Impedance Issues in SuperKEKB
- With updated results

D. Zhou

With contributions from

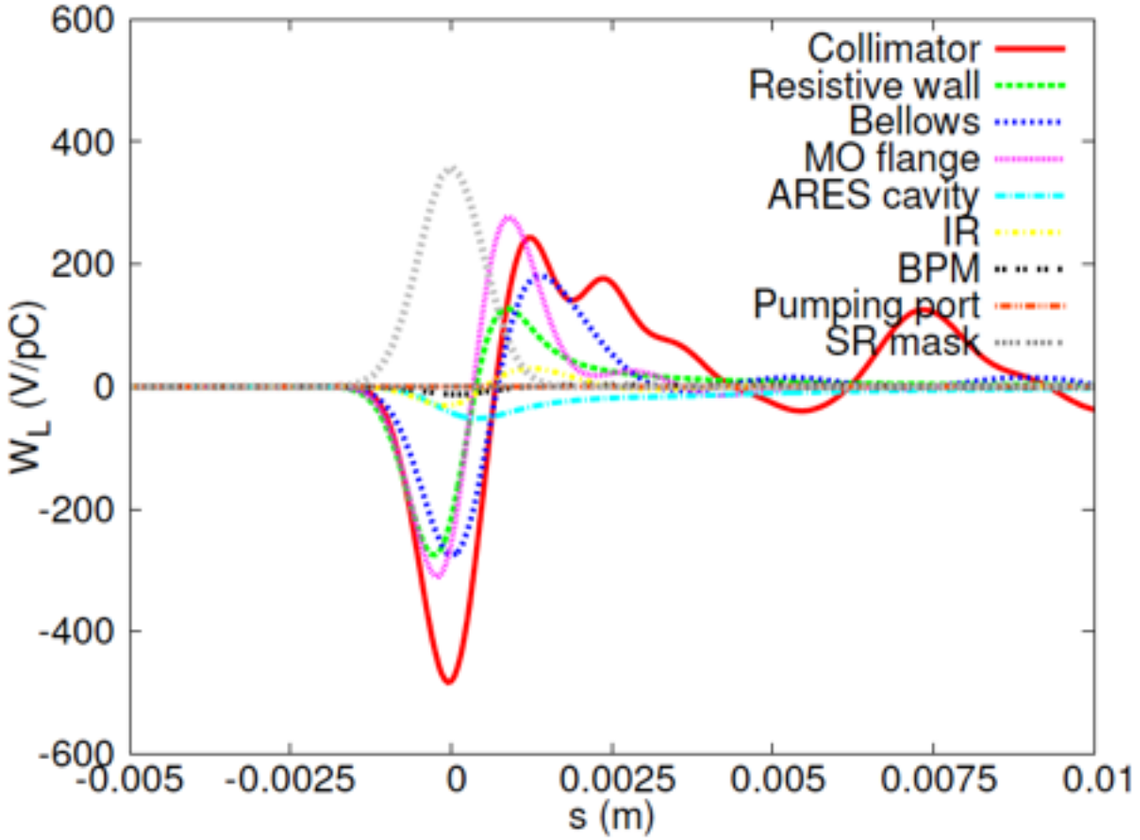
T. Abe, T. Ishibashi, Y. Morita, K. Shibata, Y. Suetsugu, M. Tobiyama, M. Yoshida, ...

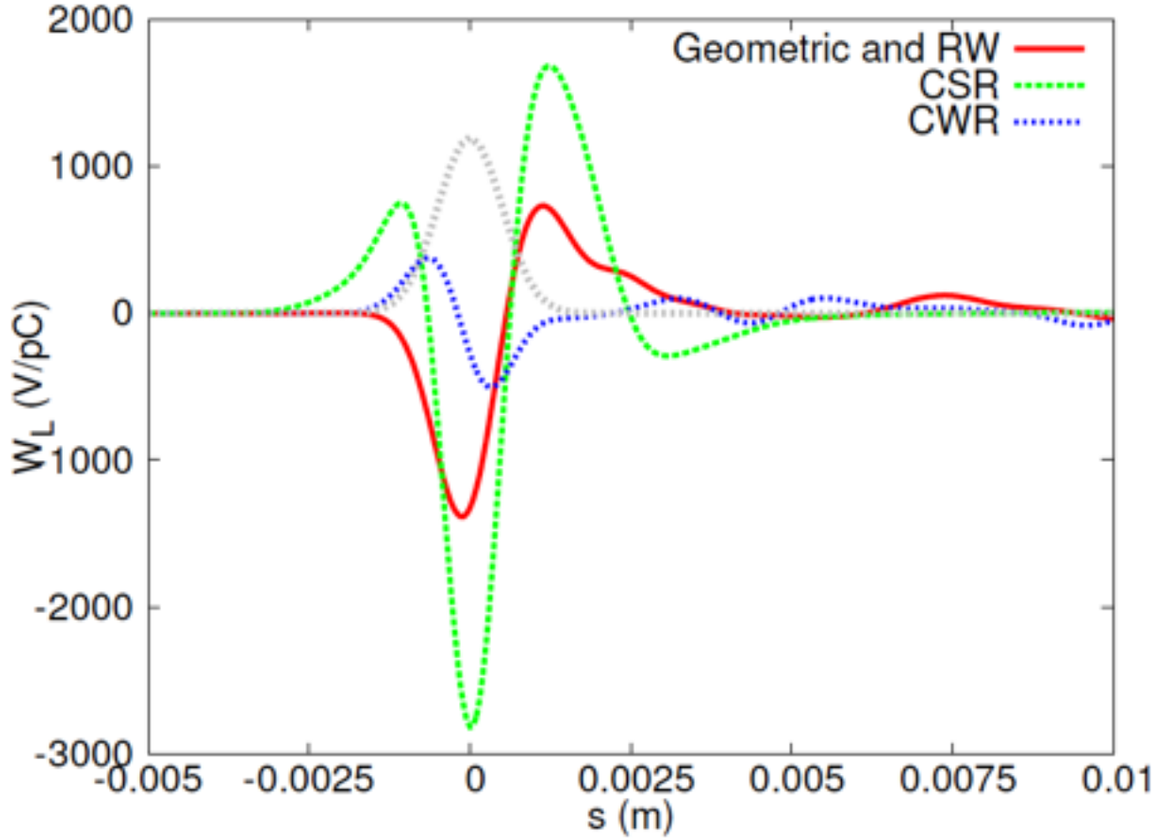
SuperKEKB optics meeting, Apr. 17, 2014

1. Impedance calculations: Results: LER

➤ Pseudo-Green wake function

- σ_z=0.5mm
- Pumping ports and SR masks are negligible sources because of antechamber
- CSR and CWR (Wiggler radiation): CSRZ code with rectangular chamber
- Not considered yet: Grooves surface, Clearing electrodes

