

Space charge effects on the main rings of SuperKEKB

- Preliminary results

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1. Space charge effects

➤ Issues related to space charge (SC):

- Tune shift
- Emittance growth
- Crosstalk between SC and **beam-beam/lat. nonlin.**
- Impact on injection
- ...

➤ Experiences of **ILC damping ring** are helpful [**M. Venturini and K. Oide, LBNL-59511, 2006**]:

- Codes: SAD and MaryLie/Impact
- Emittance degradation: Cross lattice resonances; SC amplify effects of lattice errors; Tun choices; ...

➤ Collaboration effort:

- BINP (Levichev and Piminov), KEK (Zhou, Oide, Ohmi, Ohnishi, ...)

2. Linear tune shift

$$\Delta\nu_i = -\frac{1}{4\pi} \frac{2r_e}{\beta^2\gamma^3} \int_0^C \frac{\lambda\beta_i}{\sigma_i(\sigma_x + \sigma_y)} ds$$

$$i = x, y \quad \lambda(s) = N/\sqrt{2\pi}\sigma_z(s)$$

$$\sigma_x^2 = \epsilon_x\beta_x + \langle\delta^2\rangle D^2$$

Simple estimate using SAD:

$$\Delta\nu_i = -\frac{1}{4\pi} \frac{2r_e\lambda}{\beta^2\gamma^3} \sum_j \frac{\beta_i(j)}{\sigma_i(j)(\sigma_x(j) + \sigma_y(j))} \Delta s(j)$$

2. Linear tune shift

	SuperKEKB ¹⁾		KEKB ⁴⁾		Unit
	LER ²⁾	HER ³⁾	LER	HER	
σ_z	6	5	7	6	mm
σ_δ	8.08	6.37	7.73	6.30	$\times 10^{-4}$
E	4.0	7.007	3.5	8.0	GeV
ε_x	3.2	4.6	18	24	nm
ε_y	8.64	11.5	180	240	pm
ξ_x	0.0028	0.0012	0.127	0.102	
ξ_y	0.0881	0.0807	0.129	0.09	
Δv_x	-0.0027	-0.0004	-0.0005	-3.00E-05	
Δv_y	-0.0943	-0.0121	-0.0072	-0.0004	

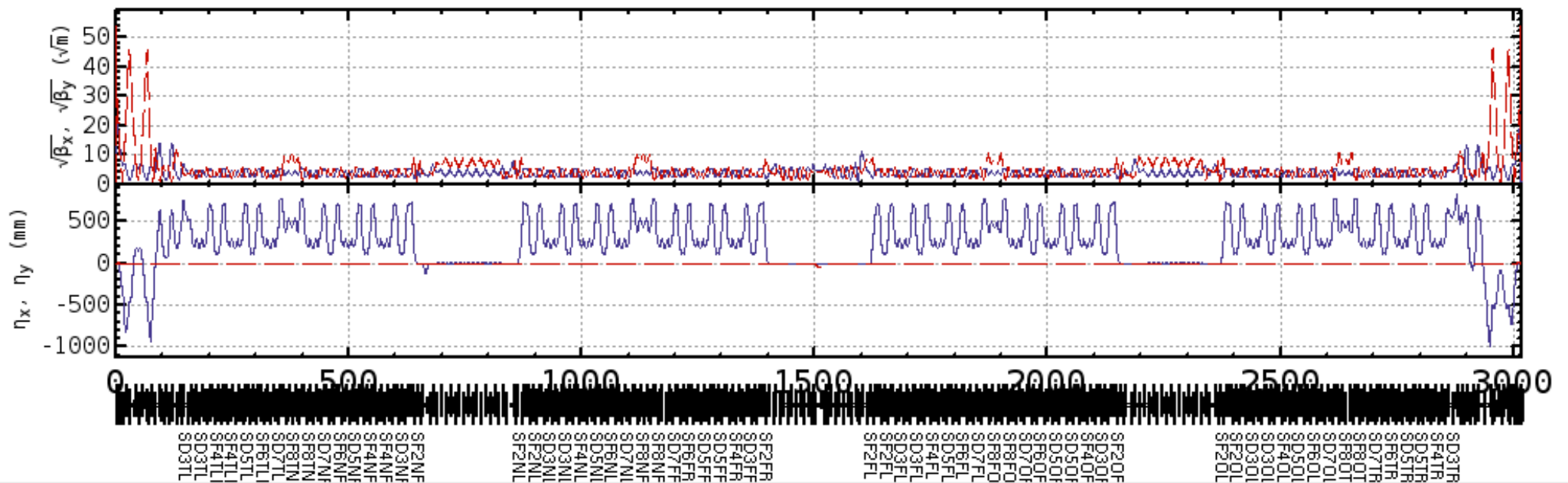
¹⁾Main parameters from Y. Ohnishi et al., Prog. Theor. Exp. Phys. 2012;

²⁾sler_1682;

³⁾sher_5753;

⁴⁾Lattice used on Jun.17, 2009.

2. Lattice of sler_1682



2. Vertical tune shift as function of distance: sler_1682

