8th XFEL 5-way collaboration meeting

X-ray optics development at SACLA

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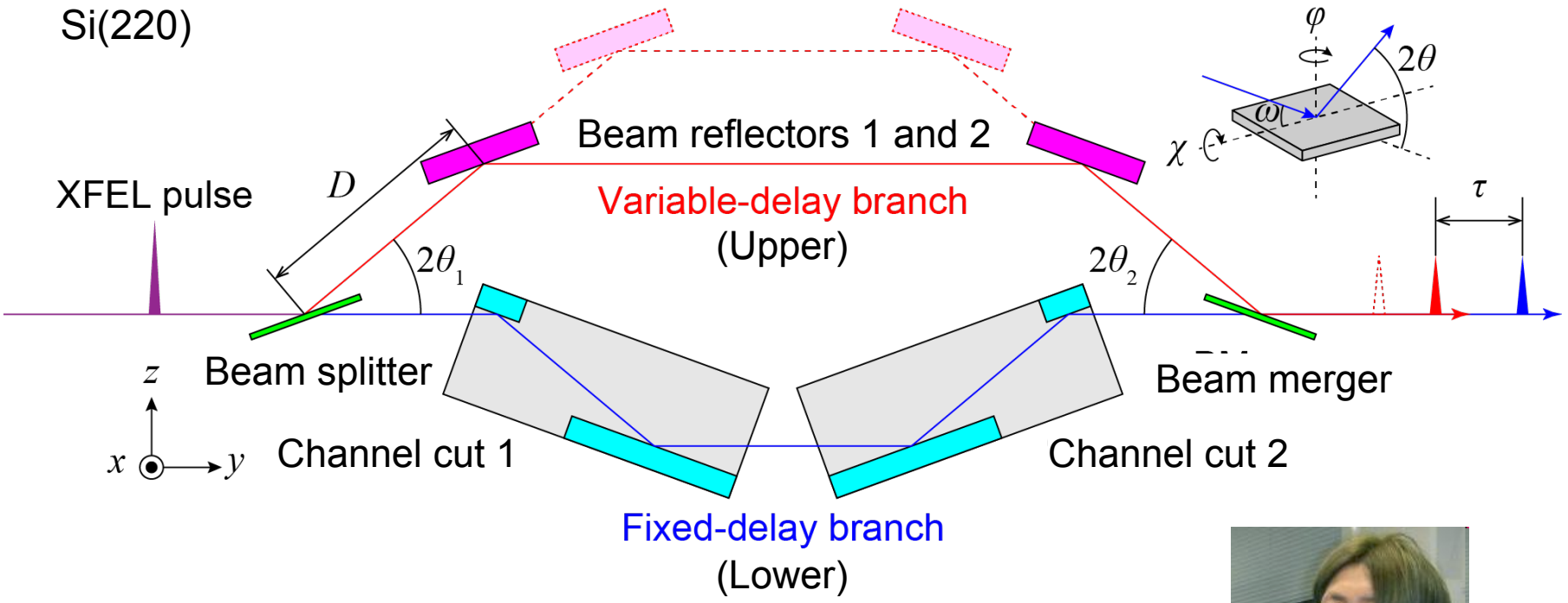
1. Split-delay optics
2. HBT experiment
3. Self seeding with micro channel-cut crystals

Crystal arrangement of SDO system @SACLA



Crystal diffraction:
Large time delays (~ sub-ns) with fs resolution
High energy resolutions ($\Delta E/E < 1\text{x}10^{-4}$)

Two independent delay branches:
Enables access to time zero

Use of channel cuts:
Much stabilized operation

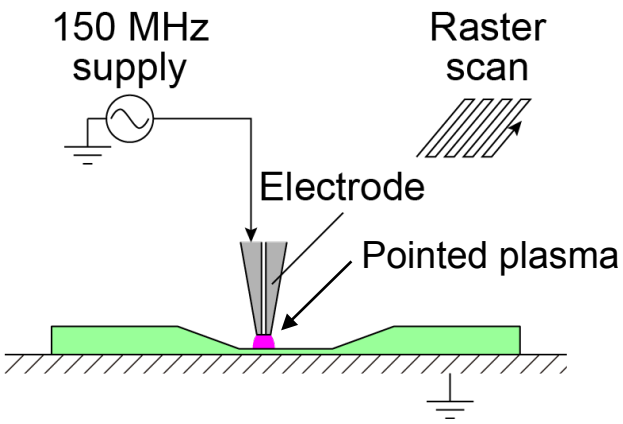
Osaka-san
(Osaka U → SACLA)