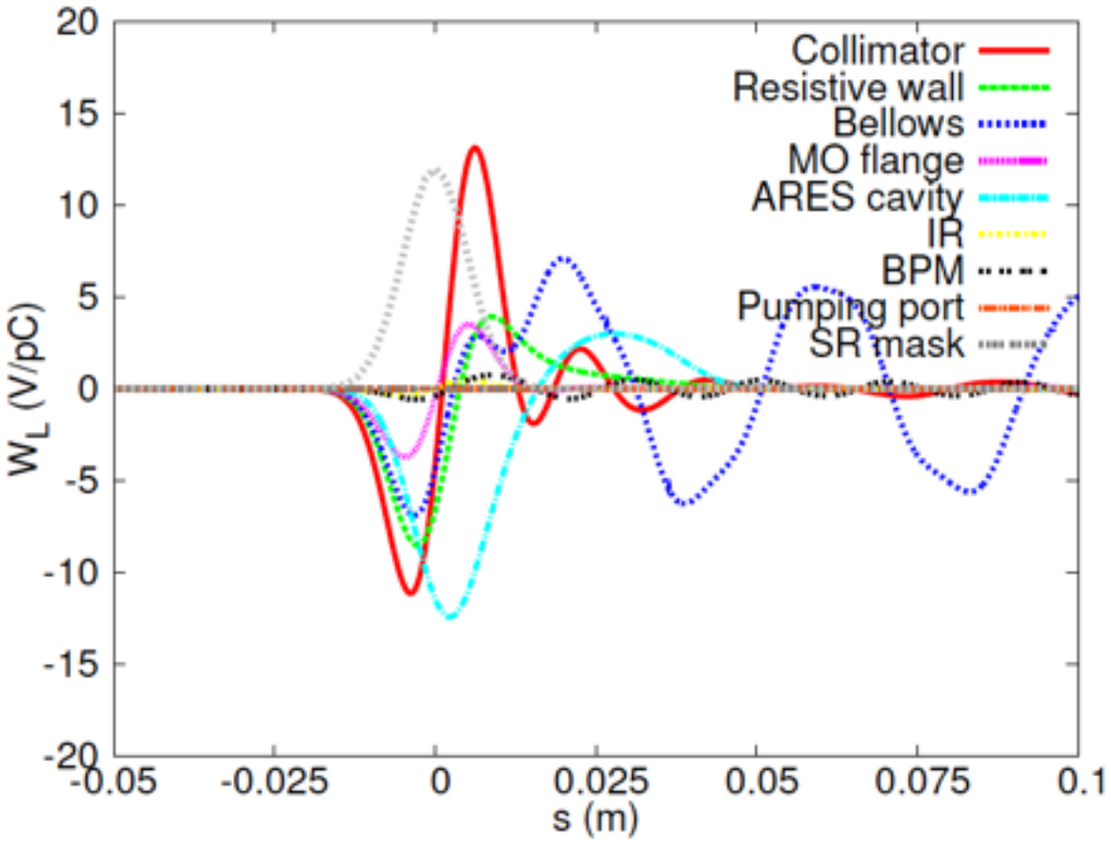


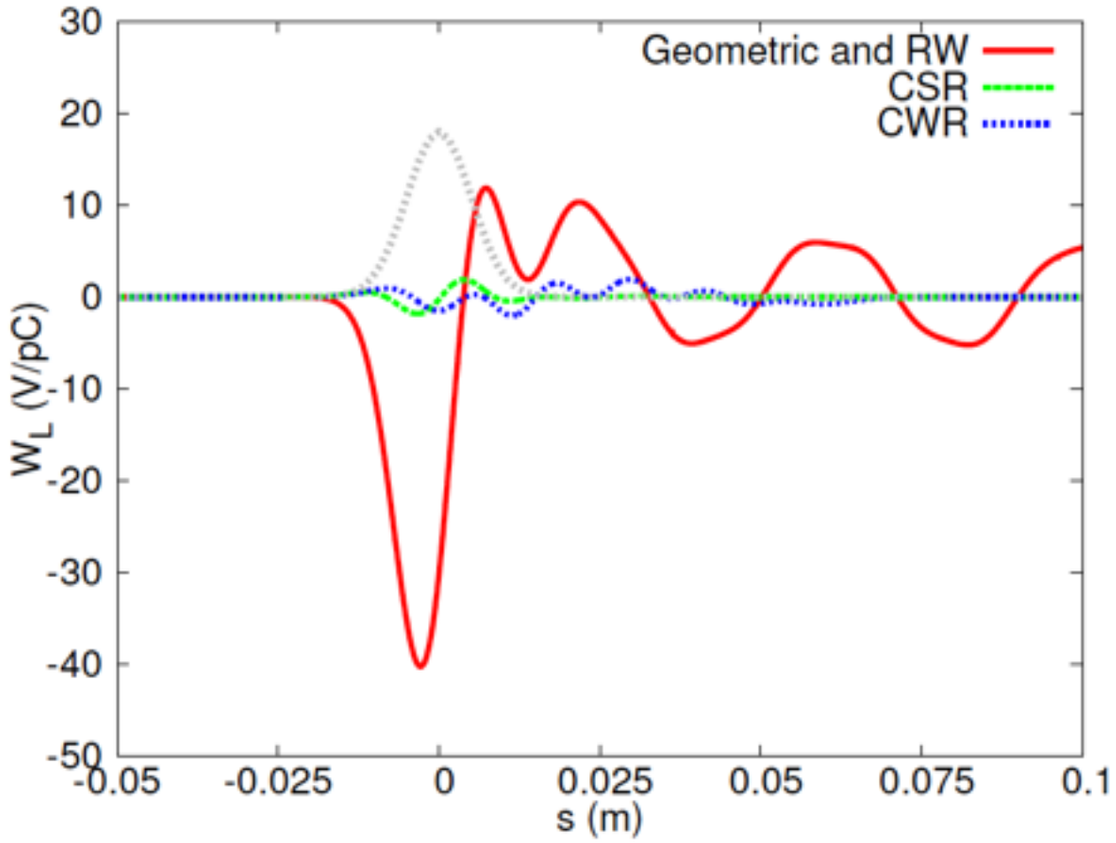


1. Impedance calculations: Results: LER

➤ **Wake potential with nominal bunch length**

- σ_z=5mm
- Main sources: Collimators, Resistive wall, ARES cavity, Bellows, MO flanges
- CSR and CWR are not strong if no microbunching happens

