

ILC DR Lower Horizontal Emittance? -2

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Correction of previous report

In intra-beam scattering calculations,
particles/bunch was wrong (1E10)
(Correct: 2E10)

“Original” design

	Wrong	Correct
Horizontal normalized Emittance (um) with out, with IBS	5.74, 6.09	5.74, 6.27

Reduction of horizontal emittance

Reduce dispersion and/or β_x in bending magnets

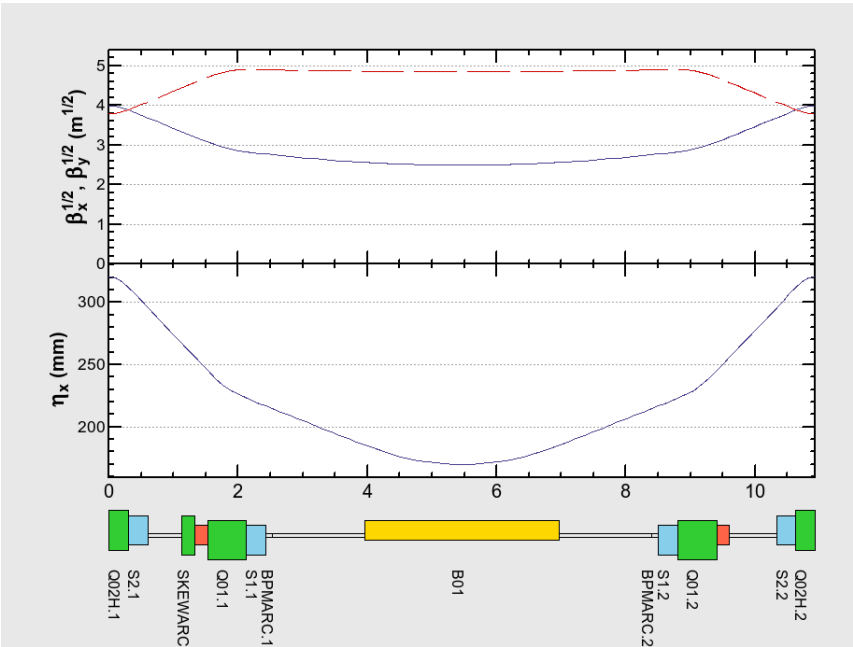
- Stronger focusing \rightarrow stronger sextupole field \rightarrow reduce dynamic aperture (aperture of original design is already tight) (previous report)

Reduction of bending field

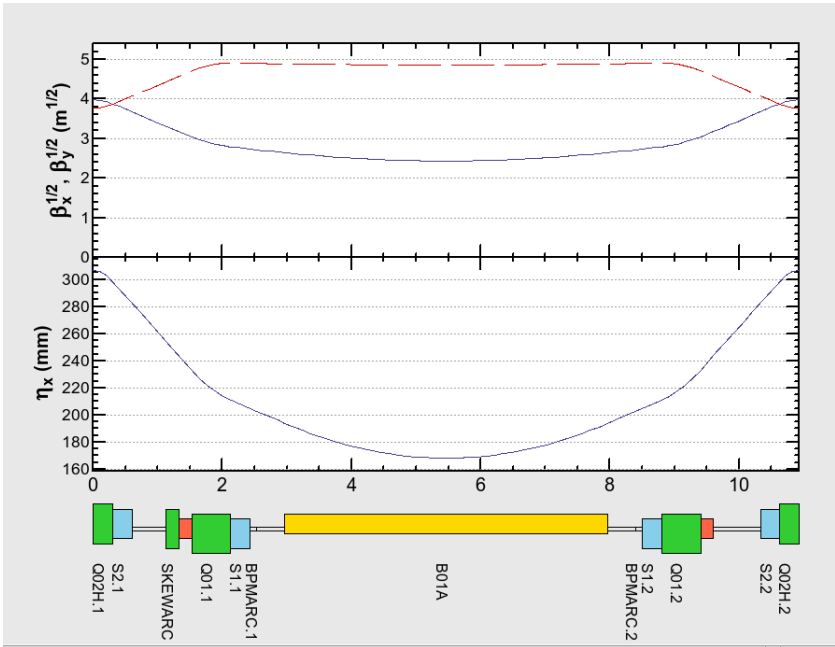
- In Wiggler dominant ring, emittance $\sim 1/\rho^2$ in arc
- Bending magnet can be longer (3 m \rightarrow e.g. 5 m)
- Tried longer bend lattice
 - No change in straight sections, except for minor changes for optics matching
 - Set phase advance/cell for emittance = 4 μm with IBS

