# Bunch Compressor KM steering. dispersion bump simulation - Vertical emittance dilution After Daresbury meeting

Kiyoshi Kubo

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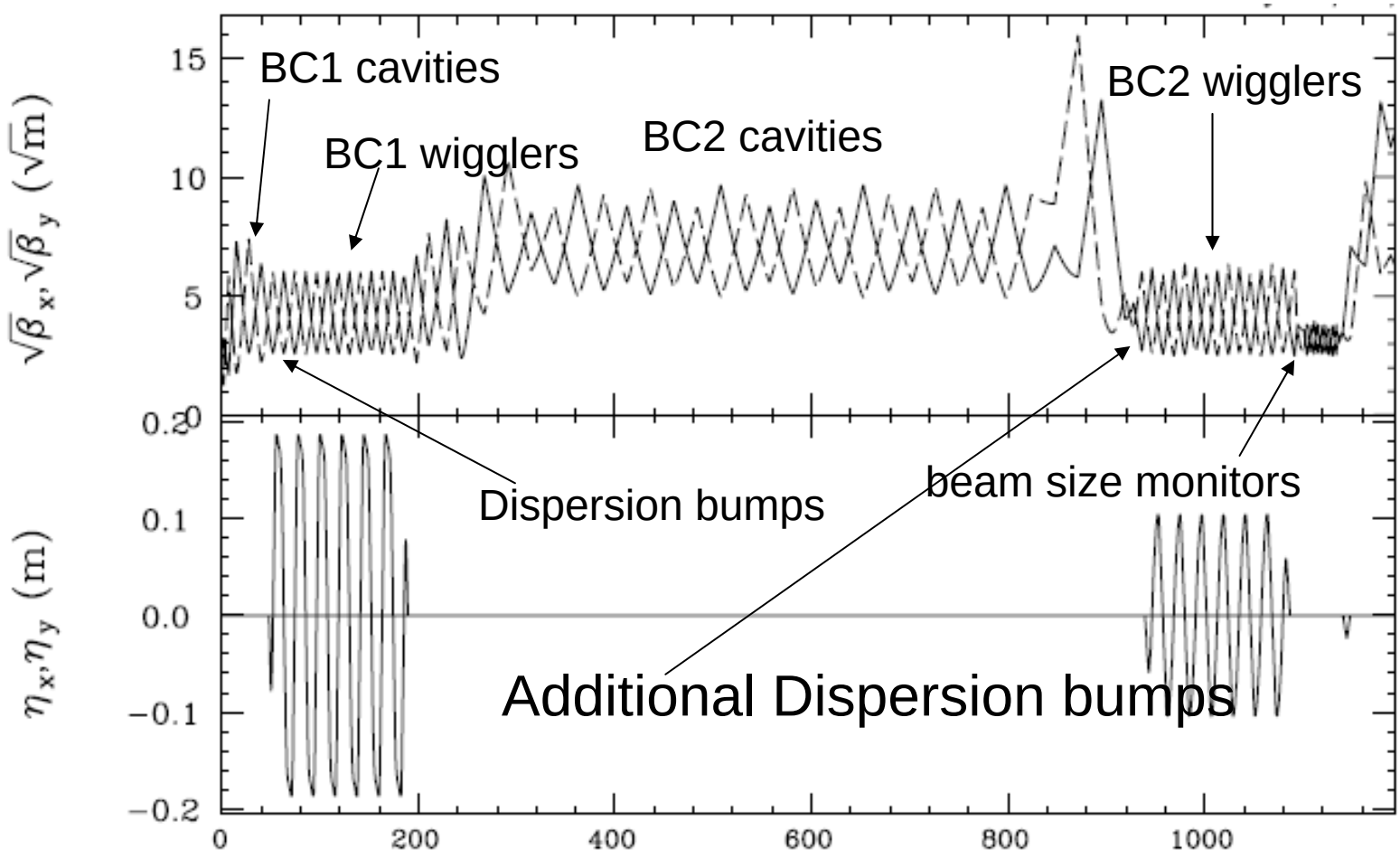
- Simulation reported at Daresbury meeting
  - KM steering + Dispersion bump correction
    - a pair of bumps in BC1
- What was done after Daresbury meeting (comments from PT)
  - Simulation with an additional set of dispersion bumps after BC2 cavities.
    - As follows, the result was not much improved.
  - Minimize beam size at one most sensitive wire scanner for each bump, instead of minimizing measured projected emittance
    - Results are not shown here. See summary.

