Ecloud effects in SuperKEKB LER

- Updated results

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Study memo

Sep. 05, 2013

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 "ecloud 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:**

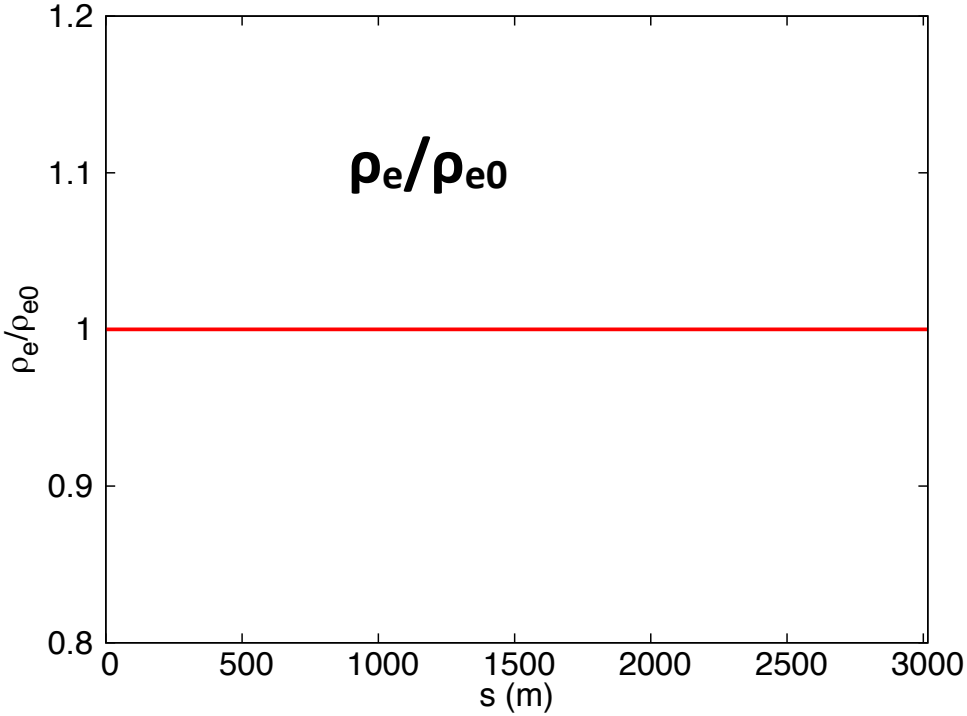
- Change the PEHTS2 code and use flexible meshes for each "elcoud element".
- Mesh sizes: $dx(s)=\sigma_x/5$, $dy(s)=\sigma_y/5$
- Mesh area: $X(s)=128dx(s)$, $Y(s)=256dy(s)$

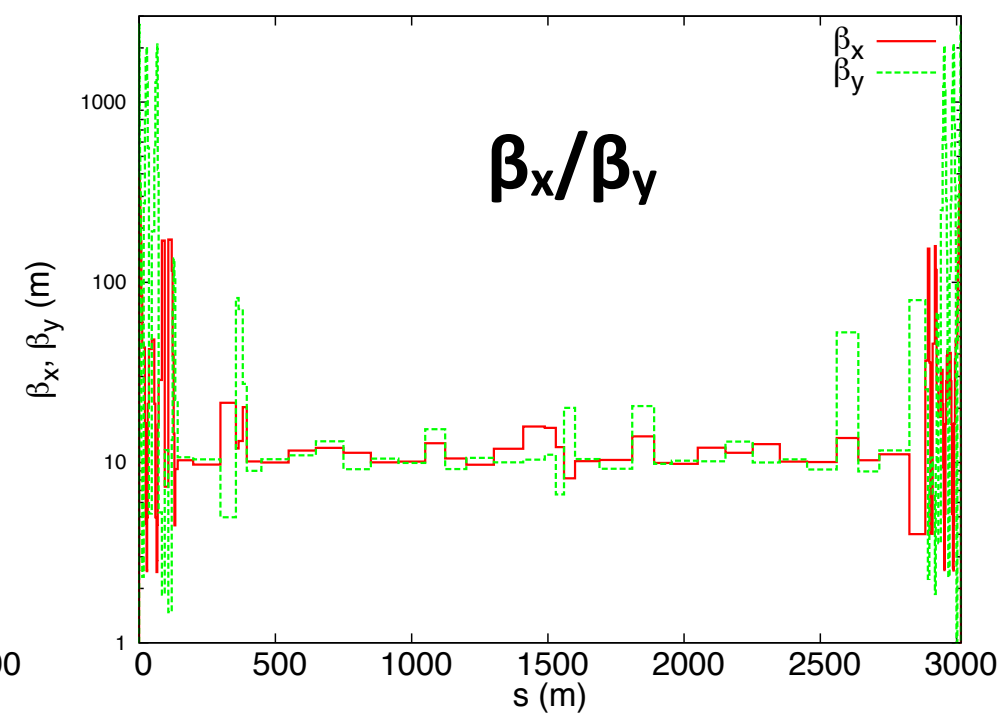
2. Results of PEHTS2

Condition 2:

➤ Parameters: ν_x=44.53,ν_y=46.57, ν_s=0.0247, PBUNCH=9.04e10, ρ_{e0}={0.6, 1.0, …, 5}e11 m^{-3}

