Beam coupling impedance from polarimeter

T. Ishibashi, Aurélien Martens, and D. Zhou

Acknowledgements

M. Roney

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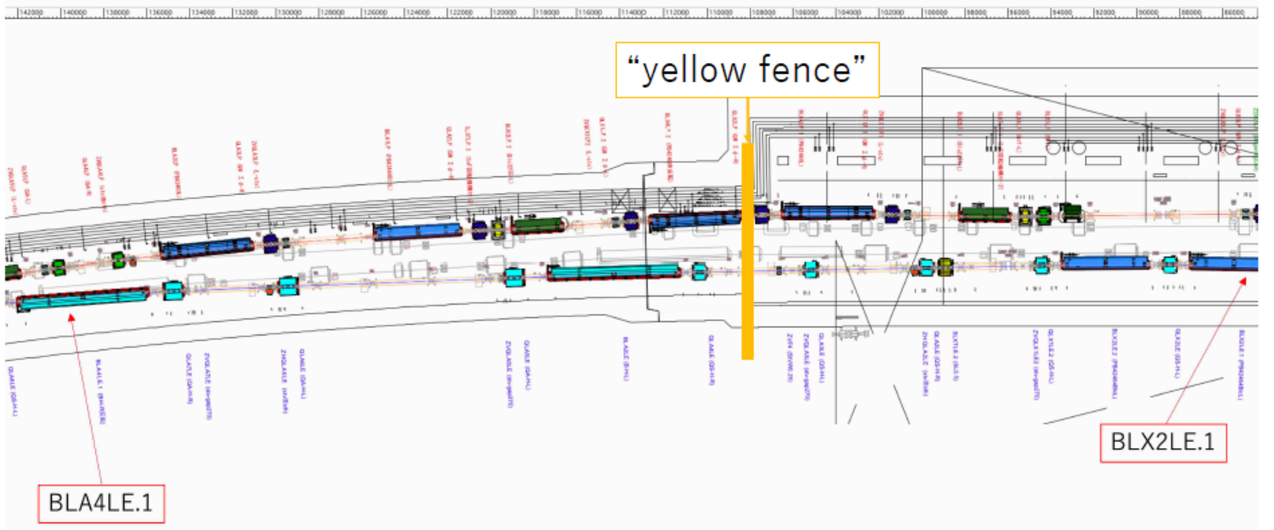
Introduction

