CERN

e-cloud in TDI

Galina Skripka and Giovanni Iadarola

Many thanks to:

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

Outline

- Simulation setup
- Single beam vs two beams in TDI and TDIS
- e-cloud depending on the TDIS gap and SEY

e-cloud simulations in TDI

We performed a series of simulations:

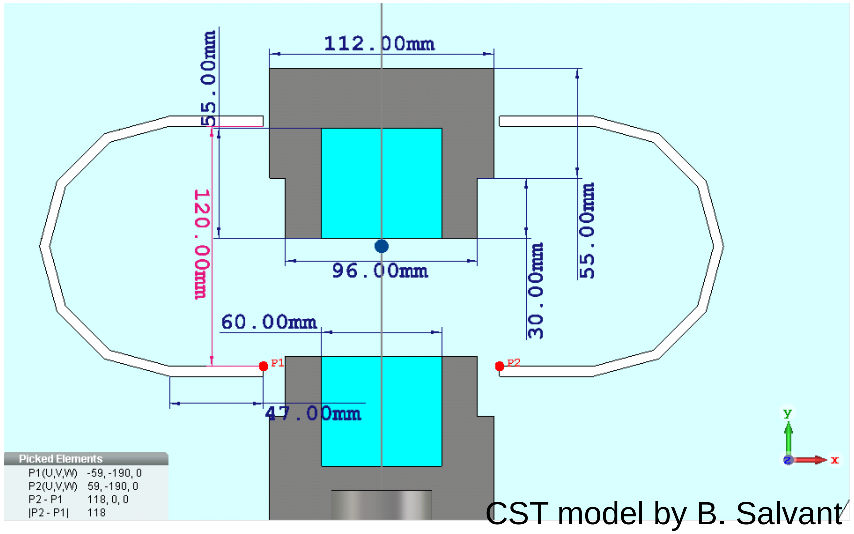
- Assumed uniform SEY for the whole profile
- SEY=1.4-1.5 (Cu-like) can be considered as a worst case scenario

Main simulation parameters

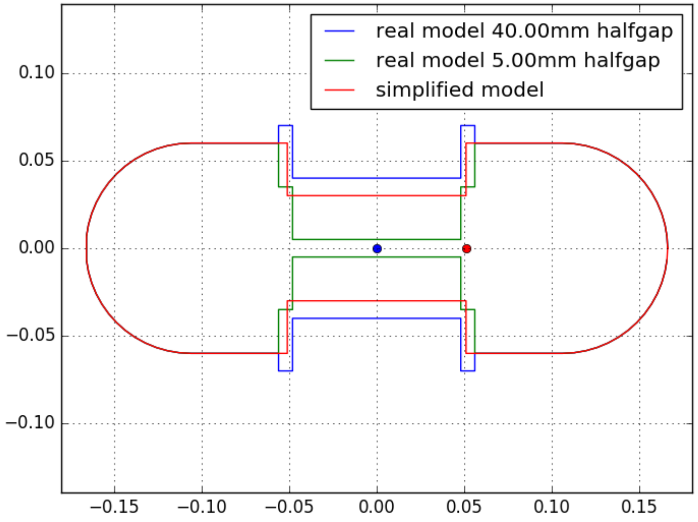
- Beam parameters: 450 GeV, 25 ns, 1.1e11 p/bunch
- Two counter-rotating beams (simulated different transverse slices of the device)
- Half-gap scan: 1 - 50 mm
- SEY scan: 1.0 – 1.6

Geometry

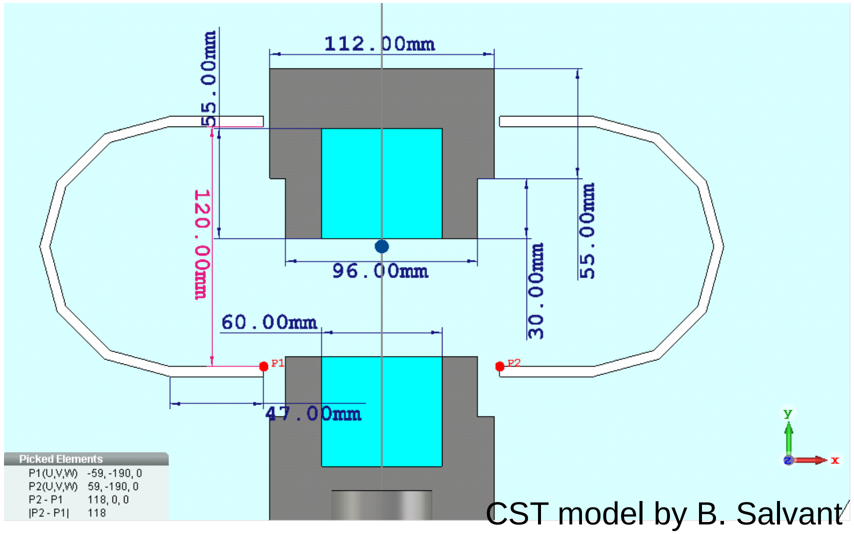
- Model simplification: no step-out included



CST model by B. Salvant



e-cloud simulations in TDI



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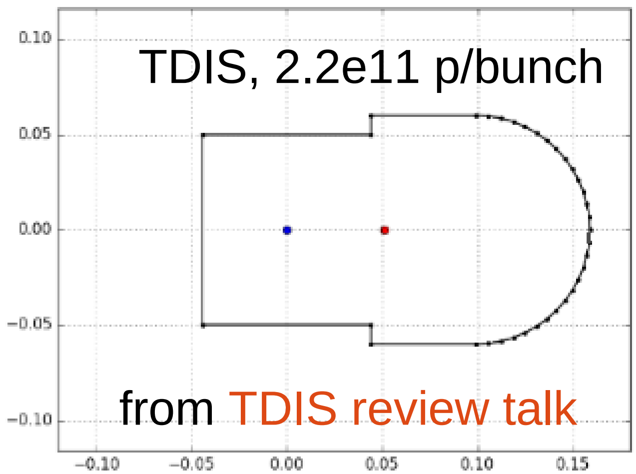
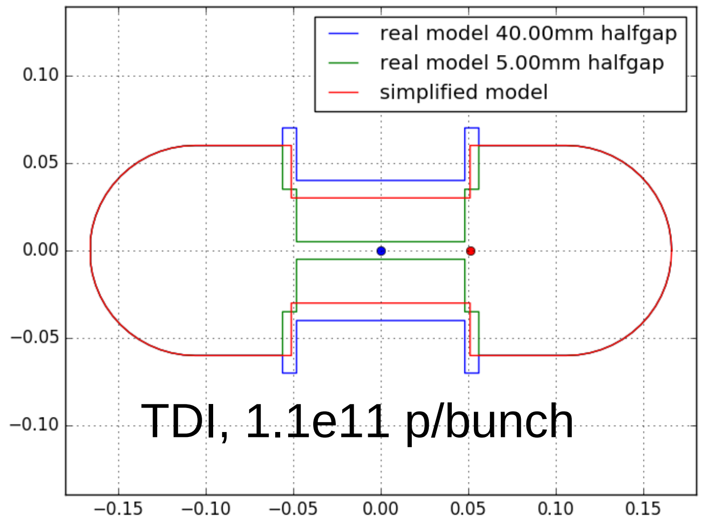
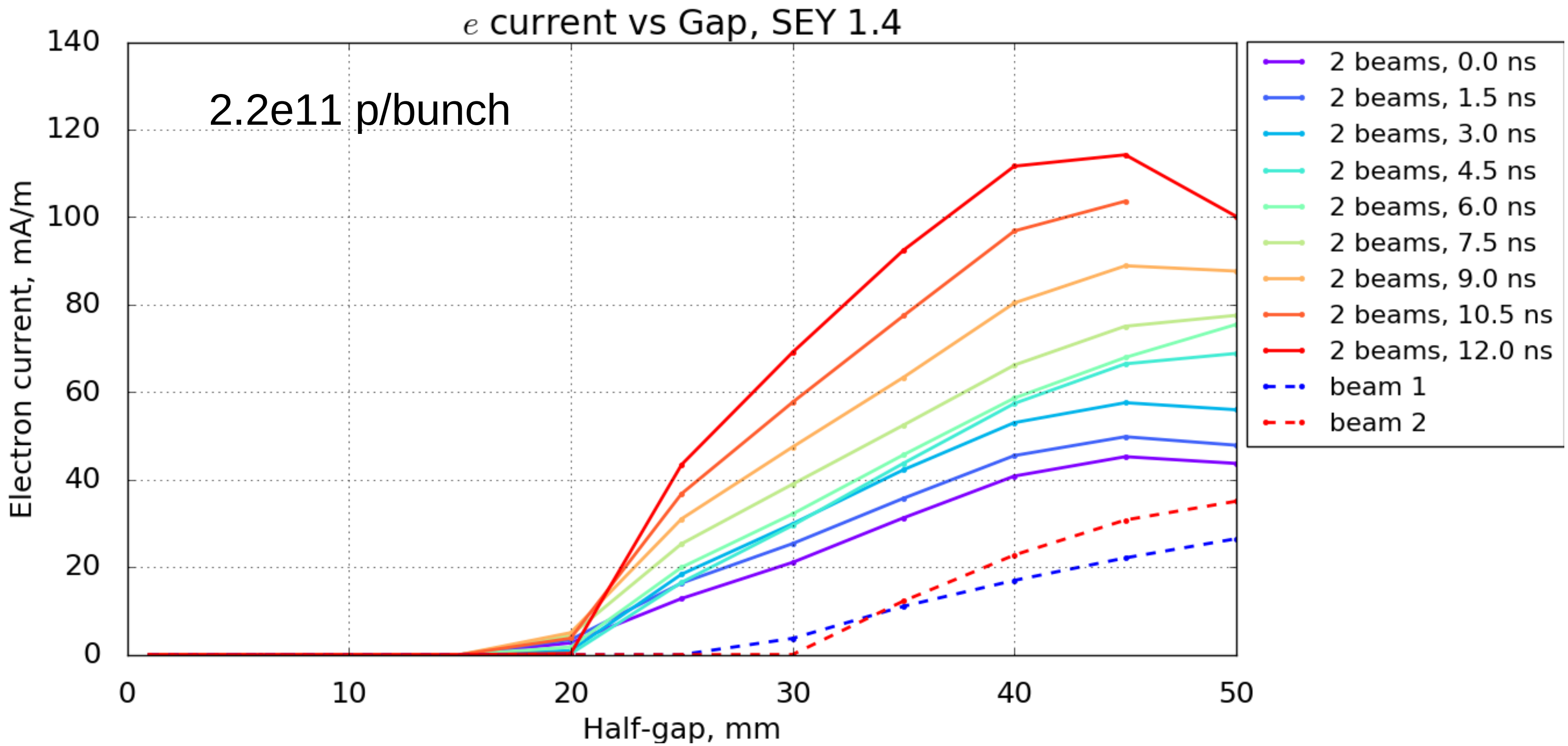




