

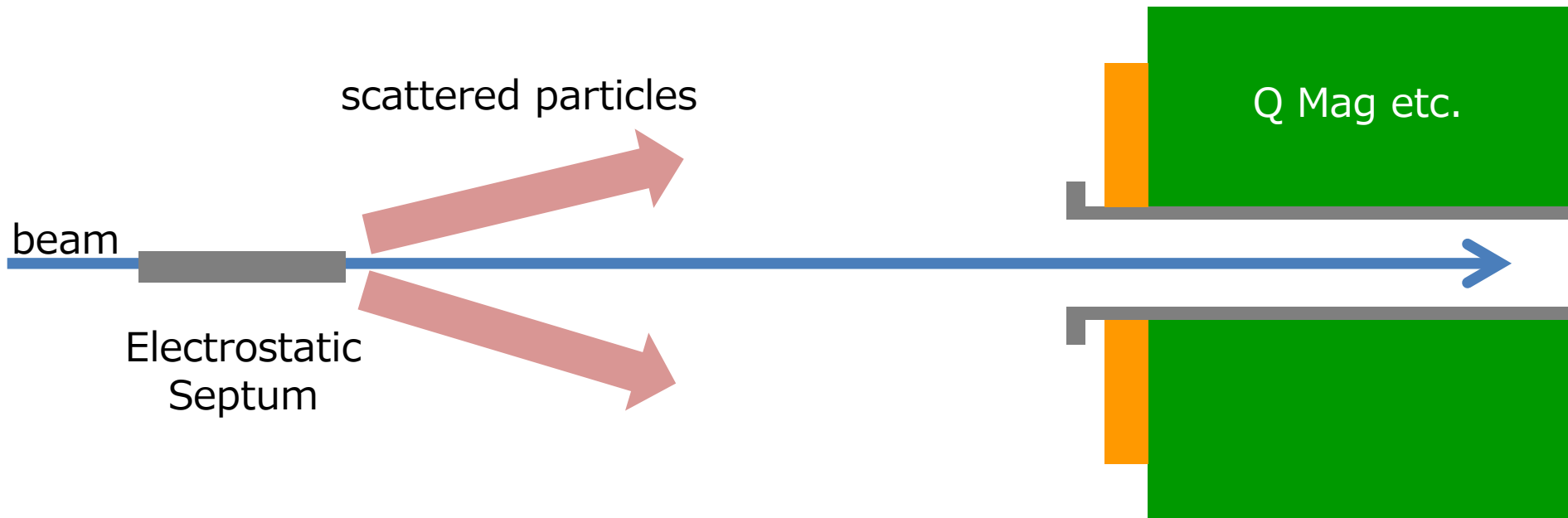
Loss Collimation at J-PARC MR Slow Extraction

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KEK / J-PARC

Slow Extraction Workshop 2017
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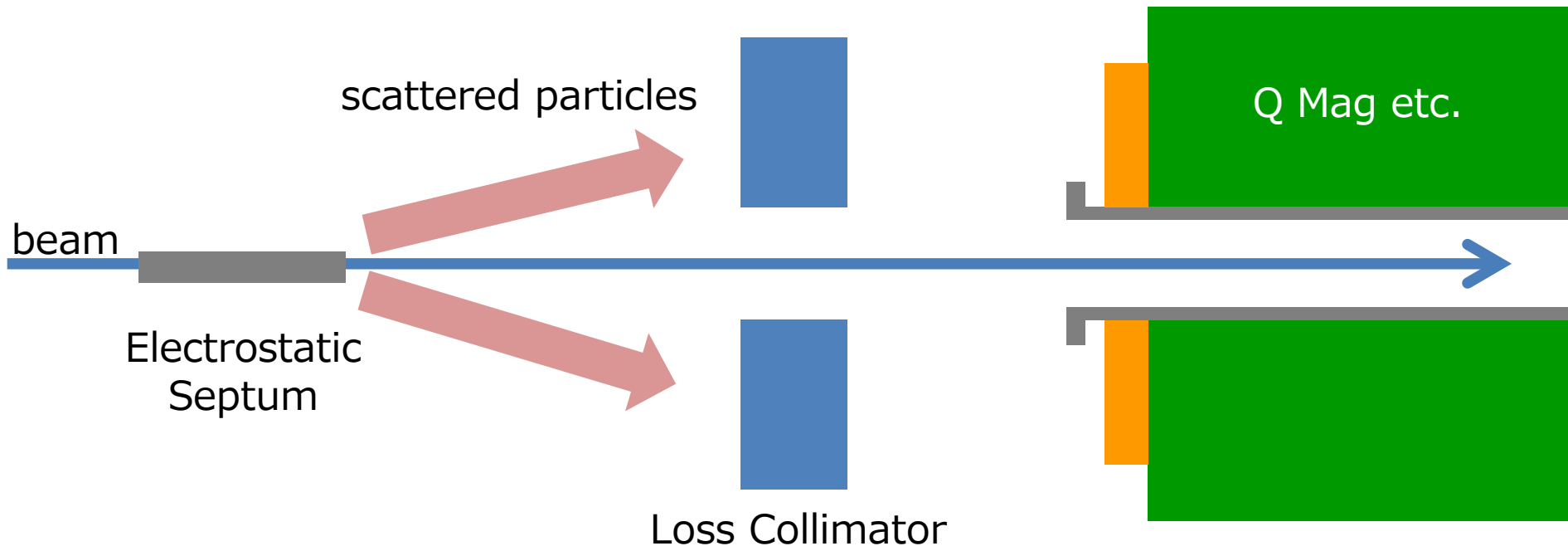
Loss Collimator

- The particles scattered by the electrostatic septum(ESS) cause high radioactivity at the downstream components such as Q magnets, steering magnets and beam monitors.



Loss Collimator

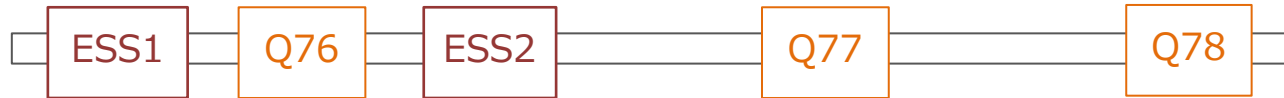
- The particles scattered by the electrostatic septum(ESS) cause high radioactivity at the downstream components such as Q magnets, steering magnets and beam monitors.
- The purpose of the “Loss Collimator” is to absorb the scattered particles and reduce the activation at the downstream of ESS.



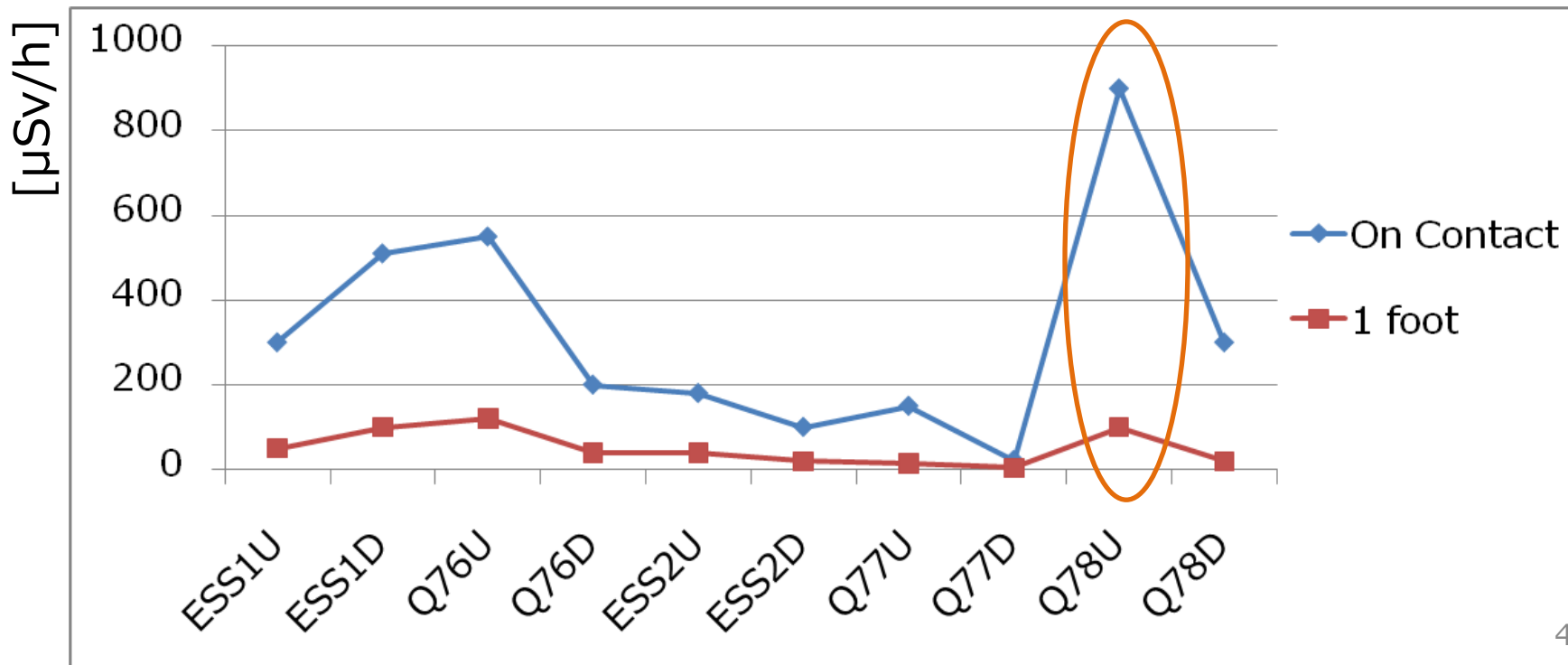
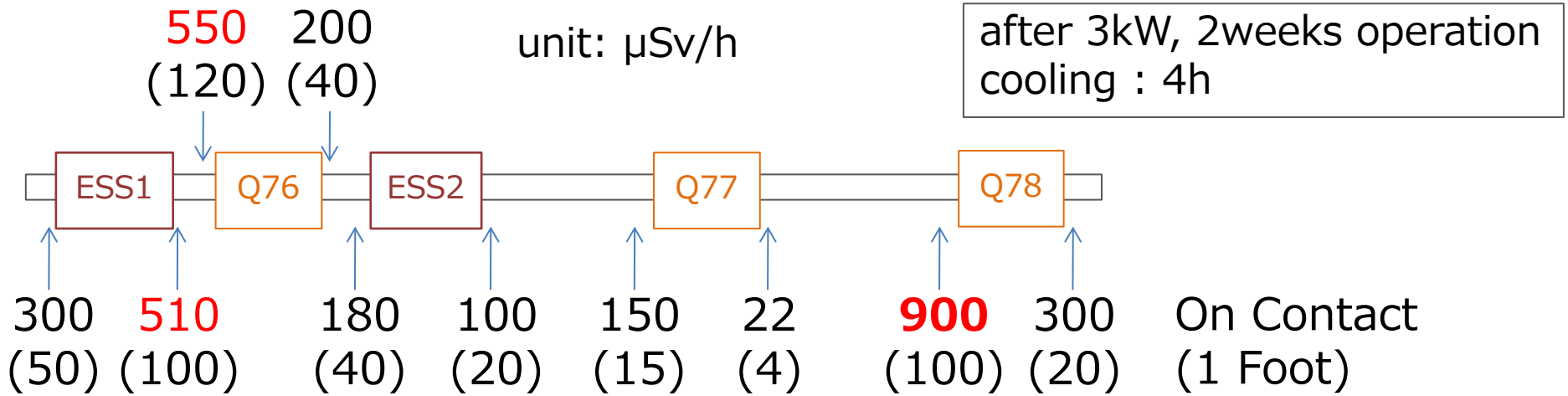
Contents

- Residual Dose of SE Section of J-PARC MR Before Installing the Loss Collimator
- Design of the Collimator
- Effect of the Collimator on the Residual Dose

