# KEKB LER for ILC Damping Ring Study

Lattice simulation of lattice errors and optics corrections.

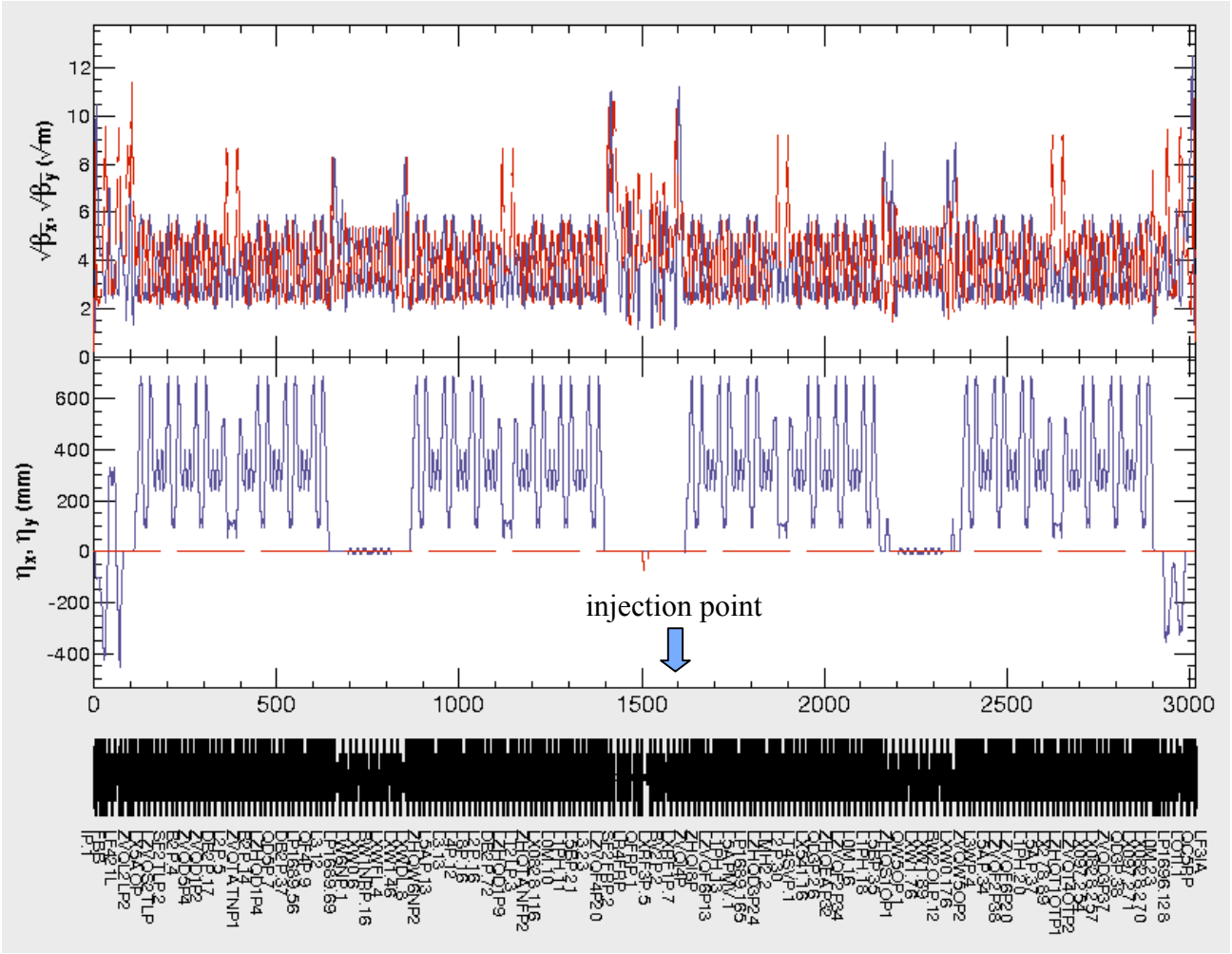
November 1, 2007

Y. Ohnishi / KEK

# Emittance and Lattice Errors

- The purpose of this study is to check a feasibility of the low emittance with optics corrections for the KEKB LER.
- Simulation study: KEKB LER lattice includes machine errors. The machine errors are magnet alignment errors, field gradient errors, and BPM accuracy.
  - BPM error means an alignment error.
- These errors are generated by Gaussian distributions with random seed numbers.

