

# Status of PAL-XFEL

Hoon Heo

Division of XFEL Accelerator

November 14, 2023



**Operation Status(I) : Reliability Summary**

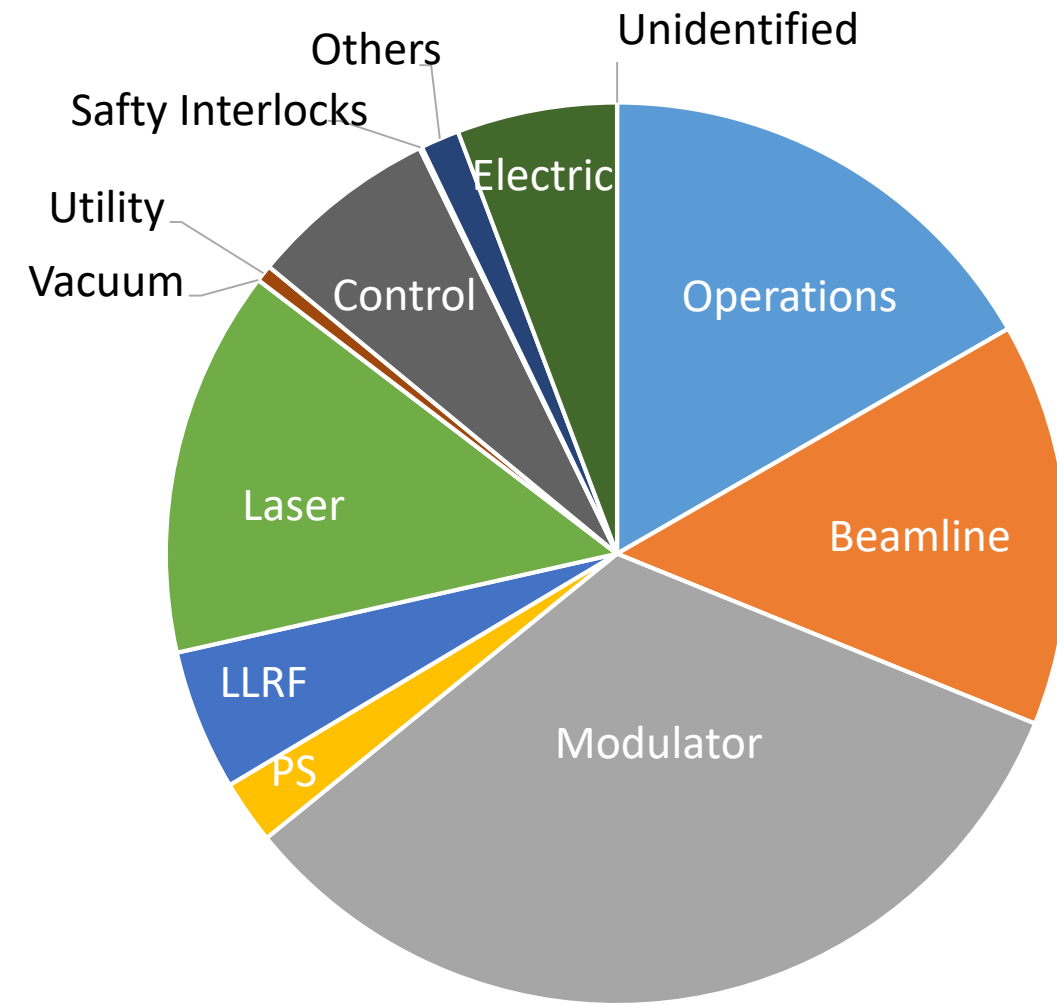
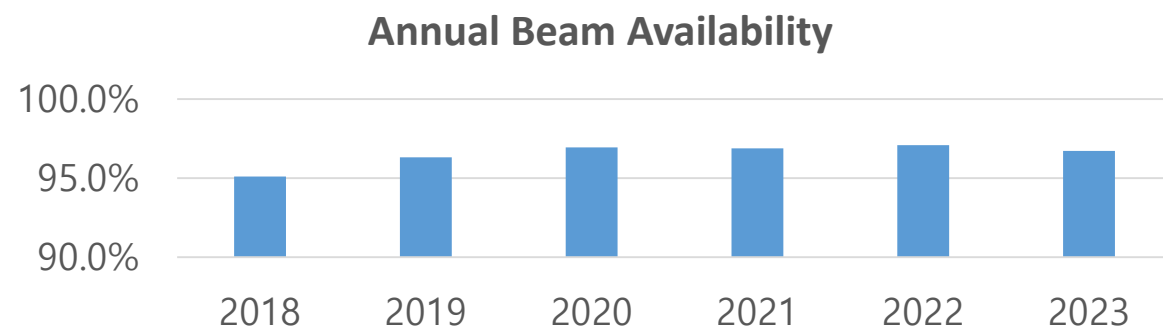
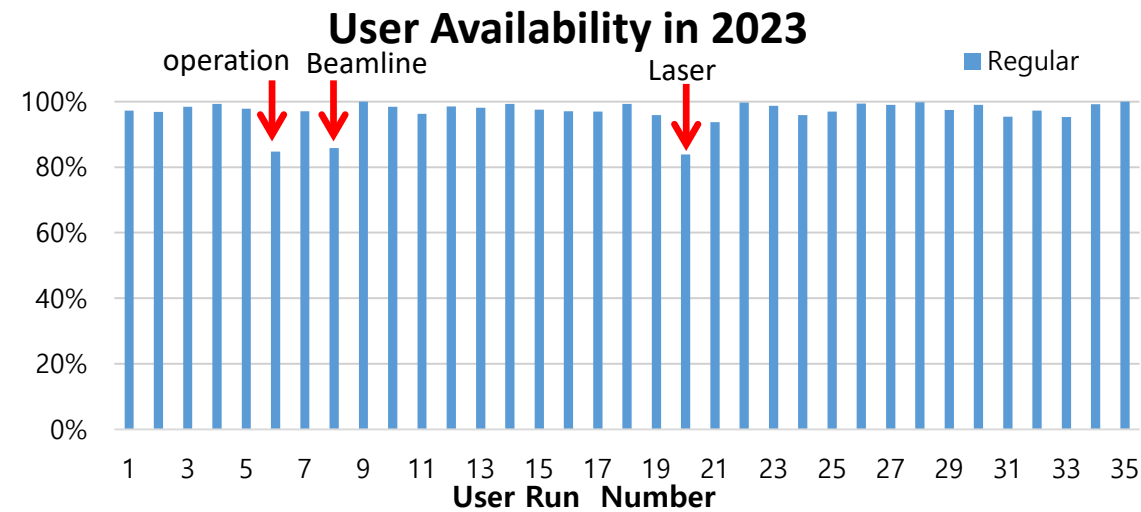
❖ **Scheduled Hours : 2432 (2023.1.1 ~2023.9.25)**