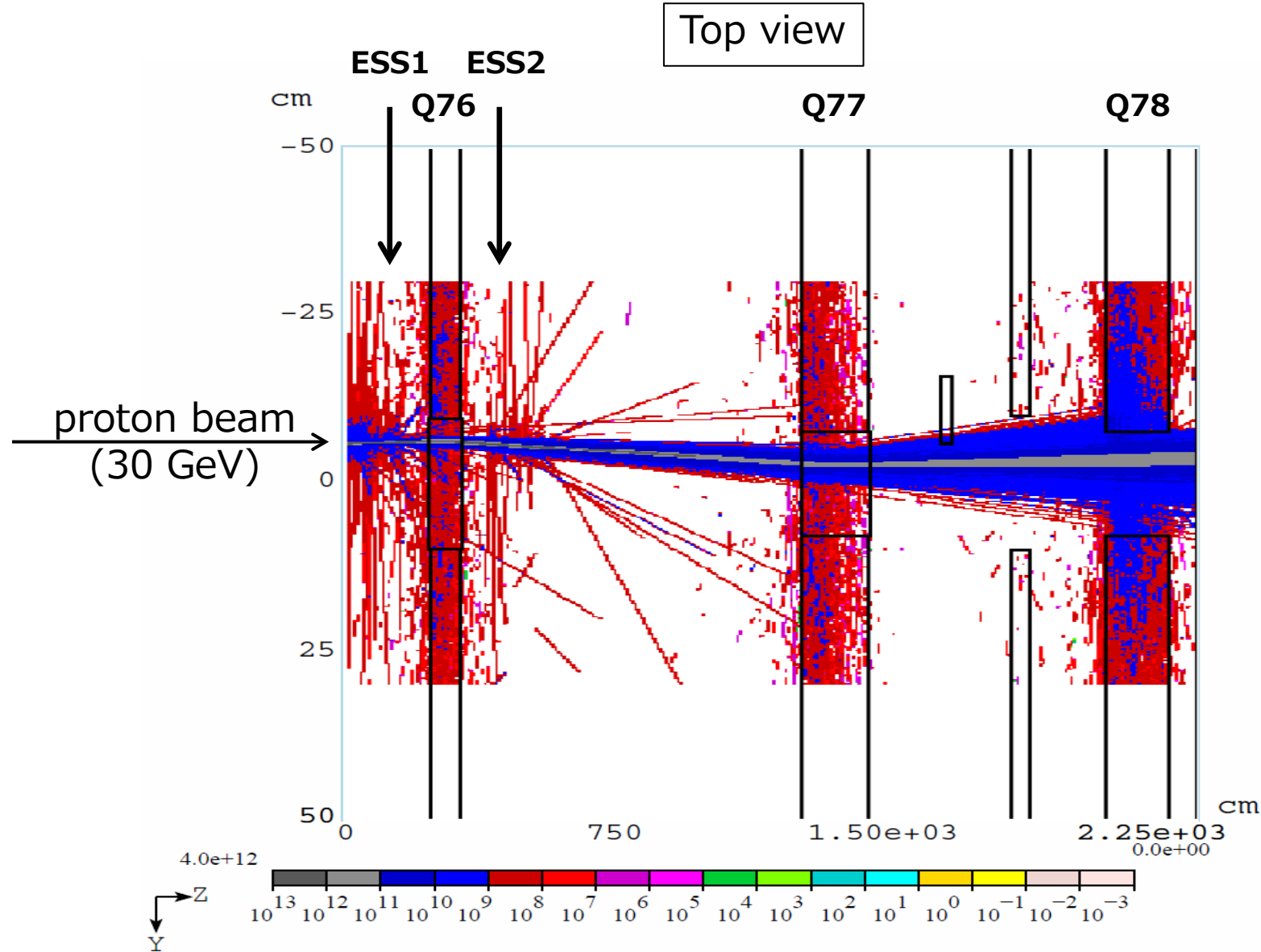
Residual Dose around ESS w/o Collimator



Residual Dose around ESS w/o Collimator



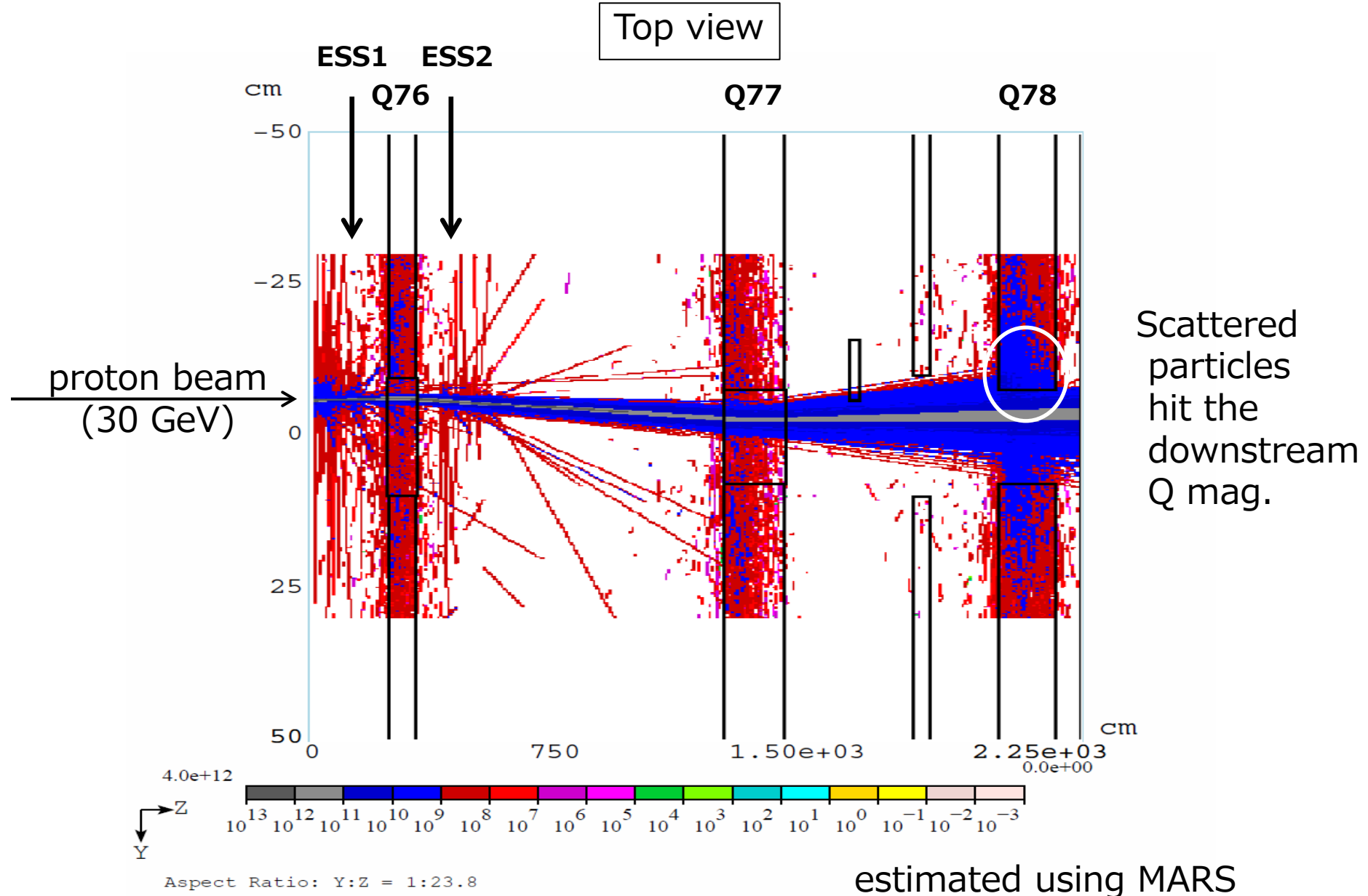
Why is the residual dose at Q78 high?



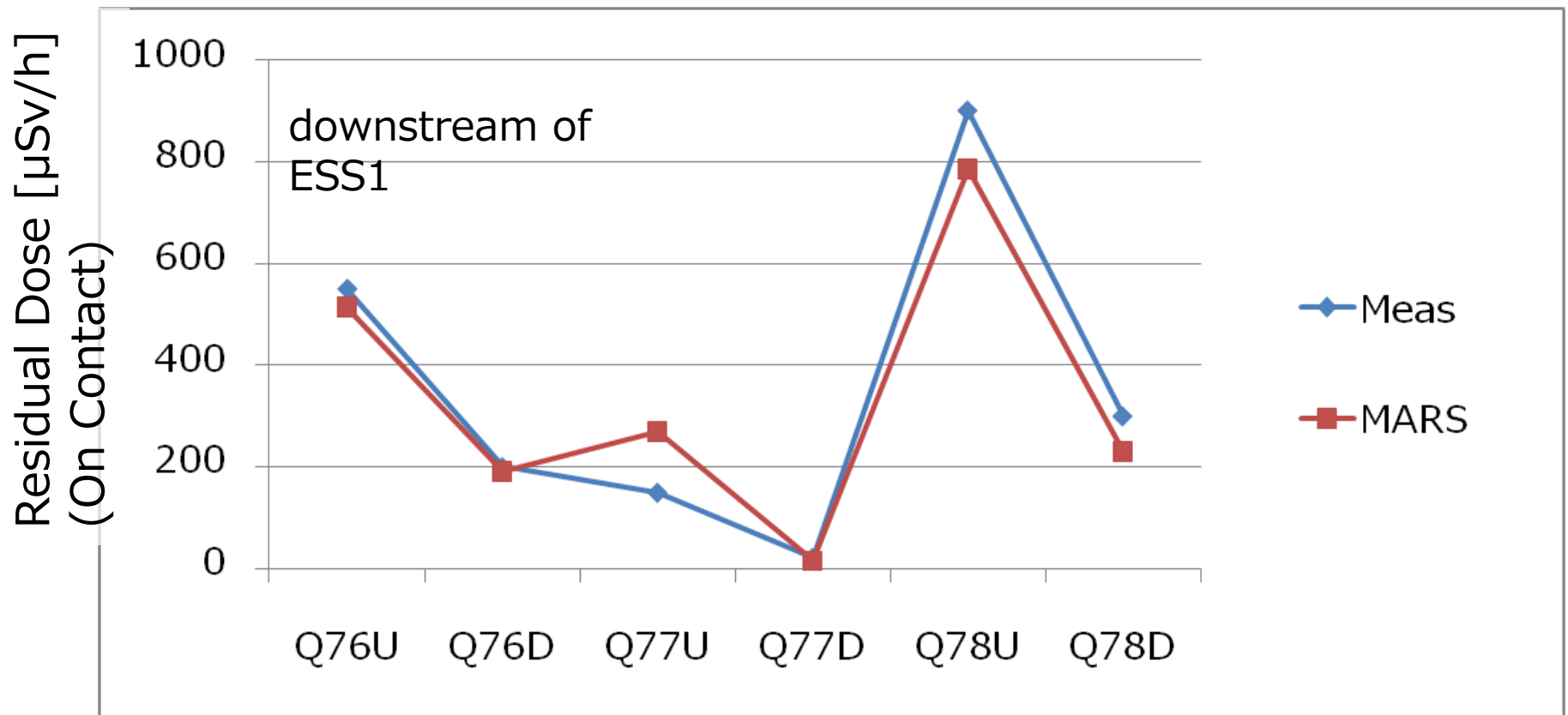
Aspect Ratio: Y:Z = 1:23.8

estimated using MARS

Why is the residual dose at Q78 high?

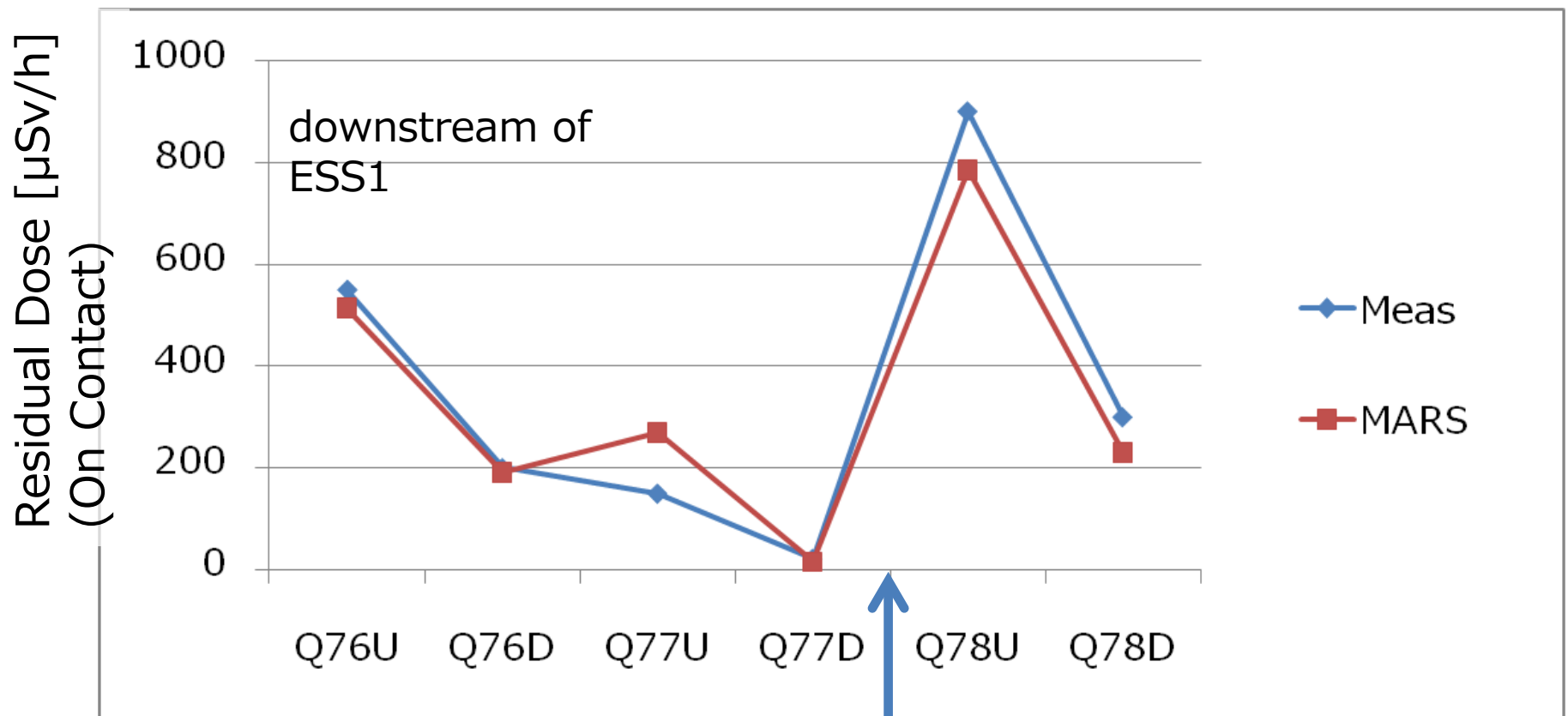


Estimation of Residual Dose using MARS



Measurements are well reproduced by MARS calculation.