Single beam vs two beams(TDIS)

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 along the device (different delays)

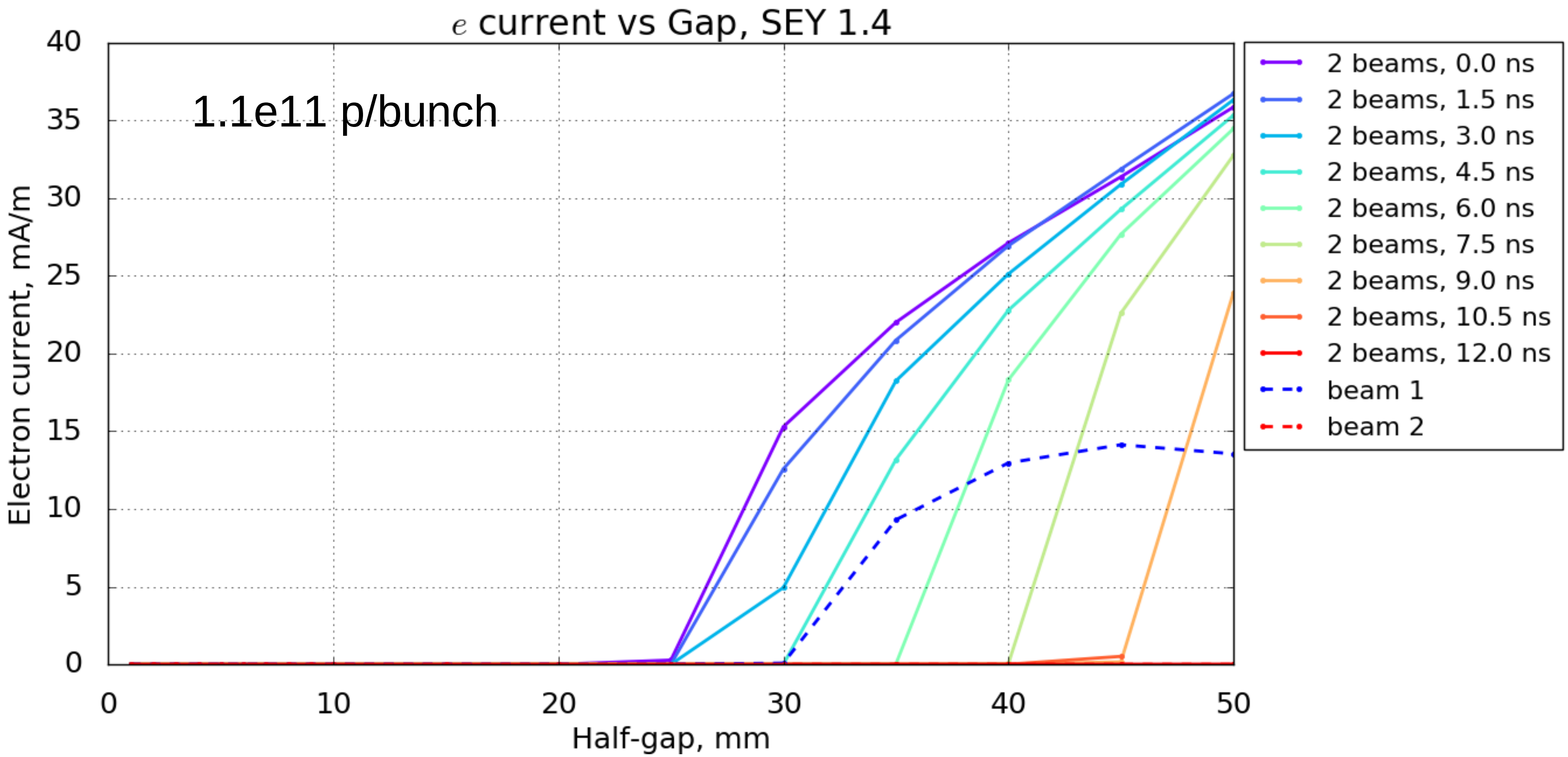
- Multipacting thresholds can be really different!
- Multipacting is stronger in presence of two beams



Single beam vs two beams(TDI)

Common vacuum chamber simulated for different locations along the device (different delays)

- Effect of beam 2 alone is negligible
- Multipacting is not always stronger in presence of two beams



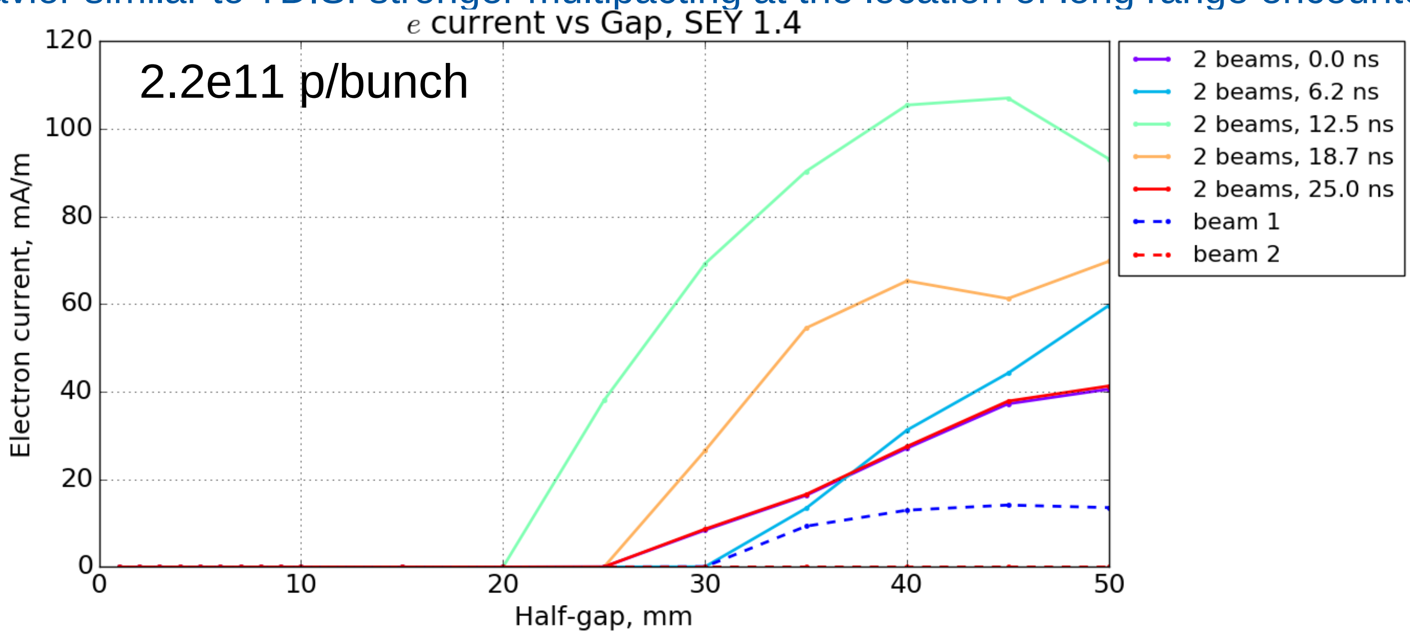
Single beam vs two beams(TDI)

