Overview of Design Issues

17th KEKB Accelerator Review
Feb. 20, 2012

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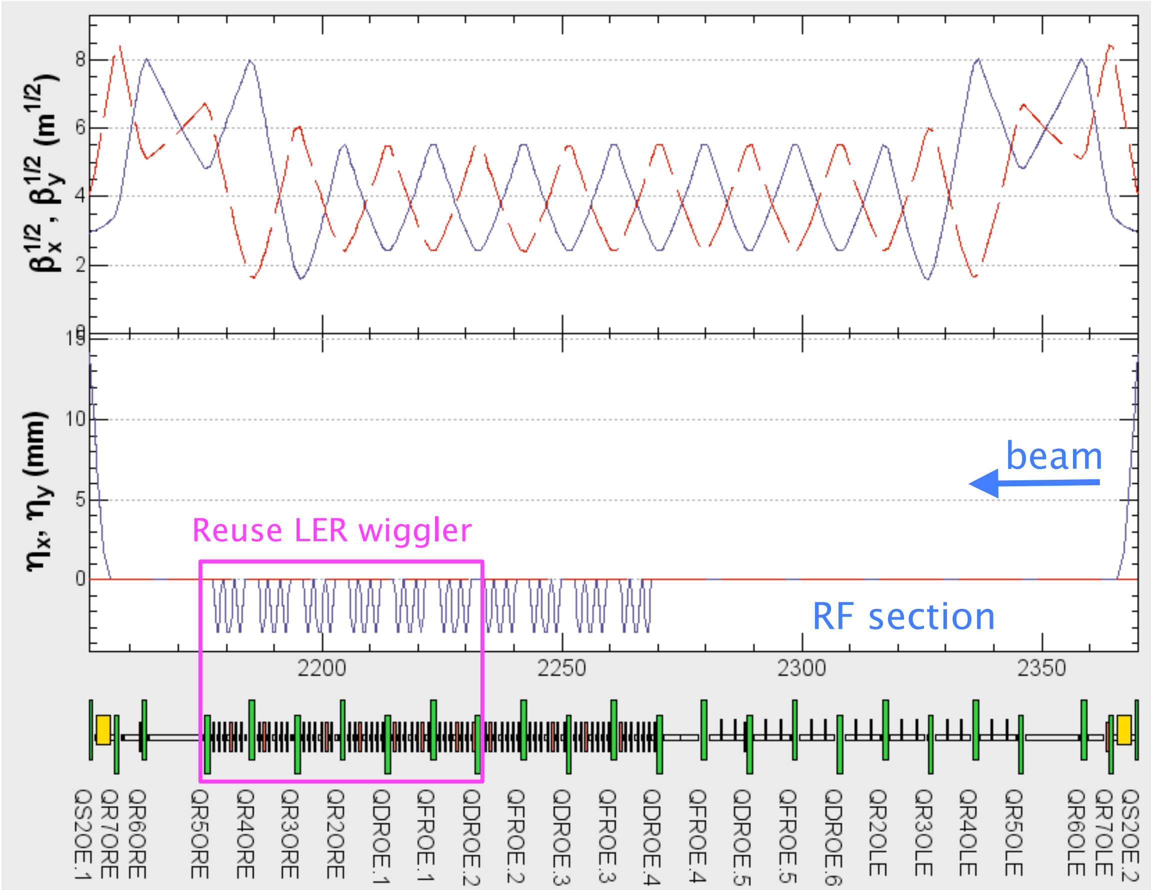
Parameters

	2011 Feb. HER no wiggler	2012 Feb. HER 60% wigglers
Energy (GeV) (LER/HER)	4.0/7.00729	4.0/7.00729
β_y^* (mm)	0.27/0.30	0.27/0.30
β_x^* (mm)	32/25	32/25
ε_x (nm)	3.2/5.3	3.2/4.6
$\varepsilon_y/\varepsilon_x$ (%)	0.27/0.24	0.27/0.28
σ_y(nm)	48/62	48/62
ξ_y	0.0897/0.0807	0.0881/0.0801
σ_z (mm)	6/5	6/5
I_{beam} (A)	3.6/2.6	3.6/2.6
$N_{bunches}$	2500	2500
Luminosity (10^{34} cm^{-2} s^{-1})	80	80

HER ε_x with 60% wigglers is used as the nominal value.
Lower HER ε_x can relax some other parameters ($\beta_{x/y}^*$, $\varepsilon_y/\varepsilon_x$, etc.).
At present, larger $\varepsilon_y/\varepsilon_x$ in HER is adopted.

