
CERN

E-cloud related aspects

Galina Skripka and Giovanni Iadarola

Many thanks to:

C. Bracco, R. De Maria, L. Gentini, G. Mazzacano, A. Perillo-Marcone, A. Romano, G. Rumolo, M. Taborelli

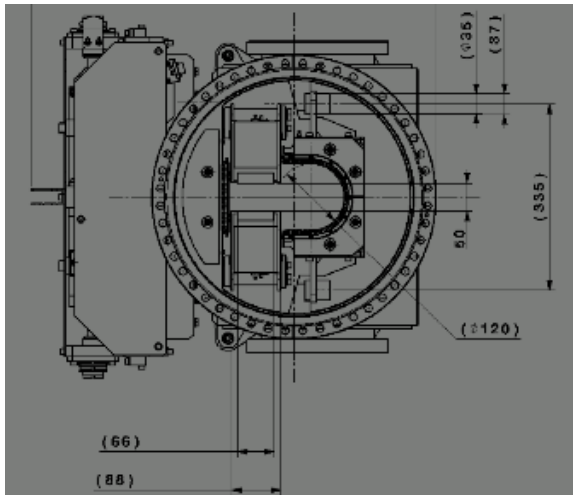
Outline

- Simulation setup
- e-cloud from single beam and two beams
- e-cloud depending on the TDIS gap and SEY

e-cloud simulations in TDIS

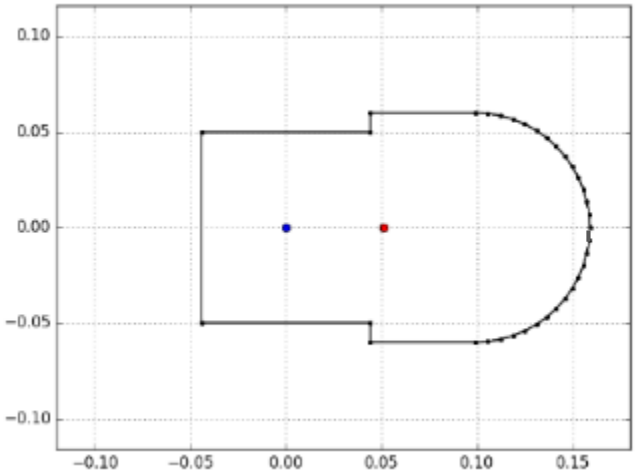
We performed a first series of simulations to identify possible critical points:

- Assumed uniform SEY for the whole profile
- SEY=1.4-1.5 (Cu-like) can be considered as a worst case scenario
- We assume that no high SEY surfaces (e.g. aluminum) are exposed to the beam

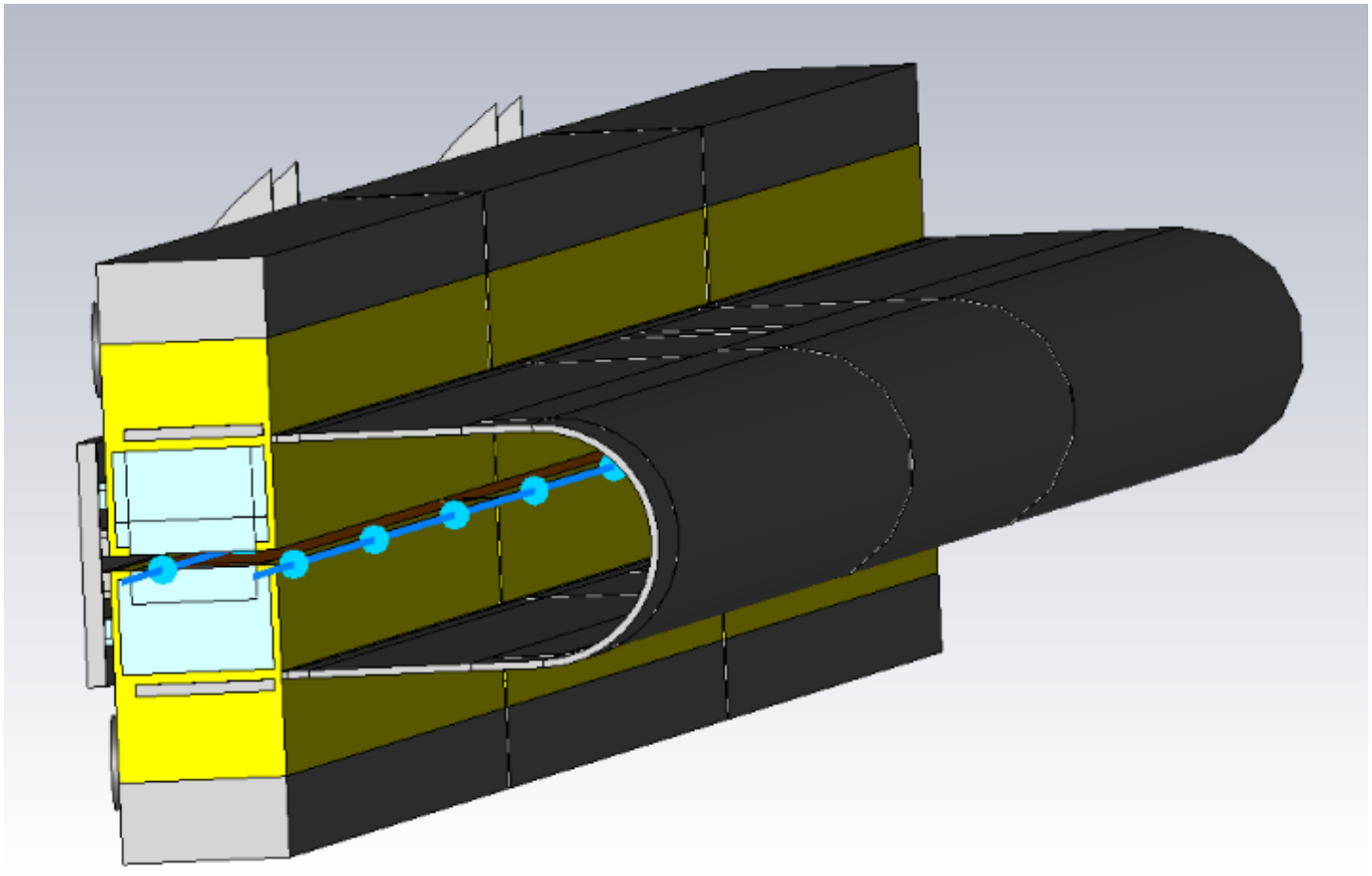


Main simulation parameters

- Beam parameters: 450GeV, 25 ns, 2.2e11 p/bunch
- Two counter-rotating beams (simulated different transverse slices of the device)
- Half-gap scan: 1 - 50 mm
- SEY scan: 1.0 - 1.6



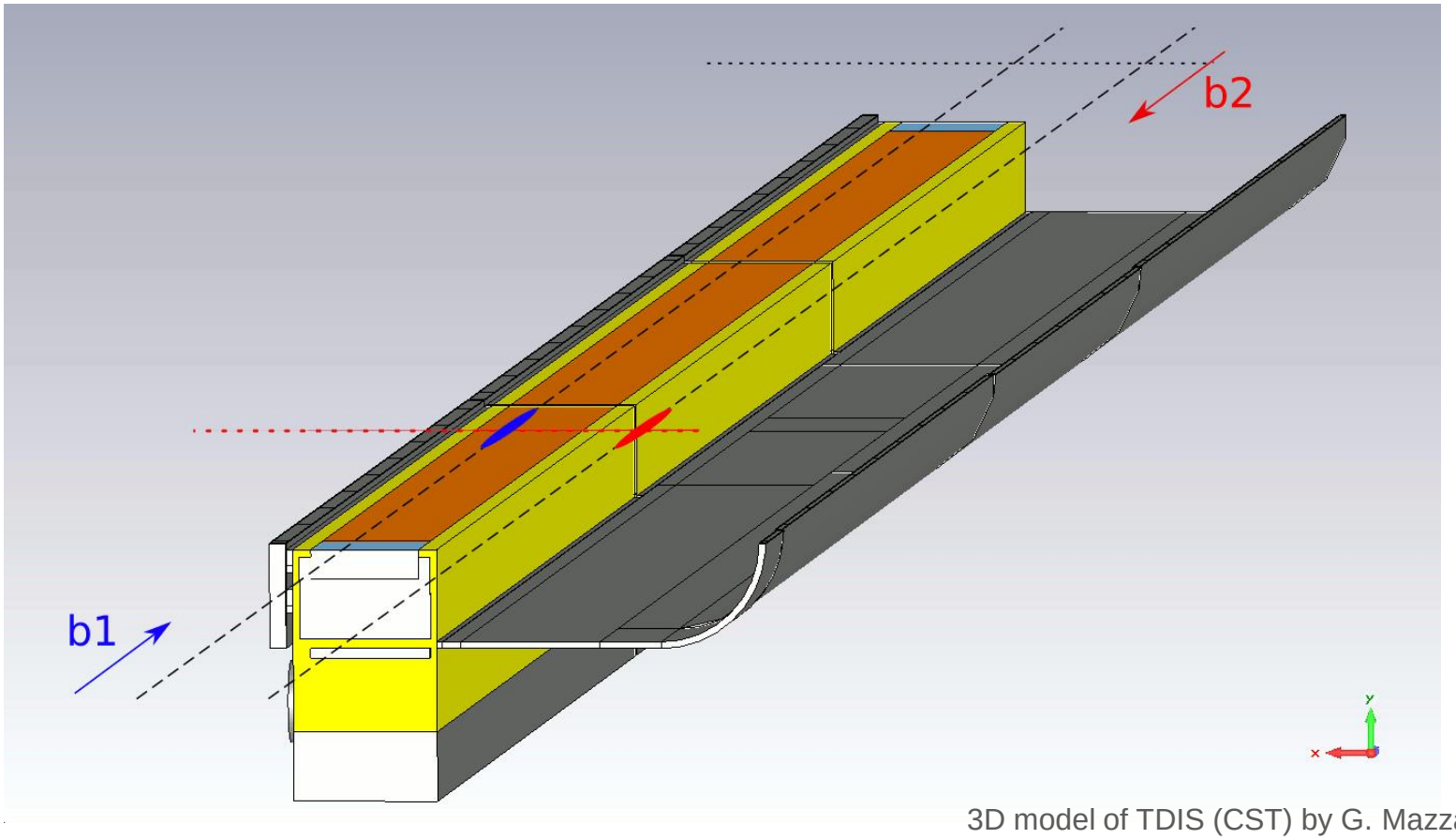
Beams inside TDIS



3D model of TDIS (CST) by G. Mazzacano

Beams inside TDIS

Hybrid bunch spacing at each section has to be taken into account when simulating the e-cloud buildup!