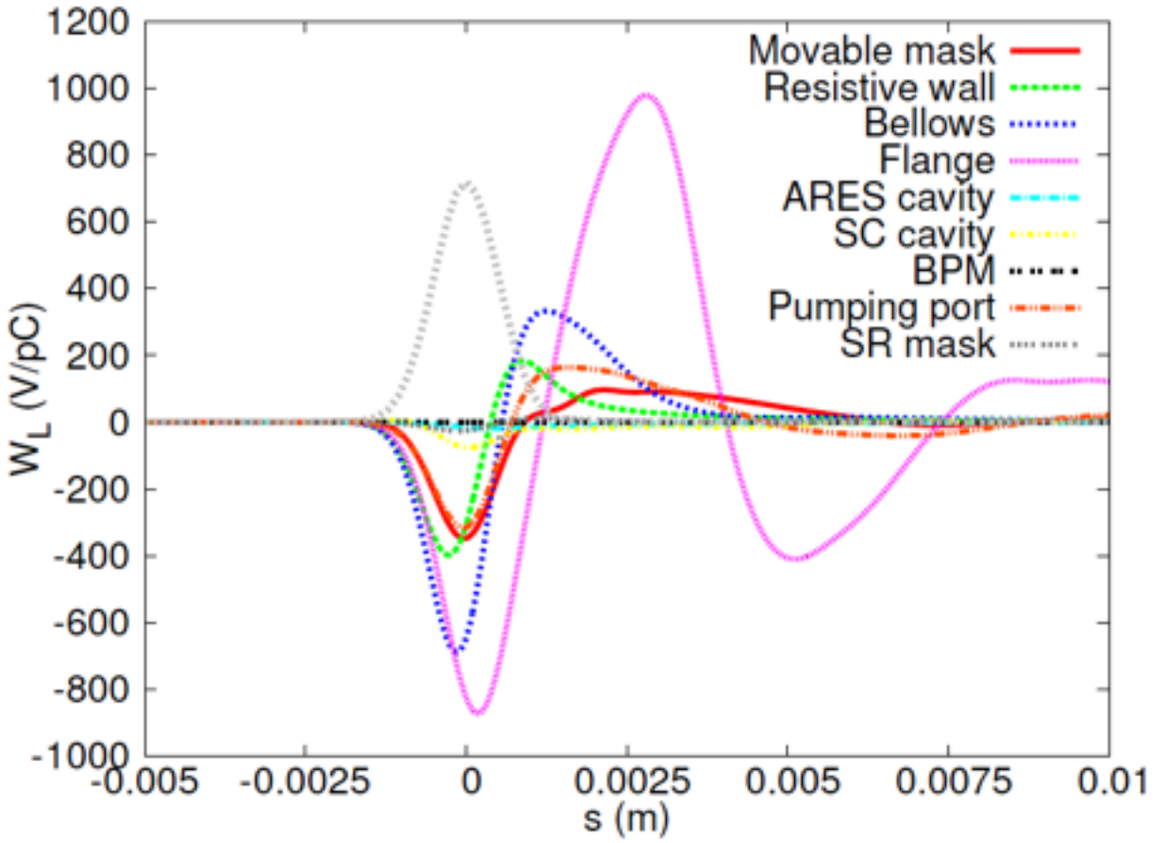


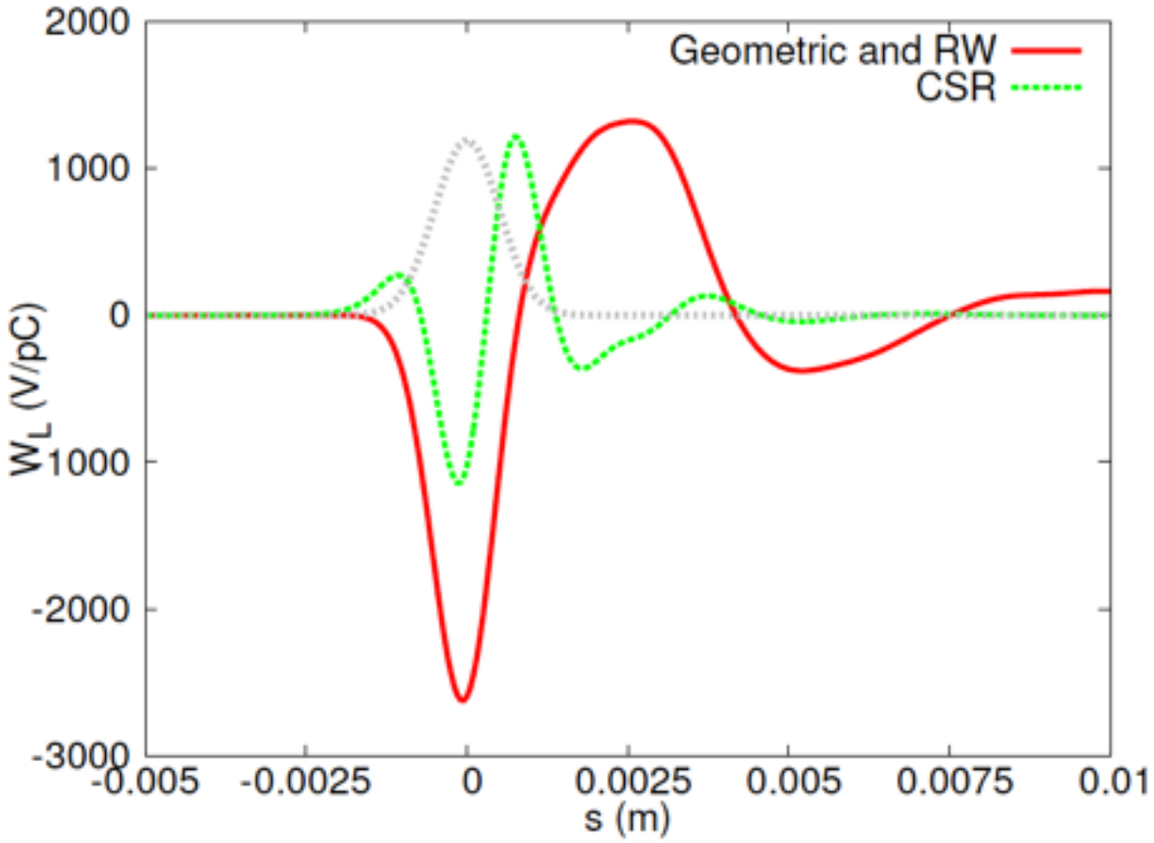


1. Impedance calculations: Results: HER

➤ Pseudo-Green wake function

- σ_z=0.5mm
- CSR: CSRZ code with rectangular chamber
- CWR (Wiggler radiation) not considered yet
- Not considered yet: Tapers (should be negligible)



