FRONTIER SCIENCE
POHANG ACCELERATOR LABORATORY

General Information

Address : 80 Jigokro-127 beongil, Nam-gu Pohang, Gyeongbuk 790-834, Korea
Funded by : MSIP(korean Gov.), POSCO, POSTECH
Facilities : Pohang Light Source-II (PLS-II) & PAL-XFEL
Name of Director : Professor Moohyun Cho (the 8th director)

2013
Apr: Book publish for PAL 25 years

2012
Mar: PLS-II user service (30 BLs)

2011
Dec: PLS-II Upgrade completed
Jan: Started the project of PAL-XFEL construction (2011-2015)

2010
Dec: PLS operation terminated & machine disassembly started

2009
Jan: PLS-II (3.0 GeV) Upgrade project started (2009-2011)

2008
Jul: 28 beamlines in operation
Nov: 20th Anniversary of the PAL

2003
Sep: Storage ring beam energy upgrade to 2.5 GeV including injector linac

2001
Nov: Storage ring building expansion completed

PLS-II

User operations started in 2012 (PLS started in 1995)

3 GeV, 320 mA Top-Up operations within 0.5 % bem current variation

5,304 hrs of operation with 4,080 h user time, 744 hrs of SRF system commissioning, and 98 % availability in FY 2013

Operations Budget: ~30 M$ (USD) in 2013 FY.

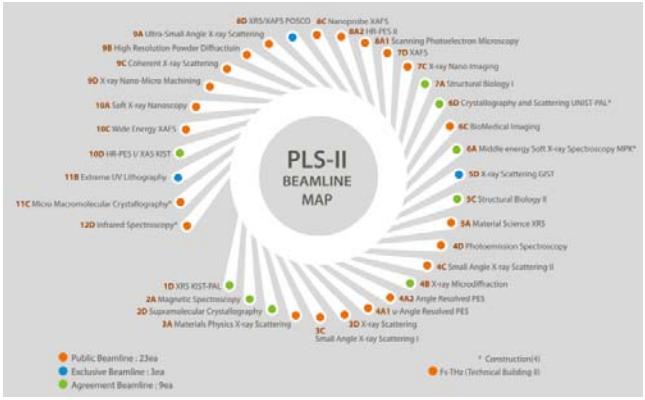
3,611 visiting users in 2013 FY.

1,293 proposals submitted, 1,081 approved (83.6 %) in 2013 FY

User affiliation: 1% from abroad, 7% from national/public institutes, 90 % from universities, and 2 % from industries

~410 publications/year in refereed journals

Beamline Map



(32 beamlines are in operation, 4 are under construction)

PAL-XFEL

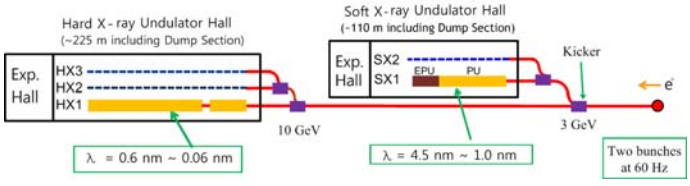
Project period: 2011 ~ 2015

Accelerator: S-band (copper structures & SLEDs are used), 10-GeV electron linac, 51 klystrons-modulator sets (1 for X-band)

FEL lines: 3 hard (HX1, HX2, HX3) & 2 soft X-ray (SX1, SX2) FEL lines (~100 m)

Overall length	1100 m (linac: 750m, undulator hall: 250m, beamline: 100 m)
Beam charge / slice emittance	0.2 nC / 0.4 mm-mrad
Peak current / repetition rate	3 kA / 60 Hz
Electron gun	PC RF-gun
Bunch compression	3 chicane-type BCs at 0.33 GeV, 2.52 GeV, and 3.45 GeV
No. of S-band structures	174
No. of quadrupole magnets	204
Undulator type	Out-vacuum, variable gap (min. 8.3 mm)
Wavelength range : HX1 SX1	0.6 ~ 0.06 nm (linear pol.) 4.5 ~1 nm (variable pol.)
Photon pulse length	10 ~ 180 fs
Photon flux @ 0.1 nm	> 1.0 E+12