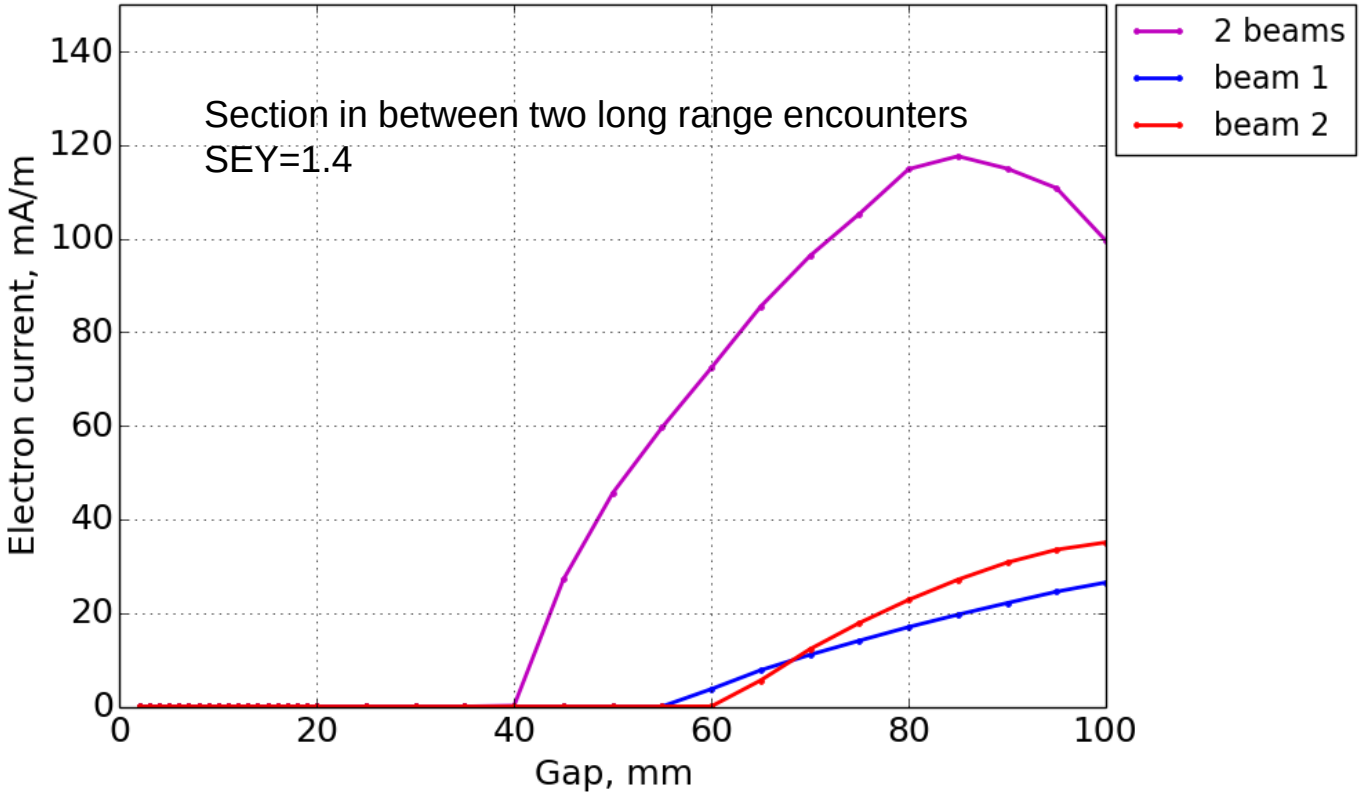


3D model of TDIS (CST) by G. Mazzacano

Single beam vs two beams

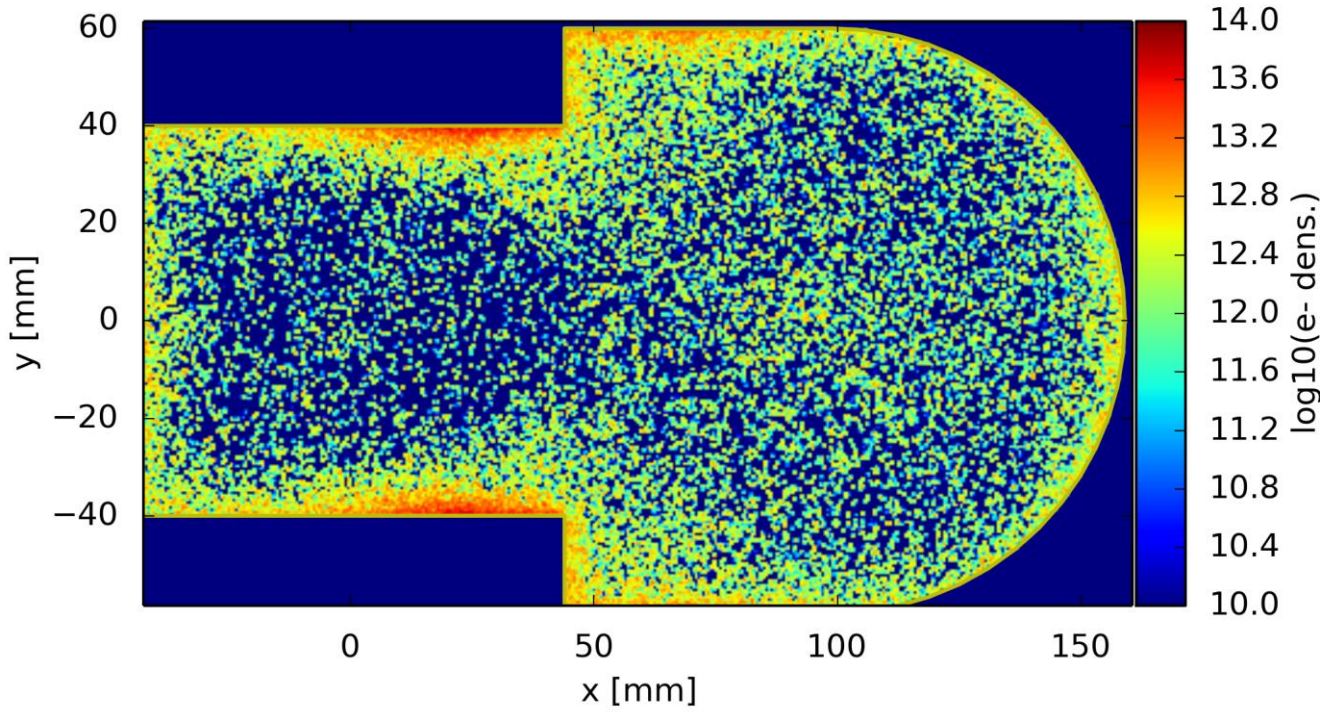
As for other devices with common chambers (e.g. Inner Triplets) it is important to correctly model the e-cloud in the presence of both beams

- Multipacting thresholds can be really different!



Electron distribution

- Quite complex dynamics due to the geometry and to the presence of the two counter-rotating beams (see video here or here)



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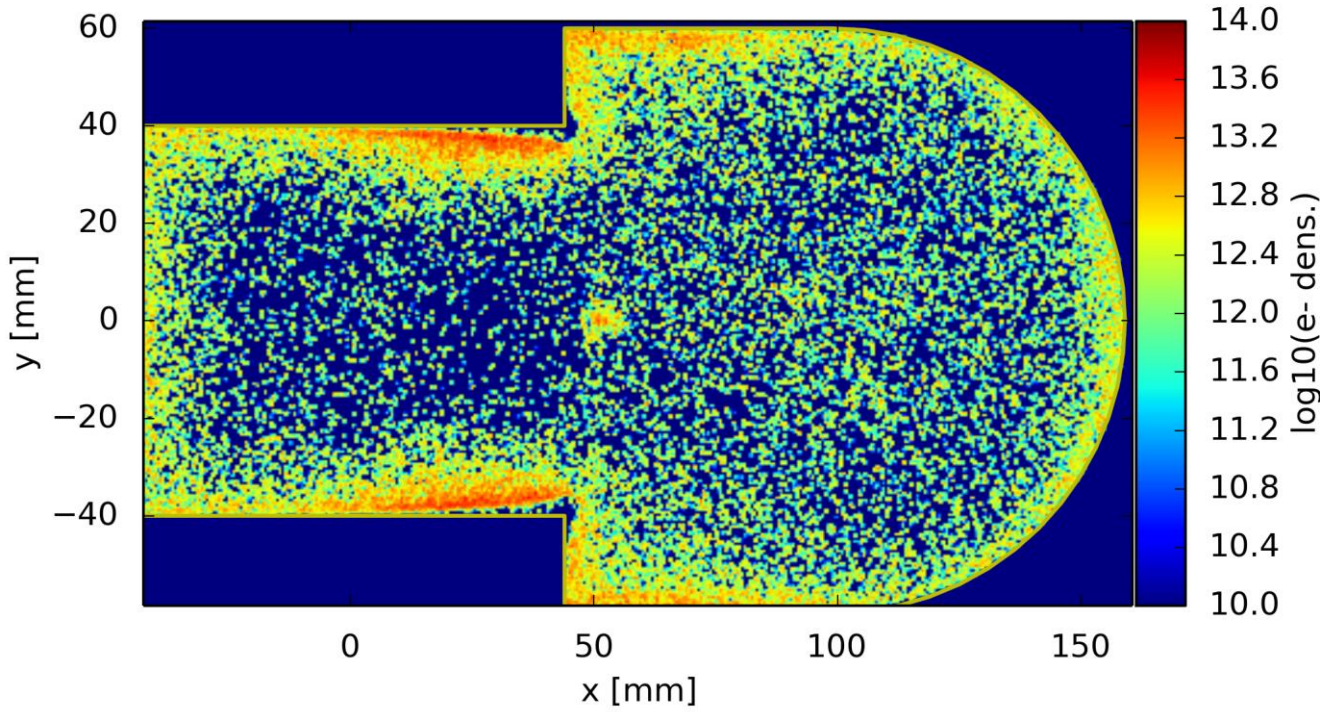

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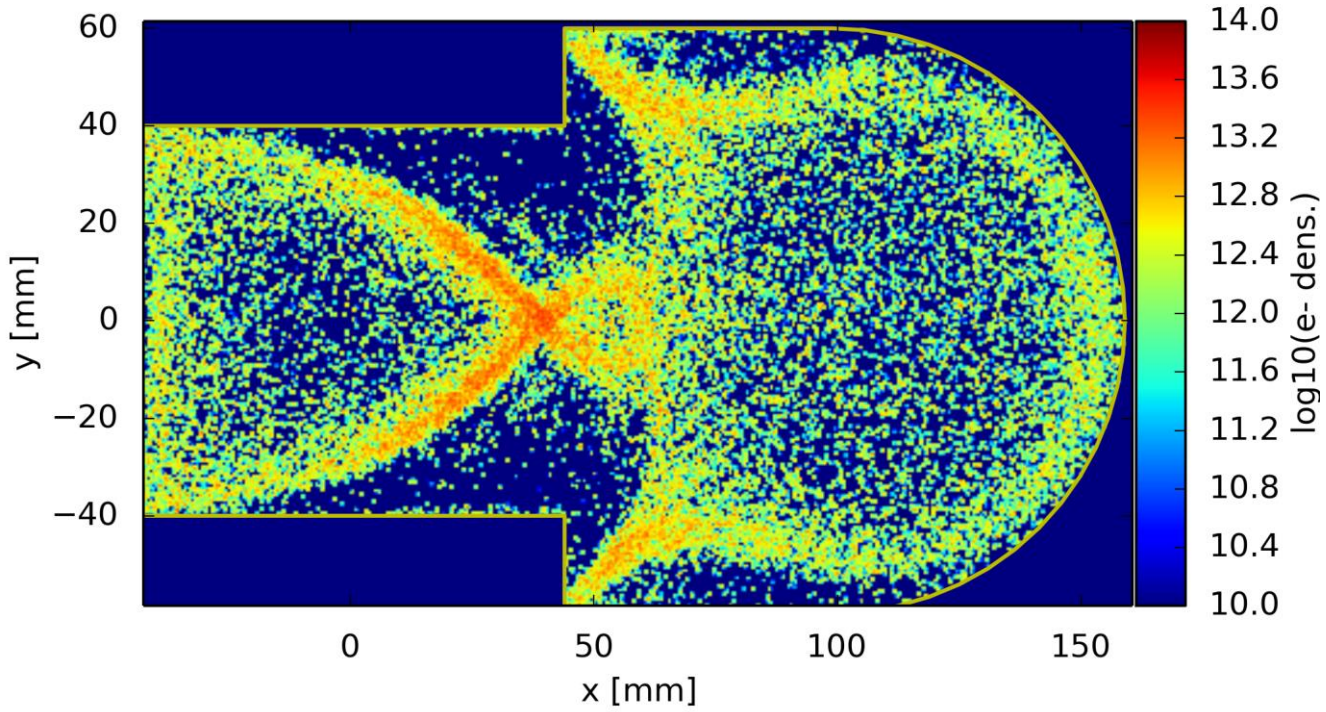