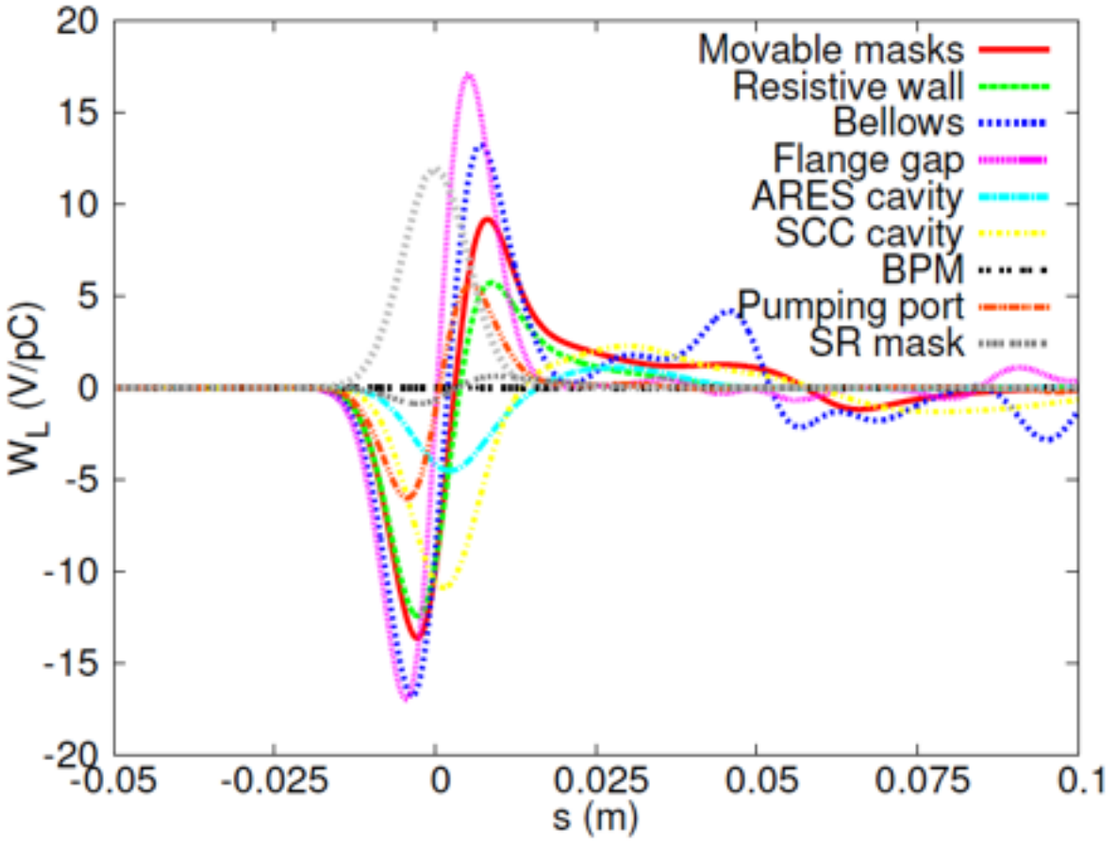


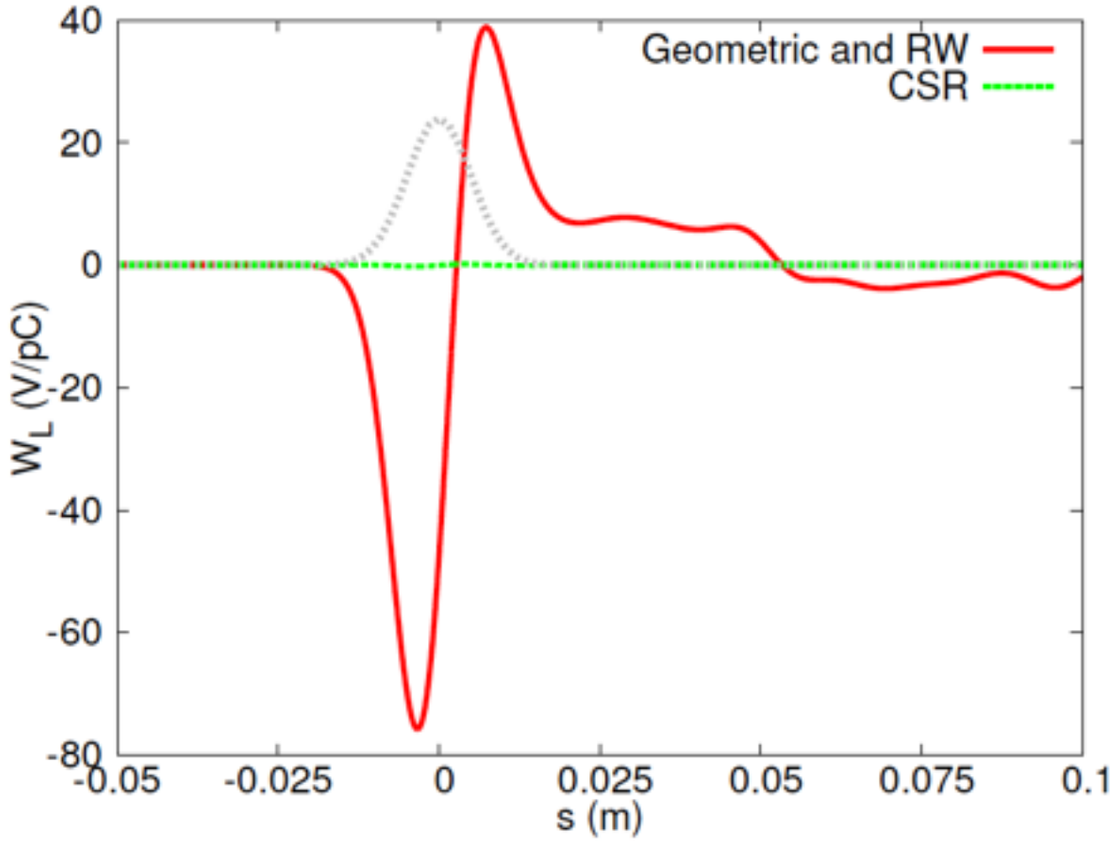
1. Impedance calculations: Results: HER

➤ **Wake potential with nominal bunch length**

- σ_z=5mm
- Main sources: Movable masks, Resistive wall, Flange gaps, Bellows, SCC cavities, ARES cavities, Pumping port
- CSR is weak if no microbunching happens

Flange and bellows: Strange?