Estimation of Residual Dose using MARS

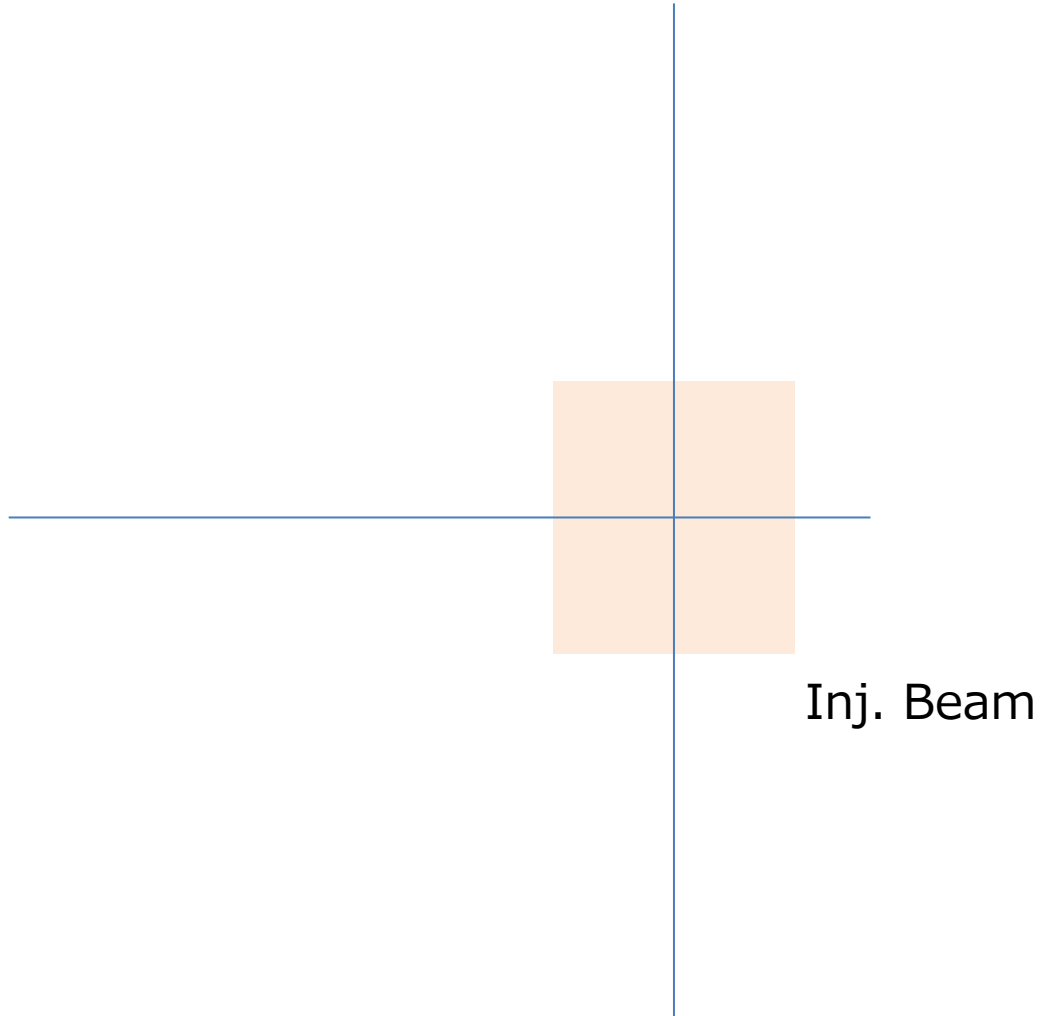


Measurements are well reproduced by MARS calculation.

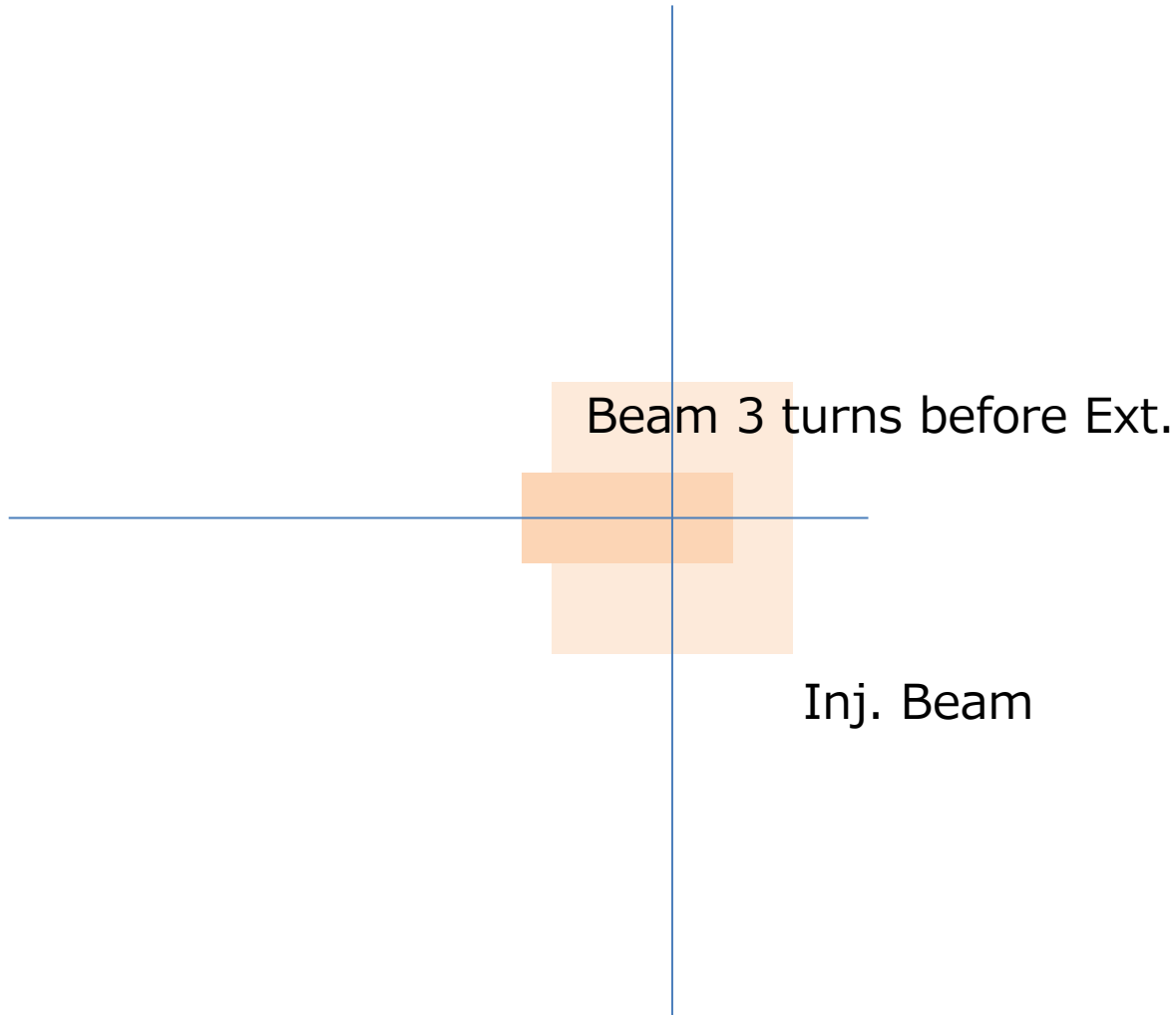
Loss Collimator

To reduce the residual dose on Q78,
a loss collimator was placed between Q77 and Q78.

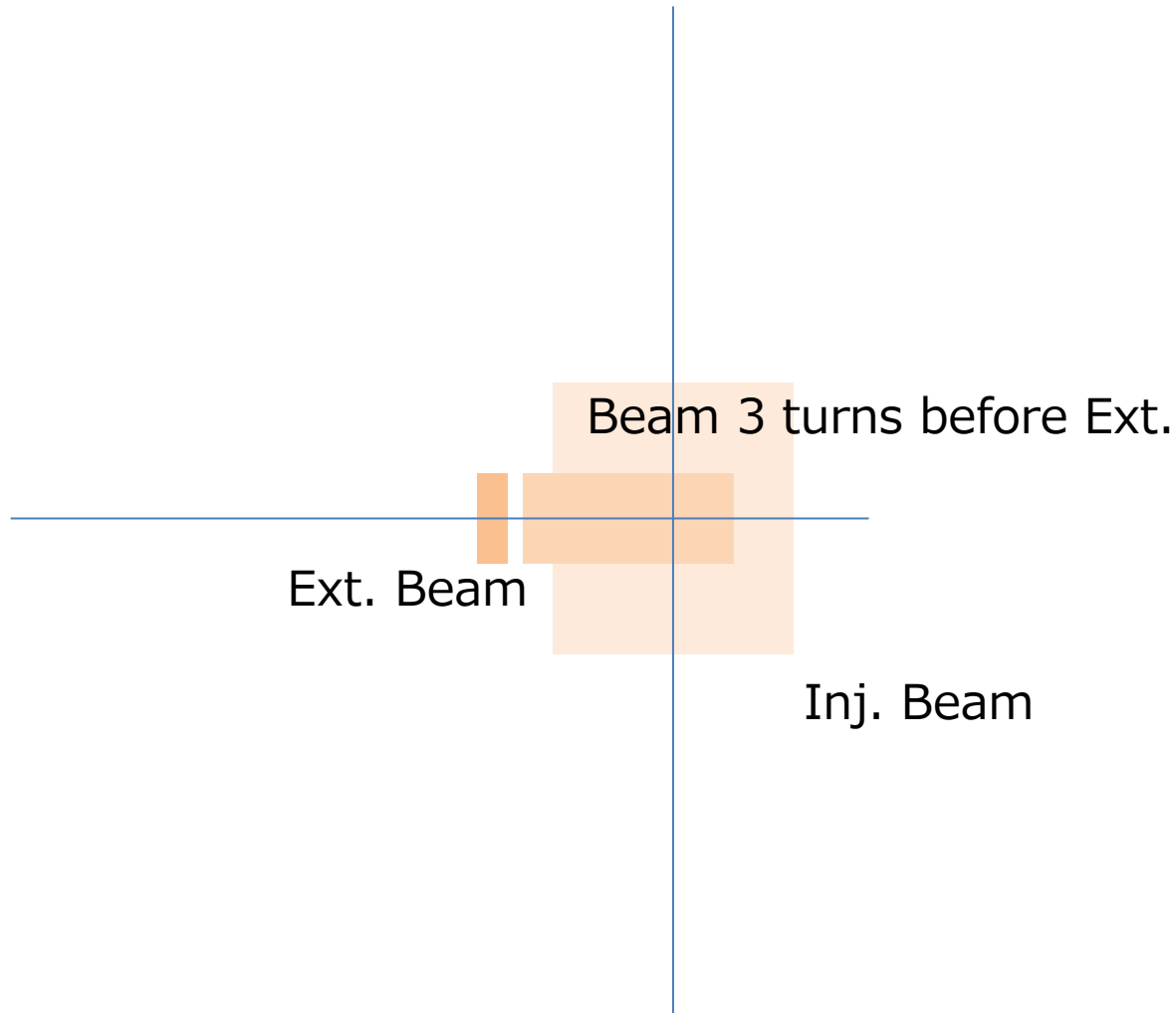
Shape and Material of Col.



Shape and Material of Col.



Shape and Material of Col.



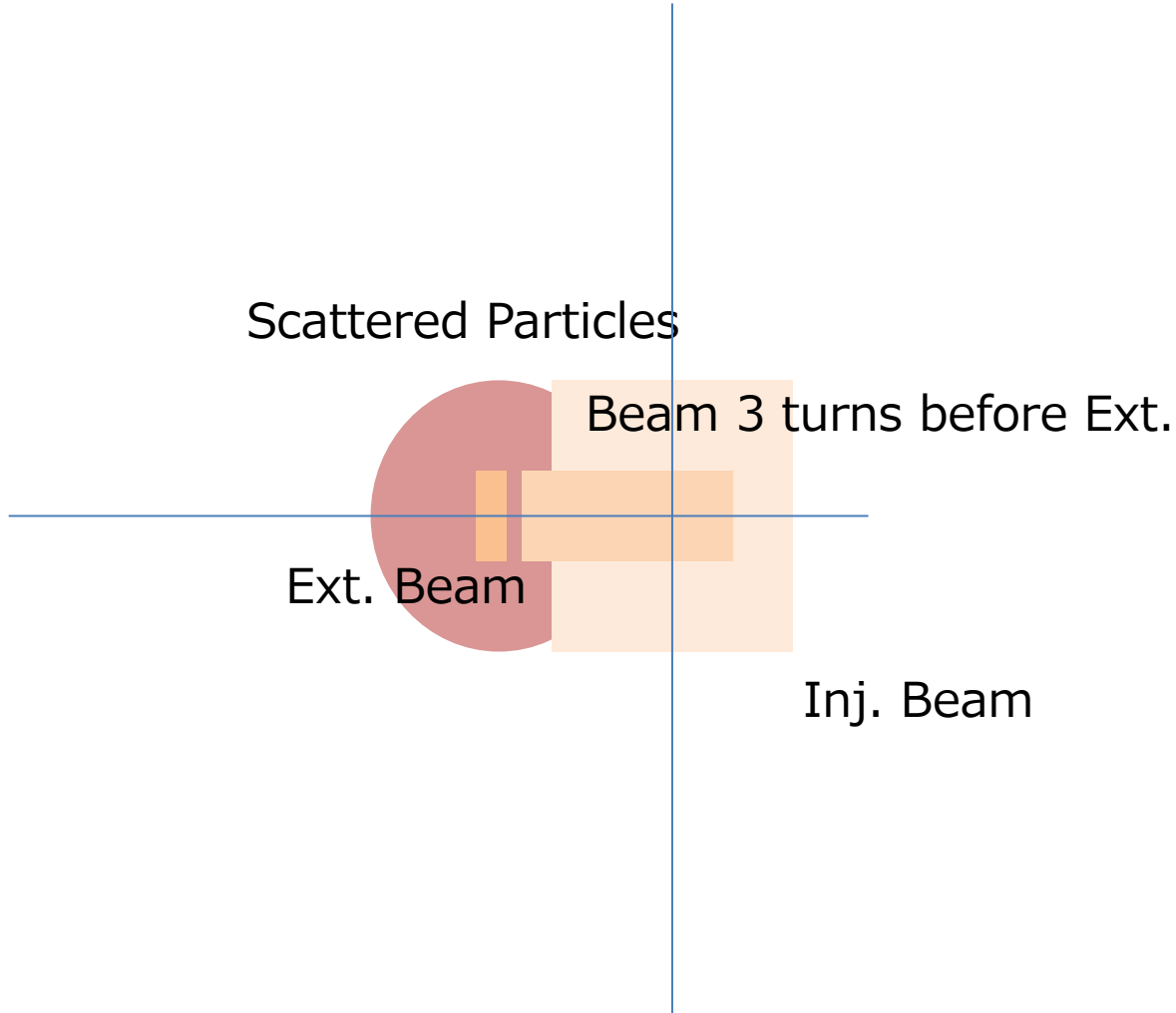
Shape and Material of Col.

