Effect of synchrotron radiation and chamber properties on LHC electron-cloud heat load

Effects of the sawtooth and its orientation

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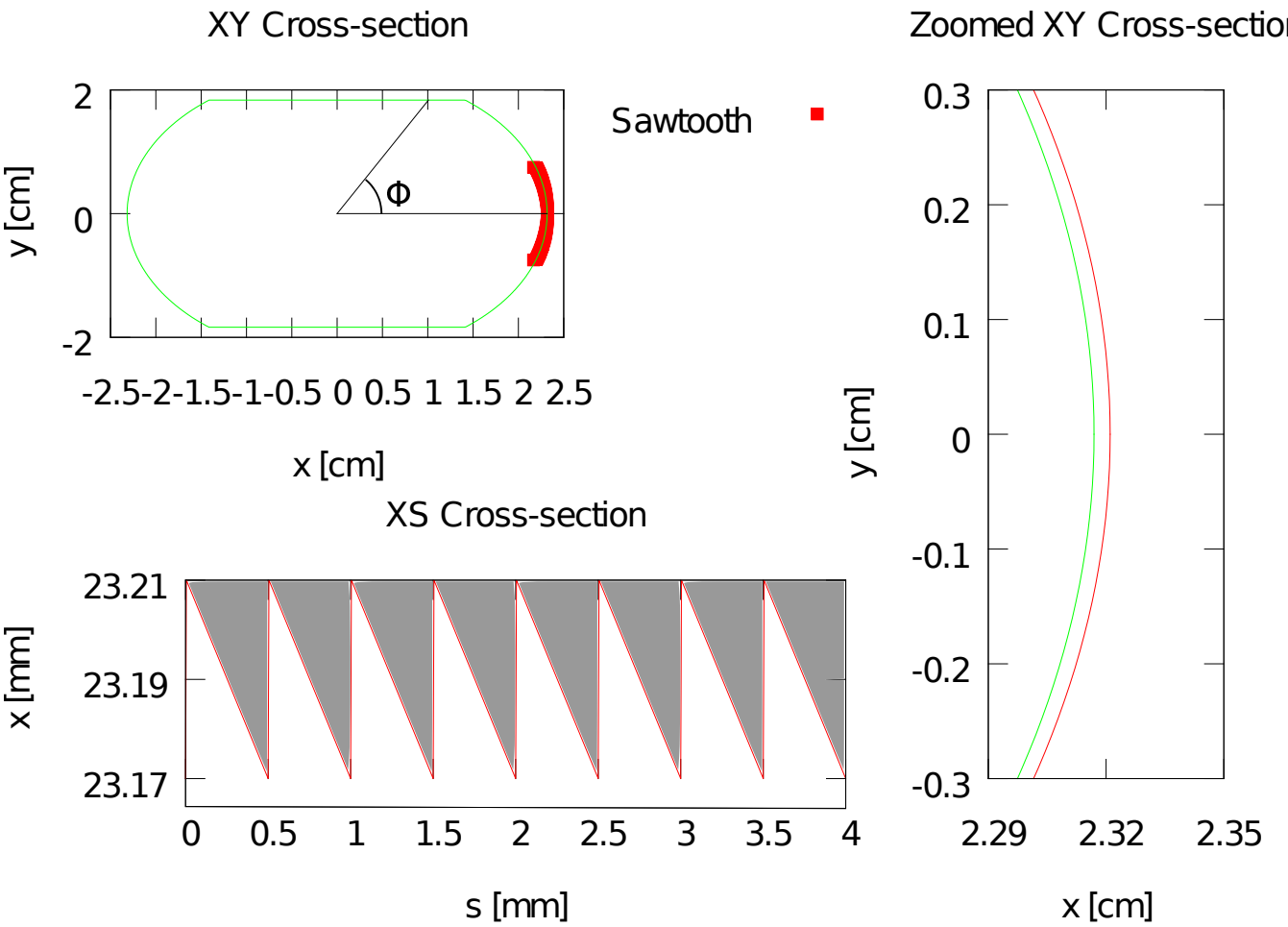
Section 1