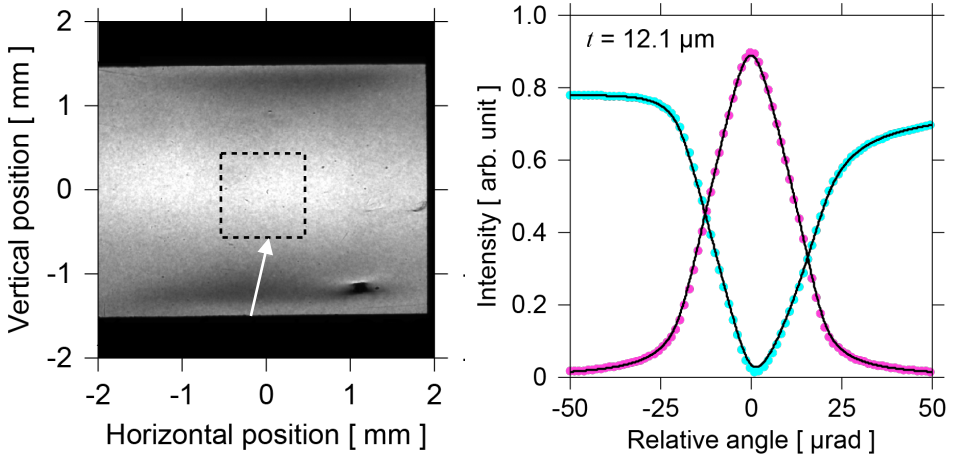
Collaboration with SLAC & DESY

Key optical devices

Thin crystal beam splitter/merger:

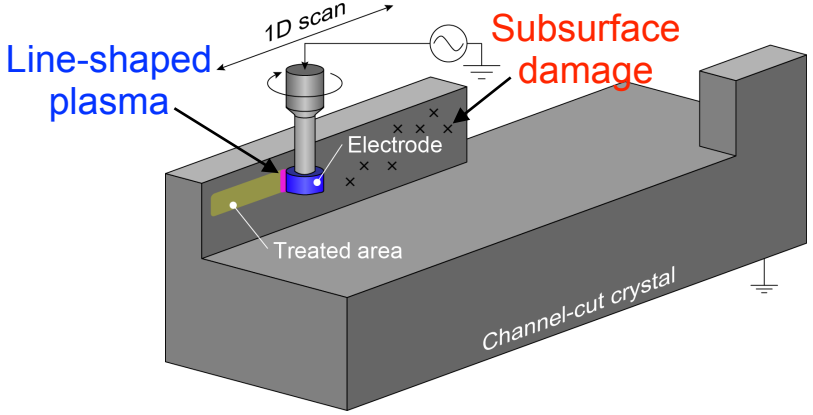
T. Osaka et al., OE **21**, 2823 (2013).

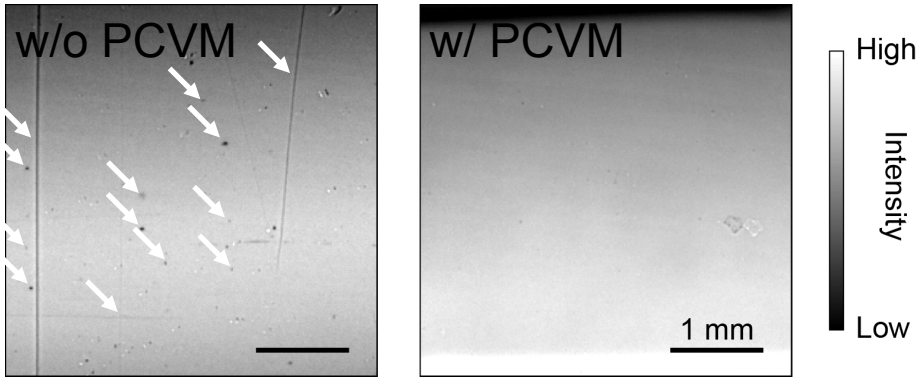




Channel cut crystals:

T. Hirano, T. Osaka et al., in reviewed.

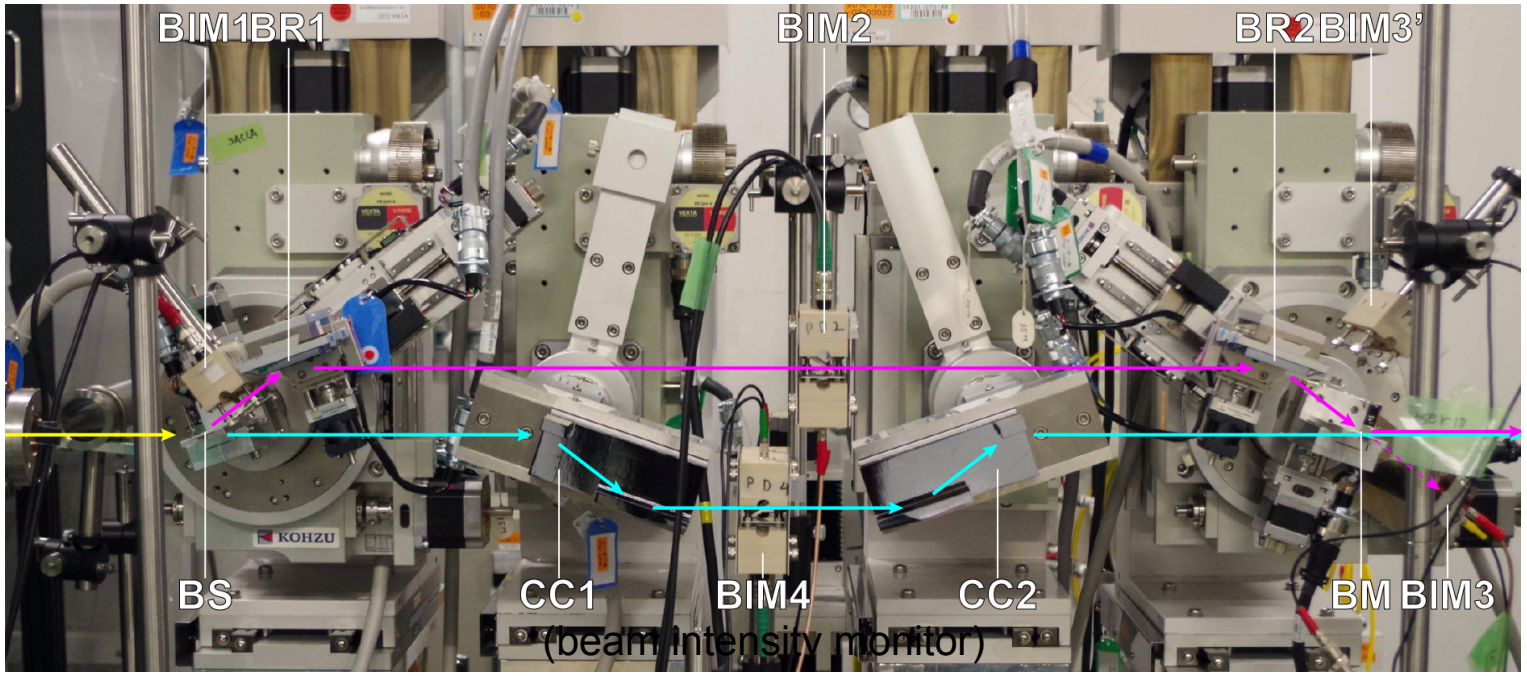




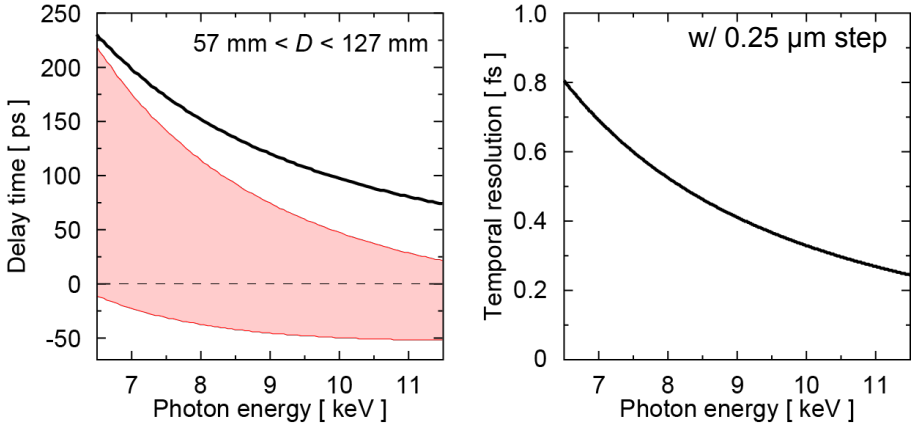
Both crystal devices were fabricated using a plasma etching technique.

PCVM: non-physical contact, damage-free, controllable plasma size

Prototype SDO



Built with all commercial components for motion control.
Each intensity diagnostic module consists of thin Kapton film scatter and photodiode.

