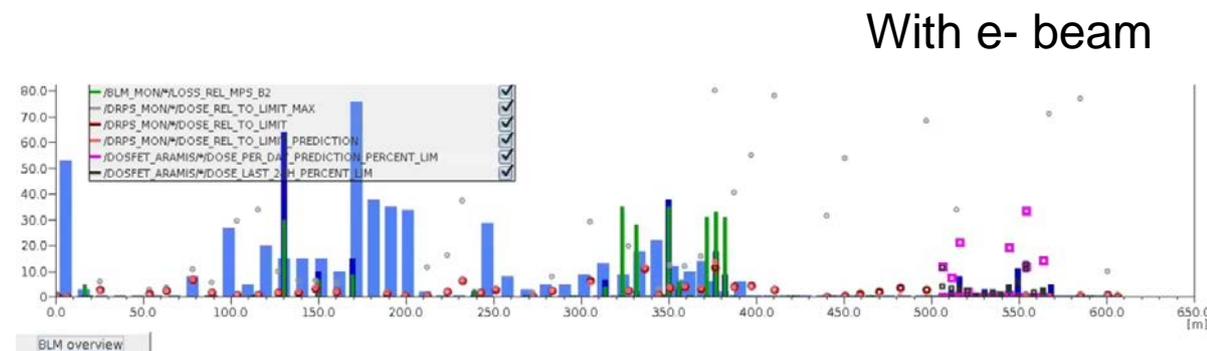
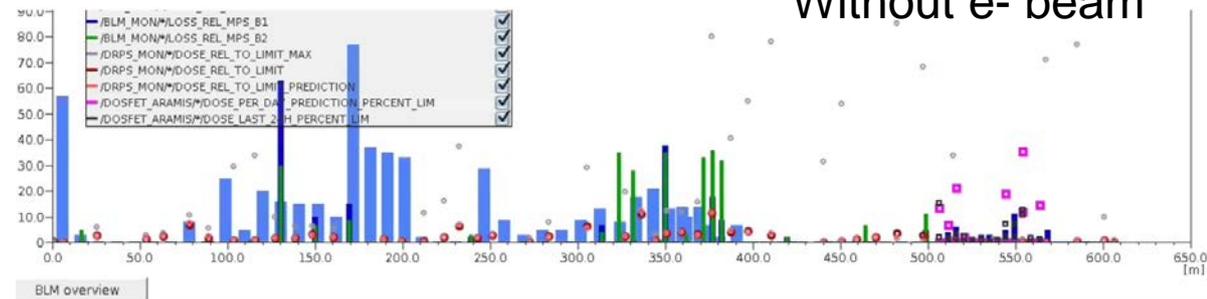
- ◆ Setup done on Monday of the previous week
- ◆ Obtained about 30 minutes to do basic checks (bunch length BC1, laser arrival time, beam at SARCL01) to be able to come back in case of major failure

Athos BLM setup

F. Loehl, G. L. Orlandi, S. Bettoni

- BLM working (all except SATUN14)
- Losses manually minimized
- BLM threshold regulated
- PSICO version to optimize losses under test

Undulators Athos	Dose (Gy)	BLM Status	OP
SATUN05-DDRM405-R	0.000 Gy	Green	OP
SATUN06-DDRM005-R	0.000 Gy	Green	OP
SATUN07-DDRM005-R	0.000 Gy	Green	OP
SATUN08-DDRM005-R	0.000 Gy	Green	OP
SATUN09-DDRM005-R	0.000 Gy	Green	OP
SATUN10-DDRM005-R	0.000 Gy	Green	OP
SATUN11-DDRM005-R	0.000 Gy	Green	OP
SATUN12-DDRM005-R	0.000 Gy	Green	OP
SATUN13-DDRM005-R	0.000 Gy	Green	OP
SATUN14-DDRM405-R	0.000 Gy	Grey	OP
SATUN15-DDRM005-R	5.388 Gy	Green	OP
SATUN16-DDRM005-R	5.568 Gy	Green	OP
SATUN17-DDRM005-R	0.209 Gy	Green	OP
SATUN18-DDRM005-R	2.693 Gy	Green	OP
SATUN19-DDRM005-R	0.334 Gy	Green	OP
SATUN20-DDRM005-R	0.330 Gy	Green	OP
SATUN21-DDRM005-R	0.134 Gy	Green	OP
SATUN22-DDRM005-R	1.257 Gy	Green	OP



...together but

- Losses manually reduced in Athos, 114 uJ lasing obtained at 0.539 keV, 10 Hz run possible
- Boris taking in several times 10 hours data for BPM studies
- In less than 24 hours not possible to run at 1 Hz because of losses
- Also Aramis seems to be affected

Possible explanation (to be confirmed):