Scattered Particles

Beam 3 turns before Ext.

Ext. Beam

Inj. Beam



Shape and Material of Col.

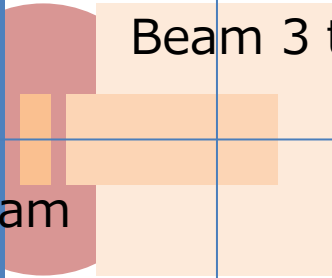
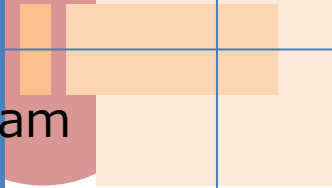
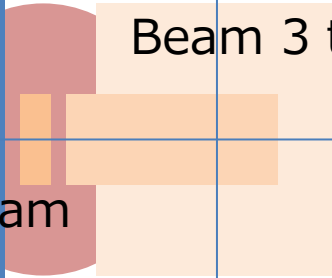
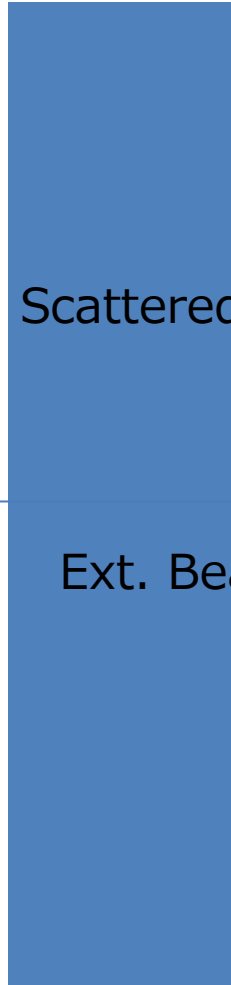
H-Col

Scattered Particles

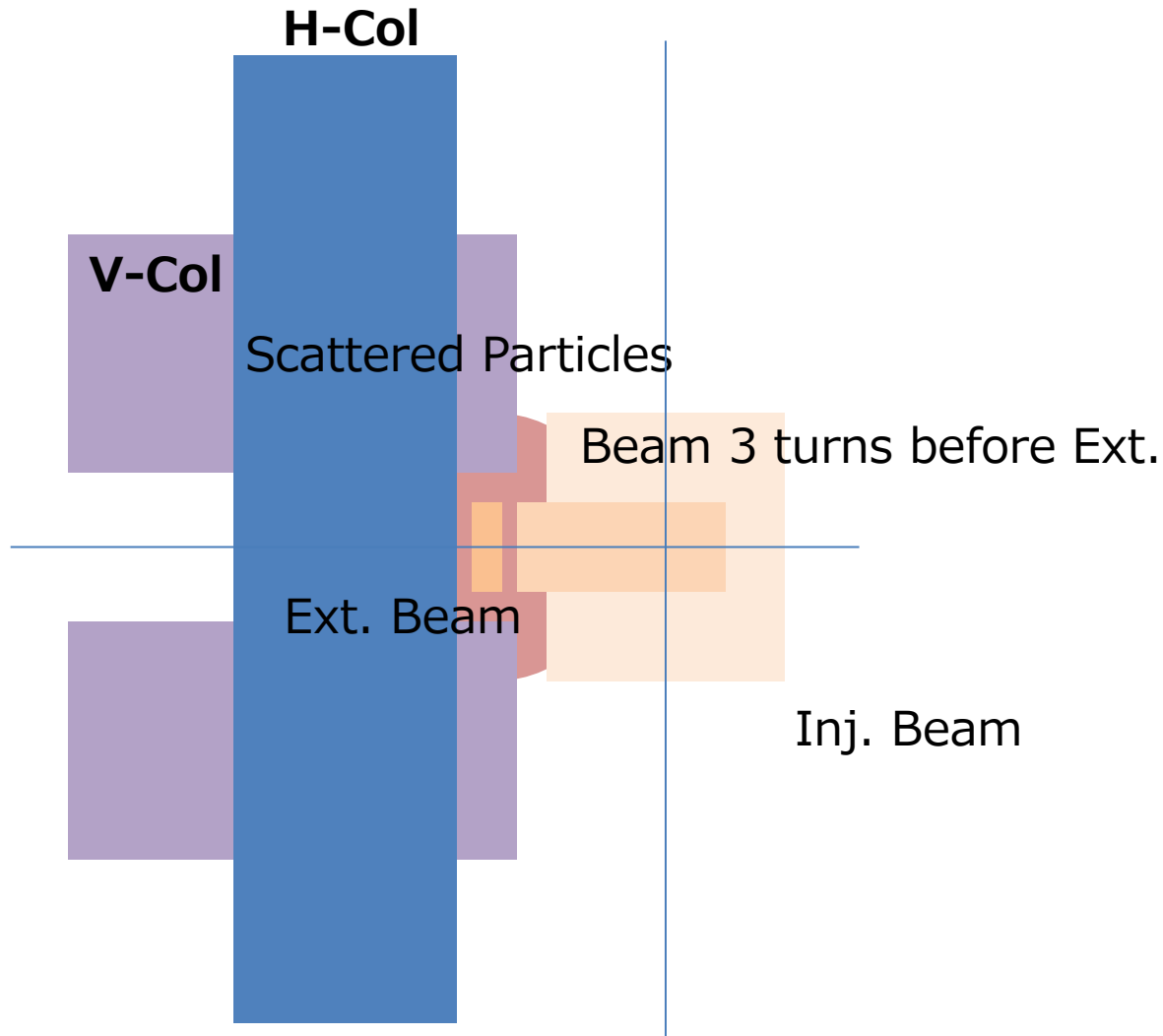
Beam 3 turns before Ext.

Ext. Beam

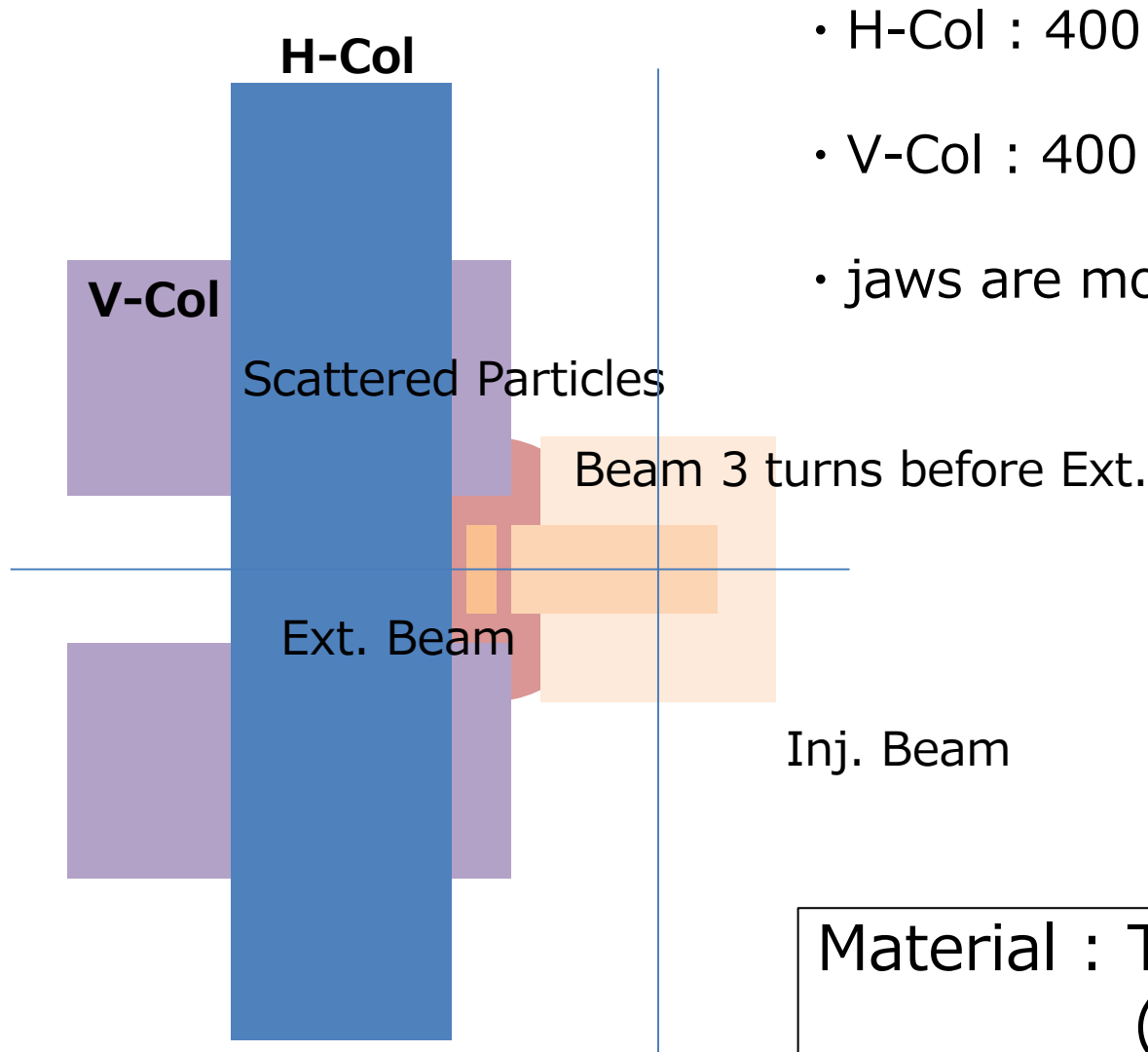
Inj. Beam



Shape and Material of Col.



Shape and Material of Col.



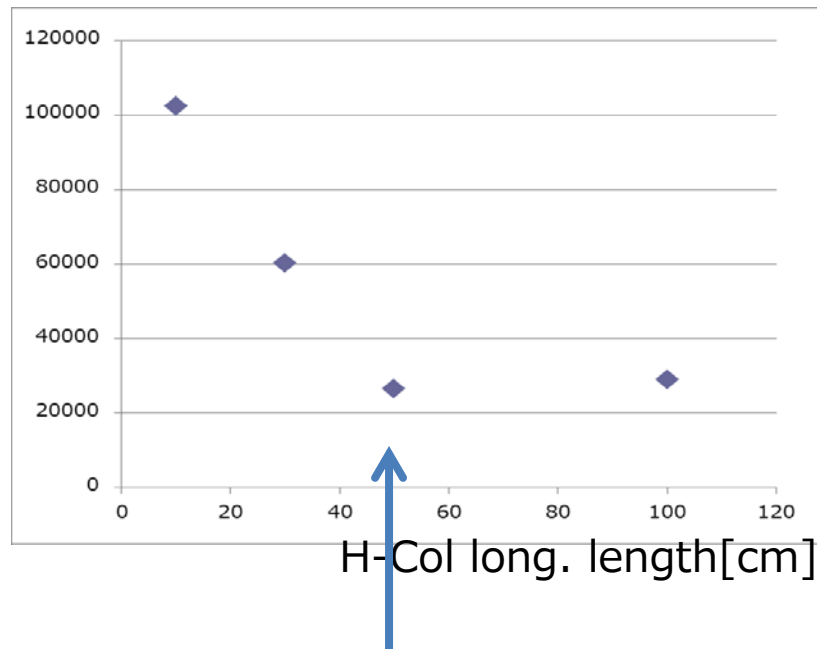
- H-Col : 400 x 250 x t60 [mm]
- V-Col : 400 x 120 x t60 [mm] x 2
- jaws are movable in ± 15 mm

Material : Tungsten Alloy
(W95%-Cu3%-Ni2%)
Density : 18g/cm³

Longitudinal Length of Collimator

H-Col only (No V-Col)