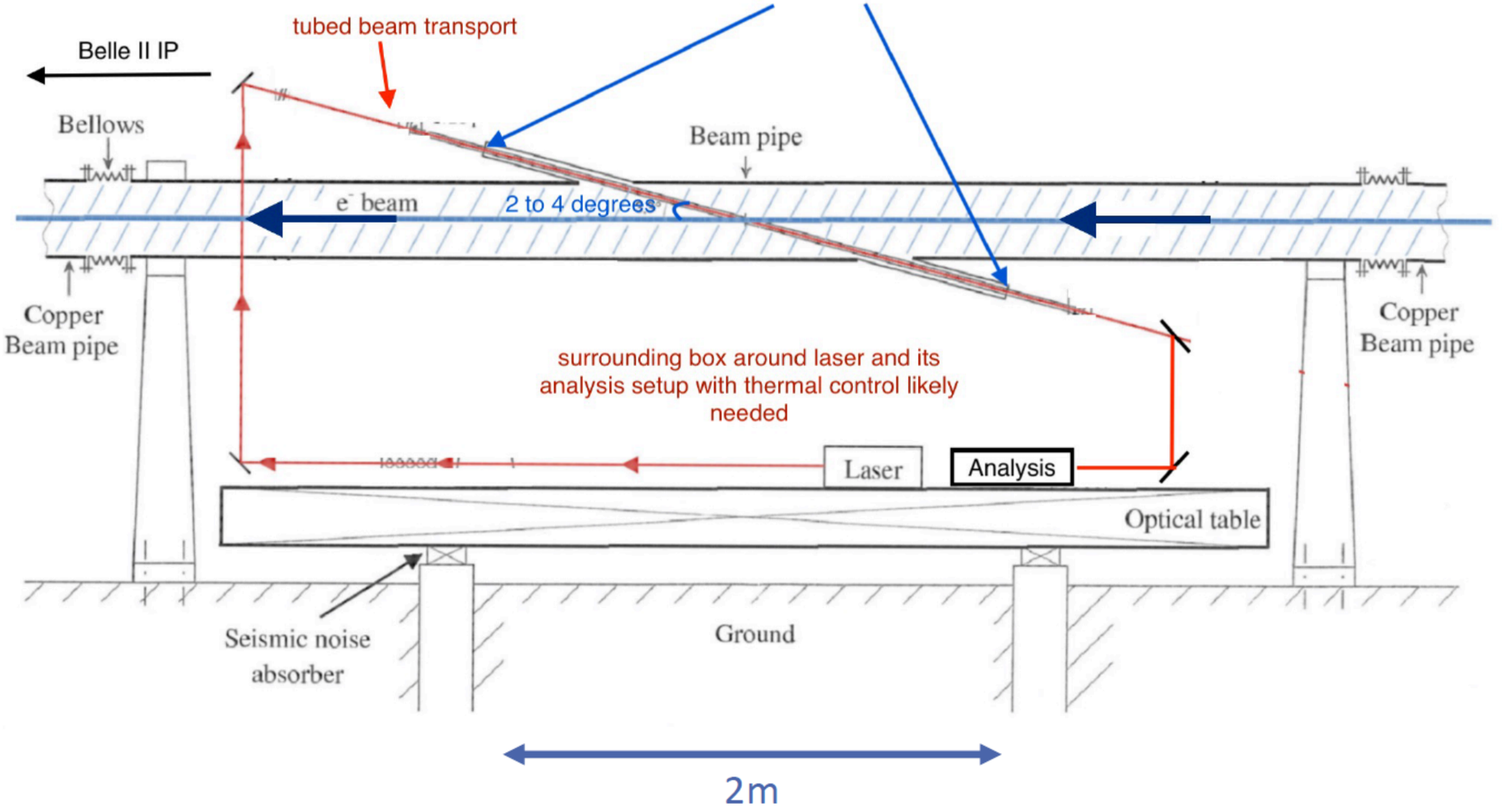
- We need to integrate three elements in the ring in between BLA4LE.1 and BLA2LE
  - « laser chamber » at interaction point with electron beam
  - « gamma-ray window » for gamma-ray measurement
  - « electron detector » to measure scaterred and deflected electrons away from the main e-beam