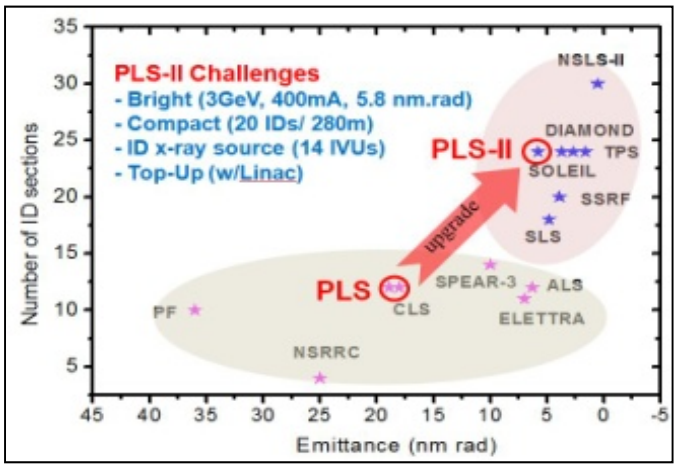
Accelerator & Beamline Map



PLS-II

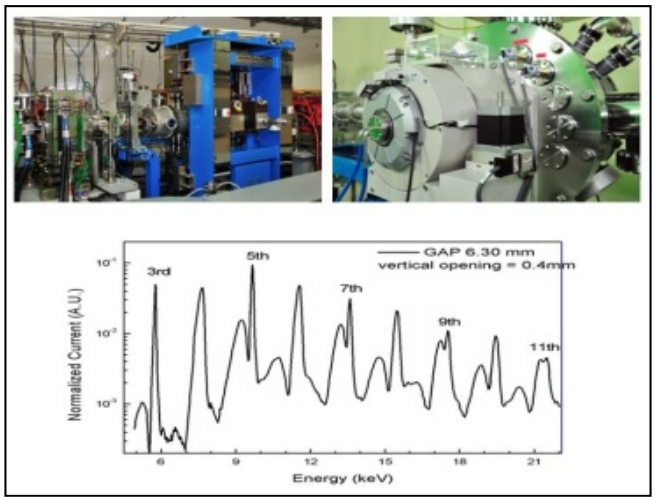
Current Activities

Completion of the PLS-II upgrade project



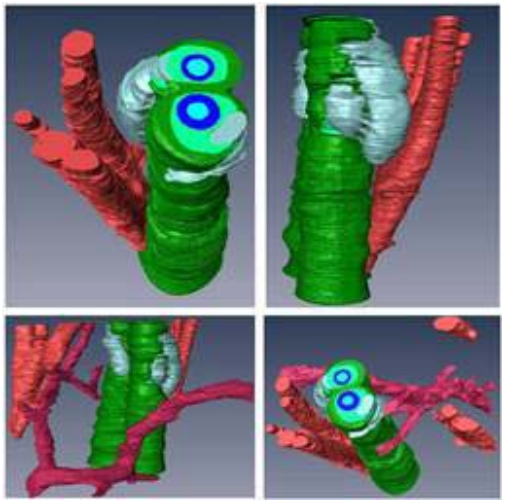
PLS-II upgrade-project has been carried out from JAN 2009 to DEC 2011. After the shutdown of PLS on DEC 10th, 2010, dismantling of PLS and installation of PLS-II storage ring as well as beamlines had been completed within 6 months. After the successful beam commissioning with 12 in-vacuum undulators and 30 beamlines, user service has been resumed in MAR 2012.

PLS-II IVU, DCM, and the hard x-ray spectrum



The key devices for PLS-II upgrade - In-Vacuum Undulator(IVU) and Double-Crystal Monochromator(DCM) - have been developed in-house and manufactured in domestic companies. Hard x-ray spectrum has been observed clearly up to 11th-harmonic during the beam commissioning, showing excellent performances.

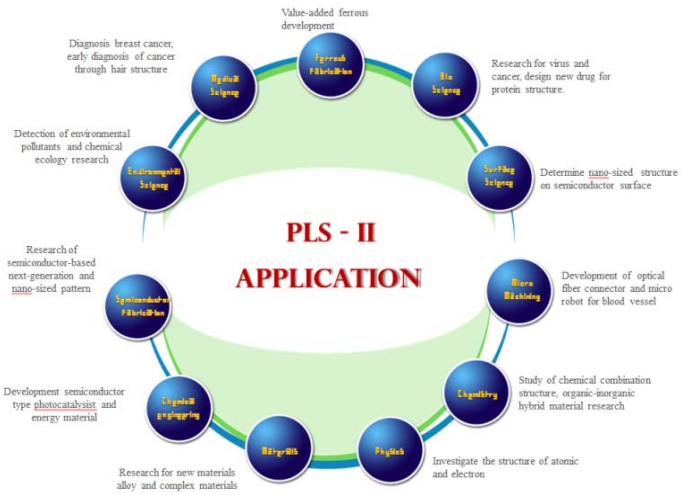
High resolution anatomy – biomedical imaging BL



Inner structure of human hair under the scalp skin was investigated. For volumetric information, computed tomography (CT) technique, which enables visualization of the sample three dimensionally, is applied. X-ray microscopy does not require sectioning of the sample.