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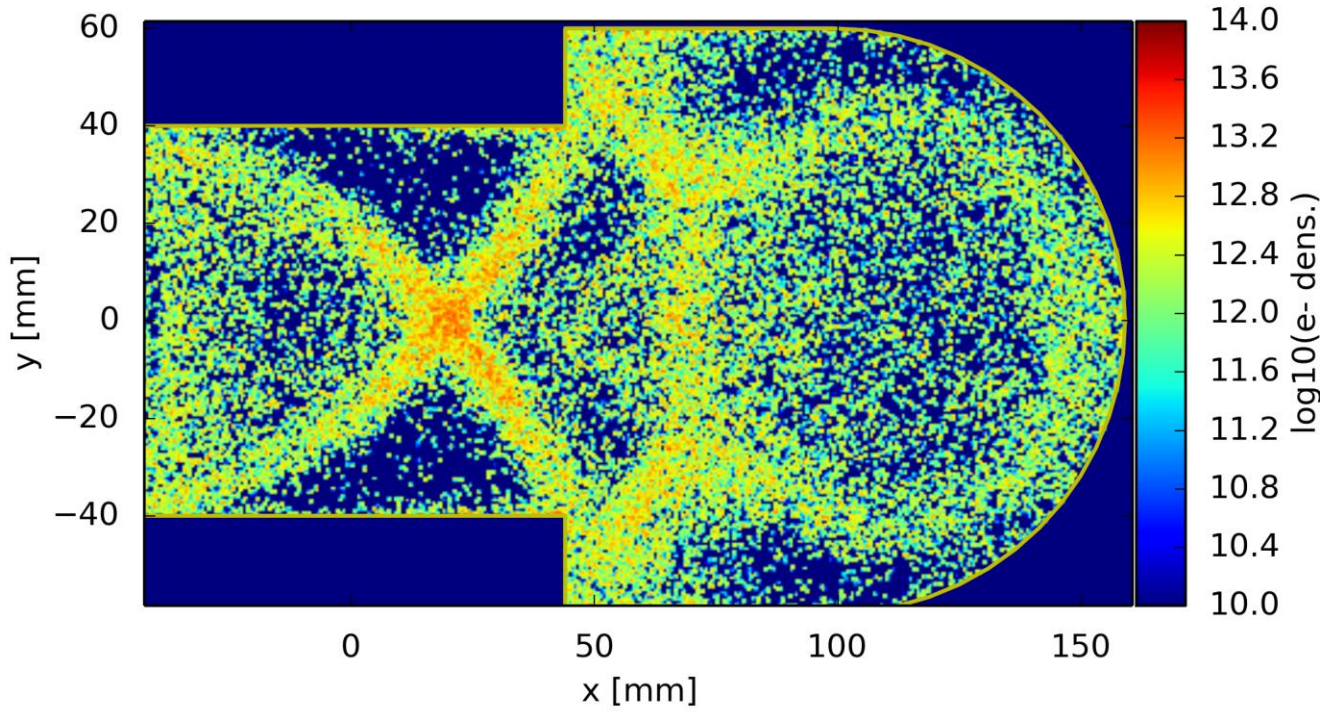

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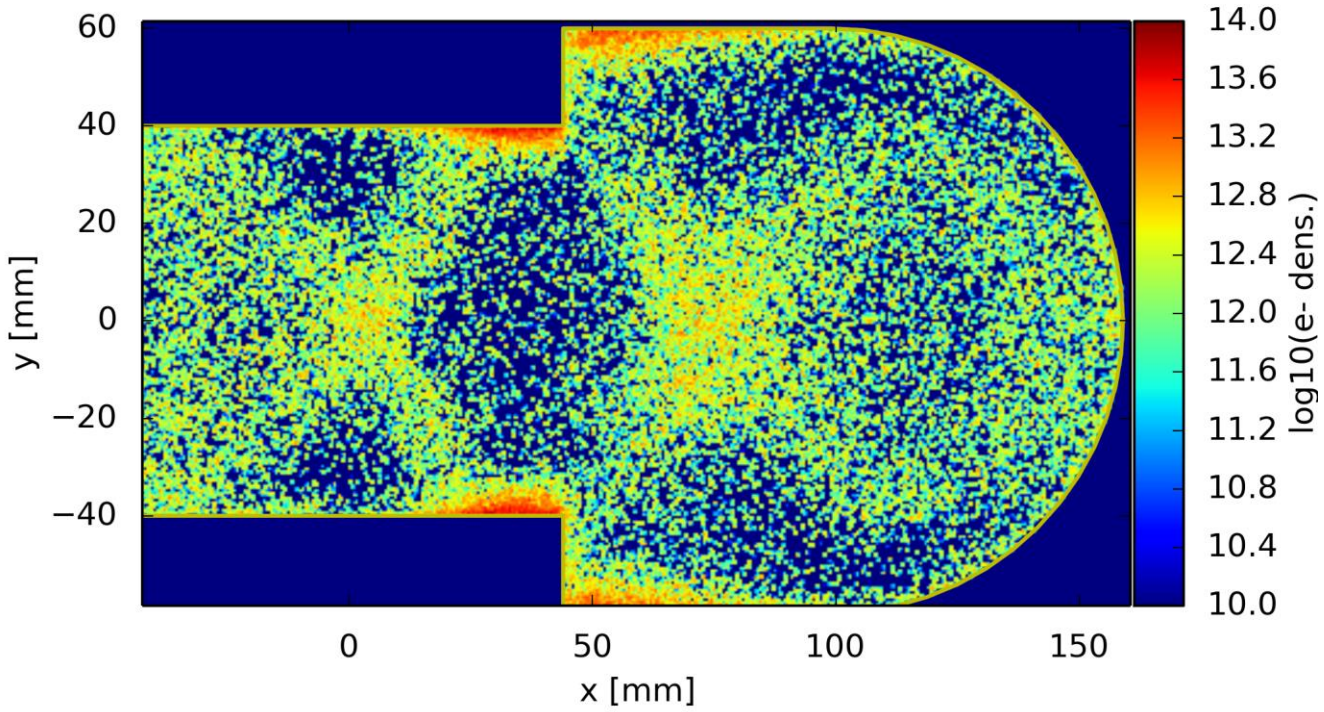

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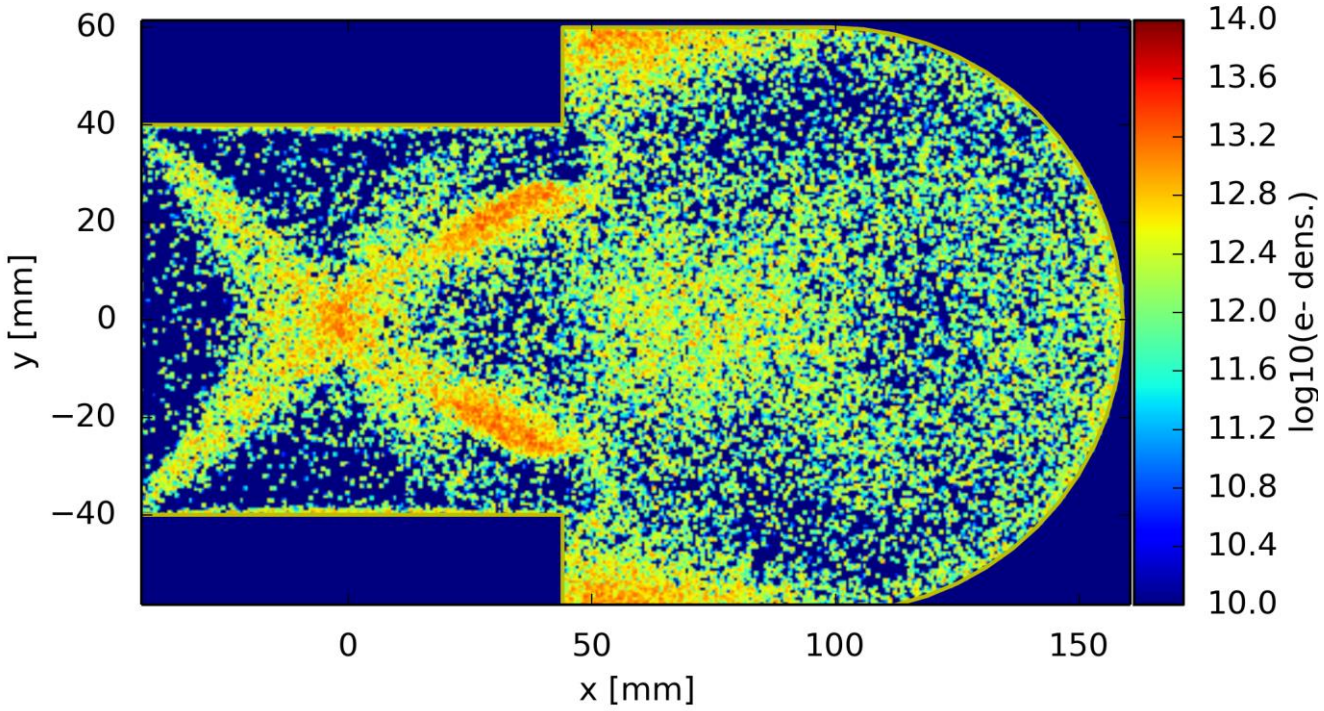
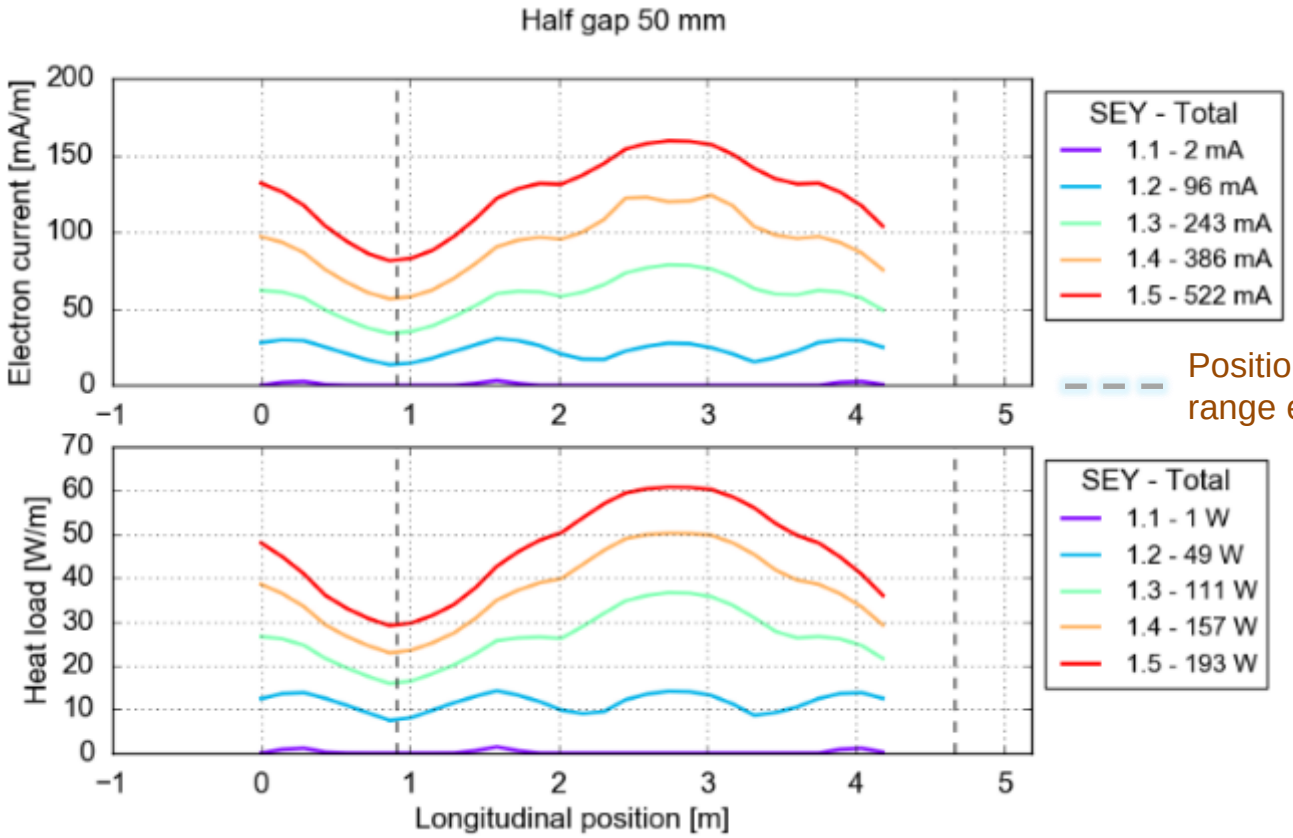


