

The X-Ray Free Electron Laser in Japan

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The X-ray Free Electron Laser (XFEL) construction project was launched in 2006 as one of Japan's five Key Technology Projects of National Importance. The XFEL is a light source based on a high-energy electron linear accelerator. The construction project will complete in FY 2010 FY and the facility will open to the public in FY 2011. The basic mechanism of laser amplification is self-amplified spontaneous emission (SASE). Projects similar to XFEL are underway in both the U.S. and Europe. Last year, the US team announced the first lasing at 8 keV. The Japanese XFEL, by adopting unique technologies, will be much more compact compared with the U.S. and European facilities. This smaller size makes it less expensive and faster to build. The feasibility of the new technologies has already been proven by operating a prototype FEL at the 50-60 nm wavelength range[1]. A seeded FEL was achieved at 170 nm[2], and development toward the daily seeded operation of the prototype FEL at 50-60 nm is currently underway.

The recent development of HHG for conventional lasers is opening up new possibilities for building FEL facilities based on conventional lasers amplified by accelerators. In addition, future development of shorter period undulators would enable us to make XFELs compact enough to be accommodated in many institutes, universities, and even industrial factories.

An 8 GeV linac-based XFEL is now under construction. All the assembly work is scheduled to finish in August. Then, the RF aging process of the accelerator tubes will continue for a few months before the electron beam commissioning (to start in January 2011).

The unique co-location of the XFEL with a 3rd generation synchrotron radiation facility at the SPring-8 site will open up a completely new type of experimental research allowing use of both the XFEL and SR beams for the same sample. The linear accelerator (linac) constructed for the XFEL will be used for an injector of the SPring-8 storage ring, which may be upgraded to take full advantage of the low emittance electron beam from the linac. The great amount of data expected to be produced by the XFEL will be analyzed using a 10 Peta-Flops computer which is constructed in Kobe as another Key Technology Project.

Reference

[1] G. Lambert et al., Nature Physics 4, 296 (2008).

[2] T. Shintake et al., Nature Photonics 2, 555 (2008).