

PAL-XFEL Beamline Pump Laser and Timing Diagnostics

PAL-XFEL, Beamline department
Intae Eom

Injector Laser systems

- Photocathode
- Laser heater
- Timing synchronization

Experimental Laser systems

- SX Experimental pump laser
- Laser driven Source generation
- XFEL Timing diagnostics
- Timing synchronization

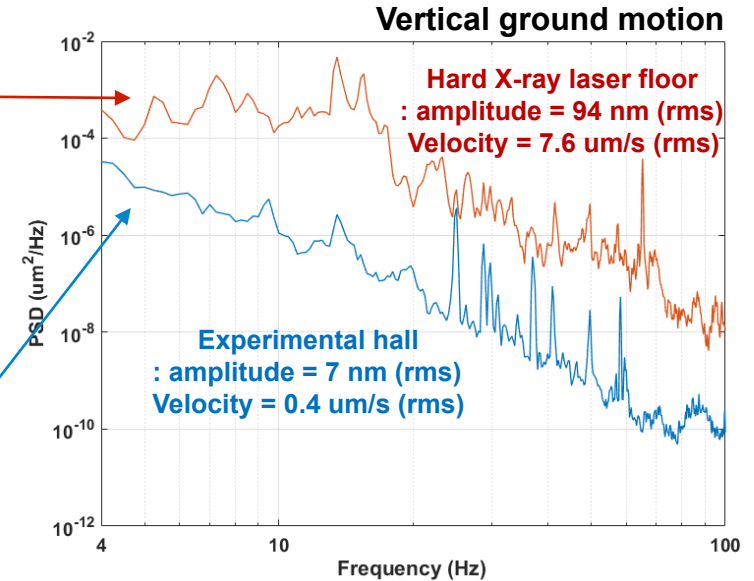
- HX Experimental pump laser
- XFEL Timing diagnostics
- Timing synchronization



Hard X-ray experimental hall



Soft X-ray experimental hall



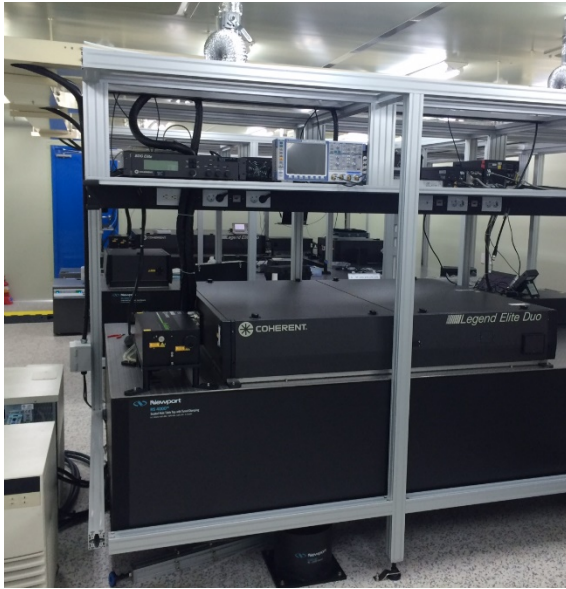
Criteria	Velocity ($\mu\text{m/s}$)	Detail size (μm)	description
VC-D	6.25 (250)	0.1 – 0.3	Suitable in most instances for demanding equipment, including many electron microscopes (SEMs and TEMs) and E-Beam systems.
VC-E	3.12 (125)	< 0.1	A challenging criterion to achieve. Assumed to be adequate for the most demanding of sensitive systems including long path, laser-based, small target systems, E-Beam lithography systems working at nanometer scales, and other systems requiring extraordinary dynamic stability.

* Detail size : line width of microelectronics fabrication

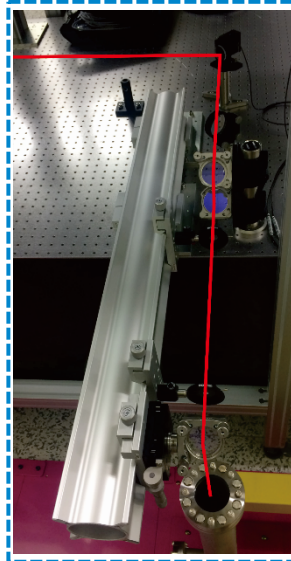
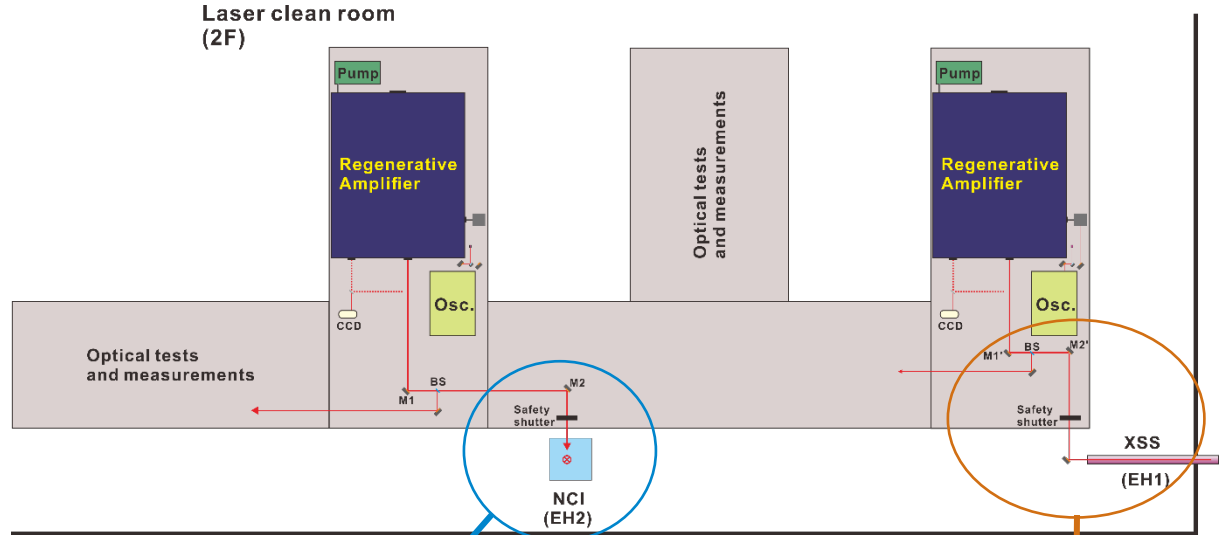
** Reference: Vibration criteria for research facilities – Colin Gordon & Associates, USA

		<i>Hard X-ray</i>	<i>Soft X-ray</i>
<i>Ti:Sapphire Oscillator</i>	Rep. rate	79.33 MHz synchronized to Master RF (S-band)	
<i>Regen. Amplifier</i>	λ_{center}	800 nm	
	Rep. rate (max)	120 Hz	1080 Hz
		Synchronized to Event timing system	
	Pulse energy after compression	12 mJ	7 mJ
	Pulse duration	<35 fs or 100~130 fs (dual)	<35 fs
	Beam size (1/e ²)	~15 mm	~10 mm
<i>Special feature</i>			CEP stabilized
<i>Wavelength conversion</i>	<i>Harmonic generator</i>		400 nm (SHG, <35 %) 266 nm (THG, <15 %)
	<i>Optical parametric amplifier (OPA)</i>	<i>pump</i>	800 nm, 3.5 mJ, ~100 fs
		<i>Tuning range</i>	240 nm ~ 20 μm
	<i>High harmonic generation</i>		