Longitudinal current/heat profiles

- Multipacting is stronger at the positions where the two beams are not synchronized (12.5 ns equivalent spacing)



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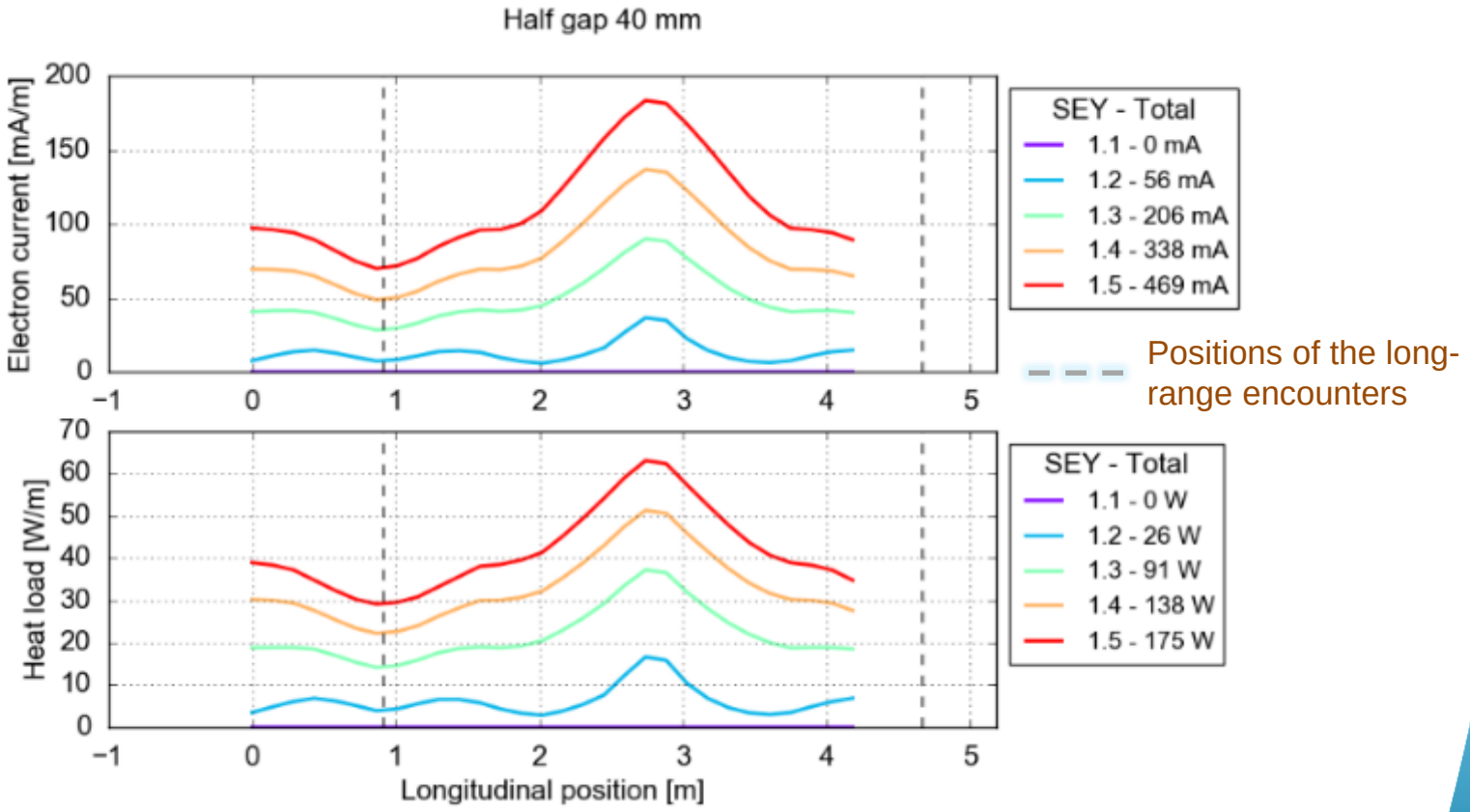

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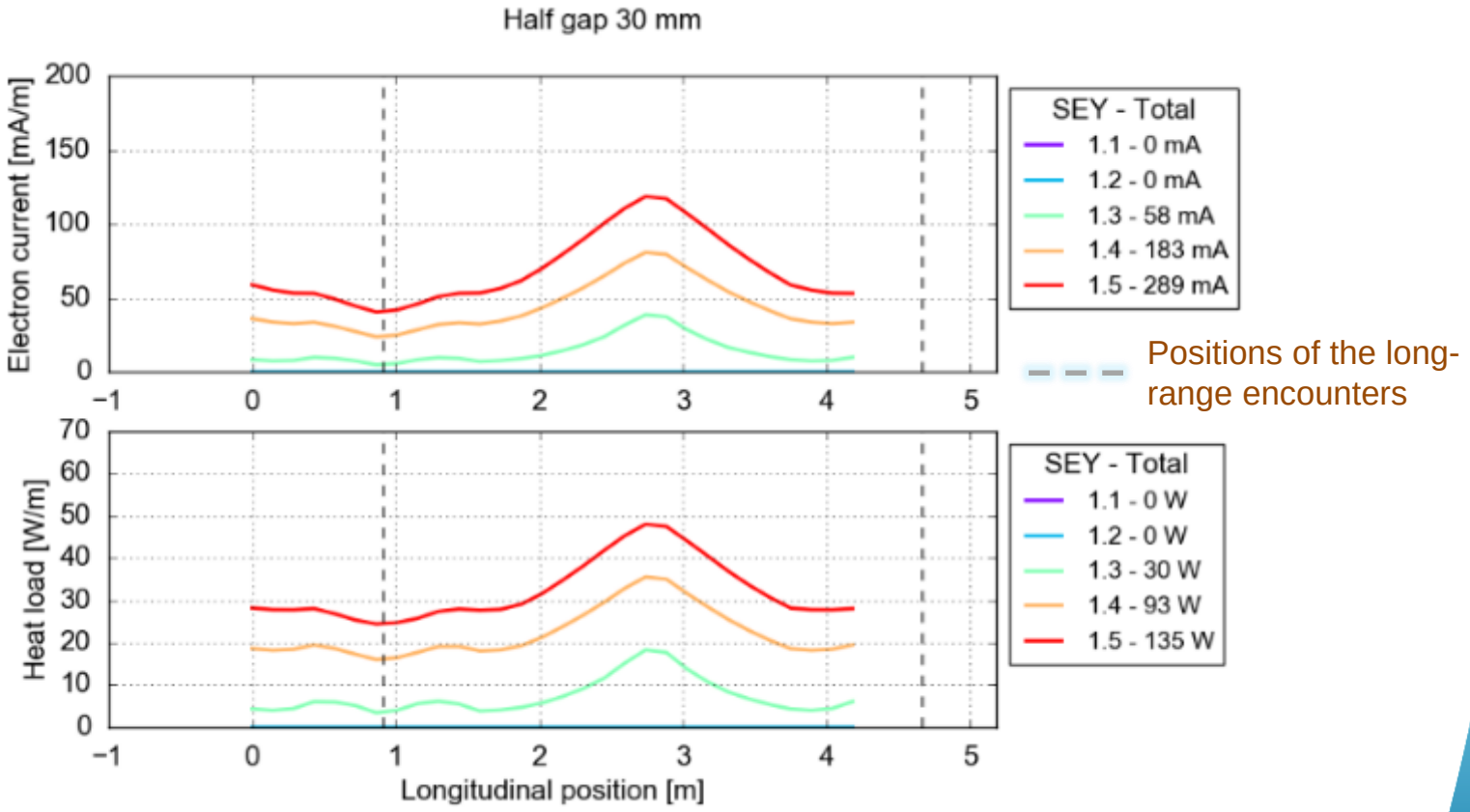

