

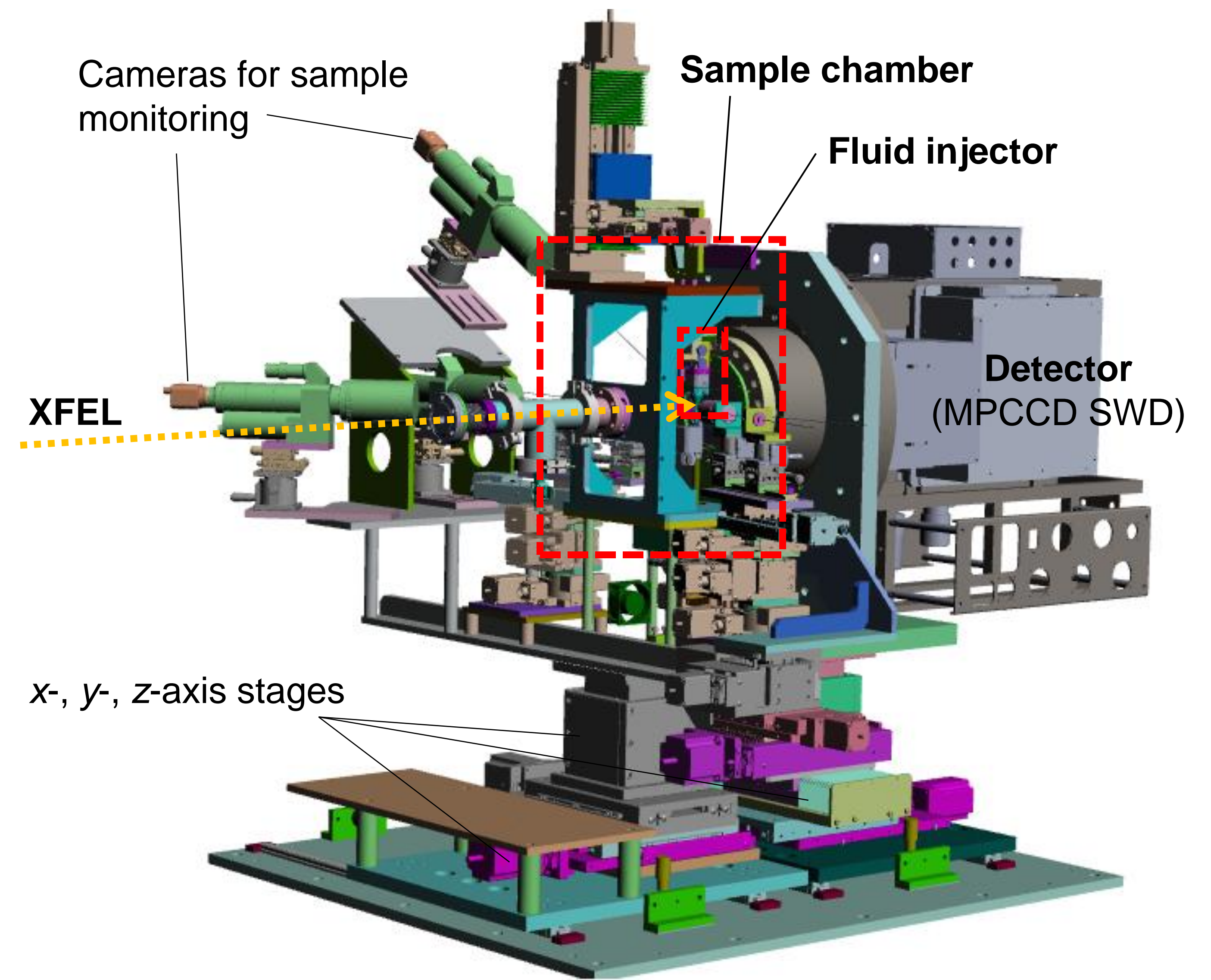
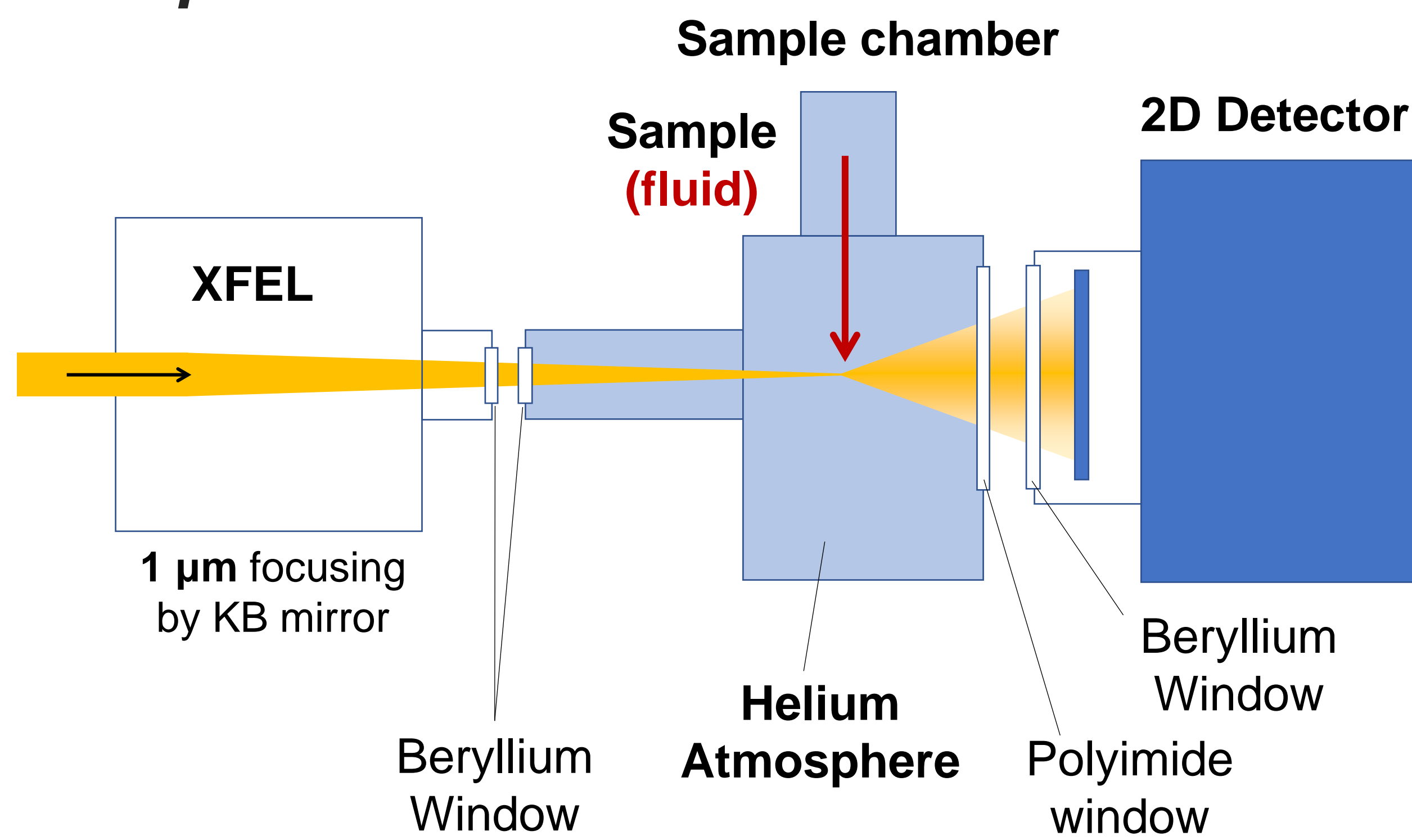
DAPHNIS: A standard platform for serial femtosecond crystallography in SACLA

