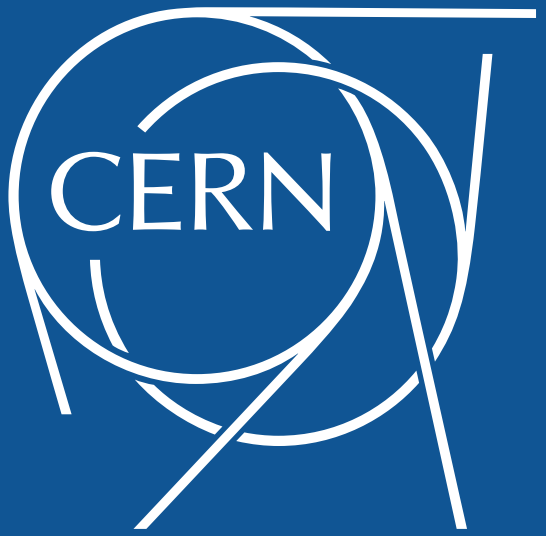
CERN

Dependence of electron cloud build-up on beam position

Eric Wulff

Acknowledgements: Thanks to Gallina Skripka and Giovanni Iadarola for helpful discussions and input

Outline

- Goal
- e-cloud simulation setup
- SEY threshold
- Heat load versus offset
- Current vs offset
- Energy spectra
- Current distribution
- Electron density animation
- Summary

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Goal

- To study the electron cloud build-up process and its dependence on **beam position**, **SEY** and **beam intensity**
- Especially the **heat load** and **current** deposited on the chamber walls were studied

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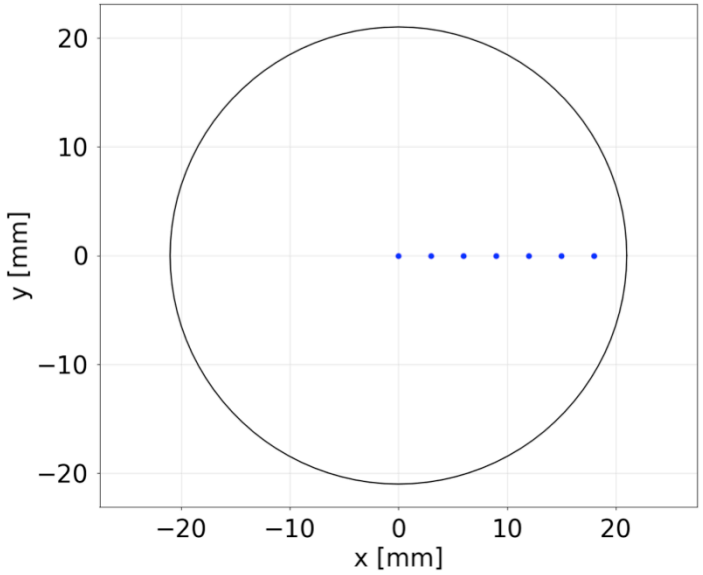
e-cloud simulation setup

- 25 ns bunch spacing
- 450 GeV beam energy
- $\beta_x = \beta_y = 100$ m
- No magnetic field
- Uniform initial electron density
- SEY scan: 1.0 - 2.9
- Intensity scan: 0.5 - 2.5 $\times 10^{11}$ p/bunch
- Beam offset scan: 0 - 18 mm
- Chamber diameter: 42 mm



