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Drive Laser Systems for Shanghai Soft X-ray Free Electron Laser

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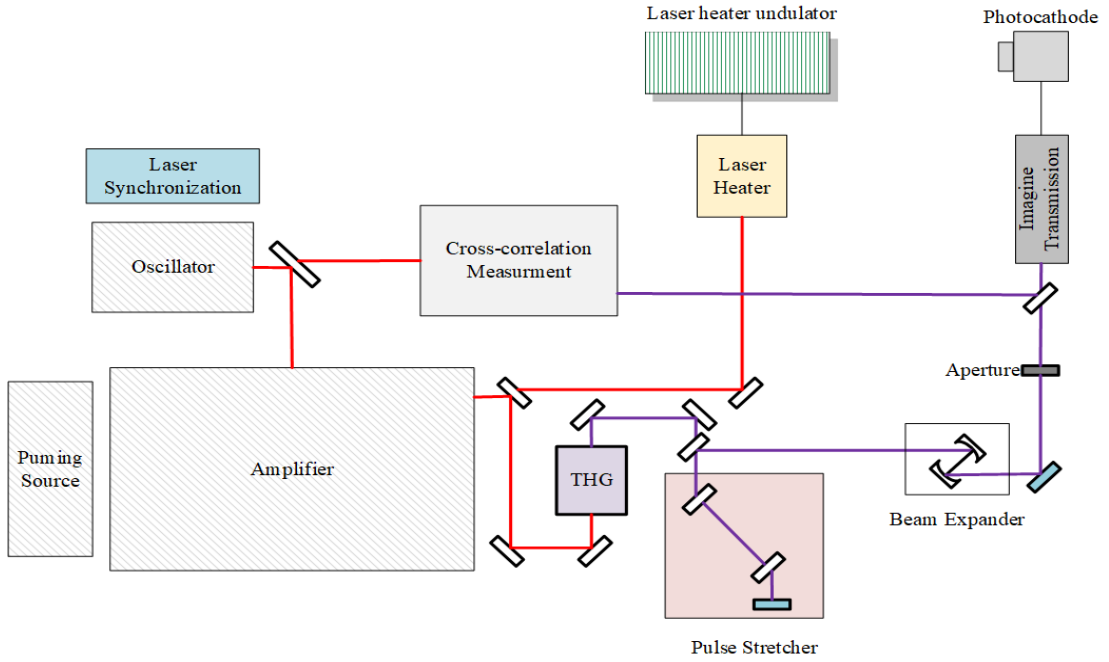
Requirements and layout

Name	Parameters
Wavelength	260nm~270nm
Repetition rate	1~10Hz
Pulse energy on the photocathode	150μJ
Energy stability in UV	<2.0%rms
Spatial profile	Gaussian
Laser spot radius on photocathode	2-4mm(FWHM)
Laser spot diameter jitter at photocathode	2% rms radius
Pointing jitter	<2% rms radius
Pulse shape	Gaussian
Pulse duration	1-8ps
Timing stability	< 250fs rms

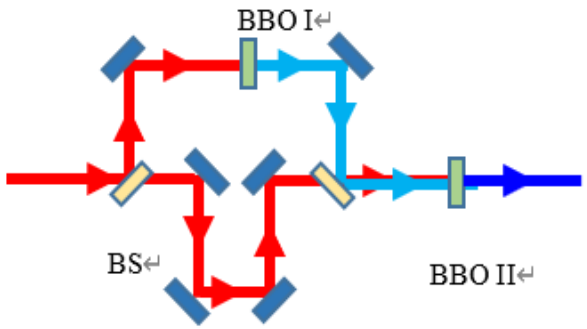
Drive Laser System Requirements



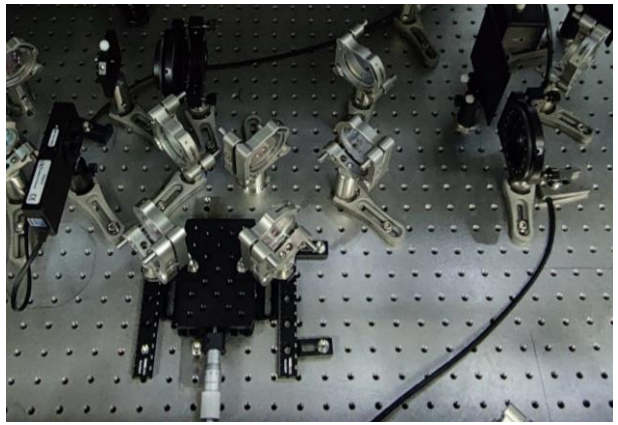
Schematic of SXFEL drive laser system

Design and layout of THG

1. The 80% pulse energy from the laser amplifier with 800nm wavelength is used to produce the third-harmonic generation.
2. 800nm to 400nm converted by second harmonic generation in a β-BBO crystal (type I, o + o = e, 0.5 mm, θ =29.2°).
3. Sum-frequency generated in a second β-BBO crystal (type I, 0.5 mm, θ=44.4°).
4. The conversion efficiency from 800nm to 266nm was about 13%.