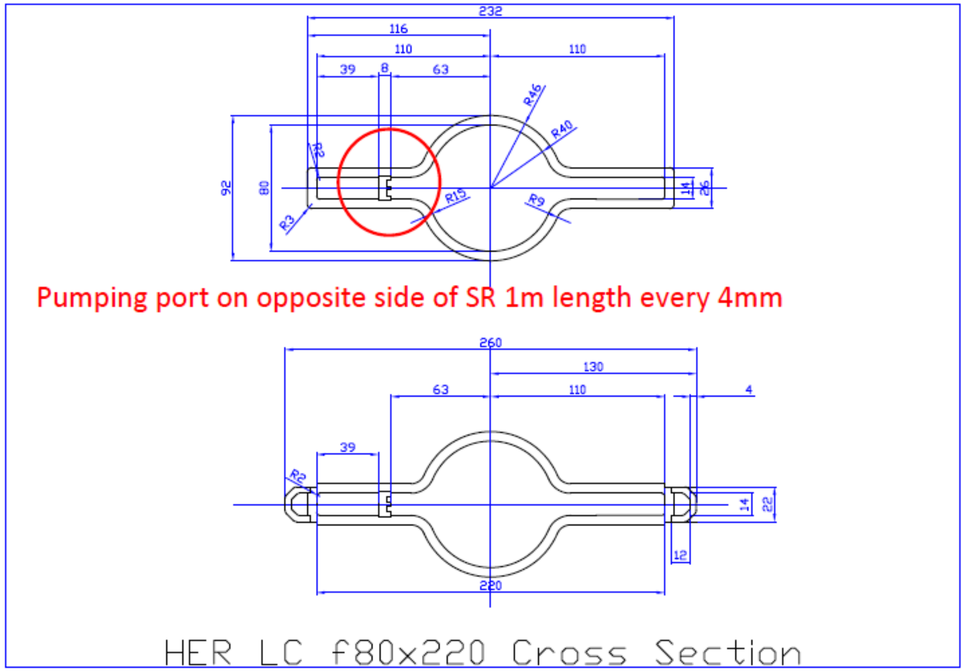
Beam pipe for interaction chamber

Fused silica ?
10mm diameter ?
optical windows

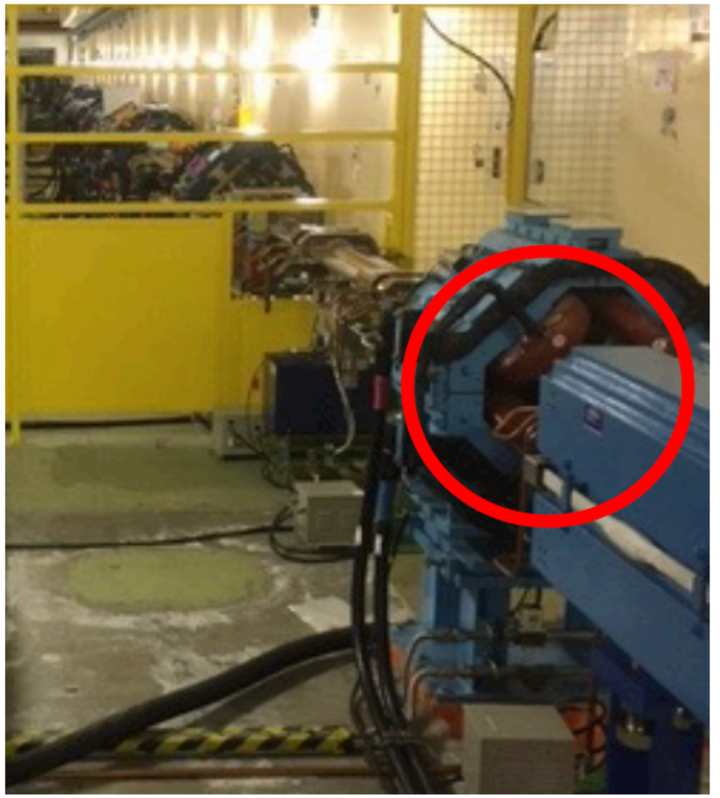
Assumed vertical crossing.



Gamma-beam detector



Magnet modifications are required to let gamma beam go through…



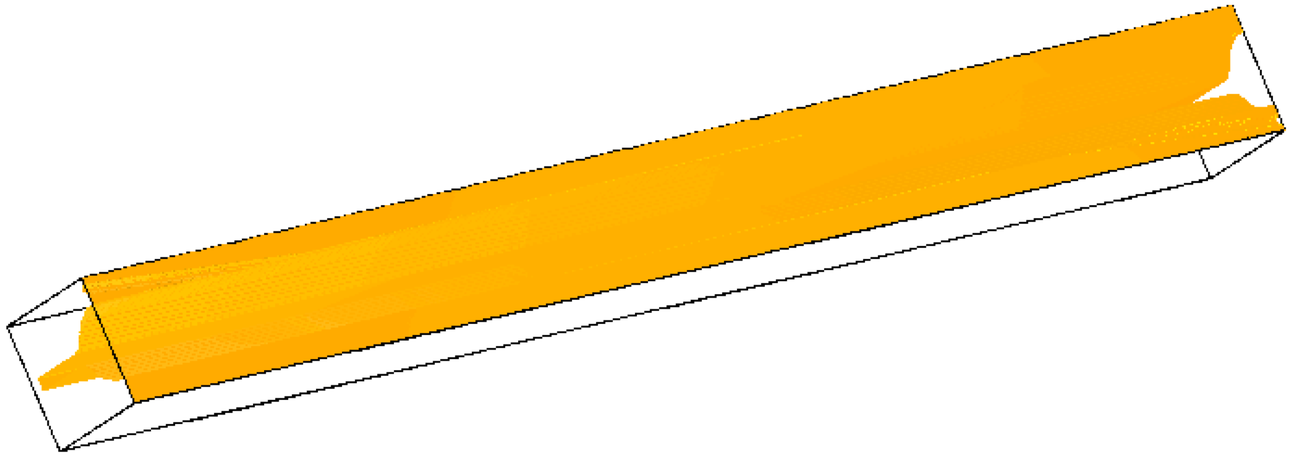
Need to have a ~25mm diameter window to let the gamma beam go through on one side (assumed compton IP 12m upstream)

→ Size can be reduced by reducing distance to compton IP

→ Material and thickness to be discussed

Preliminary results of impedance calculation

- Impedance calculation by T. Ishibashi
  - Code: GdfidL (http://www.gdfidl.de/).
  - Diameter of windows is 10 mm, the angle to the beam traveling axis is 4 deg.
  - Is the model close to polarimeter configuration?
  - The long tubes with 10 mm diameter are not modeled, but we expect no much impedance from them.