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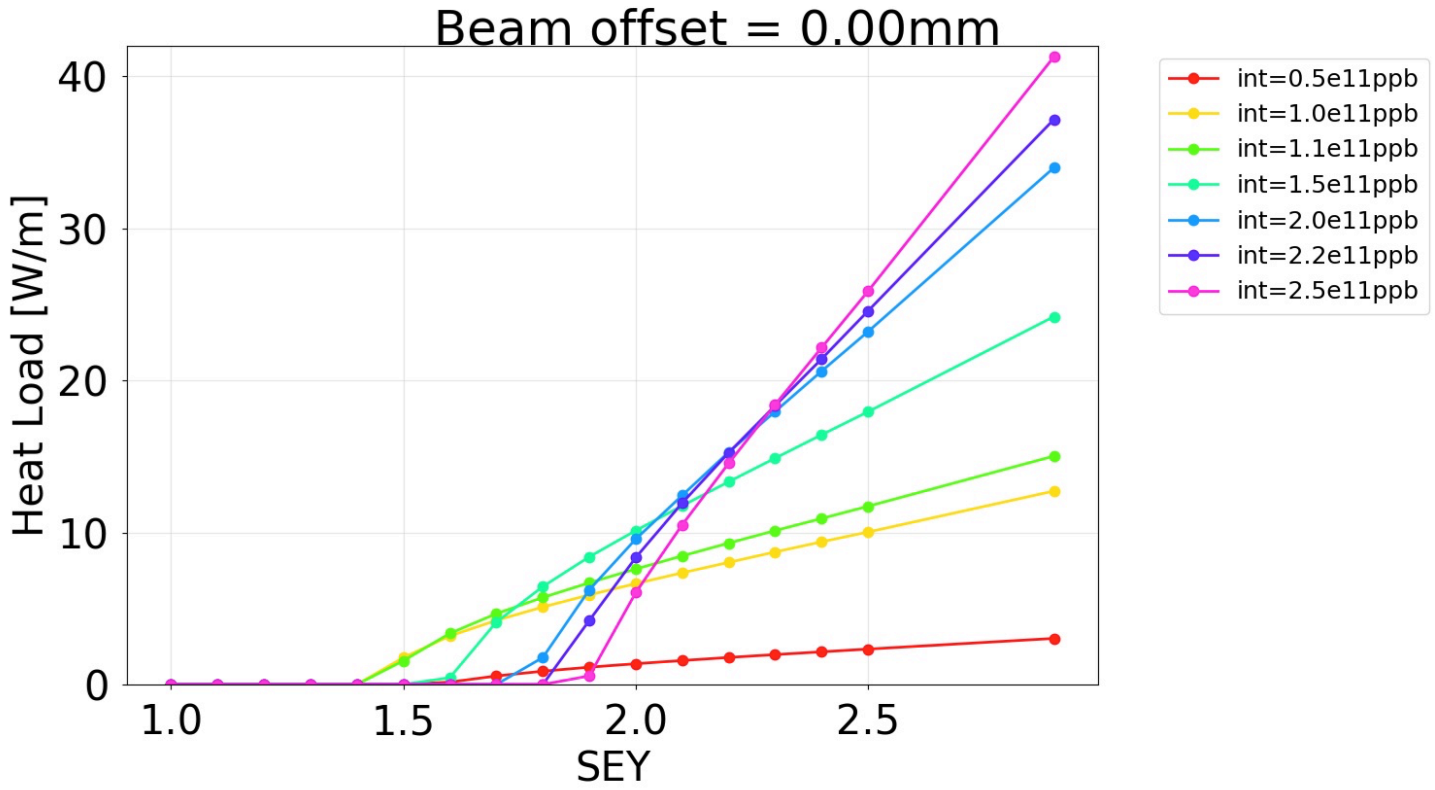
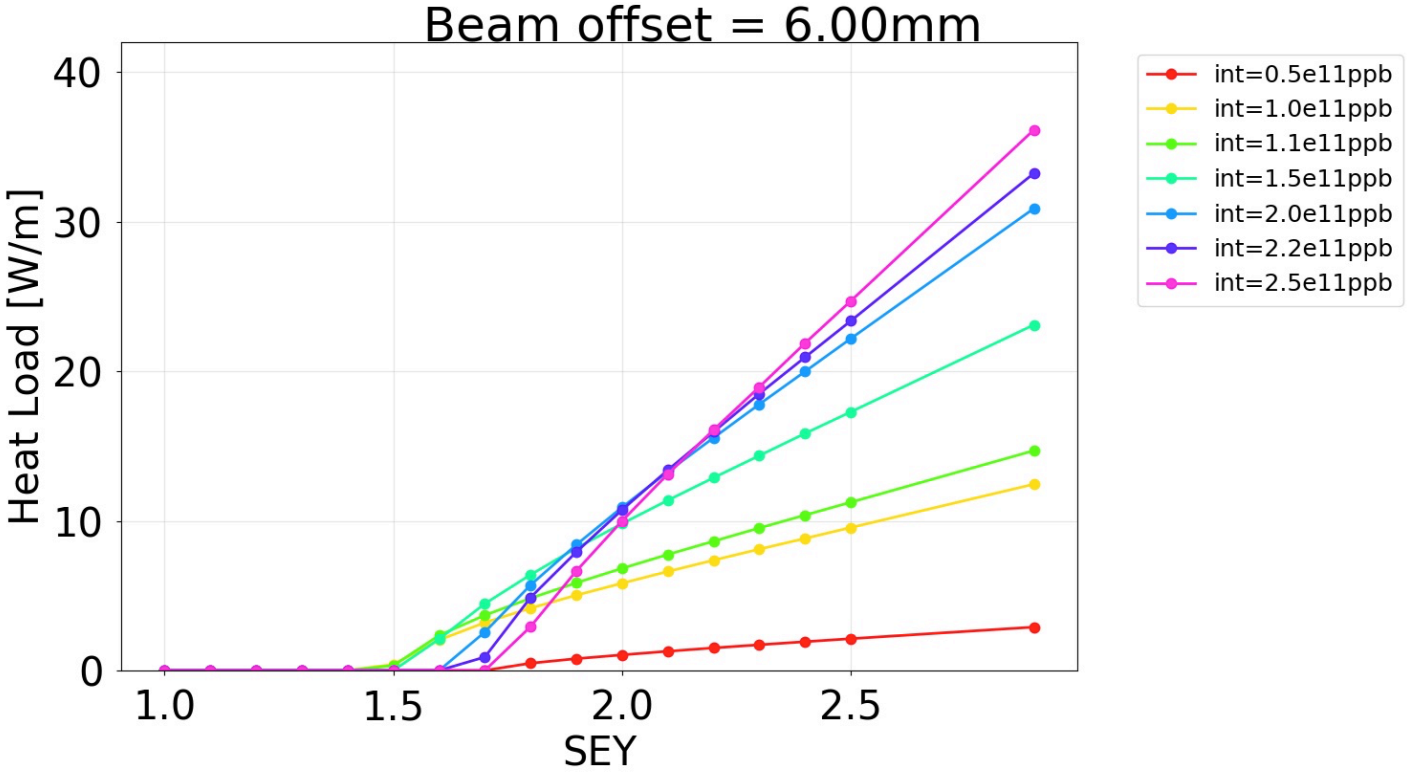
SEY threshold



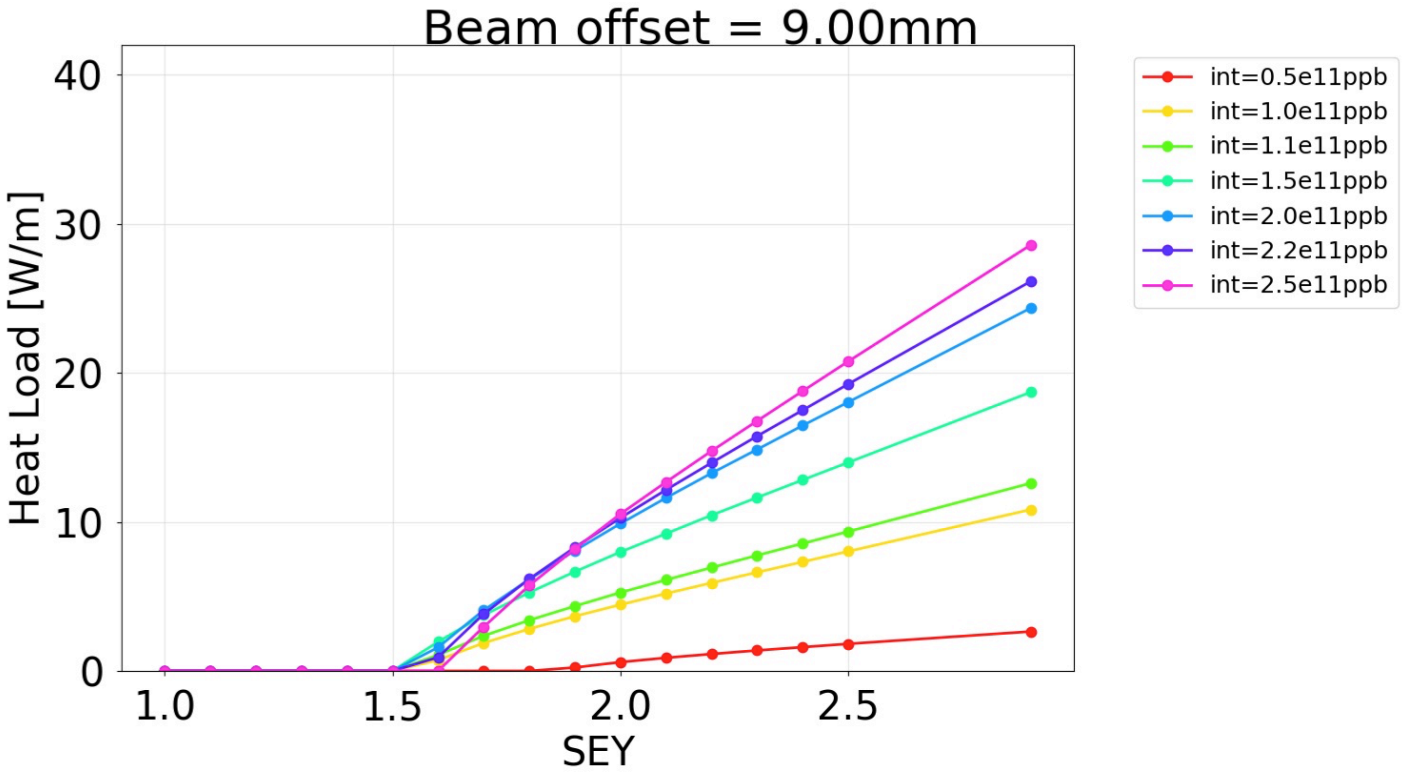
- At zero offset the SEY threshold is larger for higher intensities
- For SEYs of 1.4 or lower, no simulations show multipacting