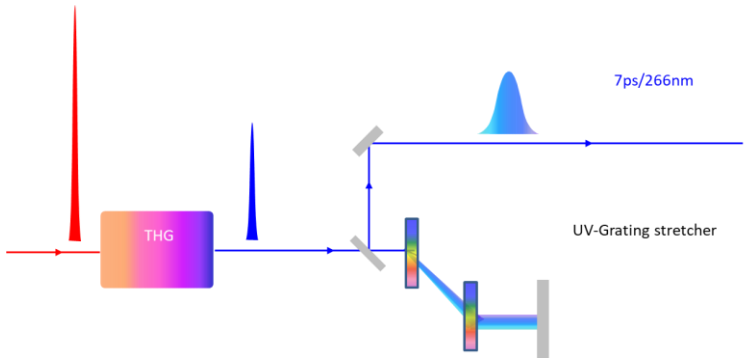


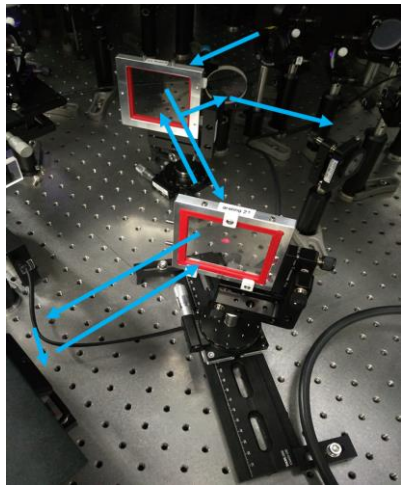
Schematic of the THG



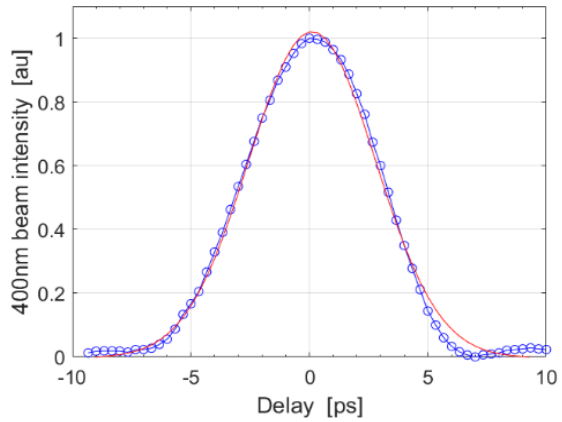
Pulse Stretcher

1. There are a pair of transmission gratings with 3846 grooves/mm, 42mm×42mm size, and 259-161nm wavelength range.
2. The incident angel is 30°, vertical polarization state.
3. Pulse duration is measured by the cross-correlator method, using 800nm laser pulse from the oscillator, and the result is 7ps.





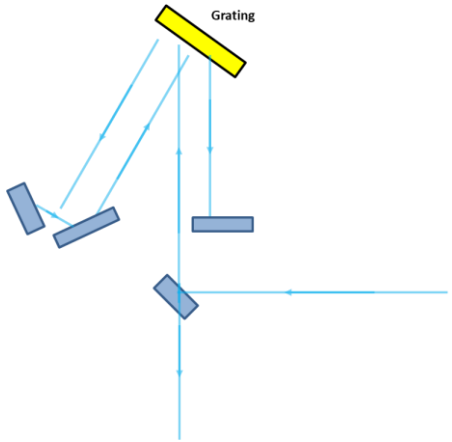
Schematic and picture of the THG



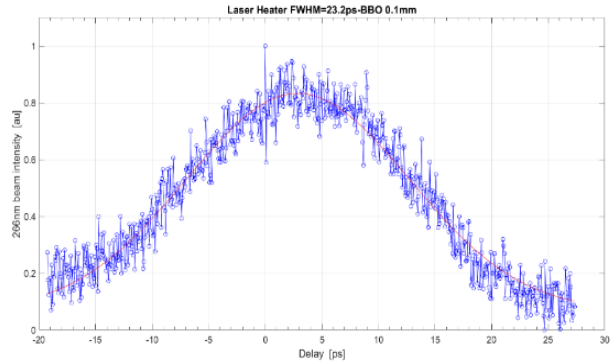
Measurement result by cross-correlation

Laser Heater

1. Requirements for laser heater: 400nm wavelength, 23ps pulse duration, 100μJ in the laser heater undulator.
2. 800nm laser pulse is converted to 400nm with a 15mm×15mm second-harmonic crystal, and the conversion efficiency is about 36%.
3. A single grating stretcher with 1800 grooves/mm is used.



Schematic and picture of the laser heater



Measurement result by cross-correlation

Thank you for your attention

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