➤ Number of sections along the ring: Nsection=129



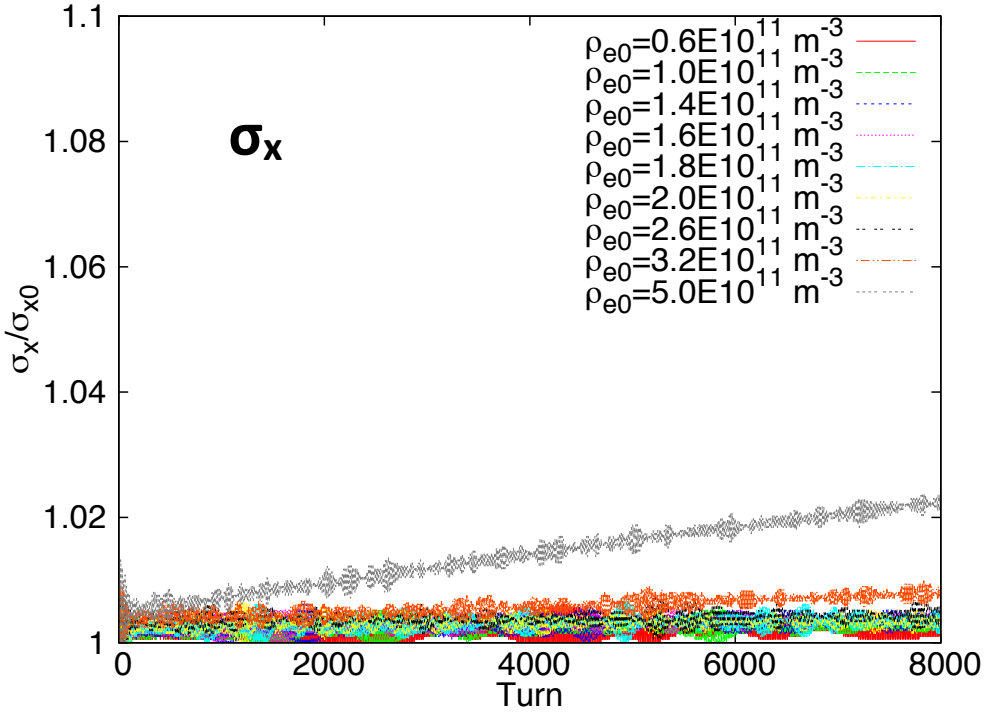


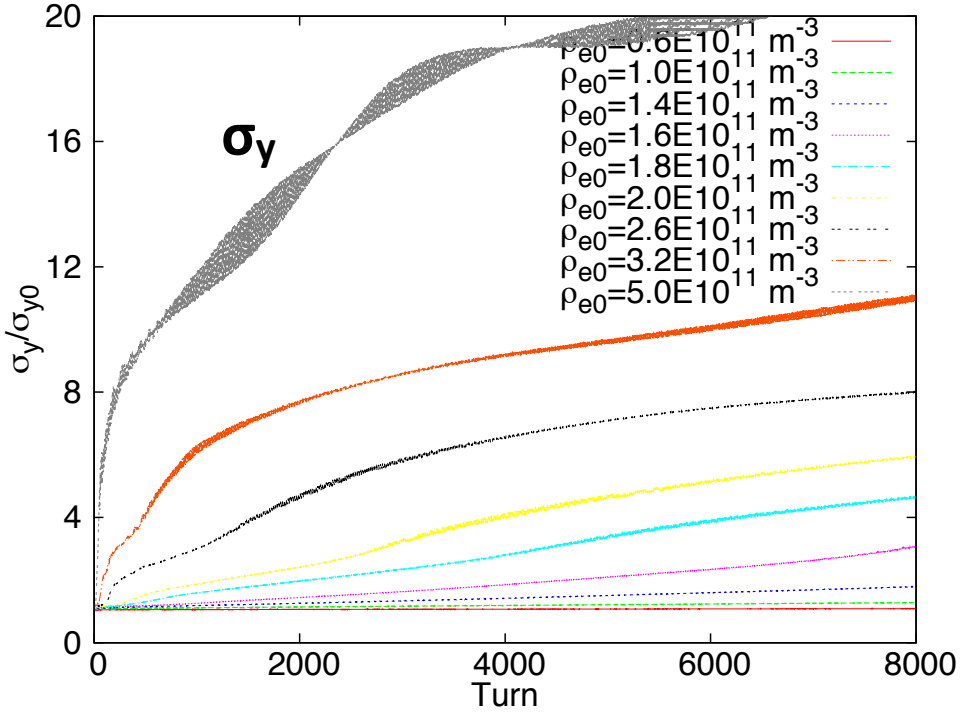
2. Results of PEHTS2

Condition 2:

➤ Incoherent emittance growth observed first at certain ρ_e

➤ Threshold of coherent instability: $<\rho_e> \approx$ 1.6e11 m^{-3}(?)