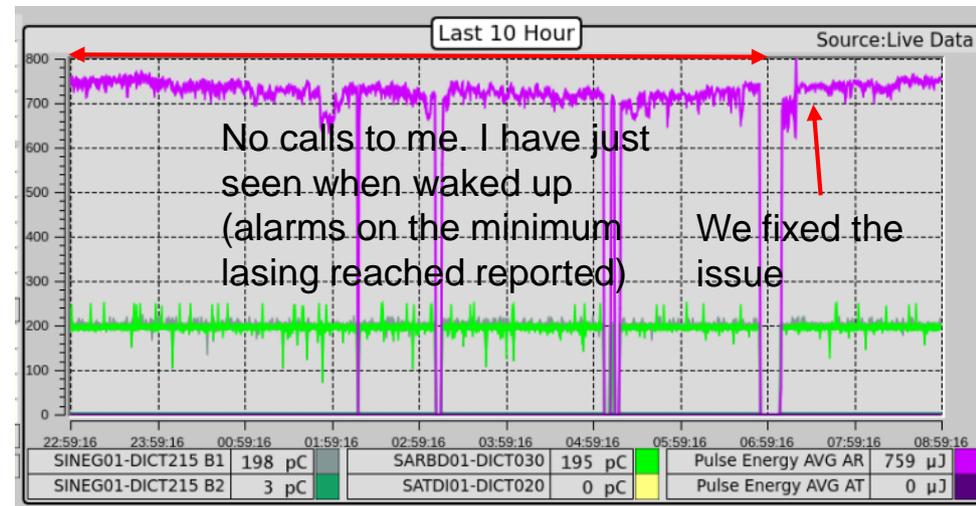
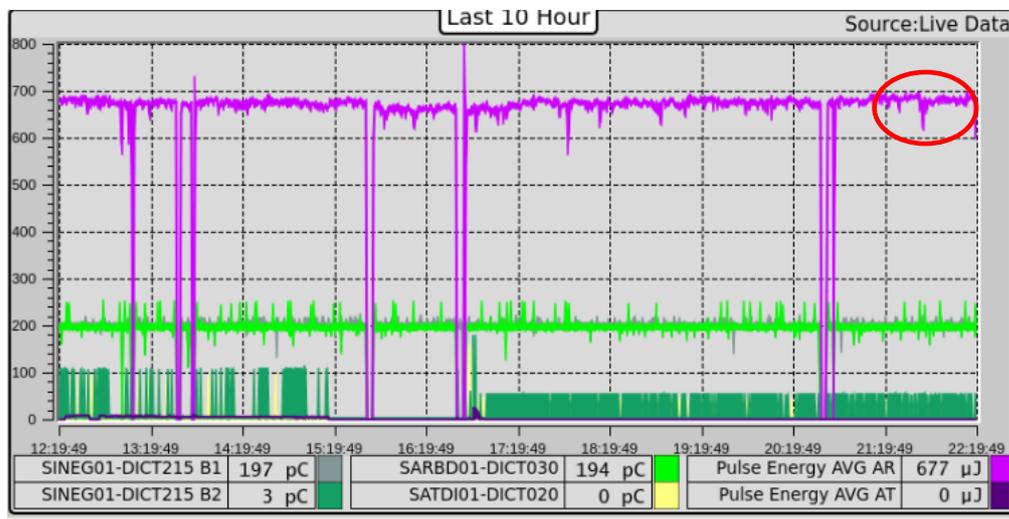
- Feed-back on the virtual cathode sees the overlap of the two lasers
- Possible that the two shift, the feed-back sees a different center of mass, and incorrectly correct

Solution:

- Discussions already ongoing to separate the pointing feed-backs among the Alcor and Jaguar (Mizar)

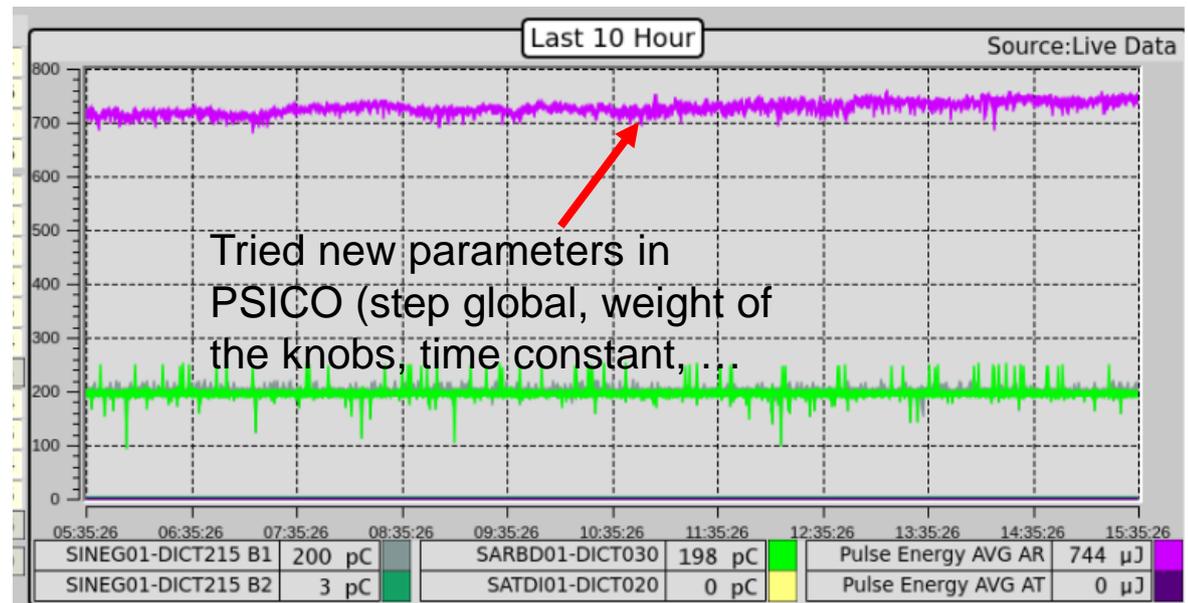
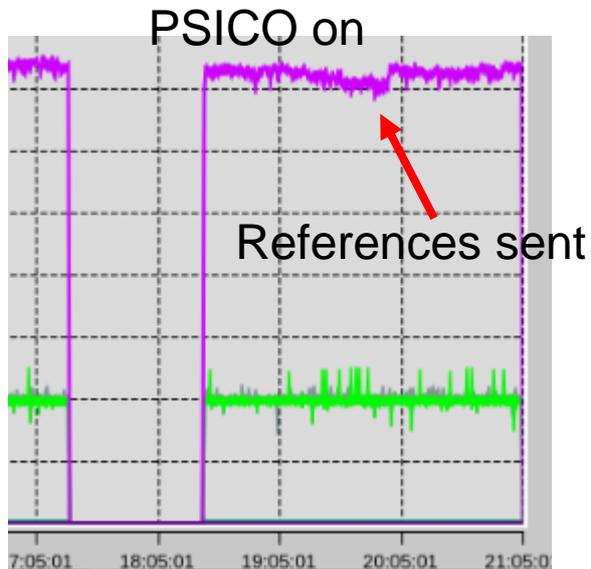
Hardware issues

