Capabilities of intense X-ray sciences at BL3

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on behalf of SACLA

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Focusing capabilities

EH2

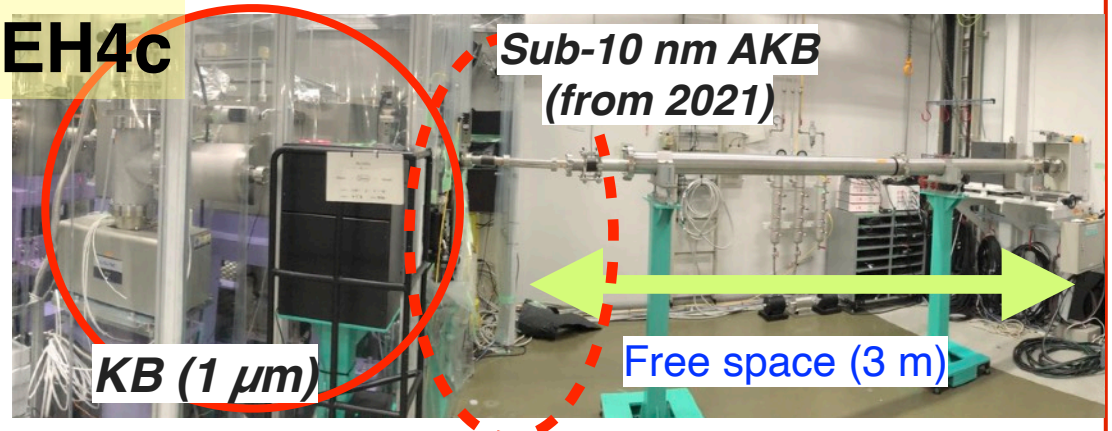
Be CRLs

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



1μm-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**

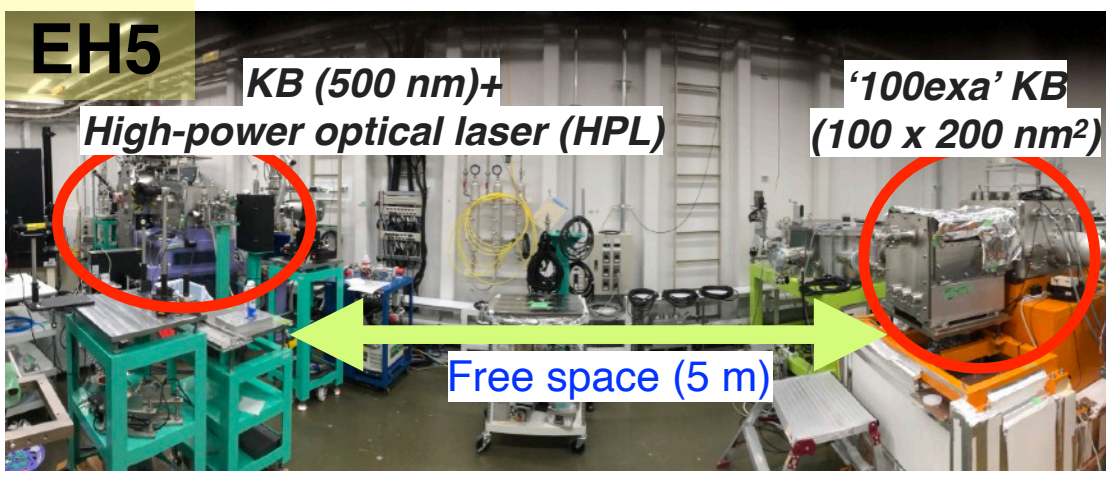
K. Tono *et al., Proc. SPIE 10237* (2017)

sub10nm-AKB (from 2021)

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**

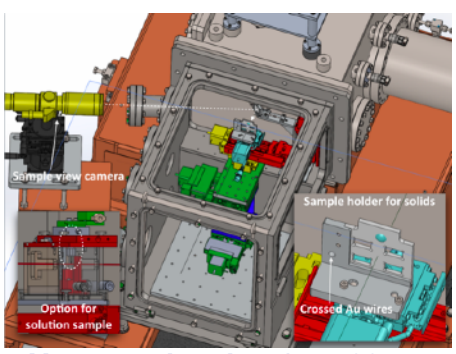
EH5



'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)



Vacuum chamber for *100exa*

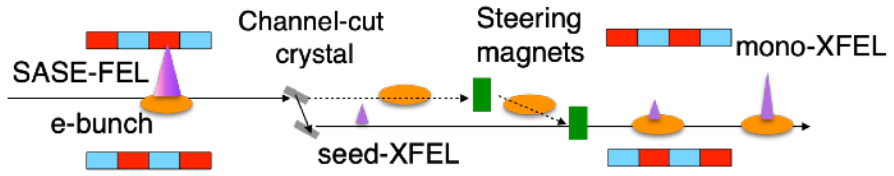
500nm-KB for HPL

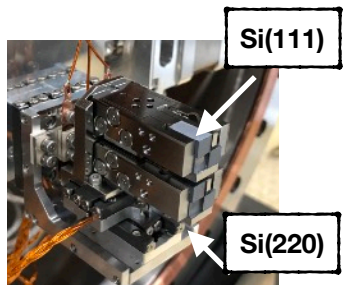
Tuning time: **~2 hours**
Lifetime of focus: > **24 hours**