# KEKB LER Lattice for ILC Damping Ring Study




$\beta_x^* = 90$ cm
$\beta_y^* = 3$ cm

- $\nu_x/\nu_y = 47.53/42.59$ $\quad \nu_s = -0.013$ $\quad \alpha_p = 2.5\times10^{-4}$
- $\varepsilon_x = 1.5$ nm $\quad \sigma_z = 4.3$ mm

# Lattice Errors

Multipole components and fringe field have been included in the design lattice.

Following errors are produced with random numbers according to Gaussian.
The values are one standard deviation(σ).

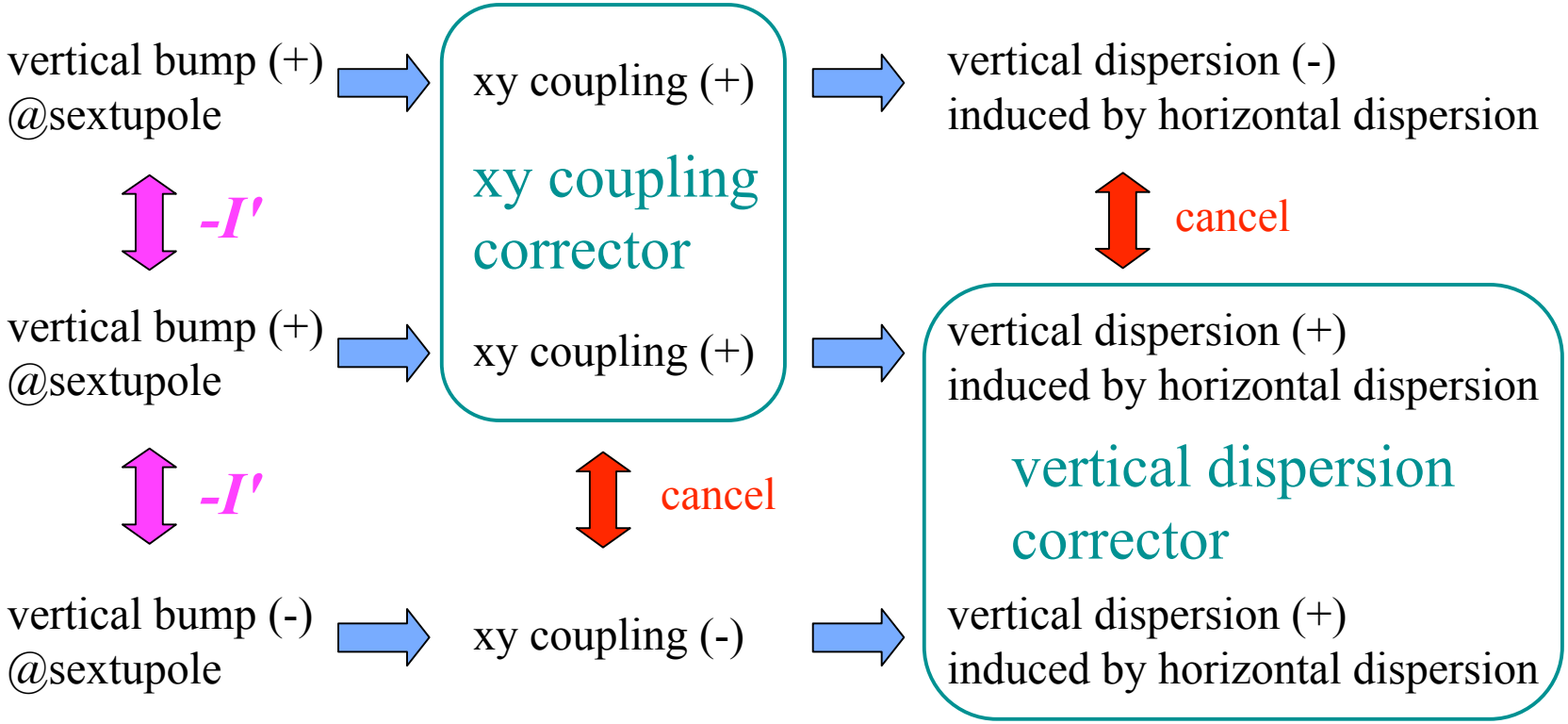
| | alignment error $\Delta x$ (μm) | alignment error $\Delta y$ (μm) | rotation error $\Delta\theta$ (mrad) | gradient error $\Delta k/k$ |
|---|---|---|---|---|
| Bending magnet | 100 | 100 | 0.1 | $1\times10^{-4}$ |
| Quadrupole magnet | 100 | 100 | 0.2 | $3\times10^{-4}$ |
| Sextupole magnet | 100 | 100 | 0.2 | $5\times10^{-4}$ |