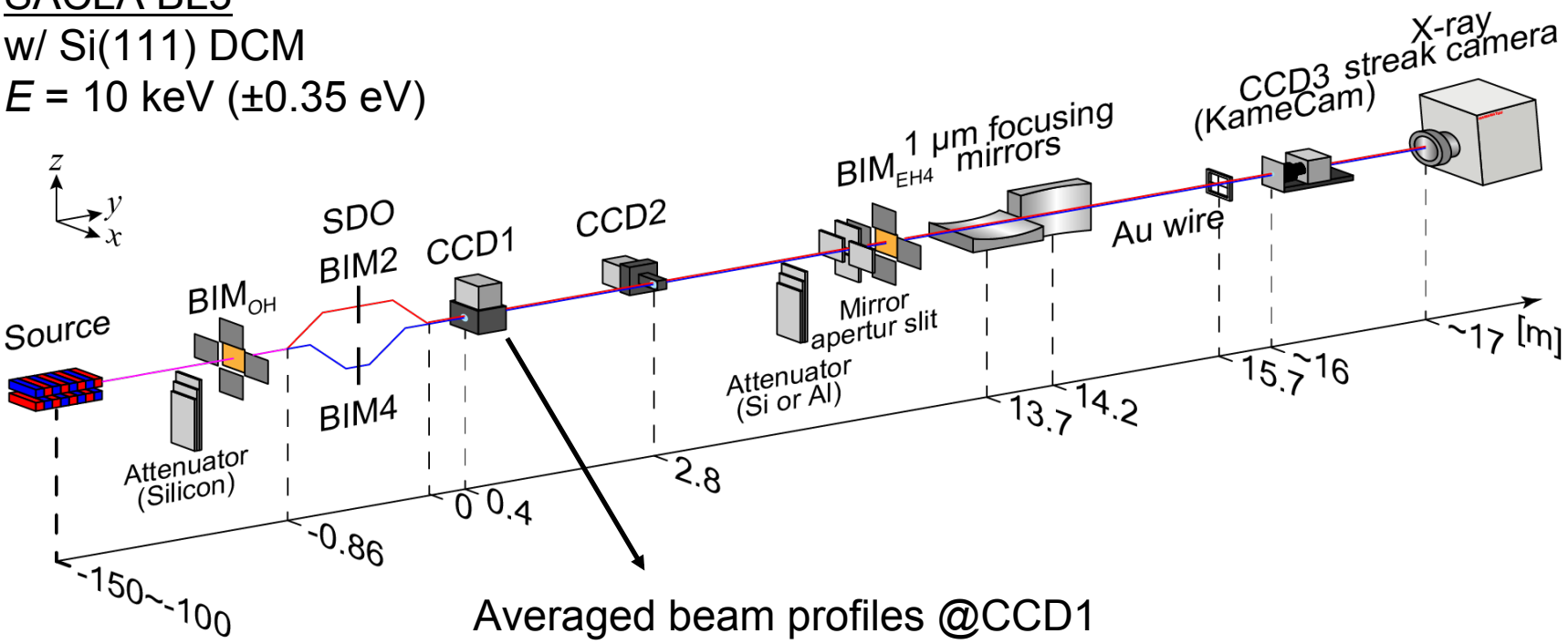


Photon energy range
6.5 keV ~ 11.5 keV

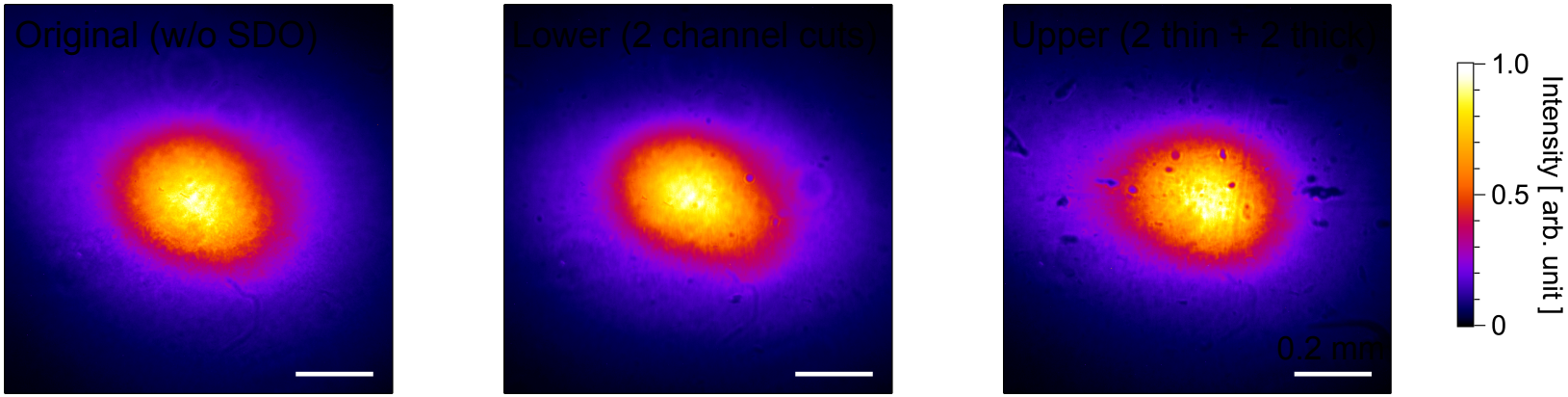
Delay time range @10 keV
−50 ~ +47 ps w/ <1 fs step