ILC Bunch Compressor, calc. by SAD,
xsif -> SAD  Translated by S.Pei (IHEP)




All simulations used SAD. Tracking of macro-particles.

# Simulated cases

| Quad offset (μm) | BPM-Quad offset (μm) | Cavity pitch (μrad) | Beam size resolution (μm) | Correction |
|---|---|---|---|---|
| 150 | 7 | 300 | - | KM |
| 150 | 7 | 300 | 0 | KM+BC1bump |
| 150 | 7 | 300 | 0.2 | KM+BC1bump |
| 150 | 7 | 300 | 0 | KM+BC1bump+ BC2bump |
| 150 | 7 | 300 | 0.2 | KM+BC1bump+ BC2bump |

# Kick Minimization (same as before)

Quad magnet, BPM and steering magnets should be attached.

$$\text{Minimize } r\sum_i (x_i^2 + y_i^2) + \sum_i \left[ (\theta_{x,i} + k_i x_i)^2 + (\theta_{y,i} - k_i y_i)^2 \right],$$

$\theta_{x(y)i}$ : Additional kick angle (additional to designed kick) of steering at $i$ - th quad

$x(y)_i$ : Offset from designed orbit at $i$ - th quad

$k_i$ : K - value (inverse of focal length) of the $i$ - th quad

$r$ : Weight ratio : (Quad - BPM offset)$^2$ /(Quad offset)$^2$

# Dispersion bumps

Knobs

- 4 skew quads at the beginning of BC1 wiggler section
- (a) Set opposite strength of a pair of skew quads, -I between them.
- (b) Set opposite strength of another pair of skew quads, -I between them. 90 degree phase difference from the first pair.
- Knob 1: (a) + (b)
- Knob 2: (a) - (b)