- RF (S10CB05) on Saturday afternoon: J. Alex fixed it
- FEL jumps: thinking they are due to RF phase jumps (J. Alex, B. Keil, F. Loehl). Other possible explanations are that we simply see more the effect on the lasing because we have more lasing than usually or it was the not optimal settings for this run of the optimization (see in some slides)
- Re-alignment of the Alcor necessary during the week: M. Huppert did it. Feed-back on the virtual cathode sees both lasers? To be checked this week
- Magnet IOC failure and machine instability

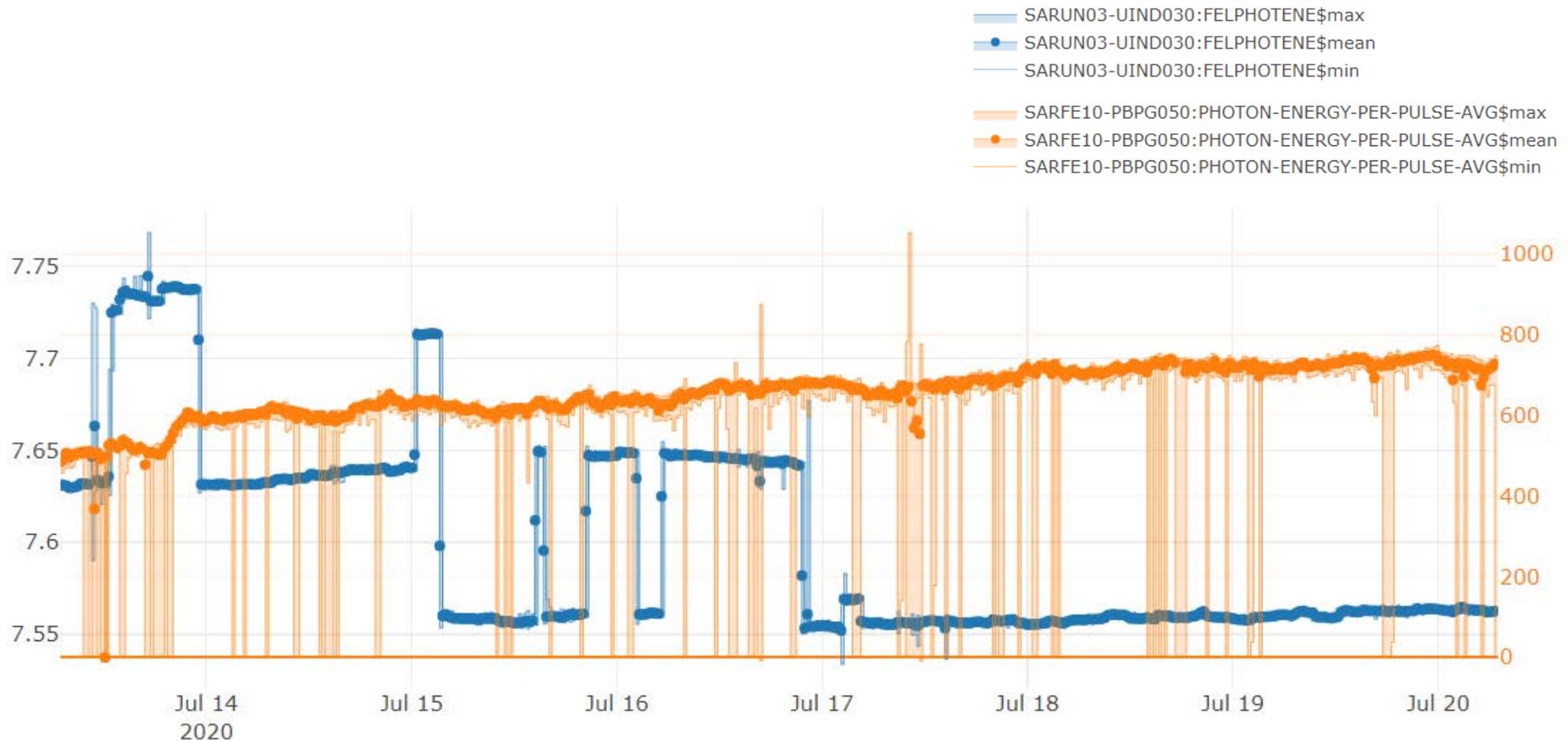


FEL optimization

- During the week trying to change knobs, manually find different starting points, and after let PSICO working
- BW optimized manually, and PSICO mainly run on the intensity (the first night reached 600 μJ). Excluded from PSICO parameters which may affect BW
- Some strange behavior of the optimization: up and after some time down. No machine drift, because resending the reference I was coming back to the initial lasing. Changed the PSICO regulation on Saturday (not successfully) and on Sunday morning successfully. From then usual FEL ramping up with PSICO on



