



the 50th ICFA Advanced Beam Dynamics Workshop on Energy Recovery Linacs

Optics Layout for the ERL Test Facility at Peking University

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- 1. Introduction to the ERL test facility
- 2. Optics for the ERL test facility
- 3. Summary



1. Introduction to the ERL test facility

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1) Primary Goals

- To demonstrate energy recovery
- To demonstrate ERL-based FEL
- ★ To produce high average current, high brightness electron beam from superconducting photo-injector
- ★ To develop superconducting RF accelerating technologies
- ★ To develop ERL based radiation sources



2) Parameters for ERL-Based FEL

E Beam Parameters		Opt Cavity Parameters		
Energy [MeV]	30	Cavity length [m]	11.5305 0.8 5.876m	
Energy spread, FWHM	0.32%	Rayleigh range [m]		
Bunch charge [pC]	60	Mirror radius of curvature [m]		
Normalized emittance [mm.mrad]	4	Beam waist, w0 [mm]	1.60 (1.14)	
Bunch length, FWHM [ps]	4	g1.g2	0.93 2%	
Micro pulse repetition rate [MHz]	26	Extraneous loss		
Macro pulse length [ms]	2	Out-coupling	8% (1%)	
Macro pulse repetition rate [Hz]	10			
Wiggler Parameters		FEL Parameters		
Wiggler wavelength [cm]	3	Wavelength [um]	10.03 (5.1)	
Gap [mm]	12 (21)	G0	0.61 (0.21)	
Kw, rms	1.14 (0.41)	G 0.30 (0.10)		
Number of wiggler periods	Number of wiggler periods 40		2.12 (0.97)	

Beta function @ wig center, horizontal [m]

Beta function @ wig center, vertical [m]

Beta function @ wiggler center, vertical

Alpha @ wiggler center, horizontal

KEK, Tsukuba, Ibaraki, Japan

Out-coupled macro pulse avg power [W]

Out-coupled avg power [W]

Intra-cavity avg power [W]

Intra-cavity peak power [MW]

0.346

0

0

0.245 (0.677)

220.7 (101.2)

26.53 (97.31)

55.2 (202.4)

4.4 (2.0)





3) Layout



(1) Distance btwn south/north straight section: 4 m; (2) injection angle: 20 degree;(3) east arc is very close to shielding wall



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(1) Electron Beam Parameters:

Injecting energy: 6 MeV; max energy: 30 MeV; bunch charge: 60 pC; FWHM bunch length at wiggler entrance: 4ps; energy spread: ~0.3%; normalized emittance: 4 mm.mrad;

(2) Bunch compression and energy spread compression:

From linac exit to wiggler entrance: R56=-0.525, T566=-42.8;

From wiggler exit to linac entrance: R56=0.525, T566=42.8;

(3) Acceleration phase: -5 degree, deceleration phase: 175 degree.



2) Injection





3) Chicane: for path length adjustment

 Path length adjustment is realized by changing the bending angle of dipoles;
Twiss parameter does not change much when adjusting the path length.

α,	degree	dl, cm	dψ, degree	δx, cm	R56
	24.1	-2.74	-42.8	-2.80	-0.7622
	24.4	-1.84	-28.7	-1.87	-0.7854
	24.7	-0.93	-14.5	-0.93	-0.8090
	25	0.00	0.0	0.00	-0.8332
	25.3	0.94	14.7	0.93	-0.8580
	25.6	1.90	29.7	1.86	-0.8833
	25.9	2.87	44.8	2.79	-0.9092





4) Arc1: for bunch compression







The beta functions do not change much at the arc exit.



5) Arc2: for energy spread compression

Bunch decompression/energy spread compression









7) Matching to Chicane and Wiggler

Four quadrupoles to match electron beam into wiggler from chicane
Three doublets for electron beam matching into chicane



KEK, Tsukuba, Ibaraki, Japan





8) Matching to ARC2

















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1) The optics design for the ERL test facility at Peking University has been updated according to the expected characteristics of DC-SC photoinjector and accelerating module.

2) The building to host the ERL test facility and the layout of LHe transfer pipes pose constraints to the optics of the ERL test facility, which has been taken into account in the design.

3) The optics design gives enough flexibility for ERL and ERL-based FEL experiments.

4) Further study on beam dynamics is on-going and a review on the physical design of the ERL test facility is expected in the near future.



Thanks