Synrad3D

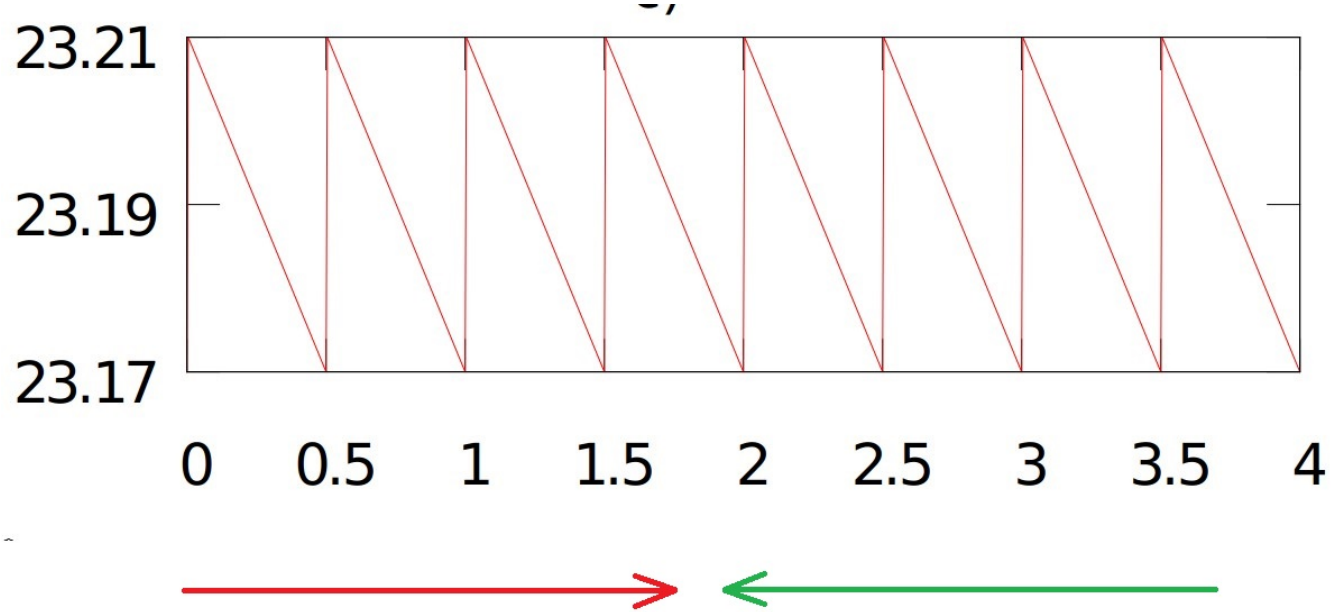
Key parameters

- Vacuum chamber
  - Material - 10 nm C over Cu
  - Surface roughness - $\sigma = 50$ nm
- Lattice - Taken from http://lhc-optics.web.cern.ch/
- Geometry