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Diverse Application Platform for Hard X-ray Diffraction in SACLA Tono et al., J. Synchrotron Rad. 22, 532 (2015).

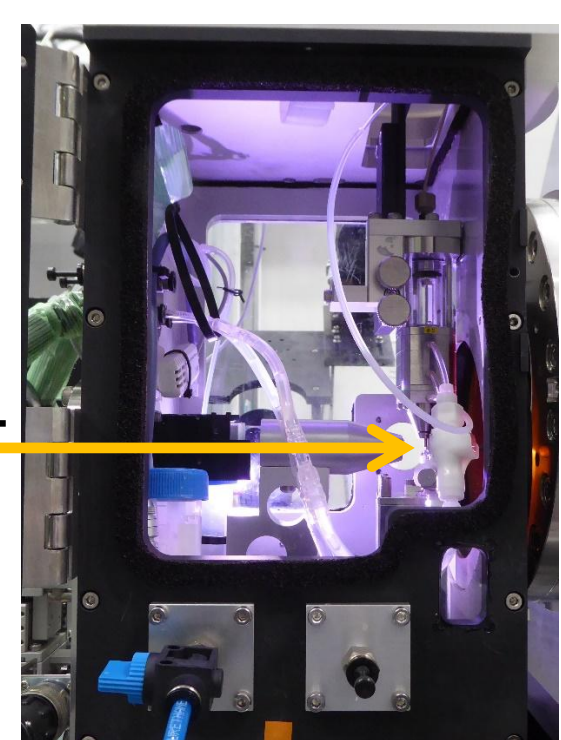
Concept



- Basically consists of a **sample chamber**, **fluid injectors**, and a **two-dimensional detector**.
- Facilitates applications to fluid samples by operating under a **helium atmosphere** at 1 atm.

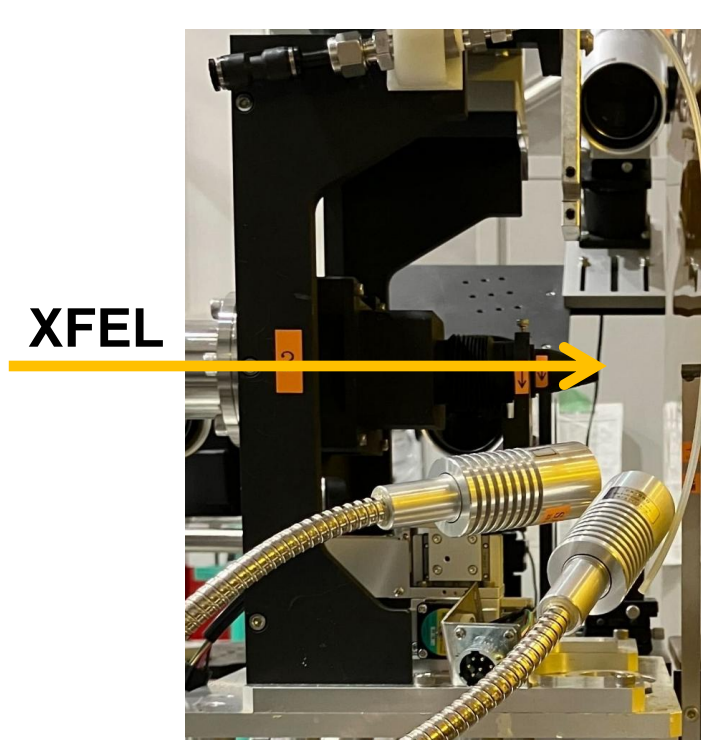
Sample Chamber

Closed-chamber type



- Helium concentration reaches 98% in 5 minutes.
- The rear window of a 0.05 mm polyimide film.