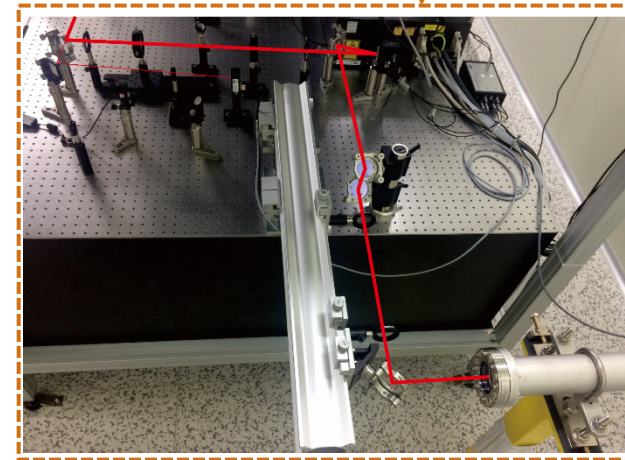
Hard X-ray laser systems and transportation (laser room)



Ti:Sapphire amplifier systems at HX laser room

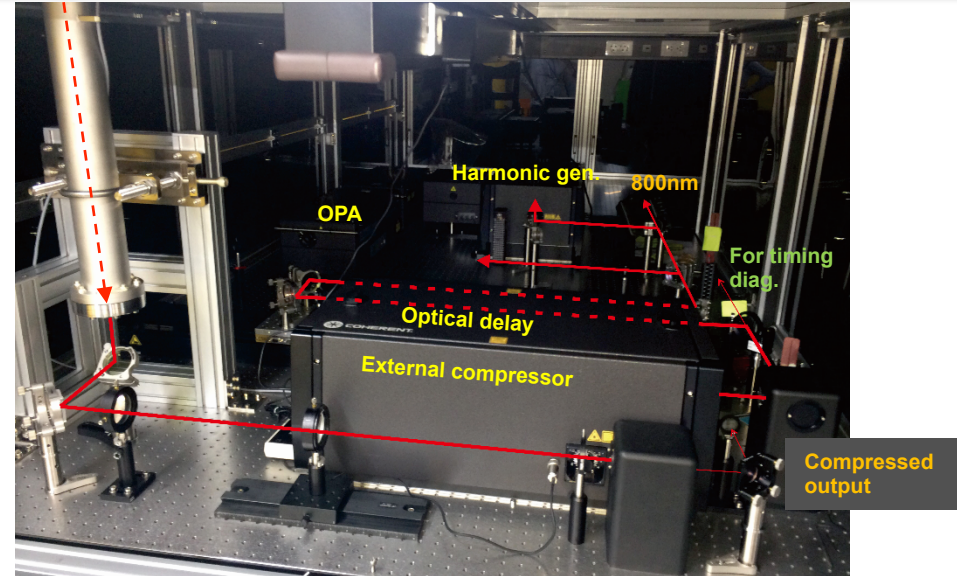
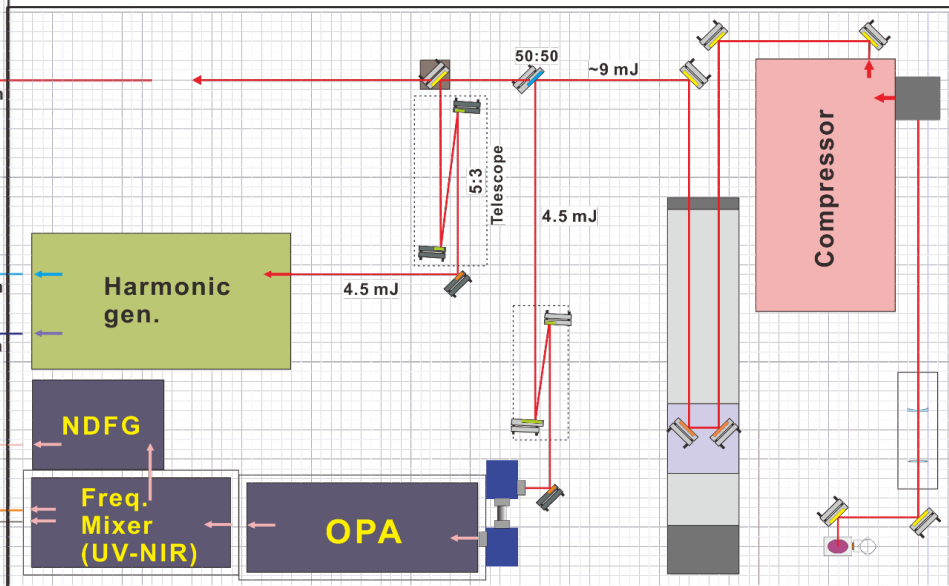
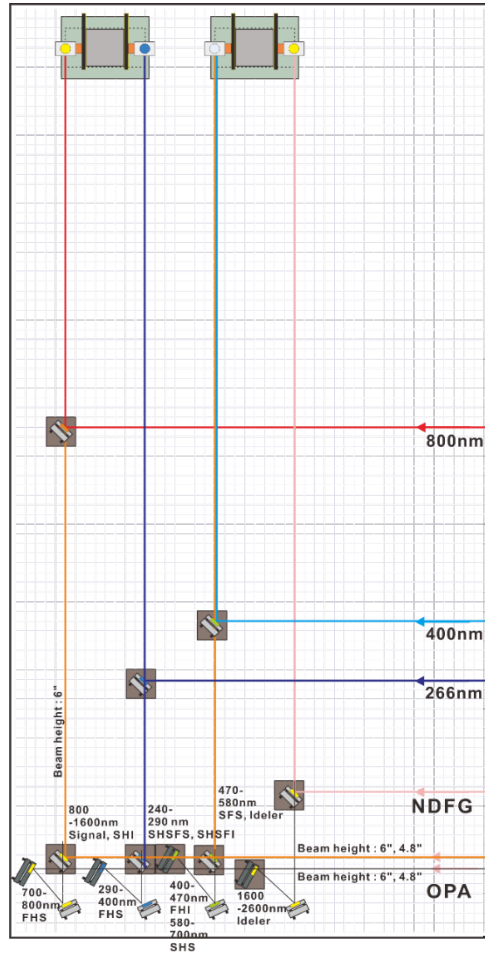


Beam transportation to NCI hutch



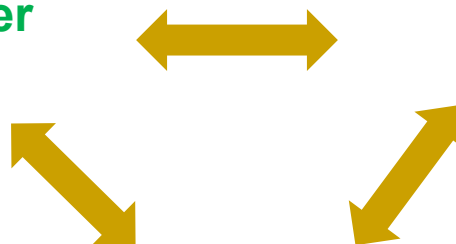
Beam transportation to XSS hutch

Optical laser for Hard X-ray end-stations (XSS end-station)