❖ **Delivered Hours : 2352 (> 96%)**

❖ **Downtime Hours: 83**

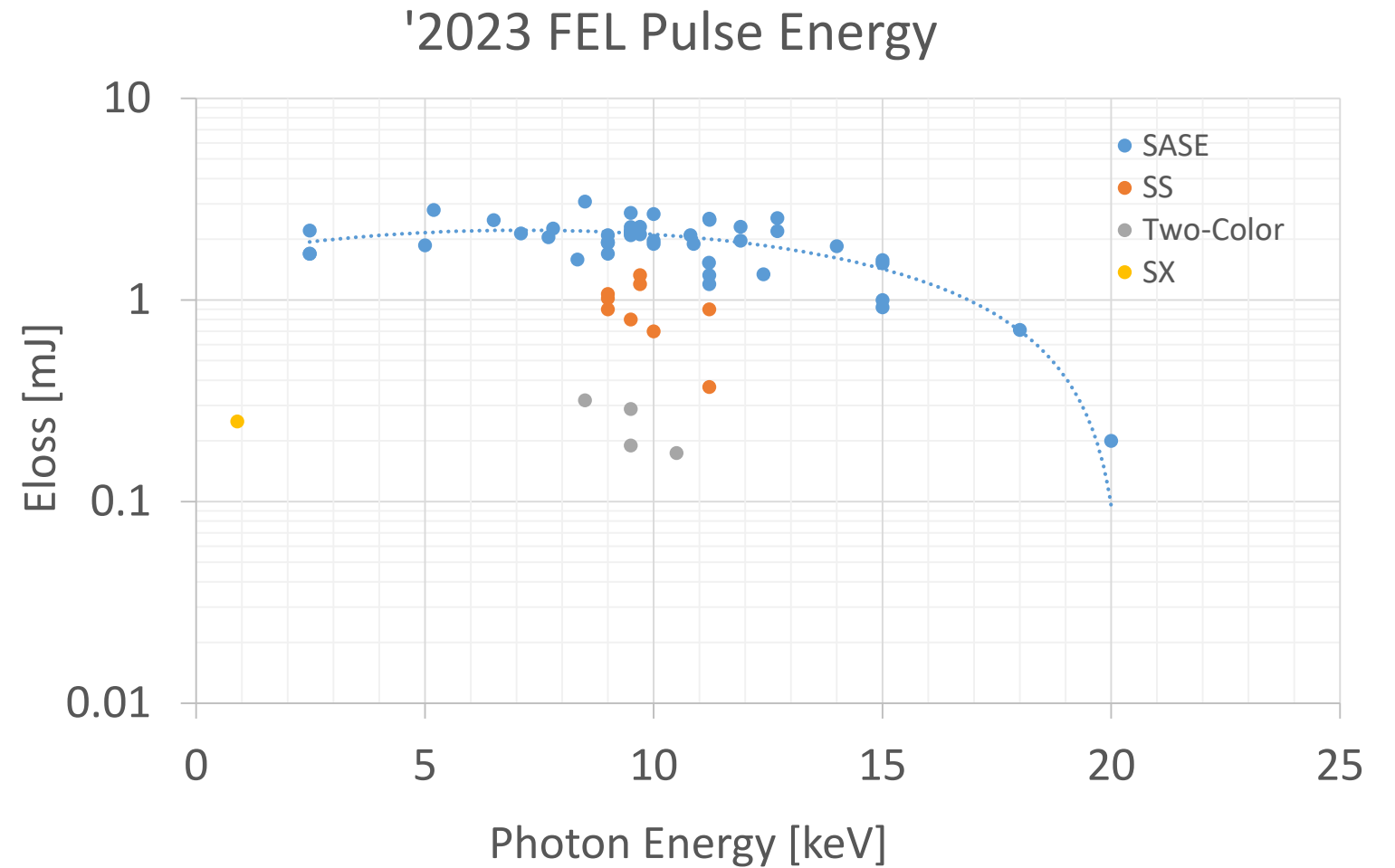
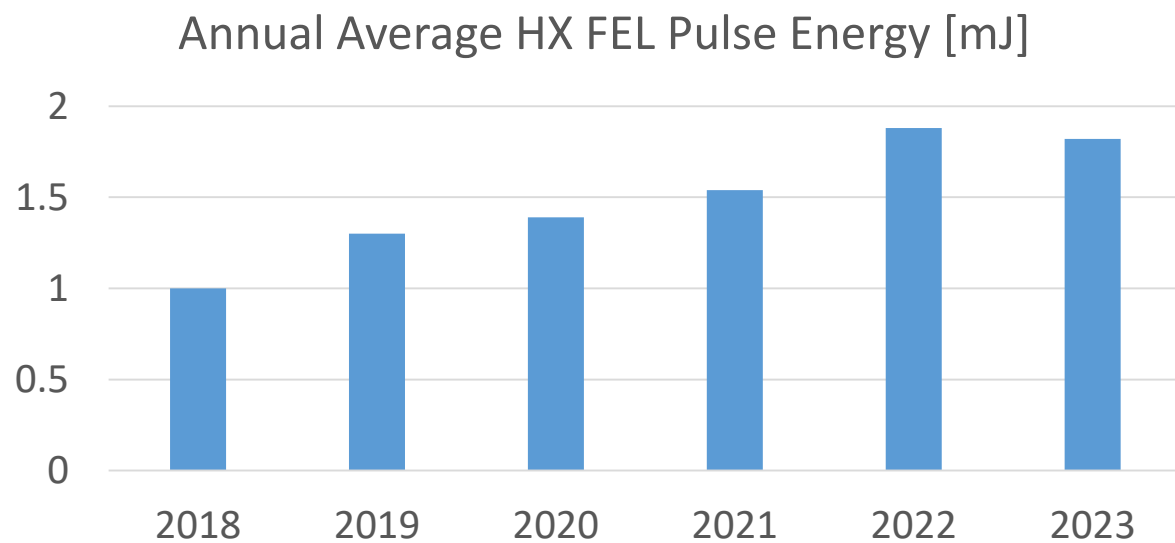
❖ **Longest Mean Time to Beam Loss : ~7 Hours (Laser)**