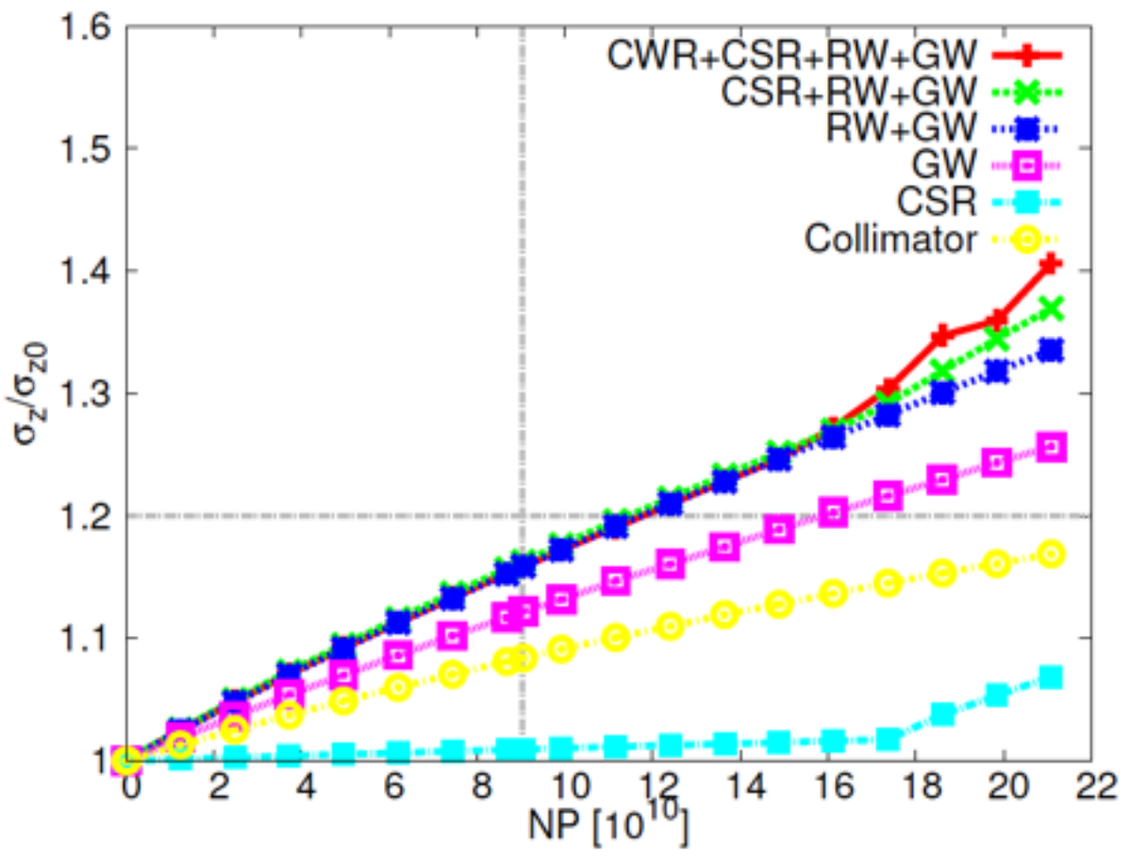


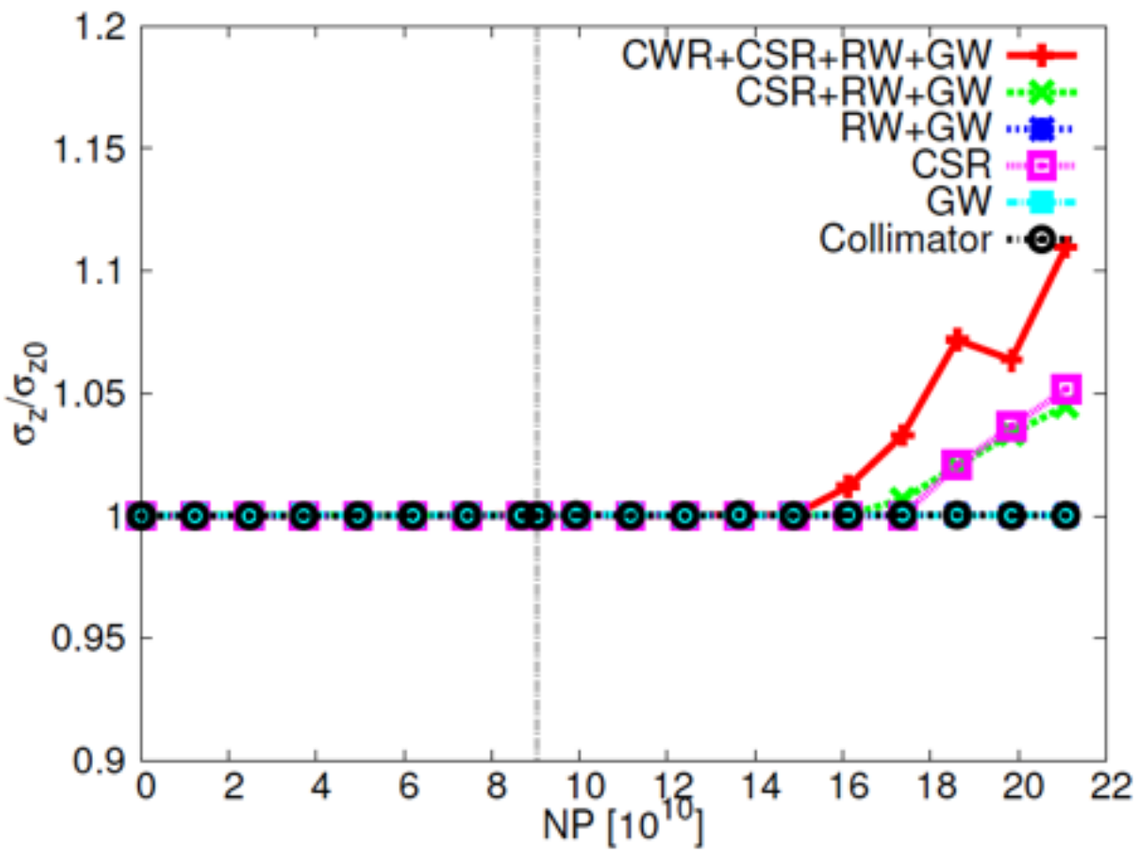


2. Single-bunch effects: Longitudinal: LER

➤ **Simulations with input of Pseudo-Green wake:**

- **Use Cai-Warnock's VFP solver**
- **Collimators are important sources in bunch lengthening**
- **Simulated $\sigma_z \approx 5.8$mm @Design bunch current**
- **Simulated MWI threshold is around NP_{th}=15.E10**
- **CSR and CWR are likely to be not important. BUT ...**