# Optics Corrections

- Correction of closed orbit distortion
- XY coupling correction
  - measurement:
    - vertical orbit response induced by a horizontal single kick due to a steering magnet.
  - corrector:
    - symmetric vertical local bumps at sextupole pairs(-I' connection)
- Dispersion correction
  - measurement:
    - orbit response changing rf frequency.
  - corrector:
    - asymmetric local bumps at sextupole pairs(-I' connection)
- Beta correction
  - measurement:
    - orbit response induced by a single kick due to a steering magnet.
  - corrector:
    - fudge factors to quadrupole magnet power supplies(families)

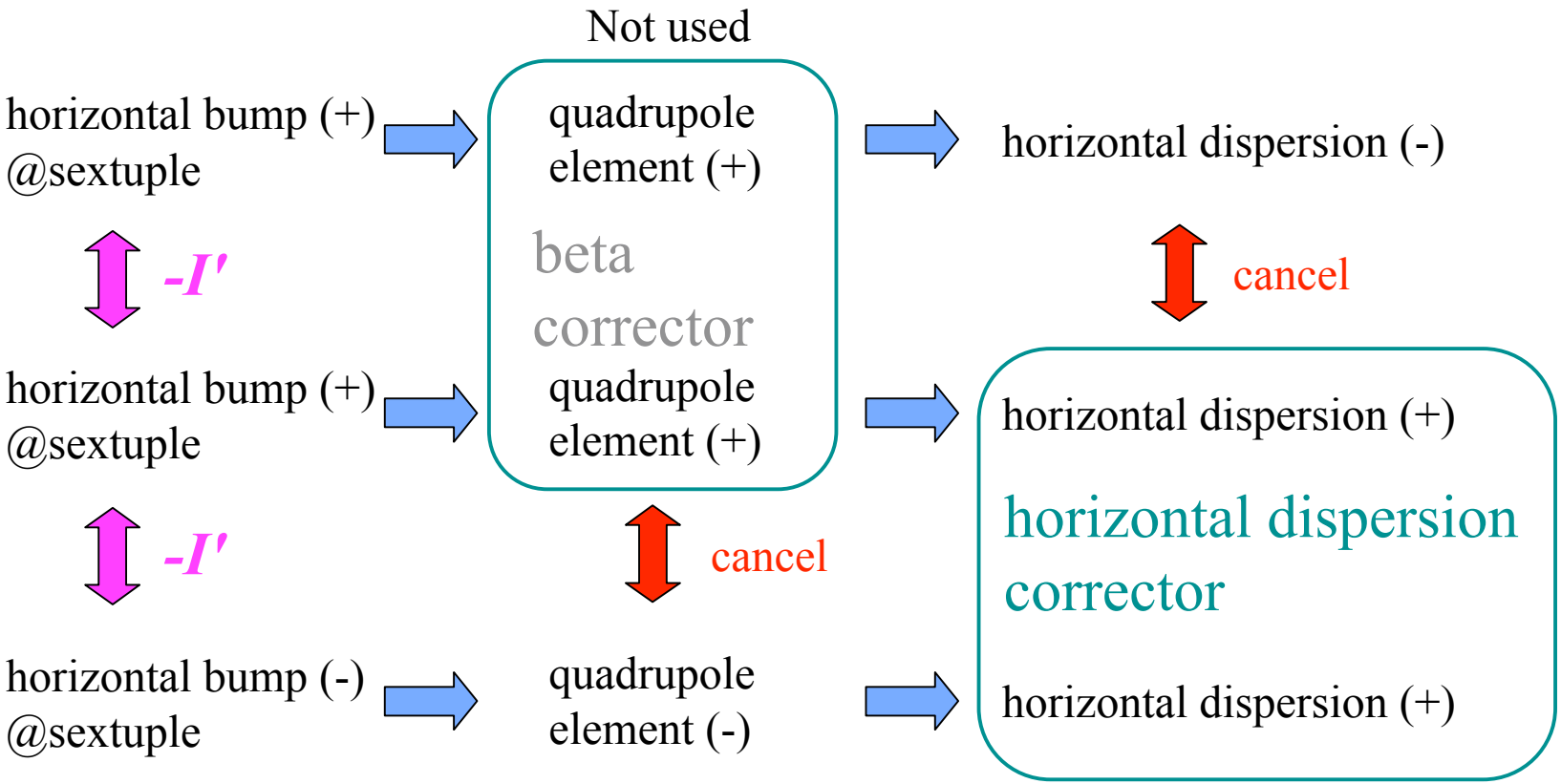
# Optics Corrections by using sextupoles (1)