SEY threshold



- At zero offset the SEY threshold is larger for higher intensities
- As the offset is increased the thresholds move

SEY threshold



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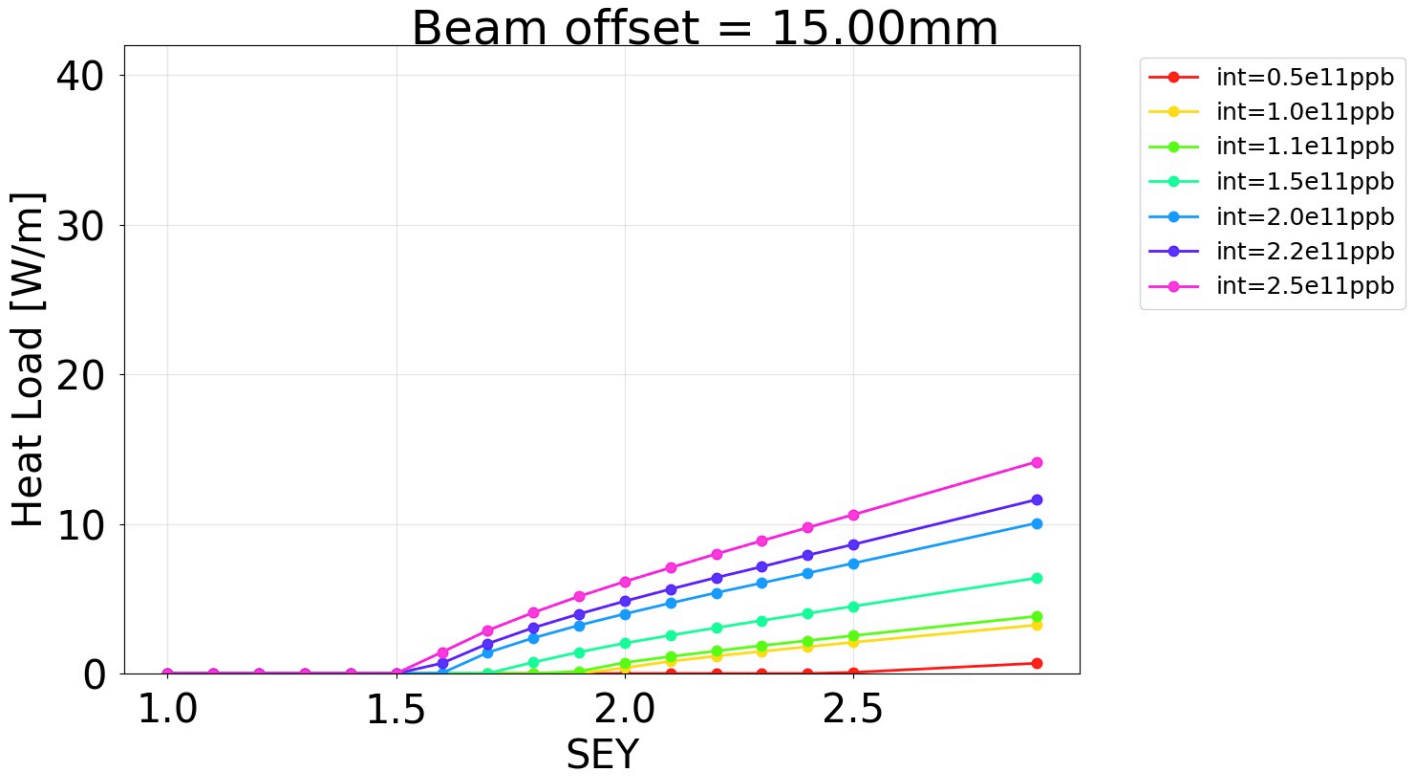
SEY threshold



- At zero offset the SEY threshold is larger for higher intensities
- As the offset is increased the thresholds move
- Eventually the situation is reversed

