Synchronized Optical Laser System

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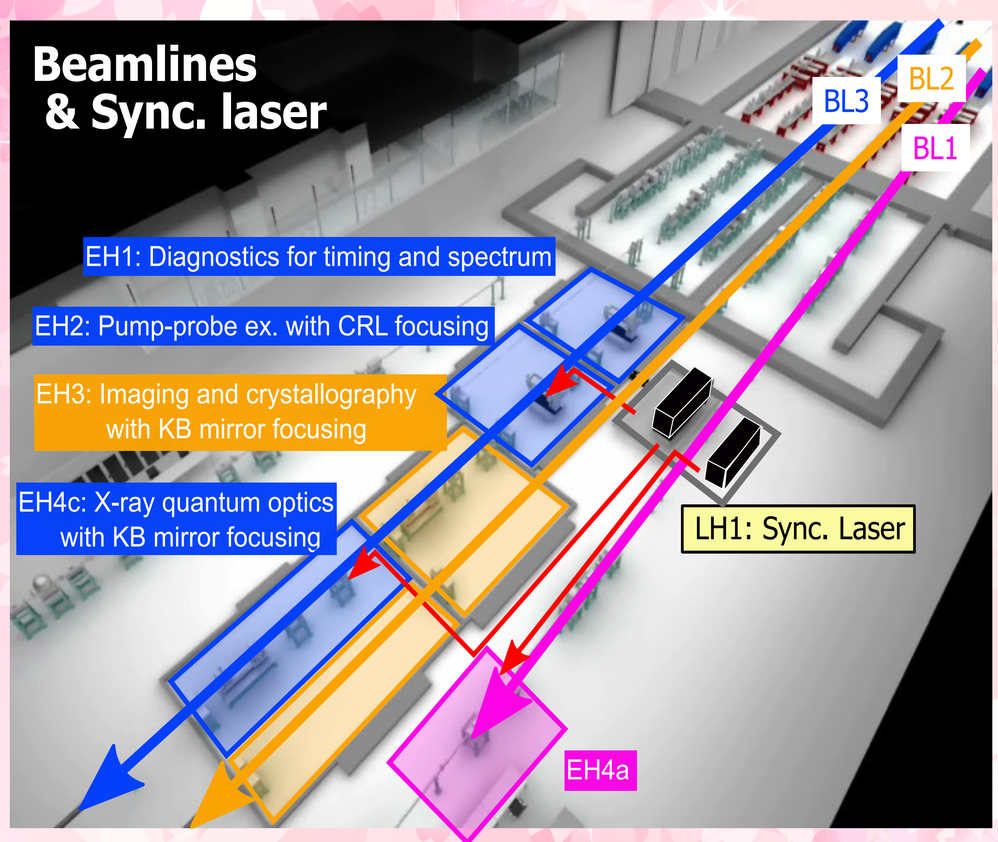
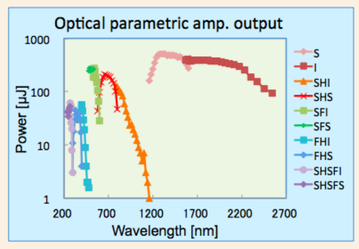


