

CLIC and XFEL study – information from SINAP

- FEL projects and R&D status
- XFEL plans and collaboration intention

FEL projects and R&D status

- Facilities
 - The SDUV-FEL facility
 - The DCLS facility
 - The SXFEL facility
- The R&D of the key components/technologies

The SDUV-FEL facility

- The Shanghai Deep Ultra Violet FEL facility is a test facility for various seeded FEL operation scheme.
- First lasing of this facility was in 2009. HGHG (3~11 harmonics), cHGHG (2*2), EEHG(4, 10 harmonics), and polarizing controlled HGHG have been demonstrated.
- The e beam parameters are:
 - Emittance (Nor.), 2~3umrad
 - Peak current (Max.), ~100A (~150pC, 3ps)
 - Energy (Max), ~180

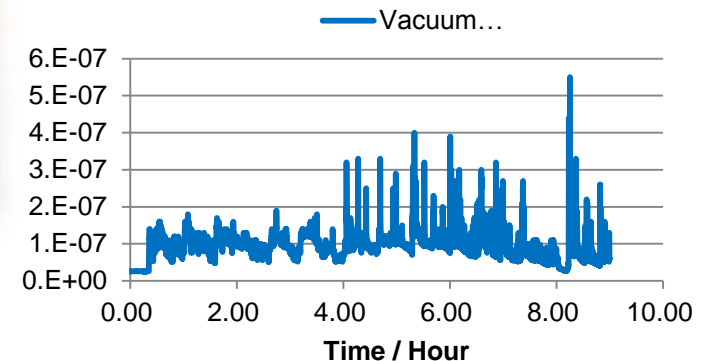
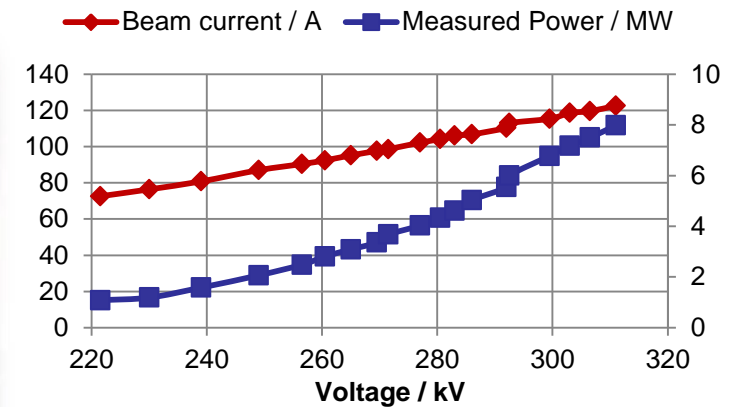
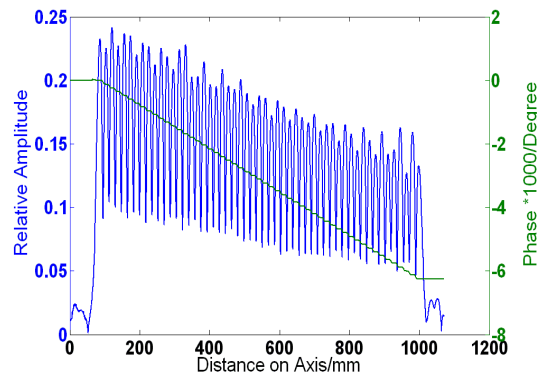
The DCLS facility

- The Dalian Coherent Light Source facility is an FEL user facility.
- This project started at 2012 and will open to the users at 2015.
- The parameters are:
 - FEL Wavelength, 50~150nm
 - FEL pulse energy (max.), 100uJ
 - FEL pulse length, 100fs, 1ps
 - E beam emittance (nor.), ~2umrad
 - E beam peak current (max.), ~300A (~500pC, 3ps)
 - E beam energy, ~300MeV
 - Repetition rate, 50Hz