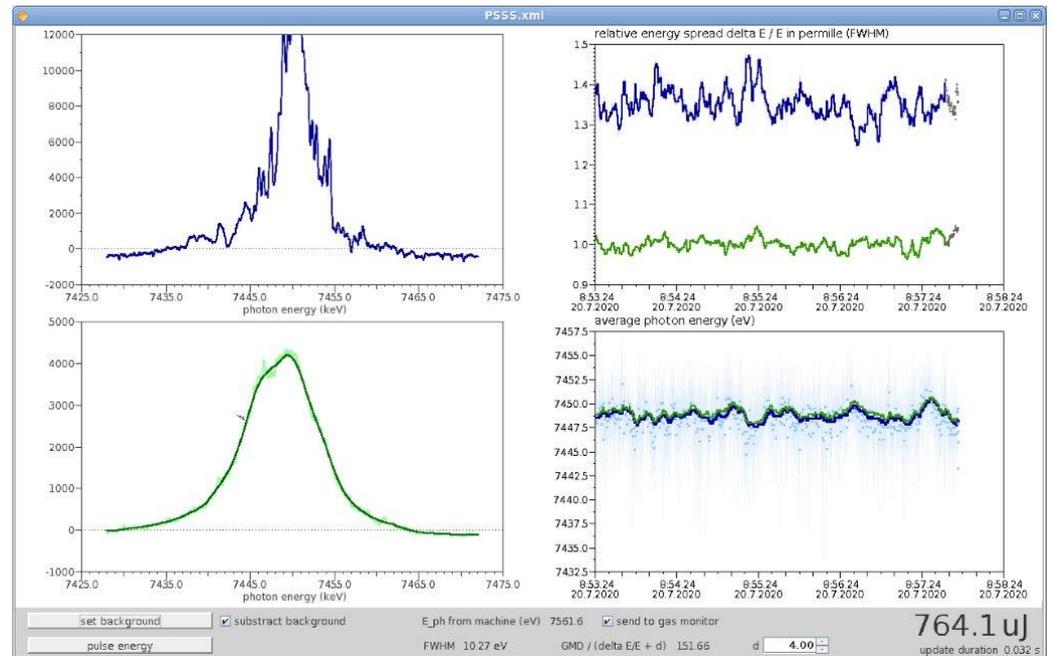
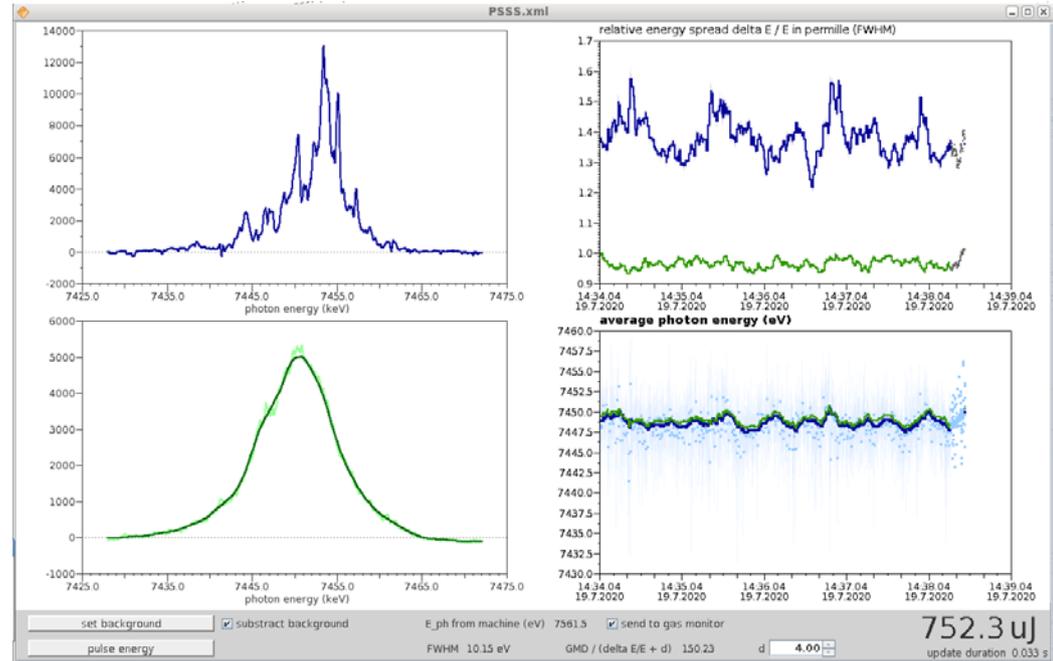
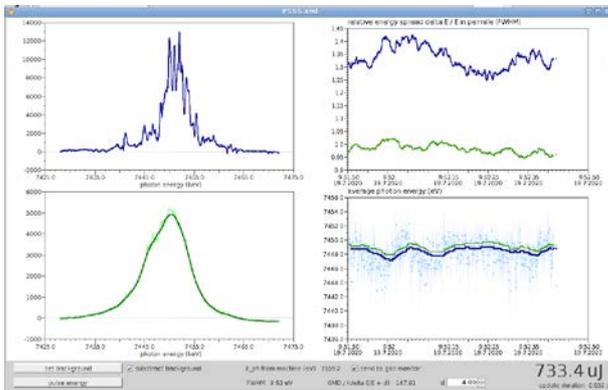
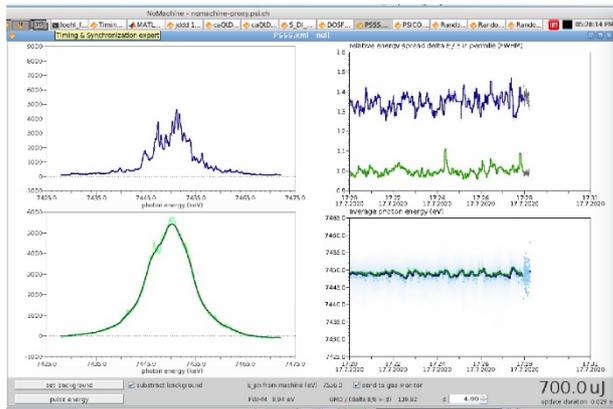
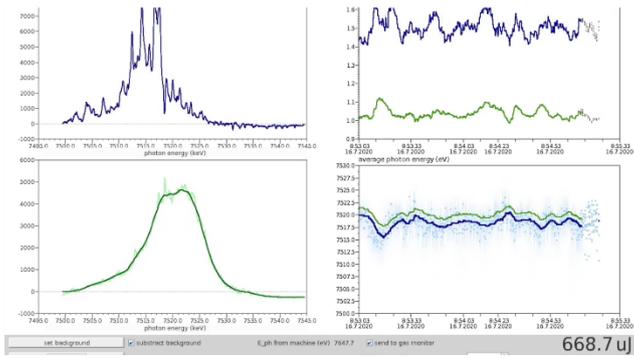
Aramis lasing