Femtosecond Optical laser

800 nm and its harmonics
Optical parametric amplifier
(UV~IR)
0.1~4.6 eV

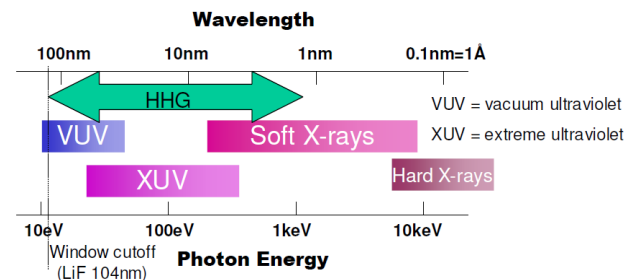


Soft X-ray FEL

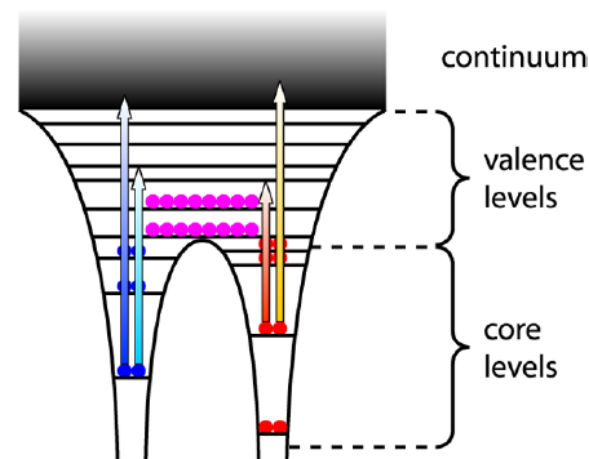
0.3~1.2 keV

Laser driven EUV source

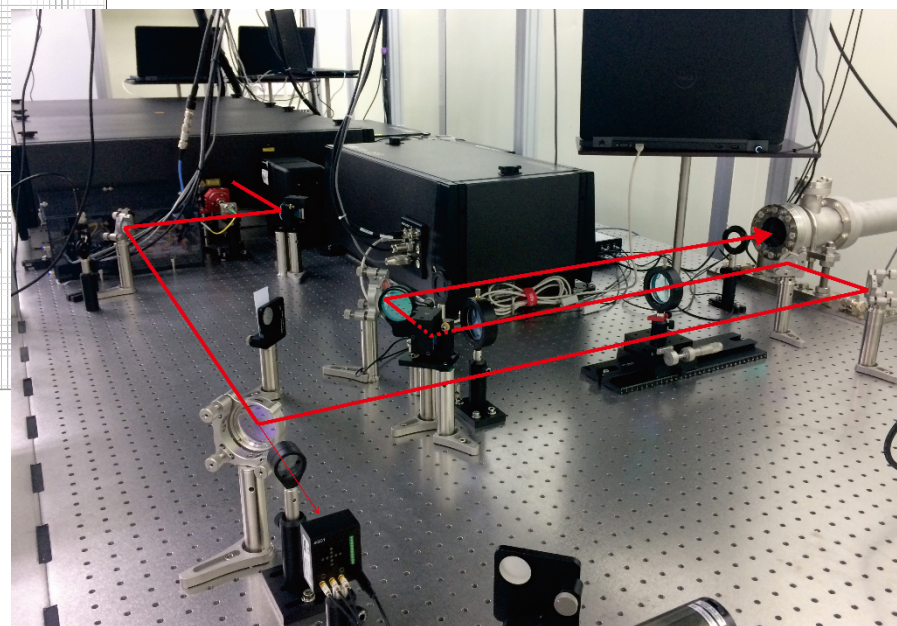
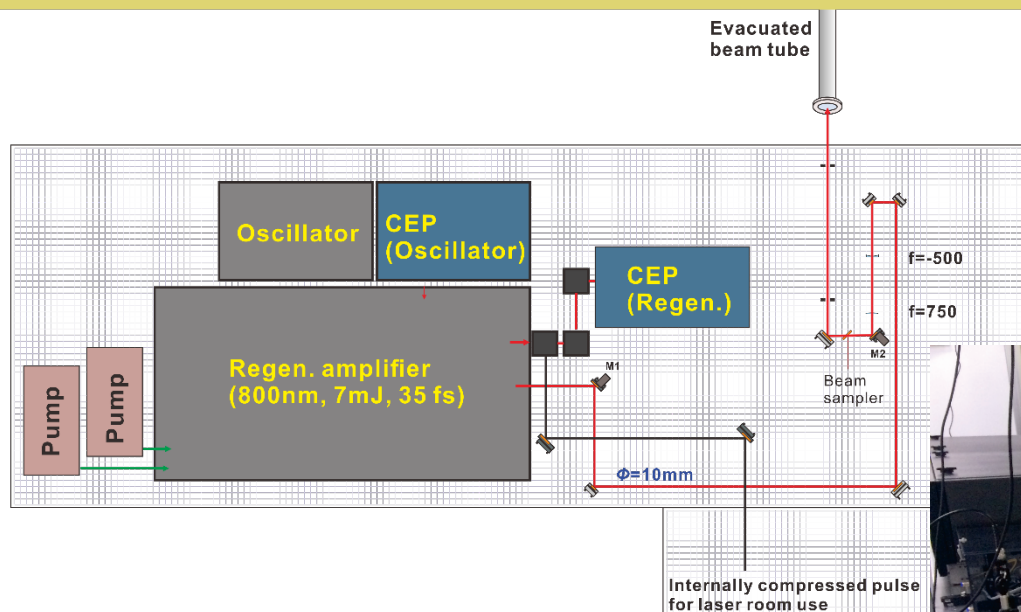
10~100 eV



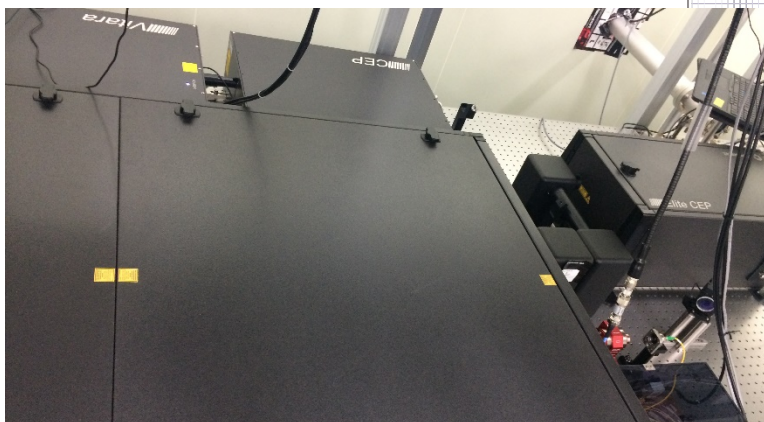
- Core level spectroscopy
 - Time-resolved photoelectron spectroscopy
 - Detection of a wavepacket on a dissociative state
 - Two-color experiments
- : photoelectron spectroscopy, pump-probe, etc..