Down-time Sources in 2023

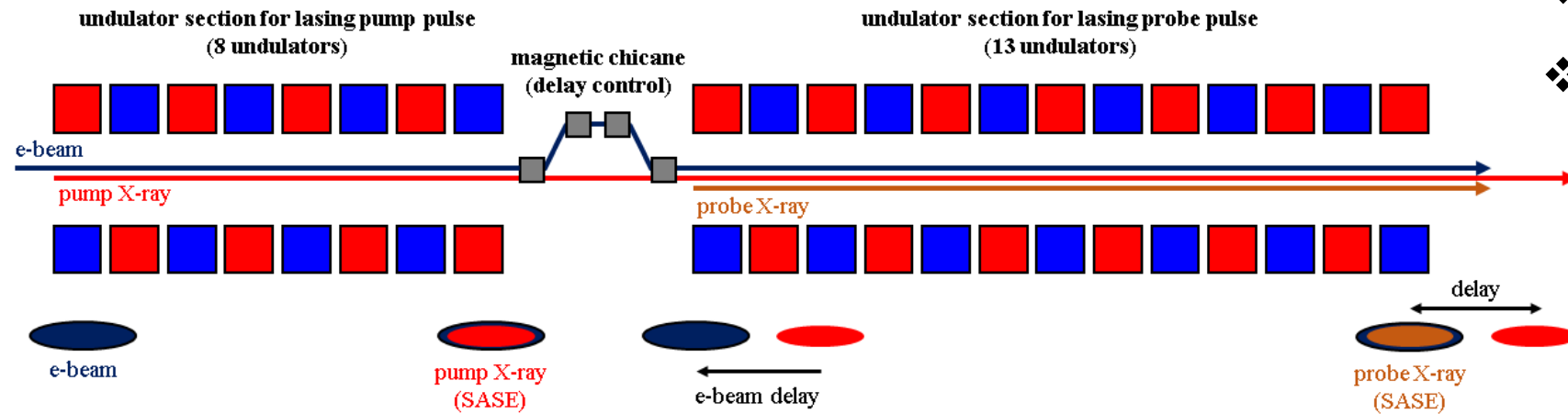


## Operation Status(II) : FEL Performance

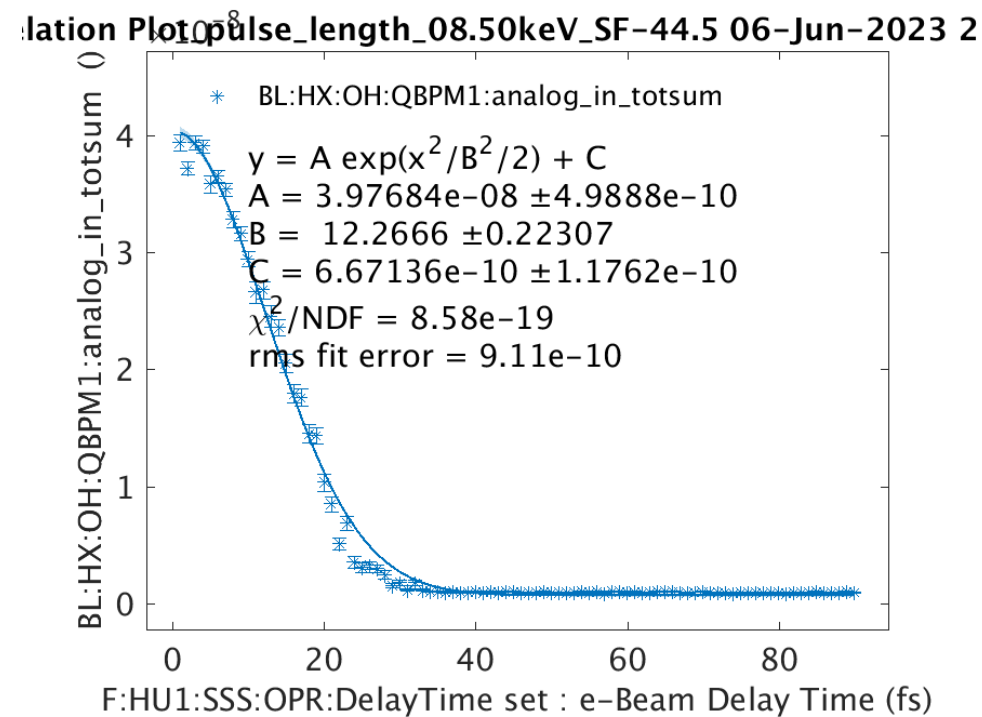
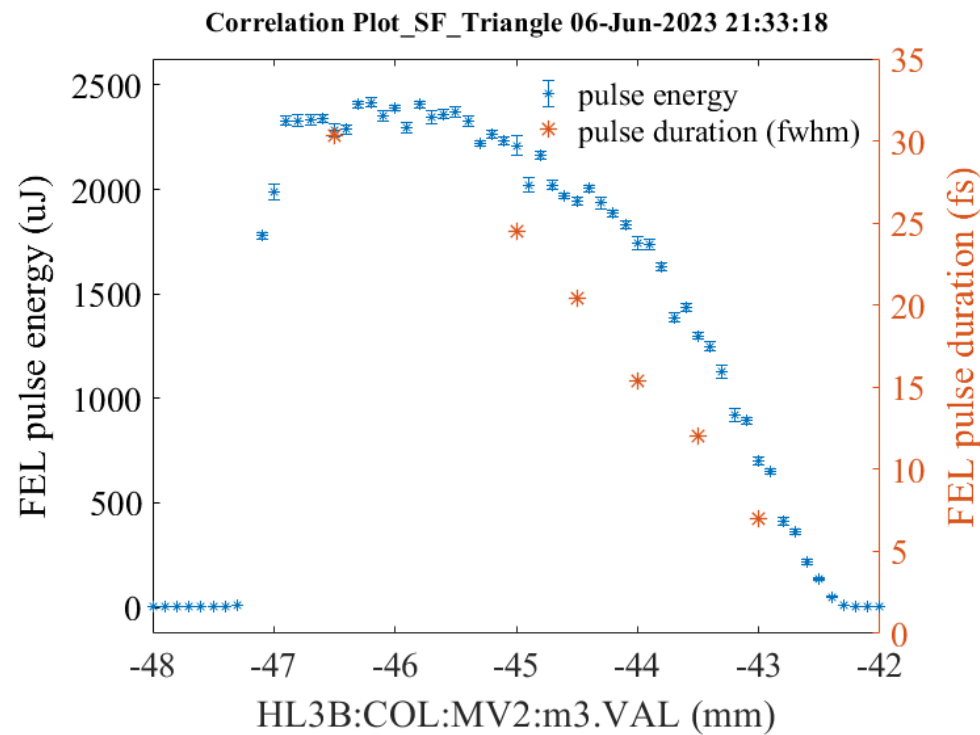
- ❖ More than 1 mJ HX FELs are serviced.
- ❖ Self-seeding HX FEL services increase.
- ❖ Two-colors user service has been started.
- ❖ SX FEL pulse energy is around 250 mJ.
- ❖ From May, RF rate is changed from 60 Hz to 30 Hz due to the electricity bill issue.



