

Summary Set-up & Optimization

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DESY

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Available guidance

XFEL Operations Scheduling Guideline

This document discusses the impact, and consequent limitations, some operation parameters requested (needed) by specific experiments at a scientific instrument and thus a specific FEL source have to the flexibility, interference and performance of the other FEL sources. In order to avoid/reduce these impacts, the scheduling of activities (experiments) at the different FEL sources needs to be optimized. This document attempts to provide an overview of such constraints and suggests specific restrictions in order to minimize the interference

The most important parameter in this regard are the achievable photon energy ranges for the FEL sources. The photon energy generally depends on the electron beam energy and the magnetic gap. Since we operate the electron accelerator at only one electron energy at the time, there is a strict connection between the possible photon energies for soft and hard X-rays. For each electron energy the variable magnetic gap allows a certain photon energy range to be attained (see Fig. 1 and Annex figures). However, the magnetic value is not a 'fully free' parameter. The further the gap is opened, the less is the magnetic field and the less is the control of the SASE process. In addition, the magnetic phase error is only compensated up to a certain max. gap value (20 mm for SA1/2; 25 mm for SA3) i.e., the operation gap range of the respective undulator system. It is for these reasons that the difficulty of achieving good lasing conditions and thus reaching high FEL performance (stability, pulse energy) is increasing with magnetic gap value (compare Fig. 1).

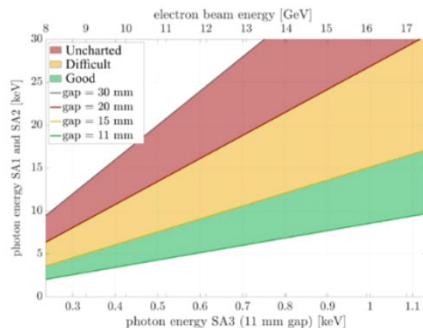


Figure 1: Photon energy range attainable at SA1/2 as a function of the SA3 photon energy.
The later corresponds to a specific electron energy, assuming a magnetic gap of 11 mm.
The colour code of the performance areas is explained in the text.

Non-Standard Operation Modes SASE3

Performance	Constraints	Additional Tuning Time	Available Techniques	Comments
Short pulses: < 5 fs > 500 uJ	Non-interleaved	1 Shift	Chirp/Dispersion/Compression potentially coupled with variable charge	Delivered several times. In most extreme cases down to single spikes.
Short pulses: < 10 fs	Reduced intensity compared to non-interleaved mode	1 Shift	Variable charge	
2 Colors: < 1 keV: > 400 uJ/pulse 1 - 1.5 keV: > 200 uJ/pulse 1.5 - 2 keV: > 100 uJ/pulse	<ul style="list-style-type: none">Pulse length of maximal 30fs for each color.Delay between 50fs and 500 fs (temporal pulse overlapping possible with a minimal color separation of 50 eV).	1 Shift	Split undulator	Delivered several times.
2 Colors & Short Pulses:	Non-interleaved	2 Shifts	Chirp/Dispersion/Compression Split undulator	Requires expert involvement

European XFEL Tuning Strategy

15 August 2025

Tuning of the accelerator and FEL sources, or even of other parts of the photon beamlines, shall be applied to achieve and maintain a high performance of the electron and x-ray beams. Usually, the tuning is part of setting up and preparing for a specific experiment and/or use of the beam. These tuning procedures are not addressed in this document, but rather tuning that is applied during the x-ray delivery period. As a general rule tuning shall occur only during defined periods and address only specific parameters to be tuned (see appendices). Excluded from these restrictions are tuning activities that are necessary after a failure or a major problem in accelerator operation.

Tuning activities that have no influence on other beamlines can be decided alone in consultation with the corresponding instrument colleagues. A list of these tuning activities can be found in the appendix A.

In general, there should be no tuning activities that have not been previously agreed upon.

Performance conservation tuning

In order to compensate for possible performance losses due to drifts etc., operators are instructed to carry out a number of minimally invasive tuning steps every day from 7:00 -7:30 am. The performance conservation steps are listed in Appendix B.

Tuning activities requested to boost a specific parameter

On working days

1. The shift crew and the RC evaluate the machine status in the morning and compare the current performance with the previous day's data. A list of important/critical parameters is provided for this purpose in appendix B.
2. A short summary of the status should be passed on from the RC to the PRC at 10 am via the logbook.
3. The PRC discusses the findings with the responsible colleagues of the instruments with priority status in the respective week, who will give feedback to the PRC by 12 noon whether tuning is necessary or not. Tuning will be applied if at least one of the instruments is requesting it.
4. The PRC informs the RC about the decision

Link to documents:

Working group members



Run Coordinators

Tuning specialists

Beamline scientists

Operation board

Suggested discussion points

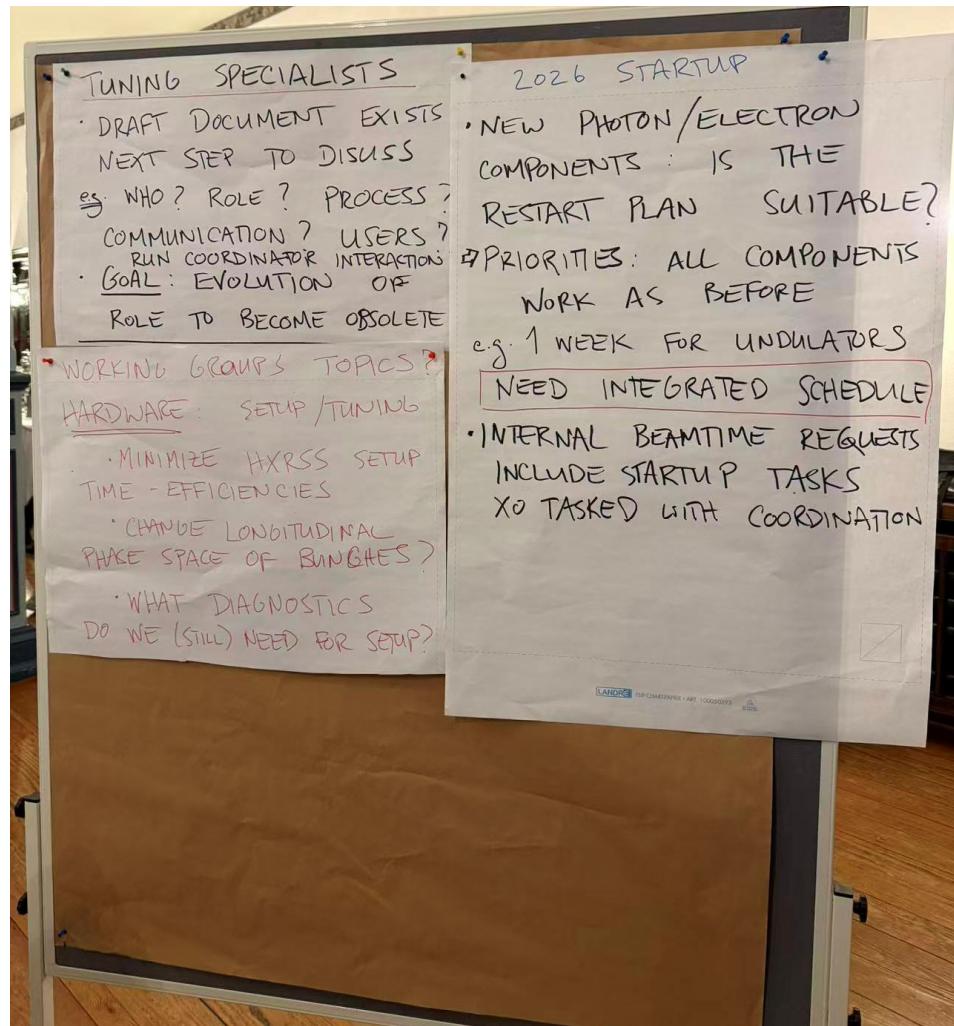
Working group Setup & Optimization

1.) Status

- a. Make a list of setup & optimization procedures at machine and experiments and rank them by the time they typically consume.
- b. Which of these procedures relate to standard versus non-standard operation modes? What make non-standard procedures non-standard?
- c. Review the documents provided by the Operations Board.

2.) Suggestions for improvements

- a. List the top five areas where you see most potential for improvements in time or quality.
- b. Make a list of actions that could lead to these improvements or are prerequisites.
- c. Make suggestions where the content of the Operation Board documents could be improved.
- d. Draw a picture of current setup and optimization procedures and the proposed improvements.