Preliminary results of impedance calculation

- Impedance calculation by T. Ishibashi
  - Longitudinal wake with 6 mm Gaussian bunch is very weak.
  - The calculated loss factor, resistance and inductance are 4.4e-5 V/pC, 3.1e-3 Ohm, and 8.0e-4 nH, respectively.
  - Comparing with Table 1 of Ref. [1], these values are very small.

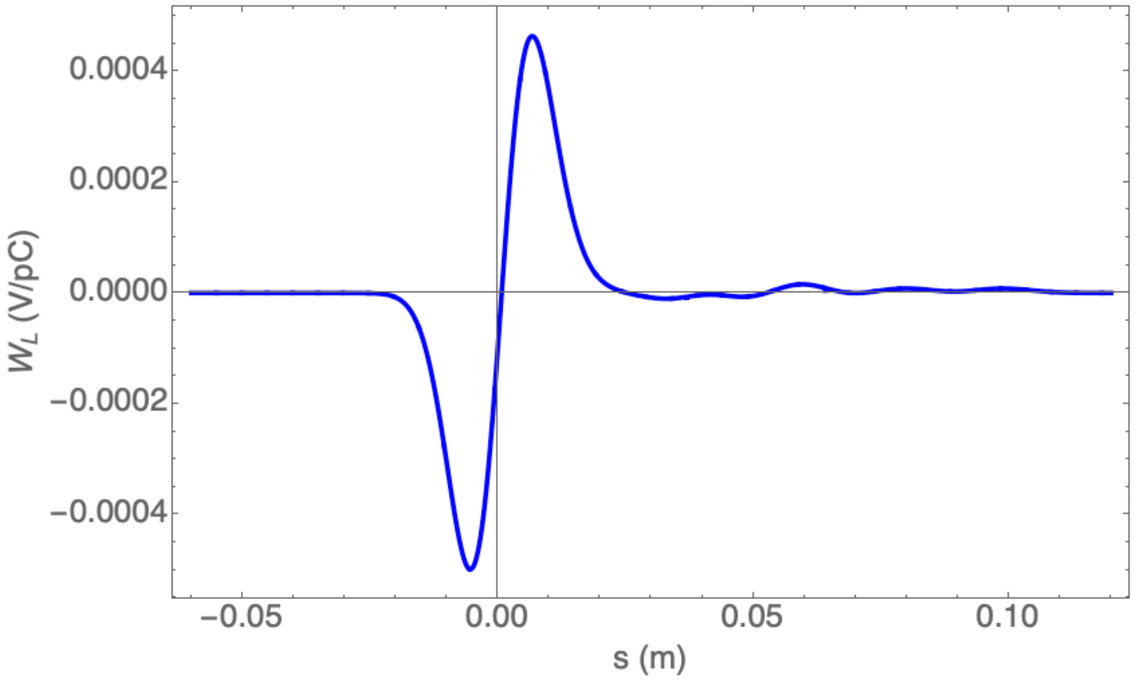


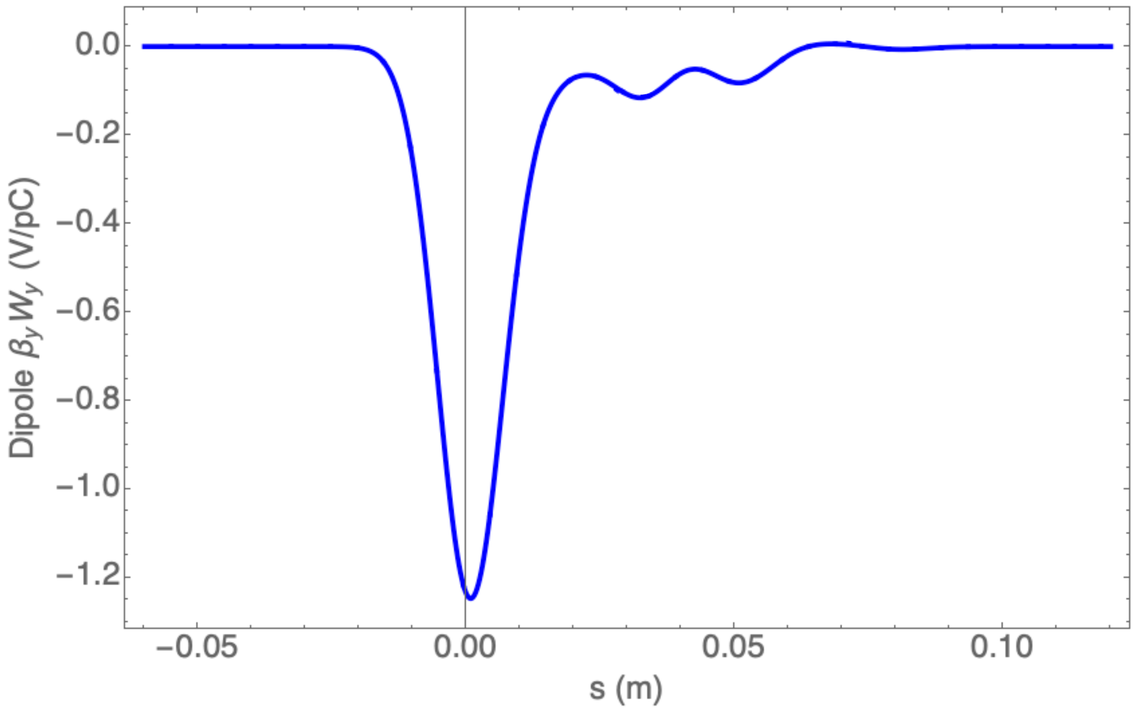
Table 1: Impedance budget for the SuperKEKB main rings. Summarised are the contributions to the loss factor $k_{||}$ [V/pC], the fitted resistance R [Ω] and inductance L [nH] for each type of components. The resistances and inductances are calculated at the nominal bunch lengths of σ_z=5 and 4.9 mm for LER and HER, respectively.