## Operation Status(III) : Two-Colors FEL User Service



- ❖ Maximum delay is ~ 30 fs
- ❖ Details will be presented in the next section



**9.5 keV Pump + 8.5 keV Probe (2023. 06. 06.)**

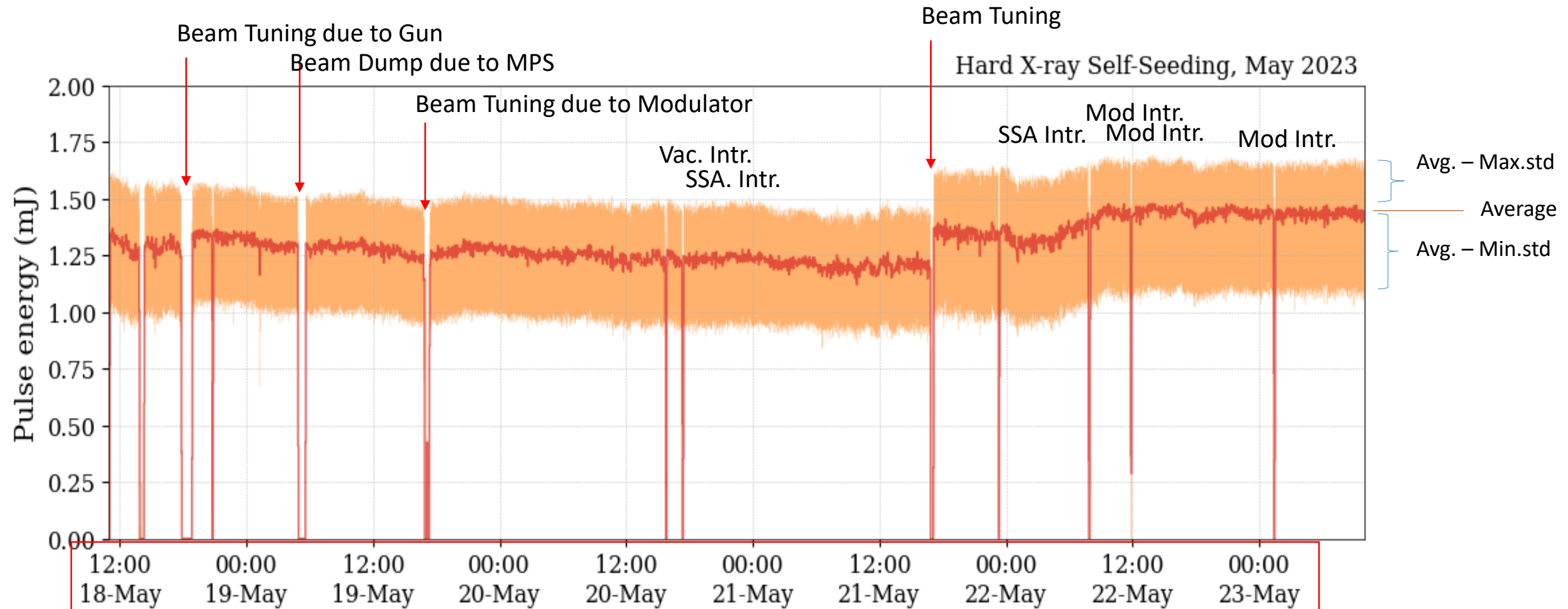
SF pos (BC3H)	Pulse duration (fs)	Cal. FEL energy by e-loss (uJ)		
		Total	Pump	Probe
-46.5	30.3	508.0	190.0	318.0
-45.0	24.5	423.5	147.5	272.0
-44.5	20.4	328.6	115.2	210.6
-44.0	15.4	270.3	88.2	177.5
-43.5	12.0	173.0	64.0	108.8
-43.0	7.0	94.8	28.8	63.6

**10.5 keV Pump + 9.5 keV Probe (2023. 06. 06.)**

SF pos (BC3H)	Pulse duration (fs)	Cal. FEL energy by e-loss (uJ)		
		Total	Pump	Probe
-46.5	30.3	442.0	174.0	268.0
-45.0	24.5	306.2	101.2	200.2
-44.5	20.4	259.3	82.1	171.8
-44.0	15.4	192.1	52.0	133.0
-43.5	12.0	132.4	26.9	97.4
-43.0	7.0	84.3	4.6	70.0

Operation Status(IV) : Long Period FEL user Service (1)

❖ We have serviced stable self-seeding FEL beams.

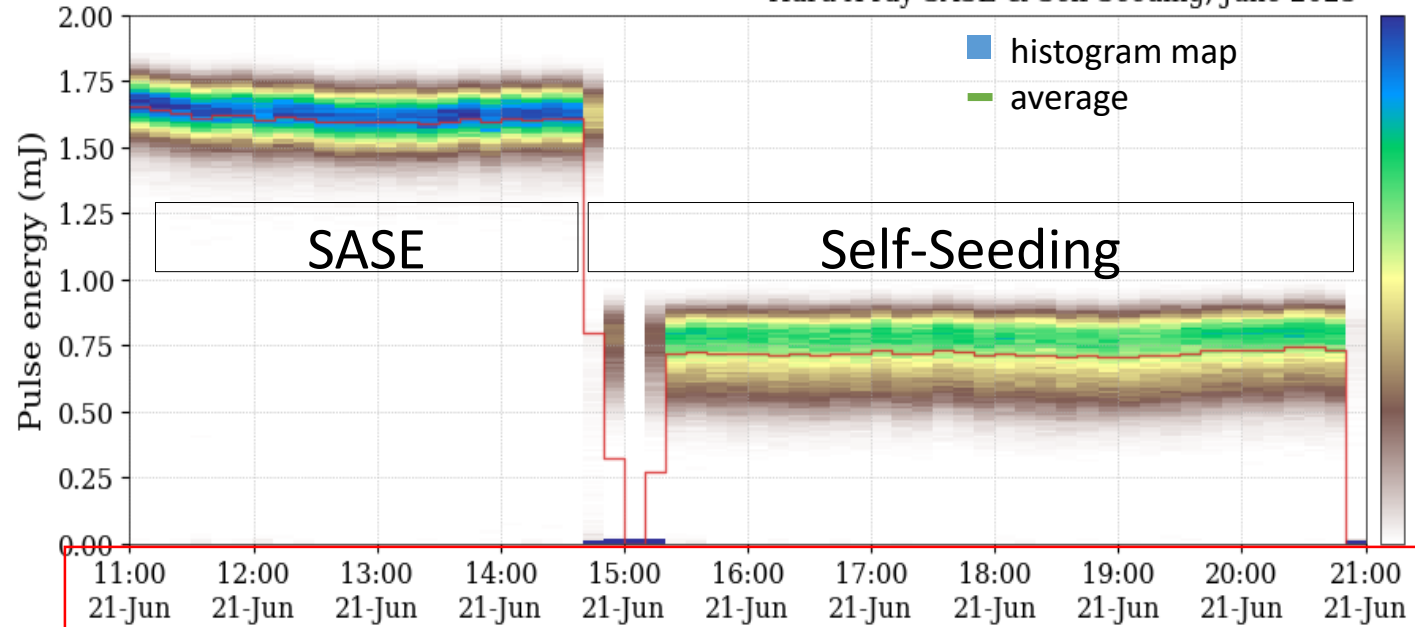


\*Pulse energy is calculated by using e-loss factor  
 \*Averaging sampling time is 180 sec