HER Wiggler Section

Oho Straight Section



- Decrease the horizontal emittance with wigglers.
- Only reuse LER wiggler magnets at T=0. (60%)
- Install more wigglers if possible. (40%)

IR Design

- Design of IR (magnets, vacuum chamber, beam background estimation, collimation system, collision feedback system, etc) has been improved.
  - Iron yokes for 3 more superconducting quadrupoles (QC1LE, QC1RE, QC2RP)
  - More precise correction of higher multipoles
  - Optimization of solenoid field distribution
  - Optimization of physical aperture
  -
- Modeling of IR optics has also been improved by using 3D magnetic field calculation.
  - Touschek lifetime is marginally kept to be ~600 sec.
- Lattice design of IR (Tsukuba section + a part of arcs) is required to be finalized around the end of this fiscal year (March 31) to meet the construction schedule.

-> A. Morita, Ohuchi, Nakayama, Kanazawa, Funakoshi, et al.

Injection

- The synchrotron injection (fully or partially) will be necessary in HER because the transverse aperture is not sufficiently large for the betatron injection.

- With the beam-beam interaction, simulations say that transient vertical blowup occurs after the betatron injection even in LER, which causes beam loss or background.
  - Optimization of phase space profile by octupole correctors may cure this blowup.

- Good qualities of injected beams with sufficient intensities are essential for stable operation with very short lifetimes.
  - Overall (Touschek, luminosity and beam-gas) lifetime: LER/HER 360/373 sec, estimated by A. Morita.
  - Needs optimization of beam distribution in Linac/BT lines.

-> M. Yoshida, T. Kamitani, H. Ikeda, T. Mori, et al.

Error Correction

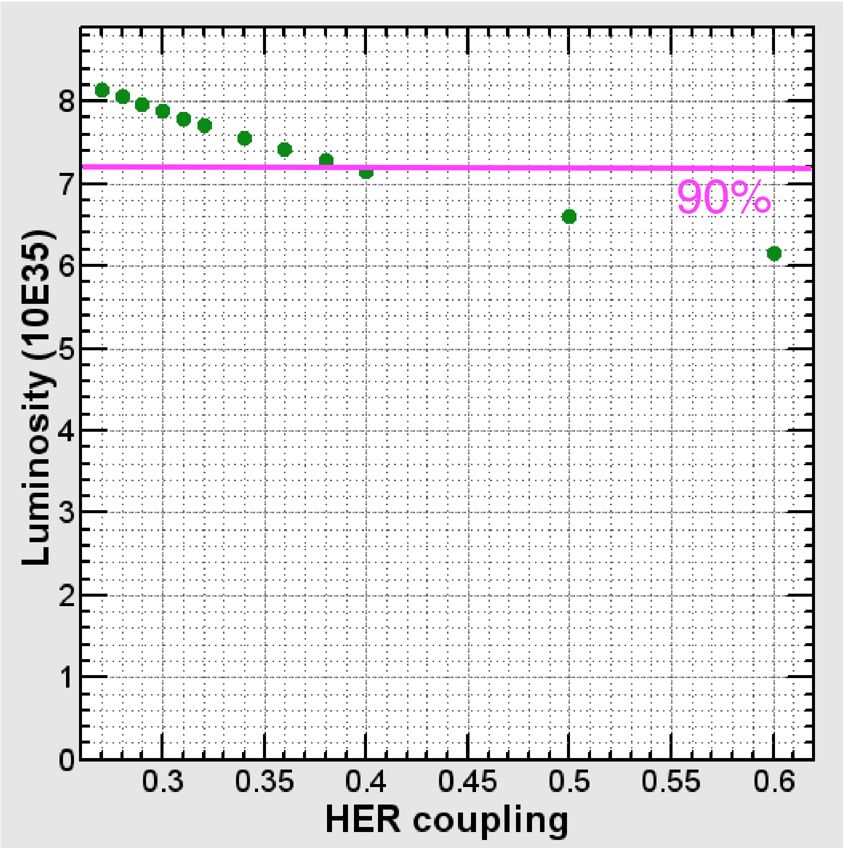
- Estimation of error tolerance and development of optics correction system have been in progress.
  - Requirements for beam diagnostics and control system (number of monitors, accuracy, speed, etc) are being decided step by step.