Soft X-ray laser systems and transportation (laser room)

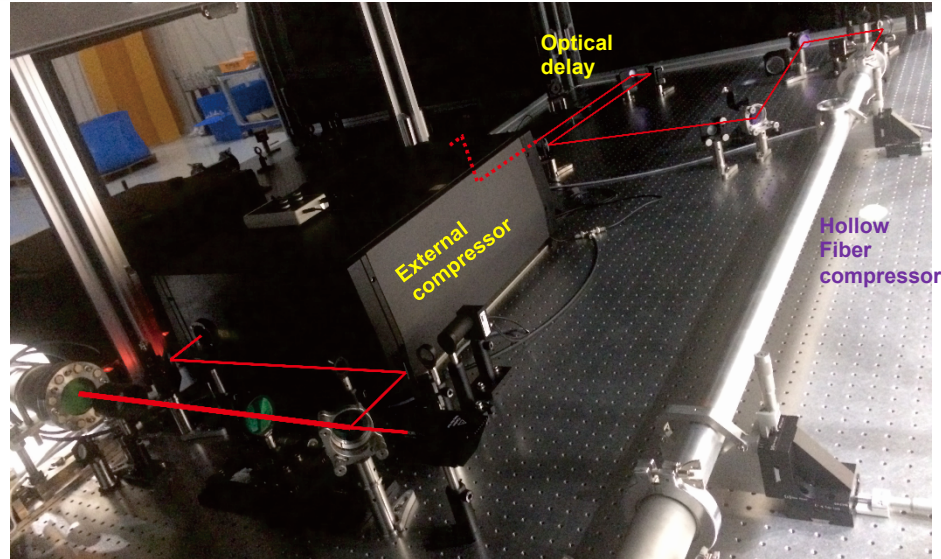
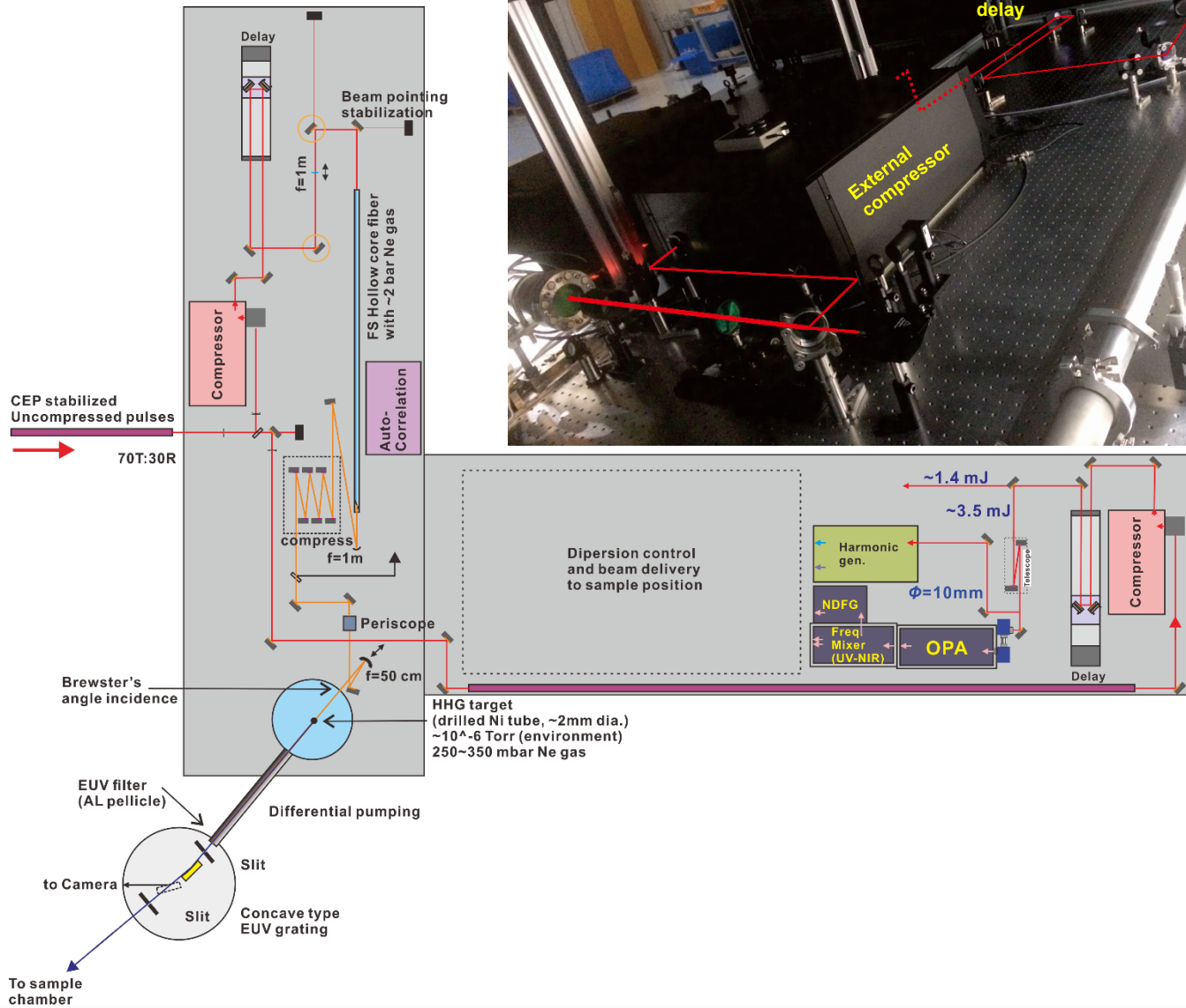


Beam transportation in the SX laser room



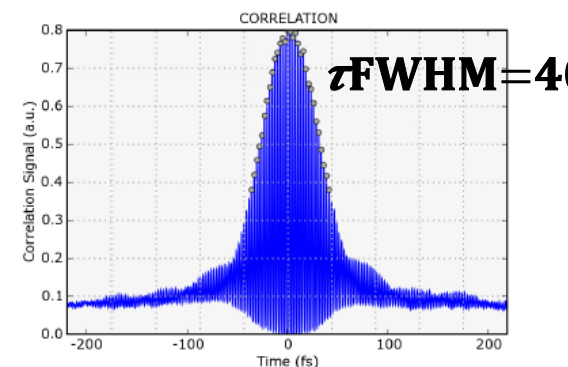
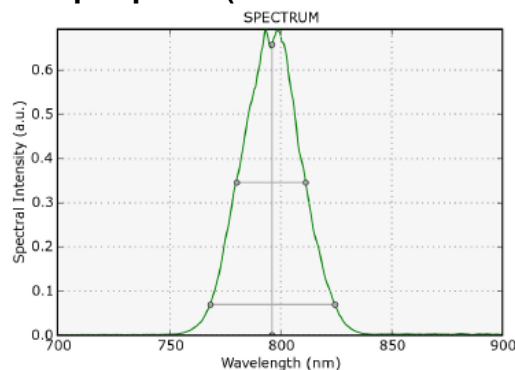
Ti:Sapphire laser system in the SX laser room