Optics of Arc Cell

Original

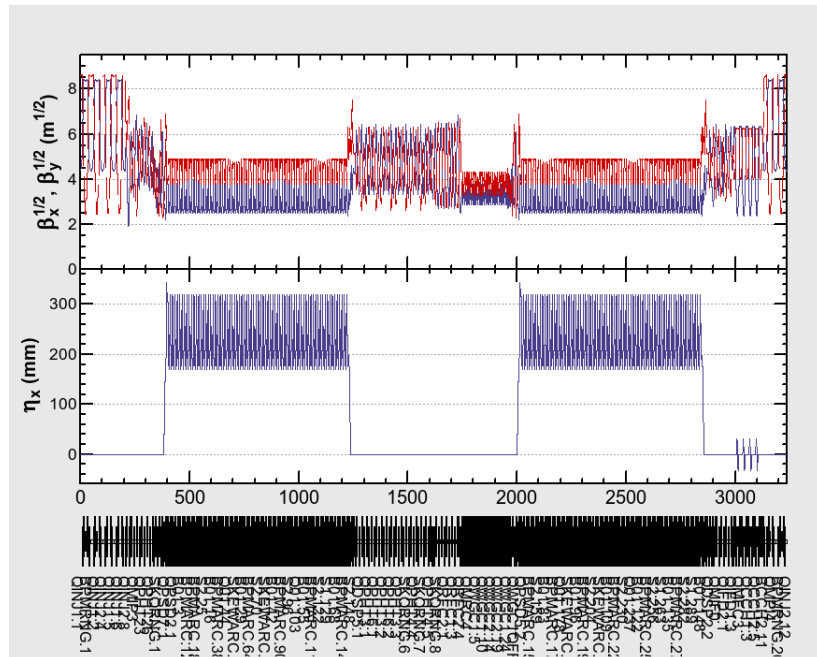


New (long bend)

