MOOP003

Wakefield mitigation studies and beamline upgrades for stable nanometer beam operation at KEK-ATF

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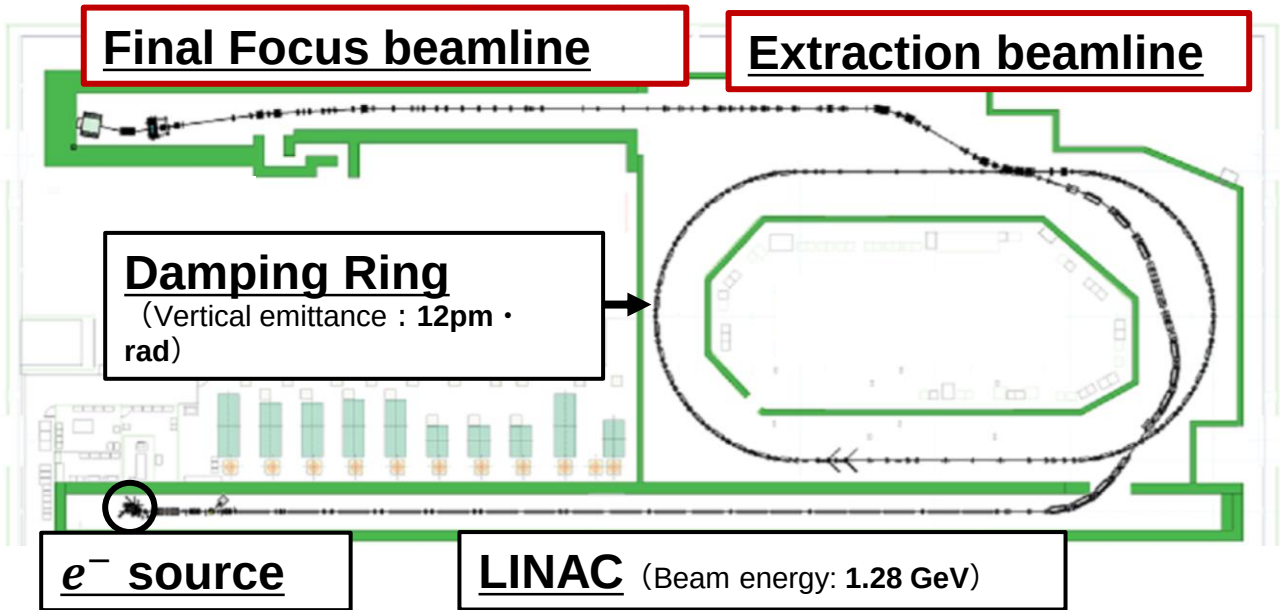
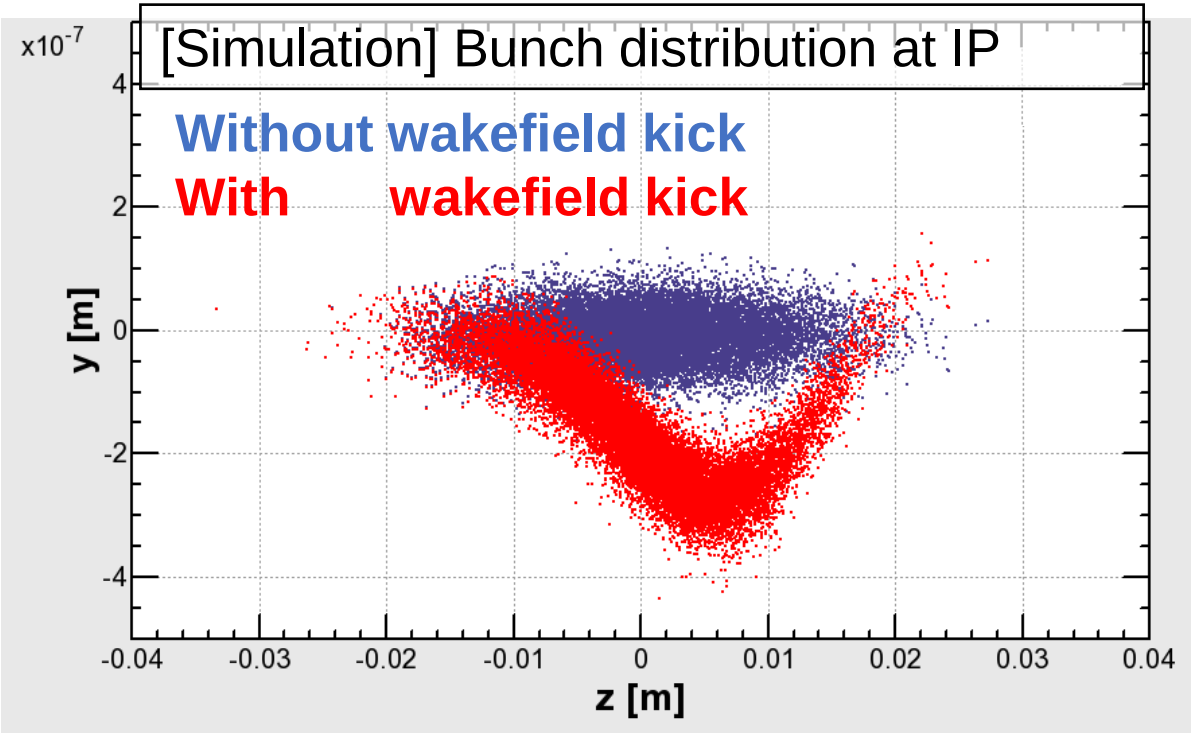
Nanometer small beam and Accelerator Test Facility (ATF)

