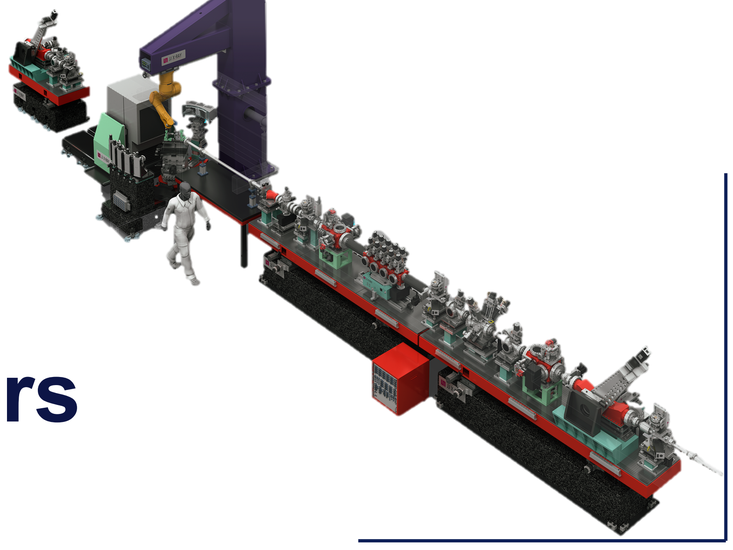


FXE Instrument Parameters for Early User Operation

All parameters are subject to change, pending the commissioning process of both the accelerator and the instrument.

Please discuss your experiment plans with your 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.

Contacts: **fxe-instrument@xfel.eu** **sample.environment@xfel.eu** **useroffice@xfel.eu**

X-Ray Photon Beam Parameters

photon energy	**9 keV**	Possible option: adjustable 7 -14 keV
pulse energy	**0.5 mJ**	at 9 keV
photons per pulse	**3.5×10^{11}**	at 9 keV
pulse duration	**50 fs**	calculated from e- beam properties
spot size on sample	**~ 10 µm** (focus)	variable up to ~100 µm
photons/µm^2 on sample	**$>3.5 \times 10^{9}$**	derived
train repetition rate	**10 Hz**	fixed
intra-train repetition rate	**1.1 MHz**	Possible option: 4.5 MHz, possibly 100 kHz, arbitrary pulse pattern
no. of bunches per train	**1-60**	Possible option: from 1 to 300
pointing stability	**2 µrad**	possibly drifting over entrance apertures
$\Delta E/E$	**~ 0.2%**	calculated

Scattering: Large Pixel Detector Parameters

no. of pixels	**1024 × 1024**	4 quadrants, each 512 × 512 pixels
pixel size	**500 × 500 µm^2**	
sensor	**Si, 500 µm**	
distance sample-detector	**100 mm – 1.5 m**	on motorized stage, up to 8 m manually
central tube diameter	**4, 10 mm**	Q_{min}(9 keV, 100 mm distance) = 0.13 Å^{-1}, 0.32 Å^{-1}
central hole size	**1 – 30 mm**	
max. Q range at 9 keV	**~ 5.1 Å^{-1}**	at the edge of detector for hole-centred beam (100 mm)
dynamic range	**10^5** at 12 keV	
quantum efficiency	**89%** at 12 keV	**98%** at 10 keV, **38%** at 20 keV

Possible Added Instrumentation*

Laser-X-ray timing tool	**< 100 fs**	Cross correlation time
Single shot spectrum analyzer	~0.1 eV resolution	at 7 keV, single burst XANES possible
4-bounce primary monochromator	**Si(111)**	5-14 keV possible
*) inquire to FXE staff about the availability		

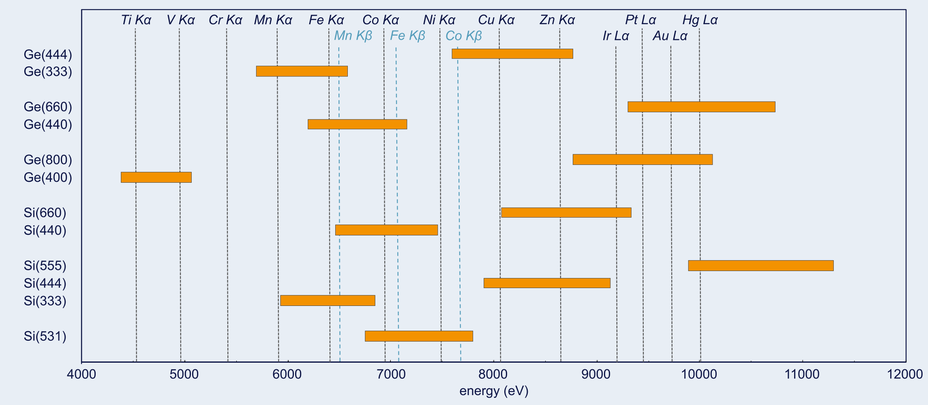
XES: von Hamos Spectrometer

crystal bending radius	**500 mm**	
total number of tiles	**16** (30 × 110 mm^2)	
angular range (1 crystal)	**~ 2.8º** (θ = 80º)	~ 1.15º (θ = 60º)

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 µm^2)	**1280 × 1** (50 µm × 8 mm)
pixel dynamic range	**~ 350** at 7 keV	**10^4** at 12 keV

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



XES: Johann Spectrometer

crystal radius of curvature	**1 m**	
total number of crystals	**up to 5**	10 cm diameter
detector and characteristics	**APD, PIN diode**	MHz readout possible
	GOTTHARD	see above
available crystals	**Si(220), Si(111), Si(531), Si(400), Si(620), Si(551)**	(* inquire with FXE staff about the availability)

Sample Delivery Systems

liquid flat-sheet jet	**100 µm, 300 µm**	fixed, for wide range of viscosities
liquid flat-sheet jet	**1 – 100 µm**	variable, for water and low viscosity liquids (inquire with FXE staff in case of interest)
slow fixed target sample	**"XFEL design"**	

Optical Laser Systems Parameters

Three synchronised femtosecond to picosecond laser systems will be available. In addition, CEP-stable single-cycle terahertz pulses (inquire to FXE staff about the availability) 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. 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 and white light generation schemes are being investigated and will be available in Run 2.

	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**	Close to TL	**0.9 or 500 ps**	Compressed or chirped	**300 fs**	
train repetition rate	**10 Hz**	burst duration up to 300µs	**10 Hz**	burst duration up to 300µs	**0.188 – 4.5 MHz**	variable, burst mode operation possible
intra-train repetition rate	**4.5 MHz or 1.1 MHz**	variable, down to single pulse	**4.5 MHz or 1.1 MHz**	variable, down to single pulse	**4.5 MHz**	variable, down to 100 kHz
wavelength conversion	**SHG, THG**	no OPA in this Run	**SHG, THG, THz**		**SHG, THG, FHG**	no OPA in this Run
pulse energy (fundamental)	**50 µJ / 200µJ**	at 4.5 / 1.1 MHz	**1 mJ / 4mJ**	at 4.5 / 1.1 MHz	**~ 6 µJ/ 25 µJ**	at 4.5 / 1.1 MHz
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**		**t.b.d.**		**~ 5%** at 400 kHz	
arrival time jitter w.r.t. X-rays	**<100 fs**	estimated	**<100fs**	estimated	**t.b.d.**	

Christian Bressler, christian.bressler@xfel.eu, +40 40 8998 1909 (phone), +49 40 8994 1909 (fax)
European XFEL GmbH, Holzkoppel 4, 22869 Schenefeld, Germany, **www.xfel.eu**

October 10th , 2017
Parameters may change at any time