Electron cloud instability study for ILC damping ring at KEKB

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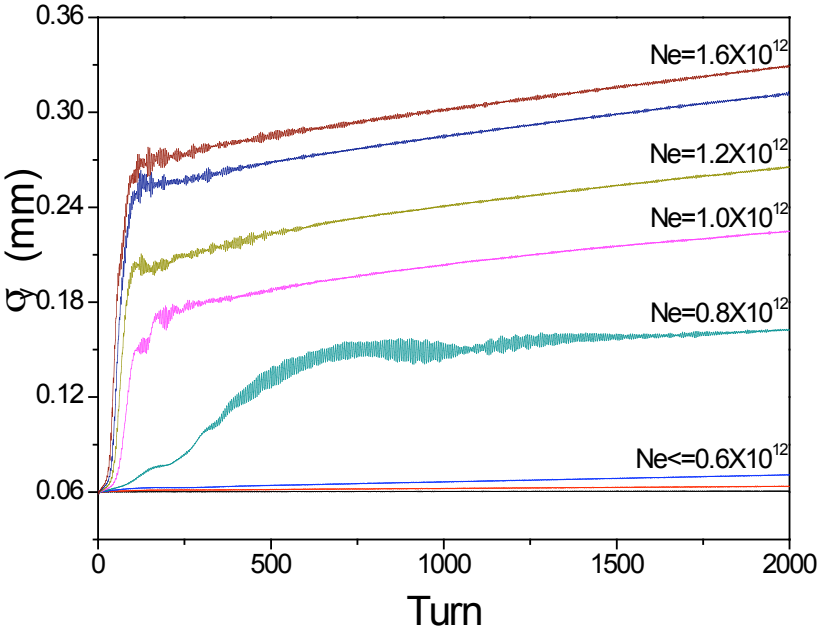
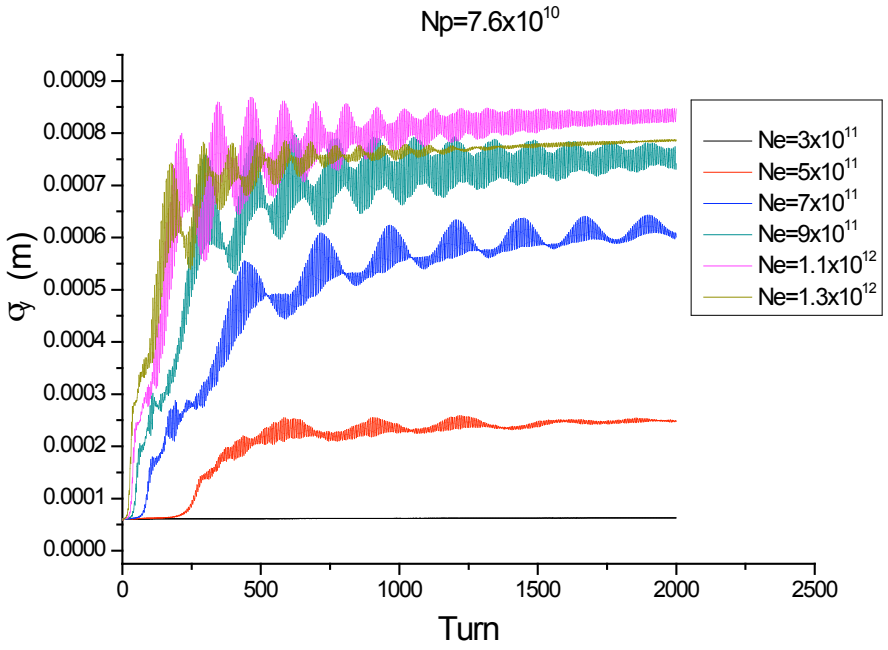
Present KEKB

- Without solenoid, the strong head-tail instability occurs at 1000 bunch and 500 mA.
- Simulations (PEHTS) gives threshold density 0.8×10^{12} cm^{-3} at the beam parameters.
- With solenoid, the strong head-tail instability occurs at 1300 bunch and 1700 mA. Simulations gives threshold density 0.4×10^{12} cm^{-3} at the beam parameters.