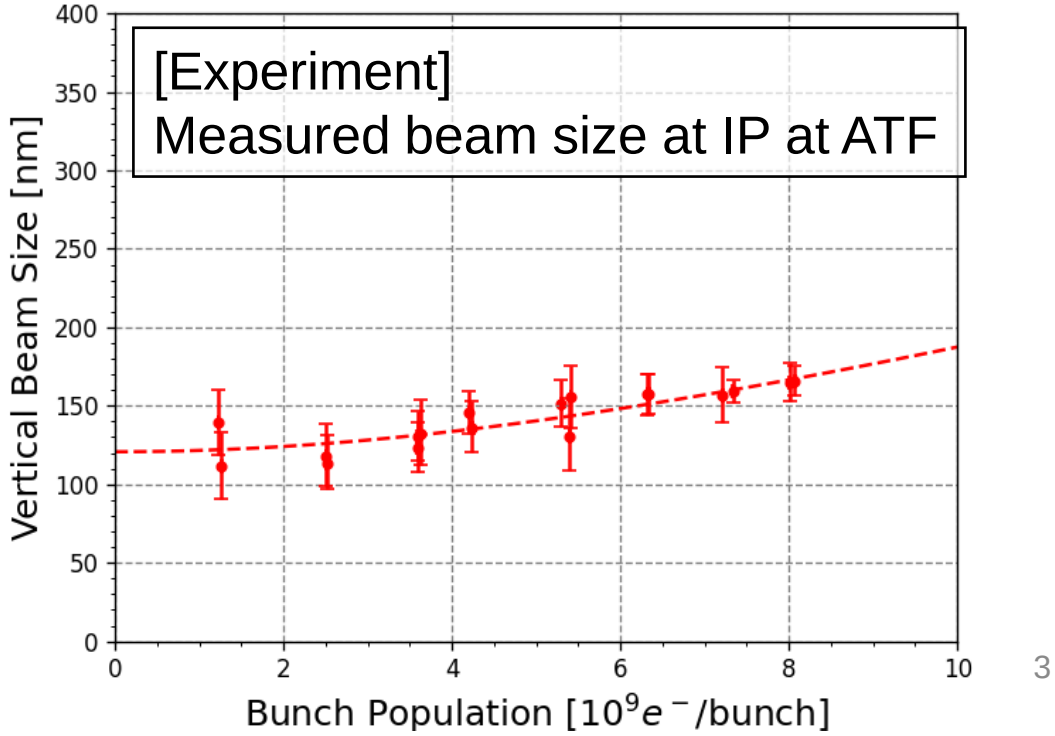
- **Nanometer small beam (small beam)** : **key technology** for the Linear Collider to maximize the luminosity
- **ATF**: **R&D facility** for the final focus system to develop the **nanometer small beam technology** required for the International Linear Collider
  - ➢ Goal: To archieve 37 nm as IP vertical beam size
- **ATF is the best research environment for wakefield study**
  - ➢ Generate the low emittance and nanometer size beam
  - ➢ There are high precision monitors (BPM, beam size monitor in nm order)