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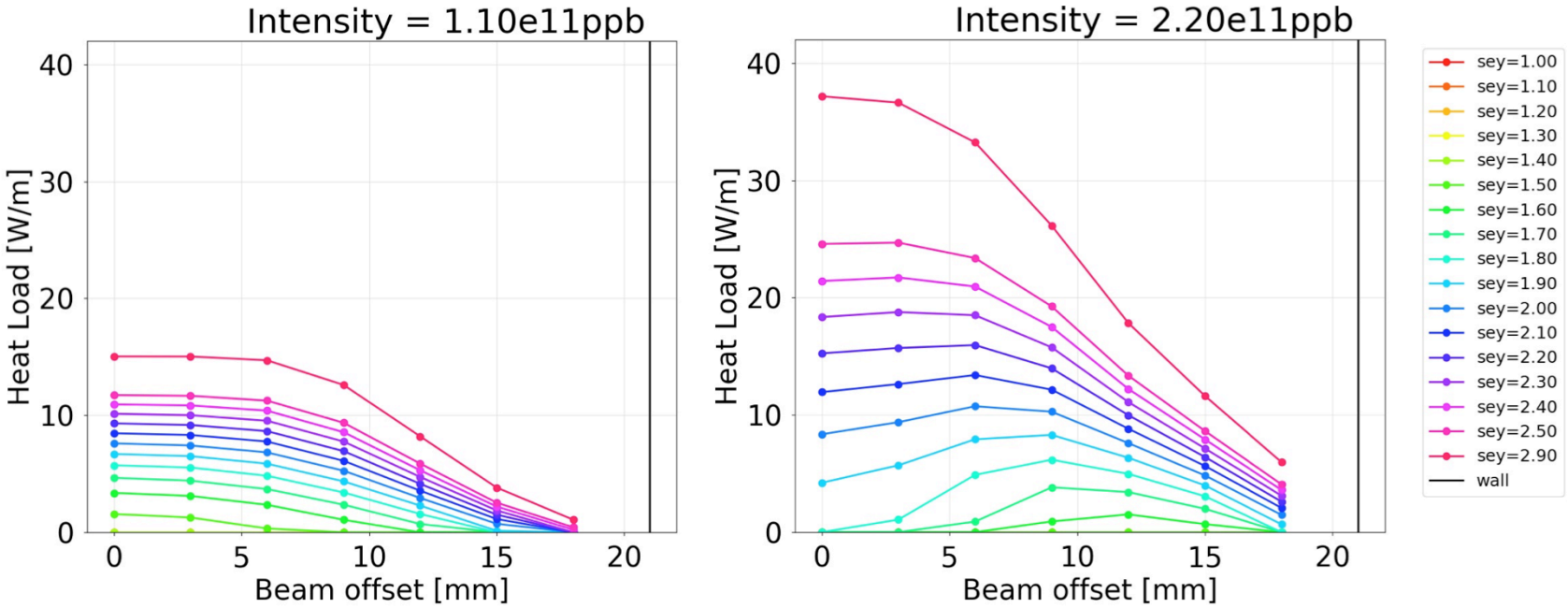
Heat load versus offset



- At beam intensity 1.1 $\times 10^{11}$ p/bunch the heat load always decreases when the offset increases
- At beam intensity 2.2 $\times 10^{11}$ p/bunch this is not always the case
- For SEYs of 2.5 or lower the maximum heat load occurs at a non-zero beam offset
- No multipacting for SEYs of 1.4 or lower

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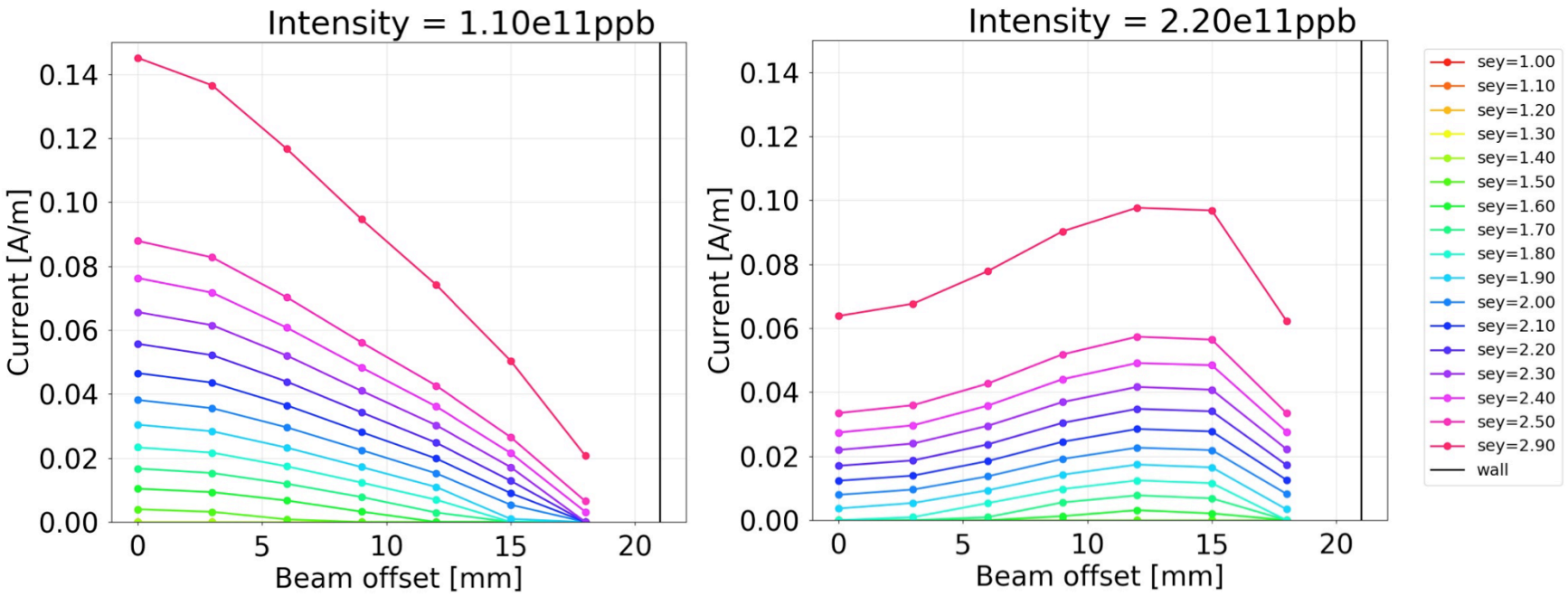
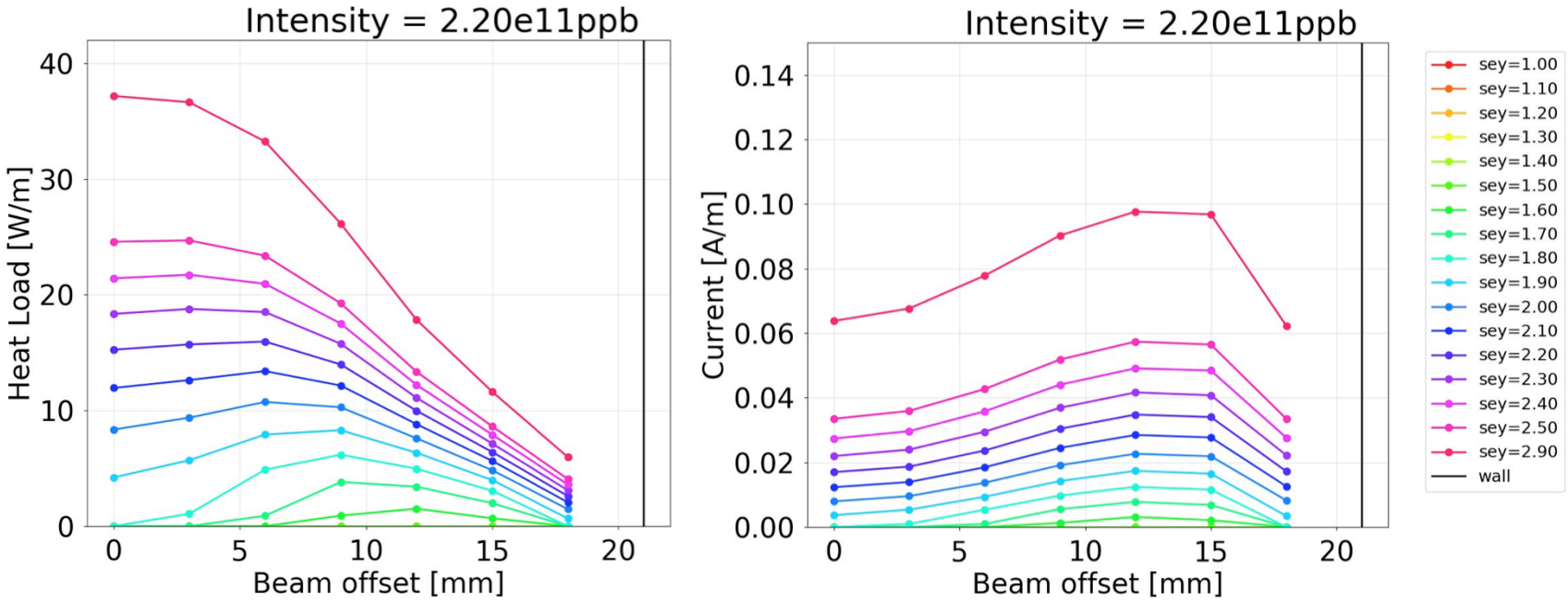
Current vs offset