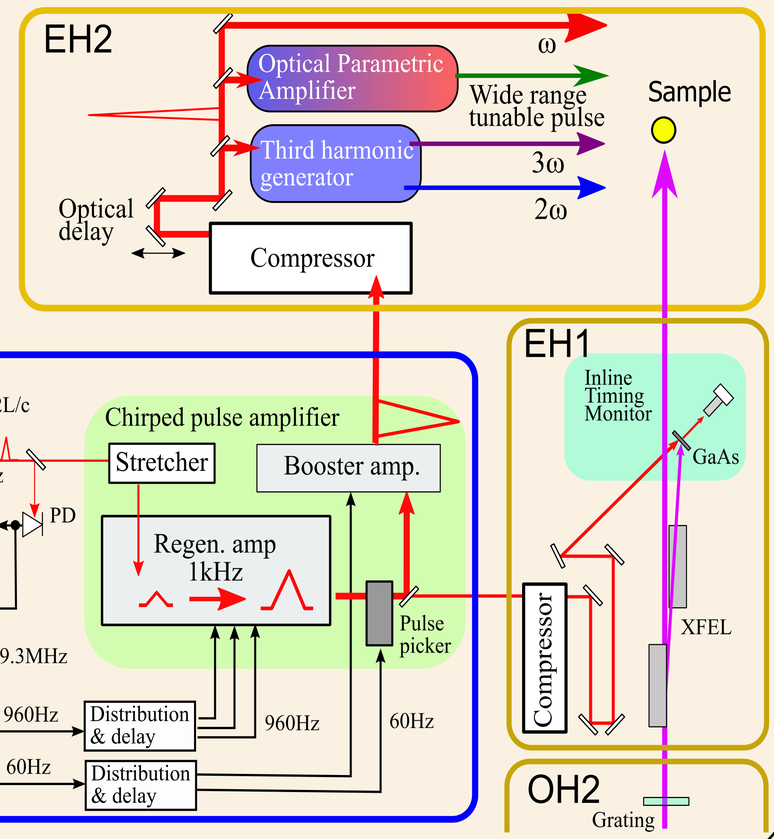
Synchronized optical laser system

Chirped pulse amp.
(based on Ti:sapphire laser)
Wavelength: 800 nm
Output: 4 mJ @ 1 kHz
15 mJ @ 60 Hz
100 mJ @ 10 Hz
Pulse width: 35 fs

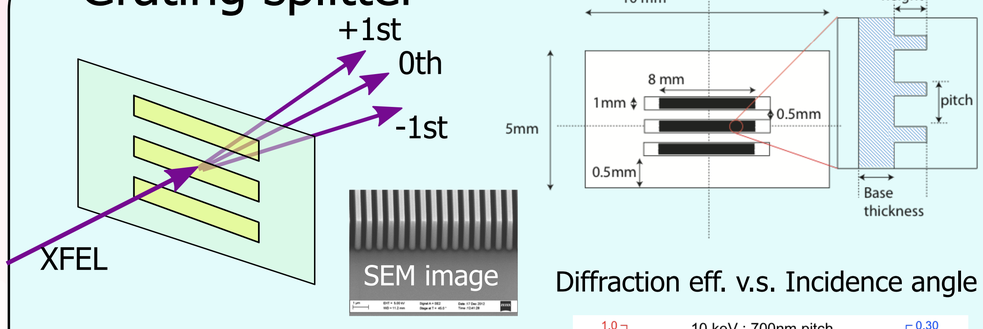
Optical parametric amp.
+ Sum frequency mixing
Wavelength: 0.25 - 2.6 μm
Output: Max. 1.7 mJ
(Signal + Idler)

Second harmonics
Wavelength: 400 nm
Output: 0.5 mJ
Third harmonics
Wavelength: 266 nm
Output: 0.3 mJ
(Option)
Fourth harmonics
Wavelength: 200 nm
Output: 0.1 mJ