Without a real setup day this week

- E_{ph} changed during the week by the users. It would be nice to stop PSICO.
- Pulse energy increase from 560 μJ to 773 μJ
- Spectral width maintained below 0.1 %
- Reduction of e-beam pulse duration (less than 30 fs)

Examples of Aramis lasing spectra



Machine behavior and reliability

First manual week setup:

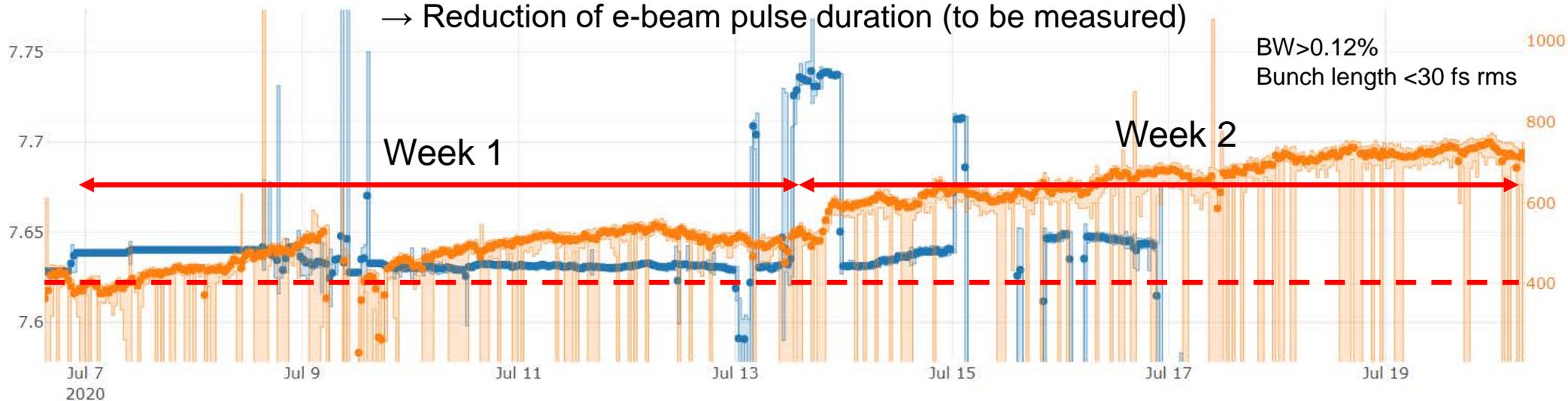
- Pulse energy increase up to 445 μJ
- Spectral width 0.11 %
- e-beam pulse duration (around 30 fs rms)

Start at the second week:

- Pulse energy 530 μJ
- Spectral width 0.095%

Status at the end of the second week

- Pulse energy 772 μJ (peak), more 730-740 μJ in the last 2 days
- Spectral width 0.095%
- Reduction of e-beam pulse duration (to be measured)