- For beam intensity of 1.1 $\times 10^{11}$ p/bunch the current always decreases as the offset increases
- For beam intensity 2.2 $\times 10^{11}$ p/bunch the maximum current occurs at a non-zero beam offset
- No multipacting for SEYs of 1.4 or lower

Comparing heat load and current



- Their maxima occur at different beam offsets, especially for large SEY values
- This means that there are fewer but more energetic electrons impacting the chamber at smaller offsets

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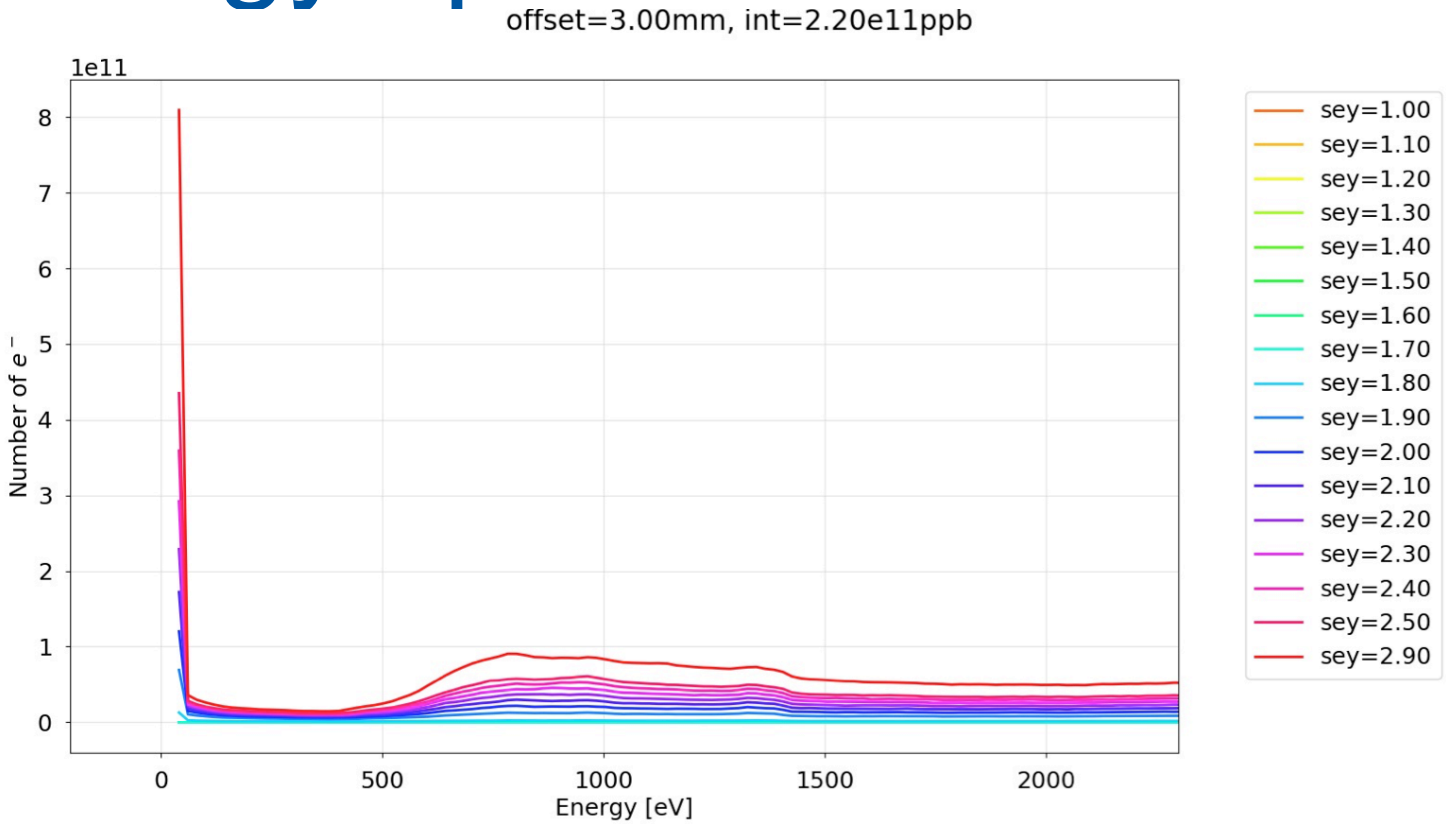
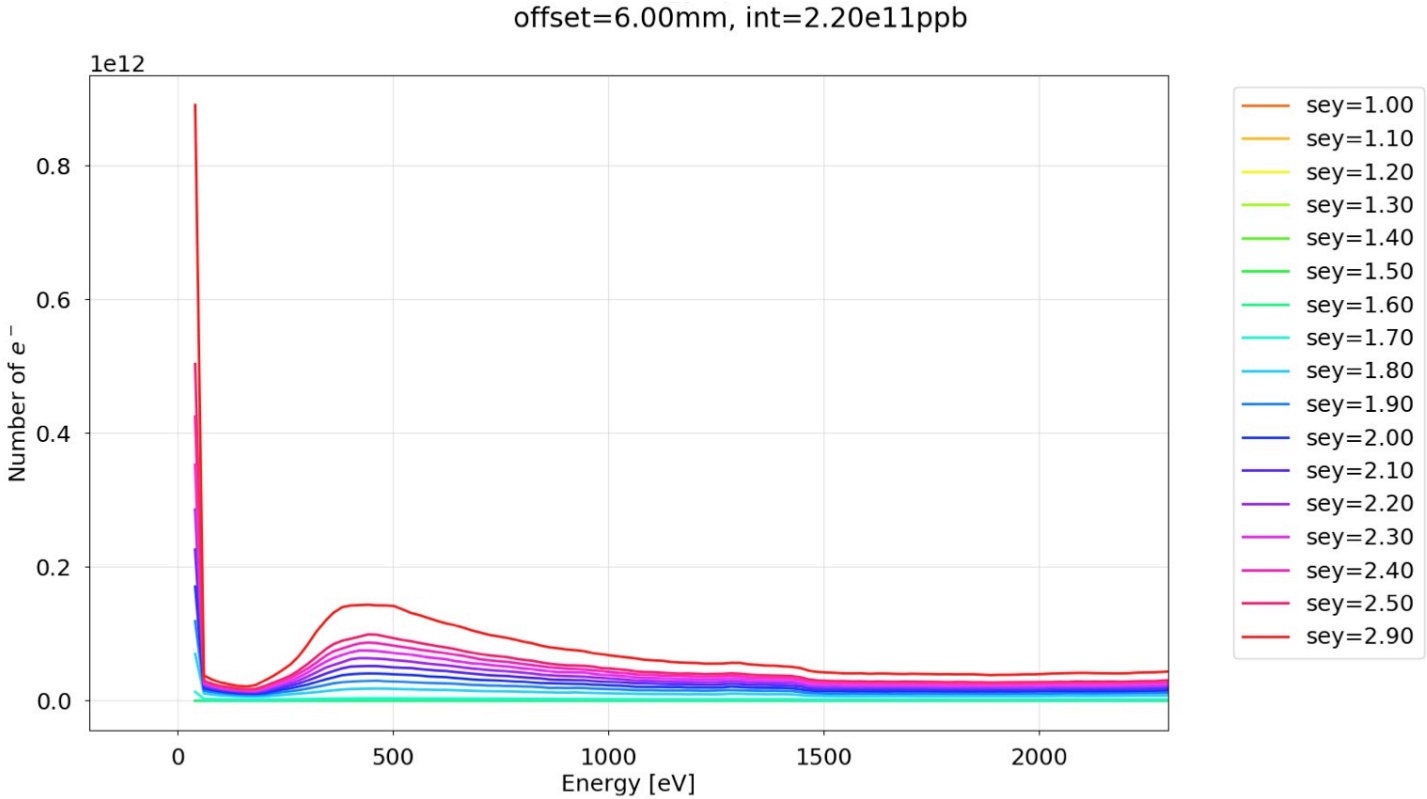
Energy spectra