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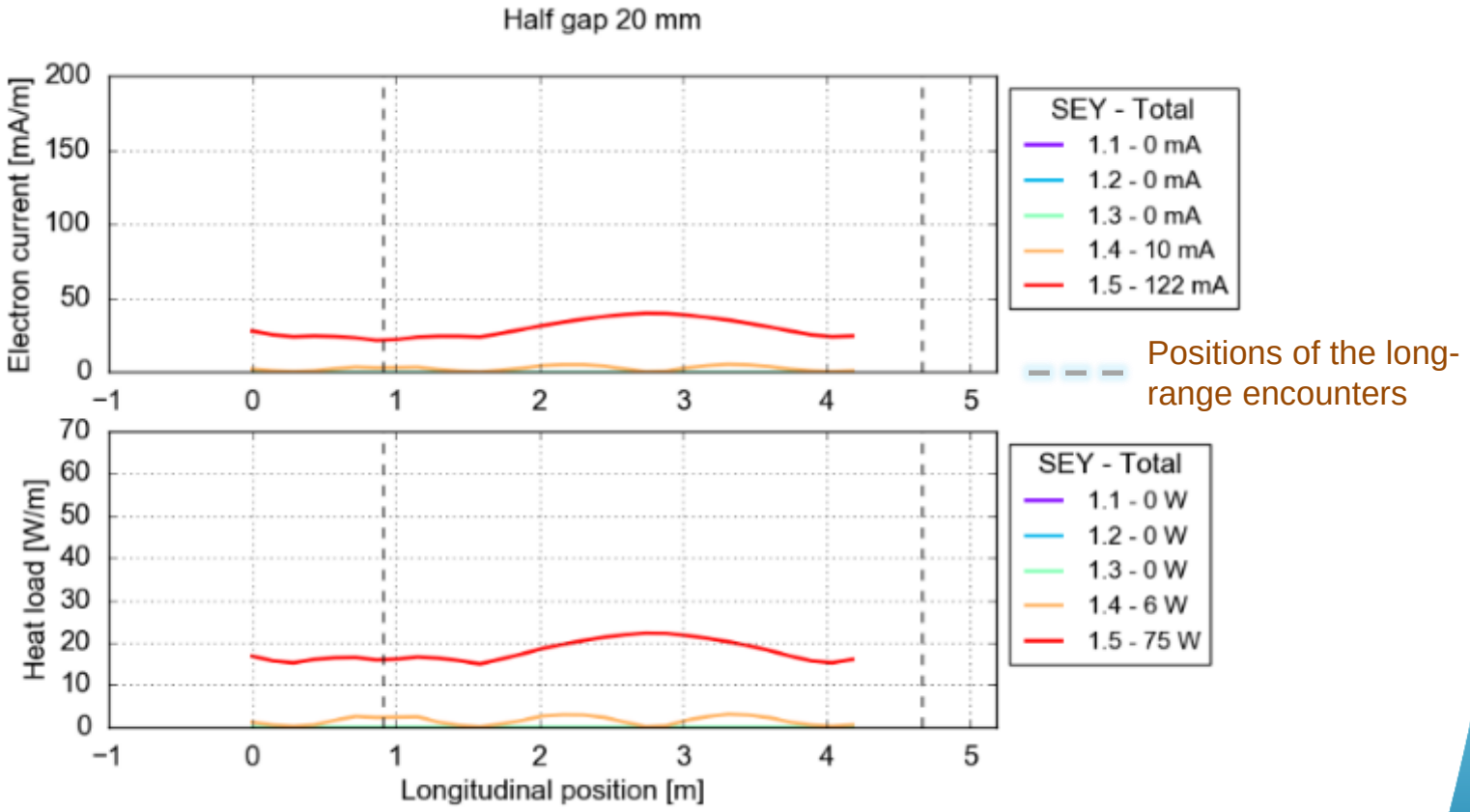

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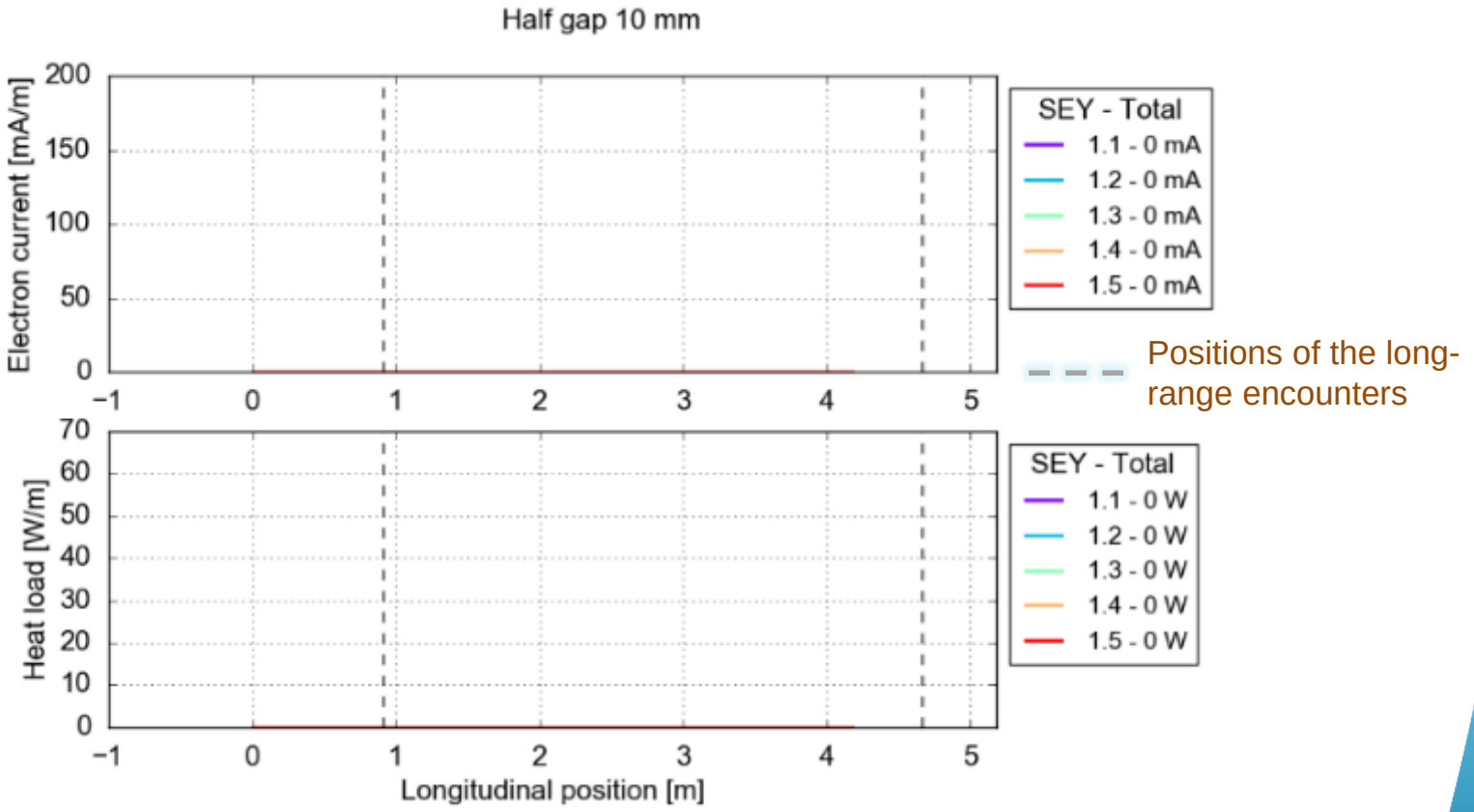

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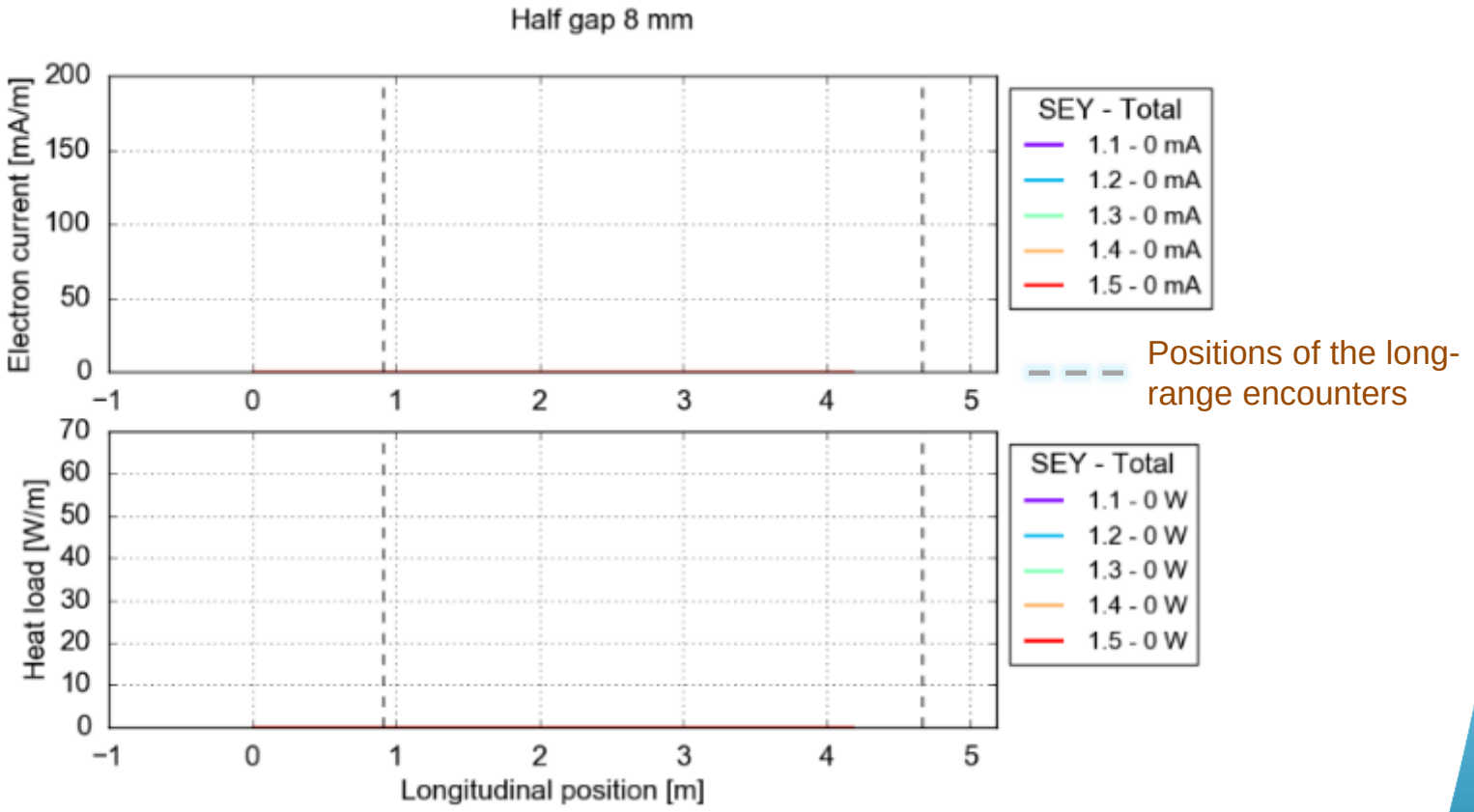