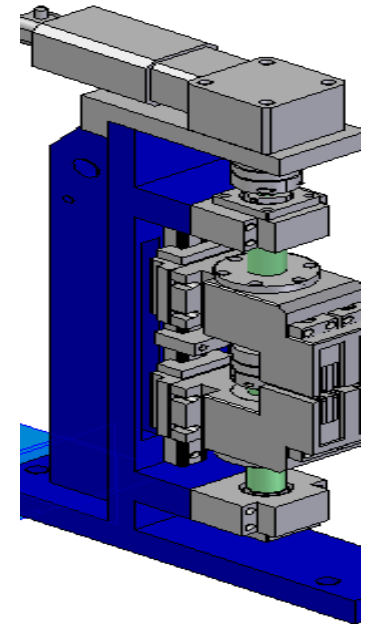
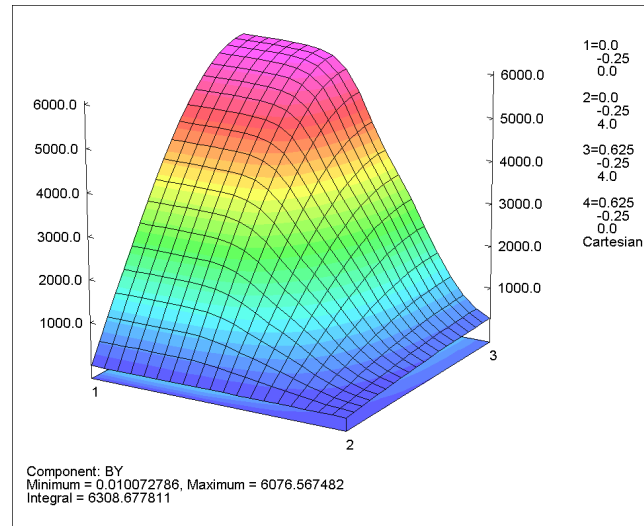
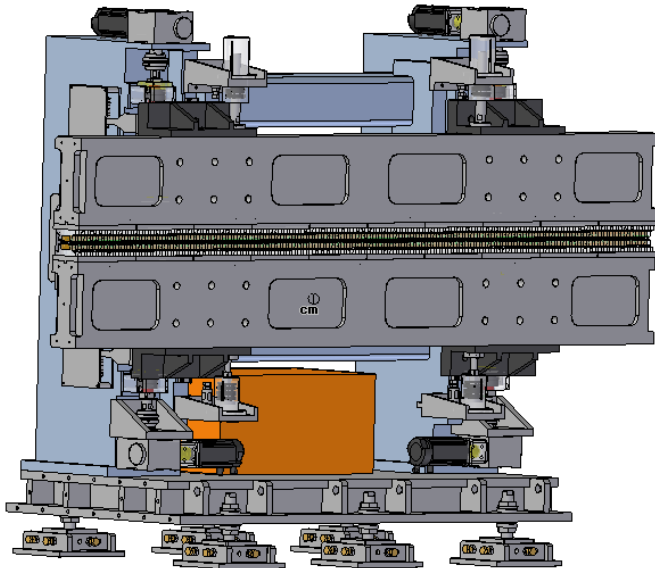
The SXFEL facility

- The Shanghai X-ray FEL is a test facility for the Hard X-ray FEL in China.
- The project will start by end of this year and get lasing within 2~3 years.
- The parameters are:
 - FEL Wavelength, ~9nm
 - FEL pulse power, ~100MW
 - E beam emittance (nor.), ~2.5umrad
 - E beam peak current (max.), ~500A (~500pC, 1ps)
 - E beam energy, ~840MeV