Res. Dose on Q78 (arbitrary unit)

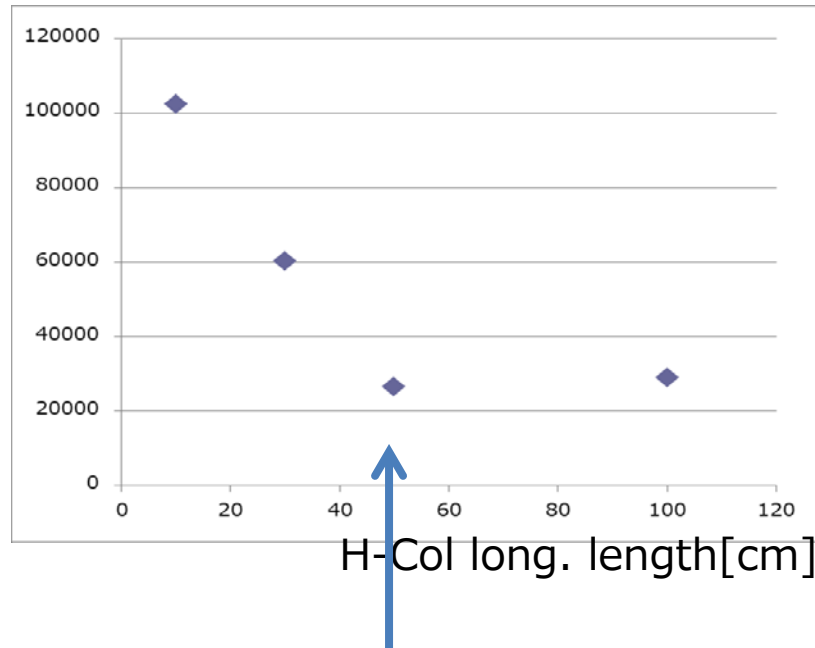


**Without V-col
H-Col should be longer than 50 cm**

Longitudinal Length of Collimator

H-Col only (No V-Col)

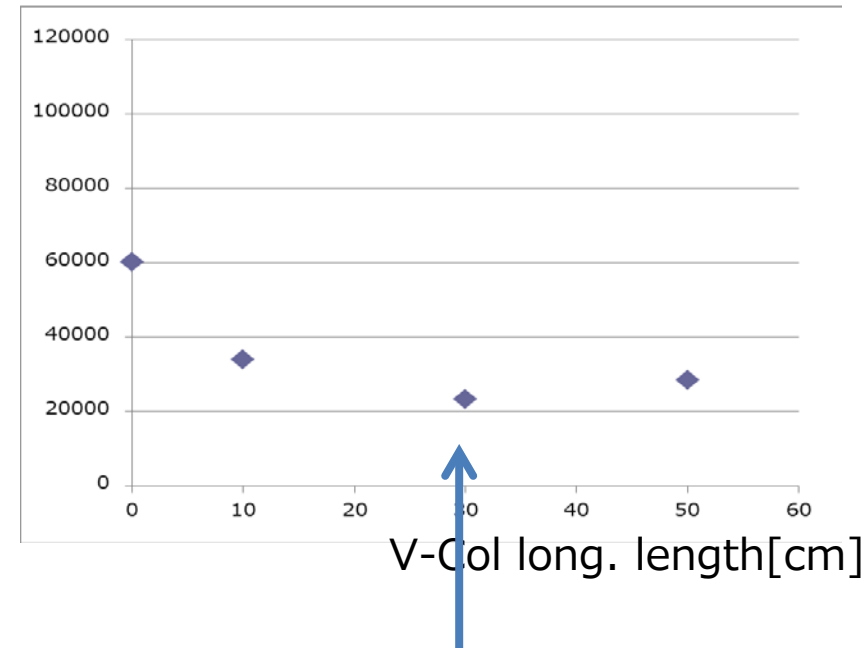
Res. Dose on Q78 (arbitrary unit)



**Without V-col
H-Col should be longer than 50 cm**

H-Col 30 cm + V-Col

Res. Dose on Q78 (arbitrary unit)



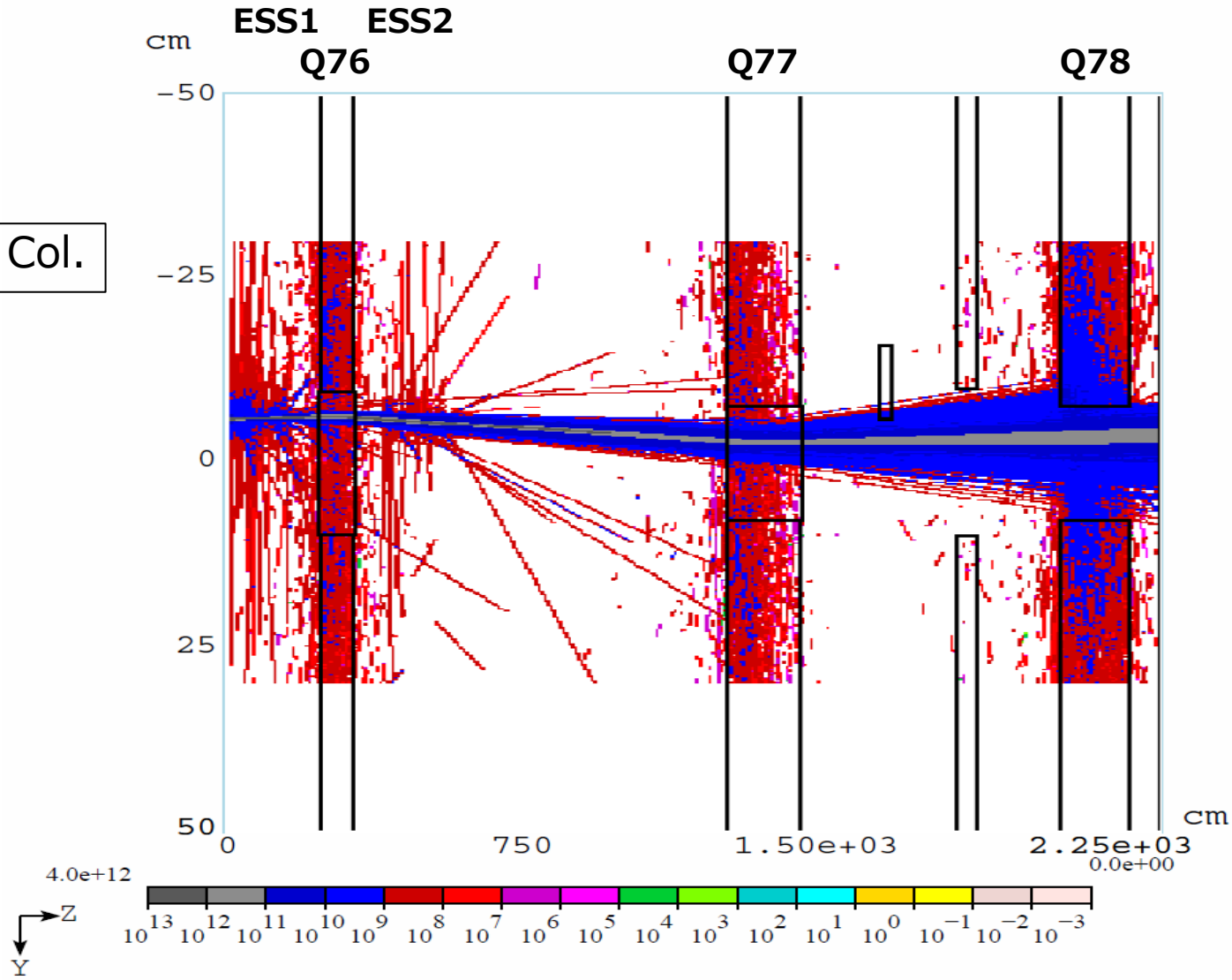
**H-Col 30cm + V-Col 30cm
is sufficient**

We chose H-Col 40cm + V-Col 40cm with margin.

Other dimensions and the position of the jaws are also determined by similar calculations.

Scattered Particle Distribution w/ Col.

w/o Col.

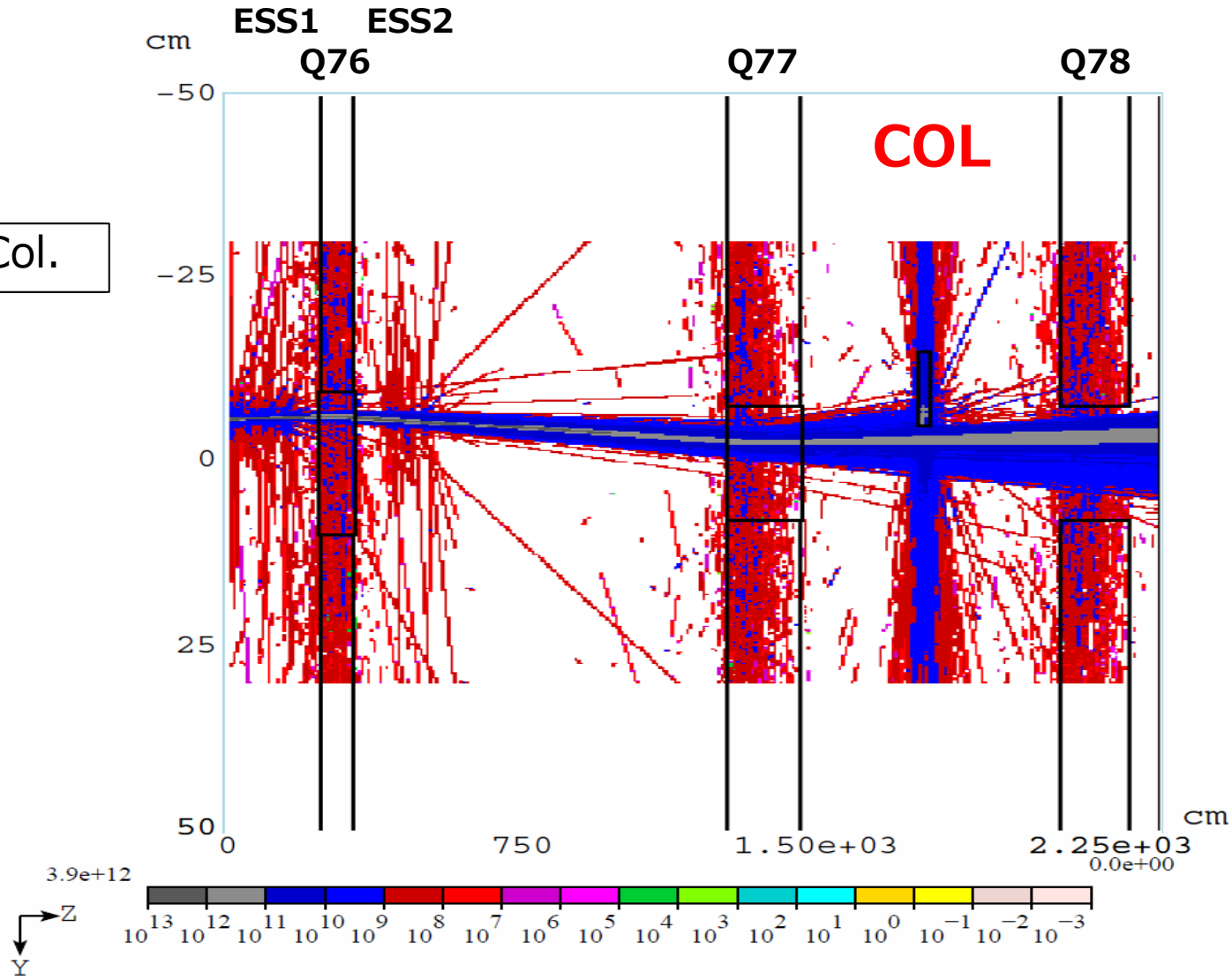


Aspect Ratio: Y:Z = 1:23.8

estimated using MARS

Scattered Particle Distribution w/ Col.

w/ Col.