- Sextupoles are located at arc sections and LCC(LER only).



# Optics Corrections by using sextupoles (2)

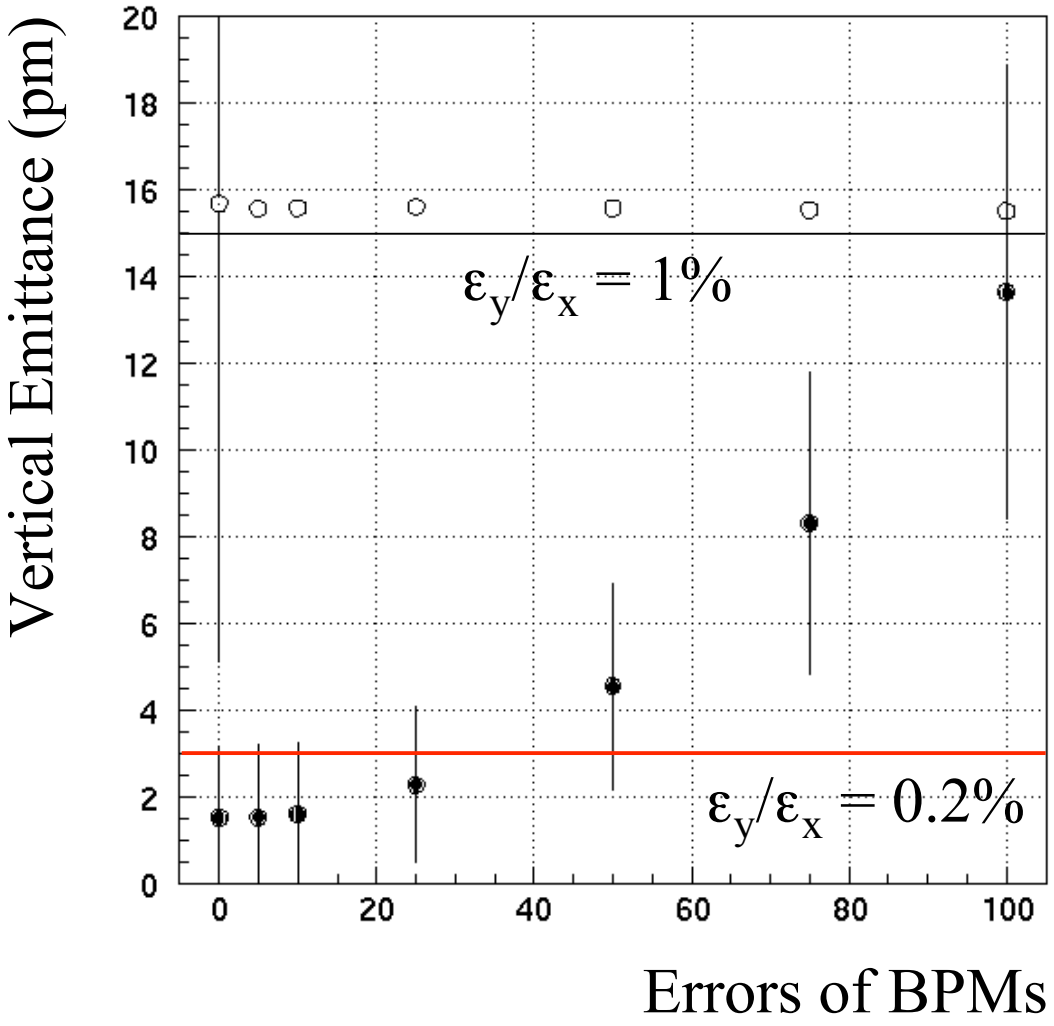
- Sextupoles are located at arc sections and LCC(LER only).