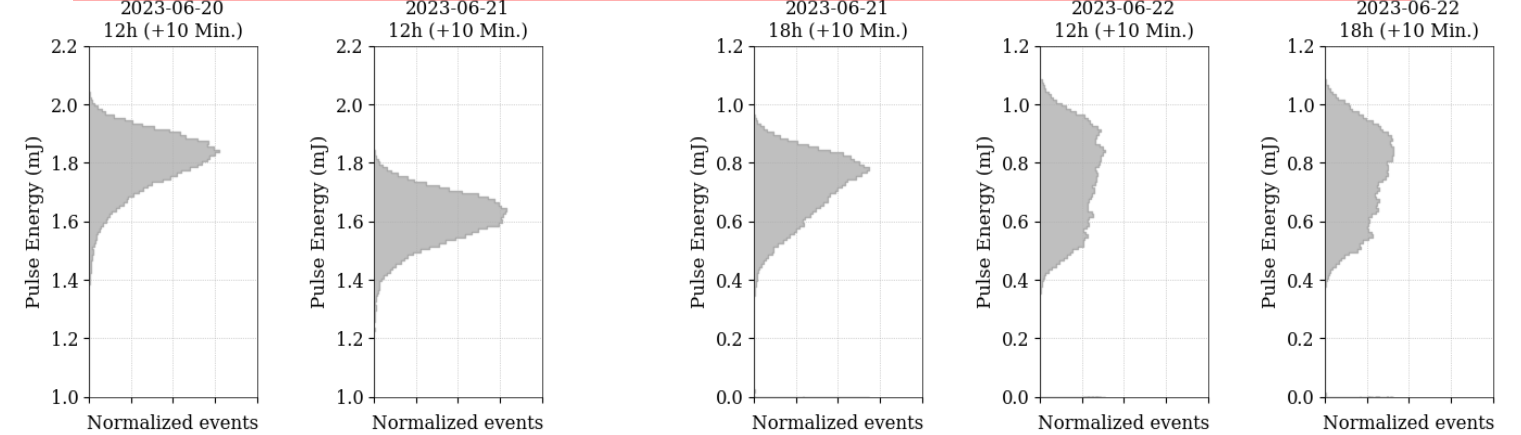
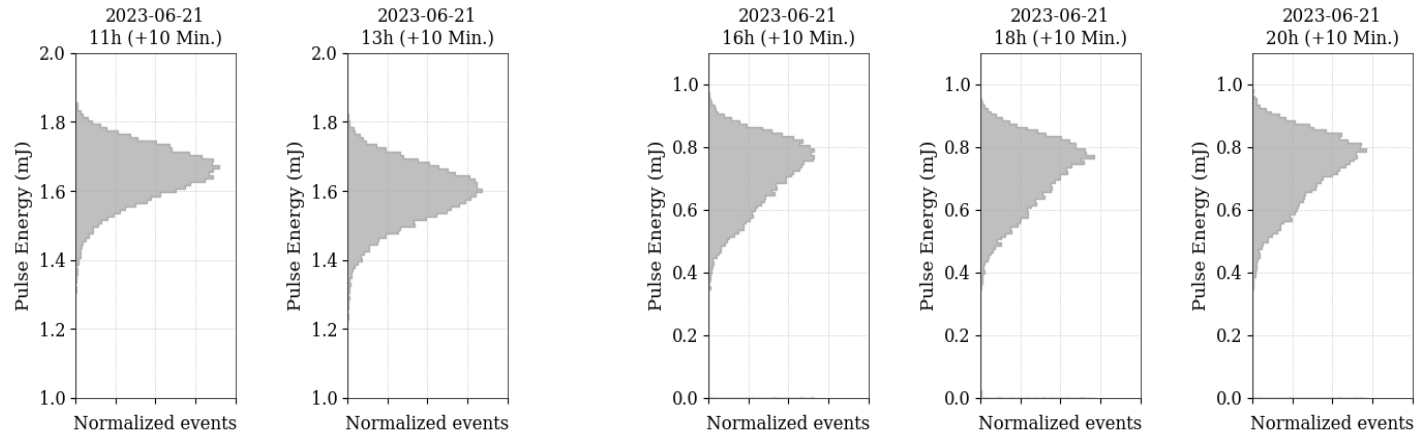
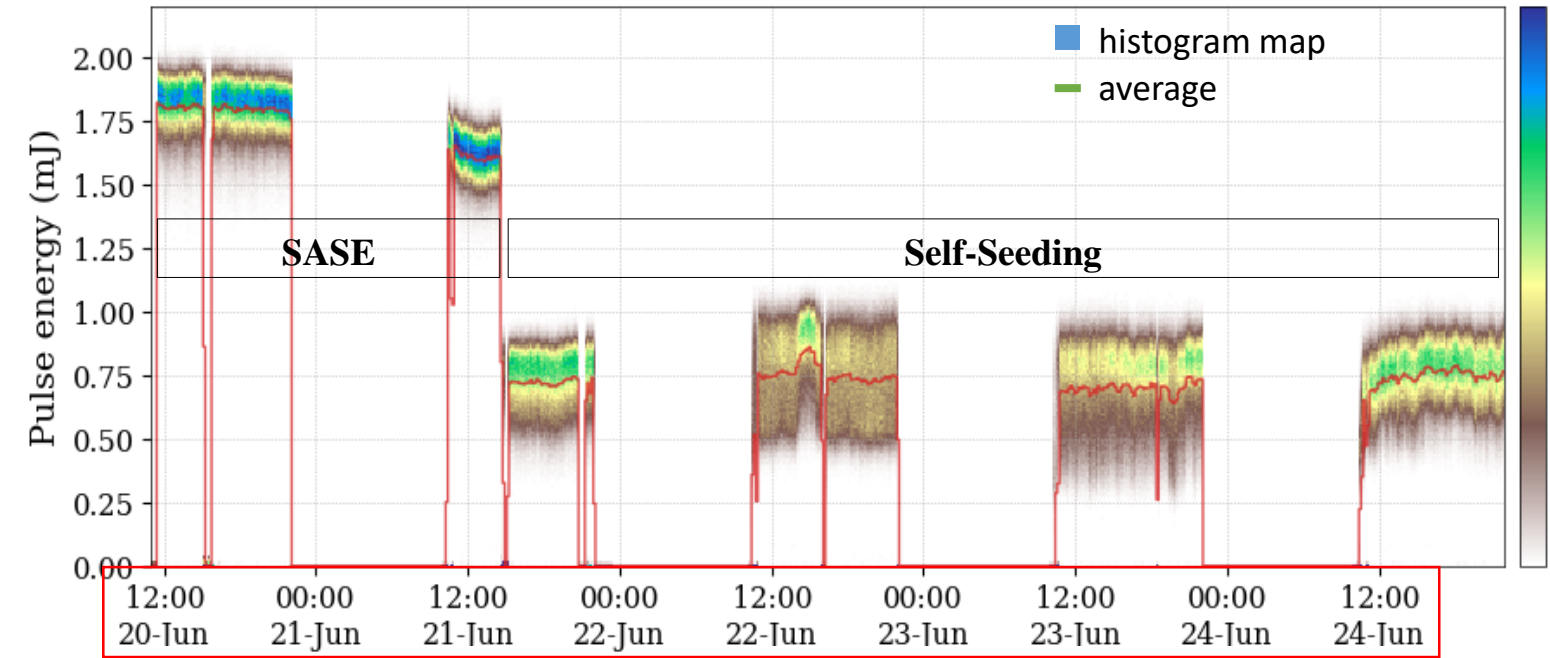
Operation Status(V) : : Long Period FEL user Service (2)

❖ Long term FEL pulse energy drift is reduced.

