# What is new?

A summary of new tools/panels and some hacks and trick to make the operation of the XFEL easier.

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## **Topics**

- Laser heater
- Laser 2
- Undulator operation
- HAMP settings
- Dosimetry in SASE1 and SASE3
- Shift documentation
- Panel expert
- Big brother
- Gun power measurement



#### Laser heater

#### • Why a laser heater?

- The laser heater helps to reduce so called longitudinal micro bunching instabilities. Those reduce the SASE output power.
- How to do that?
  - The electron beam has to overlap with an IR laser beam transversely and in time. That has to be the case inside the small LH undulator. This increases the uncorrelated energy spread along the bunch and mitigates micro bunching.

You can find the LH panel here: Main Panel/ Injector/Laser Heater Operation

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#### Laser heater

You can adjust the delay of the IR lasers with respect to the electron bunches here. Typically it is not necessary to change that value.

The power of the IR laser can be adjusted here. Keep in mind: too much power blows up the uncorrelated energy spread of you beam too much and reduces/kills you SASE output level!



Close the shutter from time to time and check whether your setup works or not.

The horizontal and vertical position of your laser beam inside the undulator. You can scan those parameters in order to find an overlap with the electron beam.



#### Laser 2 attenuator

- We have a second injector laser in operation.
- This laser provides a beam with higher charge stability.
- The laser attenuator is on a dedicated panel. You can find it here:
  - Main Panel/Injector/Laser 2 Attenuator
- The charge feedback works also with laser 2.

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Power attenuator XInL2							
Energy Diagnostics							
UV pulse energies after FHG	[nJ] Laser Pulse Energy At Gun	4 Pulses					
	+	327.46 nJ					
25000	*						
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15000	327.5						
10000	327.45						
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MAX Transmission 200 mm Min 0.0 2500.0 5000.0 7500.0 Position 8000 Set Position 8000 Move Motor $\lambda/2$ Expert Motor Control Panel	To aperture						



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### **Undulator operation**

If you get a request from the users to change the photon energy, these are the dials you should to use. Wavelength and energy are coupled. However, they request typically photon energy changes rather than wavelength changes.

Press the 'Set' button after you changed the photon or the electron beam energy in order to apply the changes. This shows the electron beam energy. The upper number is the momentum set point of a dump dipole, the lower one should be changed such that both show the same number. The electron beam energy is used to calculate the correct undulator gaps.

SASE1 Undulator Server Controls Wa elength: (0, 1355) 14100 MeV All ston Group 1 <u>.</u>9150.00 14100 MeV nergy eV Group 2 All to max, gap Active to max. gap ole phase shifter couplin Group 3 Server Message Active to park Status: Ready U40.2250.SA1 Cell 3 Cell 4 U40.2 Cell 5 U40.2269.SA1 Cell 6 Cell 9 U40.2256.SA .SA1 U40.2275.SA .... .... Gan K parameter 2 8839 2 8838 2 8830 2 883 K parameter K parameter K parameter K parameter K paramet 21.15 mm 21 24 mm 21.20 mm Phase Shifte 21.23 mm Phase Shifte 21.02 mm Phase Shift 20.93 mm aper Group: 1 💌 Air Coil Cell 10 U40.229 Cell 11 Cell 12 U40.2311.SA Cell 13 Cell 15 Cell 16 U40.2293.SA U40.2330.SA .... .... Undulator Undulator Undulator Undulator Undulator 13,505 Gap 13.512 2.8824 2 8823 K paramet K paramete 21.04 mn Phase Shift aper Group: 1 💌 Air Coil Tape roup: Air Coil Air Coil Cell 17 Cell 23 1140 2336 SA Cell 18 Cell 19 1140 2354 Cell 20 ..... ..... .... ..... ..... .... ..... Undulat 13.482 K parameter 2 8810 2 8804 K paramete K parameter K param 21.00 mm Phase Shi Cell 30 U40.239 Undulator Undulate Undulato 13 538 13 604 13.543 Gap 13.523 13.515 13 544 13 544 K parameter 2.8773 K paramer 2.8756 K parameter 2,8736 K parameter 2 8795 K parameter 2 8785 K parameter 2 8710 21.20 mm 21.08 mr Taper Group: 1 💌 Air Coil Air Coil The names of the group control buttons are Cell 31 U40.2427.SA ).2452.SA Cell 37 U40.2421.SA 10 10 10 10 10 I 10 C 10 C 10 C self-explaining. All undulator cells with a Active Undulator Undulator Undulato 210.000 210 001 210.000 checked 'Active' check box can be operated K paramete 62.50 mm Air Coil 🔵 Taper Group: 1 💌 with the buttons 'Active to max. gap' and 'Active to park'.