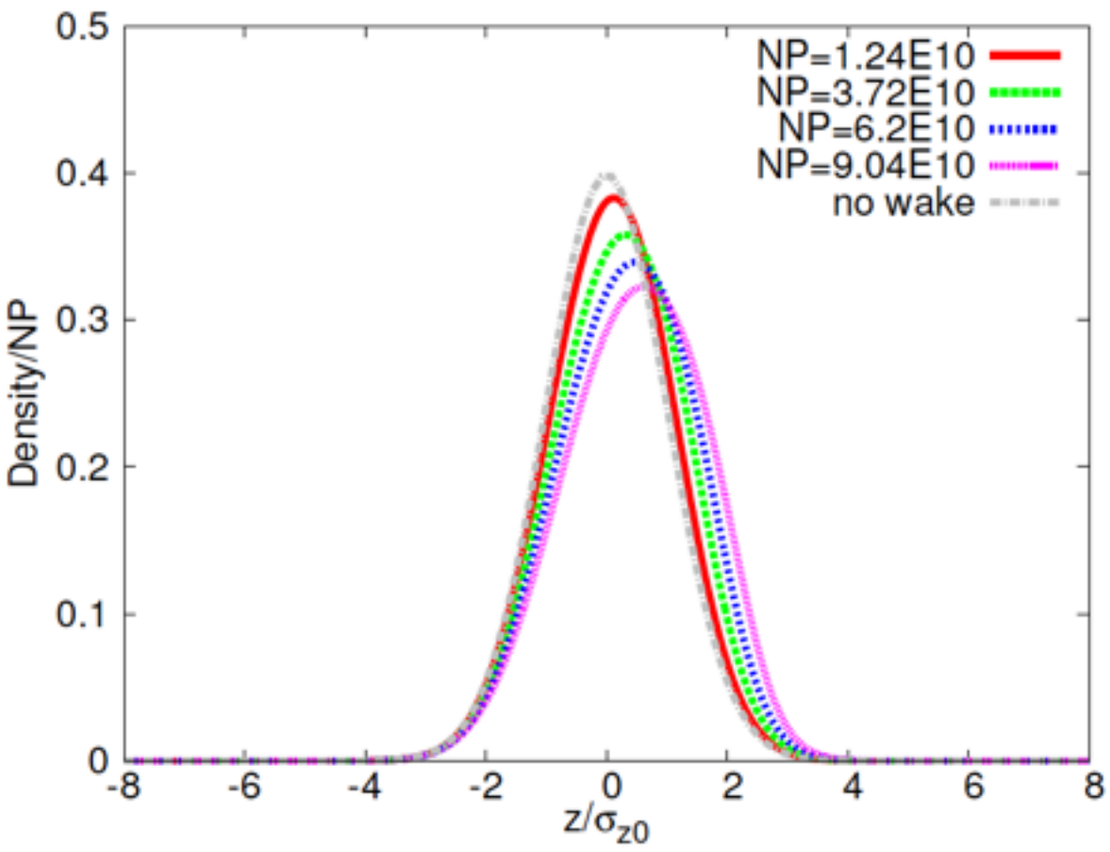


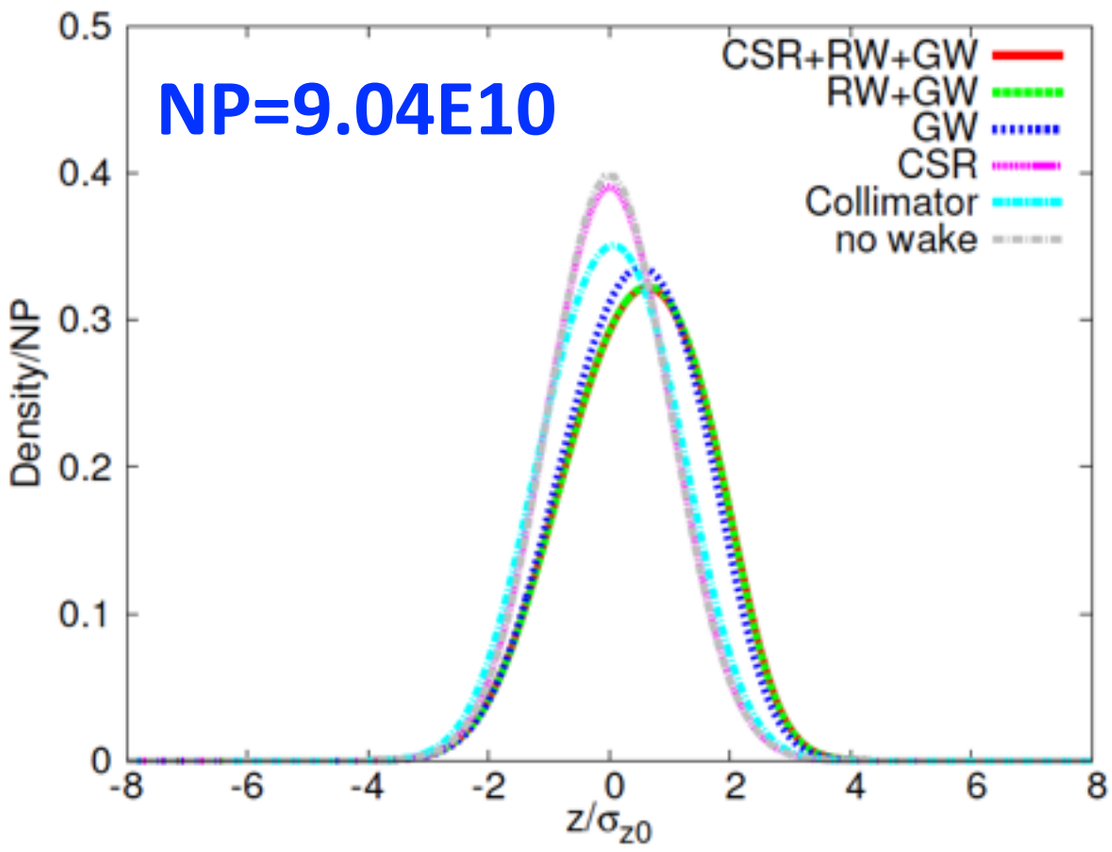


2. Single-bunch effects: Longitudinal: LER

➤ **Simulations with input of Pseudo-Green wake:**

- **BUT, pseudo-Green wakes for CSR, CWR and RW are not good choices. => To be improved.**
- **Potential-well distortion => Longitudinal beam tilt => Impact on luminosity to be evaluated**