TDI unlike TDIS is:

- Multipacting threshold is sensitive to delay between the two beams
- Has stronger multipacting at the location of long range encounters but not in between

TDI with double beam intensity:

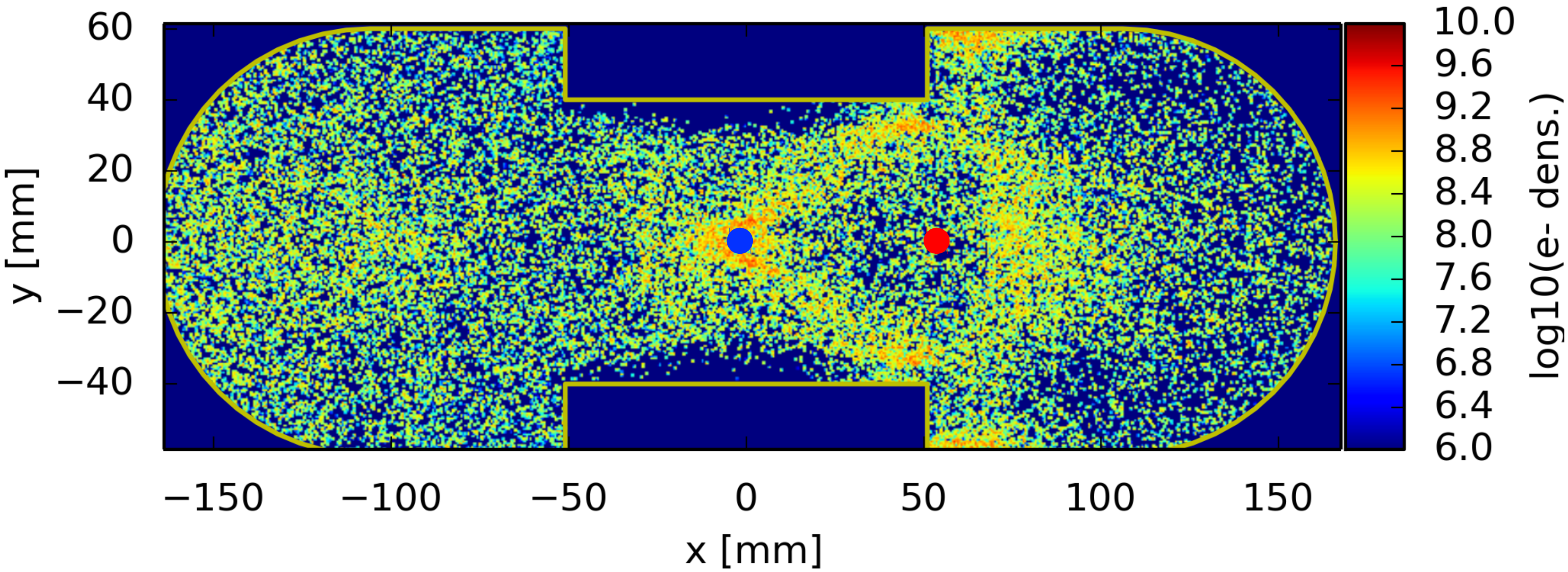
- Behavior similar to TDIS: stronger multipacting at the location of long range encounters



Double beam intensity for the same bunch spacing leads to the opposite trend of e-cloud build-up along the device!

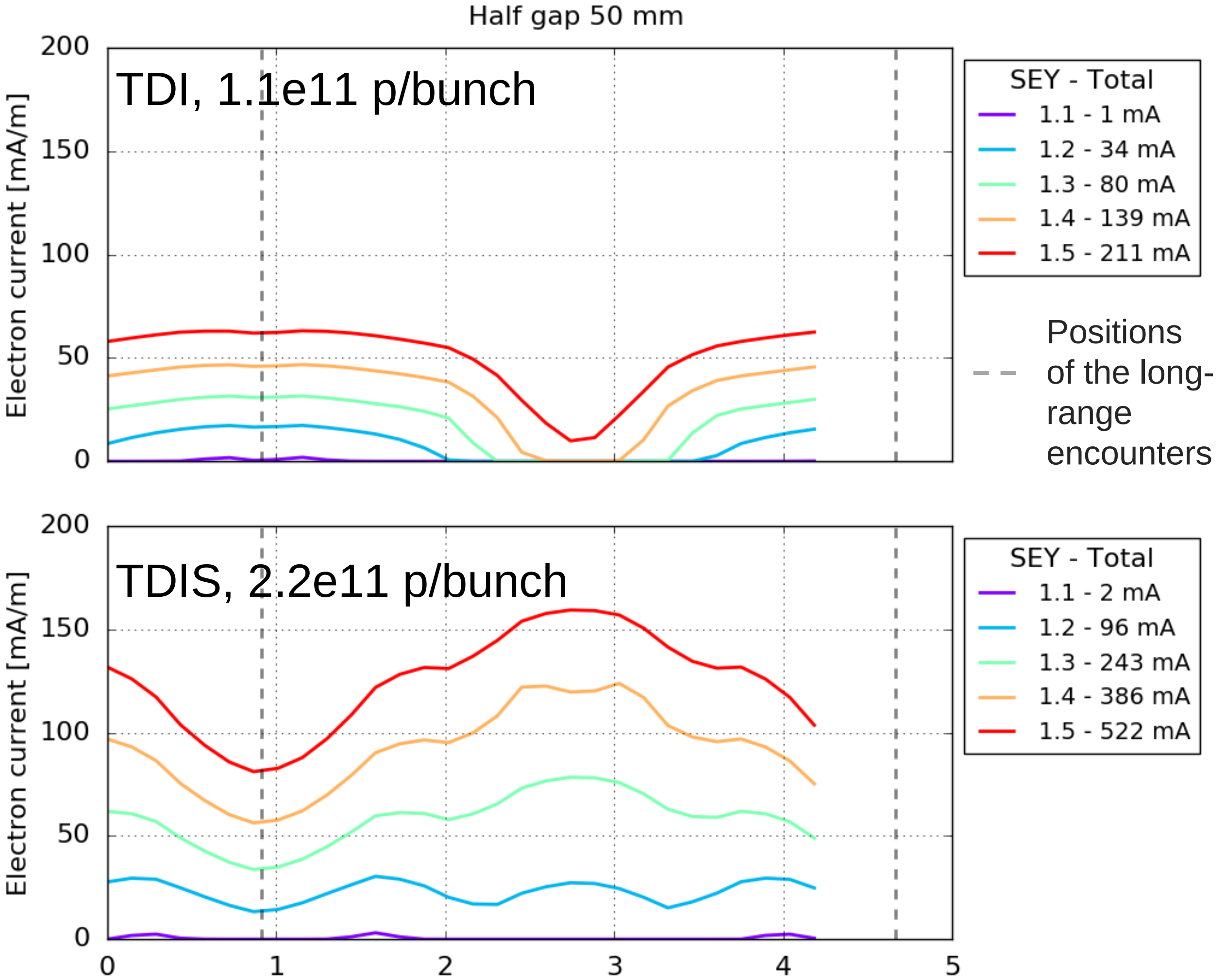
Electron distribution

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



Longitudinal current profiles (TDI vs TDIS)

- Multipacting is stronger at the positions where the two beams are not synchronized (12.5 ns equivalent spacing) in TDIS and has opposite trend in TDI