# Optics Corrections and Vertical Emittance

#samples : 100

(error bar: standard deviation)

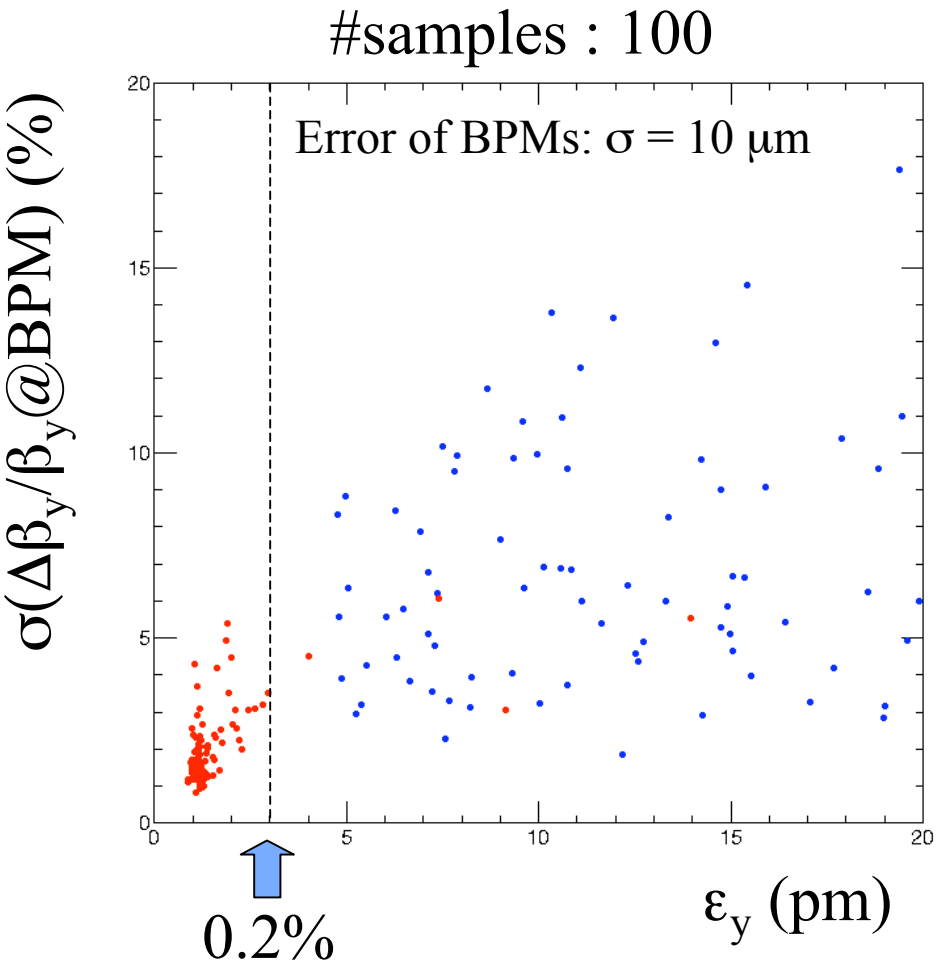



open circle:
COD correction only

closed circle:
COD+XY+Dispersion+Beta correction

target emittance ratio

# Optics Corrections and Vertical Emittance




Each point means a different seed number to give machine errors.

COD correction only

COD+XY+Dispersion+Beta correction

- Optics corrections can achieve $\varepsilon_y/\varepsilon_x$=0.2 %, where $\varepsilon_x$=1.5 nm.
- BPM accuracy should be less than 10 μm.