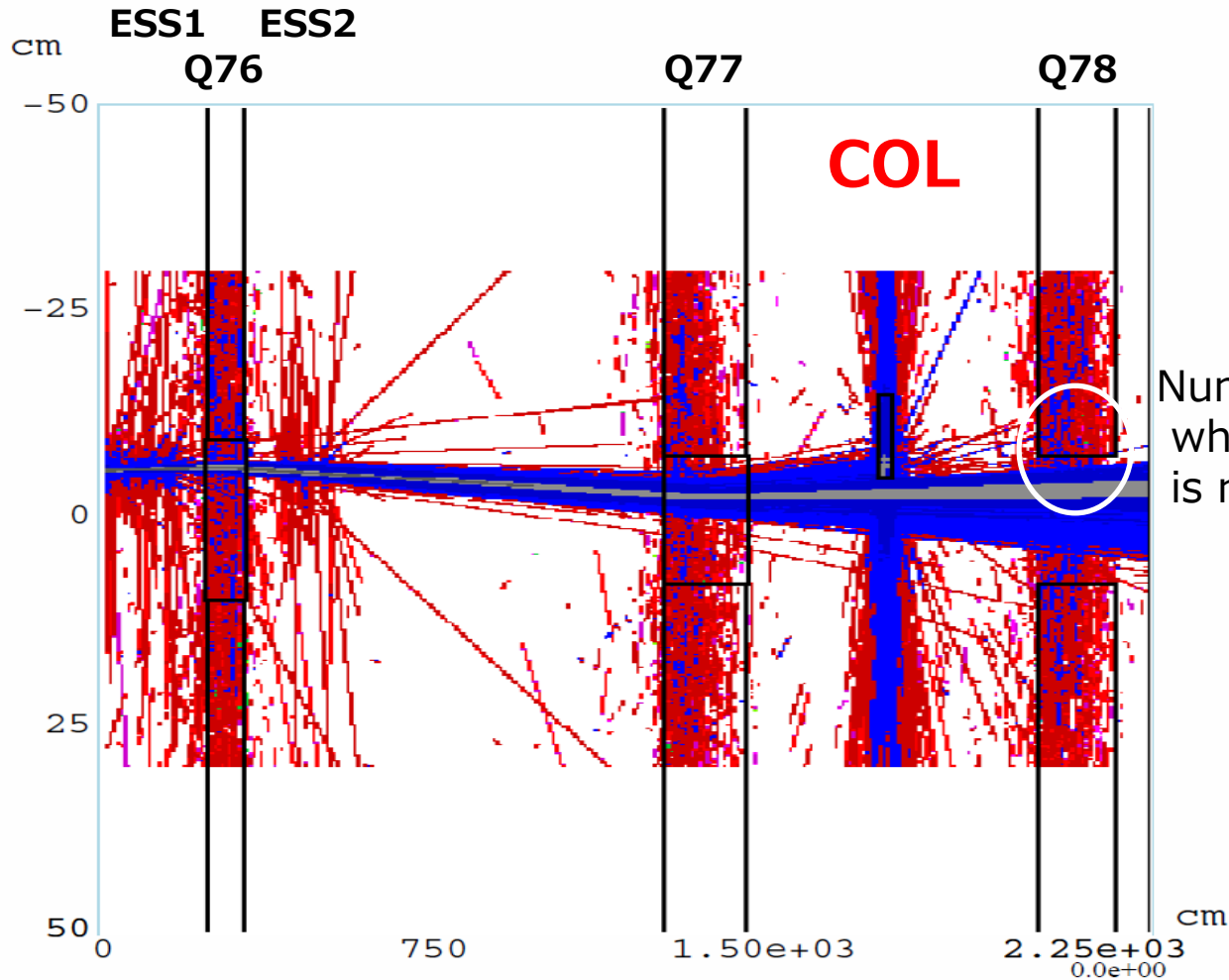


Aspect Ratio: Y:Z = 1:23.8

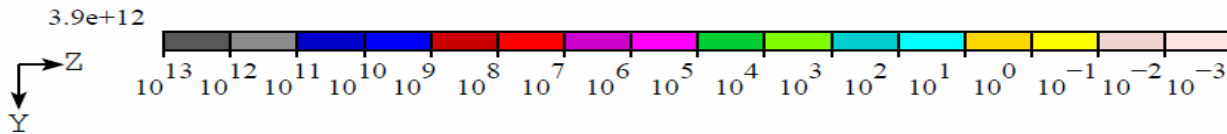
estimated using MARS

Scattered Particle Distribution w/ Col.

w/ Col.



Number of particles which hit the Q78 is reduced by Col.

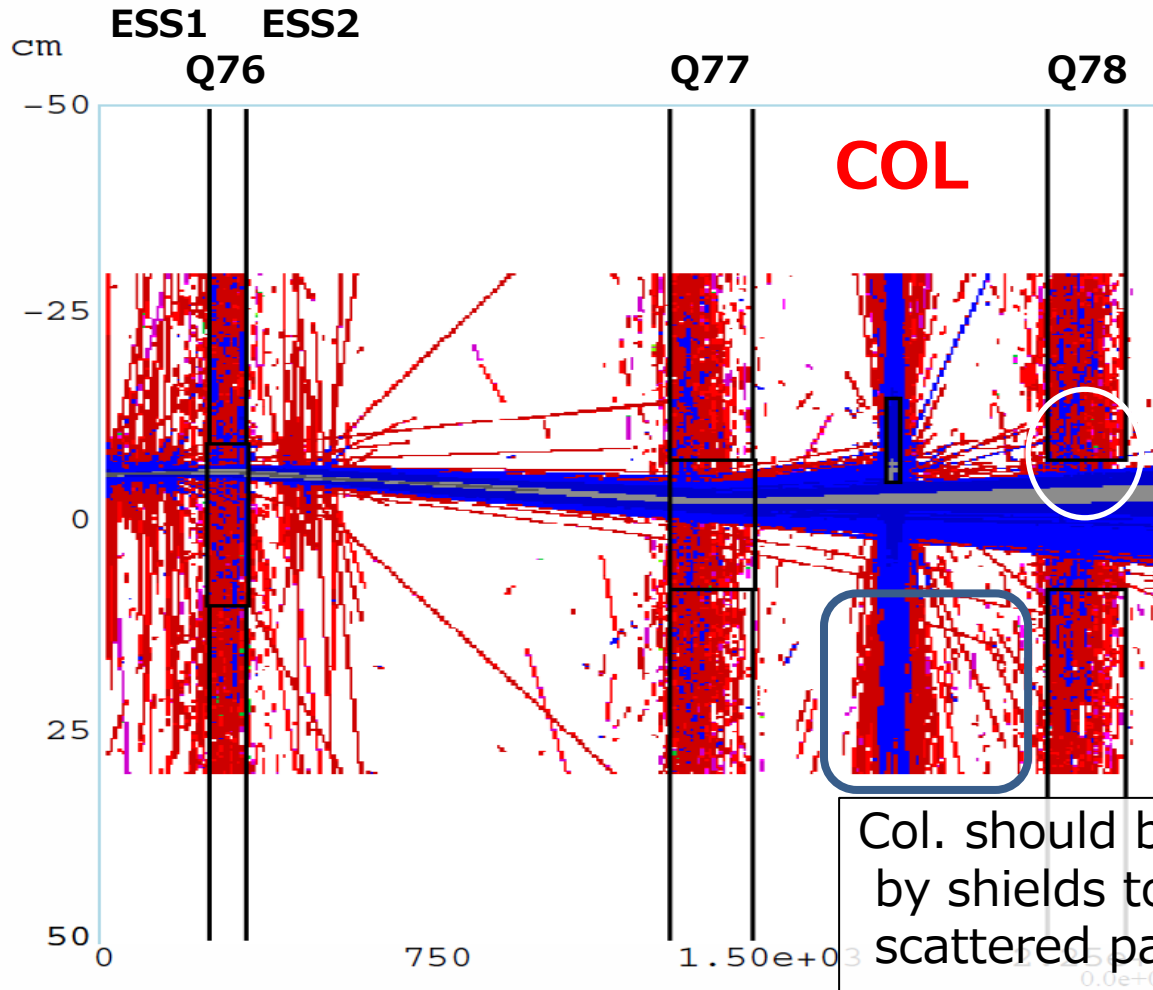


Aspect Ratio: Y:Z = 1:23.8

estimated using MARS

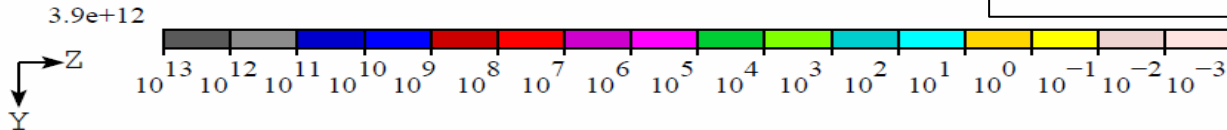
Scattered Particle Distribution w/ Col.

w/ Col.



Number of particles which hit the Q78 is reduced by Col.

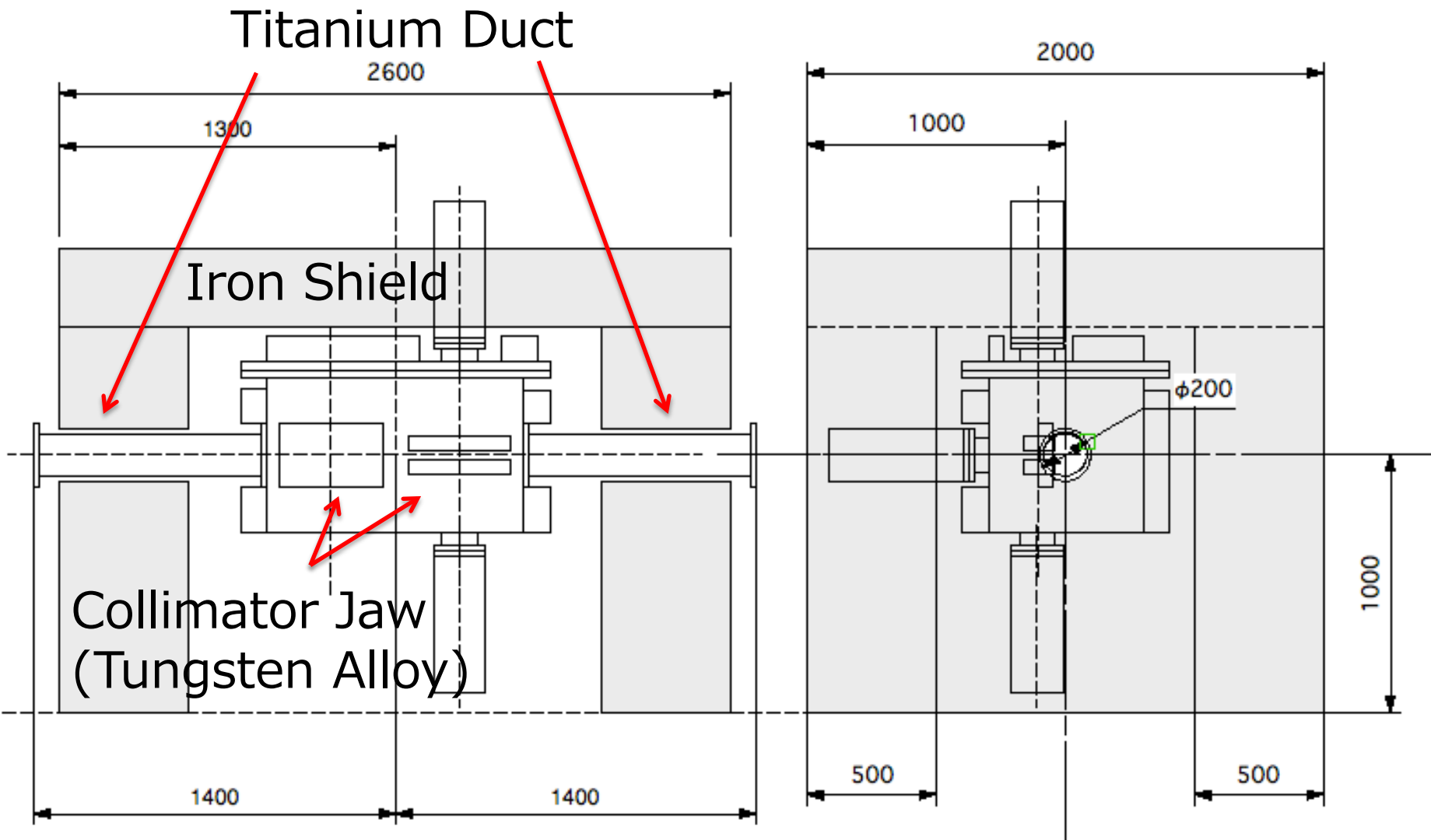
Col. should be surrounded by shields to confine scattered particles