Monitors

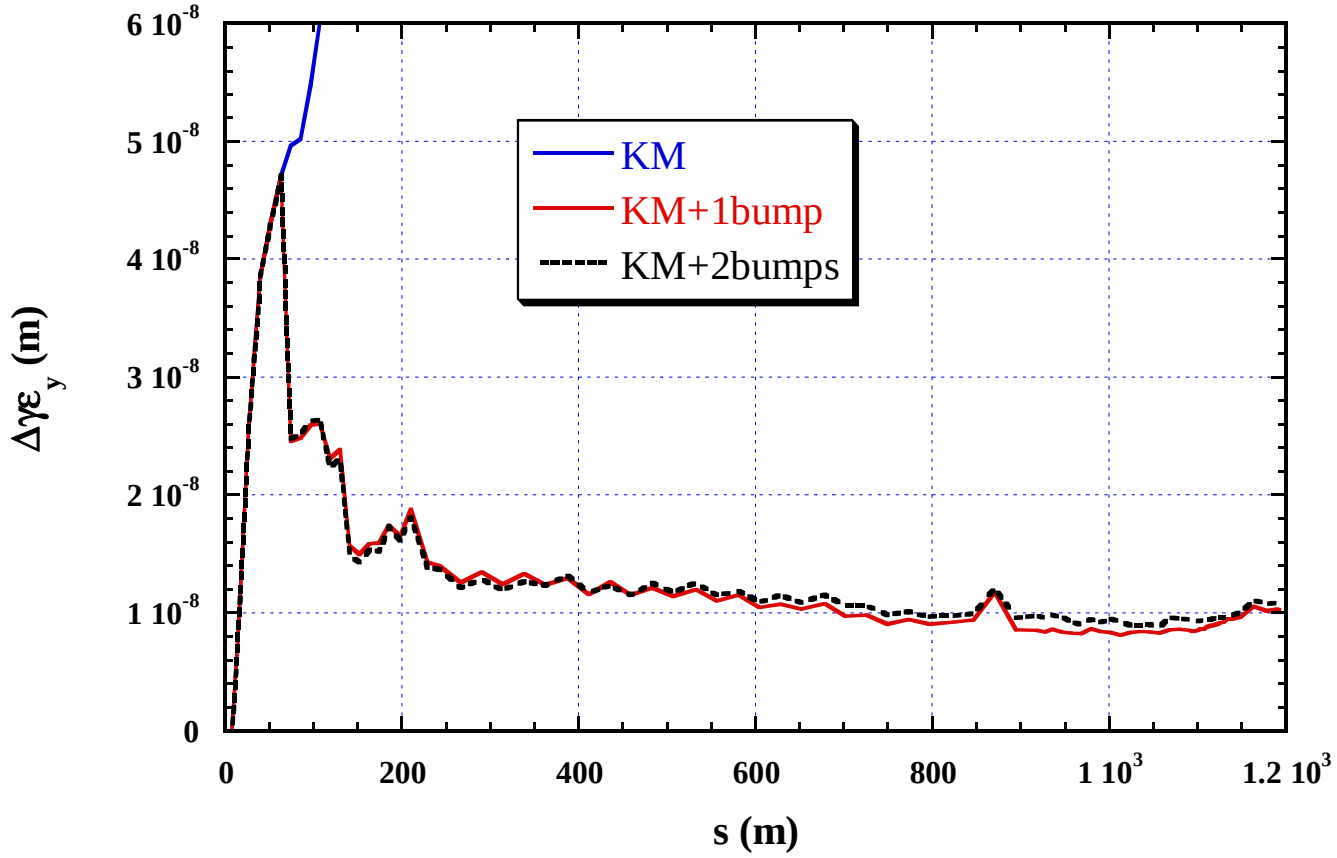
- Near the end of the beam line
  - Use three laser wire monitors (beam size monitors)
  - Minimize projected emittance calculated from beam sizes at three locations.

Add another pair of dispersion knobs using 4 skew quads at the beginning of BC2 wiggler section.
Same monitors are used.

# Quad offset + Cavity Pitch - KM + bump

Quad offset 150 um, BPM-Quad offset 7 um,
Cavity pitch 300 urad, Beam size resolution 0.2 um