Wakefield effects on the small beam

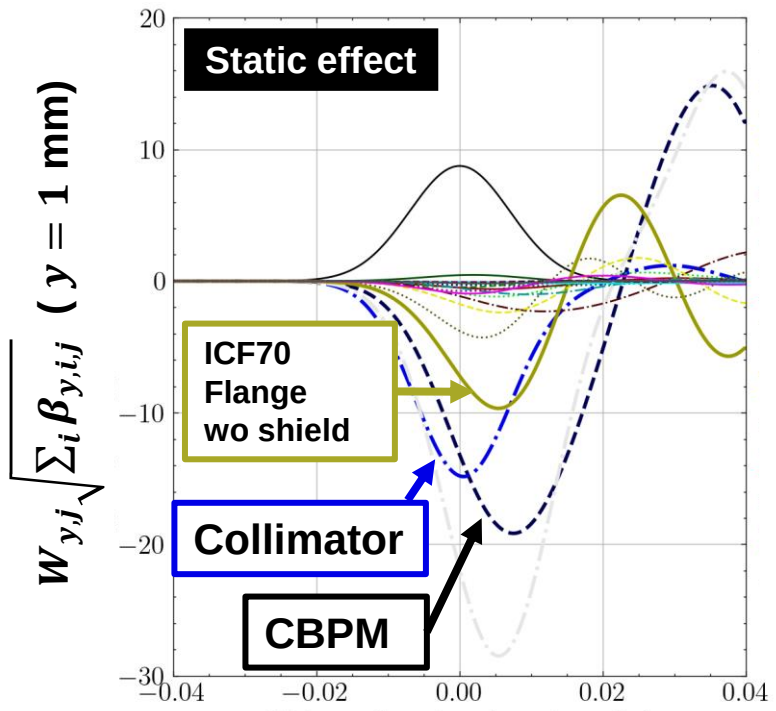
- **Not negligible：Wakefield effects on the nanometer small beam**
  - Induce the **beam size growth** and **bunch position change**
- **Wakefield study is important for the next generation accelerators**
  - Nanometer small beam：the key technology for the Linear Collider
- **IP vertical beam size growth as a function of the bunch intensity**