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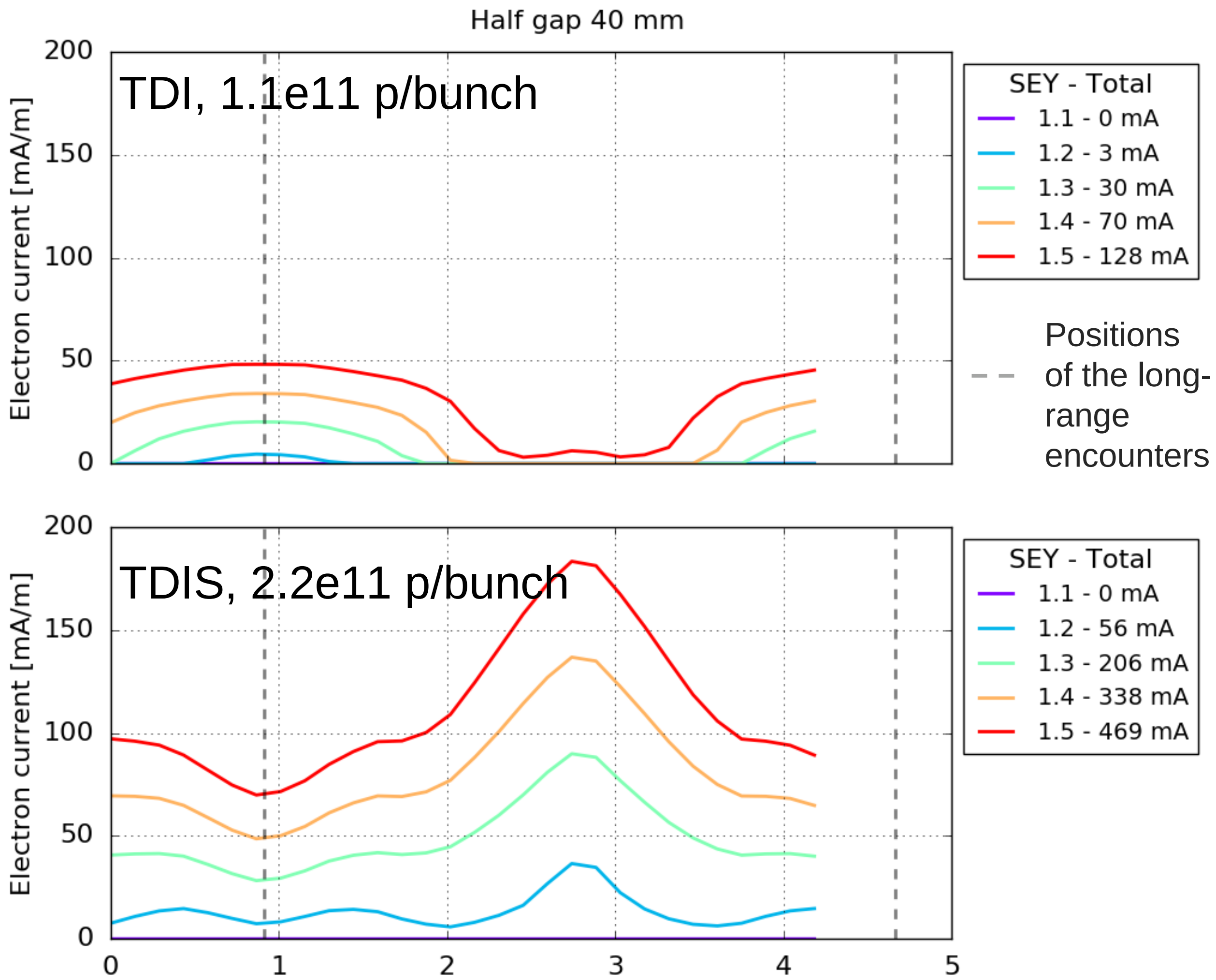

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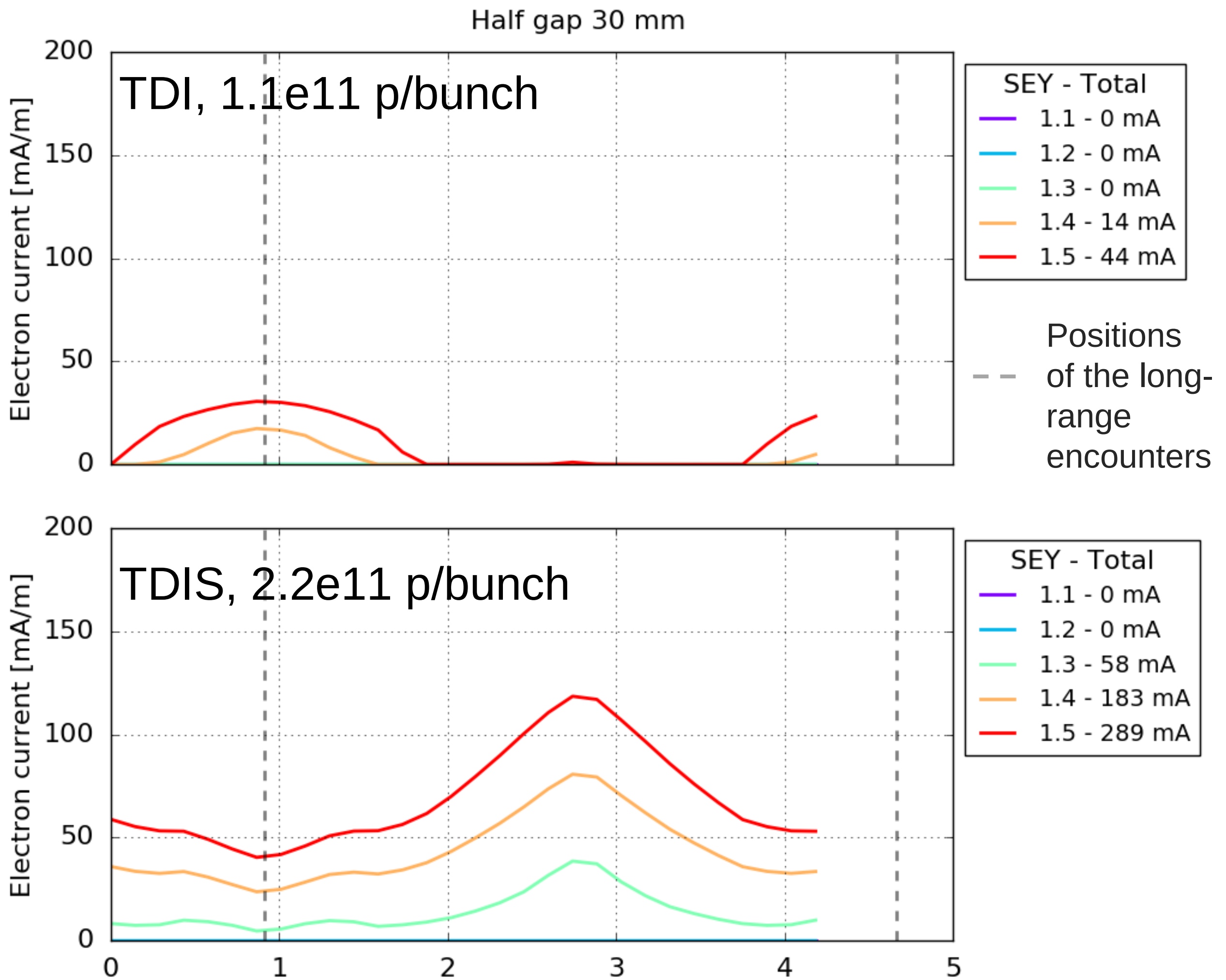

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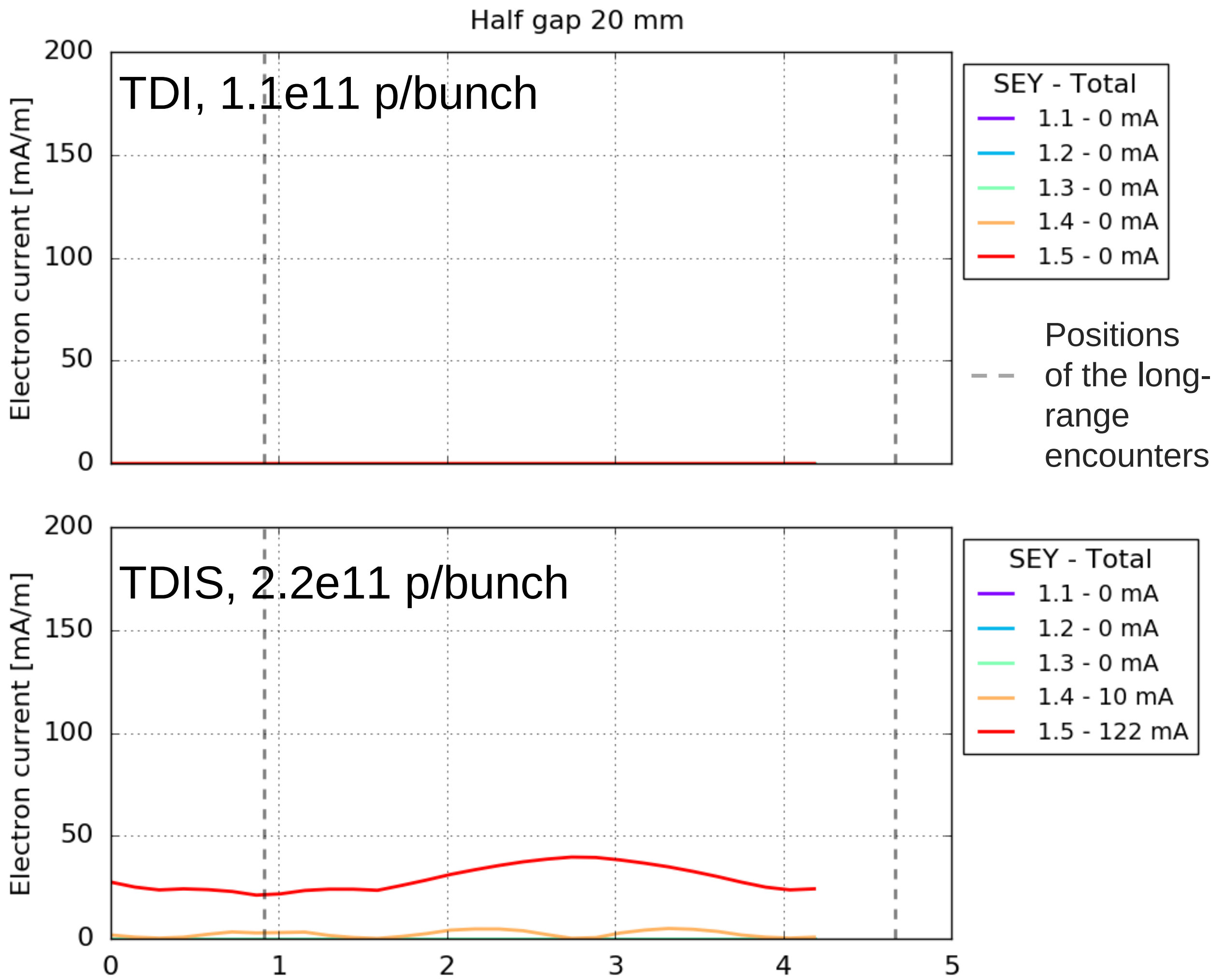