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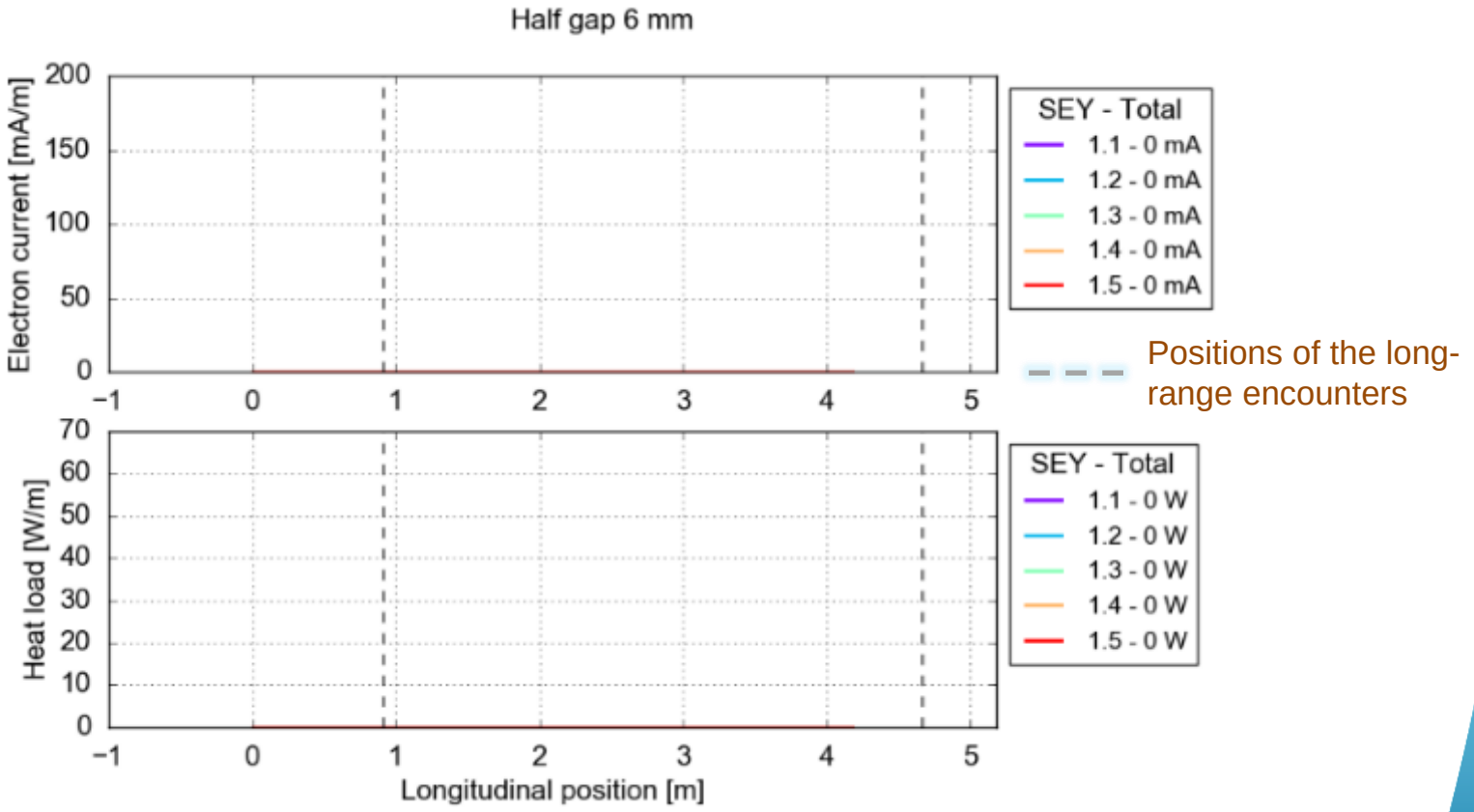

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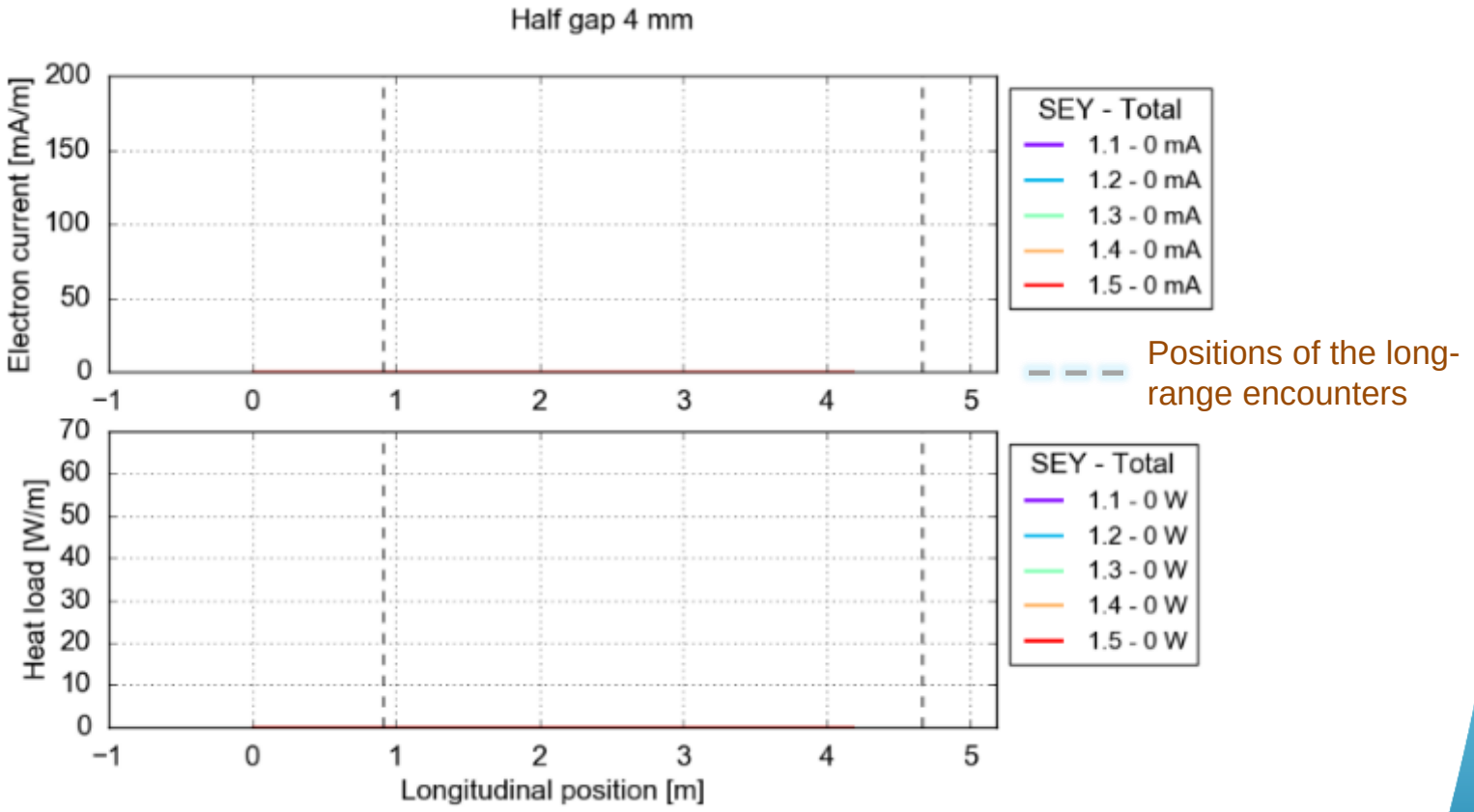
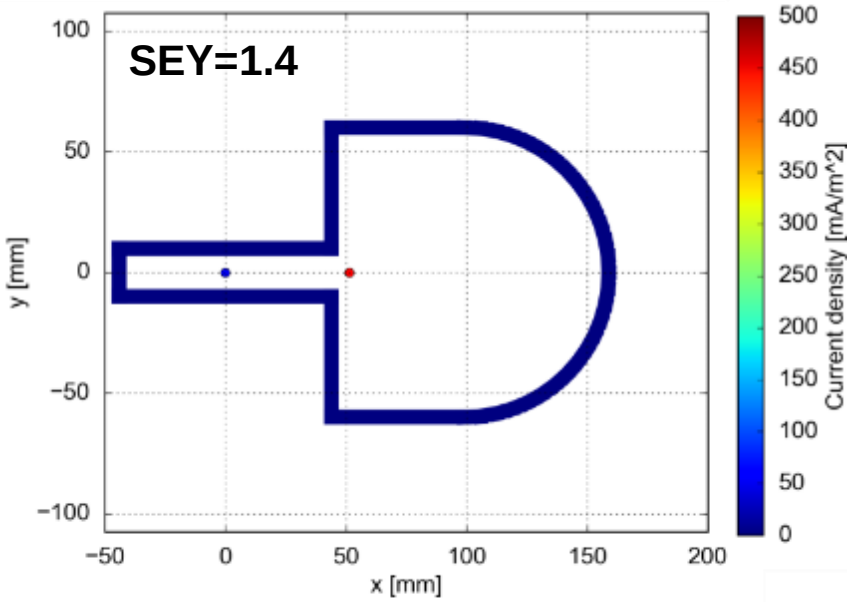
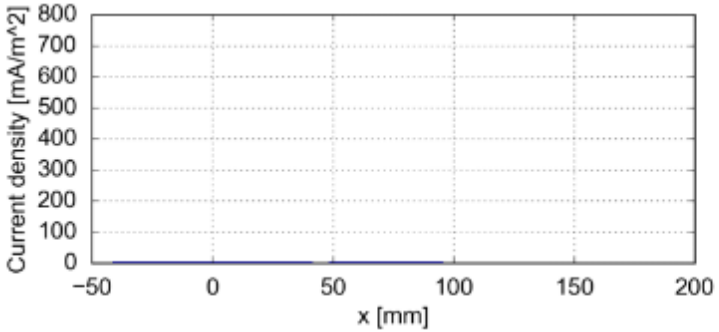


Electron flux on the different surfaces

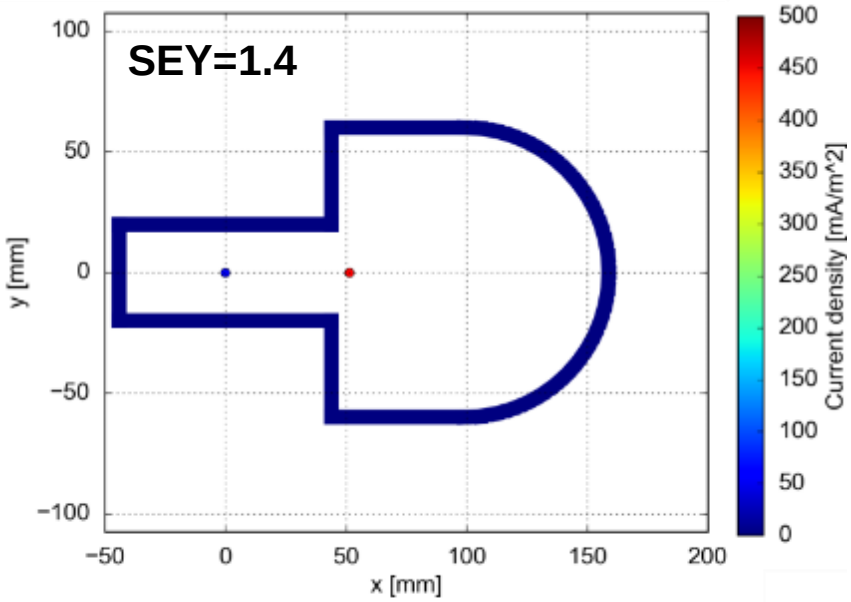


Section in between two long range encounters



- Basically nothing for small gaps

Electron flux on the different surfaces



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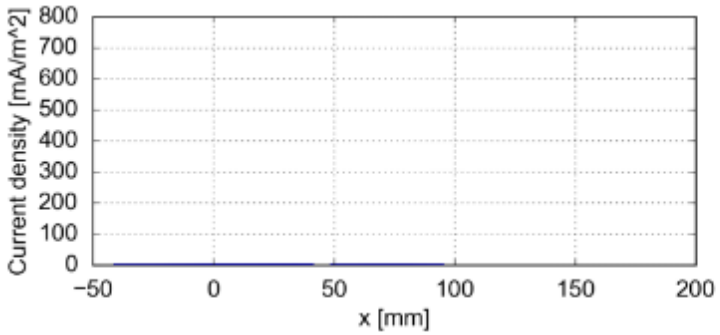

