ERL project

The energy recovery linac (ERL) being developed at KEK could help usher in a new era in materials science. Illumination of a specimen with a short, coherent, nanometer-wide X-ray beam will enable scientists to conduct nondestructive measurements on rapidly evolving dynamical materials and microorganisms with nanometer spatial resolution. This would benefit research for a host of applications in materials, life, chemical, and environmental sciences. In addition to the ERL, the XFEL-O, which is based on the high brilliant electron beam of ERL super-conduction accelerator system, should be considered to be as one of targets of the ERL. The qualities of light from ERL and XFEL-O are summarized in Fig. 1 with these of typical 3rd generation synchrotron facilities and SASE-FELs.

	average brilliance	peak brilliance	repetition rate (Hz)	coherent fraction	bunch width(ps)	# of BLs	Remark
ERL	~10^{23}	~10^{26}	1.3G	~20%	0.1~1	~30	Non-perturbed measurement
XFEL-O	~10^{27}	~10^{33}	~1M	100%	1	few	Single mode FEL (few meV)
SASE-FEL	~10^{22-24}	~10^{33}	50~10K	100%	0.05	~1	One-shot measurement
3rd-SR	~10^{20-21}	~10^{22}	~500M	0.1%	10~100	~30	Non-perturbed measurement

(brilliance : photons/mm^2/mrad^2/0.1%/s @ 10 keV)

Fig. 1 Qualities of light from ERL and XFEL-O

In order to realize 5 GeV crass ERL and 7 GeV crass XFEL-O, we have a design concept as shown in Fig. 2. The idea consists of a 2-loop configuration to realize the operations of 5-GeV class ERL and 7.5-GeV class XFEL-O. The design concept also enables saving both construction cost and space. Under ERL operation mode, electron beams are accelerated twice through a 2.5-GeV SC linac. Under the 7.5-GeV XFEL-O mode, a path length of an outer loop is changed by a half rf-wavelength by introducing an additional orbit bump. The beams are then accelerated three times through the SC linac, yielding 7.5-GeV beams for use with the XFEL-O.

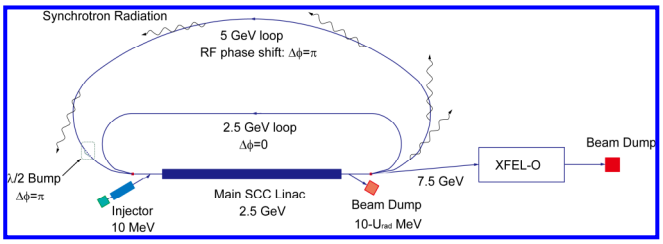

Fig. 2 Design concept of a 2-loop configuration to realize 5-GeV ERL and 7.5-GeV XFEL-O.

However, The non existence of a GeV-class ERL machine anywhere in the world has made it necessary to first construct a compact ERL (cERL) with an energy of 35–200 MeV that can be used for the development of several critical accelerator components such as the high-brilliance DC photocathode electron gun and superconducting cavities for the injector and main accelerator. The fabrication of the accelerator components is carried out from 2010 to the middle of 2012 as shown in Fig 3. We will start beam operations at the end of FY 2012 under the condition of 35-MeV accelerated energy.

Fig. 3 Construction site of cERL