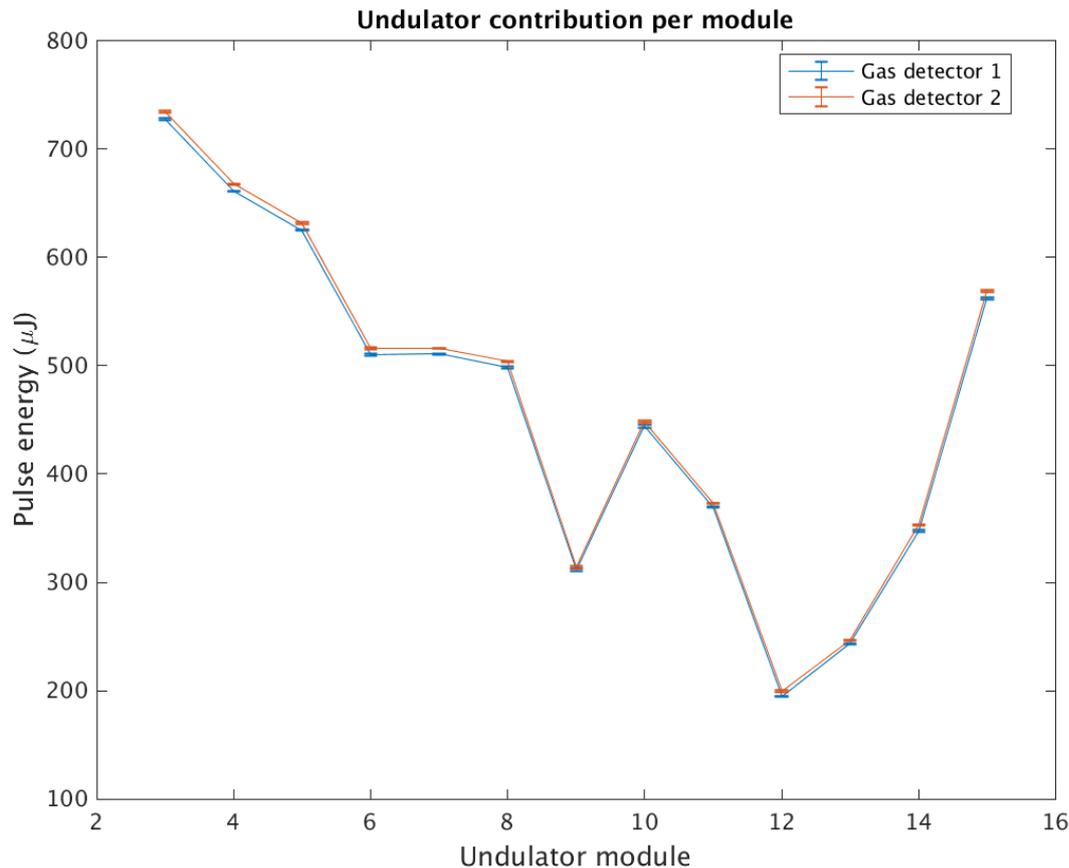


Initial manual setup, tweaking, PSICO, machine system very reliable (always restarting from a previously optimized point)

Undulator contribution

F. Loehl, S. Bettoni, M. Rast (operation)-
substituting N. Hiller

- Measured the undulator contribution before starting the 12 keV setup



- Still the first undulators do not contribute a lot
- Snail scans, adaptive orbit tool from Sven used
- Zig-zag orbit?

- Probably much to be gained there!

Conclusions

- Doubt on the cross-talk between Alcor and Jaguar: possible solution under implementation
- A single RF issue on Saturday afternoon, promptly fixed, and machine back very well
- **Except this, all the systems behaved in a nice way: total downtime of 2 hours this week (1 hour not hardware related)**

- Some parasitic beam time to B. Keil for BPM studies in Athos, and R. Ganter and R. Follat to check the radiation signal observed in Athos
- F. Loehl implemented the K2L in the machine, useful for the optics feed-back
- Started the BLM put in operation in Athos

- Lasing intensity from Monday evening always above 600 μJ , and up to 773 μJ at about 7.5 keV (also changing during the week) with bunch length shorter than 30 fs, BW below 0.1%
- Machine coming back very well after each issue

- Thanks to the RF and laser piquet, operation, and to Florian for the support in all the SwissFEL related activities in the last weeks/months!

Passing message from R. Mankovski (cannot join SEM)