Hard X-ray SASE & Self-Seeding, June 2023

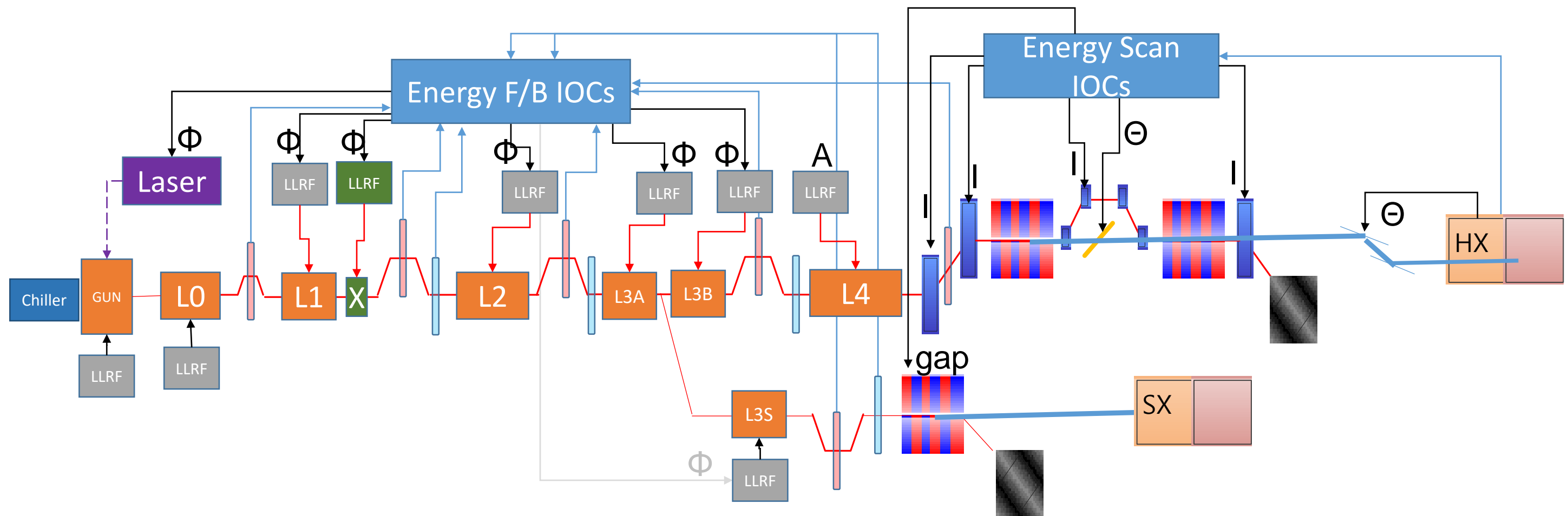


Hard X-ray SASE & Self-Seeding, June 2023

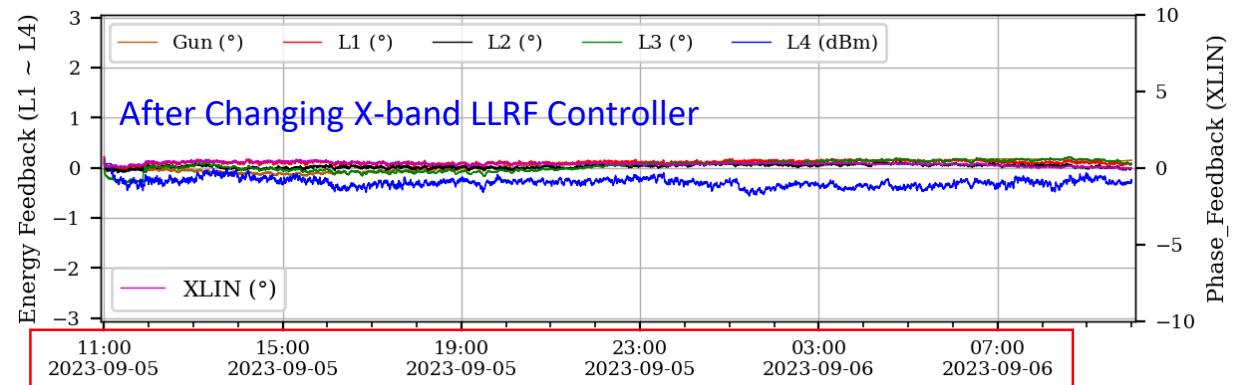
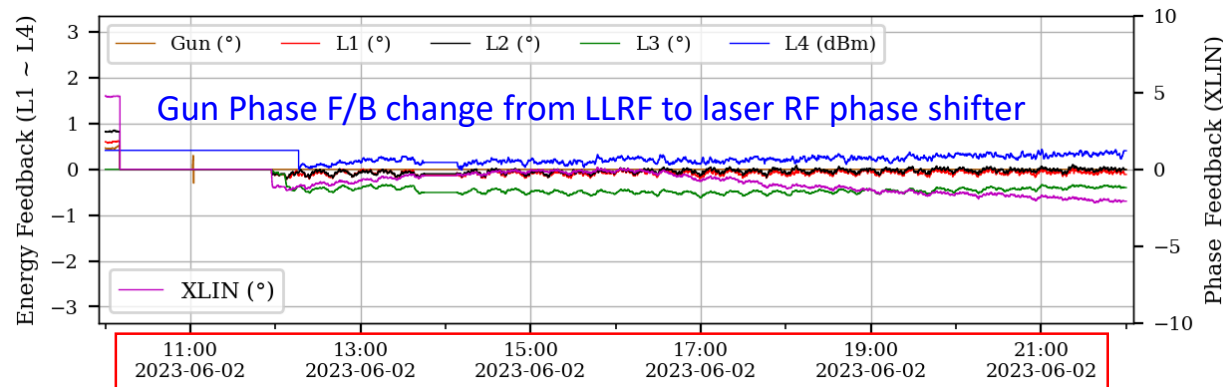
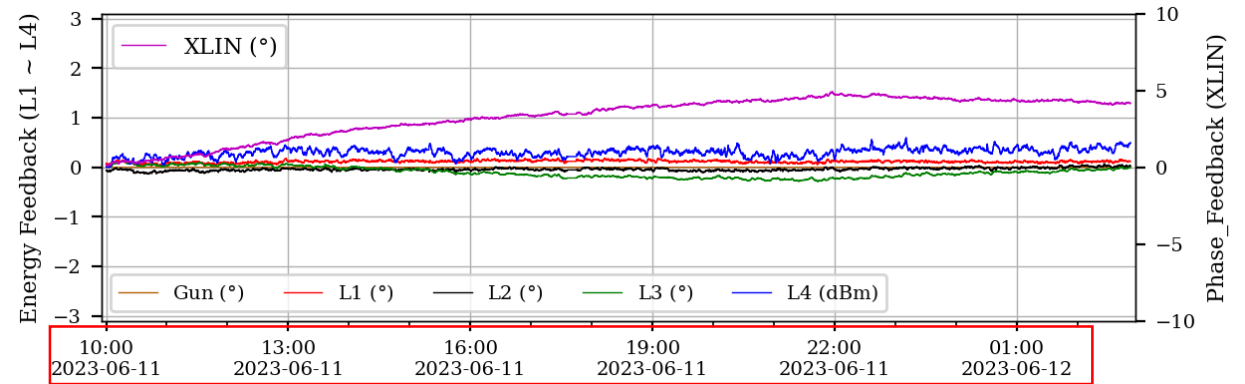
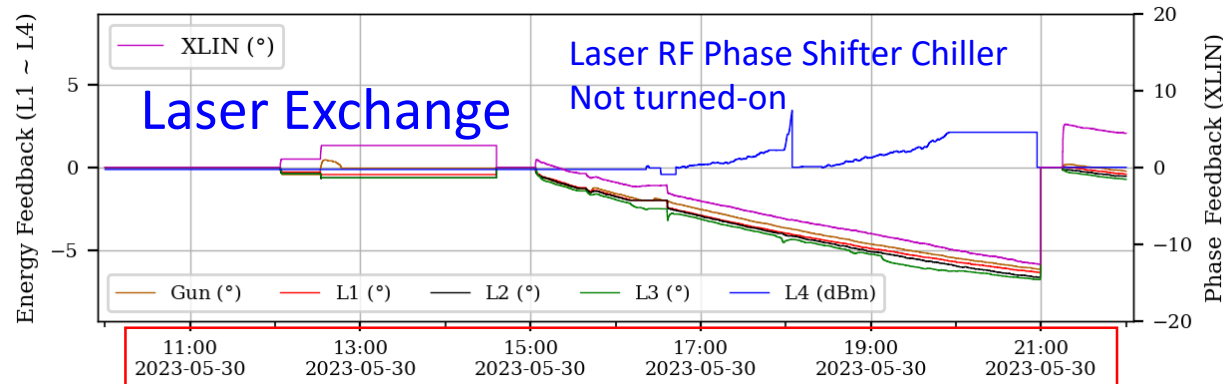
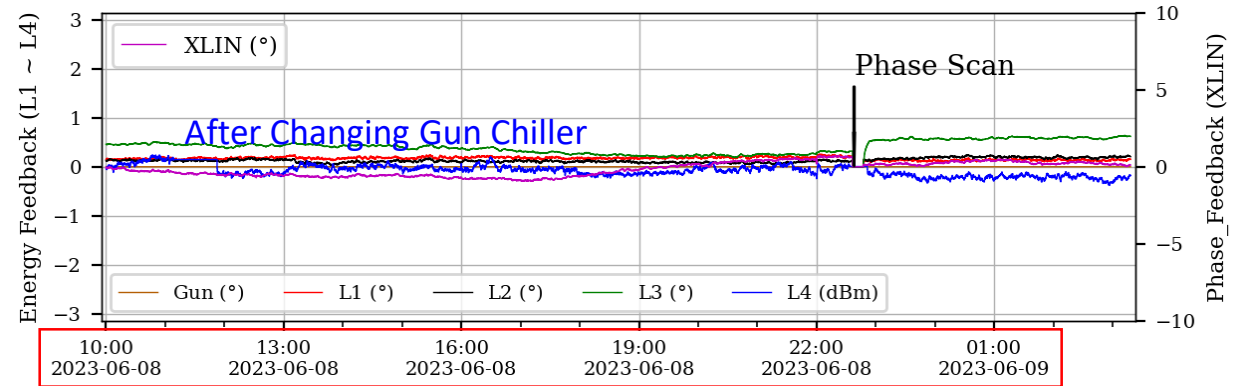