Opened-stand type

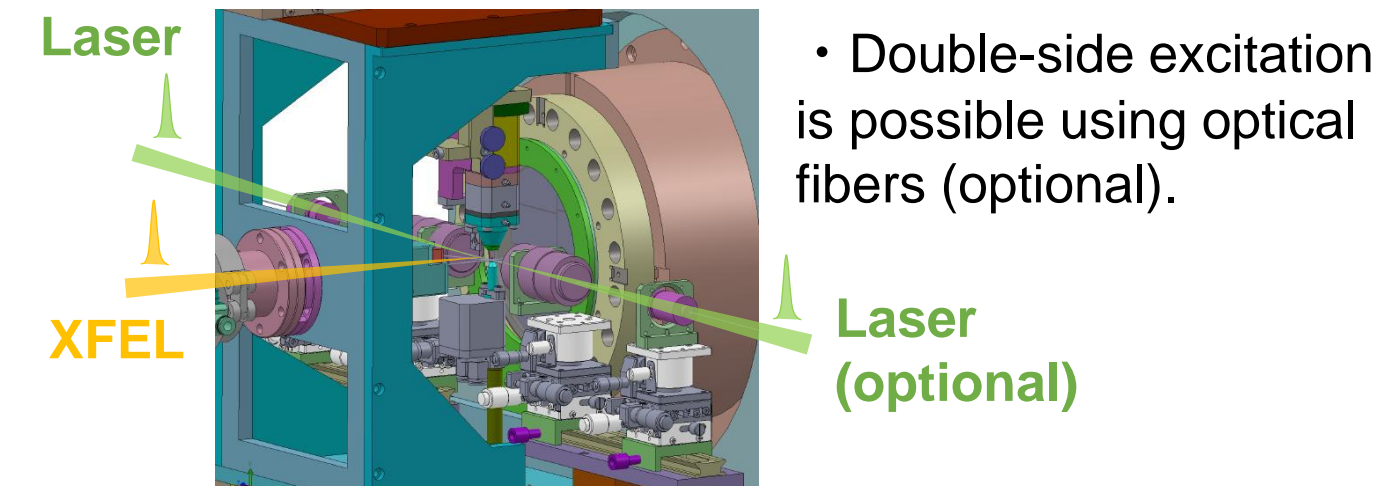


- Air atmosphere
- For the large-size detectors with a short camera length.

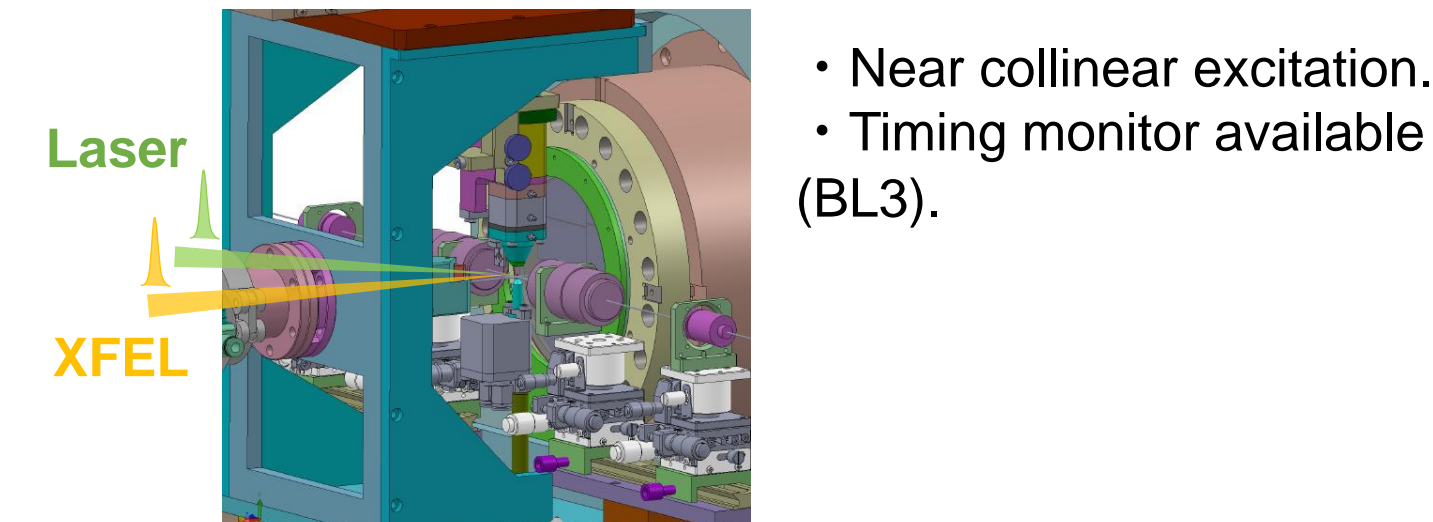
Pump-probe setup for time-resolved serial femtosecond crystallography (SFX)

Kubo et al., J. Synchrotron Rad. 24, 1086 (2017).