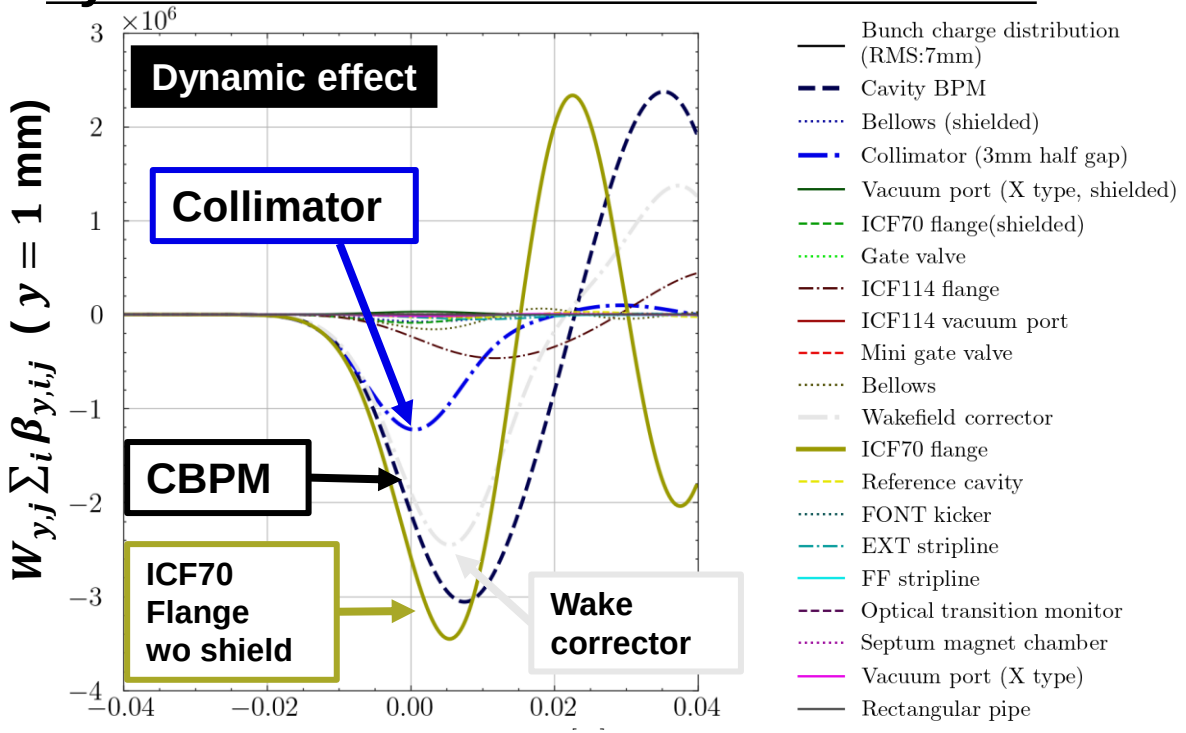


Estimated wakefield effects on the IP beam size

Caused by misalignment of wakefield sources



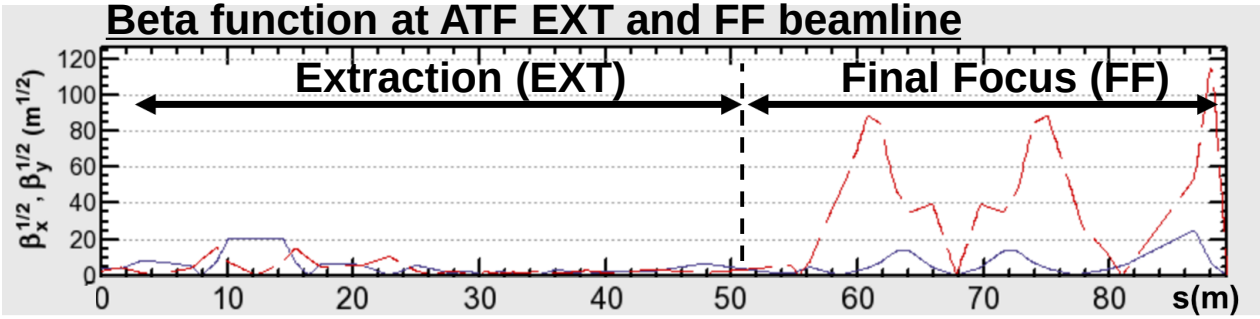
Estimated wakefield effects caused by orbit fluctuation on the IP beam size



Strong impact on the IP beam size

Cavity BPM,Collimator, ICF70 flange

→Located in FF ($\beta_{y,\mathrm{FF}} \gg \beta_{y,\mathrm{EXT}}$)



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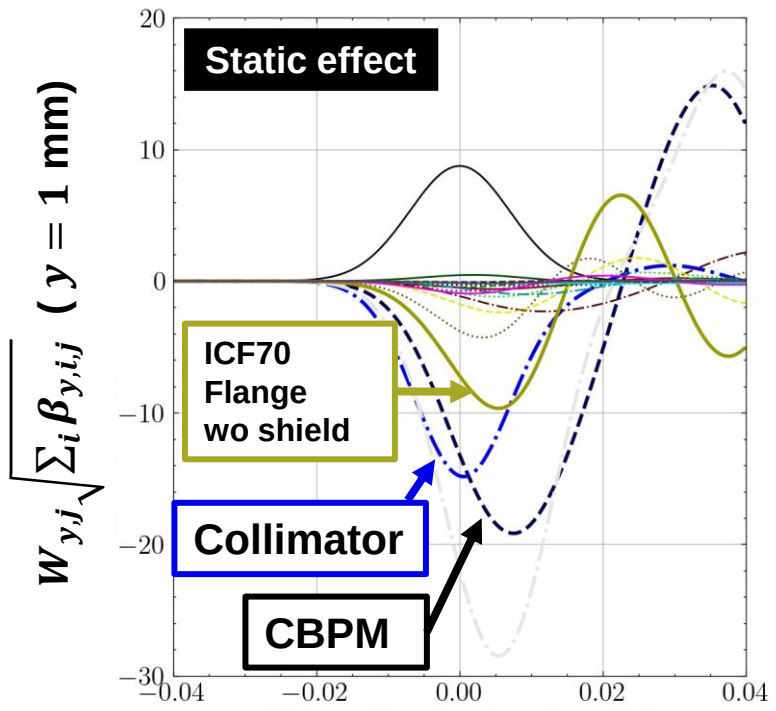