The R&D of the key components/technologies



Undulator



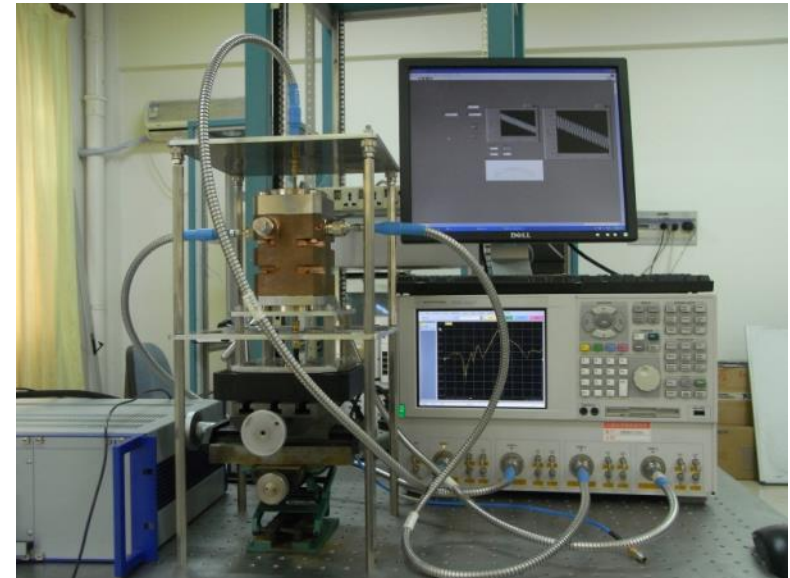
λ_u (mm)	λ_{res} (nm)	K	B _{eff} (T)	Length (m)
25	8.8	1.35	0.576	3

Proto types of cryogenic undulator and superconducting undulator are under developing