Soft X-ray end-station

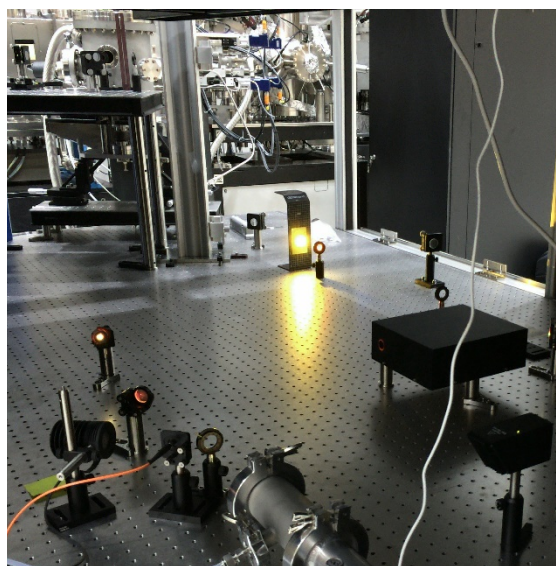
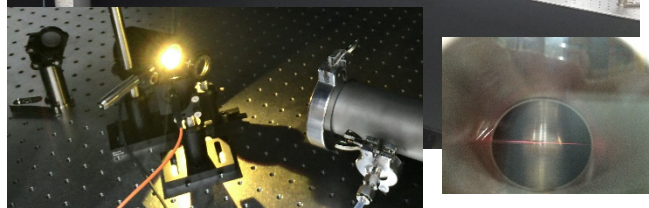
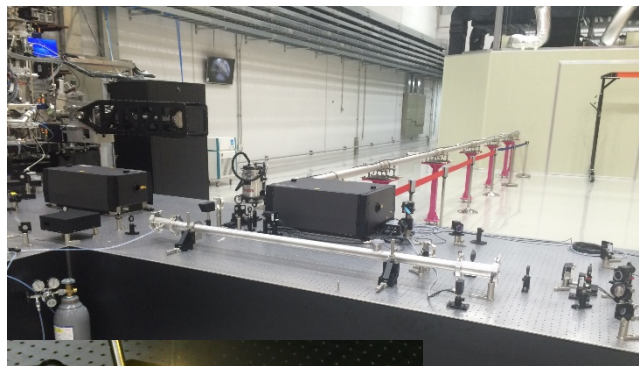
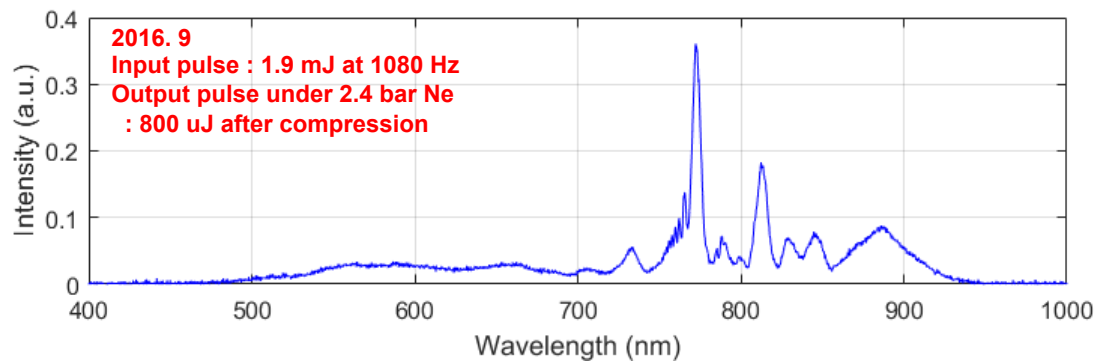
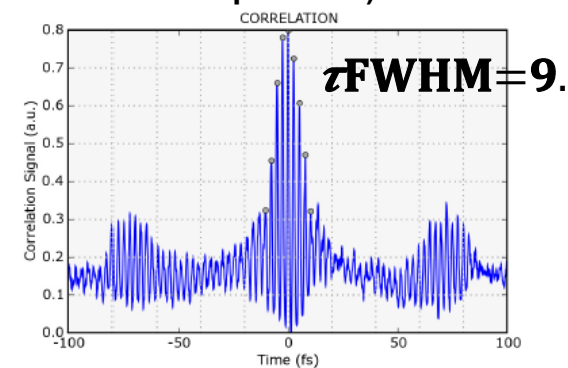
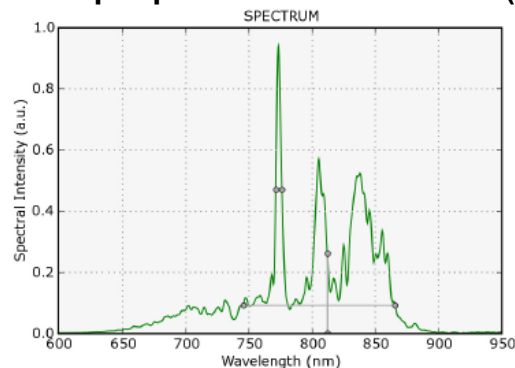


Soft X-ray end-station (Hollow fiber compressor)

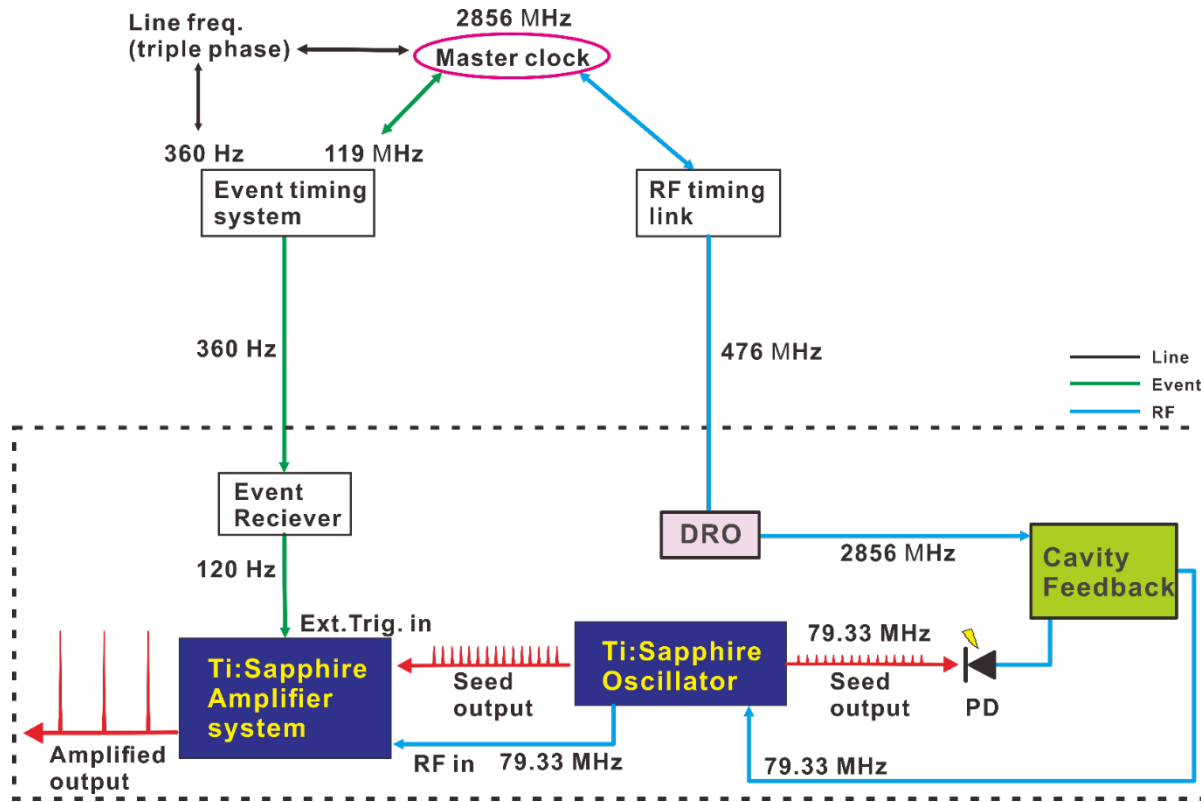
Input pulse (1.28 mJ at 1080 Hz)