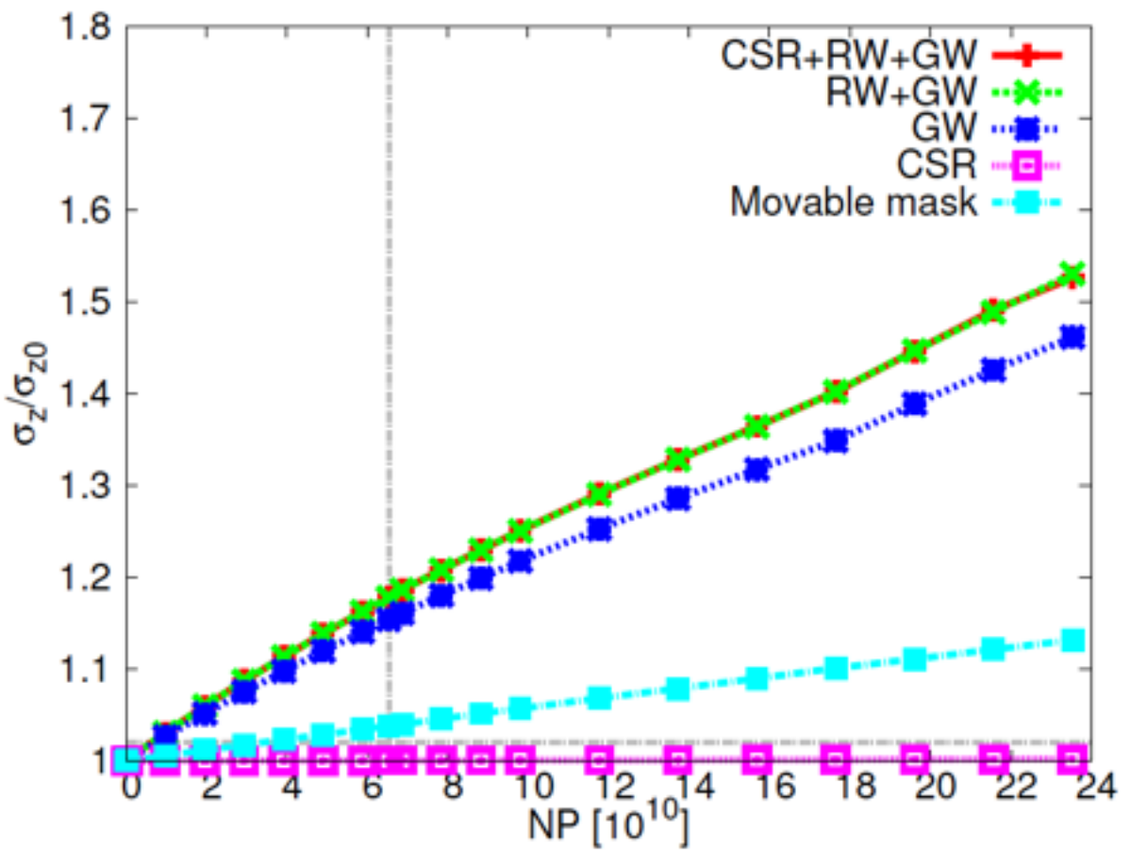


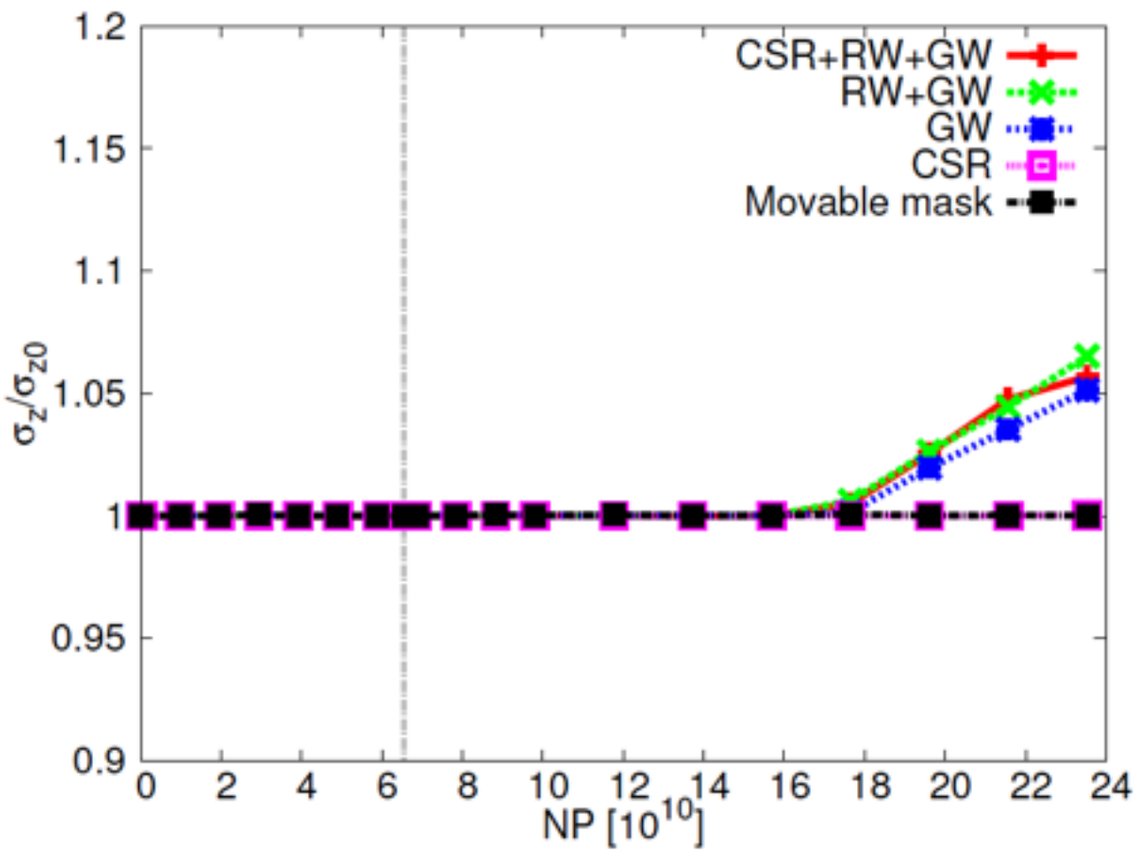


2. Single-bunch effects: Longitudinal: HER

➤ **Simulations with input of Pseudo-Green wake:**

- **Use Cai-Warnock's VFP solver**
- **Movable mask: KEKB-type model used => To be improved**
- **Simulated $\sigma_z \approx 5.8$mm @Design bunch current**
- **Simulated MWI threshold is around NP_{th}=17.E10**
- **CSR and CWR are likely to be not important.**