(up to 220 ps @6.5 keV)

Performance test @SACLA: Experimental setup

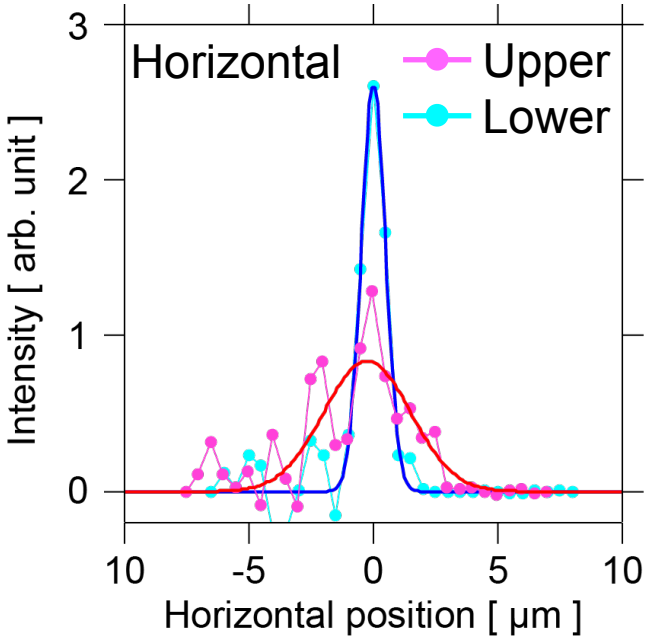
SACLA BL3
w/ Si(111) DCM
E = 10 keV (±0.35 eV)