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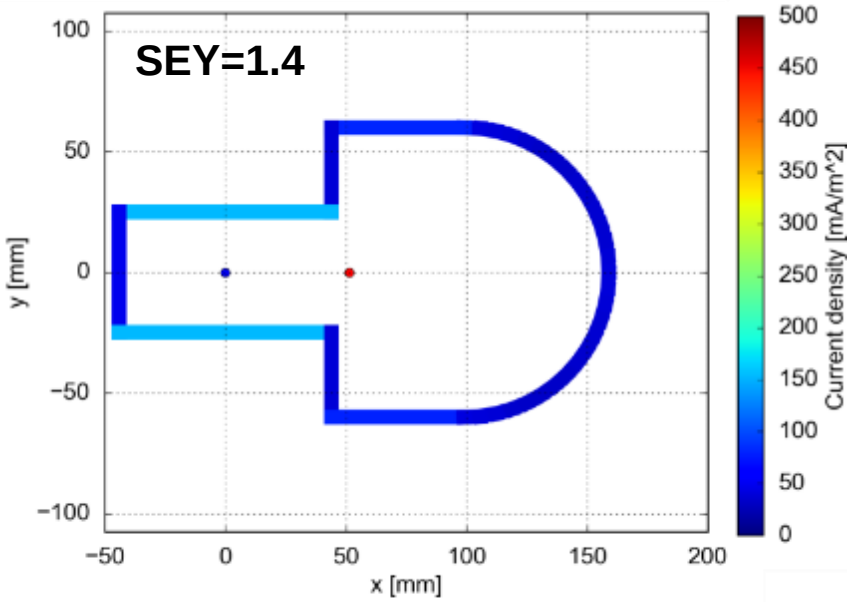

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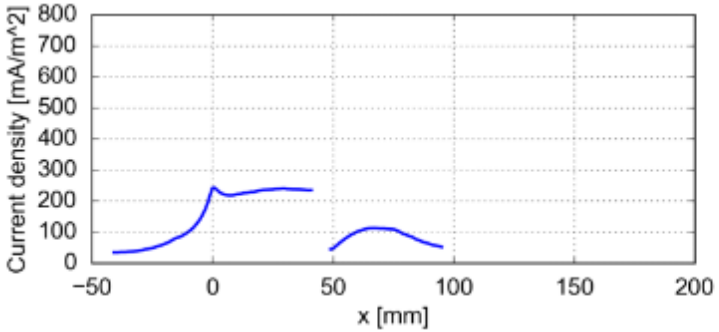
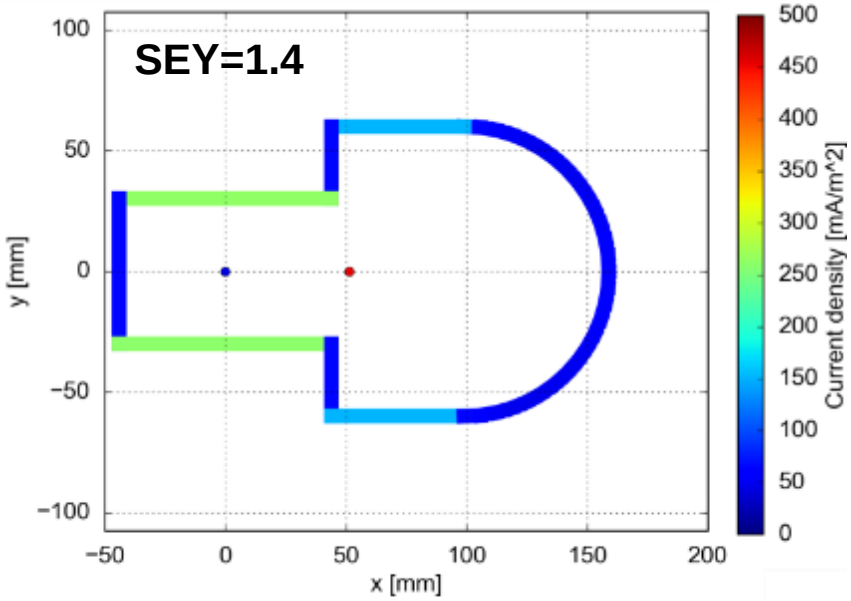


- e-cloud starts to buildup on the surface of the jaws

Electron flux on the different surfaces



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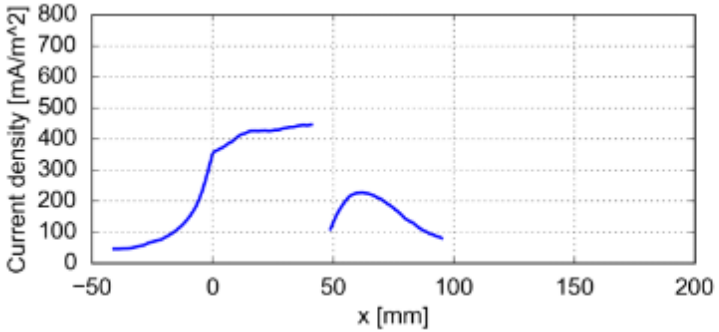
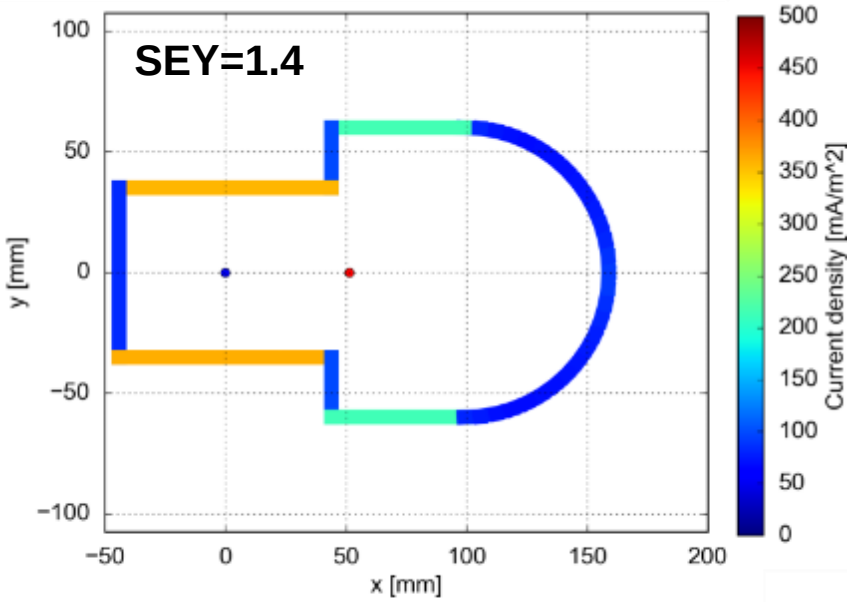


- e-cloud starts to buildup on the surface of the jaws and on the flat parts of the beam screen

Electron flux on the different surfaces



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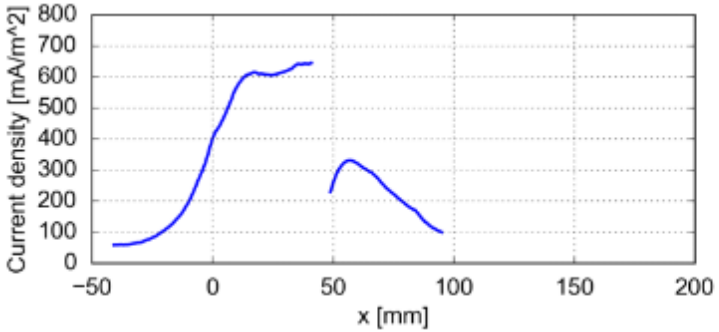

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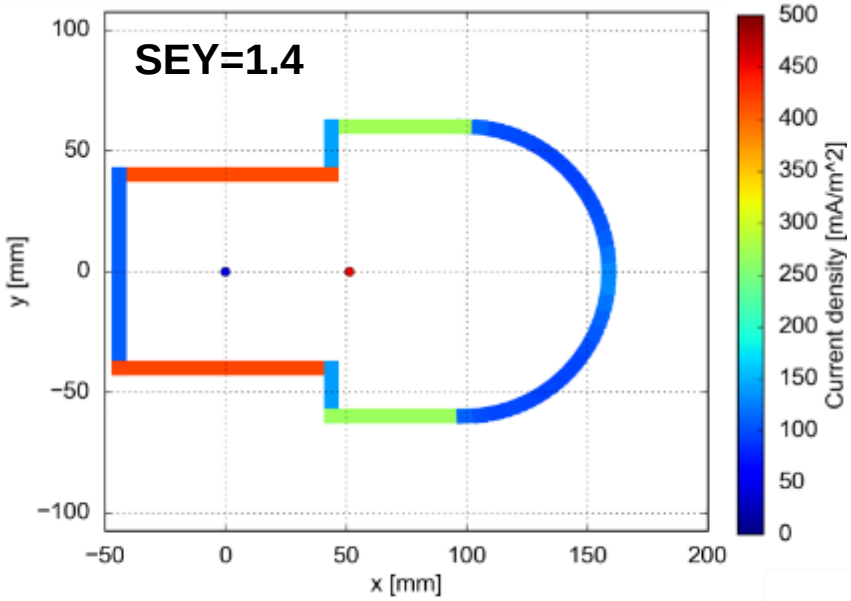

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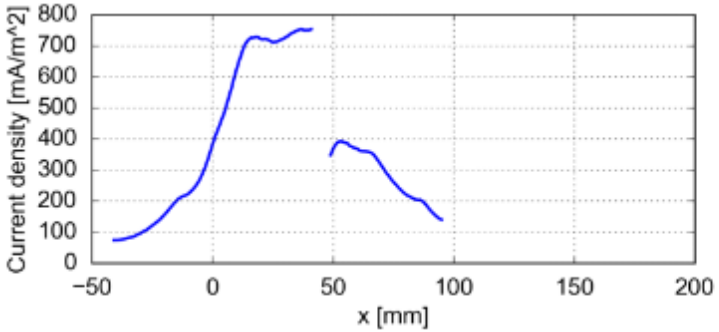
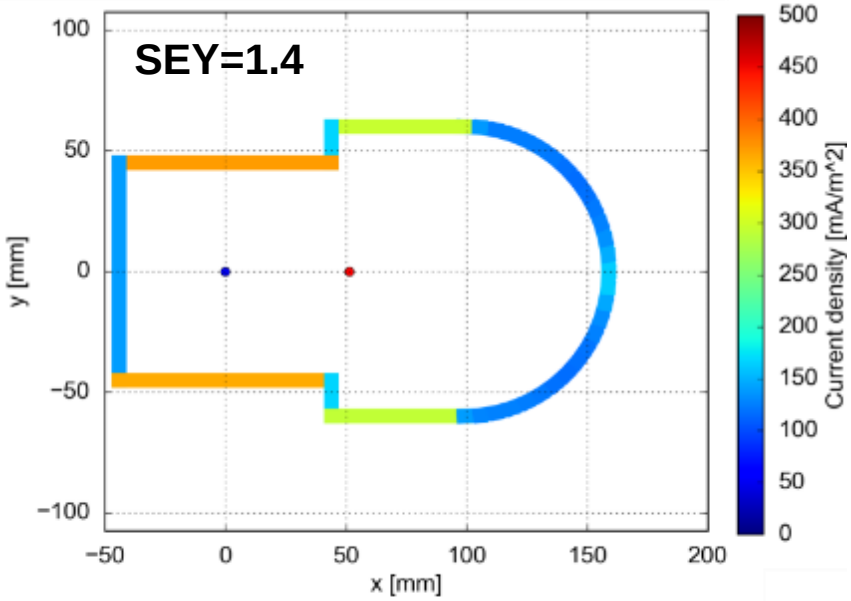