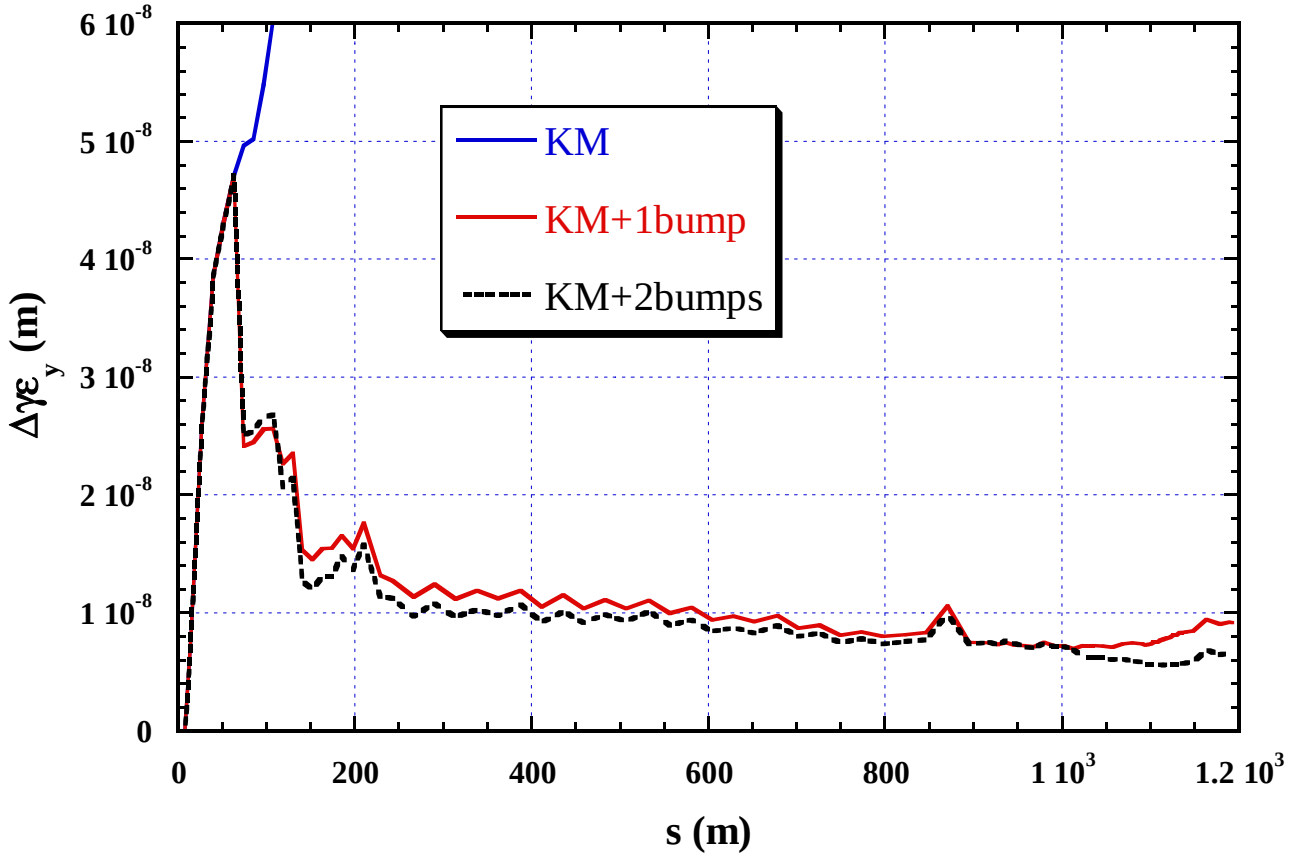
Vertical emittance increase (average of 100 seeds) vs. s



# Quad offset + Cavity Pitch - KM + bump

Quad offset 150 um, BPM-Quad offset 7 um,
Cavity pitch 300 urad, Beam size resolution 0

Vertical emittance increase (average of 100 seeds) vs. s



# Summary of simulation results

Quad offset 150 um, BPM-Quad offset 7 um,
Cavity pitch 300 urad

| Beam size resolution (μm) | Correction | $\Delta\gamma\varepsilon_y$ (nm) (average 100 seeds) |
|---|---|---|
| - | KM | 126. |
| 0 | KM+BC1bump | 9.1 |
| 0 | KM+BC1bump+BC2bump | 6.6 |
| 0 | KM+BC1bump+BC2bump* | 7.4 |
| 0.2 | KM+BC1bump | 10.3 |
| 0.2 | KM+BC1bump+BC2bump | 10.8 |
| 0.2 | KM+BC1bump+BC2bump* | 9.9 |

* Minimizing beam size at most sensitive wire scanner.

# Summary

No significant improvement.

- Simulation with an additional set of dispersion bumps after BC2 cavities.
  - Reduce $<\Delta\gamma\varepsilon_y>$ from 9 nm to 7 nm with perfect monitors (still not satisfactory)
  - But no improvement with beam size resolution 0.2 um.
- Minimize beam size at one most sensitive wire scanner for each bump, instead of minimizing measured projected emittance
  - This mitigate effect of error of beam size measurement, only a little. Reduce $<\Delta\gamma\varepsilon_y>$ from 11 nm to 10 nm with 0.2 um resolution