Nanosecond-laser excitation



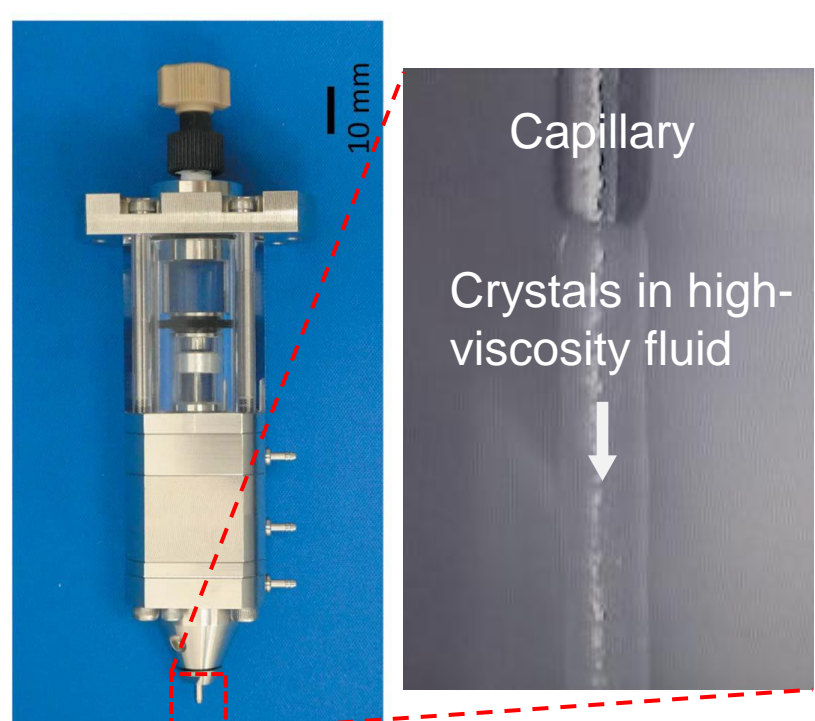
Femtosecond-laser excitation



	Ti:sapphire with OPA	Nd:YAG	OPO
Wavelength	250 - 2600 nm	532 nm	210 - 2600 nm
Pulse duration	~40 fs (800 nm), ~70 fs (VIS/NIR)	~5 ns	~5 ns
Repetition rate	≤ 60 Hz	≤ 15 Hz	≤ 30 Hz
Pulse energy	~10 mJ (800 nm)	< 10 mJ < 30 μJ ¹⁾	< 1 mJ < 30 μJ ¹⁾
Typical spot size at sample	~150 μm (FWHM, Gaussian)	~80 μm ²⁾ (FWHM, Gaussian ³⁾) 40 - 250 μm ⁴⁾ (through an optical fiber)	~150 μm ²⁾ (FWHM, Gaussian ³⁾) 40 - 250 μm ⁴⁾ (through an optical fiber)
Remark	¹⁾ For the optical-fiber option. ²⁾ Using plano-convex lens ³⁾ Optional: Top-hat beam profile ⁴⁾ Dependent on the fiber core size		

Fluid injection ➔ E. Nango's talk, Breakout session 1A

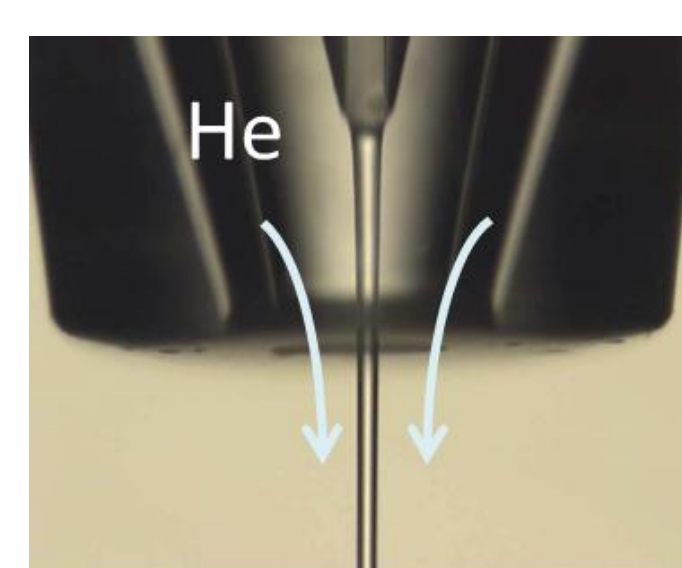
High-viscosity sample injection device



- Most popular injector in DAPHNIS setup.
- Available 50 to 200 μm capillary ID with 70 μl and 200 μl sample cartridges.
- Available for pump-probe time-resolved SFX.

Shimazu et al., J. Appl. Cryst. 52, 1280 (2019).

