Beam properties and status for SASE 3 FEL and optical laser



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SASE3 FEL and Optical Laser parameters for SQS



	SASE3 photon beam parameter	Available for users 2021
	Photon energy [eV]	500-1500 (@11.5 GeV) 660-2500 (@14 GeV) 920-3000 (@16.5 GeV)
	Spectral bandwidth	~1% (SASE); <0.1% (monochromator; E/ΔE=3000 @870eV) 2-color double pulses with controlled delay over the whole hv range possible
	Pulse duration	Nominal 30 fs / special modes < 10 fs
	Pulse energy	>10 mJ depending on photon energy and undulator settings
	Focus size in F1'	1-2 µm, can be made larger
	Repetition rate	Up to 4kHz effective (up to 400 pulses per train at 2.25MHz intratrain)
A	Polarization	Linear horizontal
	Laser	
	Optical laser	800 nm, 15 or 50 fs, 0.2mJ@1.1MHz / 1mJ@188kHz; SHG and THG available
		Multi-pass cell to deliver 1030nm, <50fs, 2mJ @MHz rep rate in development. Harmonics to 515nm and 343nm will be available.

NQS 🔒

Time resolution using timing tool: < 20 fs

Photon energy tunability and bandwidth

- Undulator can be tuned within seconds
- Automated scans are possible (for very big scan range automation can be hampered)





M. Simon et al., beamtime 2610, manuscript under preparation

SASE pink beam bandwidth is typically 1%, but...

FEL bandwidth can be tuned by adjusting the bunch compression



FEL pulse duration

- Nominal conditions give 30 fs, as given by spectral correlation function measurements
 - Special modes:
 - Low charge (100 pC):

Same power at about half the pulse duration wrt to the nominal operation condition

Non-linear compression:

Extreme compression settings allow to go for pulse duration well below 10 fs. Strong fluctuation in both power and pulse duration



This is NOT a mode of operation that is routinely available for use!

Pulse energy and source geometry



To get high pulse energy, one must accept that the source is extended over several 10s of meters!

European XFEL



SQS X-ray beam transport layout at SASE3

XTD10





SQS X-ray beam transport layout at SASE3



SQS X-ray beam transport layout at SASE3





X-ray beam transport and focusing performances



Impact of the extended source on the focusing performances, IMFH



radiation per cell (m)

0

2

12 14 16 18

10

20 22

Tommaso N





SASE3 Optical Laser



X-ray – optical laser timing jitter at the experiment



Measured jitter < 10fs RMS (see presentation by Thomas Baumann)



Optical parametric amplifier





- >5uJ delivered at 5-10um
- Orpheus ONE-HE pumped with 1.7mJ (effectively <1mJ) at 1kHz</p>
- Optimization was not completed (measurements from March 2020!); the theoretical values (2-3x higher) should be reachable

Pump at 1.1MHz in development

People

- Gianluca Geloni, Svitozar
 Serkez (FPH);
 Marc Guetg (DESY)
 - Maurizio Vannoni (XRO), Daniele La Civita (ME), Harald Sinn (Instrumentation department)
 - The SQS group















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