Geometry

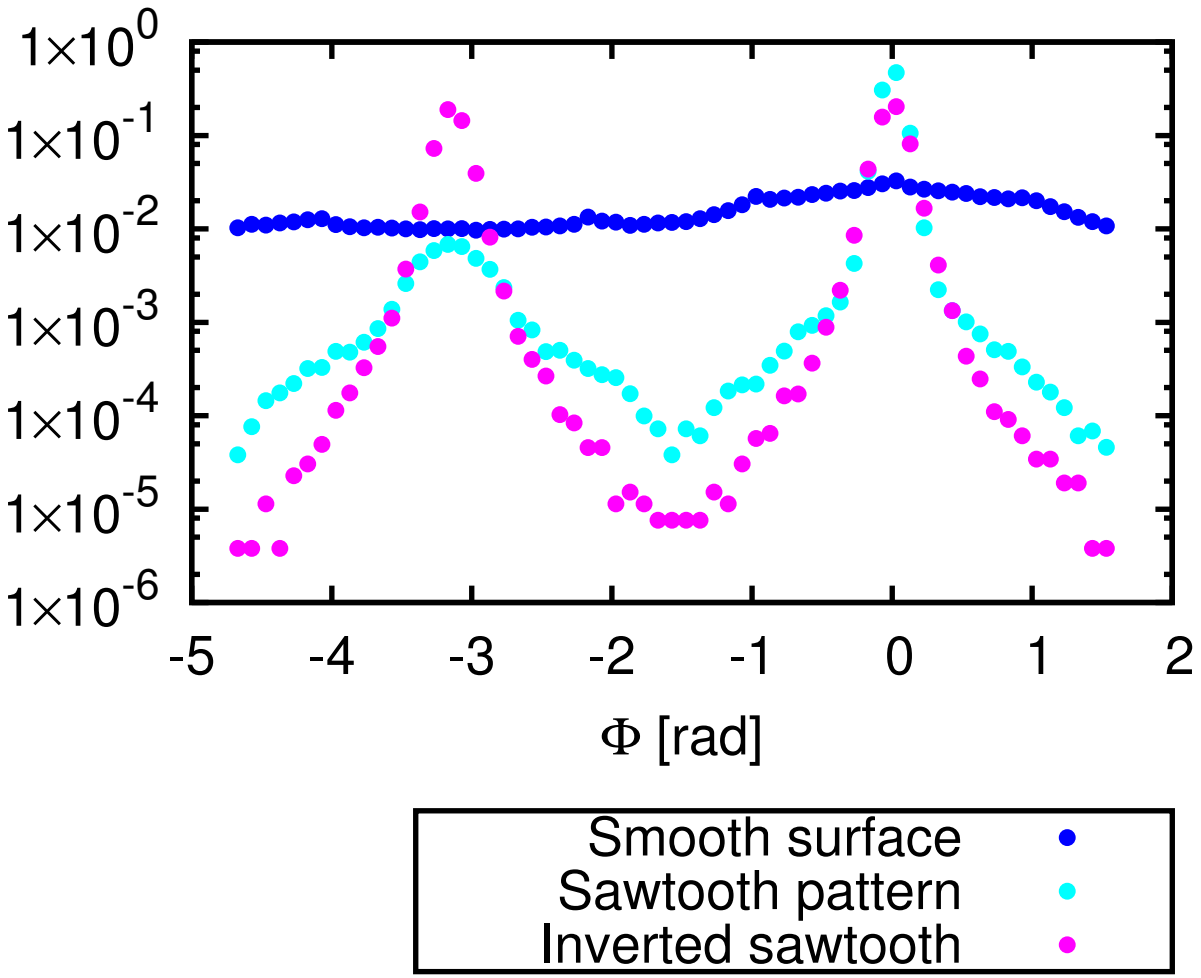

XY Cross-section
Sawtooth
Φ
y [cm]
x [cm]
2
0
-2
-2.5 -2 -1.5 -1 -0.5 0 0.5 1 1.5 2 2.5
XS Cross-section
x [mm]
s [mm]
23.21
23.19
23.17
0 0.5 1 1.5 2 2.5 3 3.5 4
Zoomed XY Cross-section
y [cm]
x [cm]
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
2.29 2.32 2.35