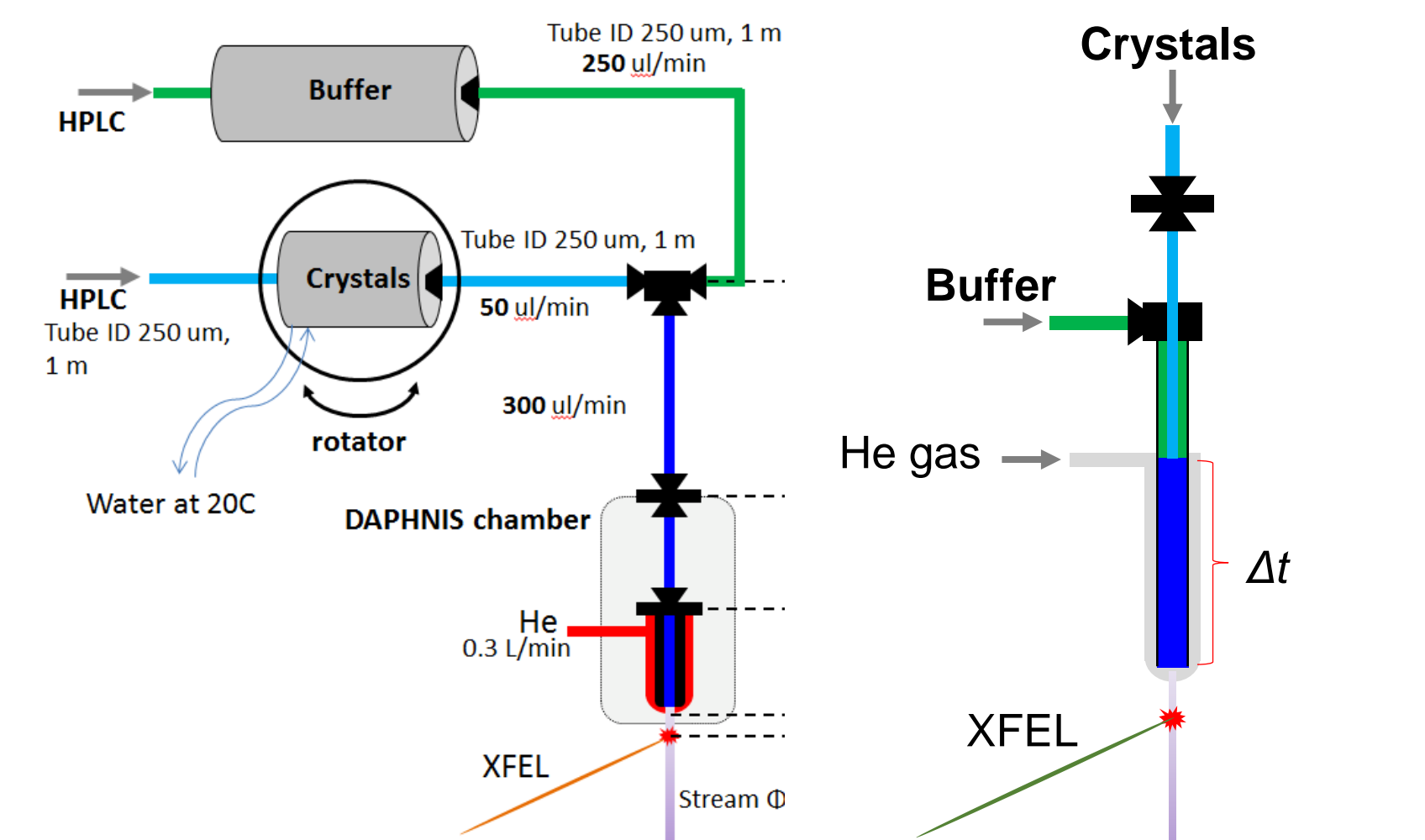
Liquid-jet injector with a gas dynamic virtual nozzle (GDVN)



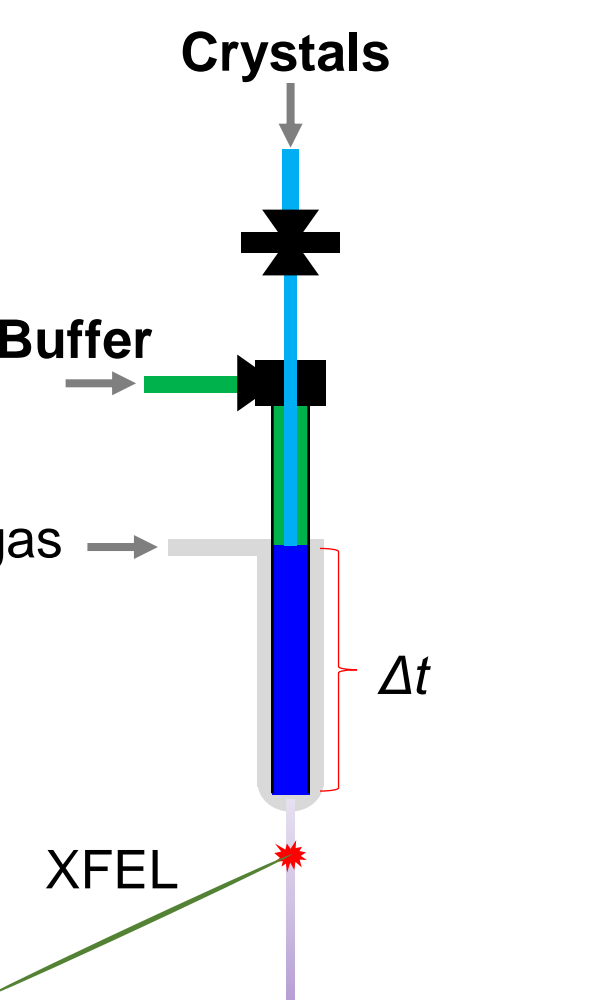
- Generally popular method, especially for mix-and-inject SFX.
- Delay time ranges from 10 ms to seconds for mix-and-inject SFX.
- Available ID of 50 to 200 μm inner capillary.
- On development for reducing sample consumption.