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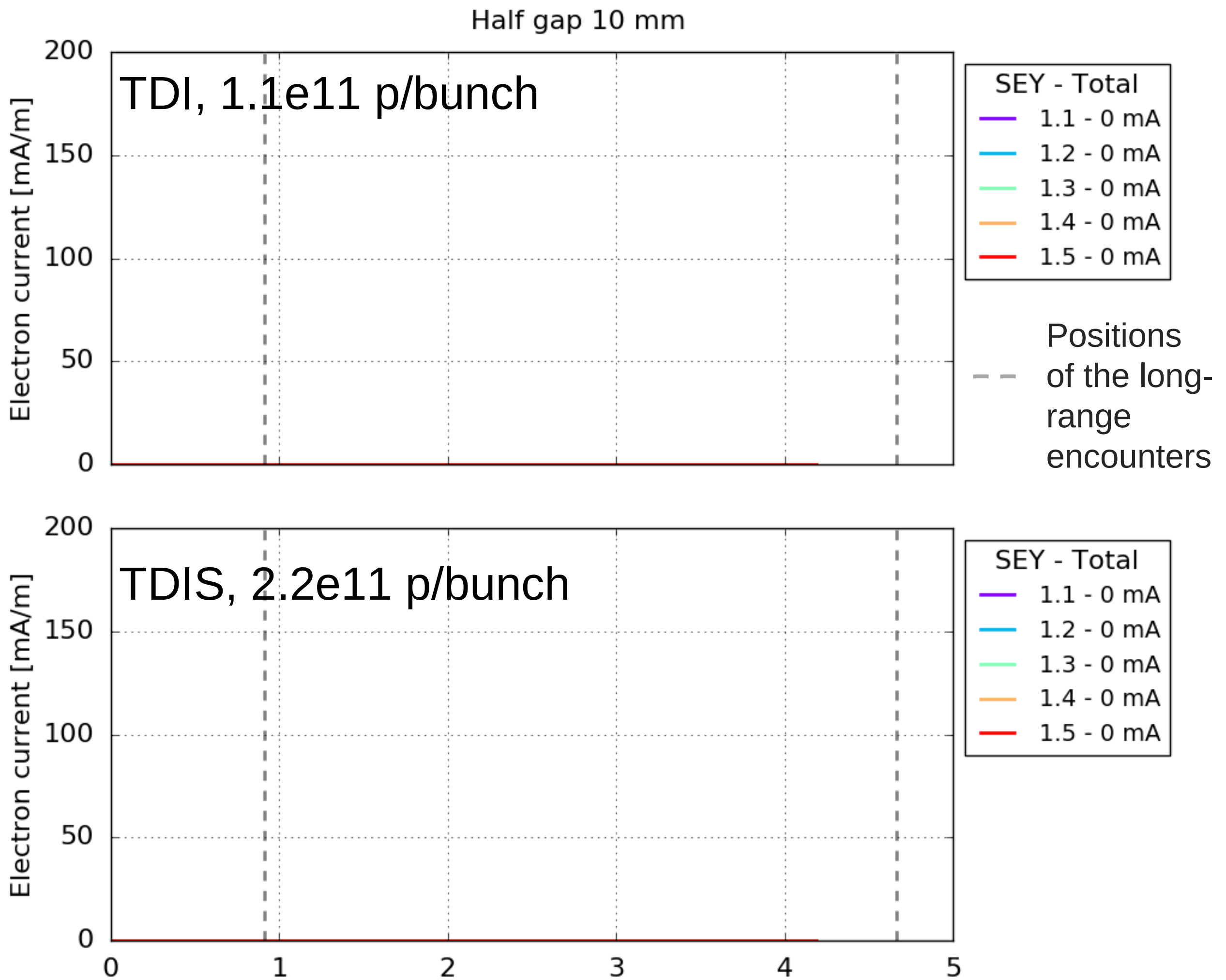
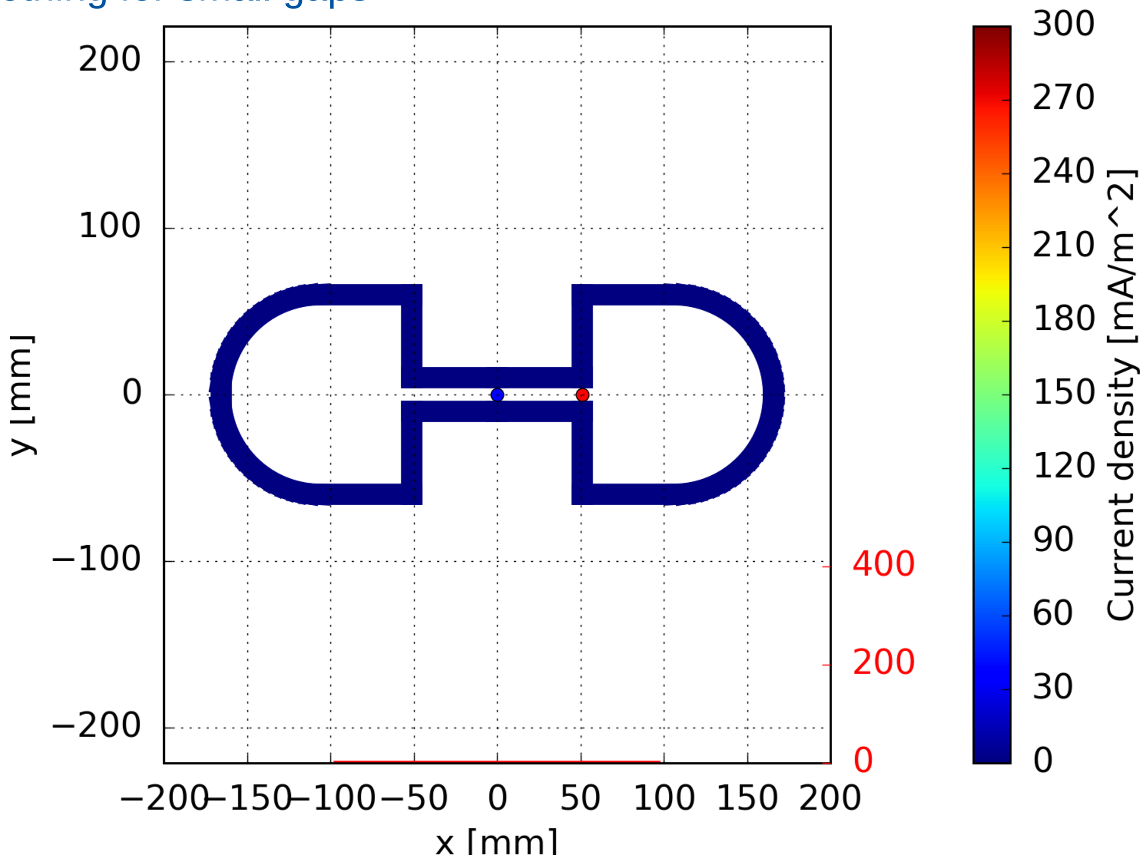


Electron flux on the different surfaces

SEY = 1.4

- Cross section at the location of the long range encounters
- Basically nothing for small gaps