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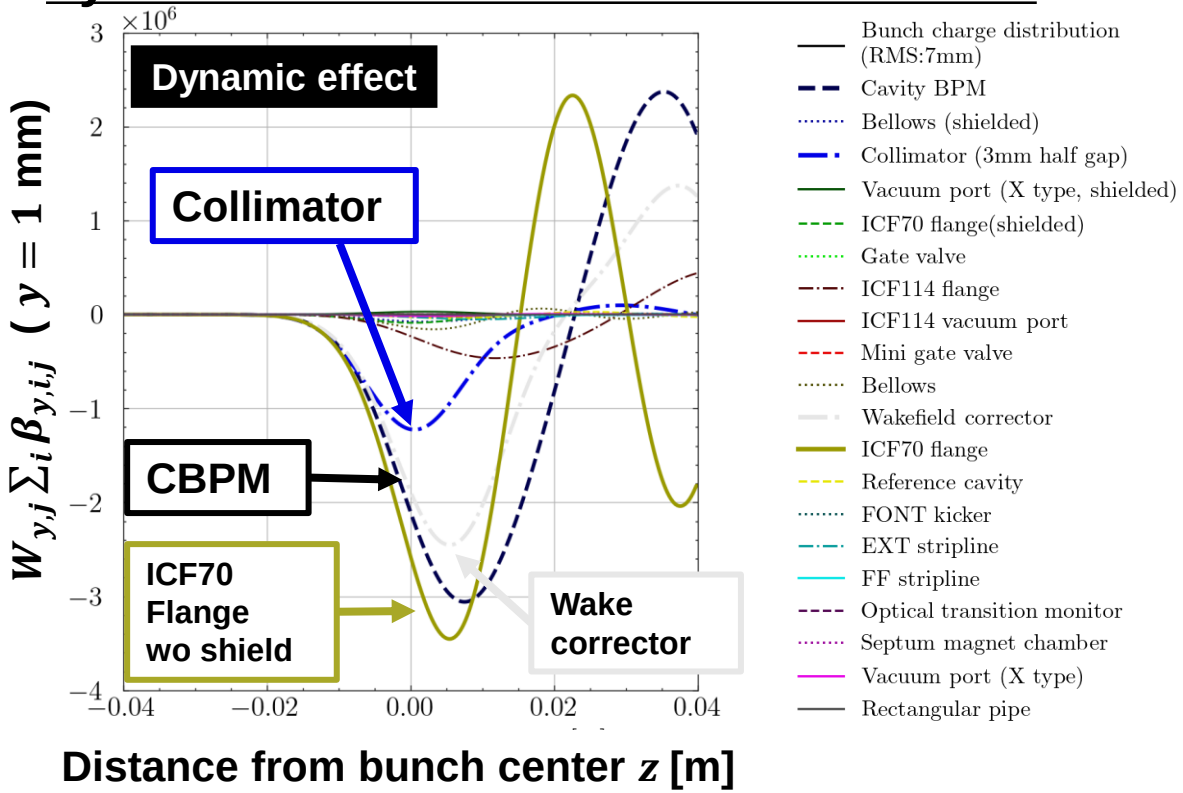


Strong impact on the IP beam size

Cavity BPM,Collimator, ICF70 flange

→Located in FF ($\beta_{y,\mathrm{FF}} \gg \beta_{y,\mathrm{EXT}}$)