Beamline scientists

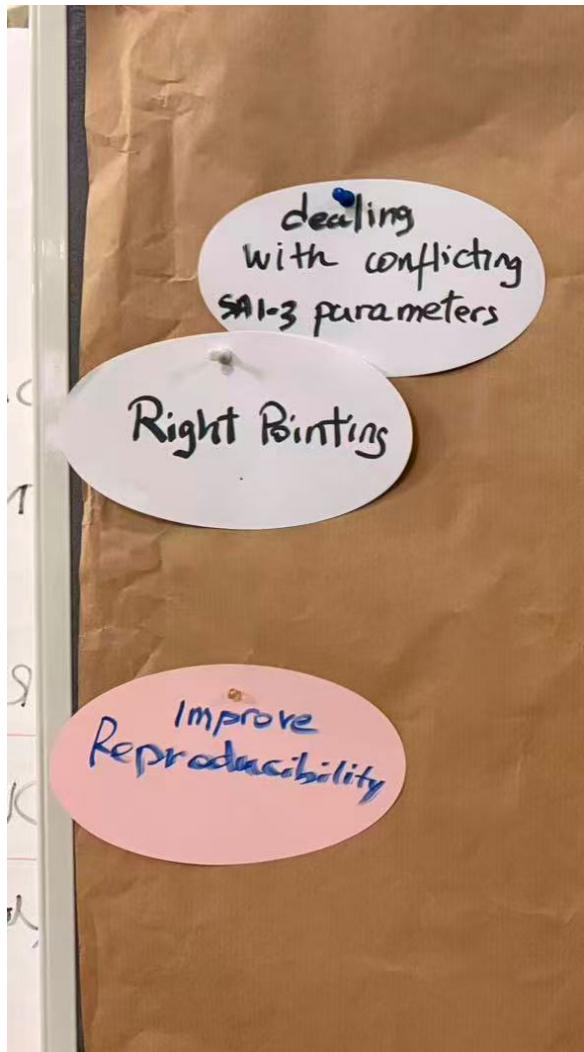
Tuning Specialists

**An ideal week of
operation...**

Run Coordinators

Operation board &
Management

Wishes from Beamline scientists



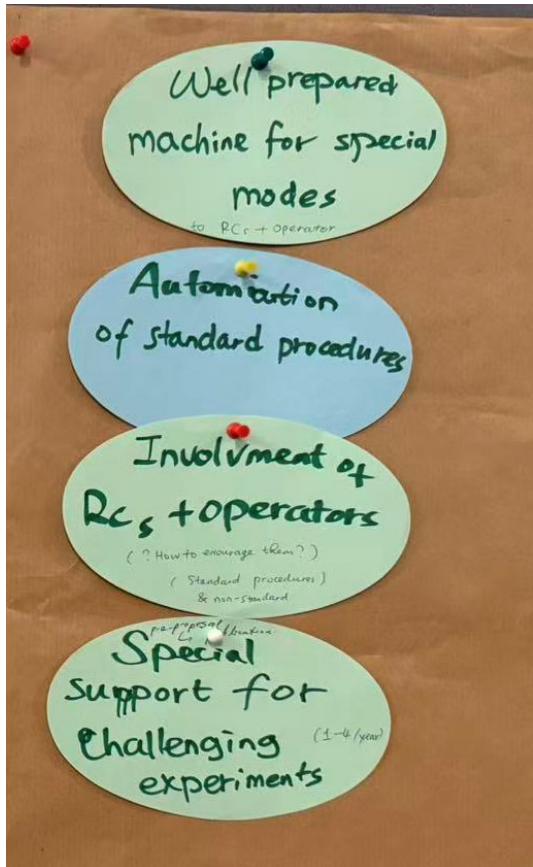
1. **Pointing -> educate operators how to better tuning pointing**
2. **Minimized cross talk -> better scheduling?**
3. **Daily operation meeting**
 - ❖ reminder to beamlines needed
4. **Usage of Tuesday evening/night: tuning starts at 14:00 on Tuesday afternoon (if setup done at 19:00 on Tuesday, what to do from 19:00-07:00 next day?)**
 - ❖ Parallel use in the night?
 - ❖ Arrange of personal from instrument side
 - ❖ SA1 and SA2 doesn't need but SA3 would like to have

Wishes from Run Coordinators



- **Hardware preparation for tuning (spectrometer, mirror alignment)**
 - ❖ User requests needs to be more specified, figure of merits of each experiment (spectral density, bandwidth) -> user questionnaires
 - ❖ Pointing (improvement of diagnostics in SA3, Improved BBA can help pointing with quad. movers)
 - ❖ Nbunch
 - ❖ Intensity
- **Any tuning required during the week (possible problems that may happen after delivery?)**
 - ❖ SA1 and SA3 crosstalk -> only visible after delivery?
 - ❖ Machine drifts during the week (7:00-7:30 minor tuning allowed)
- **Friday user operation meeting (additional 5 min. discussion on next Tuesday -> preparation for next users)**

Wishes from Tuning Specialists



- **Users: define ways to appreciate the contributions from Tuning Specialists, RCs and operators**
- **More people joining HXRSS setup and tuning (HXRSS training and demo for RCs and operators) -> machine time? availability of people?**
- **Definition of end of tuning (pointing important) -> standardize the definition and use automation tools to achieve this**
- **Decision if special mode fails -> when and who decides?**

To dos for everyone...

Photon side (Beamline scientists & Photon diagnostics and optics)

- Improve the user questionnaire
- Use Friday meeting to discuss preparations for next users

- Hardware preparation for tuning (spectrometer, mirrors)

- Define ways to appreciate the contributions from Tuning Specialists, RCs and operators

Run Coordinators

- Standardize procedures

- Reproducibility of machine

- Definition of end of tuning
- Decision if special mode fails

Tuning Specialists

- Specify starting point for special mode

Operation board & Management

- Better scheduling (avoid conflicts)

Your wishes and to dos for us and others...?
(Set-up & Optimization)