To taper the undulator means to change the undulator gaps from cell to cell in a predefined way in order to increase SASE output. A typical taper setting for a ~14 GeV electron beam and 9.15 keV photons can be found in this panel.

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#### **HAMP** settings

- The HAMP is a fast and sensitive signal for SASE tuning.
- You can find the panel here:
  - Main Panel/Photons/XGMD Overview/HAMP Operator
- You can increase the multiplier voltage via the 'set new SP' button in order to get a better signal to noise ratio.
- Keep in mind that the shown signal should never go beyond -7 mA.
  - The panel pops up with the shown axis range. Take care that the signal always stays within this range!





### **Dosimetry in SASE undulators**



- The standard SASE dosimetry panel.
- You had already a large dose measured in the respective undulator if one of the panels are red as shown.
- You can find this panel here:
- Main Panel/Diagnostics/ SASE Machine Dosimetry.
- You can reset a baseline, which will affect a plot that can be opened with the tab 'SA1-Baseline Plot'.



### **Dosimetry in SASE undulators**



- That plot shows the accumulated dose since you pressed the 'reset baseline' button shown on the last slide.
- Of course we should keep the accumulated losses in the undulator as small as possible.



#### **Dosimetry in SASE undulators**



- Another, often used panel to show the losses in the undulators.
- Again, it is our goal to keep the losses as small as possible. In the best case, you do not see any positive slope in the plots.
- The buttons top left help to select time ranges.
- You can find the panel here:
  - Main Panel/ Diagnostics/SA1 Radfet Overview

#### **Shift documentation**

- Please choose for all important entries at least a severity tag.
- It is also important that you type in you name as the author of the entry.
- Titles are very helpful and should be used. Especially when you want to send the entry to an expert.
- Logbook entries can also be written in German in case you do not feel comfortable writing them in English.

- Please write a summary of you shift!
- That can either be done in the logbook header on an an entry pint on top of all other entries.

## **Panel expert**

- You want to find out who made the panel?
  - Right click on the panel and chose 'about this panel'.
- Often the panel author is also the expert for the tool/device.
- Sometimes you can also find the experts name on the panel itself.

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	BLM Overview	Undulator BPM Offsets	TDS Bunch No.	Transmission T4D	Energy Profile
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					Injector Losses
					Camera Status



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#### **Big brother**

- We had the situation before, that the machine was running nicely and all were happy.
- Out of a sudden, the SASE level dropped and we had to search for a long time to find the difference to the setup we had before.
- We wanted to have one list with elements/readings that shows only the changes in the machine.

#### How to operate the tool:

- As soon as you have a nice setup, press 'Measure'.
- The press 'Start'



- The lists show only elements with differences to the initial setup.
- If an element name is shown but no value, that means that the difference was measured in the past and is not existing any more.
- Differences are either shown with units or as relative differences in percent.
- Check the clock every now and then to ensure that the tool is still running.

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#### **Gun power measurement**

- If you are interested in the actual measured gun power, open the following panels:
  - Main Panel/LLRF/Gun
- And then:
  - RF Meas.
- A browser window opens and shows the proper power measurement.
- Be careful, that did not work on all consoles in the past...

XFEL GUN IIrf main.xml XFEL.RF/LLRF.CONTROLLER/GUN.I1/ Print XFEL LLRF CONTROL MAIN.GUN.I1 Main Control Performance Subsystems RF Gate RF Gate Klystron <u>\$</u>9.<u>1</u>0∎ Voltage Modulator Timing 59.11 MV/m MPS - <u>45.50</u> H Phase Activate when gun is stable! Pulse Width Modulation -45.48 deg Cpl Interlock Overview Panel Activate fast protection FSMION 🖌 RF On / Off FSM GUN.I1 Protection Pulse Width Feedbac Expert views WG 1 Feed-Forward KLY1 WG 12 REFER1 WG 2 Output vector correction VM GUN REFER2 WG 3 Feedback WG 34 KLY2 WG 4 WG Overvic Feed-Forward correction Learning FF DAQ Viet LLRF Expert RF Meas. GUN Power LLRF Special Virtual Probe Amplitude [deg] 180.0 Phase 70.0 140.0-60.0 100.0-50.0-60.0-40.0-20.0 -20.0-30.0--60.0-20.0--100.0-10.0 -140.0-180.0 0.0 200 600 1000 1400 1800 [us] 1800 [us] 0.0 200 1000 1400