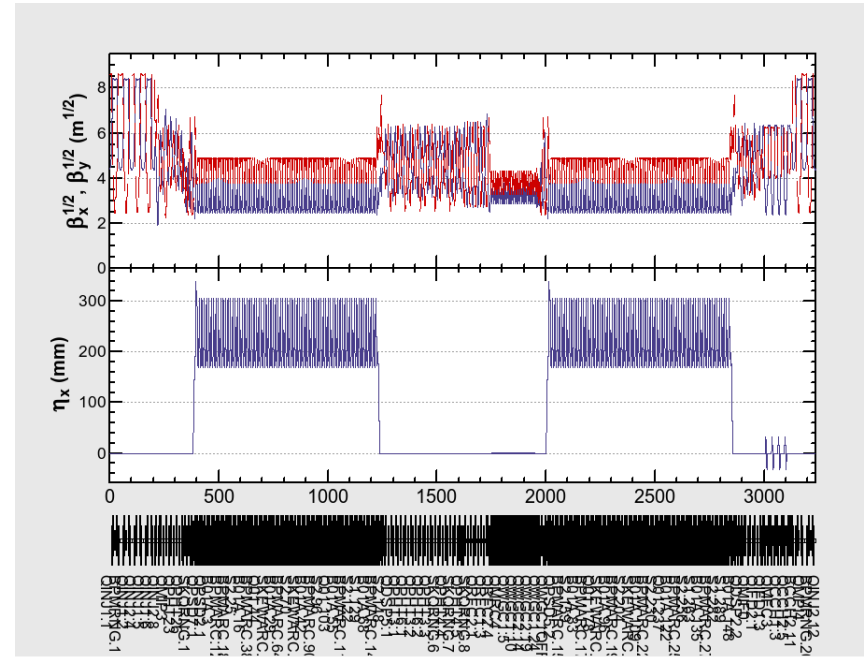


Optics of Whole Ring

Original



New long bend



	Original	New (stronger focus)	New (long bend)
Horizontal normalized Emittance (um) wo, w IBS	5.74, 6.27	3.22, 4.00	3.14, 3.97
Tune x/y	48.26/26.76	57.79/26.46	49.33/26.86
phase adv./cell /2pi x/y	0.21891 /0.08098	0.2788 /0.08	0.2250 /0.0808
Damping time x/y/z (ms)	23.9/23.9/11.9	23.9/23.9/11.9	25.5/25.5/12.8

Some surveys of phase advances/cell and total tunes were performed, for good dynamic aperture. (Surveys were not complete.)

Dynamic Aperture calculation

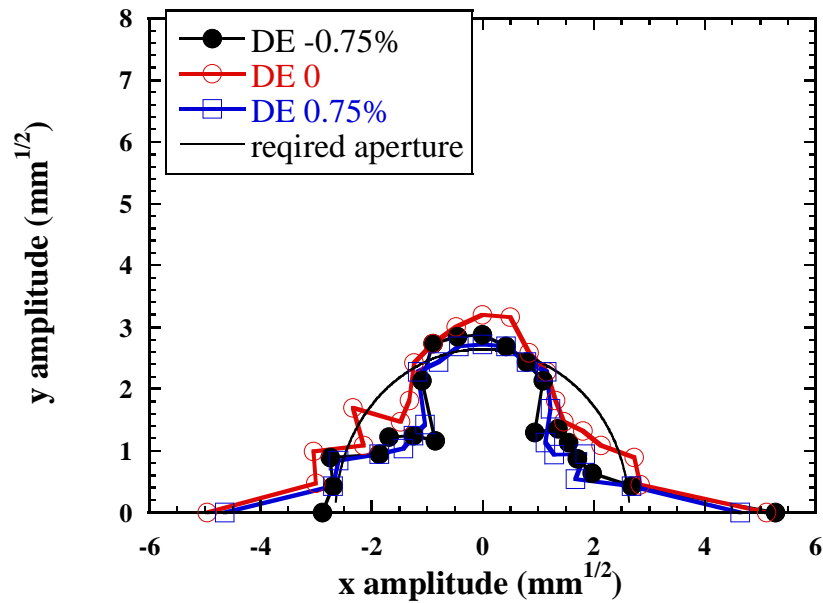
Tool prepared in SAD

- Set initial orbit and energy deviation and perform tracking
- Survived in 1000 turns tracking → “accepted”
- No errors included.
- No special treatment of wiggler’s magnetic field.