- The energy spectra shows electrons moving from higher to lower energy as the beam offset increases

Energy spectra



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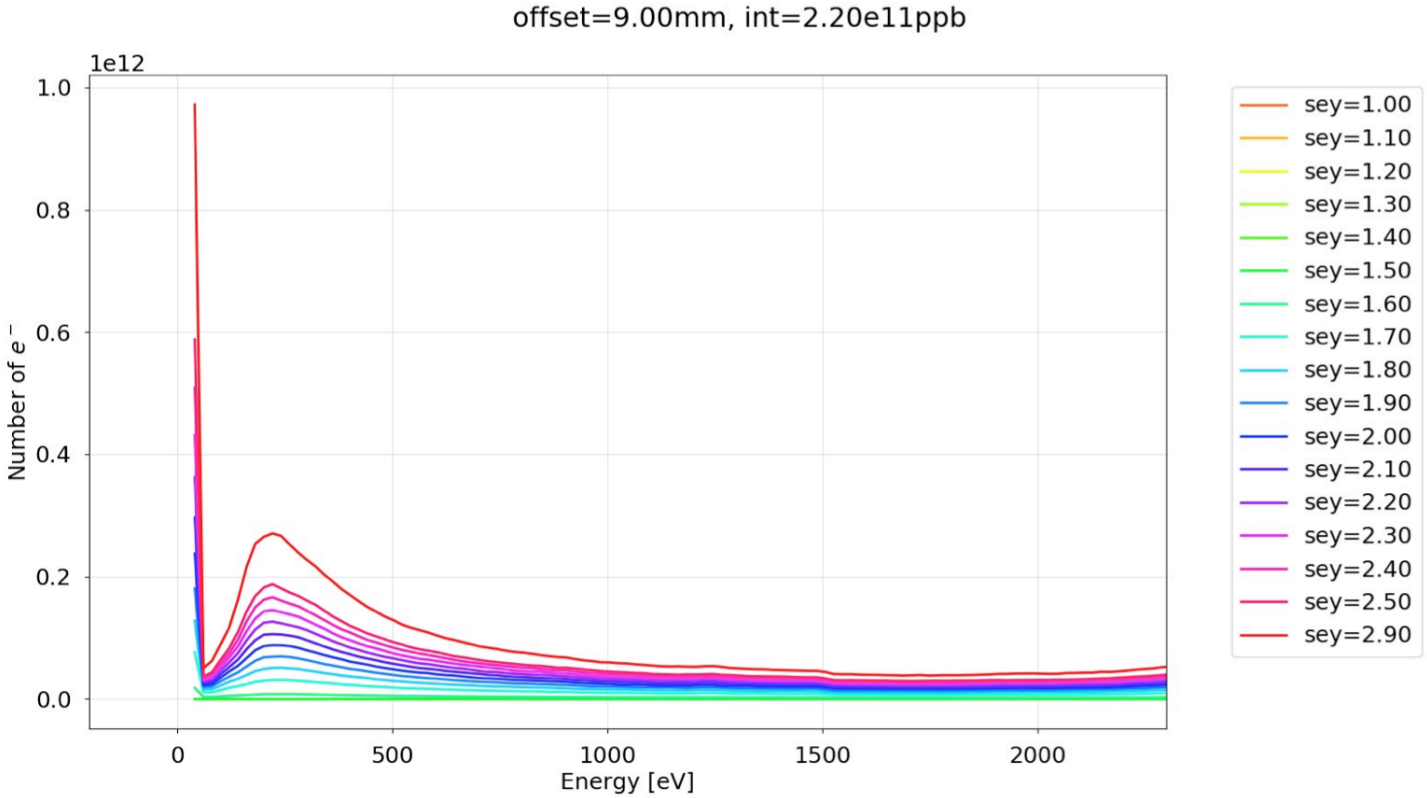
Energy spectra