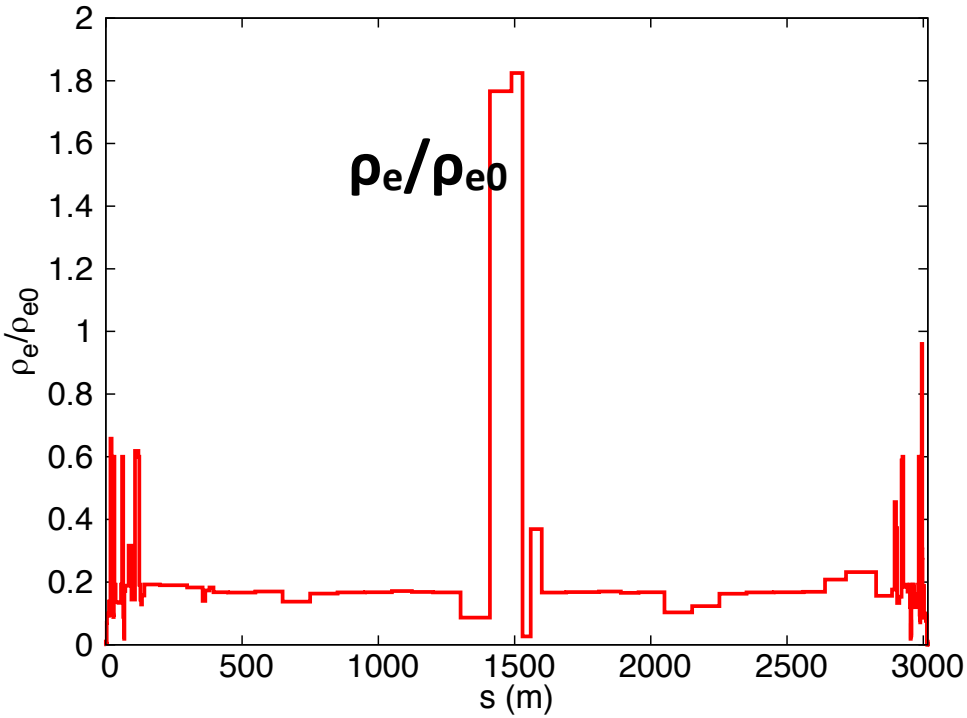


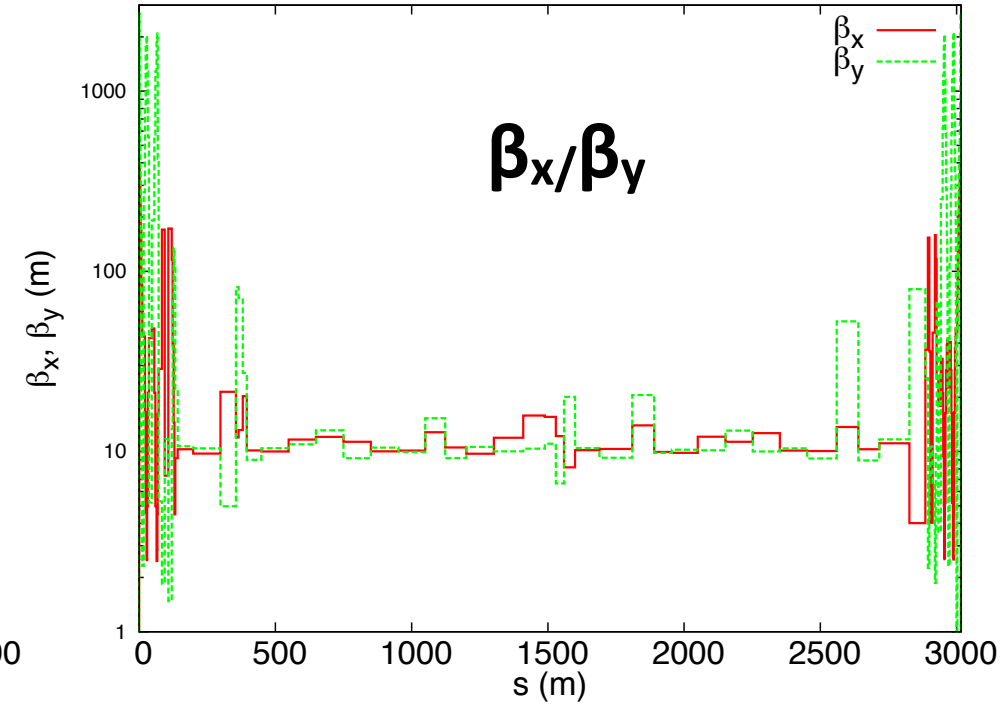


2. Results of PEHTS2

Condition 4:

- Parameters: ν_x=44.53,ν_y=46.57, ν_s=0.0247, P_{BUNCH}=9.04e10, ρ_{e0}=1e11 m^{-3}
- Number of sections along the ring: Nsection=129
- Ecloud density data by Y. Suetsugu (2013.05.01)