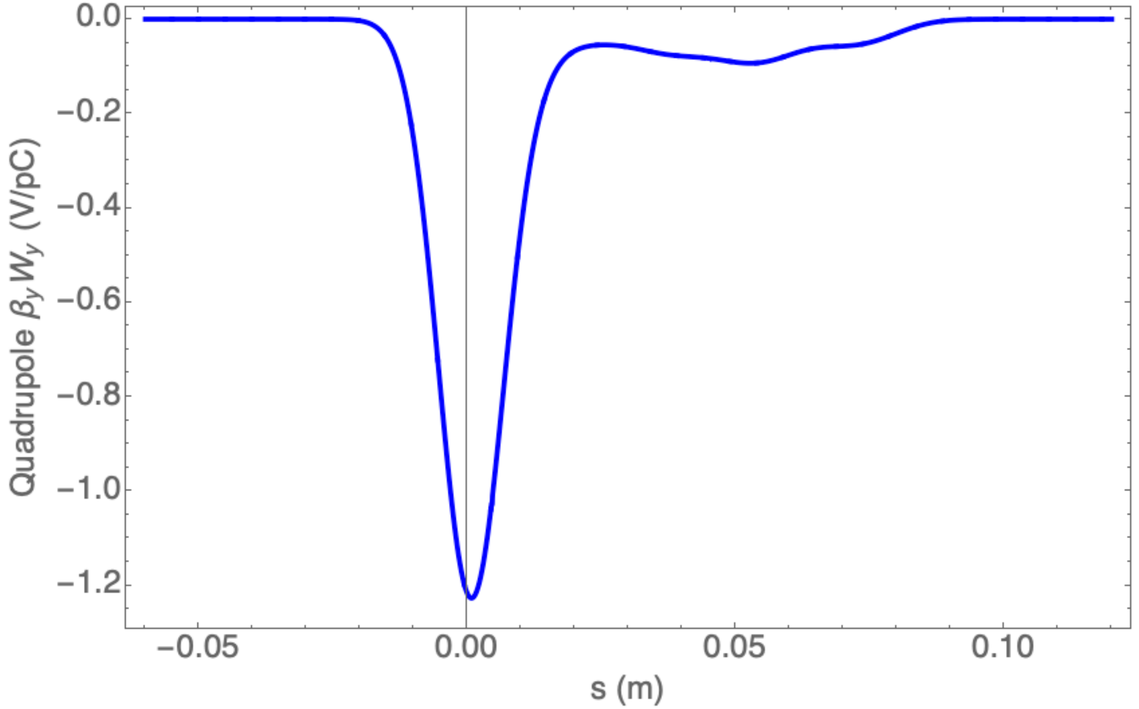
Component	LER			HER		
	$k_{\|\|}$	R	L	$k_{\|\|}$	R	L
ARES cavity	8.9	524	-	3.3	190	-
SC cavity	-	-	-	7.8	454	-
Collimator	1.1	62.4	13.0	5.3	309	10.8
Res. wall	3.9	231	5.7	5.9	340	8.2
Bellows	2.7	159	5.1	4.6	265	16.0
Flange	0.2	13.7	4.1	0.6	34.1	19.3
Pump. port	0.0	0.0	0.0	0.6	34.1	6.6
SR mask	0.0	0.0	0.0	0.4	21.4	0.7
IR duct	0.0	2.2	0.5	0.0	2.2	0.5
BPM	0.1	8.2	0.6	0.0	0.0	0.0
FB kicker	0.4	26.3	0.0	0.5	26.2	0.0
FB BPM	0.0	1.1	0.0	0.0	1.1	0.0
Long. kicker	1.8	105	1.2	-	-	-
Groove pipe	0.1	3.8	0.5	-	-	-
Electrode	0.0	0.7	5.7	-	-	-
Total	19.2	1137	36.4	29.0	1677	62.1