Aperture with original arc cell

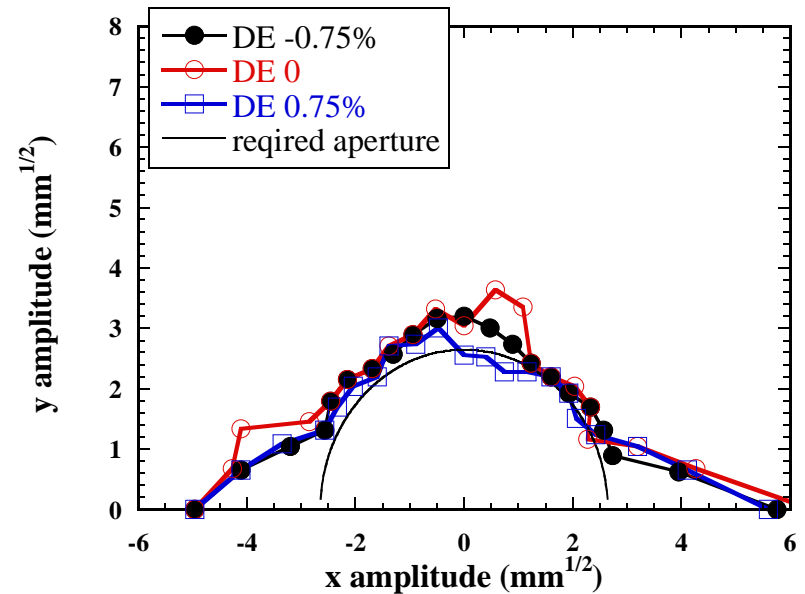
Original

Tune x 48.2643 y 26.7628



Original cell, change tunes

Tune x 48.14 y 26.68

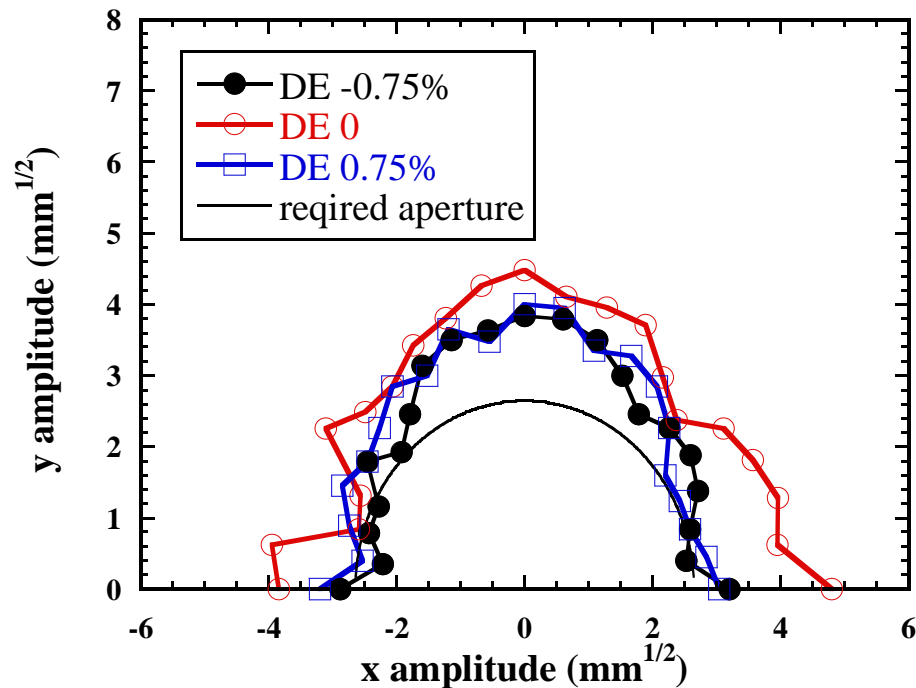


Dynamic aperture: stronger focus

New arc cell: stronger focus

tune/cell: x.2788 y.0800

Tune: x 57.79 y 26.46

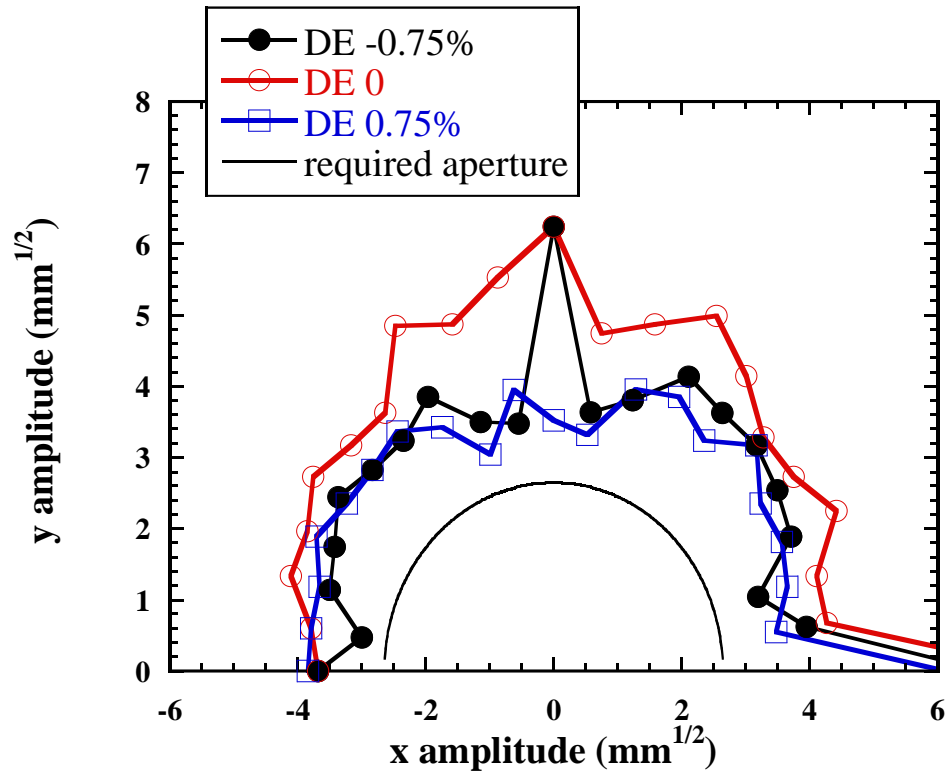


Dynamic aperture: long bend

New arc cell: long (5 m) bend

tune/cell: x.225 y.0808

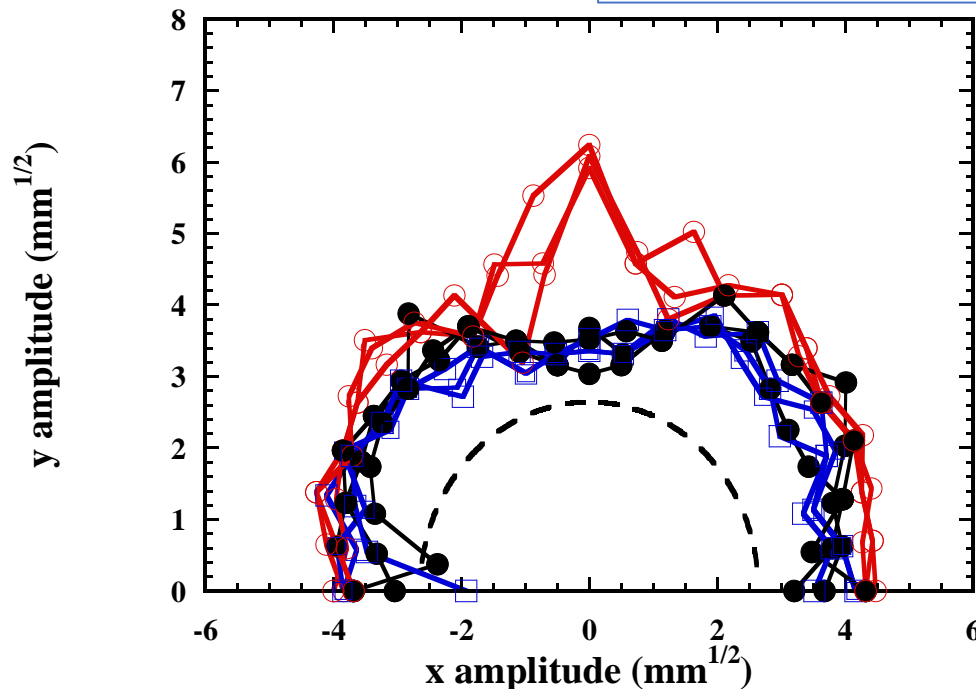
Tune: x49.33 y26.86



Dynamic aperture: long bend Misalignment + correction

New arc cell: long (5 m) bend
tune/cell: x.225 y.0808
Tune: x49.33 y26.86

Quadrupole & sextupole offset: 50 μm
Quadrupole roll: 100 μrad
BPM offset: 100 μm
BPM roll: 10 mrad
COD & Dispersion correction



Summary, Discussion

- Easy way to reduce emittance, keeping dynamic aperture, is using longer bending magnets in arcs.
 - E.g., 3 m \rightarrow 5 m (any problems with long bend?)
 - **Horizontal emittance 4 μ m seems possible**
 - (dynamic aperture calculated without field errors.)
 - We may add wigglers for further emittance reduction (?)
- Dynamic aperture of original lattice in past paper(s) could not be reproduced.
- Stronger focusing (for lower emittance) reduces dynamic aperture.
- Larger dynamic aperture may be possible with major changes of design. (too much work for now?)
 - Change arc cell length (?)
 - Non-interleaved chromaticity correction.