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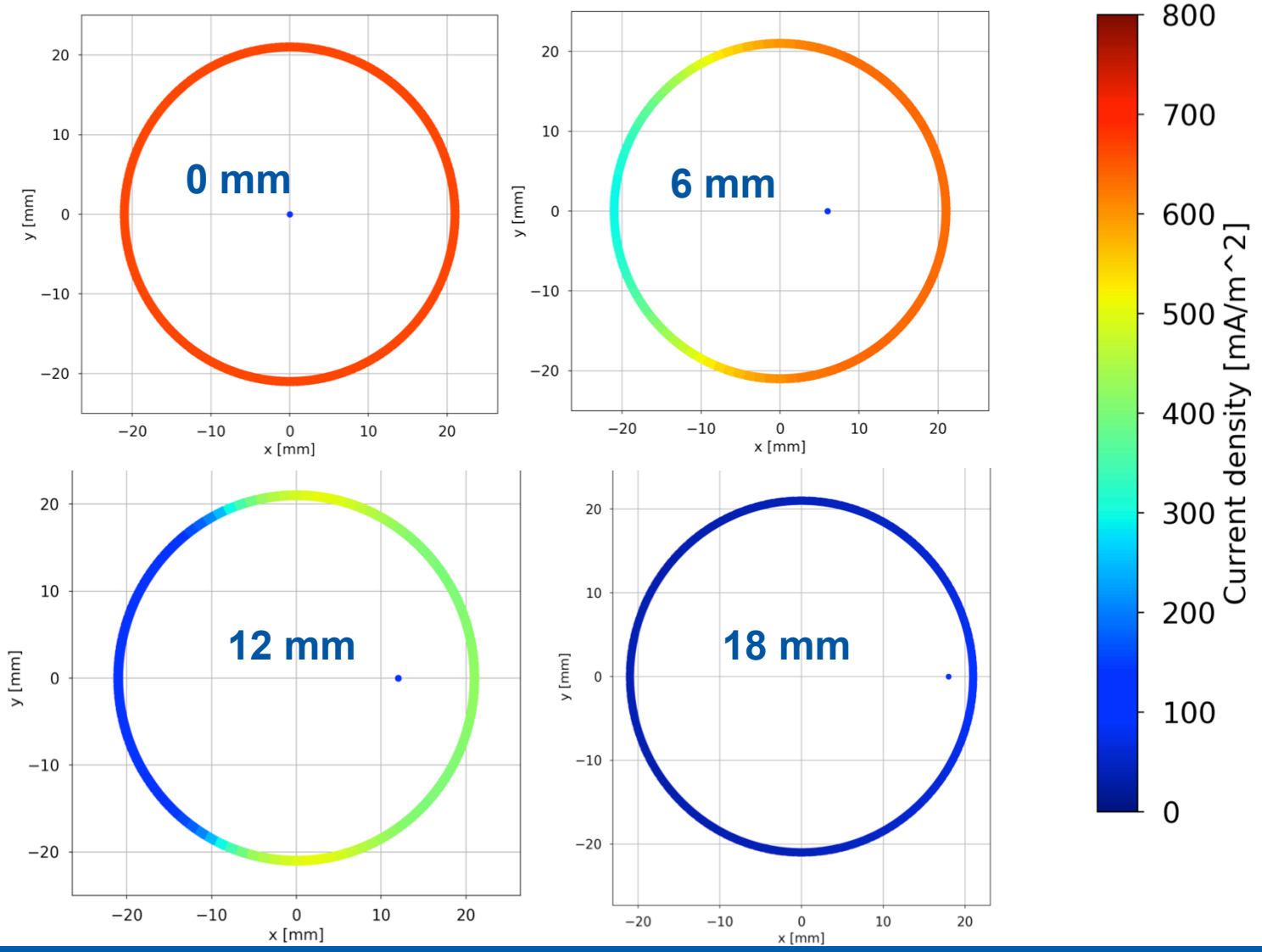
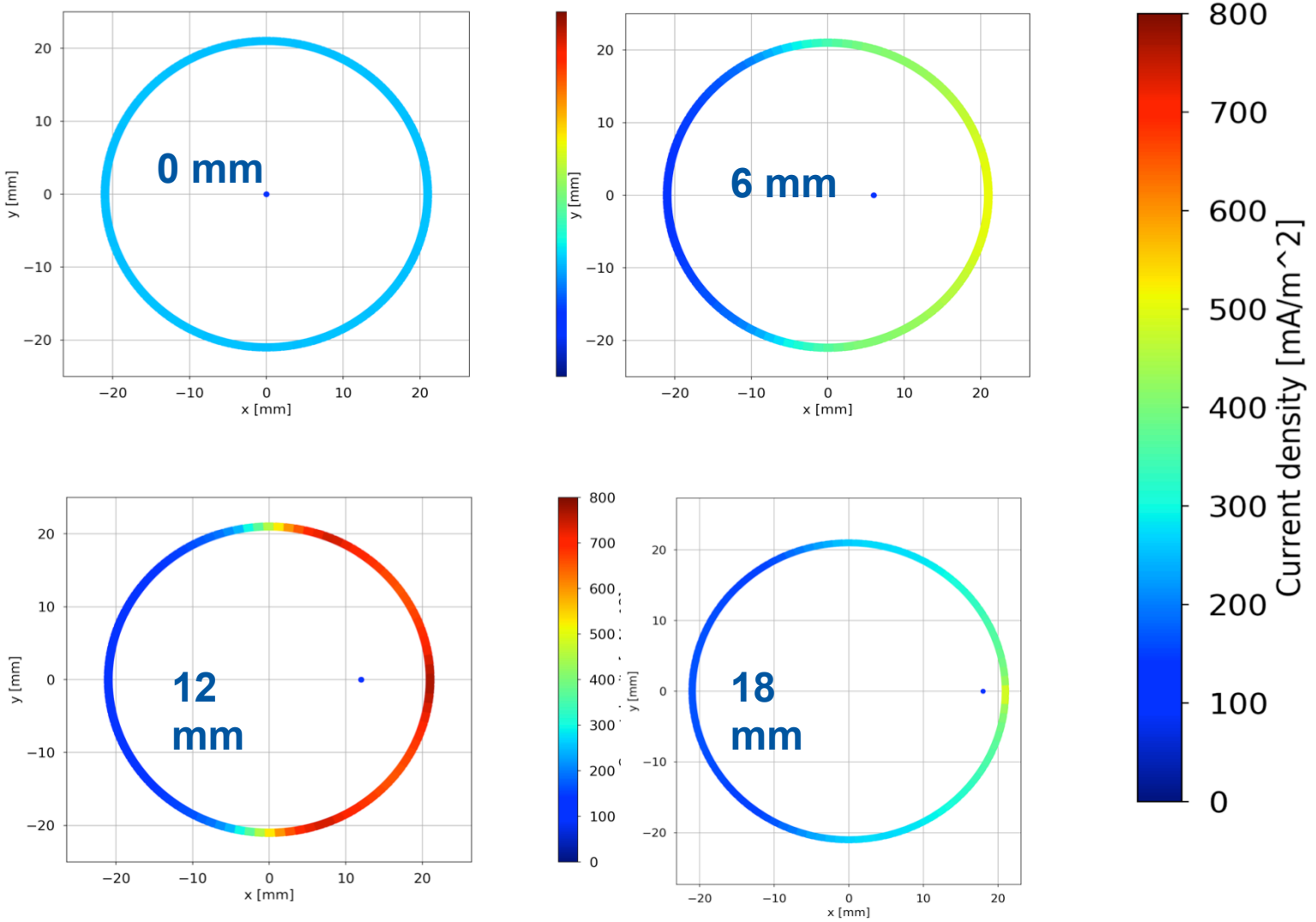
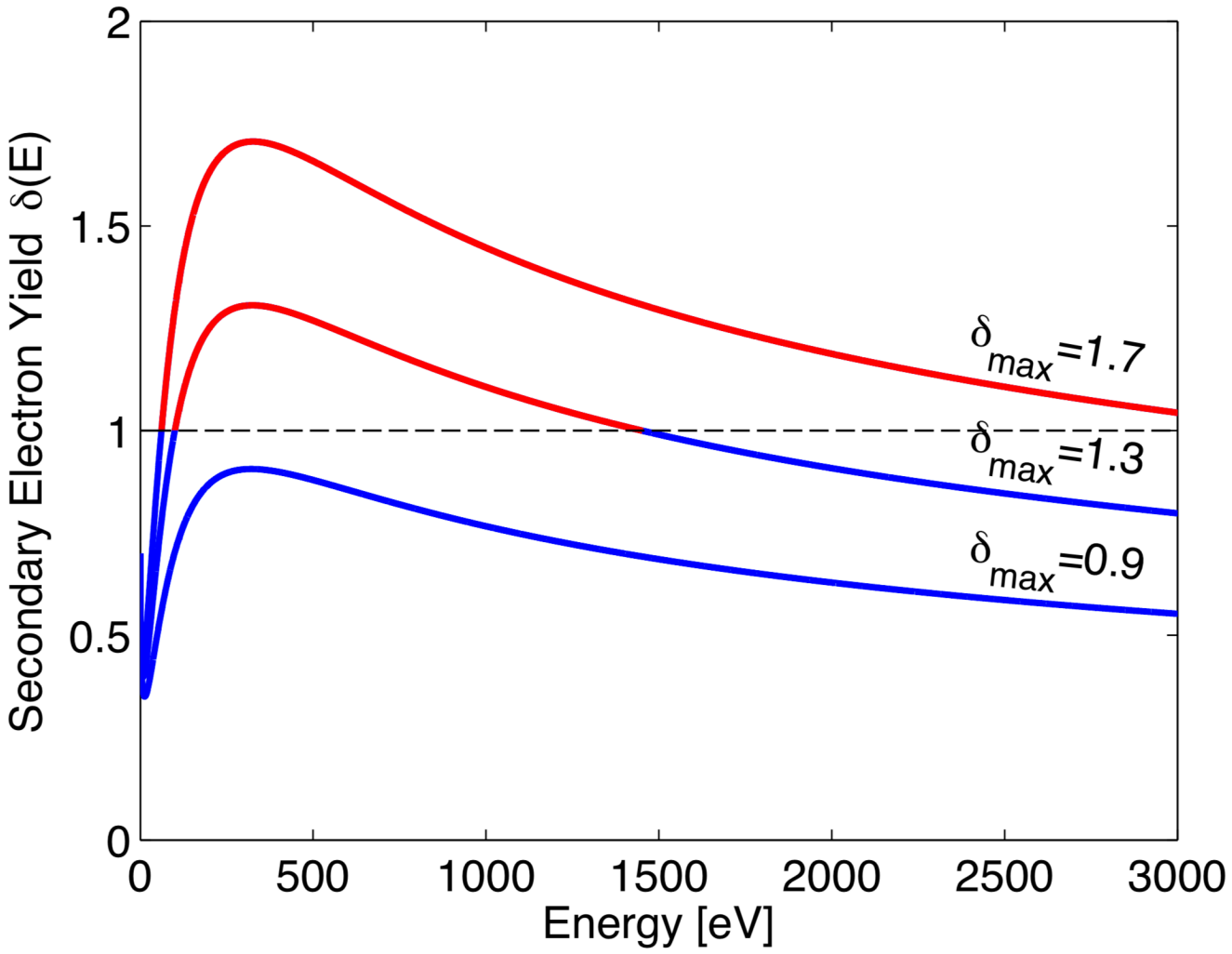
Current distribution 1.1 ×10^{11} p/bunch



Current distribution, 2.2 ×10^{11} p/bunch



The SEY curve



- The SEY depends on the energy of the impacting electrons
- The SEY curve can explain the differences in current simulated at different intensities

Electron density animation

Intensity = 1.1e11ppb
SEY = 2.5
Offset = 12 mm

Summary

- The dependence of e-cloud build-up on beam position was studied
- For SEYs of 1.4 or lower, no simulations showed multipacting
- The SEY threshold depends on the beam position as well as the beam intensity
- At high intensities the heat load and the current have their maxima at different beam offsets
- The current distribution on the chamber wall depends on both beam intensity and beam position