Upgraded the FF beamline to mitigate wakefield effects

ATF FF beamline upgrade to mitigate wakefield effects

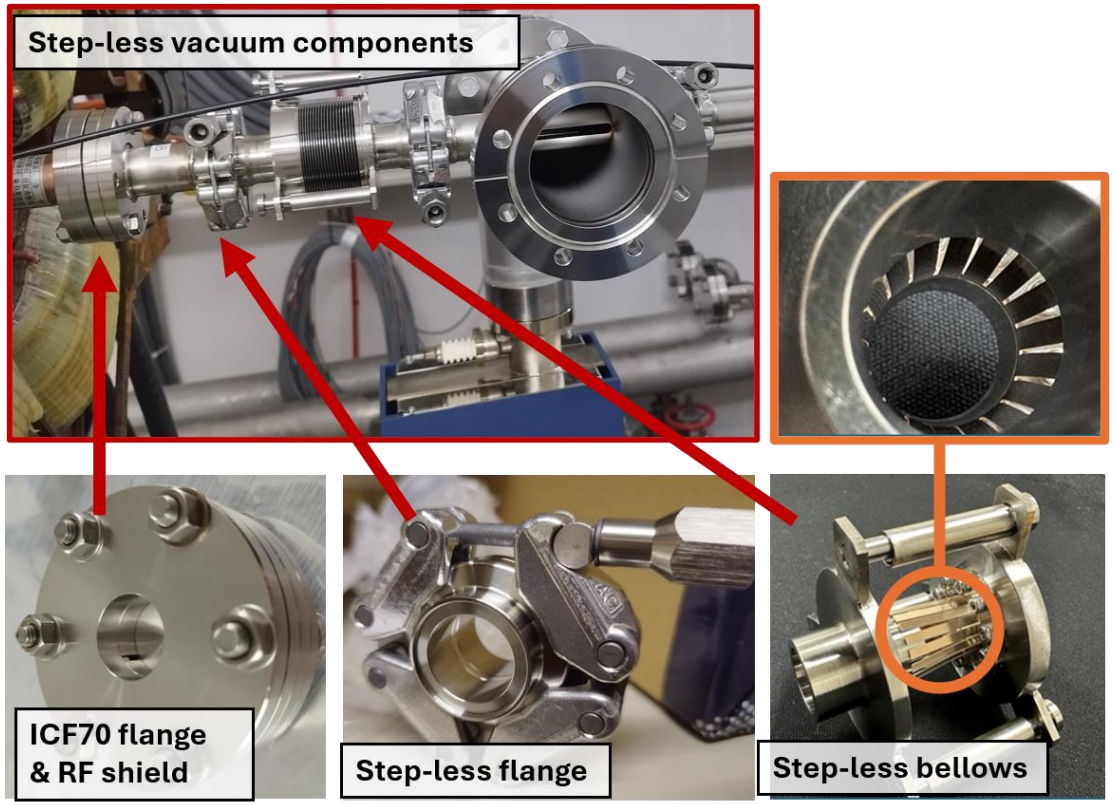
① Insert-type RF shields installed to the ICF114 flanges

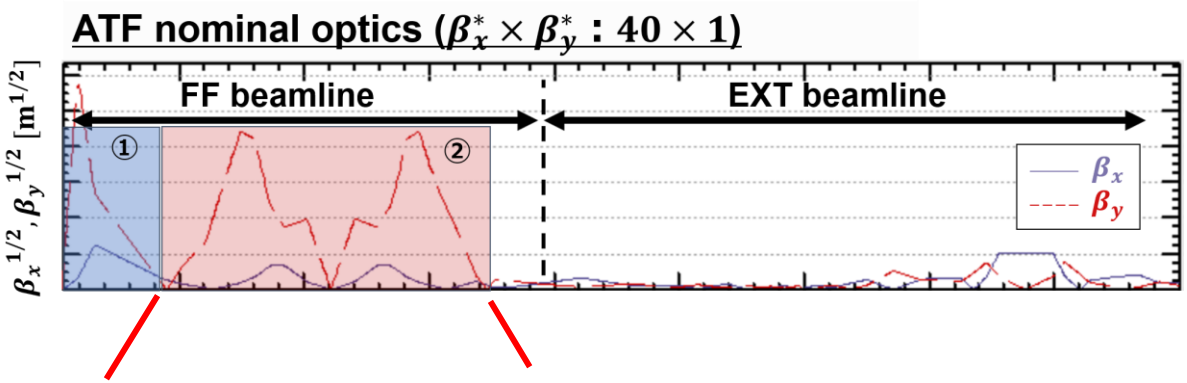
- ✓ **Shielded 12 ICF114 flanges** by RF shields

