

Capabilities of intense X-ray sciences at BL3

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on behalf of SACLA

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Focusing capabilities

EH2 fs optical laser system & Be lens (spot size: 2-20 μm)

Free space $\sim 3\text{ m}$

Be CRLs

Tuning time: ~ 2 hours
Lifetime of focus: > 72 hours

Available photon energy: 5~15 keV
Throughput of optics: 25~60 %
Typical focus size: 1~2 μm fwhm
T. Katayama et al., JSR 26 (2019)

EH4c Space for sub-10 nm advanced KB (AKB) optics

Free space (3 m)

KB (1 μm)

1 μm -KB

Tuning time: ~ 2 hours
Lifetime of focus: > 72 hours

Available photon energy: 4~20 keV
Throughput of optics: > 90 %
Typical focus size: 1 μm fwhm
K. Tono et al., Proc. SPIE 10237 (2017)

sub10nm-AKB (removable)

→ breakout session B2 for details

Tuning time: 6~8 hours
Lifetime of focus: > 12 hours

Available photon energy: 9.1 keV
Throughput of optics: ~ 40 %
Designed focus size: < 10 nm fwhm

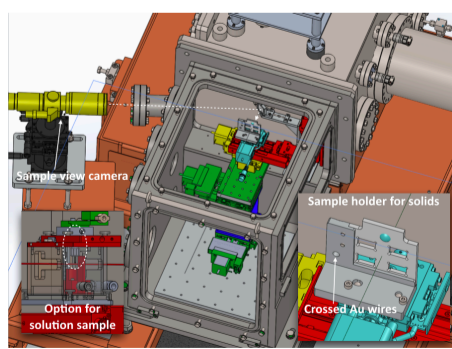
EH5 KB (500 nm)+ High-power optical laser (HPL) '100exa' KB (100 x 200 nm^2)

Free space (5 m)

'100exa' system

Tuning time: ~ 4 hours
Lifetime of focus: > 12 hours
Available photon energy: < 12 keV
Throughput of optics: ~ 80 %
Typical focus size: 100x200 nm fwhm

H. Yumoto et al., Appl. Sci, 10 (2020)



500nm-KB for HPL

Tuning time: ~ 2 hours
Lifetime of focus: > 24 hours

Available photon energy: < 12 keV
Throughput of optics: > 80 %
Typical focus size: 500 nm fwhm
Y. Inubushi et al., Appl. Sci, 10 (2020)

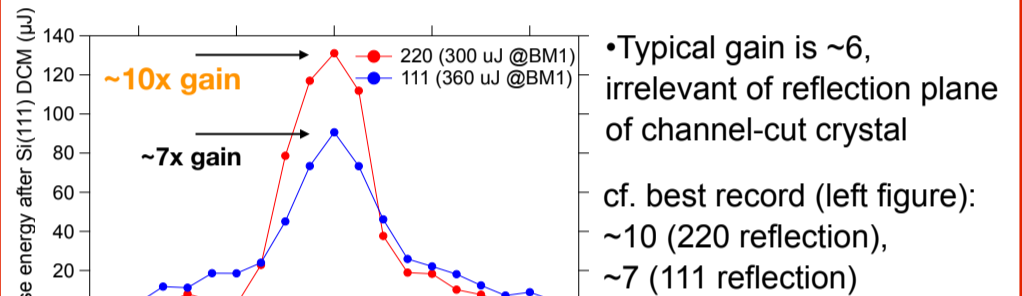
Self-seeded XFEL (only available at BL3)

Applicable photon energy:

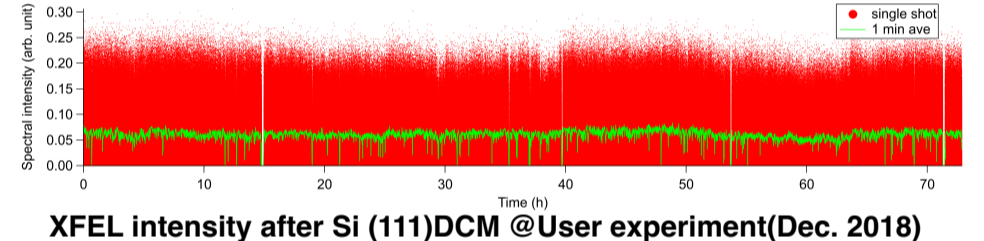
- < 8 keV (in principle)
- 8-12 keV (confirmed)

Inoue et al., Nat. Photon. 13 (2019).
Osaka et al., JSR 28 (2019).
Matsumura et al., Opt. Exp. (2020).

Gain of spectral brightness (compared with normal SASE XFEL)



Long term stability: seeding is stable over 3 days



Two-color XFEL (only available at BL3)

Total pulse energy (1st color + 2nd color): ~ 200 μJ
Maximum photon energy separation: ~ 6 keV
Maximum time interval between twin pulses: ~ 300 fs

Hara et al., Nat. Commun. 4 (2013).
Inoue et al., PNAS 113 (2016).

Advanced two-color mode (SASE beam+seeded beam)

Inoue, JSR 27, 1720 (2020)