Geometry

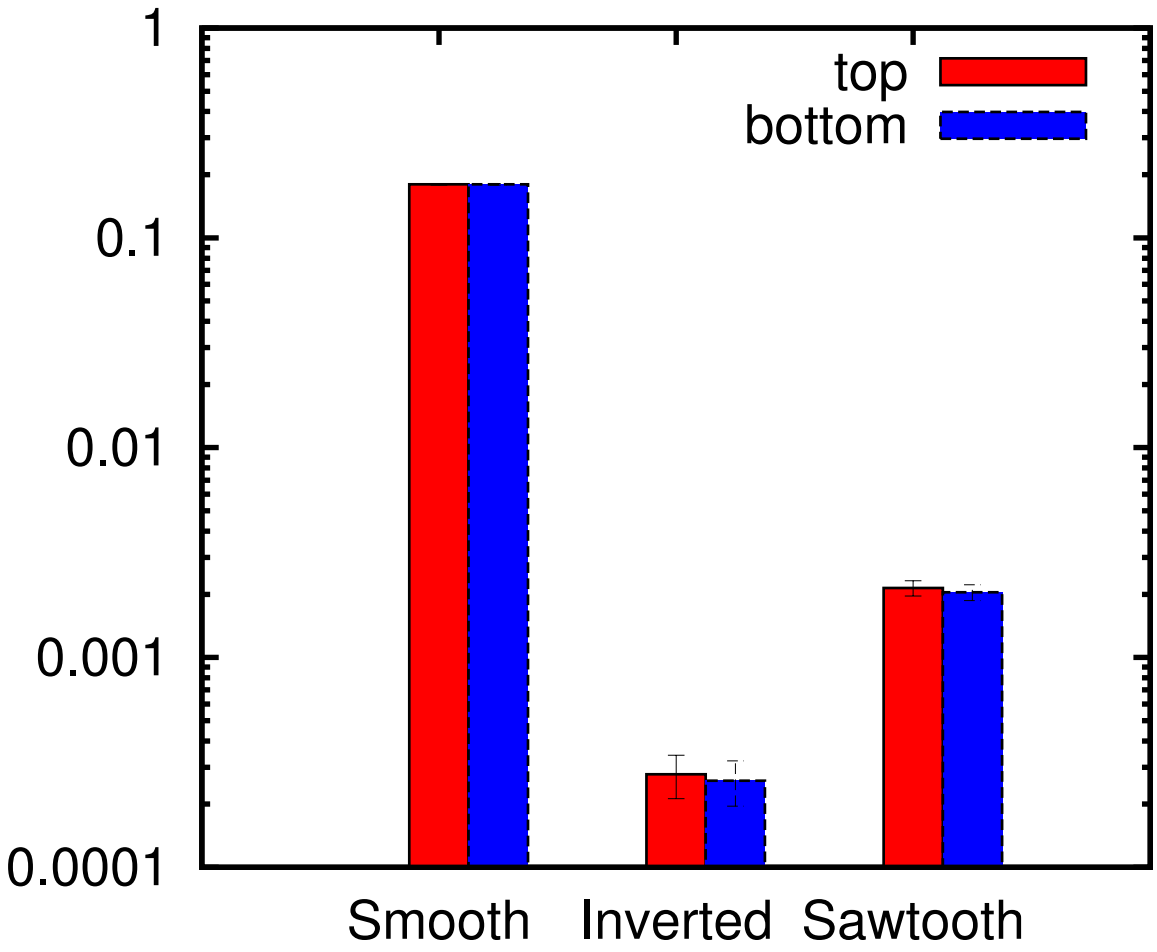


Green is a beam seeing a correct orientation.
Red is a beam seeing an inverted orientation.