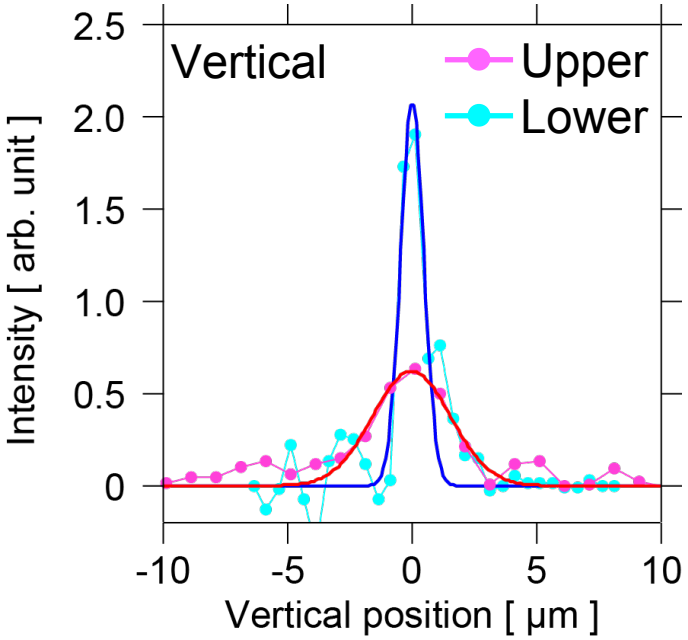


Averaged beam profiles @CCD1



Focal profiles

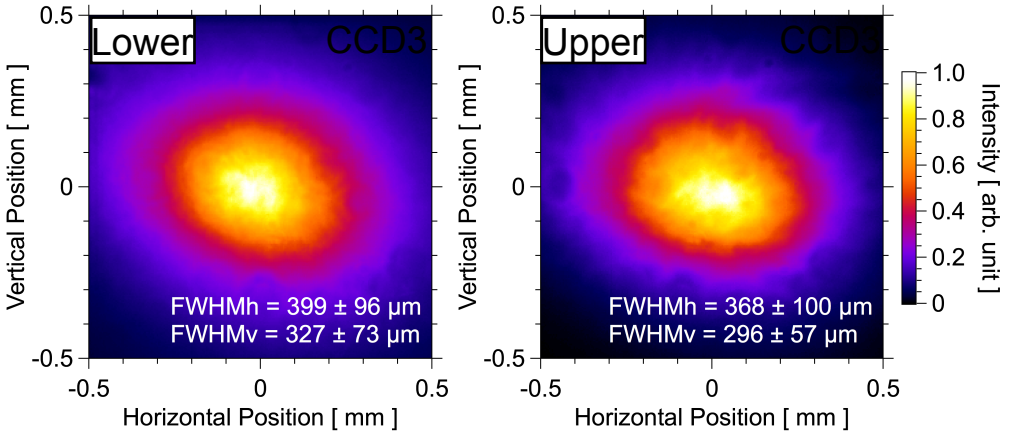




Lower: 1.1 μm × 1.1 μm (H × V)

Upper: 4.1 μm × 3.7 μm (H × V)

Distortion of upper branch mainly due to small lattice strain in thin crystals



Beam profiles @CCD3 (16 m downstream)

Summary

- We continue to develop challenging x-ray optics
- Identification of key targets are very important; What come next ?

  e.g., Tight focusing of non-collinear two beams to single point for NL X-ray optics

End