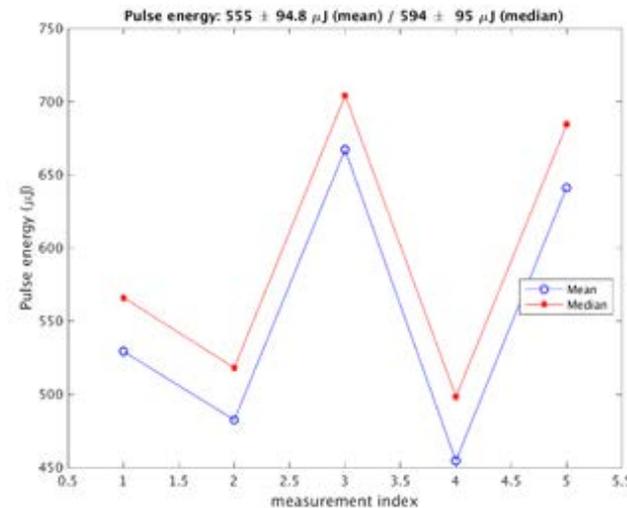
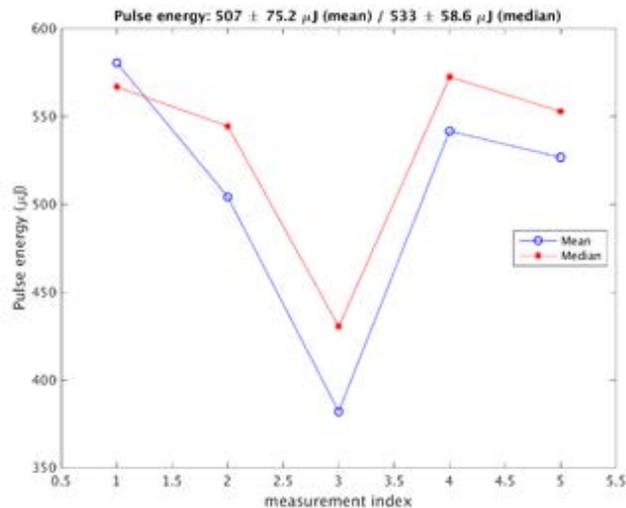
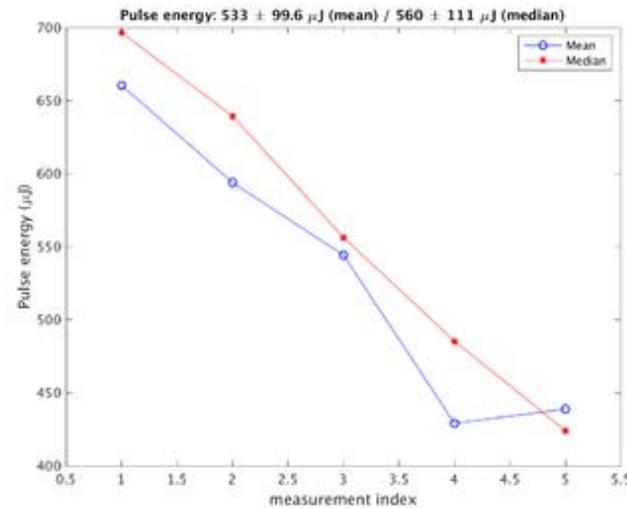
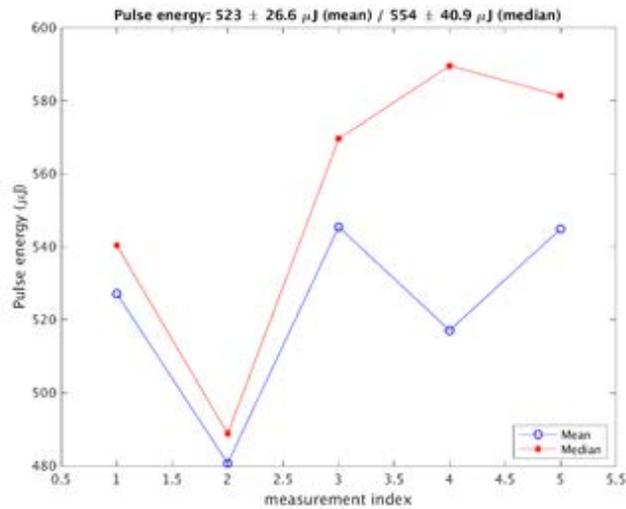
The low bandwidth and high pulse energy gave us large time tool signals and we found oscillations at 8.7 THz and at the end of the beamtime possibly even at 12 THz (to be confirmed), which means the overall time resolution must have been well below 50 fs FWHM. The performance of the machine and also the 100 Hz data acquisition were elemental in not only reaching our initial goals but also observing these additional dynamics.

- The DAQ worked at 100Hz, including saving PCO edge processed data
- The bandwidth, pulse duration and pulse energy and stability far surpassed our requirements
 - We often changed energy in a 130eV range during this beamtime, turning on and off the feedback, which was great
 - The PSSS was also very easy to adjust
 - The pointing feedback on our backscattering monitor worked very well
 - We did not have to realign the machine or the monochromator during the whole two weeks
- The experimental laser system was stable and we managed to control drifts in the THz generation
- The new Bernina experimental chamber was used for the first time with THz pump and all of the components have successfully been commissioned
 - We demonstrated stable performance down to 4.2K sample temperature

Mostly, it is very important to me to express my thanks for the great job the different groups did during this beamtime.

E-loss measurements (today)

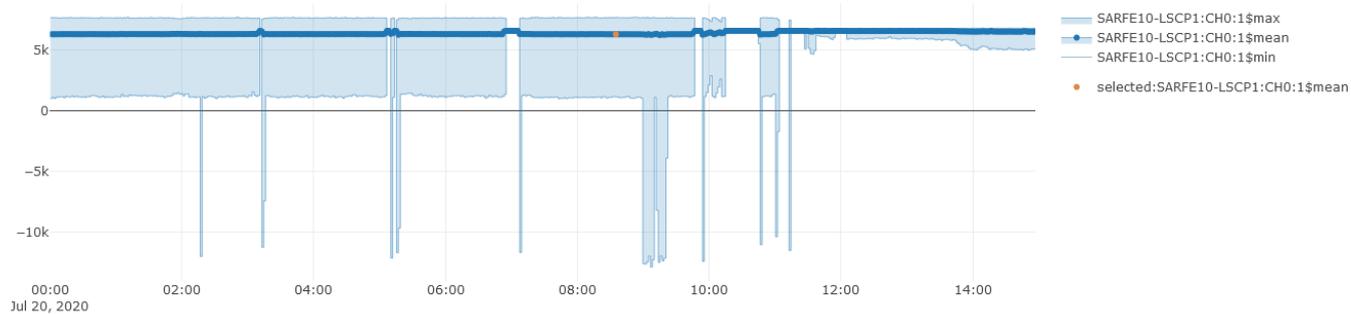
F. Loehl, S. Bettoni, M. Rast (operation)