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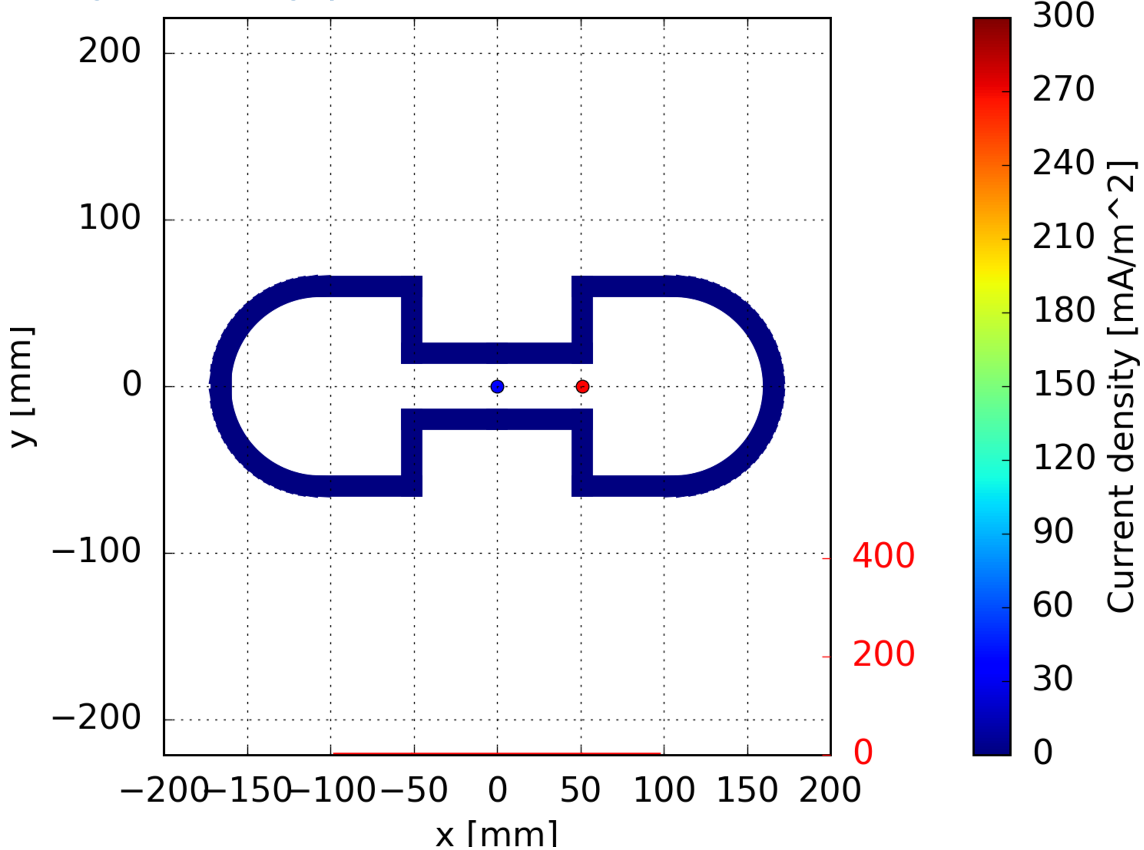
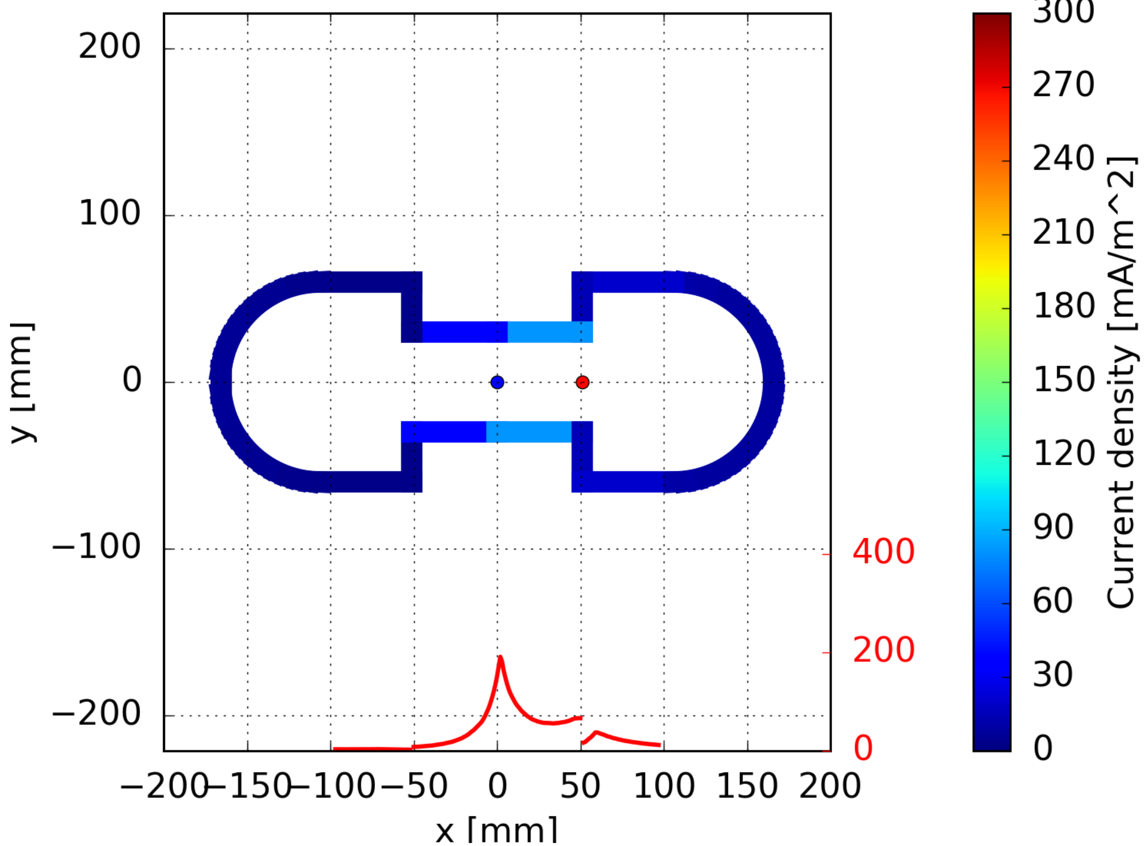


Electron flux on the different surfaces

SEY = 1.4

- Cross section at the location of the long range encounters
- e-cloud starts to buildup on the surface of the jaws and flat parts of the beam screen



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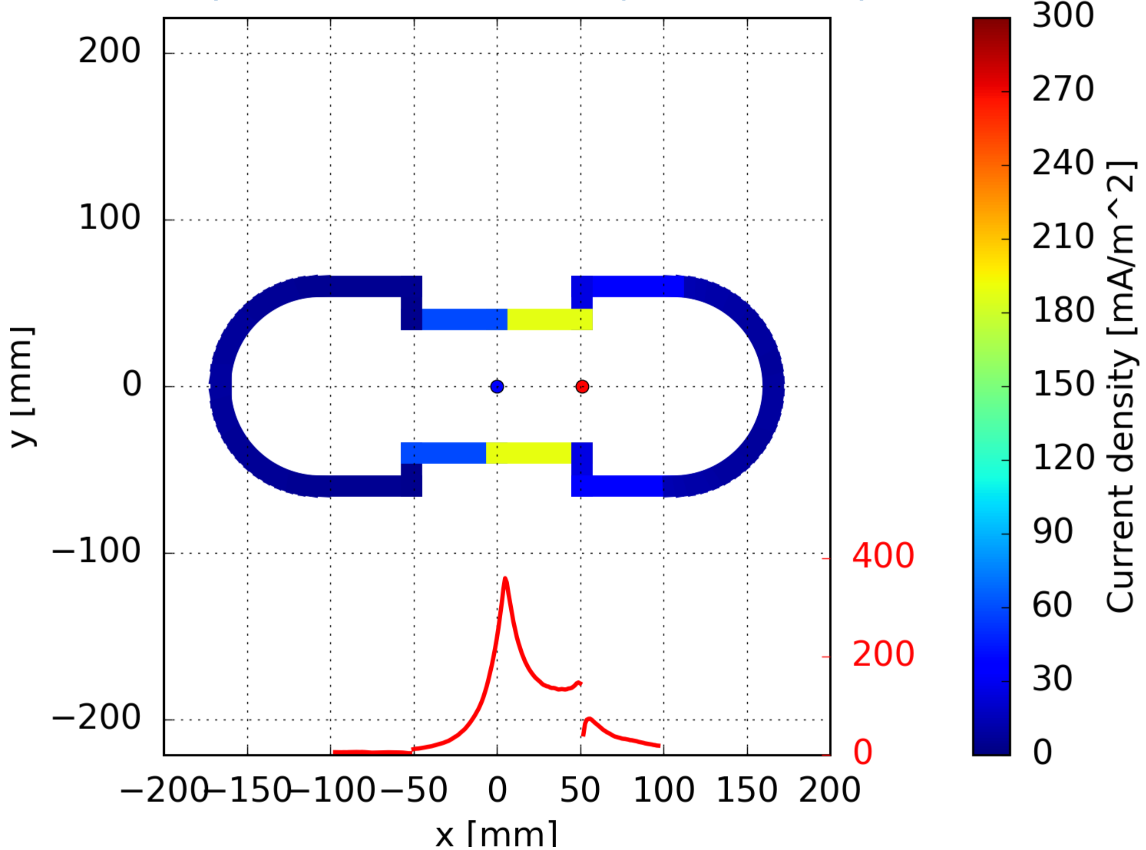