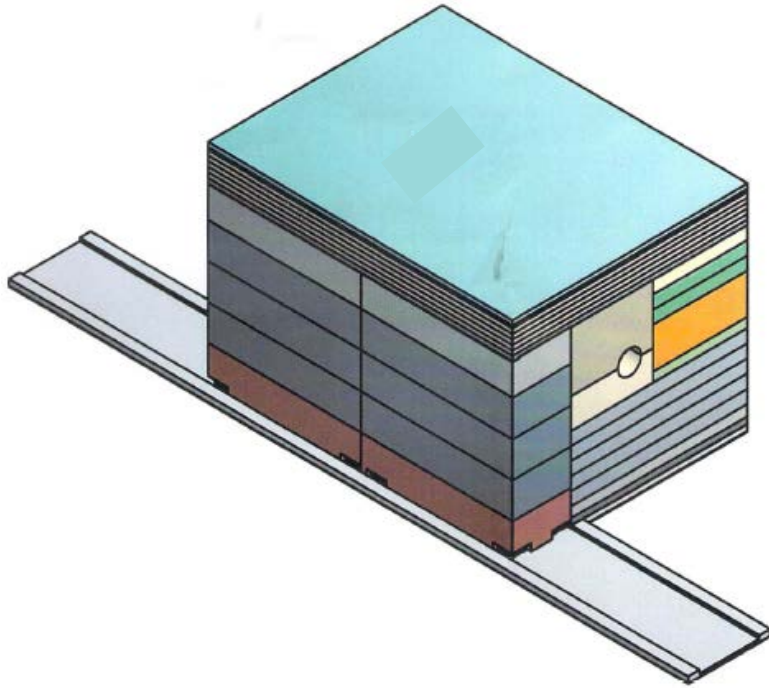
Aspect Ratio: Y:Z = 1:23.8

estimated using MARS

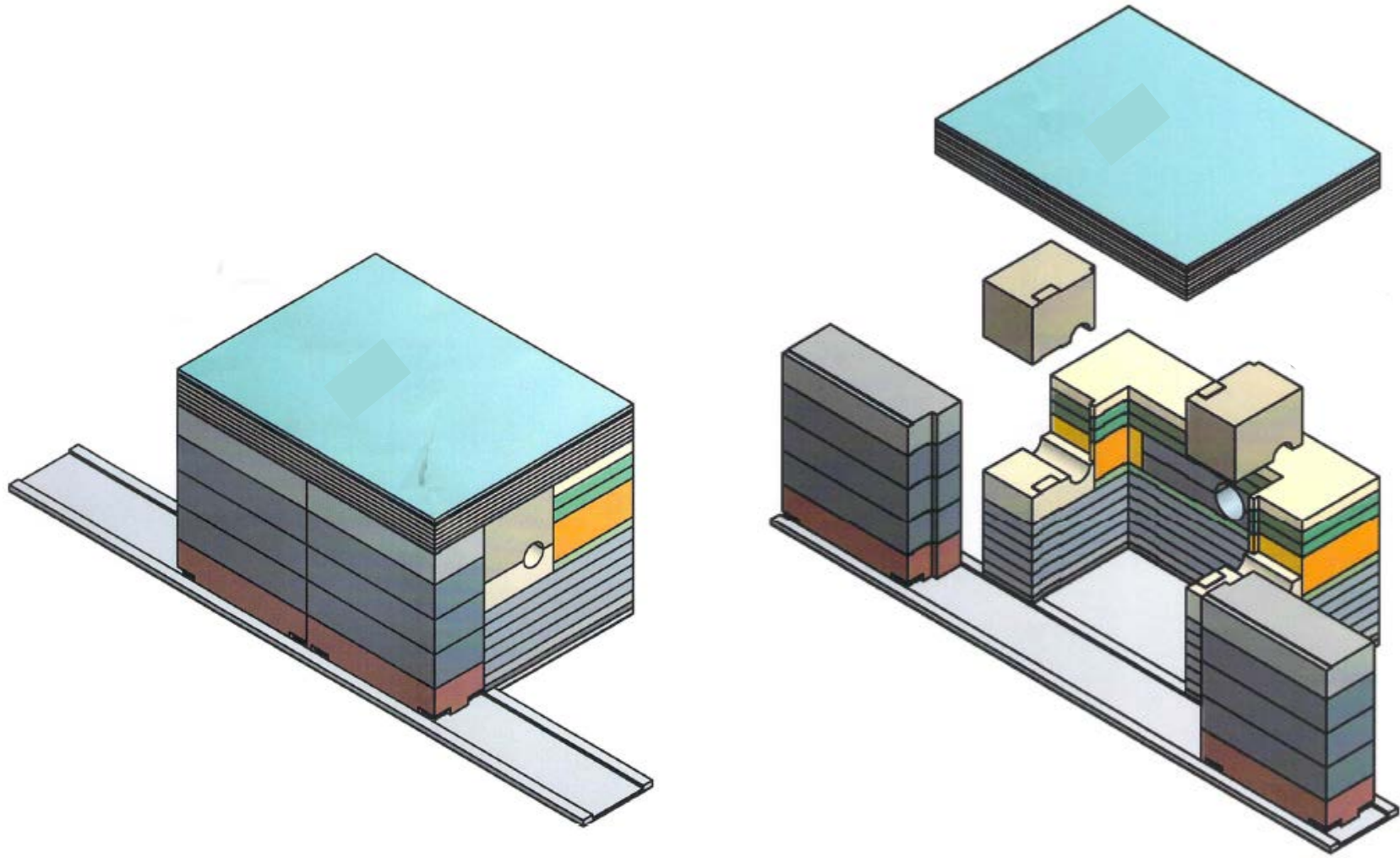
Shield Configuration around Col.



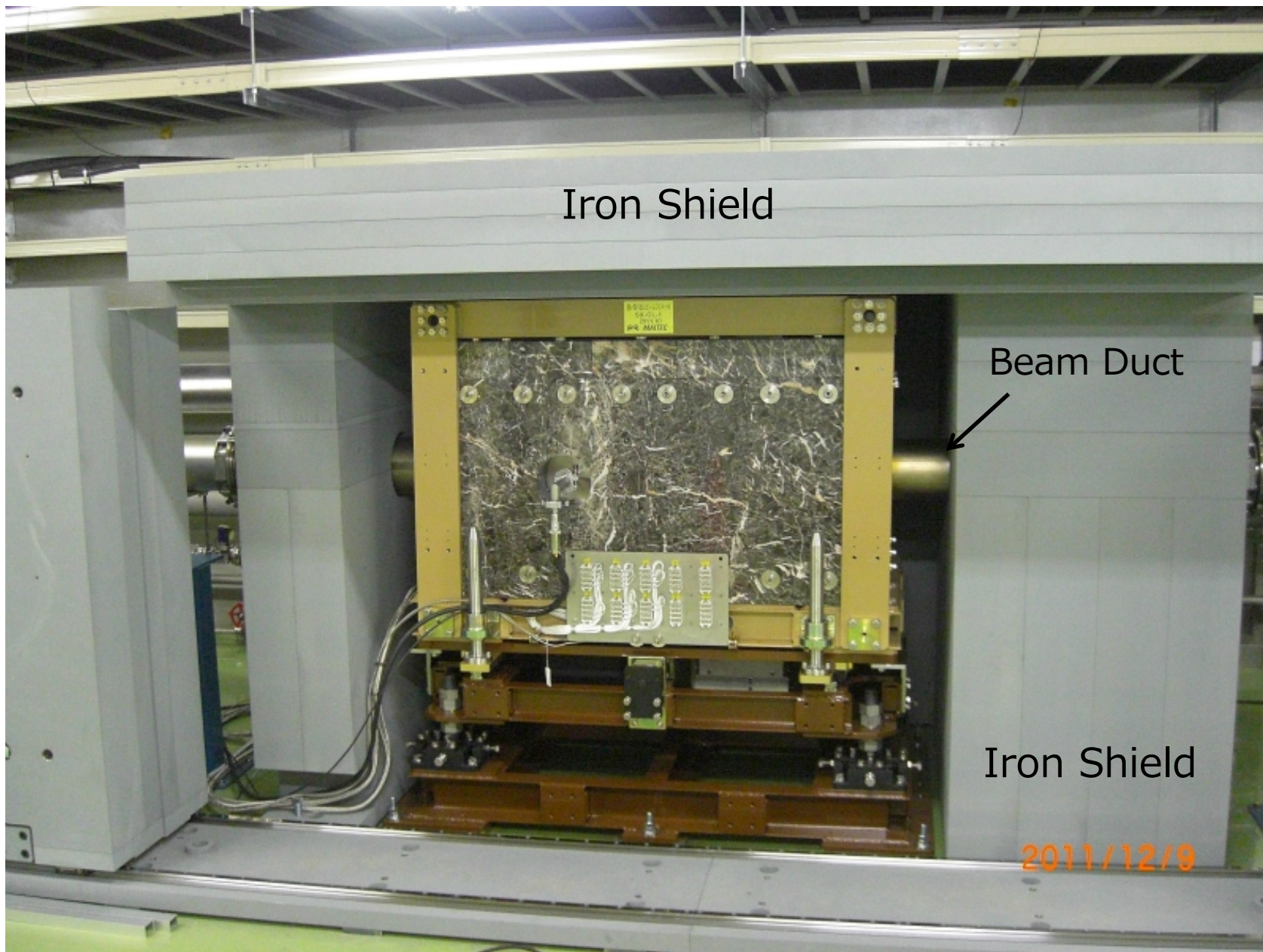
Shield Configuration around Col.



Shield Configuration around Col.



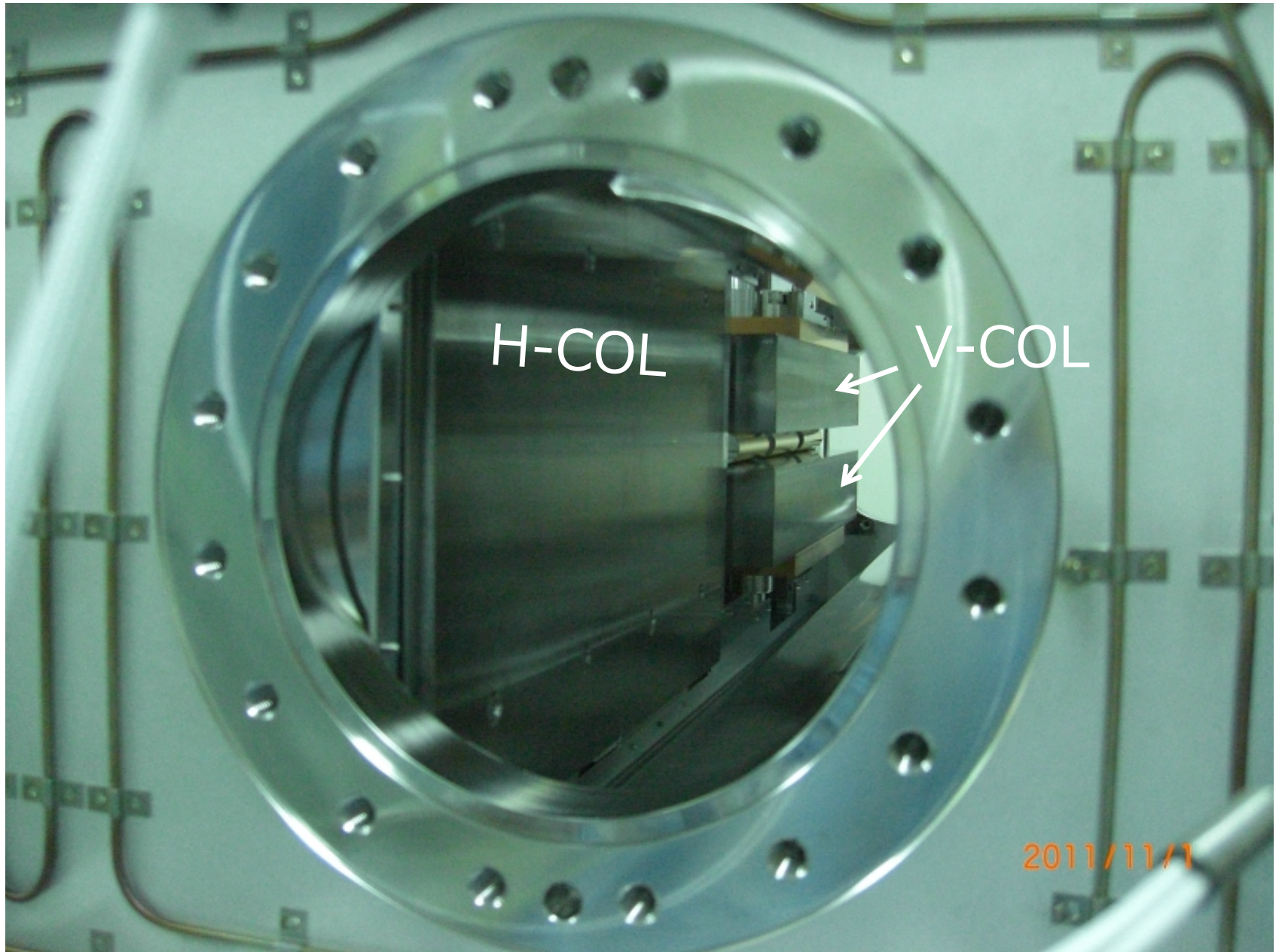
Shield Configuration around Col.



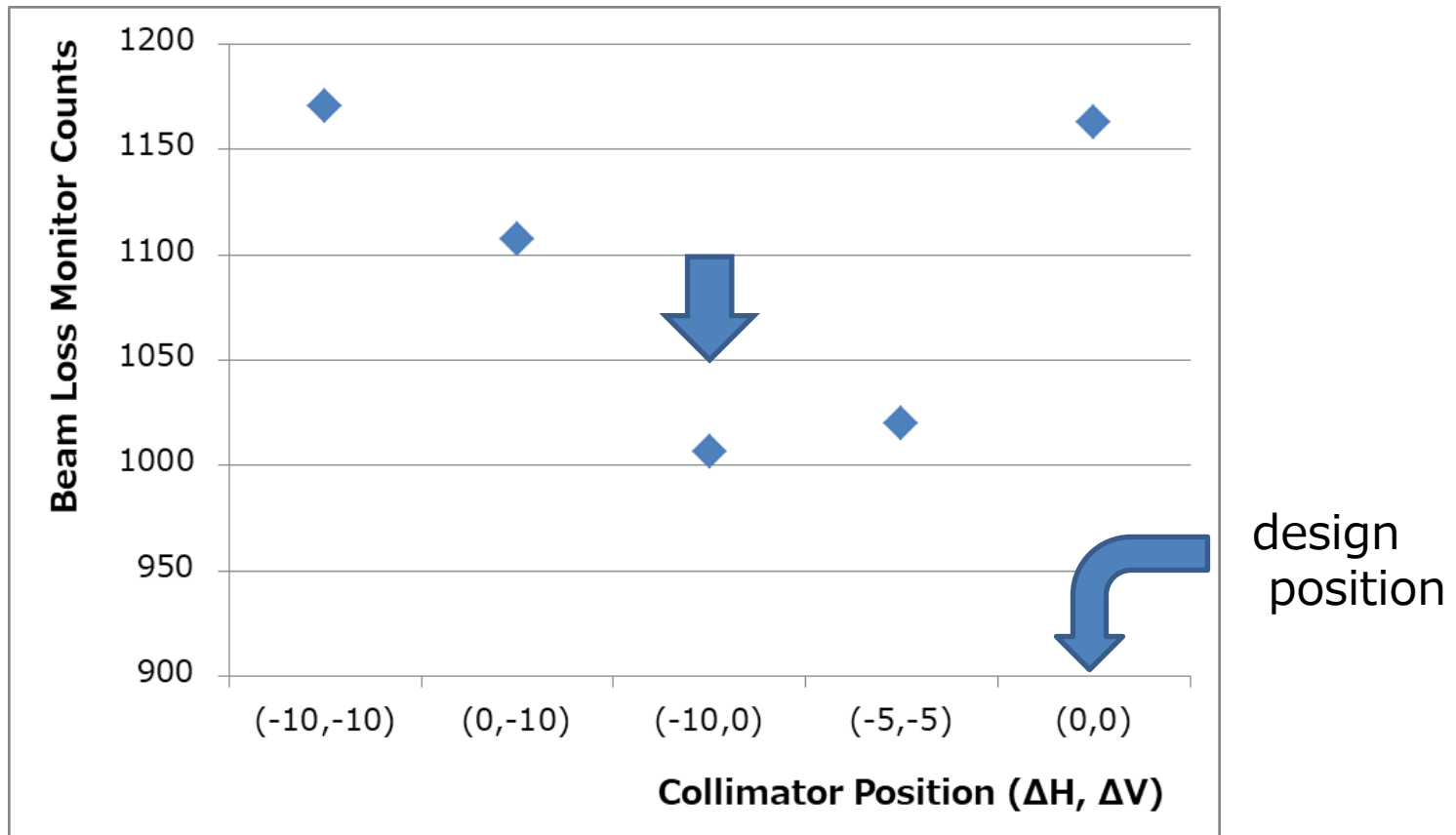
Shield Configuration around Col.