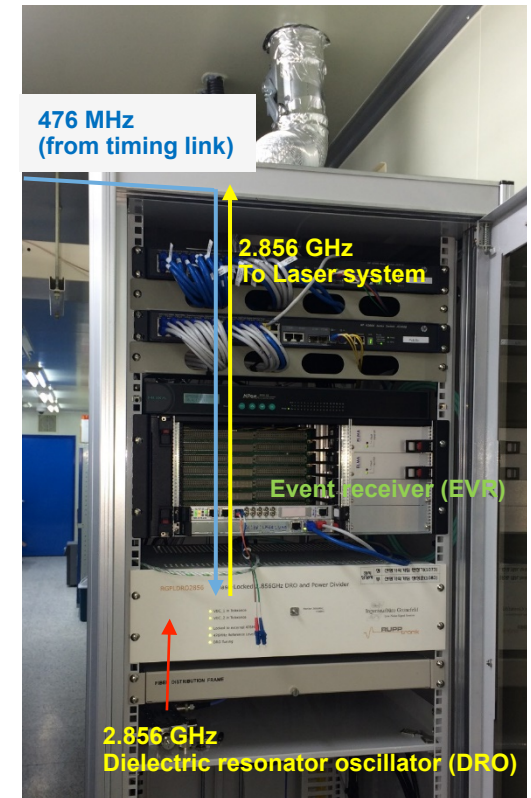
Output pulse under 2.4 bar Ne (0.69 mJ after compression)



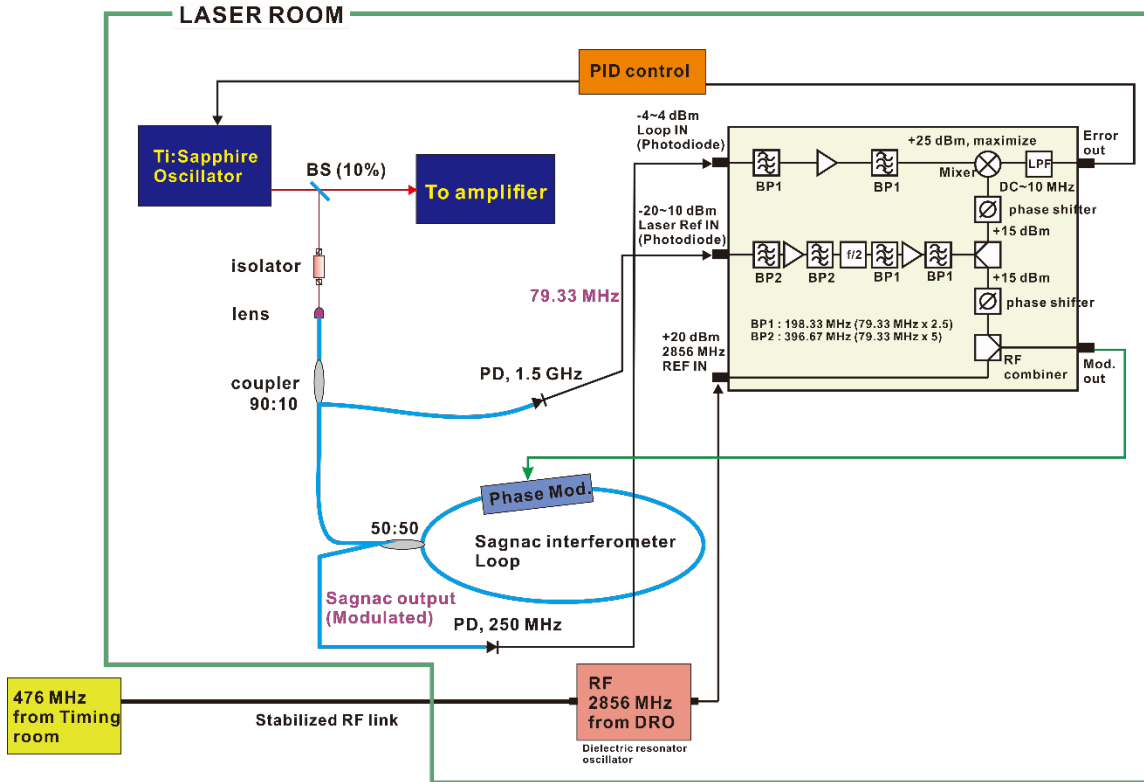
Timing synchronization scheme (for Hard X-ray)



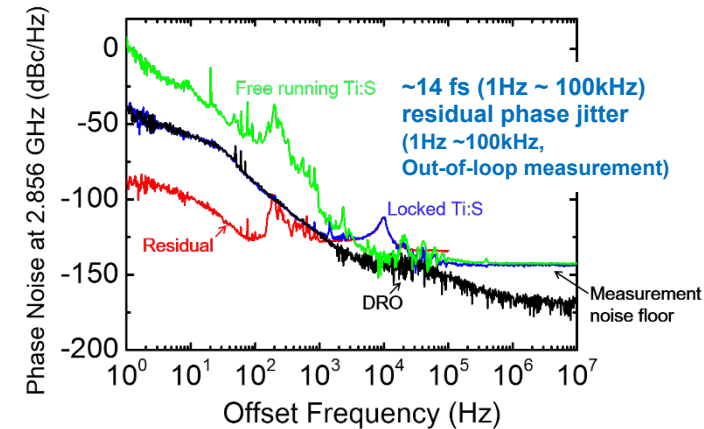
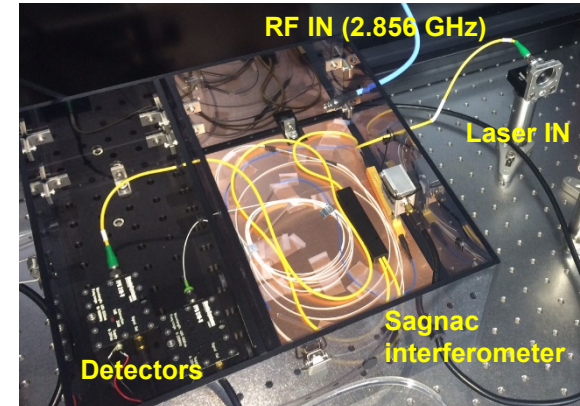
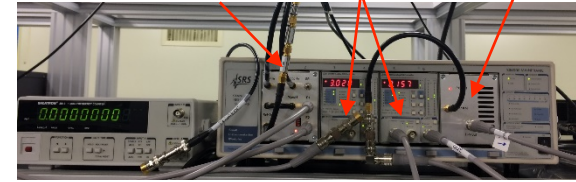
<Timing rack at HX laser room>