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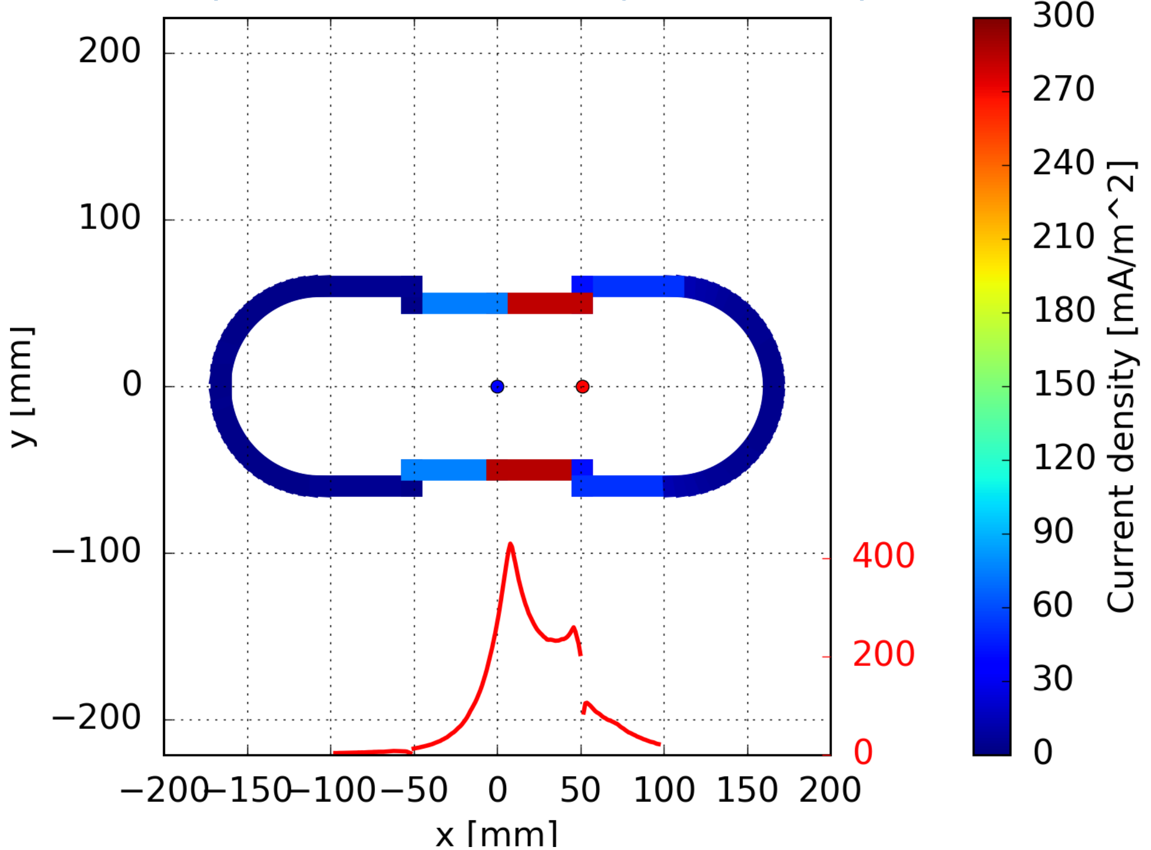
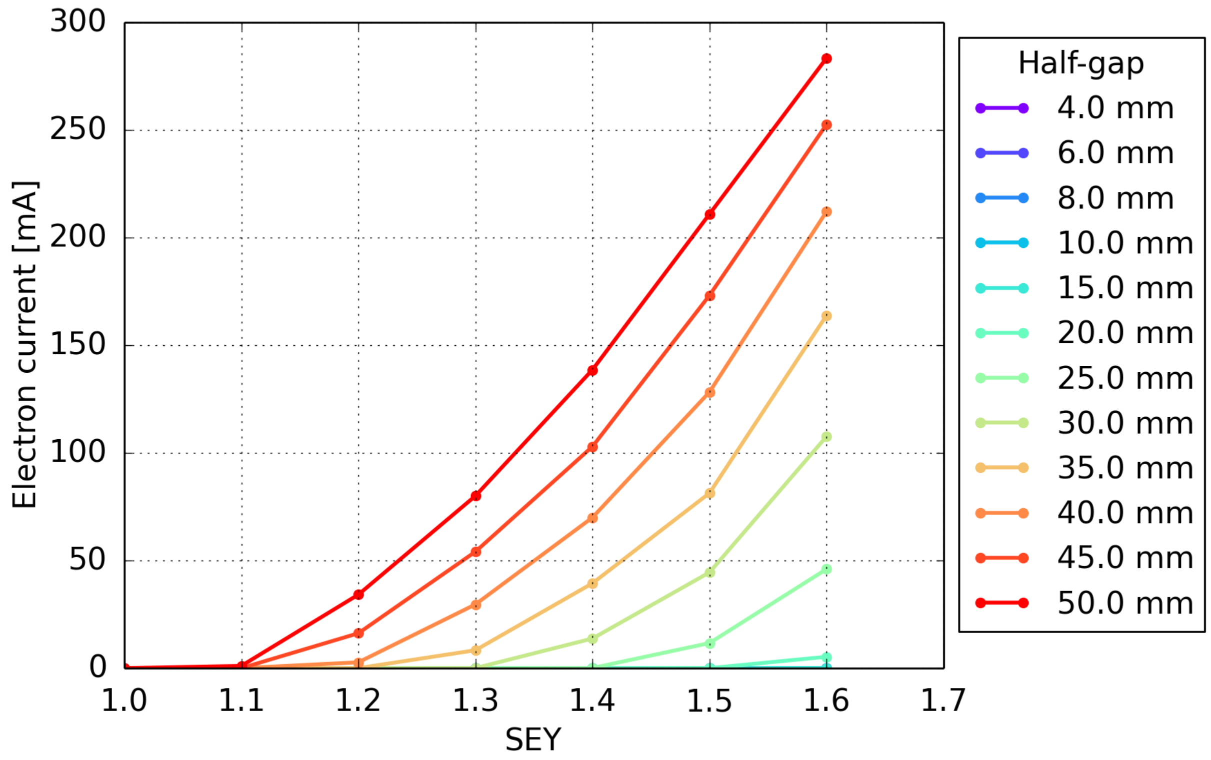


Total electron flux

- Electron flux on the walls increases for large gaps
- Multipacting threshold very high for small gaps and decreasing when the jaws are opened
- Unlike in HL-LHC case (TDIS, 2.2e11 p/bunch) there is no saturation