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)



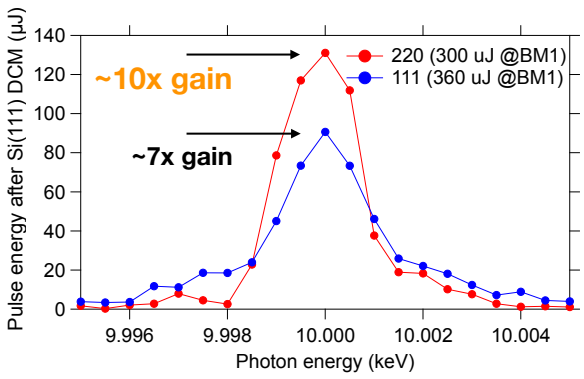


Applicable photon energy:

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

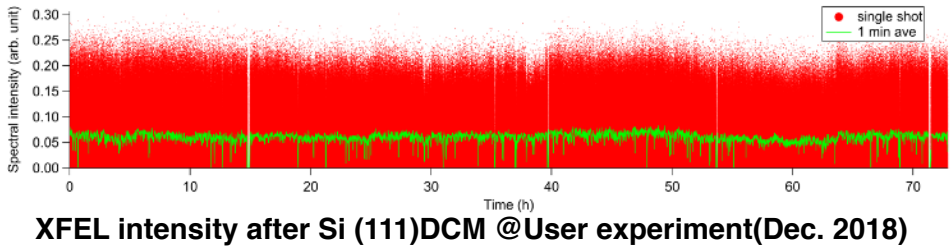
Inoue *et al., Nat. Photon.* 13 (2019).
Osaka *et al., JSR* 28 (2019).
Matsumura *et al., Opt. Exp.* (2020).

Gain of spectral brightness (compared with normal SASE XFEL)



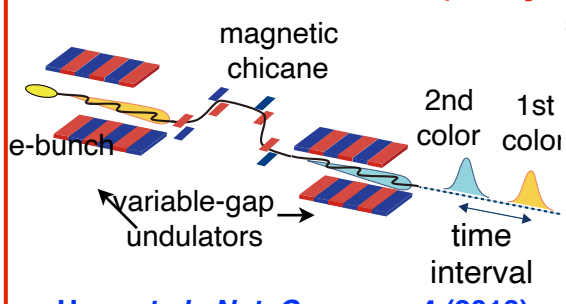
- Typical gain is ~6, irrelevant of reflection plane of channel-cut crystal
- cf. best record (left figure): ~10 (220 reflection), ~7 (111 reflection)

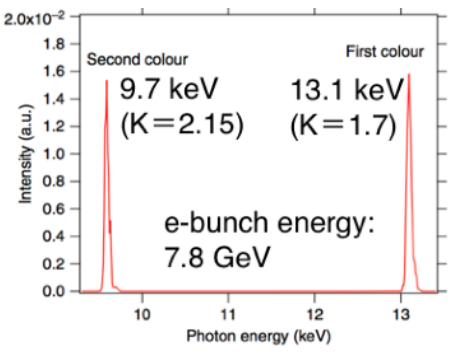
Long term stability: seeding is stable over 3 days



XFEL intensity after Si (111)DCM @User experiment(Dec. 2018)

Two-color XFEL (only available at BL3)

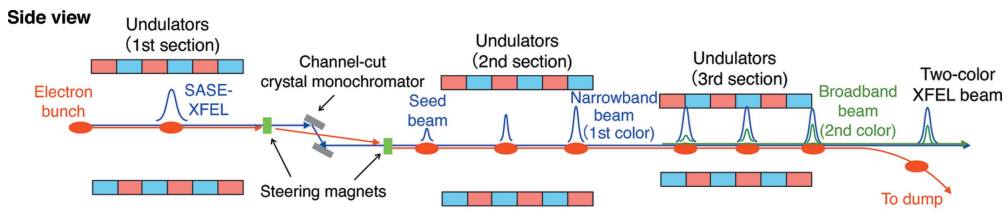


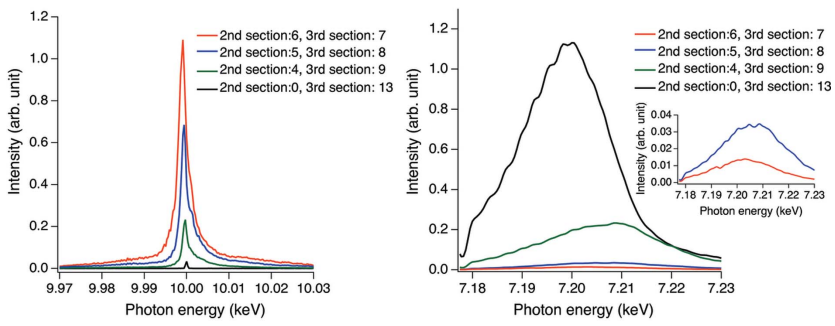


Hara *et al., Nat. Commun.* 4 (2013).
Inoue *et al., PNAS* 113 (2016).

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

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





Inoue, JSR 27, 1720 (2020)