Mix-and-inject for liquid-jet injector

For seconds ~ minutes

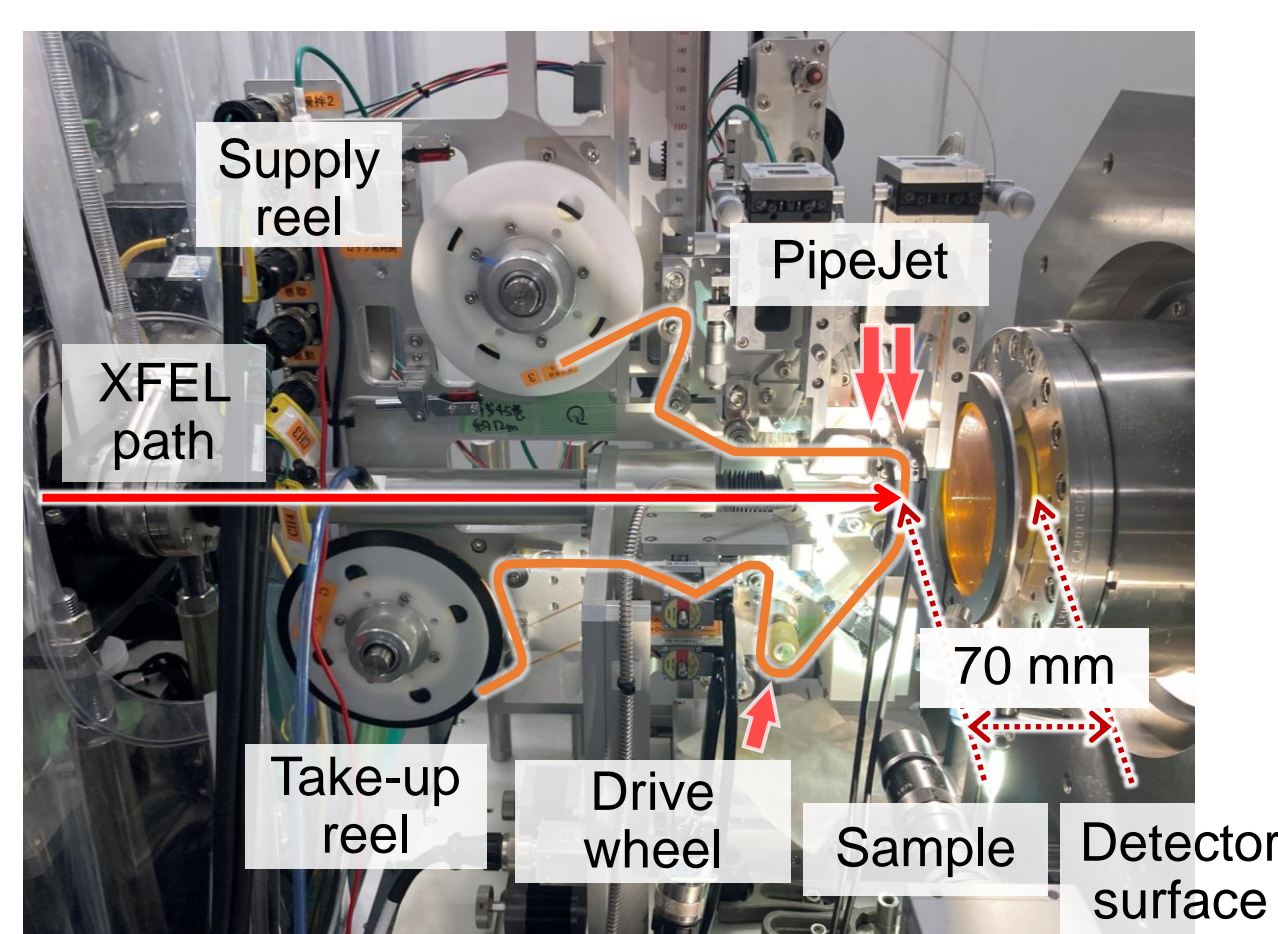
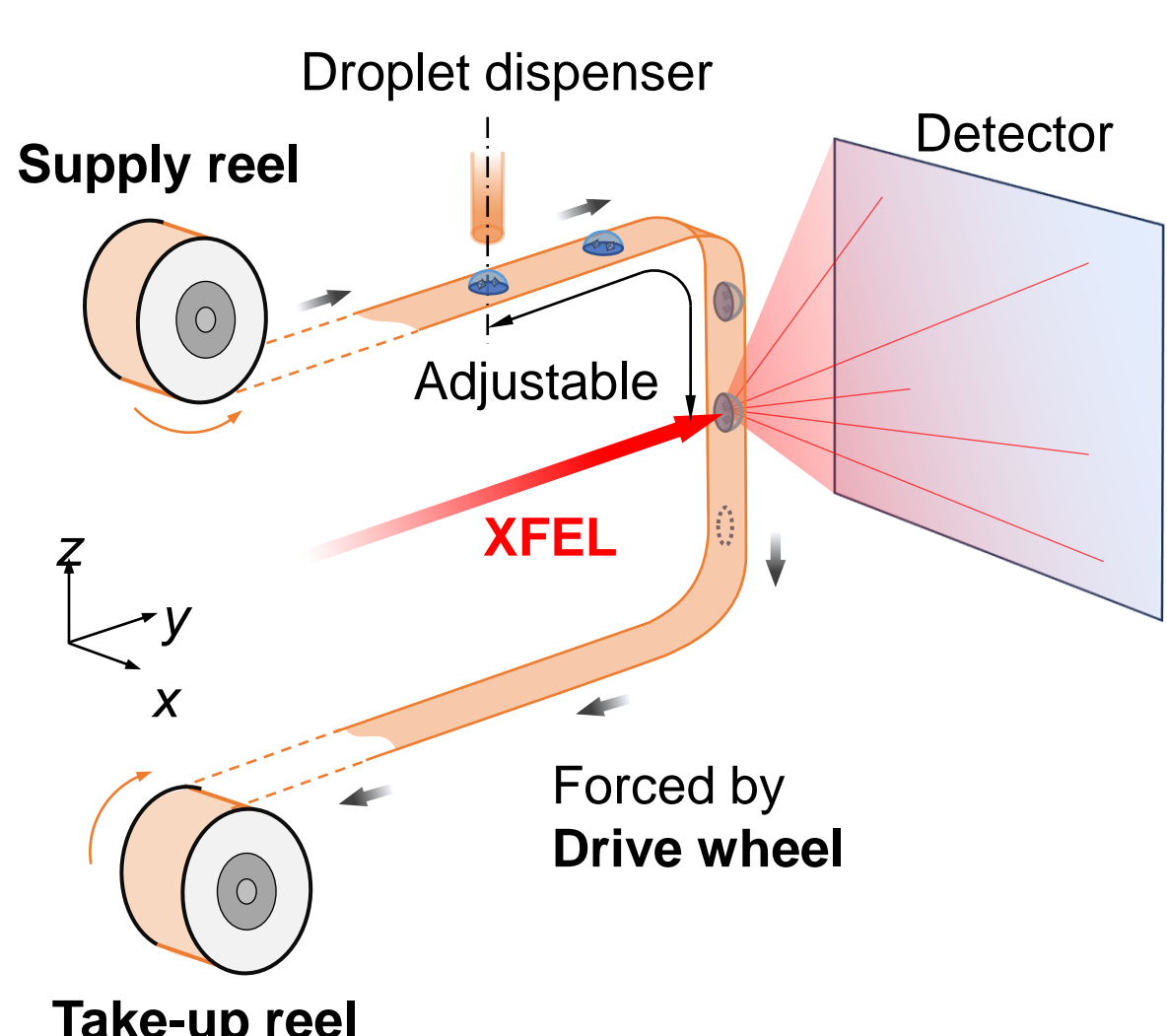