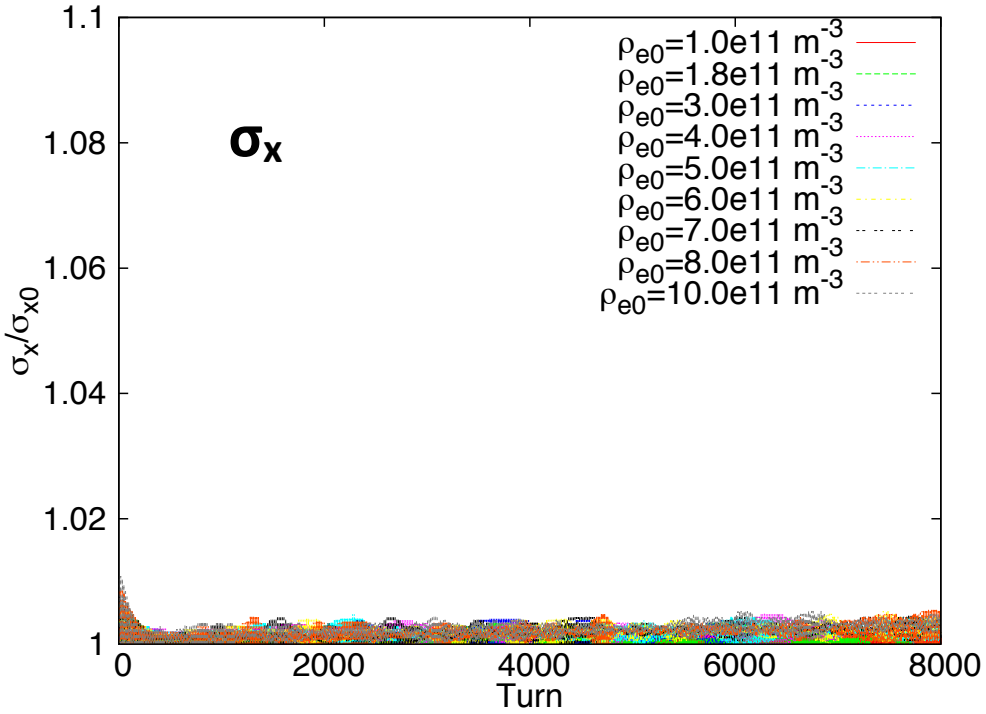


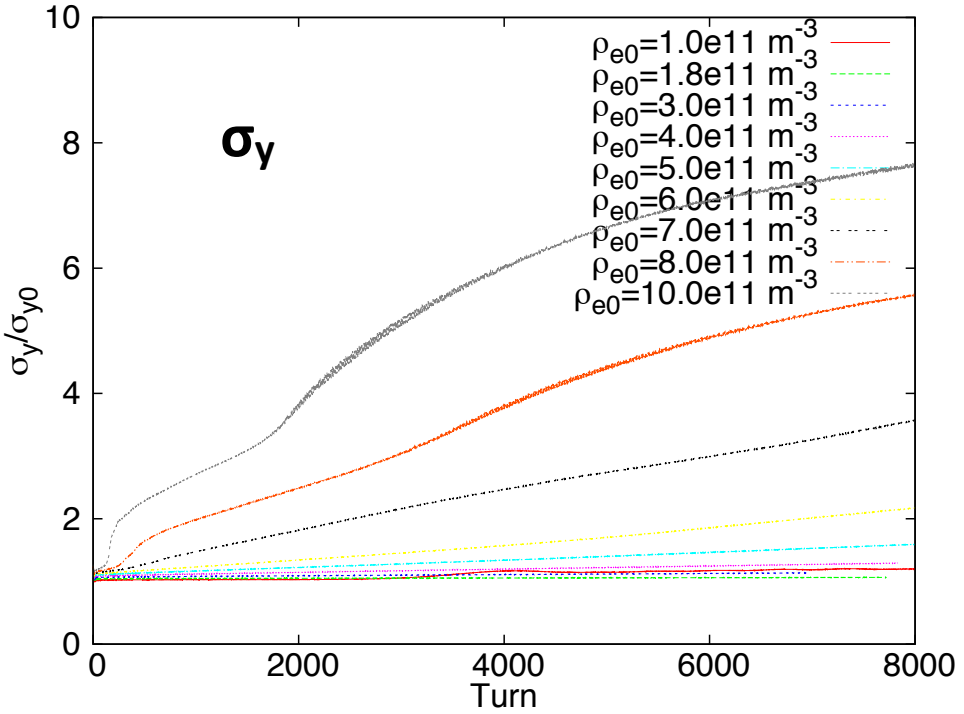


2. Results of PEHTS2

Condition 4:

- Vary ρ_{e0}={1, 2, …, 10}e11 m^{-3}
- Seems no coherent instability up to ρ_{e0}=6e11 m^{-3}
- Safety margin for LER: factor of 6?



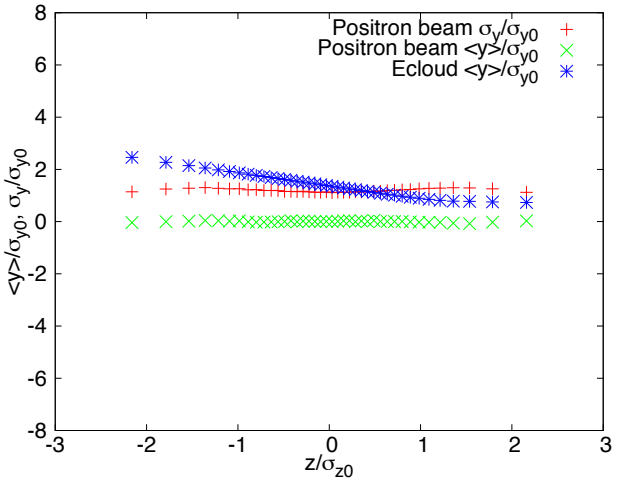


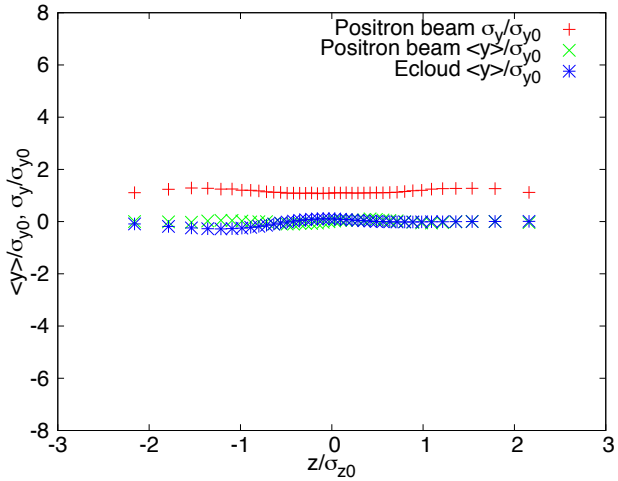
2. Results of PEHTS2

Condition 4:

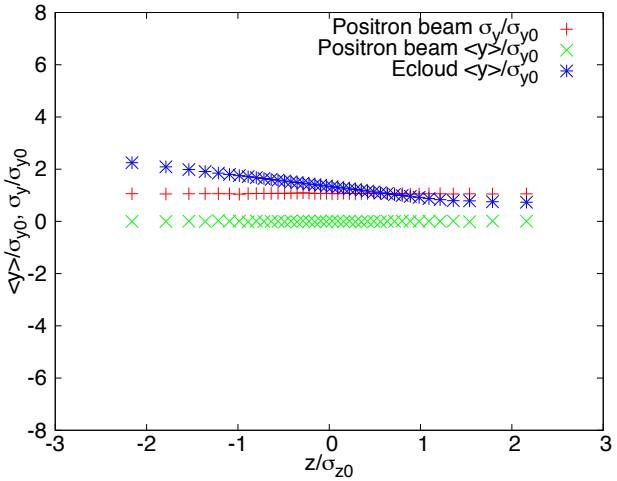
➤ **Monitors at s=0m (β_y=0.13m) and s=1m (β_y=2716m)**