<Schematic description>

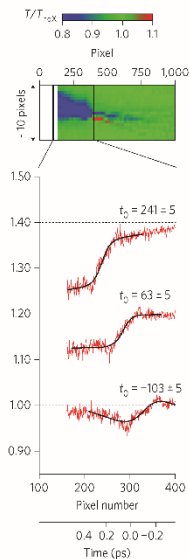
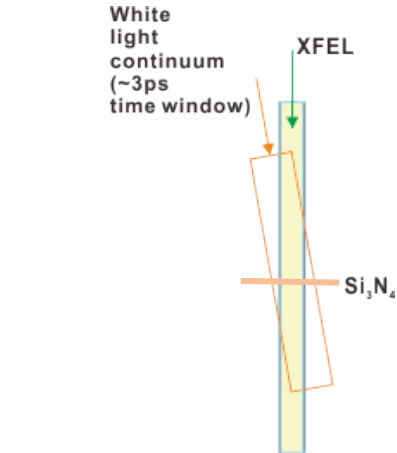


BOM-PD electronics & Piezo controller PID controllers Piezo driver

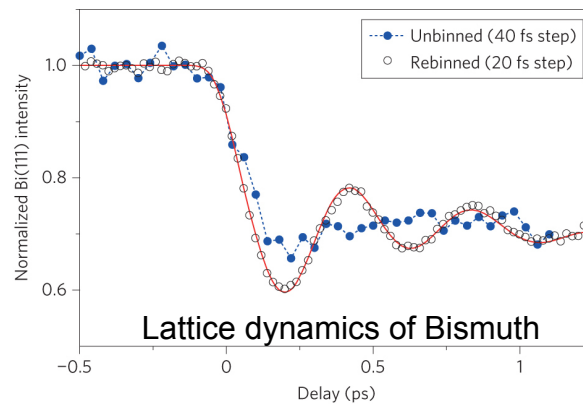
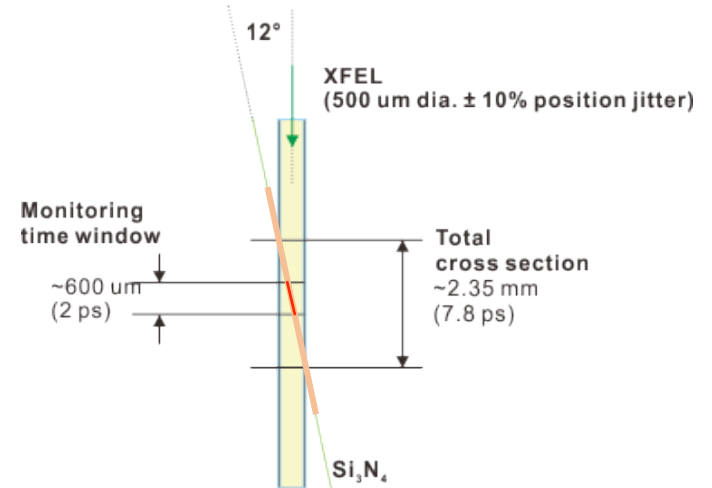


Work by Dr. Changki Min at PAL

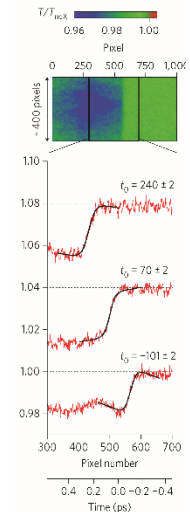
1. Spectral encoding (Time window is on the LASER)



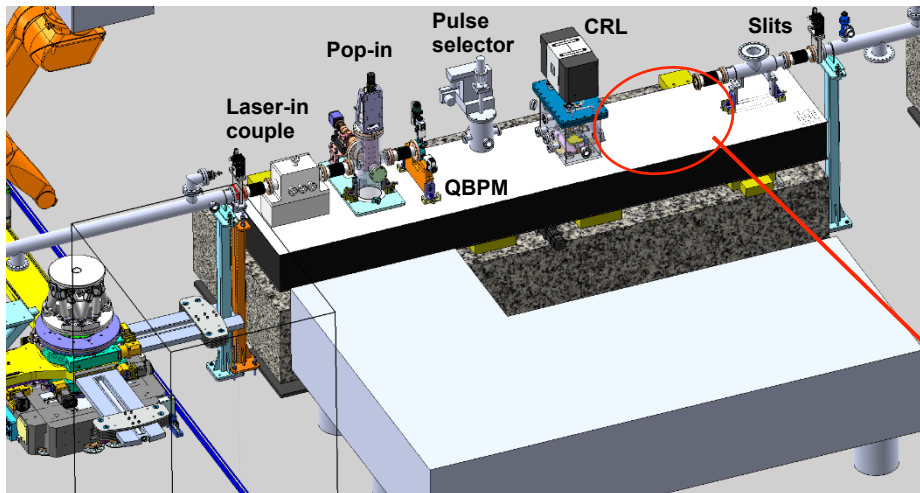
2. Spatial encoding (Time window is on the XFEL.)