For milliseconds



Luo et al., in preparation.

Belt conveyor setup on the DAPHNIS platform

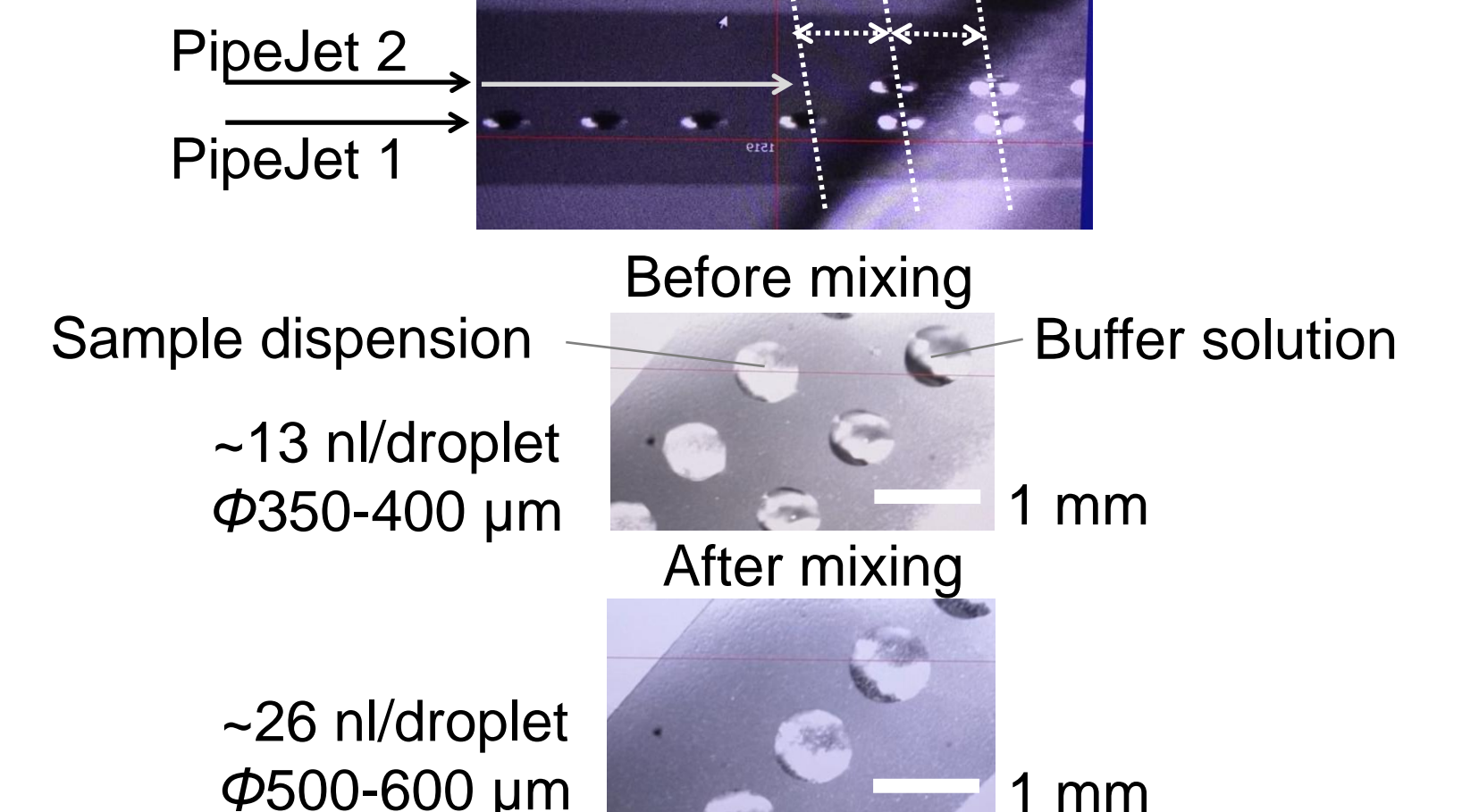


- Designed as a compact reel-to-reel tape conveyor setup without recycling tapes.
- Eject sample droplet on the thin-polyimide tape surface and deliver to the XFEL beam position.
- XFEL pulses transmit the tape and irradiate the sample droplet.
- Mix-and-inject & pump-probe time-resolved SFX is available (under development).

Kang et al., in preparation.

Mix-and-inject for belt-conveyor setup

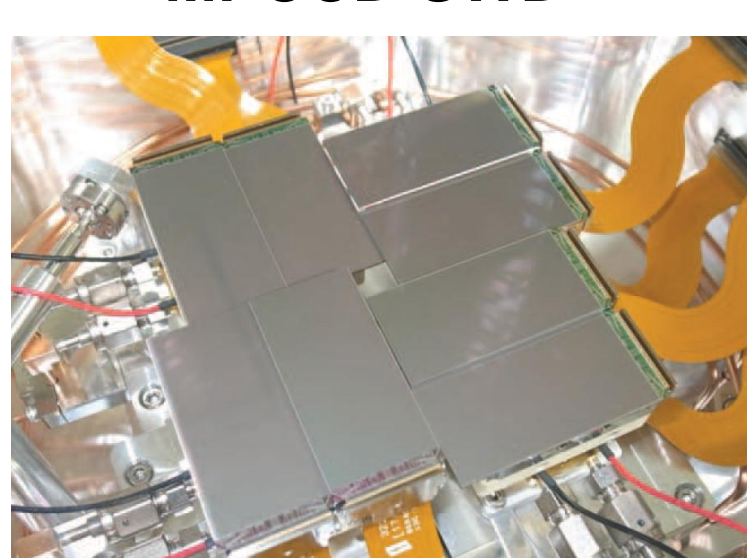
For sub-seconds ~ tens of seconds



Detector

- MPCCD SWD is the most popularly provided detector for SFX at SACLA.