- e-cloud starts to buildup on the surface of the jaws and on the flat parts of the beam screen

Electron flux on the different surfaces



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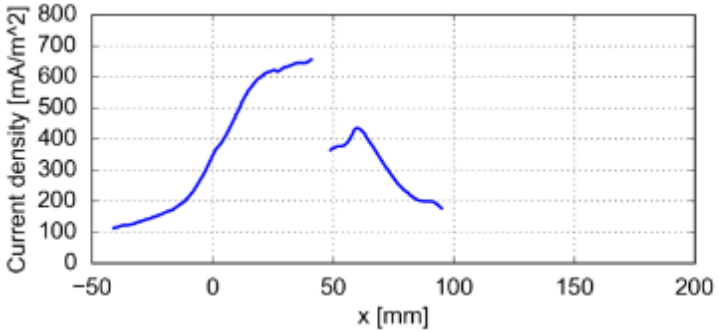

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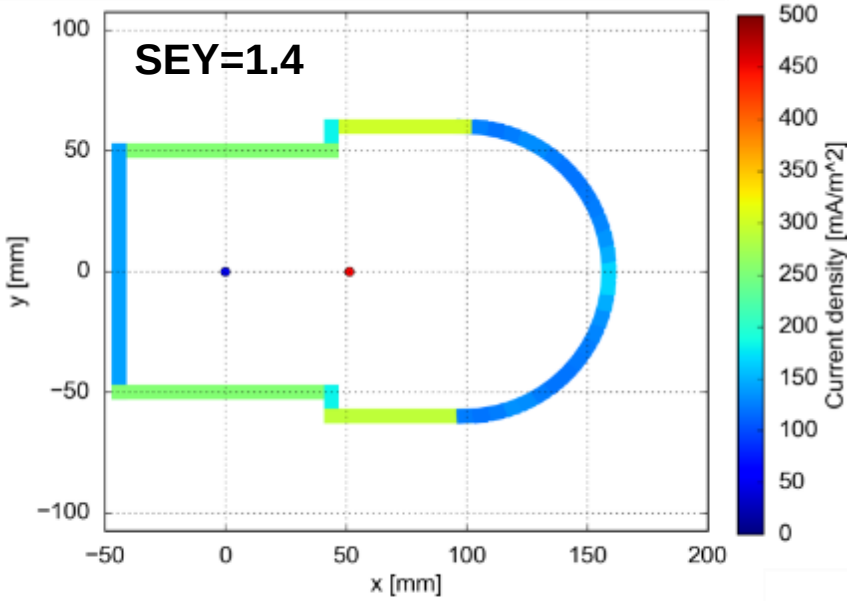

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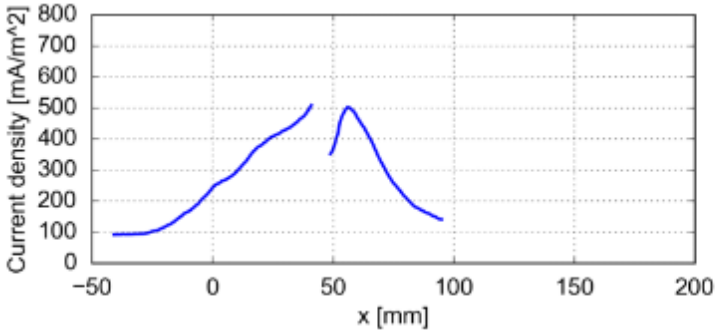
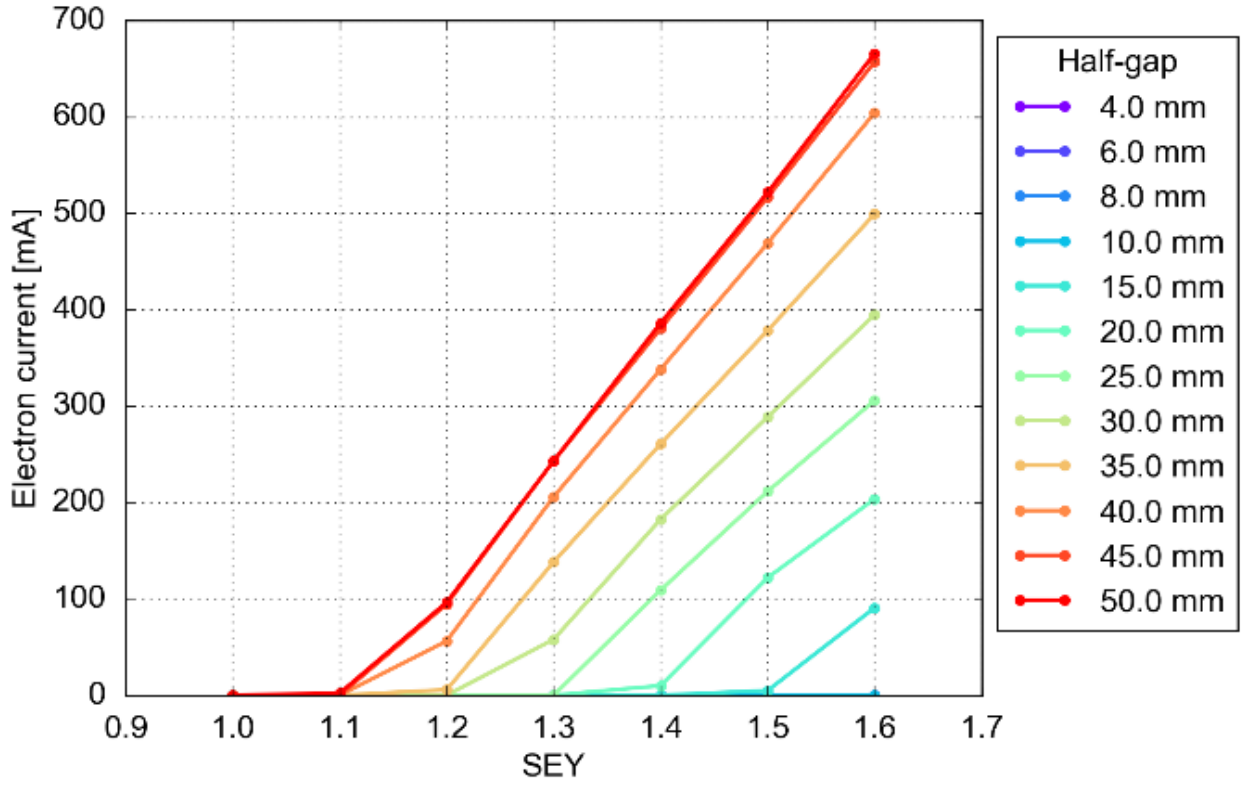


- e-cloud starts to buildup on the surface of the jaws and on the flat parts of the beam screen

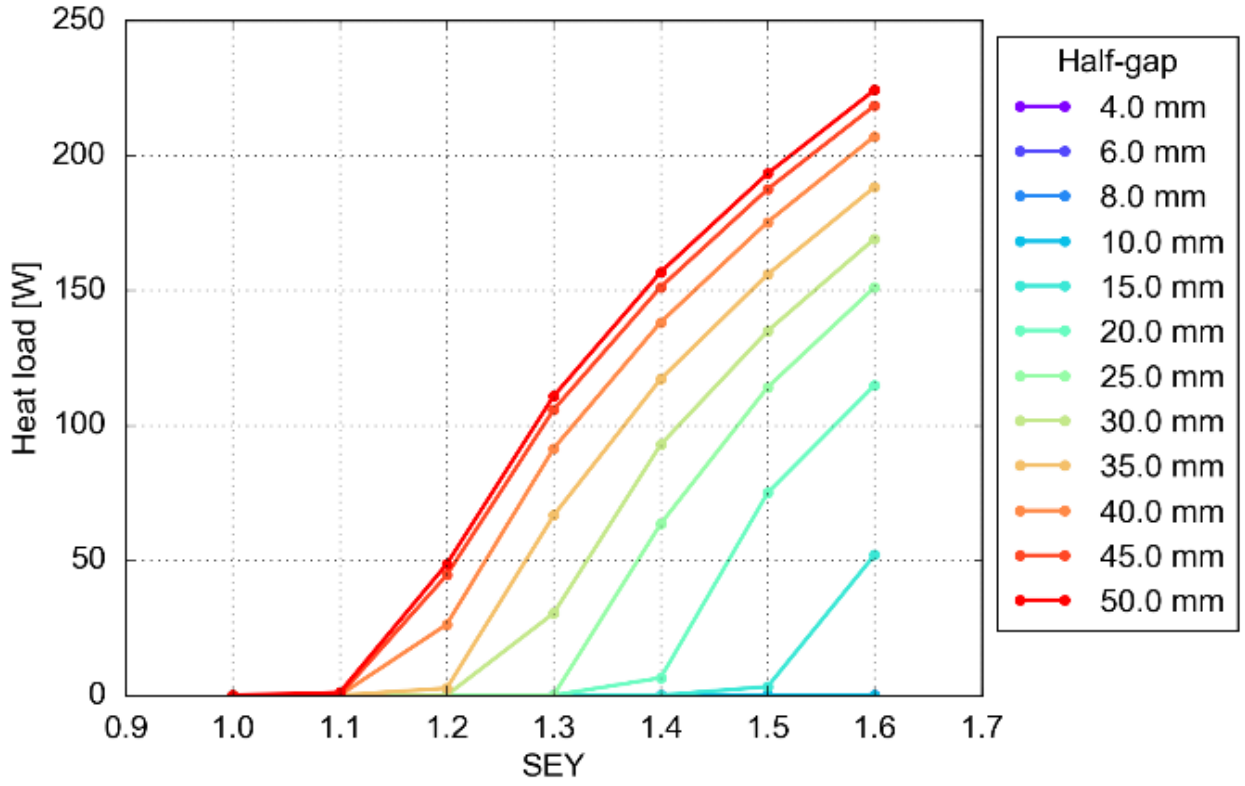
Total electron flux

- Electron flux on the walls increases for large gaps
- Multipacting threshold very high for small gaps and decreasing when the jaws are opened
- Situation tends to saturate for half-gaps larger than 40 mm



Heat deposition from the e-cloud

- Even for the worst half-gap (50 mm) and for high SEY the heat load on the whole device does not reach 250 W



Summary

We simulated the e-cloud in the presence of both beams in the TDIS assuming:

- Different gaps: 1-50 mm
- Uniform SEY: 1.0-1.6

Electron flux on the walls increases for large gaps:

- e-cloud builds up mainly from the surface of the jaws and on the flat parts of the beam screen
- Multipacting threshold very high for small gaps and decreasing when the jaws are opened
- Electron flux and heat-load tend to saturate for half-gaps larger than 40 mm

Heat load from e-cloud on the whole device does not reach 250 W even for large gaps