[1] D. Zhou et al., Impedance calculation and simulation of microwave instability for the main rings of SuperKEKB, in Proceedings of IPAC'14, Dresden, Germany.

Preliminary results of impedance calculation

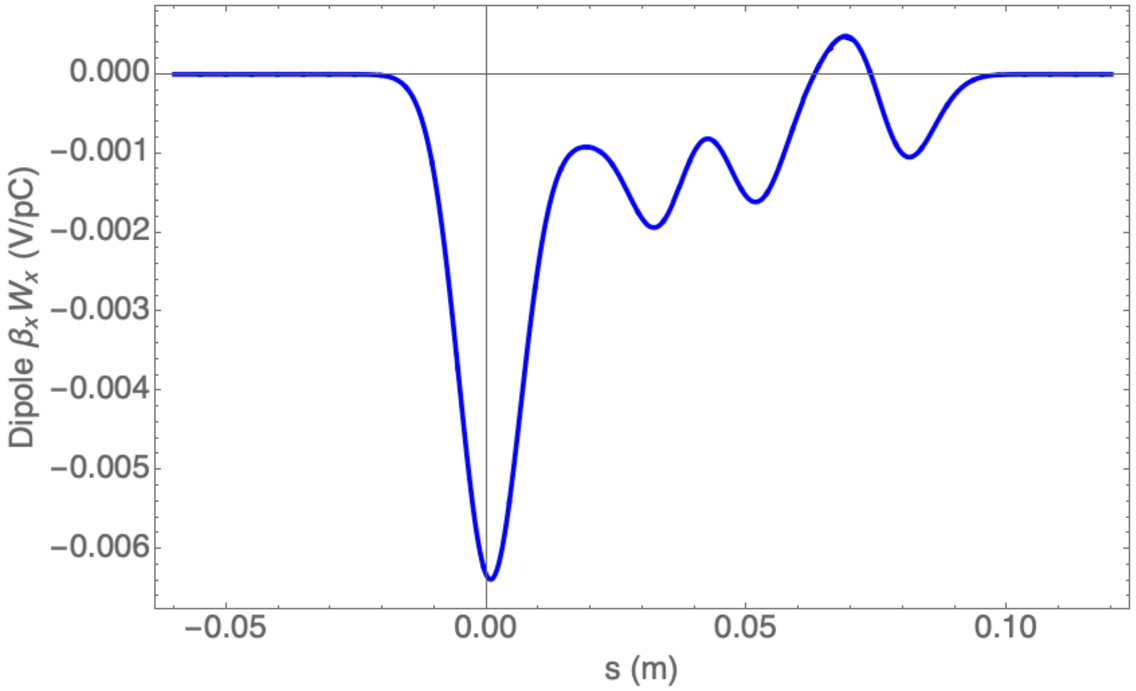
- Impedance calculation by T. Ishibashi
  - Vertical dipole and quadrupole wakes with 6 mm Gaussian bunch are weak.
  - The dipole and quadrupole kick factors weighted by beta function β_y=100 m are $\beta_y\kappa_y$=-0.89 V/pC and -0.88 V/pC, respectively. These values are very small, concerning the total $\beta_y\kappa_y$ of HER in the order of 10^4 V/pC.