Future Perspective

After the completion of PLS-II upgrade, we are carrying out the performance optimization of the storage ring and full energy injector linac. Major topics for the performance optimization are energy margin securing of 3-GeV linac injector with photo-cathode RF gun implementation, Linac automation for fast beam recovery from faults, photon beam stability improvement, special beam operation mode, and science programs for PLS-II beamlines.
We have launched in-house program of 'search-select-fund' for the star beamline sciences and star beamlines.



PAL-XFEL

Current Activities

The PAL-XFEL project started in April 2011 is expected its building construction and installation to be completed by 2015. The 250-m long undulator hall is being constructed to house three undulator lines. However, the current budget will cover only one undulator line (HX1) for the hard X-ray FEL.

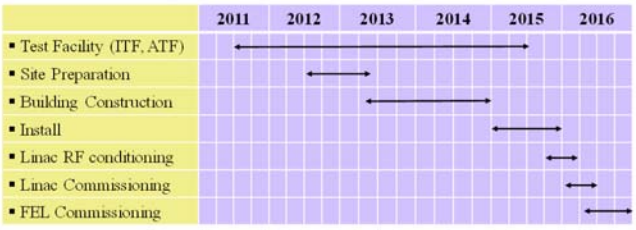
Building construction started in September 2012. Since then, 1.2 million cubic meters of soil was removed, and the concrete shielding of the machine tunnel is completed. It is expected that the building will be ready for use by the end of 2014. Installation of the linac, undulator system, and beamlines will start when the beneficial occupancy of the building is available in the beginning of 2015, and will be completed by the end of 2015.

The major procurement contract was made in 2013 for the critical components of S-band main linac: SLED, waveguide components, S-band accelerating structures, and klystron modulators. PAL collaborated with local companies for developing those components in a way of the design and test by PAL and the fabrication by the local company. The collaboration actually started one year before the PAL-XFEL project, and the performance of the prototype was confirmed for the specifications of the PAL-XFEL before the contract. The prototype klystron modulator satisfies the requirement of the beam voltage stability of 50 ppm in rms. A total of 51 klystron modulators were contracted with local companies in June 2013.

After a successful test of the prototype undulator with the undulator field accuracy of better than 2 x 10-4 and the undulator gap setting accuracy of 1 um, we made a contract for a total of 18 HX undulators with local company in September 2013.

Future Perspective

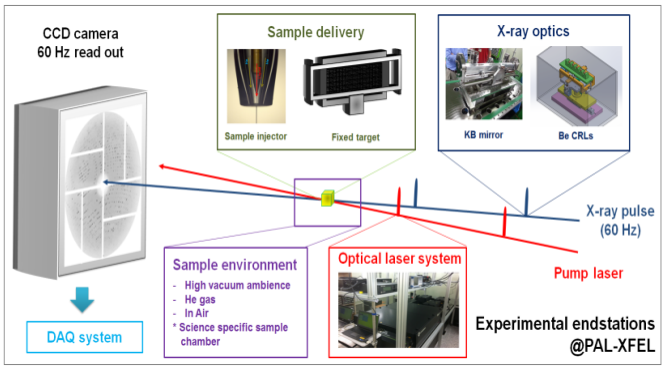
Linac rf conditioning and injector commissioning are scheduled in October to December 2015. The first XFEL commissioning is scheduled in early 2016 aiming for 0.3-nm radiation with 6-GeV beam at 10 Hz. The 2-nd FEL commissioning is scheduled in September to December 2016 for 0.1 nm HX and 3 nm SX at 10Hz.



In the first phase, PAL-XFEL plans to construct HX-XPP (X-ray Pump Probe) and HX-CXI (Coherent X-ray Imaging) endstations from one hard X-ray undulator and SX-XPP (X-ray Pump Probe) endstation from one soft X-ray undulator. Basically all instruments are focusing on application of time-resolved studies of physical, chemical and biological samples, and also have uses in high-filed physics and materials science.

Science programs

- HX-XPP
  - Dynamics of photo-induced materials
  - X-ray correlation spectroscopy
- HX-CXI
  - Serial Femtosecond Crystallography
  - Coherent X-ray Diffraction Imaging
- SX-XPP
  - Magnetic Scattering and Imaging
  - X-ray emission spectroscopy



All beamline components (optics, diagnostics, sample environment and detector) will be installed in 2015.

PAL-XFEL beamlines will allow us to travel into the ultra-fast and ultra-small world.