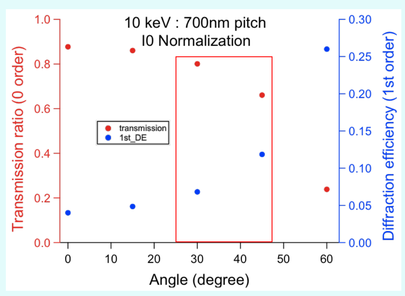




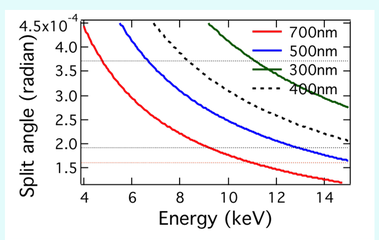
Grating splitter



Diffraction eff. v.s. Incidence angle



Photon energy v.s. Split angle



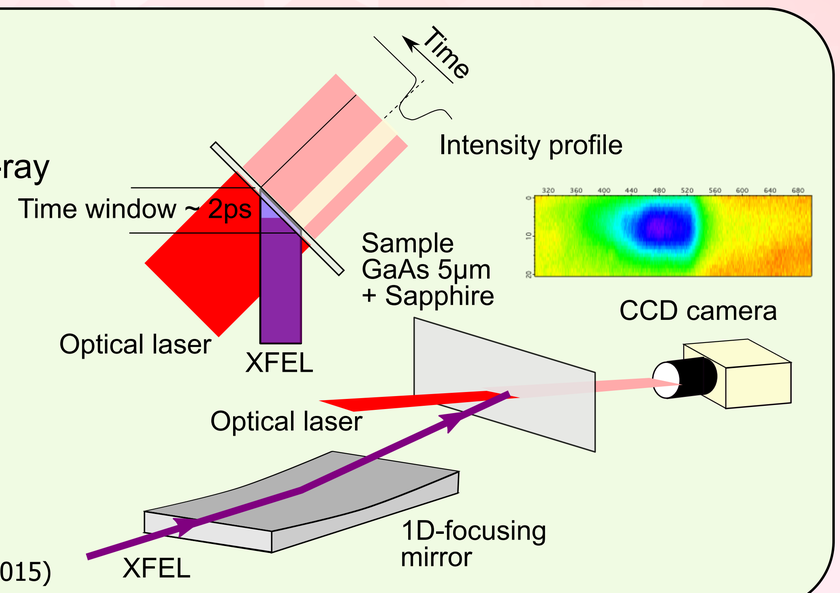
Collaboration with C.David et al. (Paul Scherrer Institute, Switzerland)
T. Katayama et al. APL. 103, 131105 (2013)

Arrival timing monitor

Transient transmittance change of GaAs
- High efficiency of High-Z material for X-ray

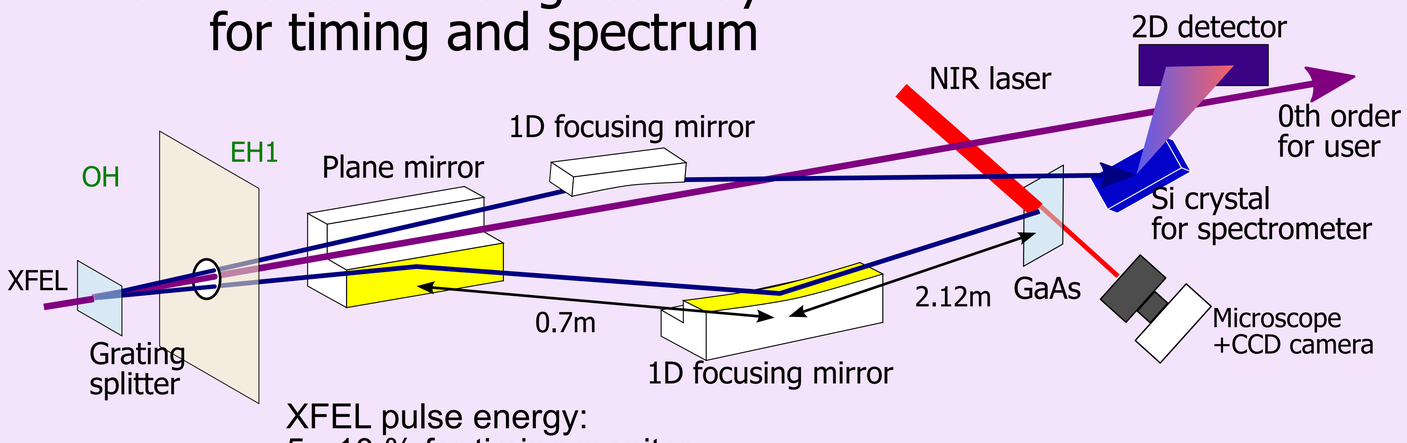
Spatial decoding:
- It dose not need a wide spectrum of optical laser.
- Convenient calibration.
- Monitoring range defined by only geometry and beam size