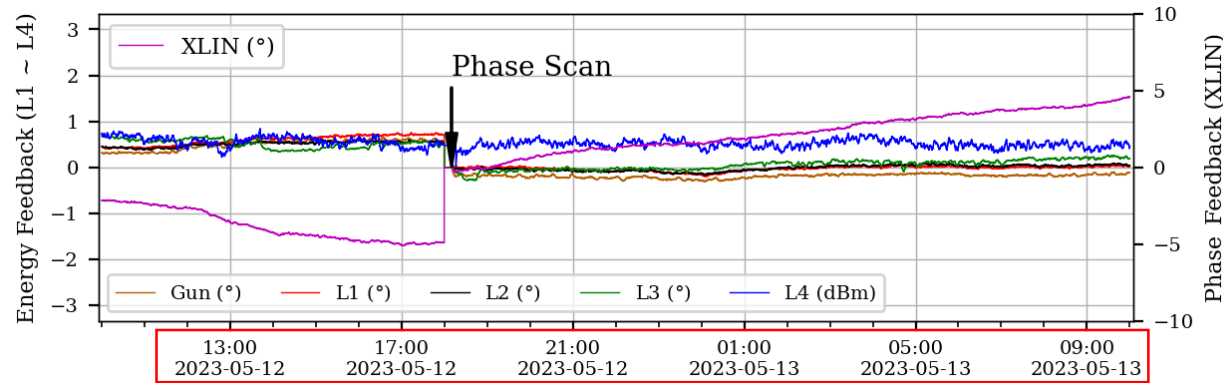


## Machine Status Update (I) : Feed-Back Controls, Energy Scan Controls and RFs

- ❖ We are upgrading the F/B system in both hardware & software.
- ❖ We are providing various energy scan services for HX-SASE, HX-SS, and SX-SASE.
- ❖ It will be more complex in case of both HX line and SX line operation.