- Difficult interpretation results of this measurement. Is it because we are lasing a lot, so energy spread is large, so beam size is big, so we lose in precision in this method?
- From last week setup P. Juranic did not see spurious light

Waveform during the measurement

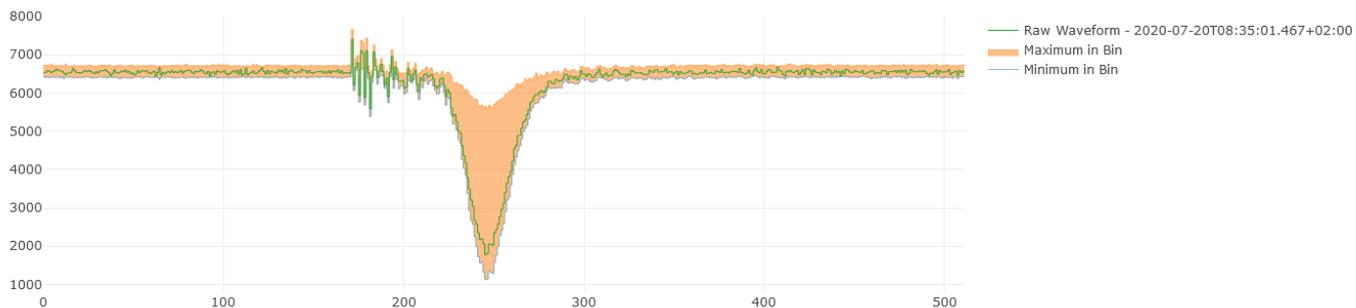
Thanks P. Juranic for providing this



Data information

Channel Name	Description	Shape	Reduction	# Events	Connected	Recording	Details
databuffer/SARFE10-LSCP1:CH0:1	n/a	waveform	reduced	5411520			

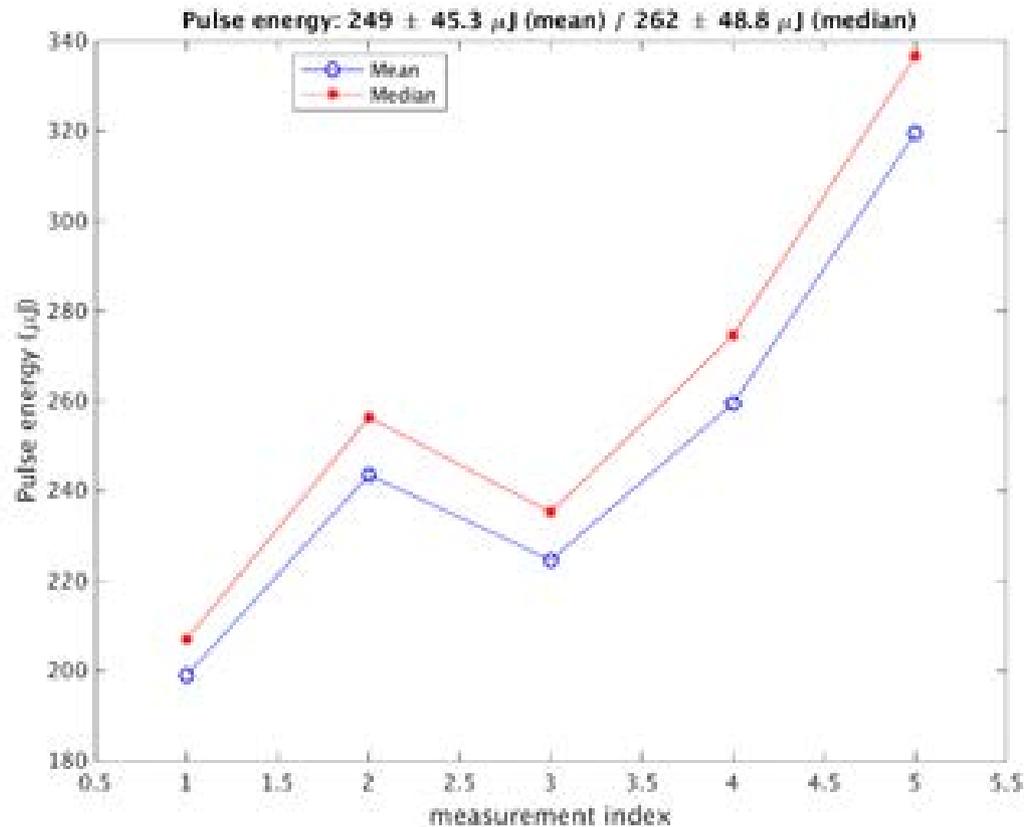
Index-Plot from 2020-07-20T08:35:01.467+02:00 to 2020-07-20T08:36:46.565+02:00



- No large spurious light observed

Measurement at low lasing

Repeated the e-loss measurement with a smaller lasing



Gas detector reads 280 uJ