Normalized photon absorption functions



Normalized absorption at top and bottom of the chamber



Section 2

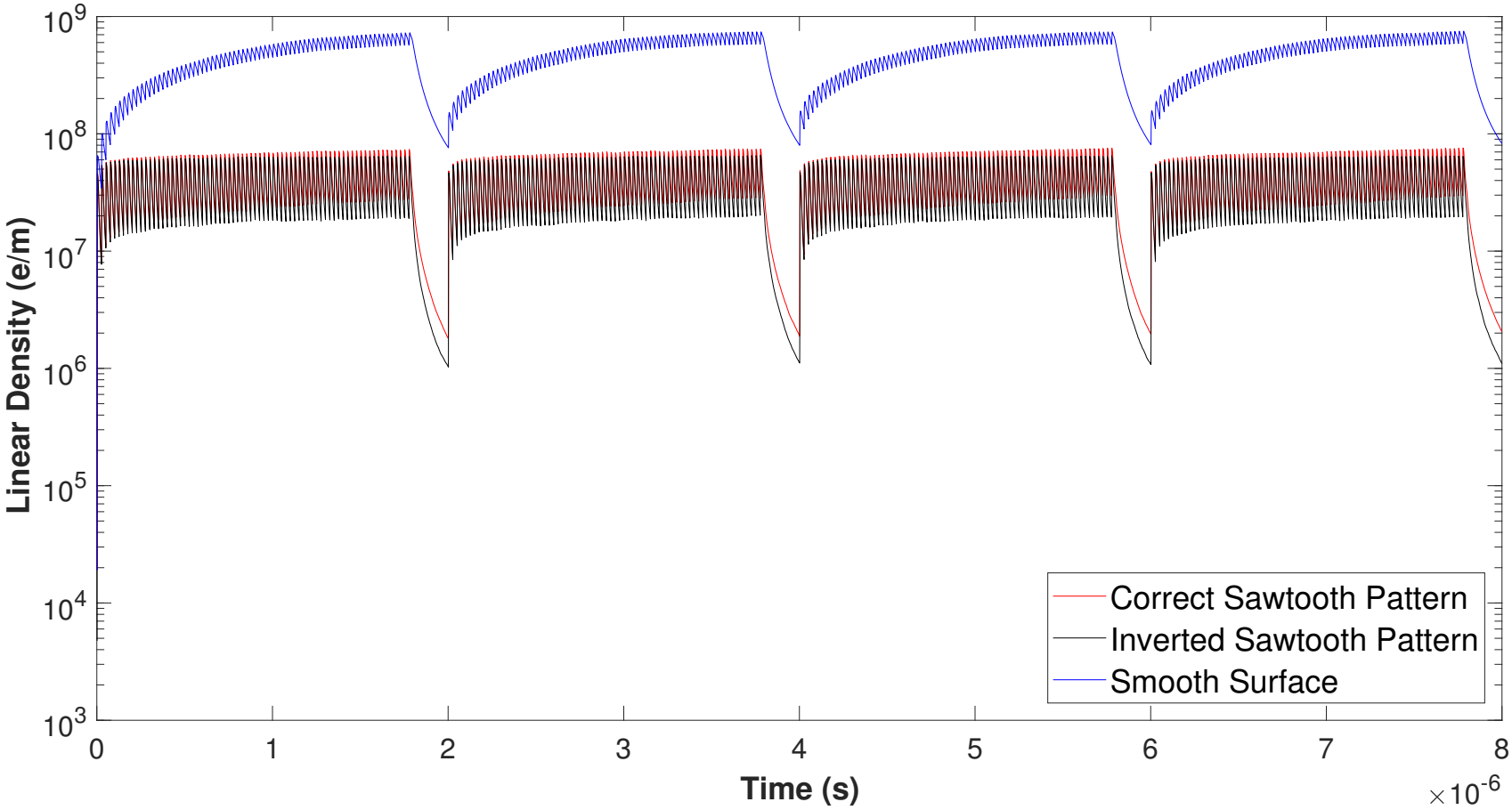
PyECLOUD

Key parameters

- SEY values from 1.0 to 1.7 in 0.1 steps.
- Proton Beam Energy of 6.5 TeV
- Vacuum chamber used is rectellipse
- Filling pattern, repeated 4 times
  - 72 particle-filled bunches
  - 8 empty bunches
- Bunch spacing of 25 ns