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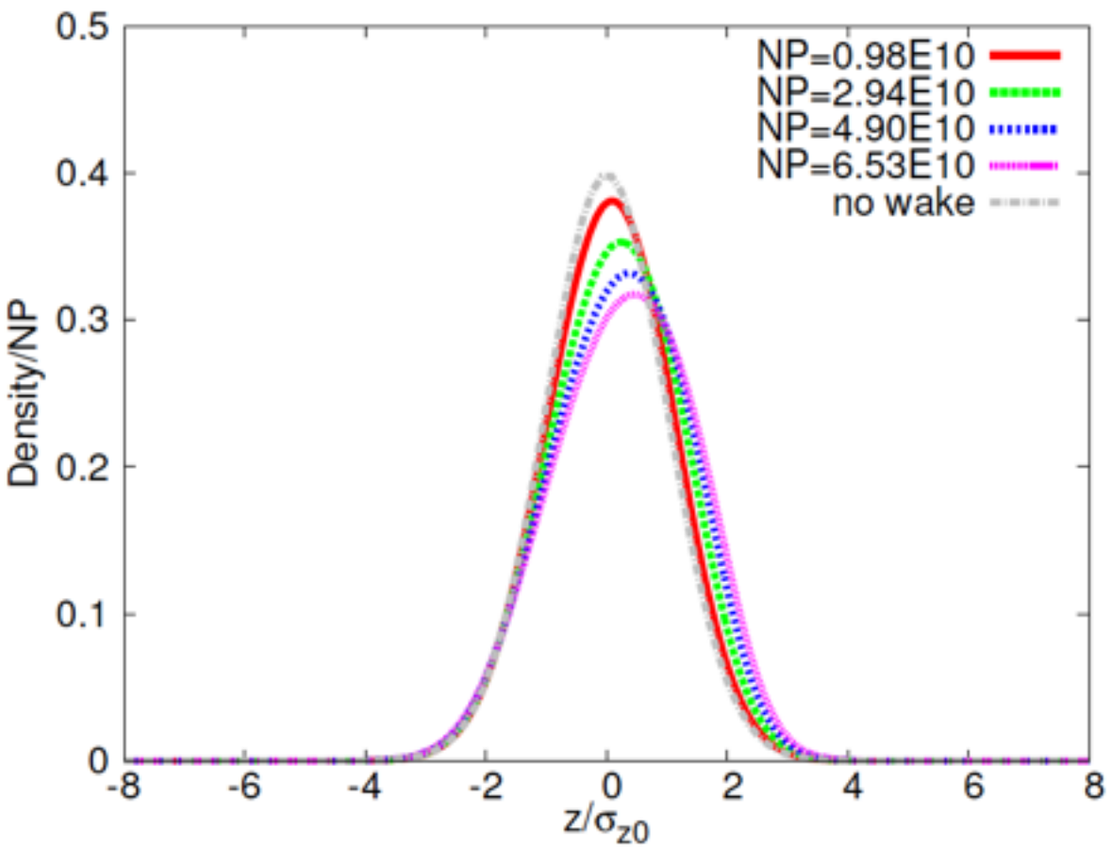

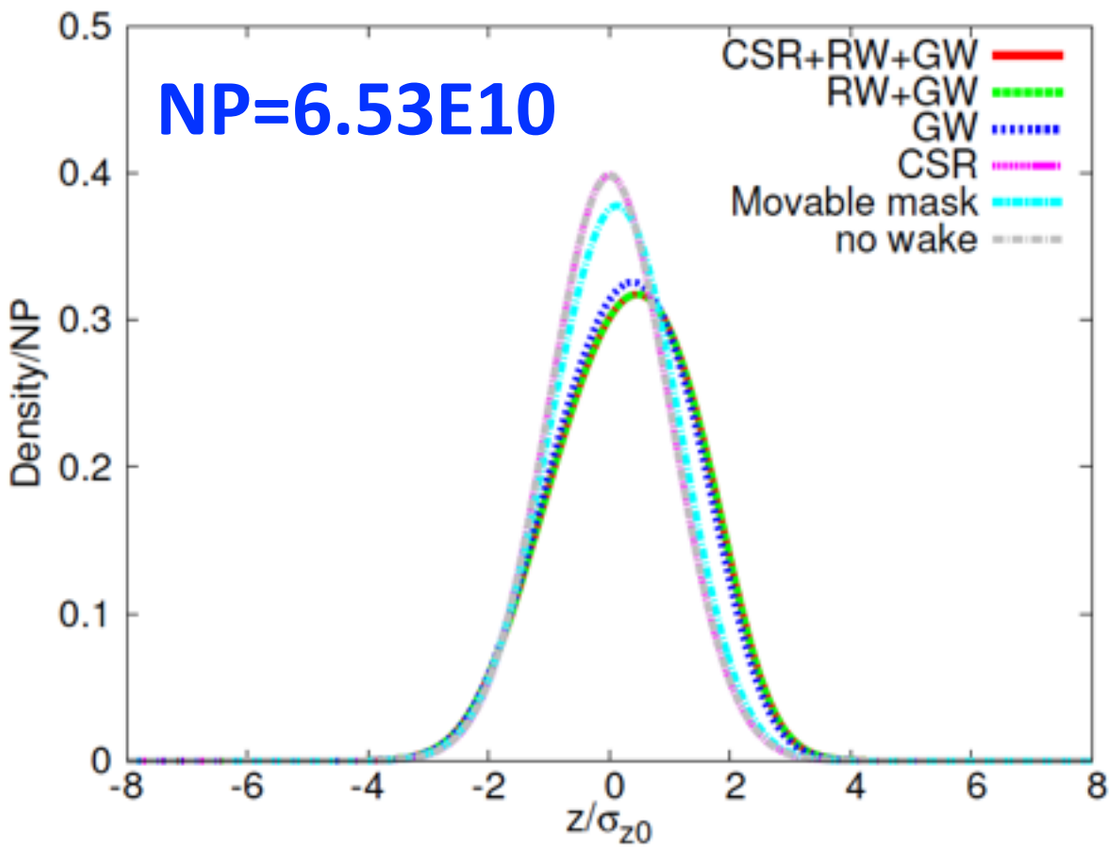

3. Summary

➤ **Impedance calculations**

- **Longitudinal impedance calculations with σ_z=0.5mm => Pseudo-Green wake => Simulations of MWI**

➤ **Longitudinal single-bunch effects**

- **σ_z≈5.8mm @Design bunch current for both LER and HER [Optimistic estimation. Measured bunch should be longer due to unknown impedance sources]**
- **LER design: σ_{zp}=6mm; HER design: σ_{ze}=5mm (Challenging?).**

➤ **Simple estimate of lum. loss ≈8%, if σ_{ze}=5mm → σ_{ze}=6mm**

$$L = L_0 R_{H\theta}$$

$$L_0 = \frac{N_e N_p f_0 N_b}{2\pi\sqrt{\sigma_{xe}^{*2}+\sigma_{xp}^{*2}}\sqrt{\sigma_{ye}^{*2}+\sigma_{yp}^{*2}}} \qquad R_{H\theta} \approx \frac{1}{\sqrt{1+\frac{\sigma_{ze}^2+\sigma_{zp}^2}{\sigma_{xe}^2+\sigma_{xp}^2}\tan^2\frac{\theta}{2}}}$$