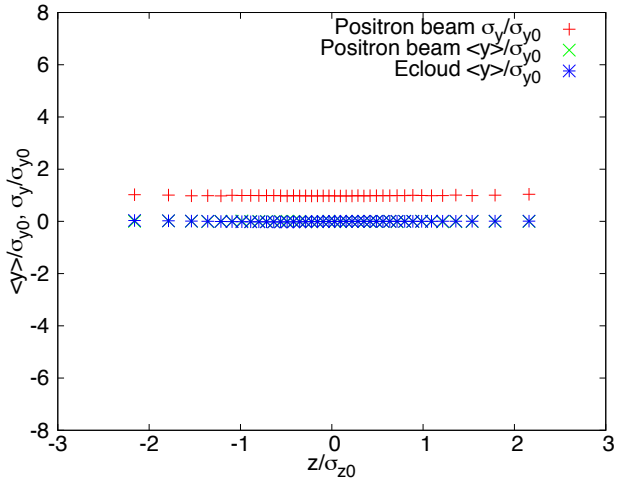
ρ_{e0}=1.0e11





ρ_{e0}=1.8e11



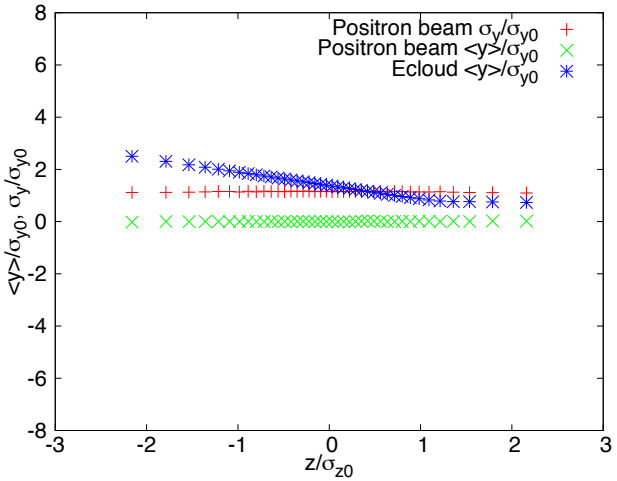


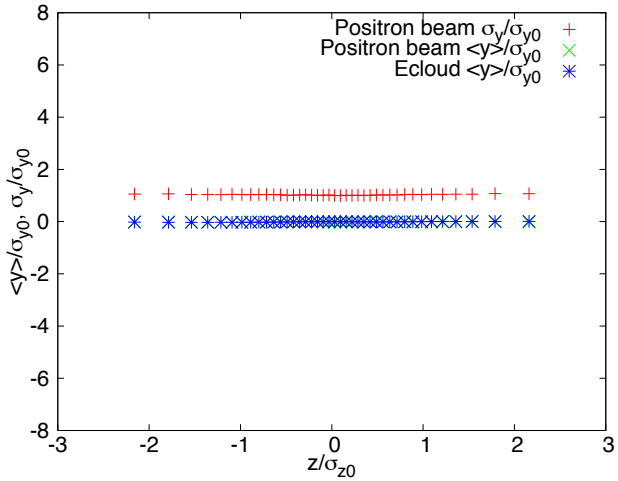
2. Results of PEHTS2

Condition 4:

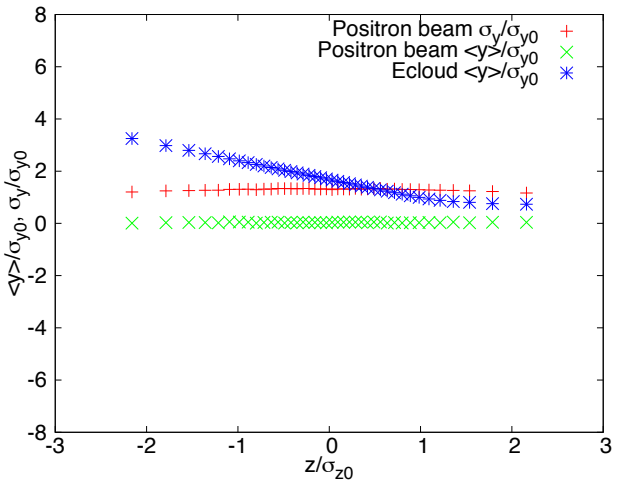
➤ **Monitors at s=0m (β_y=0.13m) and s=1m (β_y=2716m)**

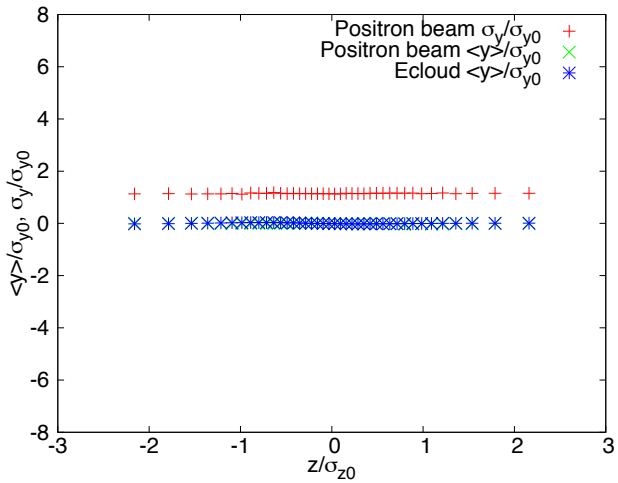
ρ_{e0}=3.0e11





ρ_{e0}=4.0e11



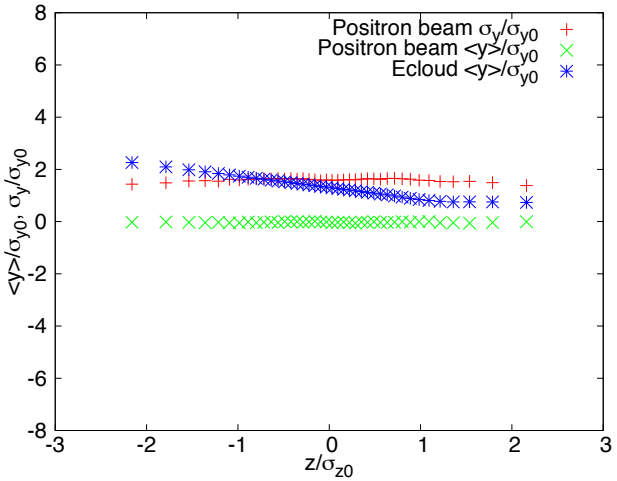


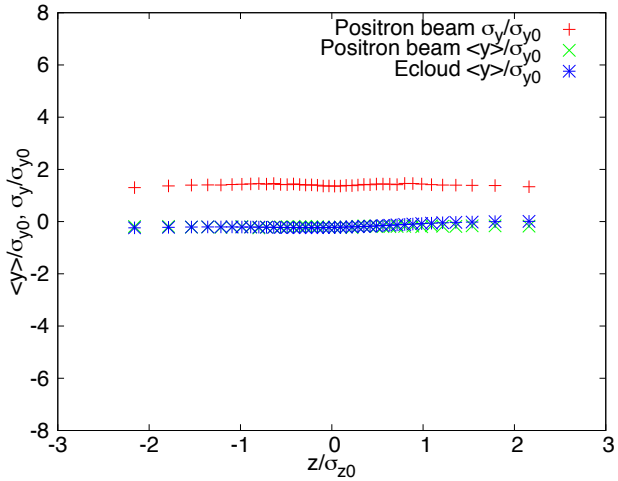
2. Results of PEHTS2

Condition 4:

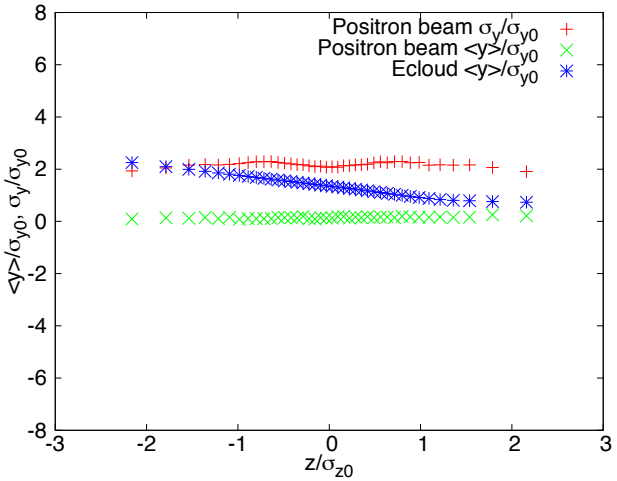
➤ **Monitors at s=0m (β_y=0.13m) and s=1m (β_y=2716m)**

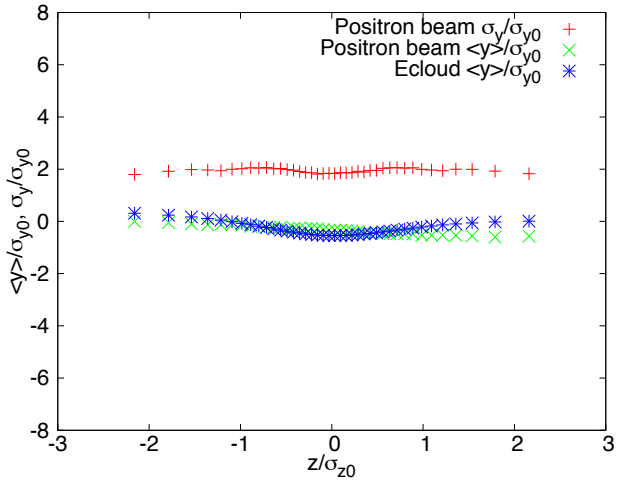
ρ_{e0}=5.0e11





ρ_{e0}=6.0e11



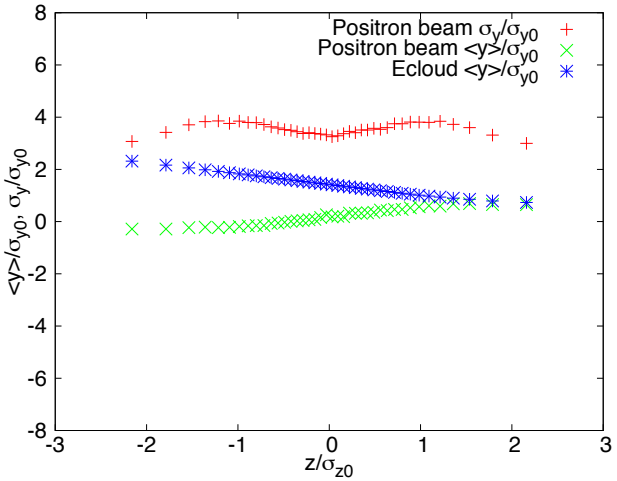


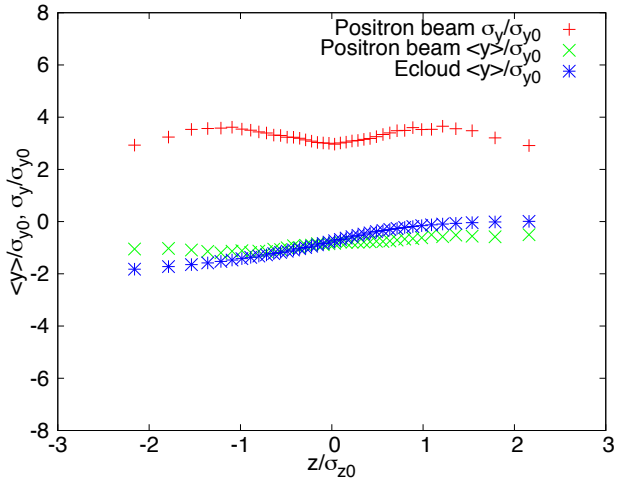
2. Results of PEHTS2

Condition 4:

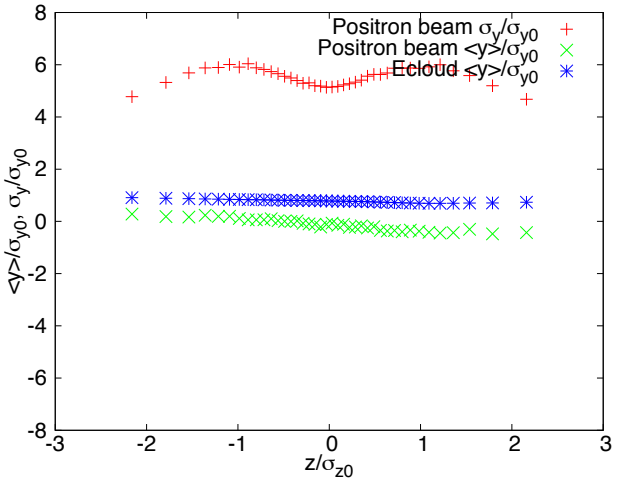
➤ Monitors at s=0m (β_y=0.13m) and s=1m (β_y=2716m)

