The SRF ERL Based FEL Test Facility at Peking University

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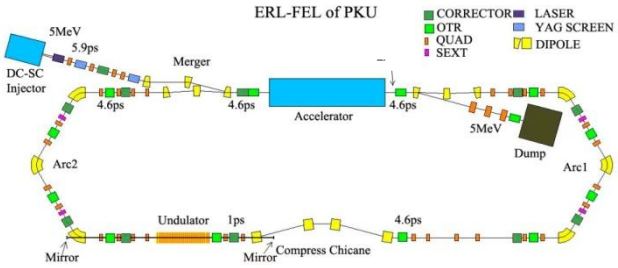
To provide coherent radiations with high luminosity, high RF efficiency and low waste, the construction of a SRF (Superconducting RF) ERL (Energy Recovery Linac) test facility (PKU-SETF) was initiated by the PKU-SRF group in 2005 as a mid-term goal. The PKU-SETF consists of mainly a 5 MeV DC-SRF injector, a cryomodule of 9-cell TESLA cavity for accelerating electrons to ~20 MeV and an energy recovery beam transport loop with two arcs matching with the main accelerator. An undulator and a chicane compressor are inserted in the loop to produce FEL with 4-8 micron wave length. The PKU-SETF might be realized in 3 steps. First the 5 MeV beam from the DC-SRF injector will be injected directly to an undulator to produce THz radiations. After the main accelerator and the energy recovery loop are accomplished, an ERL Compton Backscattering (CBS) device will be constructed to produce high flux X-ray of ~10 keV. Finally with an 11.5 m long optical cavity, an IR high brightness laser can be obtained. A 900 m^2 experimental area was completed last year, the layout of PKU-SETF is shown in the poster. The cryomodule and the cryogenic system is in position. The 1st beam from the injector is hopeful this year.

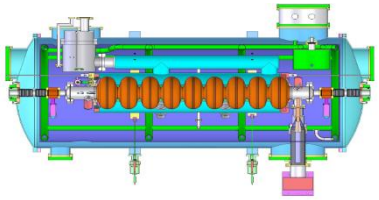
Schematic layout of PKU-SETF

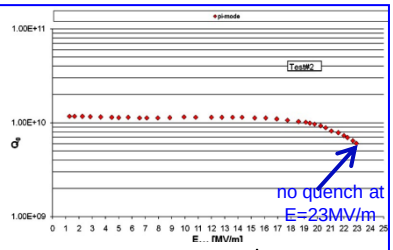


Main parameters of PKU-SETF

Injection Energy	~5 MeV
Output Energy	~20 MeV
Bunch Frequency	81.25 MHz
Bunch Charge	-60 pc
Bunch Length at the entrance of Undulator	~1 ps
Macro Pulse Length	2 ms
Rep. Frequency of Macro Pulse	10 Hz
Energy Spread (rms)	0.24 %
Transverse Emmittance (rms, n)	~3 mm-mrad
Length of Undulator	1.5 m
Period of Undulator	3 cm
K of Undulator	0.5-1.4
Optical Cavity Length	11.52 m
Wave Length of FEL	4.7-8.3 μm

Main SRF Accelerator

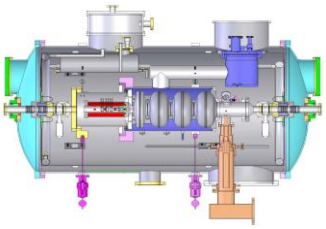


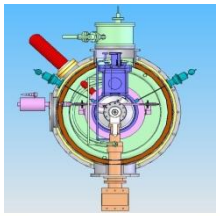


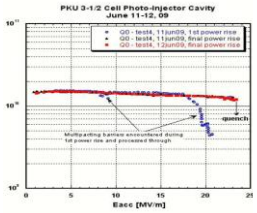
RF frequency	1.3 GHz
Field gradient	15-20MV/m
Q_0	1×10^{10}
Peak Current	20~50 A
Bunch Charge	20~50 pC
Average Current	1.6~4.0 mA
External Q	$0.2\text{–}1\times10^{7}$
Cryogenic losses	12W@2K

DC-SRF photoinjector

- 100 KV Pierce gun
- renewable photocathode
- 3.5-cell large grain Nb cavity
- working at 2K







PKU-SETF

(1) Main Accelerator
(2) DC-SRF Photoinjector
(3) 2K Cold Box
(4) Cryogenic System
(5) ERL Beam line loop
(6) 900 m^2 SRF Laboratory