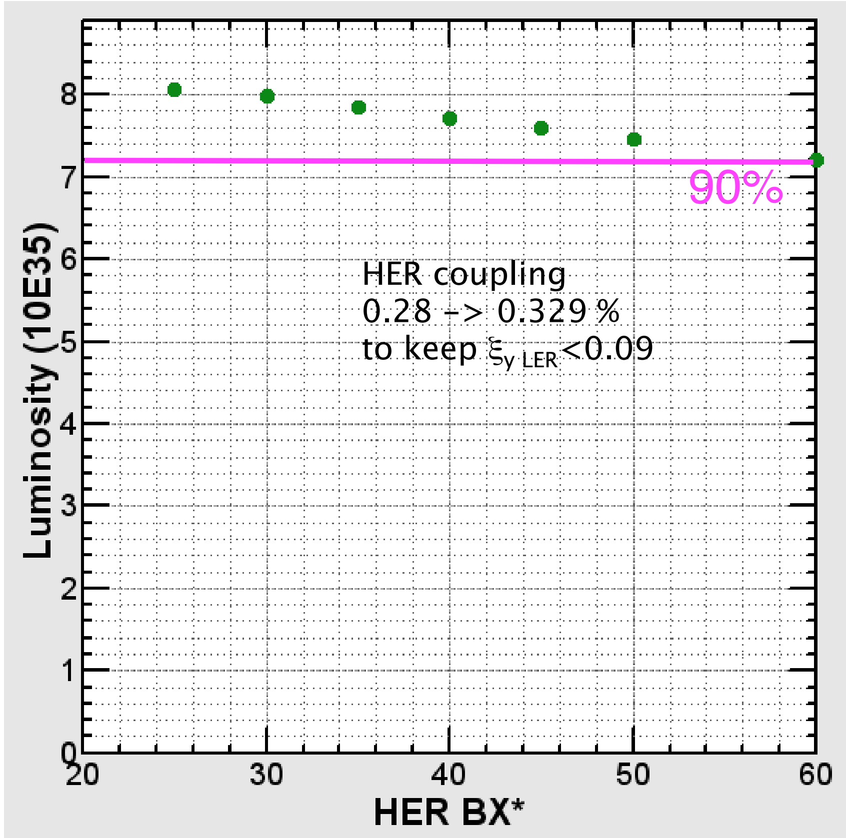
- Error tolerances of IR magnets (vibration, ripple of power supplies, etc) are very small. Realistic solution to maintain good conditions of optics and collision should be developed.

- Sufficient correction and tuning knobs for optics correction and luminosity tuning should be equipped.
  - Correction winding of each quadrupole (0.5%)
  - Skew quadrupole windings of each sextupole ($\Delta y \sim 1$ mm)
  - Rotated sextupoles or skew sextupoles to correct chromatic couplings
  - etc.

-> H. Sugimoto, Y. Funakoshi, et al.

Example of Parameter Dependence





Luminosity degradation depending on some parameters are not so steep.
We will find several ways to reach 90 % of the target luminosity.

backup

Luminosity: $7.2070 \times 10^{35}\ cm^{-2}s^{-1}$

LER

	Value	Min.	Max.	
ε_{xL}:	3.2000	3.2000	3.2	nm
β_{xL}:	32.0000	32.000	50	mm
$\varepsilon_{yL} / \varepsilon_{xL}$:	.2700	.2700	INF	%
β_{yL}:	.2700	.2700	.27	mm
ξ_{xL}:	.0028	.0000	INF	
ξ_{yL}:	.0896	.0000	.09	
I_L:	3.6000	A		
σ_{zL}:	6.0000	mm		
E_L:	4.0000	GeV		
σ_x:	10.119 μm	σ_y:	48.299 nm	
θ_{xh}:	41.5000	41.500	41.5	mrad

HER

	Value	Min.	Max.	
ε_{xH}:	4.6000	4.3000	5.3	nm
β_{xH}:	60.0000	25.000	INF	mm
$\varepsilon_{yH} / \varepsilon_{xH}$:	.3290	.2400	INF	%
β_{yH}:	.3000	.3000	INF	mm
ξ_{xH}:	.0029	.0000	INF	
ξ_{yH}:	.0807	.0000	.09	
I_H:	2.6000	A		
σ_{zH}:	5.0000	mm		
E_H:	7.0073	GeV		
σ_x:	16.613 μm	σ_y:	67.381 nm	
N_b:	2500.0000	2500.0	2500	