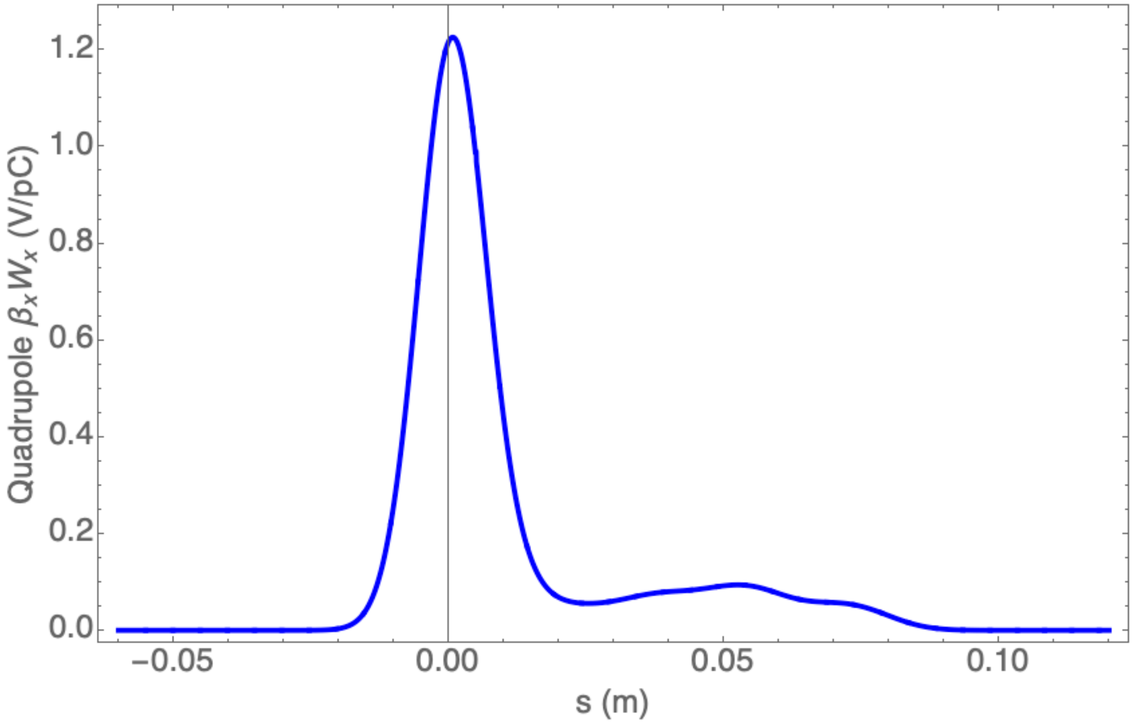




Preliminary results of impedance calculation

- Impedance calculation by T. Ishibashi
  - Horizontal dipole and quadrupole wakes with 6 mm Gaussian bunch are weak.
  - The dipole and quadrupole kick factors weighted by beta function β_x=100 m are $\beta_x\kappa_x$=-4.6e-3 V/pC and +0.88 V/pC, respectively. These values are very small, concerning the total $\beta_x\kappa_x$of HER in the order of 10^4 V/pC.





Conclusion

- The preliminary results showed that the impedance from gamma-ray window is quite small and should have very weak effect on beam instability.
- When more detailed engineering design is available, the impedance calculation and evaluation of impedance effects can be updated.