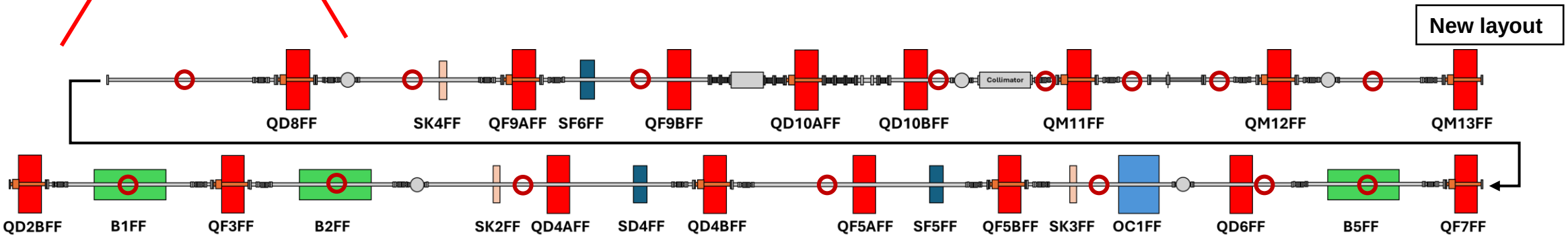
② Bellows, beam pipes, and pumping ports replaced

- ✓ **Removed 35 ICF70 flanges** by step-less type flanges
- ✓ **Shielded 23 ICF70 flanges** by RF shields
- ✓ **Replaced 19 bellows** with step-less RF shields
- ✓ **Replaced 5 vacuum ports**
- ✓ **Removed 17 steps** at each cavity BPM