$N_+=3.3x10^{10}$, $7.6x10^{10}$

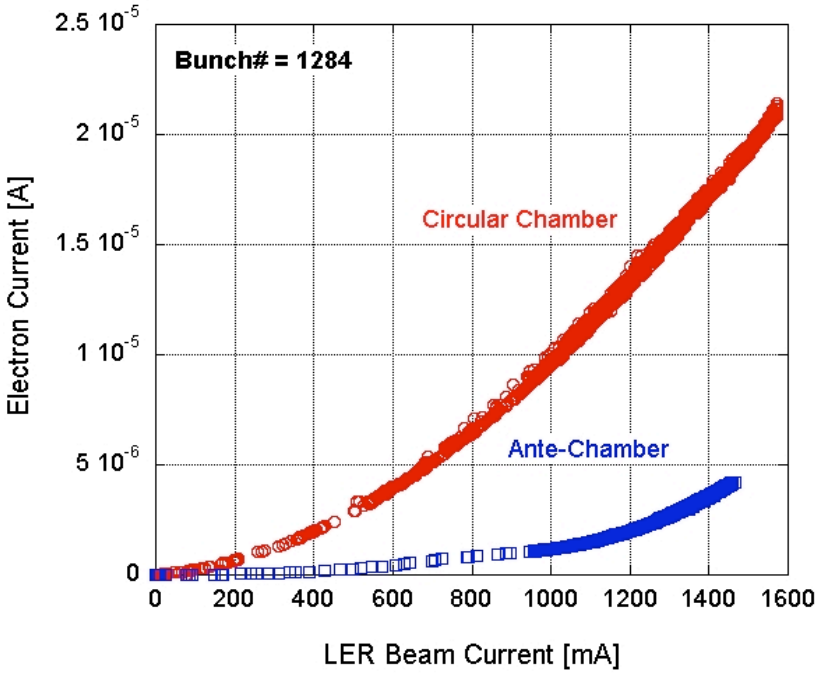




By H. Jin

Cloud density - current relation

- Electron current
- Cloud density is current times electron travel time.
- High current means a short travel time.
- The cloud density may approximately be linear for current in circular chamber.
- Solenoid reduces cloud density 1/6.



