FXE Instrument Parameters for Early User Operation

All parameter are subject to change, pending the commissioning process.
Note in particular that for grey parameters/devices availability has to be cross-checked with the FXE instrument scientists.

Please discuss your experiment plans with an FXE instrument scientist **before** submitting your proposal.

They can help you with any details that may have been updated, assist with evaluating the experiment feasibility, and much more.

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Photon Beam Parameters

Photon energy	**6-14 (5-10) keV**	potentially changeable
Pulse energy	**1 mJ**	measured, (0.35 mJ calculated, at saturation)
Electron bunch charge	**0.25 nC**	
Photons per pulse	**3.6 × 10^{11}**	calculated for 0.5 nC at 8.979 keV
Pulse duration	**25 fs**	calculated from e- beam properties (50 fs at 0.25 nC)
Spot size on sample	**~ 15 µm** (focus)	calculated (2 µm), variable up to ~100 µm
Photons/µm² on sample	***ca.* 10^{10}**	derived
Train repetition rate	**10 Hz**	fixed
Intra-train repetition rate	**1.1 MHz**	possibly changeable to 4.5 or 0.1 MHz
No. of bunches per train	**300**	possibly variable between 1 and 300
Pointing stability	**2 µrad**	possibly drifting over entrance apertures
$\Delta E/E$	**< 0.2%**	calculated
Primary 4-bounce monochromator	$\Delta E/E = 10^{-5}$	calculated

Beam and Timing Diagnostics

(Technical Design http://www.xfel.eu/research/instruments/fxe)

Spectrum analyzer	Spectral fingerprint of beam using crystal diffraction
Post-sample diagnostics bench	Beam position, intensity, spectrum
Timing tool	**~ 20-40 fs (calculated), temporal, spatial, interferrometric**

Sample Delivery System

Liquid flat-sheet jet/ Cylindrical jet	**100 µm, 300 µm/ 20-200 µm**	fixed, for wide range of viscosities
Swivel/translation sample stack		more details at **http://www.xfel.eu/research/instruments/fxe**

Scattering: Large Pixel Detector (LPD) Parameters

No. of pixels	**1024 × 1024**	4 quadrants, each 512 × 512 pixels
Pixel size	**500 × 500 µm²**	
Sensor	**Si, 500 µm**	
Max. frame rate	**4.5 MHz**	
Memory depth	**510 images**	per pulse train (with vetoing capability)
Sample-detector distance	**80 – 1500 mm**	on motorized stage
Central hole diameter	**10 mm**	Q_{min}(9 keV, 100 mm distance) = 0.32 1/Å
Max. Q range at 9 keV	**~ 5.1 1/Å**	at edge of detector for hole-centred beam (100 mm)
Max. Q range at 14 keV	**~ 7.9 1/Å**	at edge of detector for hole-centred beam (100 mm)
Dynamic range	**10^5** at 9 keV	
Quantum efficiency	**98%** at 9 keV	**89%** at 12 keV, **38%** at 20 keV

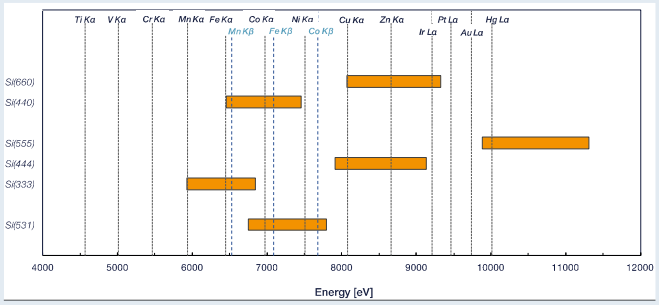
XES: von Hamos Spectrometer

Crystal bending radius	**500 mm**	
Total number of tiles	**16** (30 × 110 mm²)	
Angular range (1 crystal)	**~ 2.8°** (θ = 80°)	~ 1.15° (θ = 60°)

Detectors

	"GreatEyes" (2D)	**GOTTHARD** (1D)
Detector efficiency	**~ 90%** (5 keV), **> 25%** (10 keV)	**> 90%** (5 – 10 keV), **> 50%** (15 keV)
Detector frame rate	**10 Hz**	**40 kHz – 0.8 MHz**
No. of pixels (pixel size)	**1024 × 256** (26 × 26 µm²)	**1280 × 1** (50 µm × 8 mm)
Pixel dynamic range	**~ 350** at 7 keV	**10^4** at 12 keV

Available Crystals and Energy Coverage in 60° – 90° Geometry



XES: Johann Spectrometer

Crystal radius of curvature	**1 m**	2 m will be available in the future
Total number of crystals	**up to 5**	10 cm diameter
Detector and characteristics	**APD, PIN diode**	MHz readout possible
	GOTTHARD	see above
Available crystals	5 × **Si(220)**	

Optical Laser Systems Parameters

Three synchronised femtosecond to picosecond laser systems will be available. All laser pulses can be time delayed with respect to the X-ray pulse over a range of 4.6 ns in steps of 2.5 fs. Optical parametric amplification, white light generation schemes and laser system II should become available after the early user experiments. In addition, CEP-stable single-cycle terahertz pulses can be generated using optical rectification, with a centre frequency of 0.3 THz (1 mm wavelength) and ~50 µJ pulse energy at 100 kHz repetition rate will be available in the near future.

	pump-probe laser system I		**pump-probe laser system II**		**pump-probe laser system "Tangerine"**	
wavelength	**800 nm**		**1030 nm**		**1030 nm**	
pulse duration	**15 – 300 fs**		**0.8 – 500 ps**		**350 fs**	
train repetition rate	**10 Hz**		**10 Hz**		**N/A**	no burst mode operation; quasi cw
intra-train repetition rate	**1.1 MHz**	variable, down to 100 kHz	**4.5 MHz**	**variable, down to 100 kHz**	**4.5 MHz**	variable, down to 100 kHz
wavelength conversion	**SHG, THG**	no OPA in Run 1	SHG, THG, THz	no OPA in Run 1	**SHG, THG, FHG**	no OPA in Run 3
pulse energy (fundamental)	**160 µJ at 1.1 MHz**	up to 1 mJ at 100 kHz	**1 mJ at 4.5 MHz**	**up to 40 mJ at 100 kHz**	**5 µJ**	
efficiency of 2nd harmonic gen	**t.b.d.**		**t.b.d.**		**~ 40%** at 400 kHz	
efficiency of 3rd harmonic gen	**t.b.d.**		**t.b.d.**		**~ 10%** at 400 kHz	
efficiency of 4th harmonic gen	**N/A**		**N/A**		**~ 5%** at 400 kHz	
arrival time jitter w.r.t. X-rays	**100 fs**	estimated	**t.b.d.**		**t.b.d.**	

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Parameters may change at any time