● Modified the beamline layout at largest β_y in FF

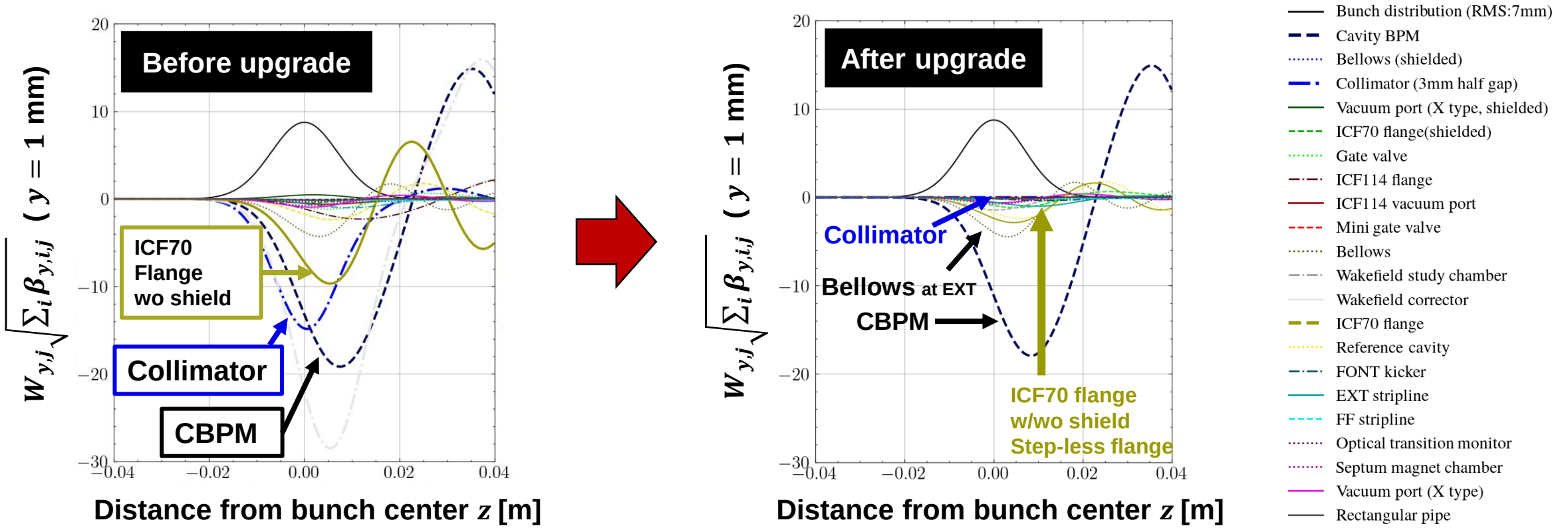






Estimated mitigation effects for static wakefield on the IP beam size

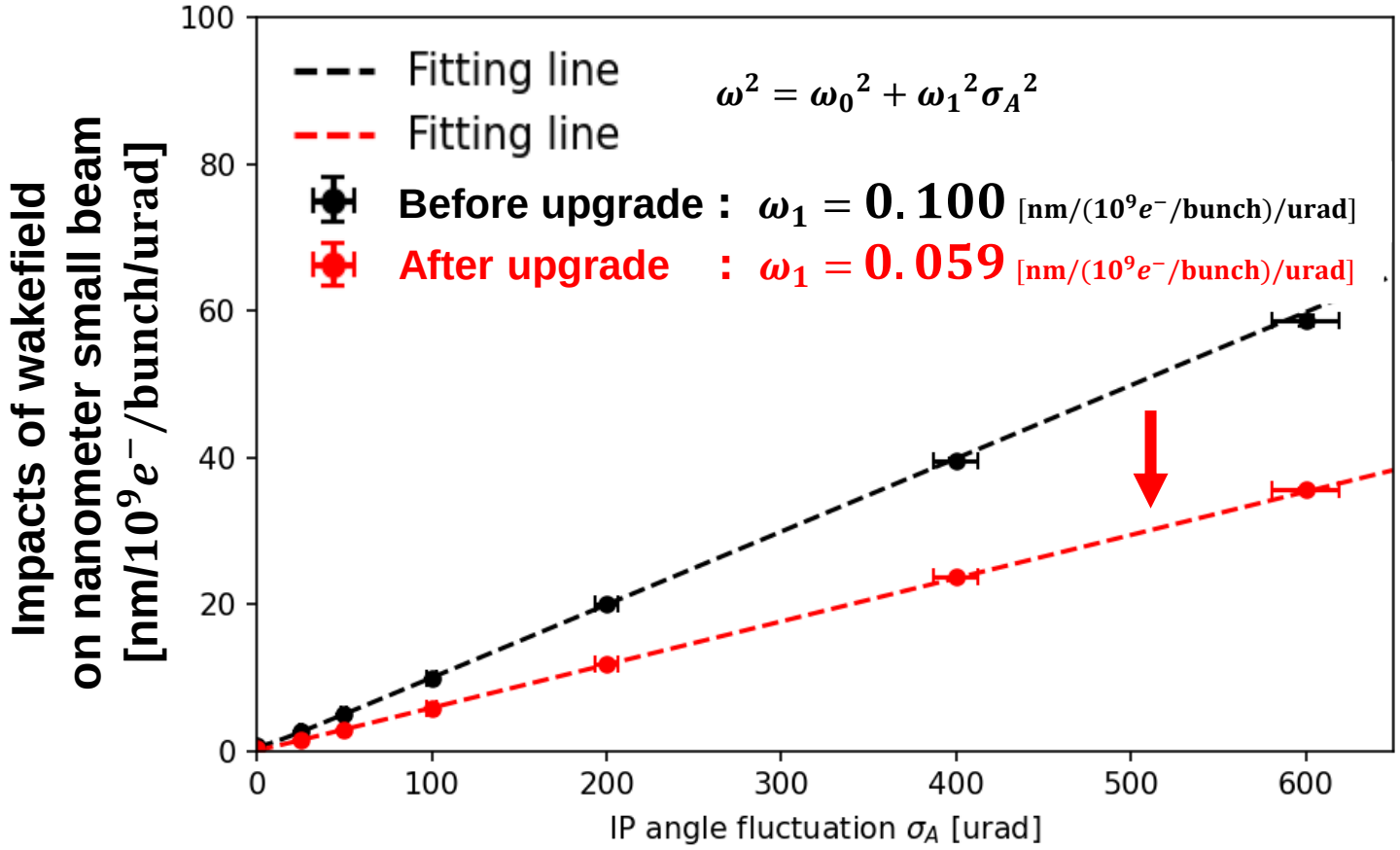
Estimated static wakefield effects caused by misalignment of wakefield sources or orbit distortion



- ✓ Reduced wakefield effects of **vacuum flanges (ICF70, ICF114)**
- ✓ Possible reduced wakefield effects of **collimator** to adjust its vertical position
- ✓ Remained wakefield source：CBPM, Vacuum components in EXT

Wakefield effects on nanometer small beam

Tracking simulation result wakefield effects caused by orbit fluctuation



- **Approx. 40% reduction in wakefield effects on the nanometer-scale beam expected after the bemline upgrade** (Undergoing the experimental evaluation)
- **Remaining major wakefield source :** CBPM, Vacuum components in EXT

Summary

- **Upgraded vacuum components identified as major wakefield sources**
- **Simulations predict ≃40% reduction of the wakefield effects on the beam**
- **Remaining sources: CBPMs, vacuum components in EXT (collimator)**

The details of this study at MOPO003
Welcome the questions and discussions!!