Y.Suetsugu

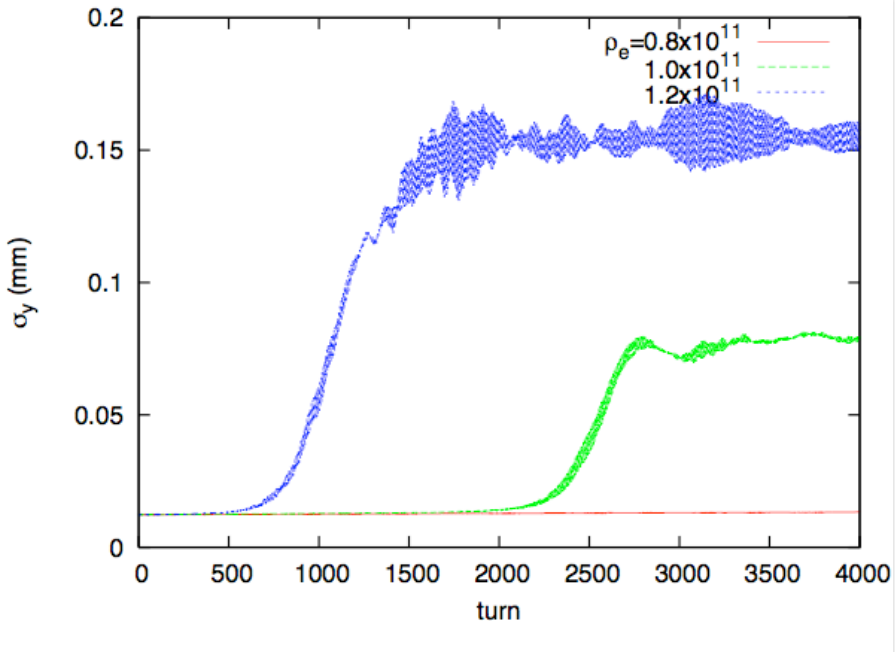
Low emittance operation in KEKB

	Nor ε	Nor ε	Low ε–I	Low ε–II
E (GeV)	3.5	3.5	2.3	5.0
N_+ (10^{10})	3.3	7.6	2.0	2.0
N_b	1000	1338	1250	2500
I (mA)	500	1700	400	800
ε_x (nm)	18	18	1.5	1.0
σ_z (mm)	6	7	9	9
ν_s	0.024	0.024	0.011	0.011
$\omega_e \sigma_z/c$	3.1	5.1	12.5	12.5
$\rho_{e,th}(m^{-3})$	$8x10^{11}$	$4x10^{11}$	$1x10^{11}$	$2.2x10^{11}$

- ω_e: electron frequency in a bunch
- ρ_e: threshold density

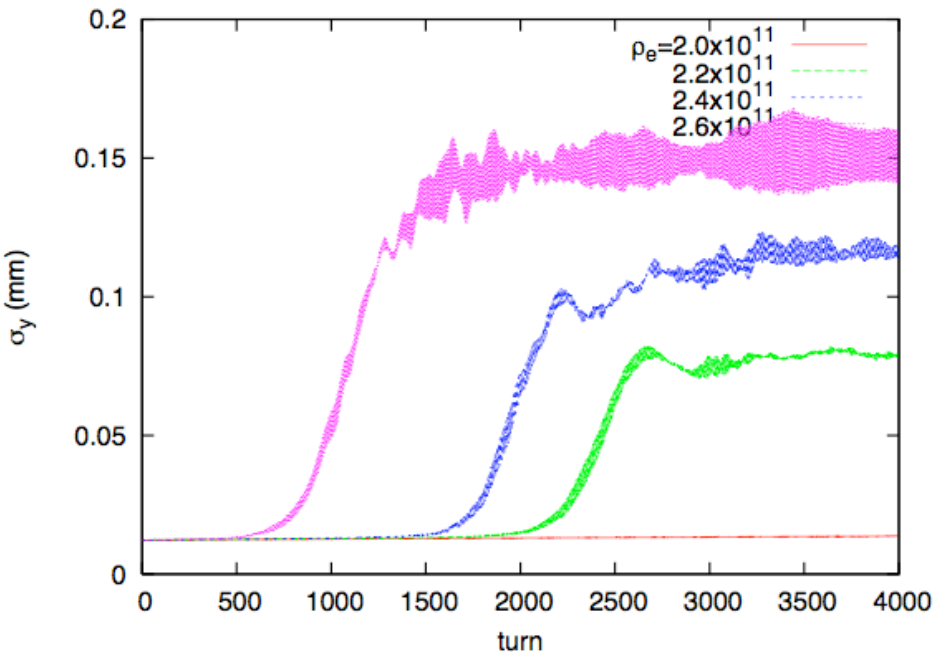
Threshold cloud density given by PEHTS at the Low emittance

2.3 GeV,



$\rho_{e,th}$=1.0x10^{11} cm^{-3}

5 GeV



$\rho_{e,th}$=2.2x10^{11} cm^{-3}

Cloud density and threshold at the low emittance operation

- Cloud density does not seem to depend on emittance strongly.
- Electron density is proportional to energy for a case of photoelectron dominant.
- Current is 400mA which is 1/4.25 of the present KEKB.
- The cloud density at low ε–I can be below the threshold.

- These should be studied experimentally at KEKB.

For actual Damping ring

- Higher energy gives high cloud density, but the threshold increases due to the larger γ factor.
- The scaling of $\rho_{e,th}/\nu_s$ was perfect for coherent instability in simulations and theory:i.e., a higher ν_s is higher threshold.
- Ante-chamber can suppress electrons further.
- The actual damping ring with 3000 m circumference, low ε–II, may be within the range depending on the study progress.

- Incoherent effect should be studied by H. Jin.