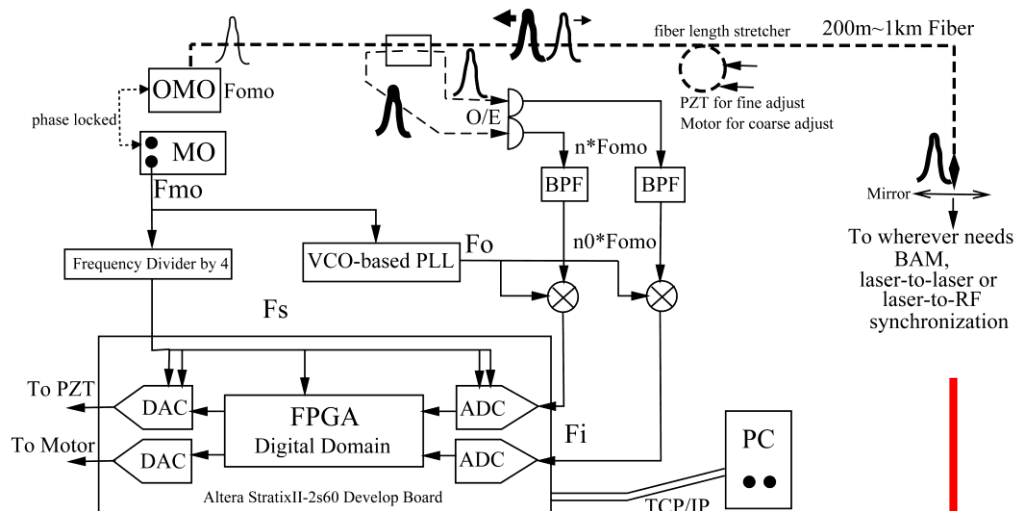
Cavity BPM

Parameters of the RF-BPM Cavity

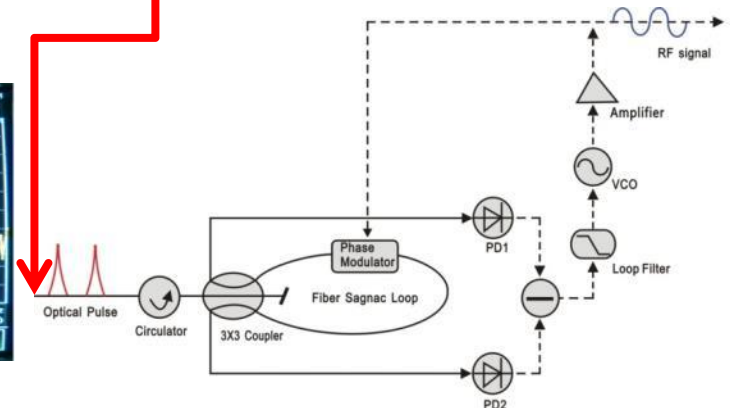
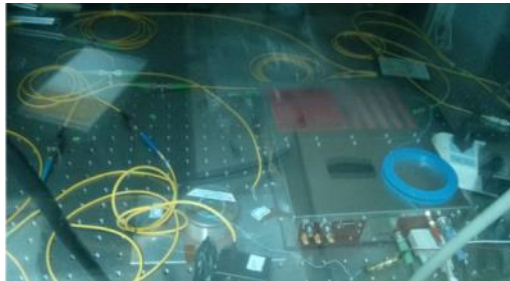
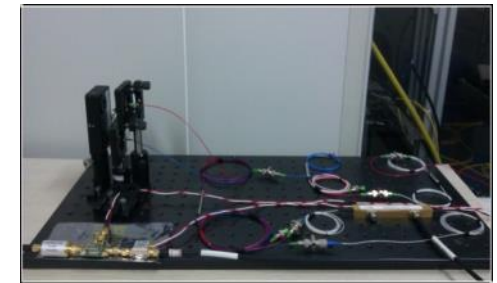
	TM110 cavity	TM010 cavity
Resonant Frequency	4760 MHz	4760 MHz
Loaded Q factor	50	50
Number of ports	4 (X: 2, Y: 2)	1
Signal amplitude at the 50 ohm port	14 mV/ μ m/nC (peak)	200 V/nC (peak)



Signal distribution



For SDUV-FEL at Shanghai, $F_{omo}=238\text{MHz}$, $F_{mo}=238\text{MHz}$
 $F_s=59.5\text{MHz}$, $n_0=6$, $n_0 \cdot F_{omo}=1428\text{MHz}$, $F_o=1472.625\text{MHz}$, $F_i=44.625\text{MHz}$



XFEL plan and collaboration intention

- The key features of the hard x-ray FEL
 - Compact user facility, <600m
 - FEL operation scheme, seeded
 - FEL pulse wavelength, <0.1nm
 - FEL pulse power, >10GW
 - E beam energy, 6~8GeV
 - E beam peak current, >3kA
 - Repetition rate, >50Hz
- Preliminary study has shown that 6GeV (0.1nm) could be achieved with the C band system within 300m long linac

Design

- The accelerator
 - Simulation tools: astra/impactT, litrack, elegant, MAD/transport
 - Gun and injector: emittance/peak current optimization, jitter analysis, dark current tracking
 - Main accelerator: lattice, micro bunching instability, longitudinal jitter analysis, trajectory correction, emittance preservation, energy and peak current feedback
 - E beam distribution: lattice, emittance preservation

- The radiator
 - Simulation tools: genesis
 - Lasing scheme choosing, undulator parameters optimization, lattice, stability study (S2E), trajectory correction

RF system

- Collaboration with CLIC on the X band system R&D including accelerating structure, waveguide components and high power test stand
- The structure development
 - By end of this year, a mini workshop with turning and milling machines, CMM, interferometer, surface treatment equipment, vacuum furnace will be ready and we could produce the structure in house
 - Optimizing the accelerating structure to increase the RF to e beam energy efficiency and reduce the cost in case of FEL linac application

- RF test stand
 - The building for the SDUV-FEL facility with the tunnel and service area could be used for the high power test
 - RF power combination and compression with high repetition rate
 - We asked an EVD company in China to develop an X band klystron with 20MW RF power based on a collaboration agreement

E Beam test stand

- Gun test stand
 - The building for the SDUV-FEL facility with the tunnel, S band RF power source, drive laser system, and the beam instrumentation could be used for the gun test stand (with limited repetition rate)
- Structure test stand with e beam
 - The building for the SDUV-FEL facility with the tunnel, a 180MeV (max.) e beam from the linac could be used for the structure test (with limited repetition rate)

Thanks for your attention
Questions and comments please