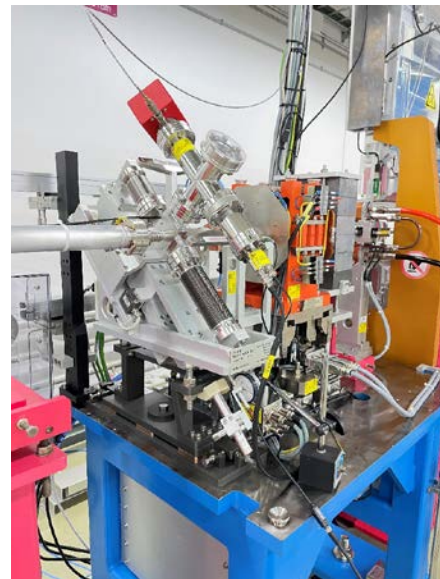
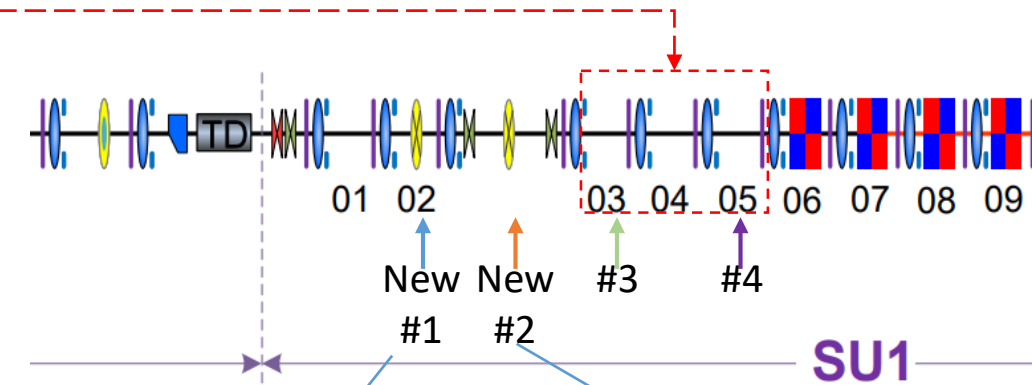
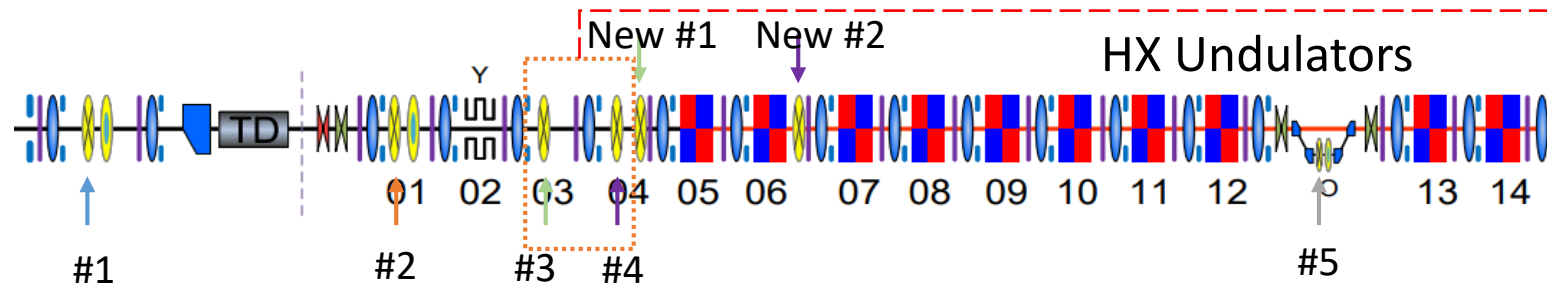
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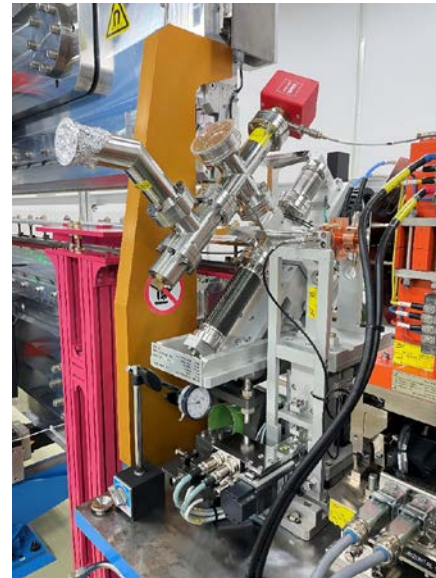


## Machine Status Update (II) : More Wire-scanners for Better Beam Matching

- ❖ Currently, there are no wire-scanners for the SX-undulator line.
- ❖ After finding best positions of the HXU, two wire scanners will be moved to the SXU in 2024.

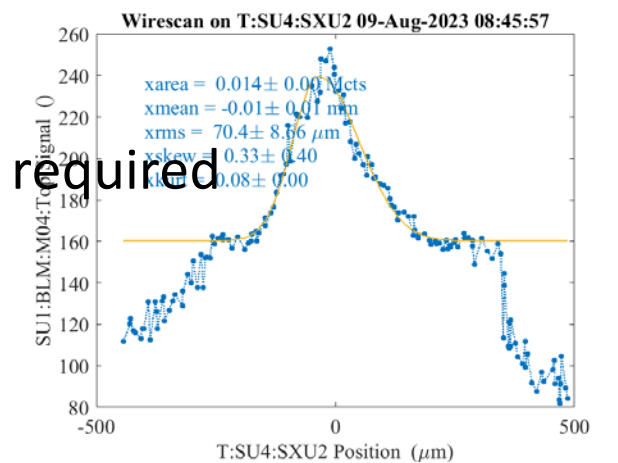
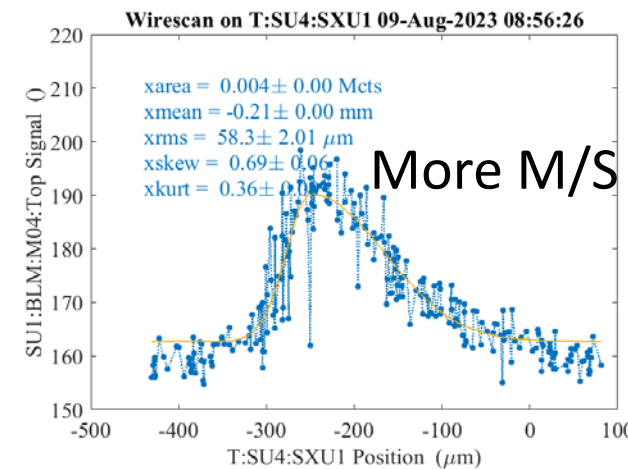


New #1  
HXU105 upstream



New #2  
HXU107 Upstream

- Wire specification
  - Diameter : 25  $\mu\text{m}$
  - Material : Al(99%)/Si(1%)



More M/S is required

## Machine Issues : Hardware Troubles

### ❖ Gun solenoid magnet cooling water leakage

- We are preparing for repairment in next maintenance period and purchasing a similar magnet.

### ❖ Klystron focusing magnet cooling water leakage

- We ordered four new ones in this year, and two of them have been delivered.

### ❖ Temperature controlled rack cooling water leakage

- The number of occurrence is reduced after exchanging whole modules two years ago, but still reported.

### ❖ PFN-capacitor oil leakage

- The number of PFN-capacitors broken is similar to previous year, but it dose not mean safe status considering 30 Hz operation in this year.

### ❖ Klystron drive amplifier repair problems

- Due to the vender's internal situation and device extinction, repairment for existing solid state amplifiers is not easy.

### ❖ VME type event-timing board production stop problems

- We are under field and lab testing by buying new micro-TCA base ones.

### ❖ Testing new PLC controller for the modulators for exchanging

- New version PLC controller is under test after completing the software importing.

## R&D Issues

### ❖ **Second Hard X-ray line**

- Under planning the detailed schedules and budgets based on current design.

### ❖ **Two bunches operation**

- Laser system is under developing. Preliminary tests are completed.
- BPM electronics simulator for two electric pulses have been implemented. Various filters are under testing.
- Kicker system similar to the SWISS-FEL's is under studying. Basic designing has been finished.

### ❖ **Atto-second FEL**

- Final machine design is under going.
- New laser facility is under construction above the SX undulator tunnel. Laser system is under developing.

### ❖ **UED facility operation**

- Now preparing for demonstration experiment cooperating with PAL-XFEL beamline experts.

### ❖ **Details will be presented in the next section**



**Thank you for your attention!**