Ecloud effects in SuperKEKB LER
- Updated results

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Study memo
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1. Introduction

➤ Previous results:
  - Talk at SuperKEKB optics meeting, Jun. 11, 2013

➤ Issues in the previous results:
  - Incoherent emittance growth was observed and not well understood.
  - The number of “elcloud elements” is limited due to limited computing power. The beta functions along the ring vary fast but can not be well resolved.
  - The mesh sizes and mesh area are fixed in the old version of PEHTS2 code

➤ Conditions for the updated results in these slides:
  - Change the PEHTS2 code and use flexible meshes for each “elcloud element”.
    - Mesh sizes: \(dx(s)=\sigma_x/5\), \(dy(s)=\sigma_y/5\)
    - Mesh area: \(X(s)=128dx(s)\), \(Y(s)=256dy(s)\)
2. Results of PEHTS2

**Condition 2:**

- Parameters: $v_x=44.53, v_y=46.57, v_s=0.0247$, $PBUNCH=9.04e10$, $\rho_{e0}=\{0.6, 1.0, ..., 5\}e11$ m$^{-3}$
- Number of sections along the ring: $N_{section}=129$
2. Results of PEHTS2

**Condition 2:**
- Incoherent emittance growth observed first at certain $\rho_e$
- Threshold of coherent instability: $<\rho_e> \approx 1.6 \times 10^{11}$ m$^{-3}$ (?)
2. Results of PEHTS2

Condition 4:

- Parameters: $v_x = 44.53, v_y = 46.57, v_s = 0.0247, P_{BUNCH} = 9.04e10, \rho_{e0} = 1e11$ m$^{-3}$
- Number of sections along the ring: $N_{section} = 129$
- Ecloud density data by Y. Suetsugu (2013.05.01)
2. Results of PEHTS2

Condition 4:

- Vary $\rho_{e0} = \{1, 2, \ldots, 10\} \times 10^{11}$ m$^{-3}$
- Seems no coherent instability up to $\rho_{e0} = 6 \times 10^{11}$ m$^{-3}$
- Safety margin for LER: factor of 6?
2. Results of PEHTS2

**Condition 4:**

- Monitors at $s=0\text{m} \ (\beta_y=0.13\text{m})$ and $s=1\text{m} \ (\beta_y=2716\text{m})$

\[ \rho_{e0}=1.0\times10^{11} \]

\[ \rho_{e0}=1.8\times10^{11} \]
2. Results of PEHTS2

Condition 4:

- Monitors at $s=0$ m ($\beta_y = 0.13$ m) and $s=1$ m ($\beta_y = 2716$ m)

$\rho_{e0} = 3.0 \times 10^{11}$

$\rho_{e0} = 4.0 \times 10^{11}$
2. Results of PEHTS2

Condition 4:

- Monitors at $s=0m$ ($\beta_y=0.13m$) and $s=1m$ ($\beta_y=2716m$)

$\rho_{e0}=5.0e11$

$\rho_{e0}=6.0e11$
2. Results of PEHTS2

**Condition 4:**

- Monitors at $s=0\text{m} (\beta_y=0.13\text{m})$ and $s=1\text{m} (\beta_y=2716\text{m})$

$\rho_{e0}=7.0\times10^{11}$

$\rho_{e0}=8.0\times10^{11}$
2. Results of PEHTS2

Condition 4:

- Monitors at $s=0\ m (\beta_y=0.13m)$ and $s=1m (\beta_y=2716m)$

$\rho_{e0}=10.e11$
2. Results of PEHTS2

**Condition 5:**

- **Parameters:** $v_x=44.53, v_y=46.57, v_s=0.0247$, $P_{\text{BUNCH}}=9.04 \times 10^{10}$, $\rho_{e0}=1 \times 10^{11}$ m$^{-3}$
- **Number of sections along the ring:** $N_{\text{section}}=129$
- **Ecloud density data by Y. Suetsugu** (2013.05.08)
2. Results of PEHTS2

Condition 5:

- Vary $\rho_{e0}=\{1, 2, \ldots, 10\} \times 10^{11}$ m$^{-3}$
- Seems no coherent instability up to $\rho_{e0}=5 \times 10^{11}$ m$^{-3}$
- Safety margin for LER: factor of 5?
3. Summary

- Simulation results:
  - With conditions of uniform beta functions and uniform ecloud density along the ring, the threshold for ecloud density is about $5.0 \times 10^{11} \text{ m}^{-3}$.
  - With conditions of realistic beta functions and assumed uniform ecloud density along the ring, the threshold reduces to about $1.6 \times 10^{11} \text{ m}^{-3}$.
  - With conditions of realistic beta functions and estimated s-dependent ecloud density along the ring, the threshold is about 6 times that of estimated values (data of 2013.05.01).

- More systematic studies needed