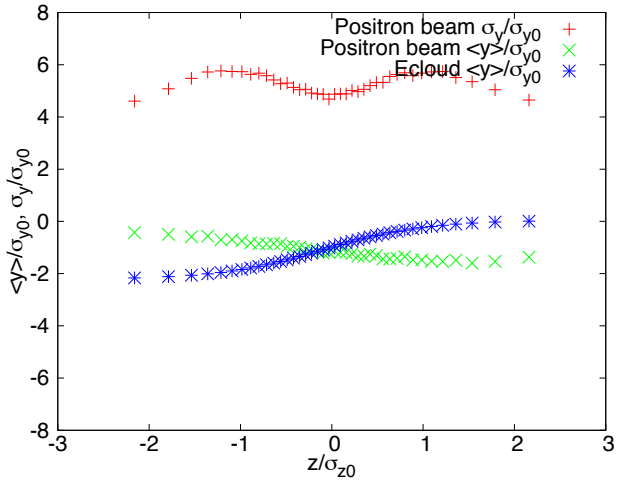
ρ_{e0}=7.0e11





ρ_{e0}=8.0e11



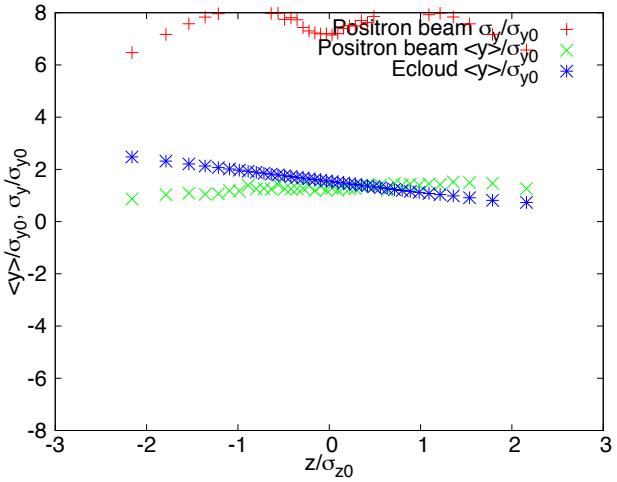


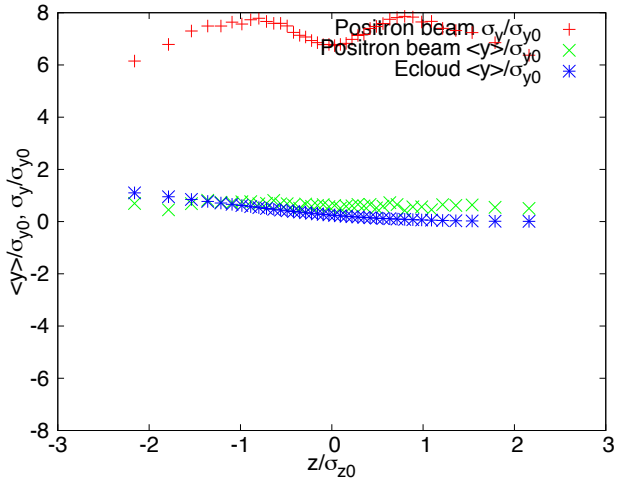
2. Results of PEHTS2

Condition 4:

➤ **Monitors at s=0m (β_y=0.13m) and s=1m (β_y=2716m)**

ρ_{e0}=10.e11

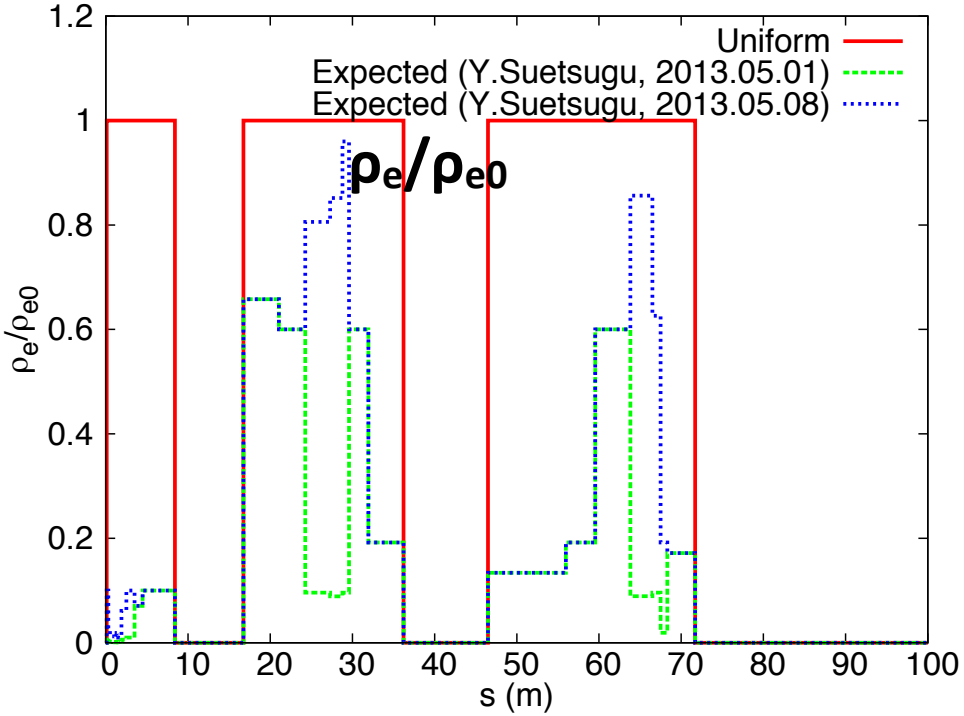


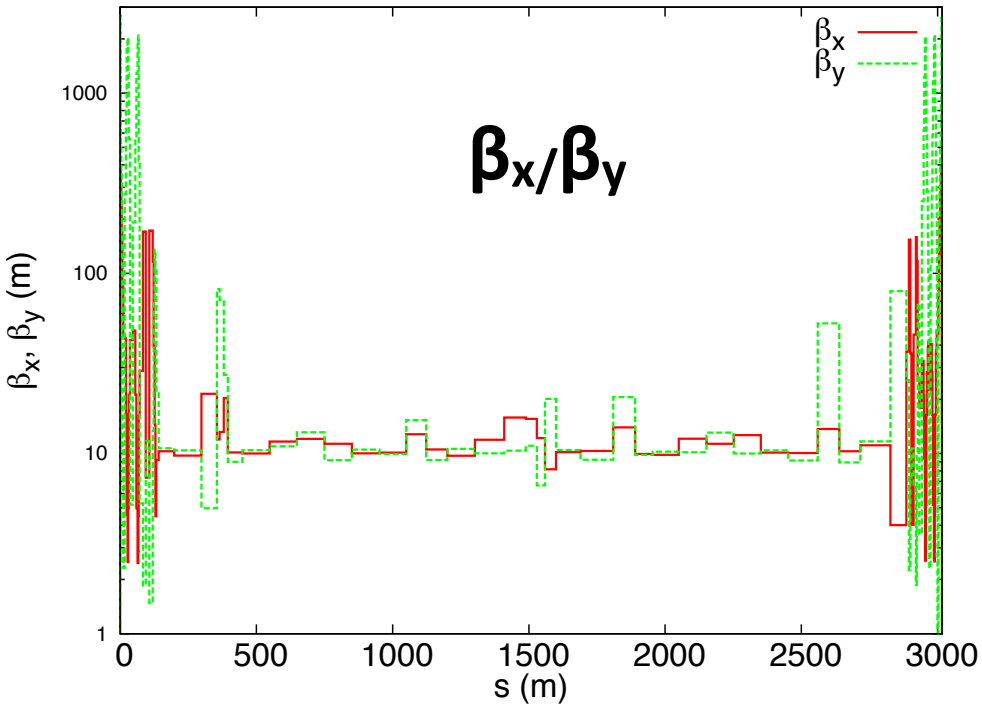


2. Results of PEHTS2

Condition 5:

- Parameters: ν_x=44.53,ν_y=46.57, ν_s=0.0247, P_{BUNCH}=9.04e10, ρ_{e0}=1e11 m^{-3}
- Number of sections along the ring: Nsection=129
- Ecloud density data by Y. Suetsugu (2013.05.08)

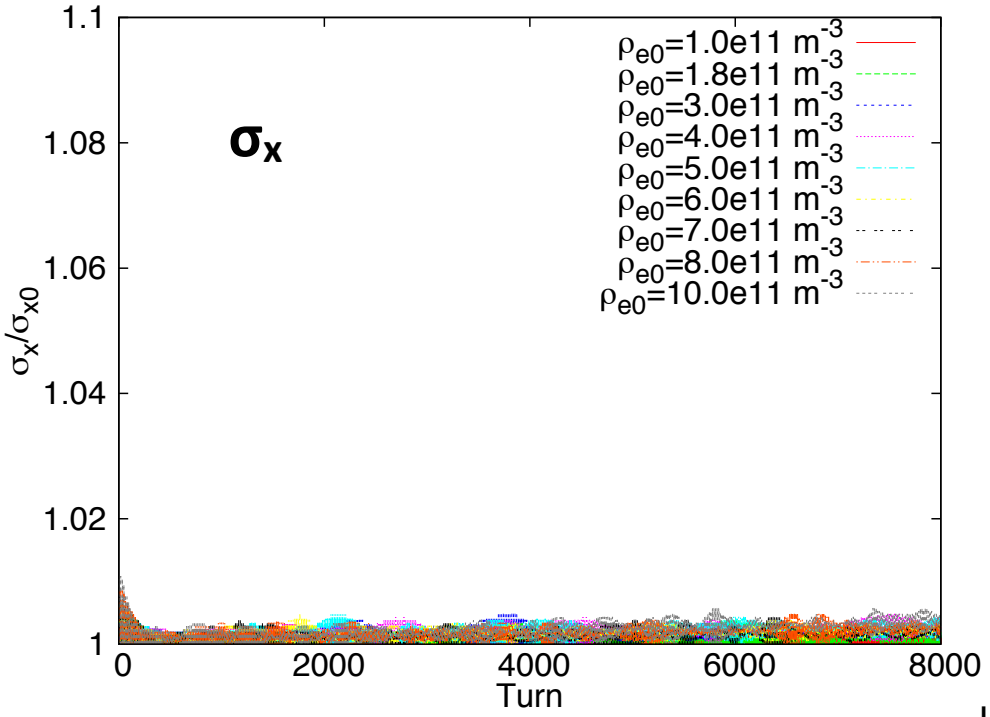


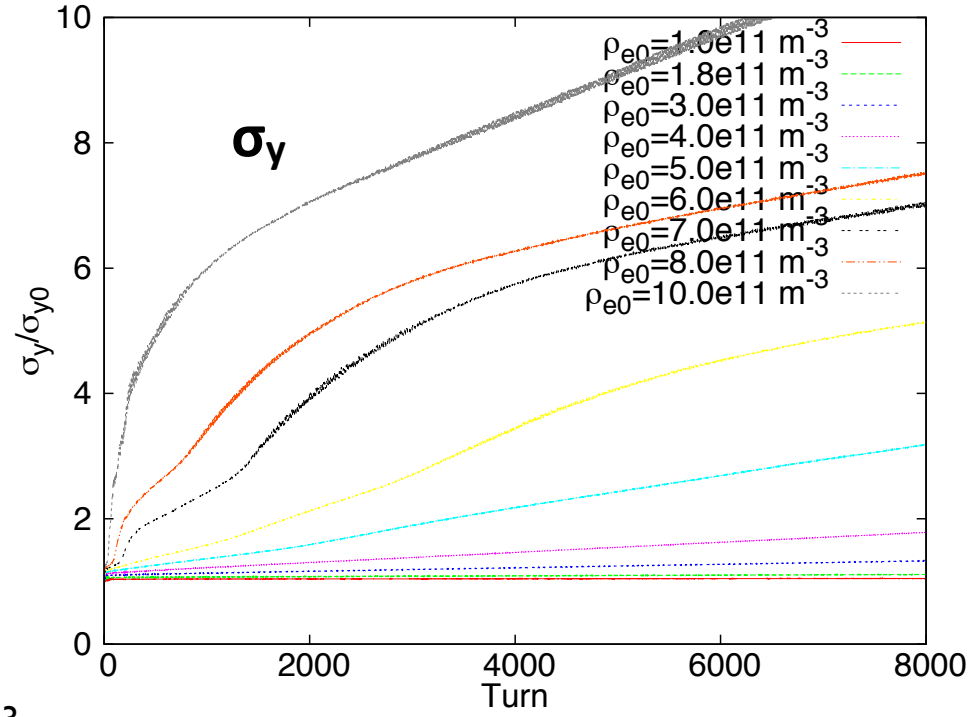


2. Results of PEHTS2

Condition 5:

- Vary ρ_{e0}={1, 2, …, 10}e11 m^{-3}
- Seems no coherent instability up to ρ_{e0}=5e11 m^{-3}
- Safety margin for LER: factor of 5?





3. Summary

➤ **Simulation results:**

- **With conditions of uniform beta functions and uniform elcoud density along the ring, the threshold for ecloud density is about 5.E11 m^{-3}.**
- **With conditions of realistic beta functions and assumed uniform ecloud density along the ring, the threshold reduces to about 1.6E11 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**