Inside the Chamber



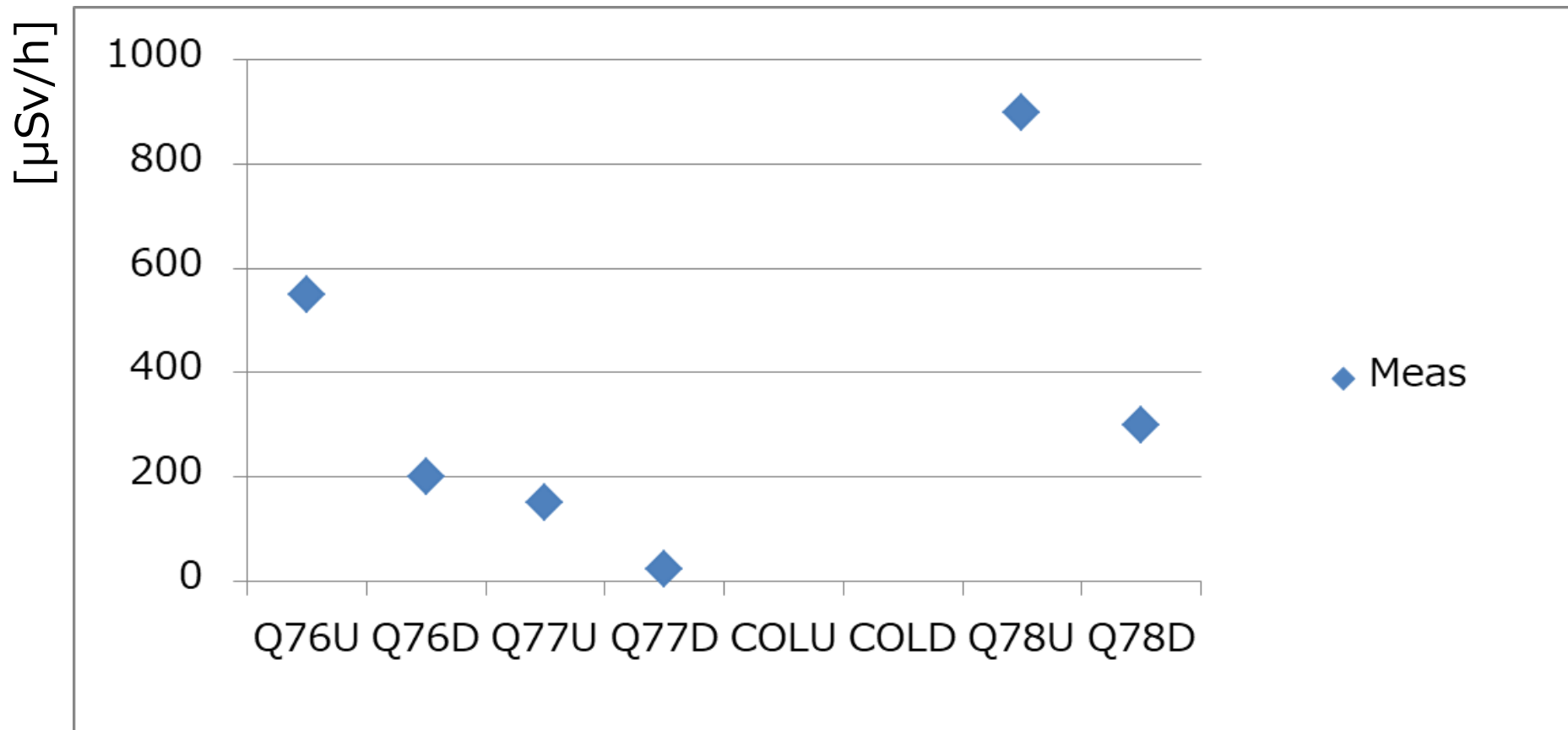
Adjustment of Collimator Jaw Position



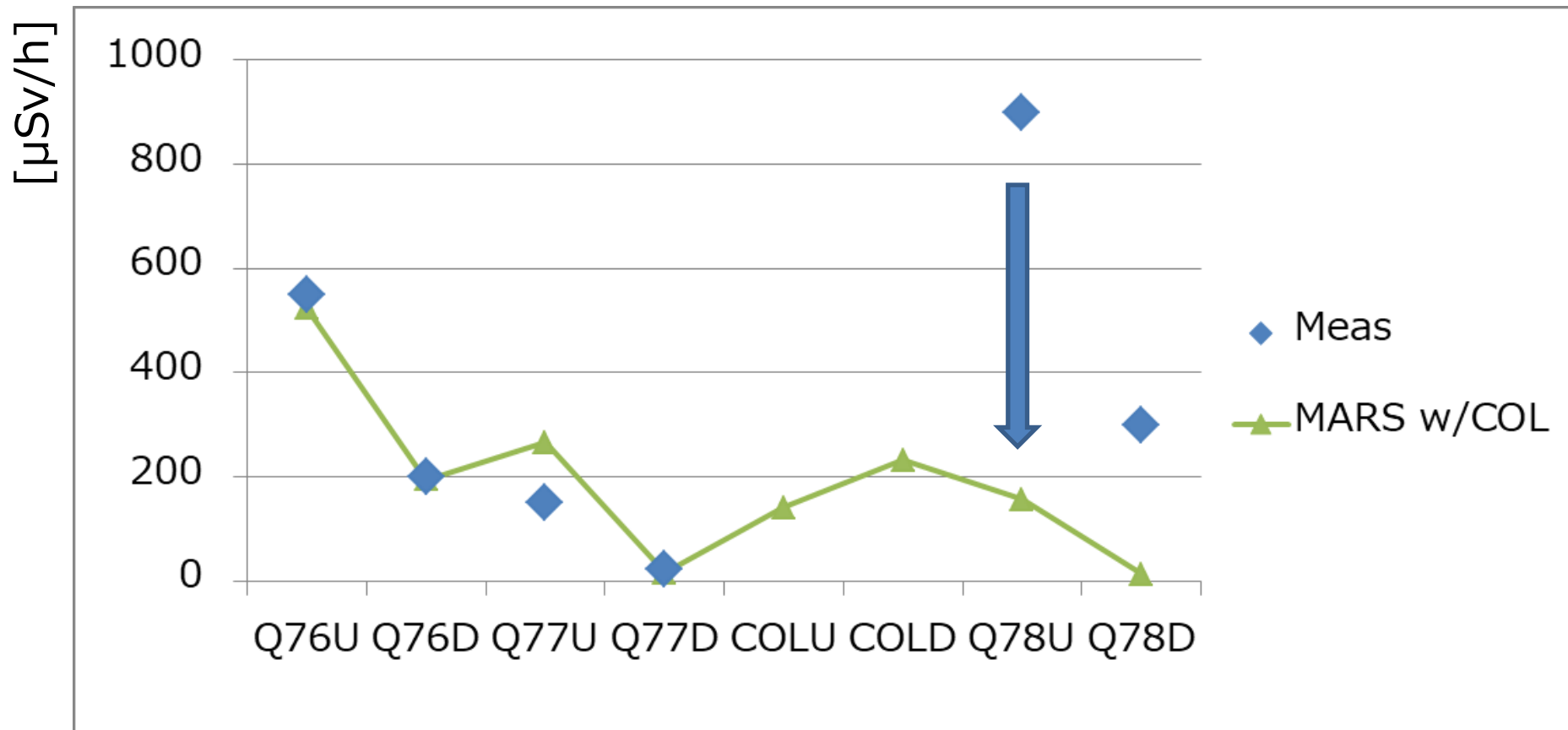
Positive : Close
Negative : Open

- Collimator Jaws are movable in ± 15 mm range
- Jaws' positions are adjusted to minimize the counts of the beam loss monitors in SE region

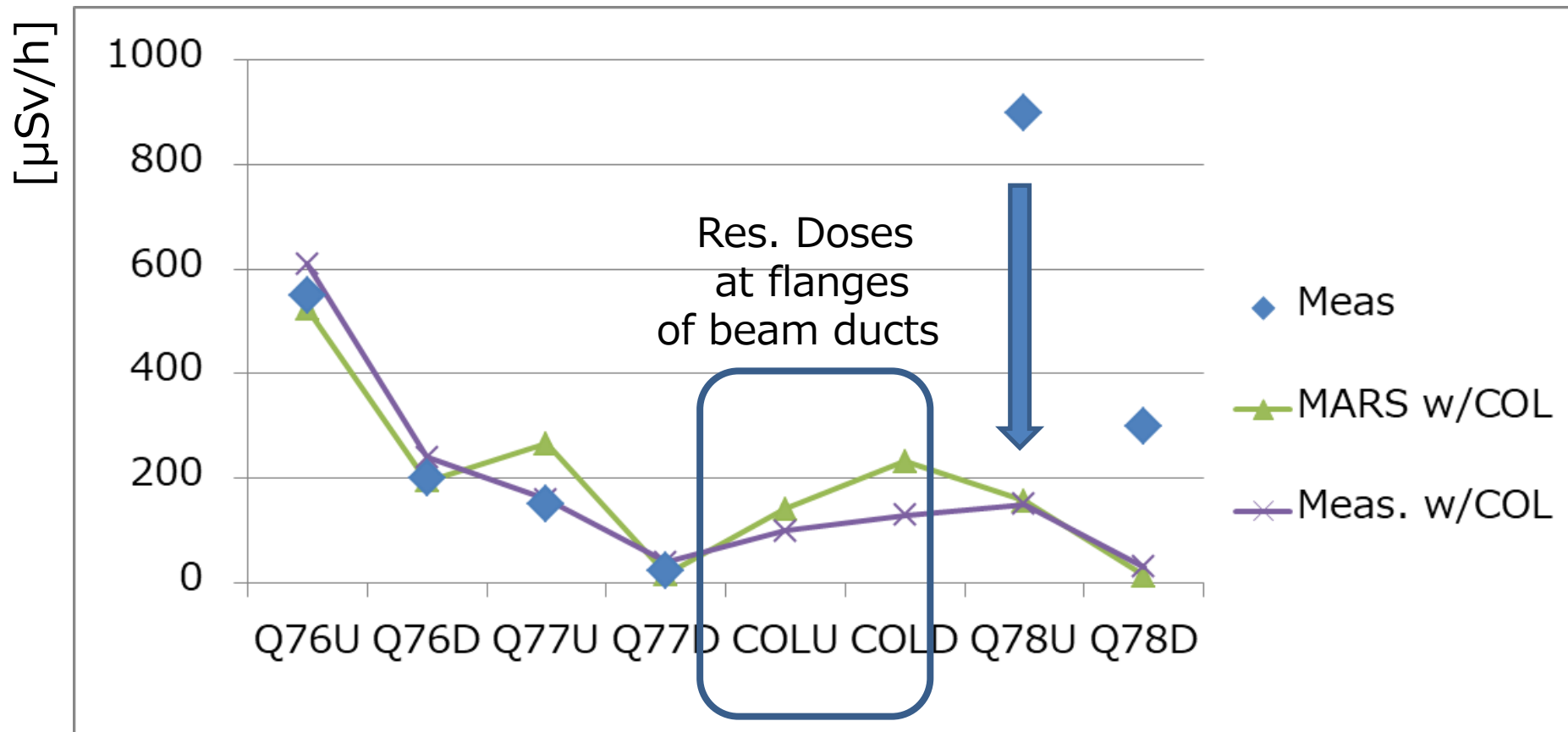
Estimation of Residual Dose w/ Col.



Estimation of Residual Dose w/ Col.



Estimation of Residual Dose w/ Col.



- Res. Dose of Q78 is significantly reduced.
- Measurement and MARS calculation are in good agreement

Summary

- Loss Collimator was installed in J-PARC Main Ring to mitigate large residual dose on components at the downstream of electrostatic septum.
- The residual dose on the downstream Q was reduced by factor $1/5$, which is in good agreement with the estimation using MARS.