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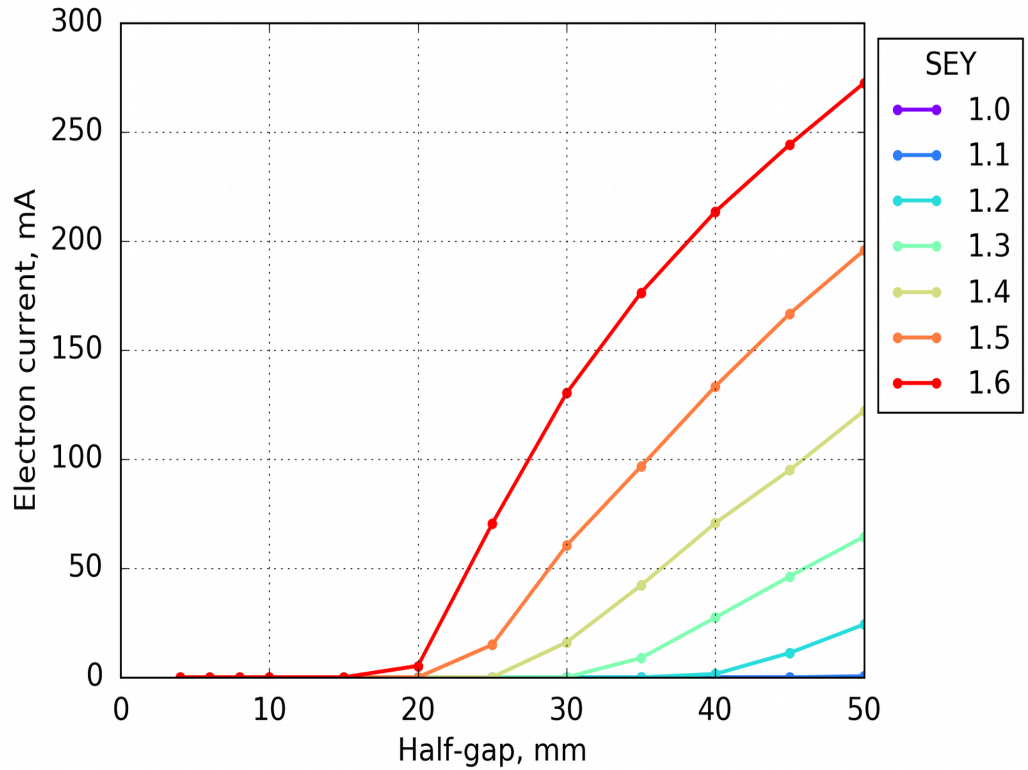
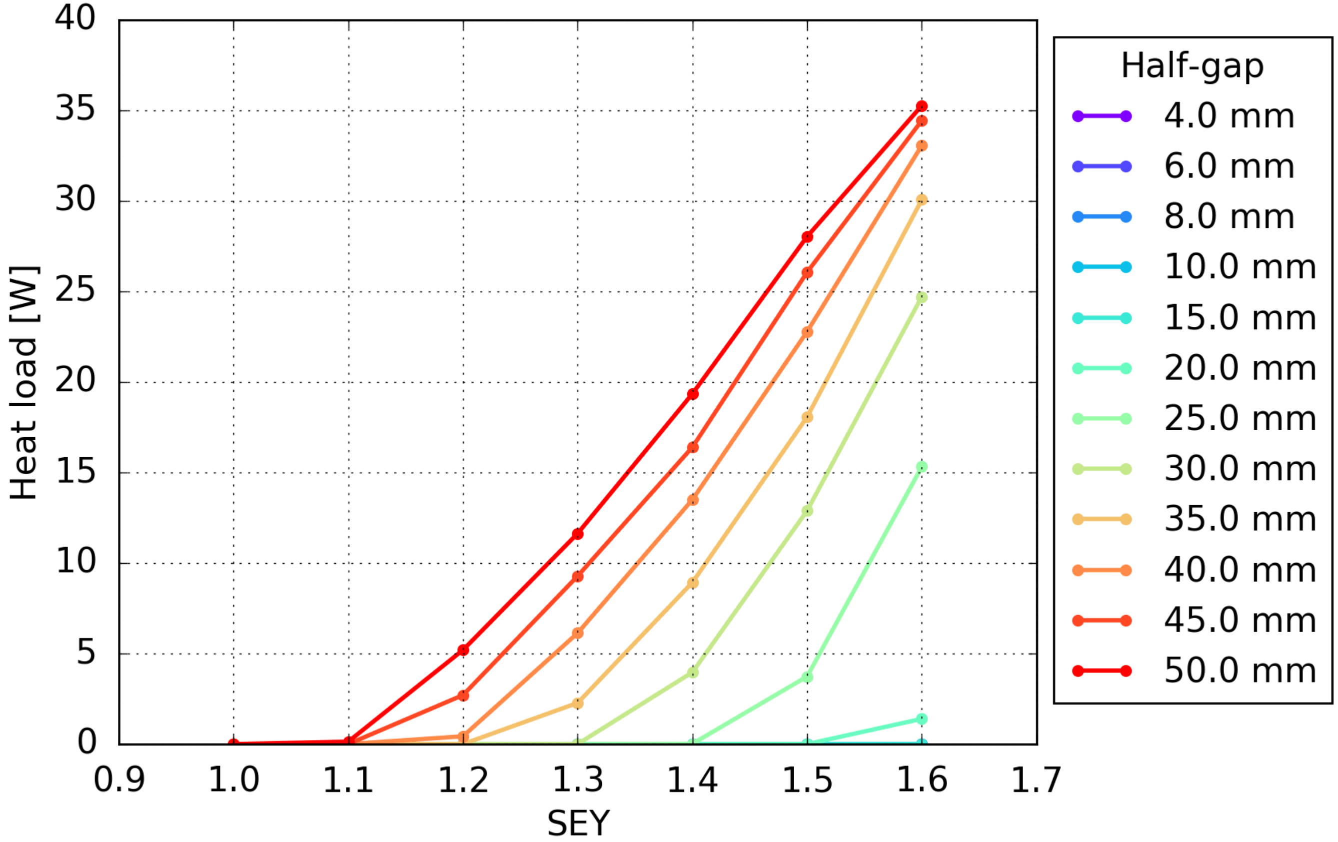


Heat deposition from the e-cloud

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



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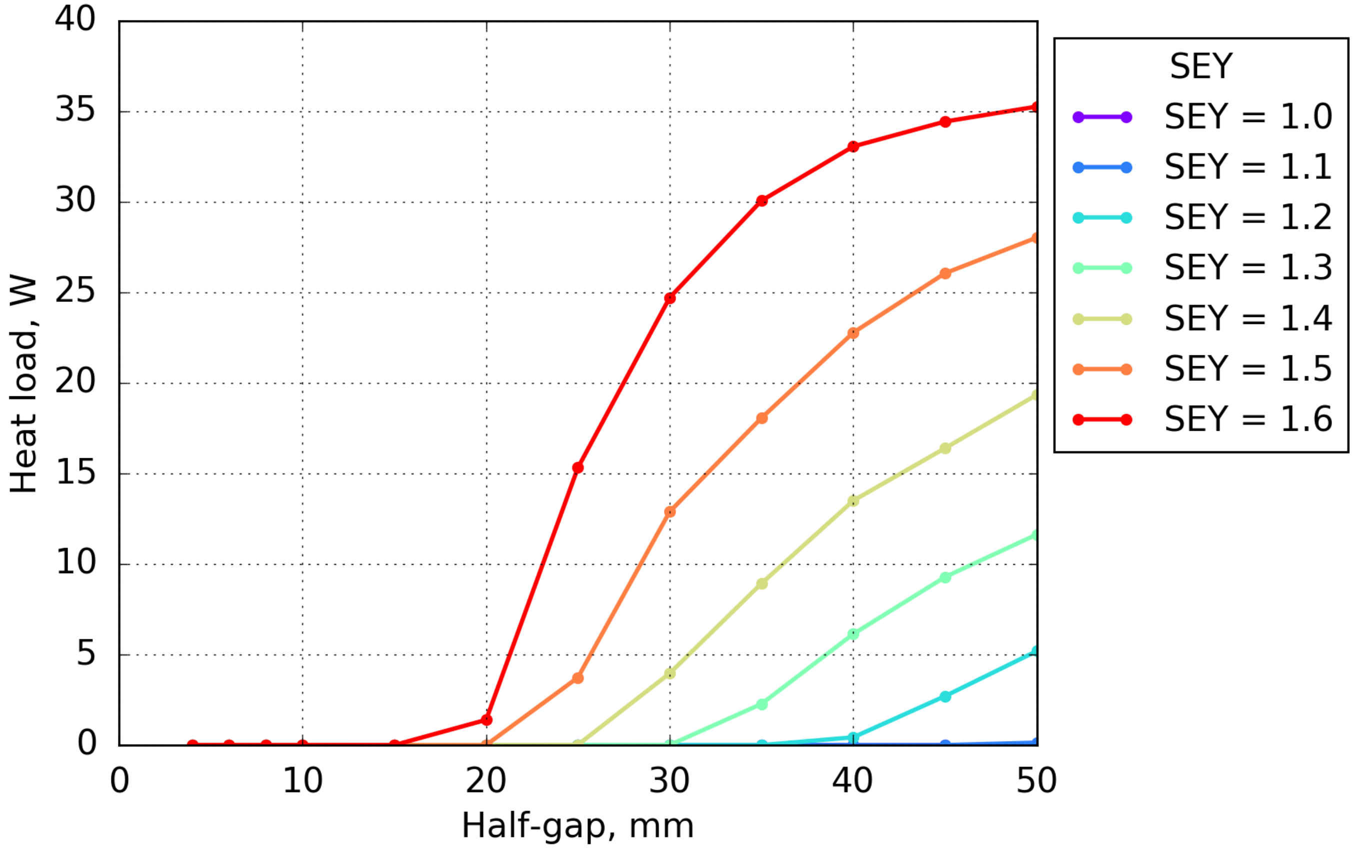

Summary

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

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

Double intensity (2.2e11 p/bunch vs 1.1e11 p/bunch):

- Electron current along the device has opposite trend

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

Heat load from e-cloud on the whole device does not reach 50 W even for large gaps