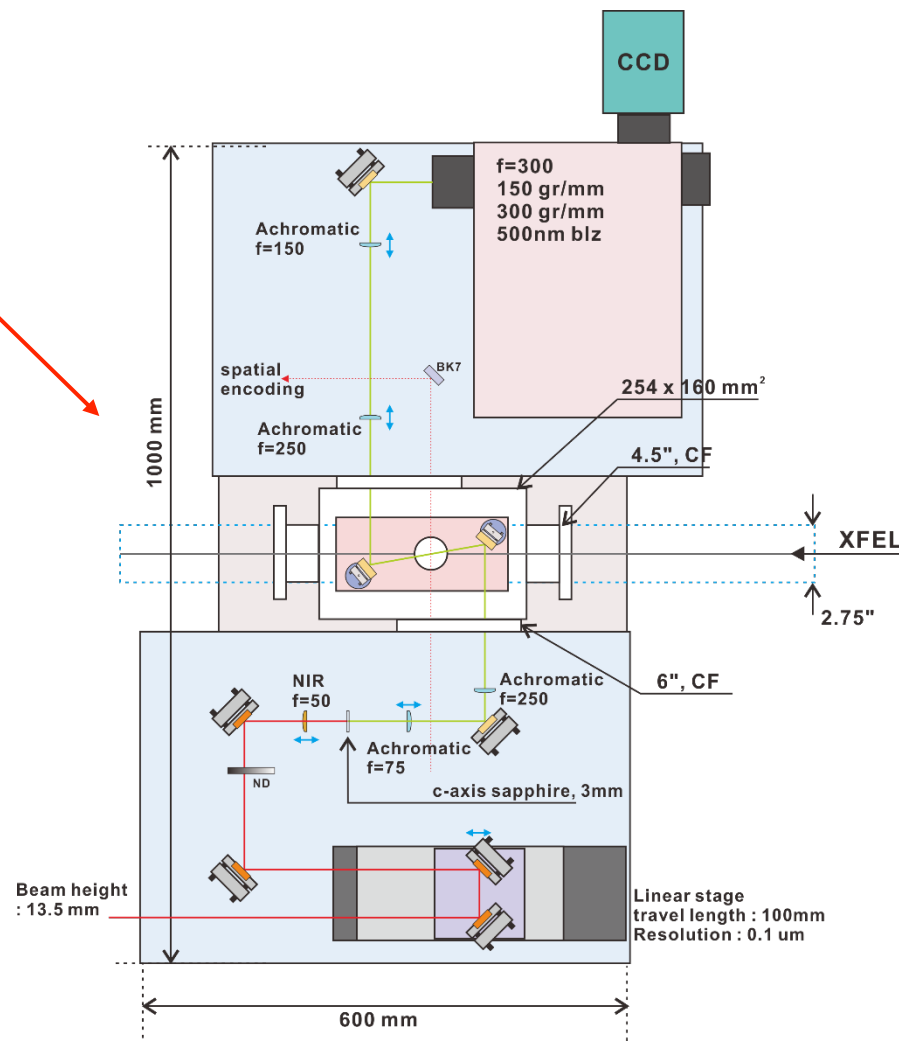
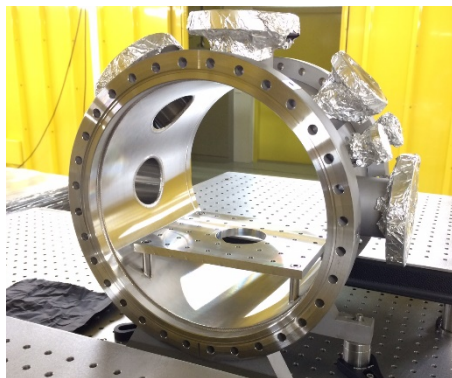
M. Harmand et al., *Nature Photon.* 7 (2013) 215.



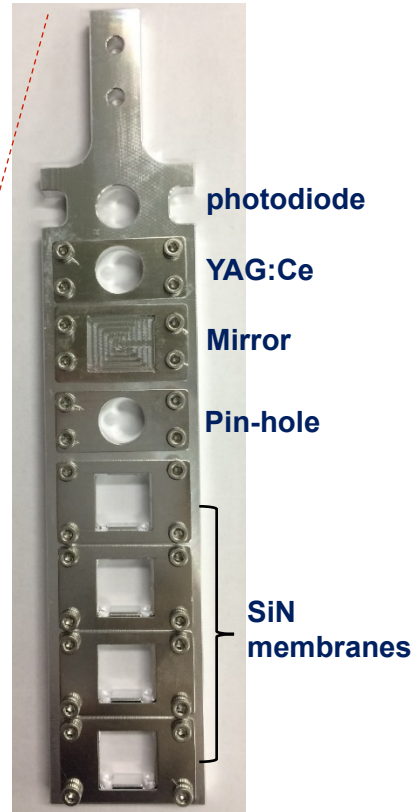
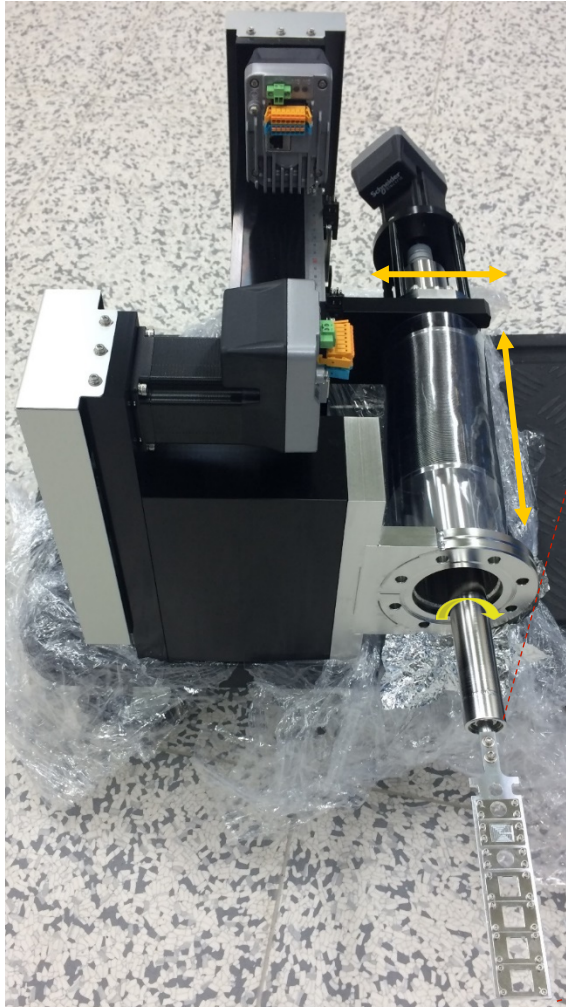
XSS beamline instruments at PAL-XFEL



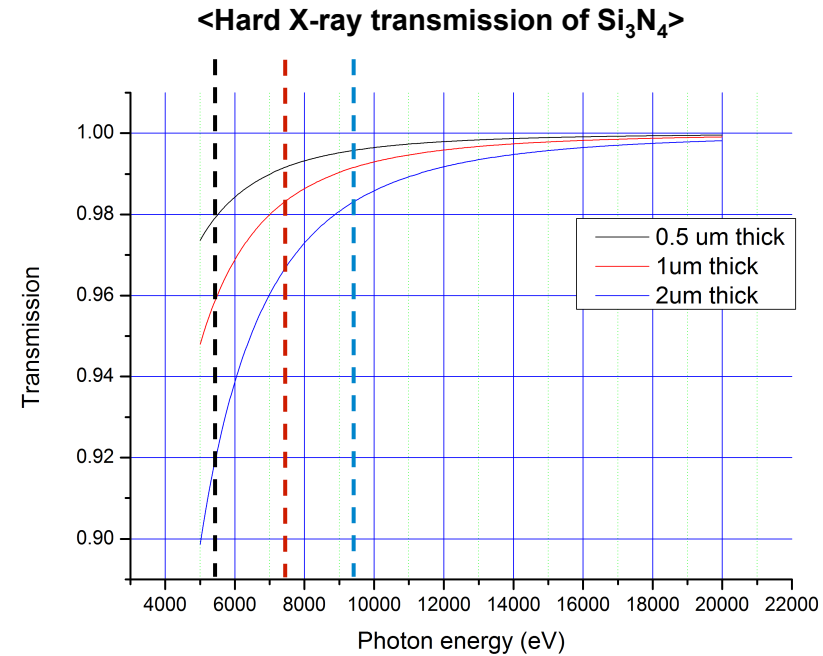
<Prototype Timing chamber>



<Membrane manipulator and holder>



- Picosecond timing
: GaAs Photodiode (Biased), 30 ps rise
- Femtosecond timing
: Spectral or spatial encoding with Si_3N_4 membrane



Preliminary alignment and test by laser pulses