- CITIUS 20.2M is under commissioning for SFX at SACLA. ➔ [Poster #7](#)

MPCCD SWD



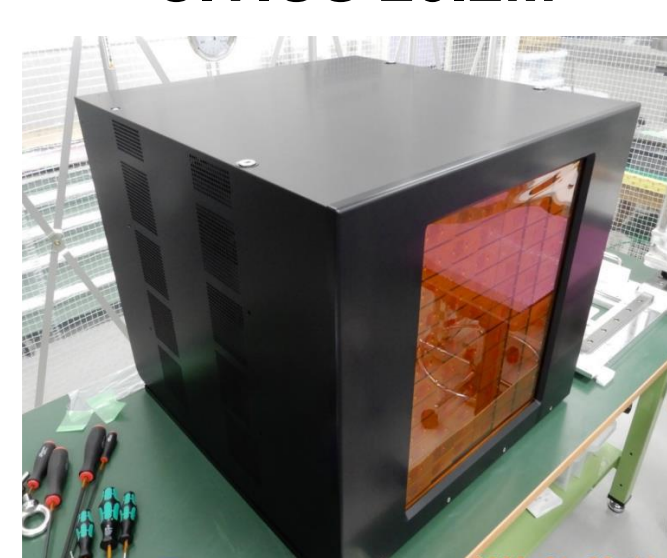
Kameshima et al., Rev. Sci. Instrum. 85, 033110 (2014).

Rayonix MX300-HS



© Rayonix

CITIUS 20.2M



See [Poster #7](#) for detailed information.

	4M-pixel MPCCD (phase III SWD type)	Rayonix MX300-HS	CITIUS 20.2M (under commissioning)
Frame rate	60 fps	10 fps @ 2x2 Binning 30 fps @ 4x4 Binning	60 fps
Standard camera distance in DAPHNIS platform	50 mm	75 mm or longer @ Opened-stand	75 mm or longer @ Opened-stand
Active area	102 mm x 102 mm	300 mm x 300 mm	W321 mm x H393 mm
Achievable resolution on the detector edge	~0.15 nm @ 10 keV	~0.11 nm @ 10 keV, 4x4 Binning	n/a