X-ray 1D focusing
- Enhancing pump efficiency



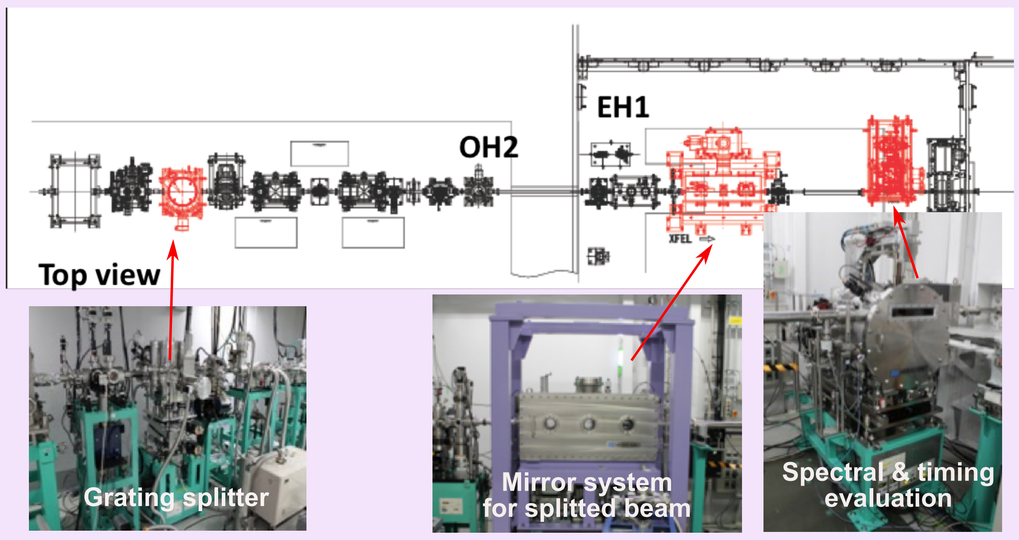
T. Sato et al. APEX 8 012702 (2015)

Non-destructive diagnostic system for timing and spectrum



XFEL pulse energy:
5 - 10 % for timing monitor
>70 % for user experiment

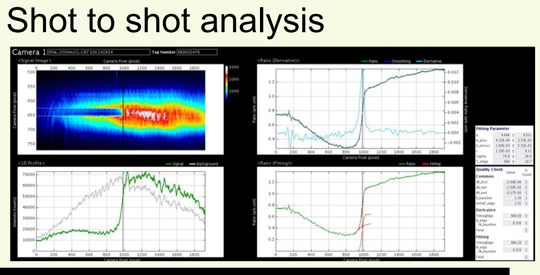
T. Katayama et al. Struct. Dyn. 3, 034301 (2016)



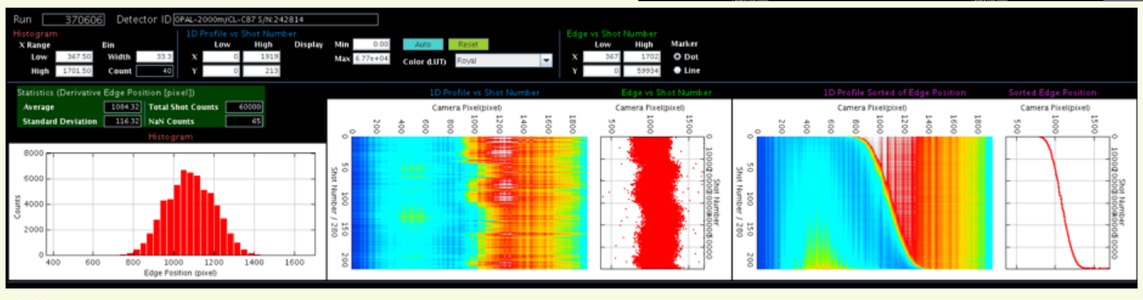
Analyzing tool & result

K. Nakajima et al. J. Synchrotron. Rad. 25, 592 (2018)

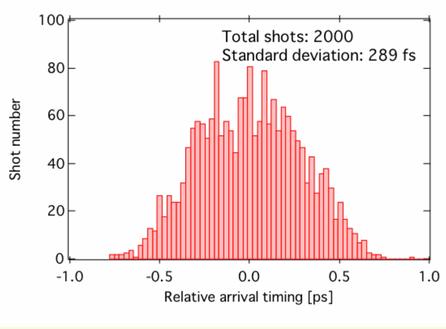
Shot to shot analysis

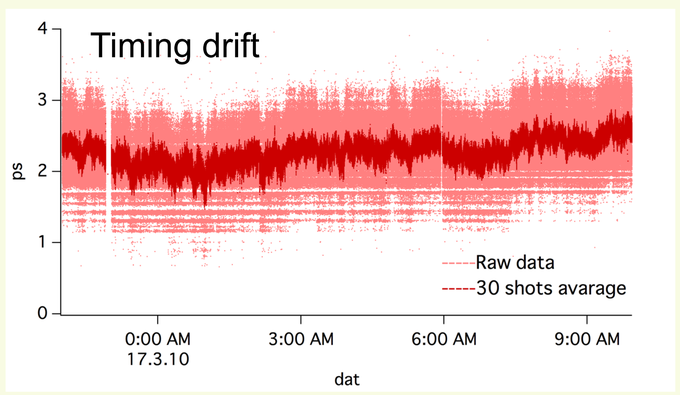


Sorting
Users shot time resolved data with the timing monitor



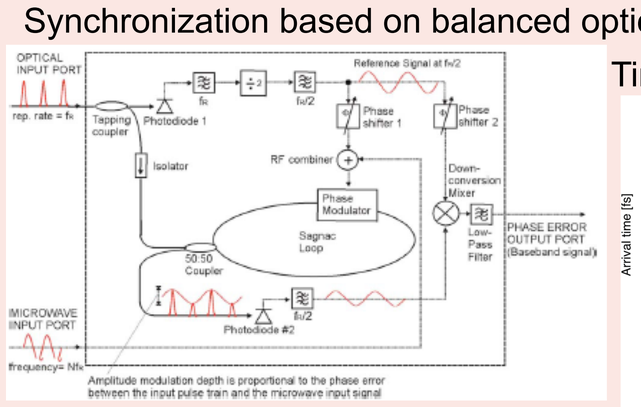
Histogram





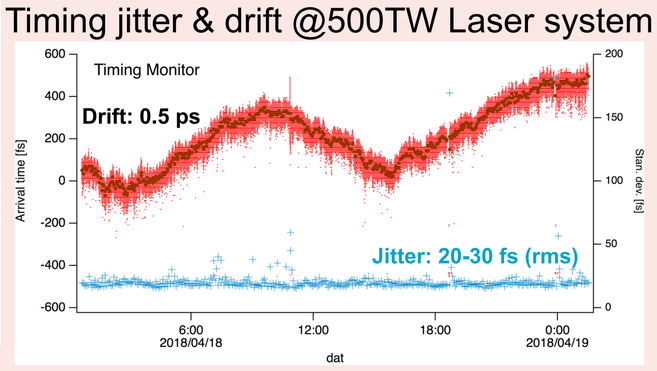
R&D for jitter improvements

Synchronization based on balanced optical microwave phase detector (BOM-PD)



J. Kim et al. Opt. Lett. 31, 3659 (2006)

Timing jitter & drift @500TW Laser system



We are going to install the BOM-PD based synchronization system in this summer

Conclusion

We have developed arrival timing monitor in order to provide shot-to-shot jitter values for user experiment.
We determined the edge position with both differential and fitting methods from the projection trace of the image. We evaluated the jitter value to be 300fs (rms).
Users can obtain data of the relative arrival timing of individual shots through the data acquisition system of SACLA.