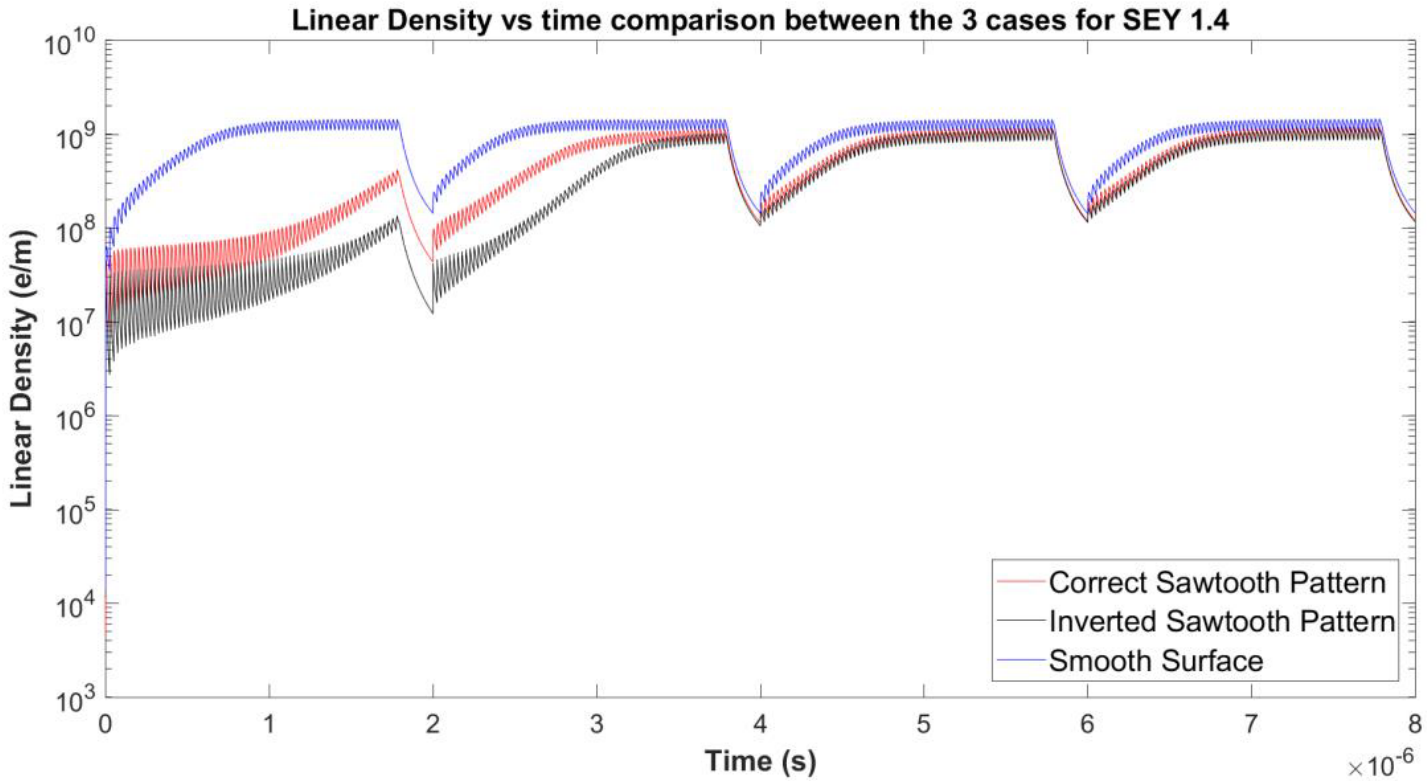
Linear Density

Electron linear density for a SEY = 1.3

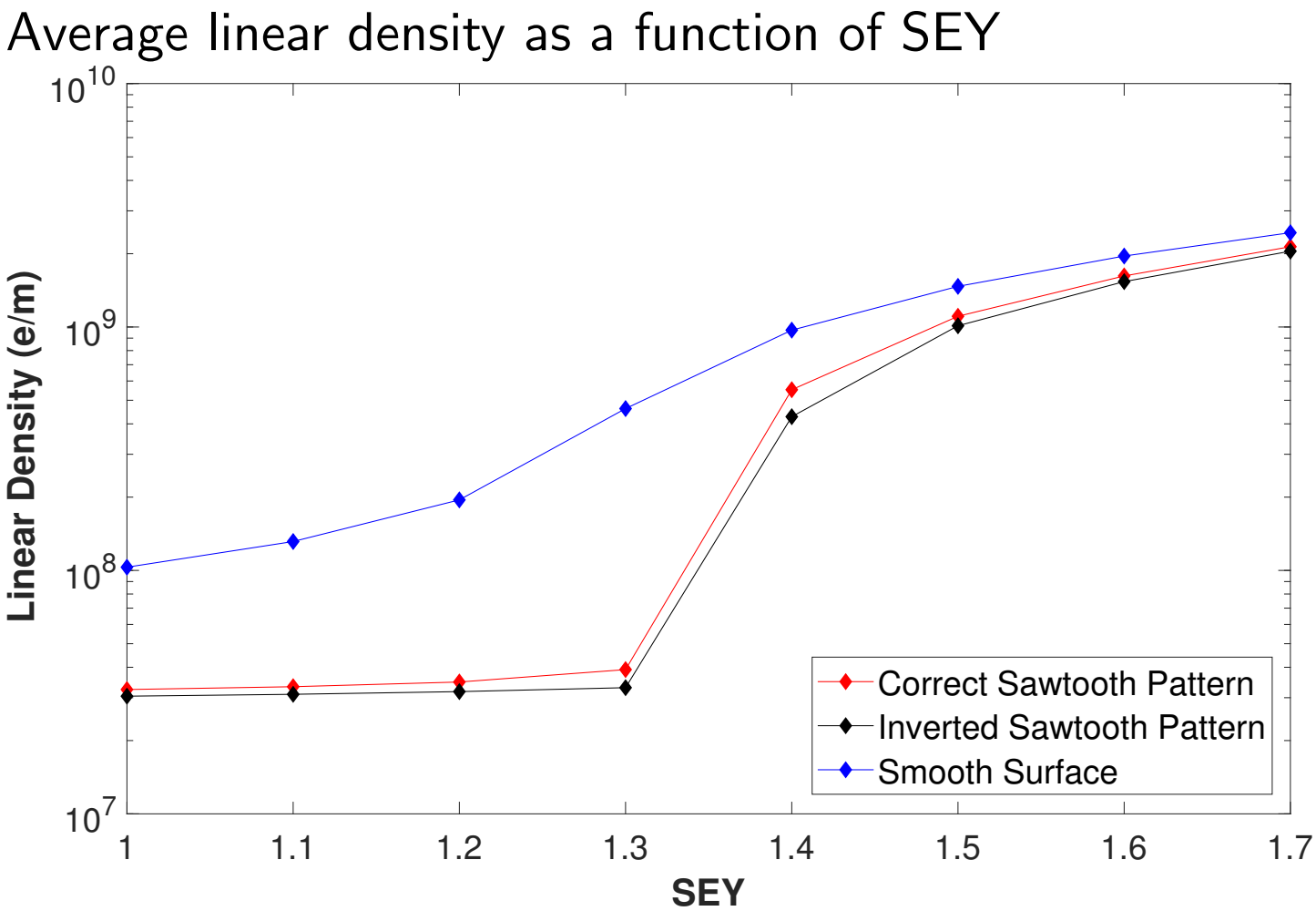


Linear Density

Electron linear density for a SEY = 1.4

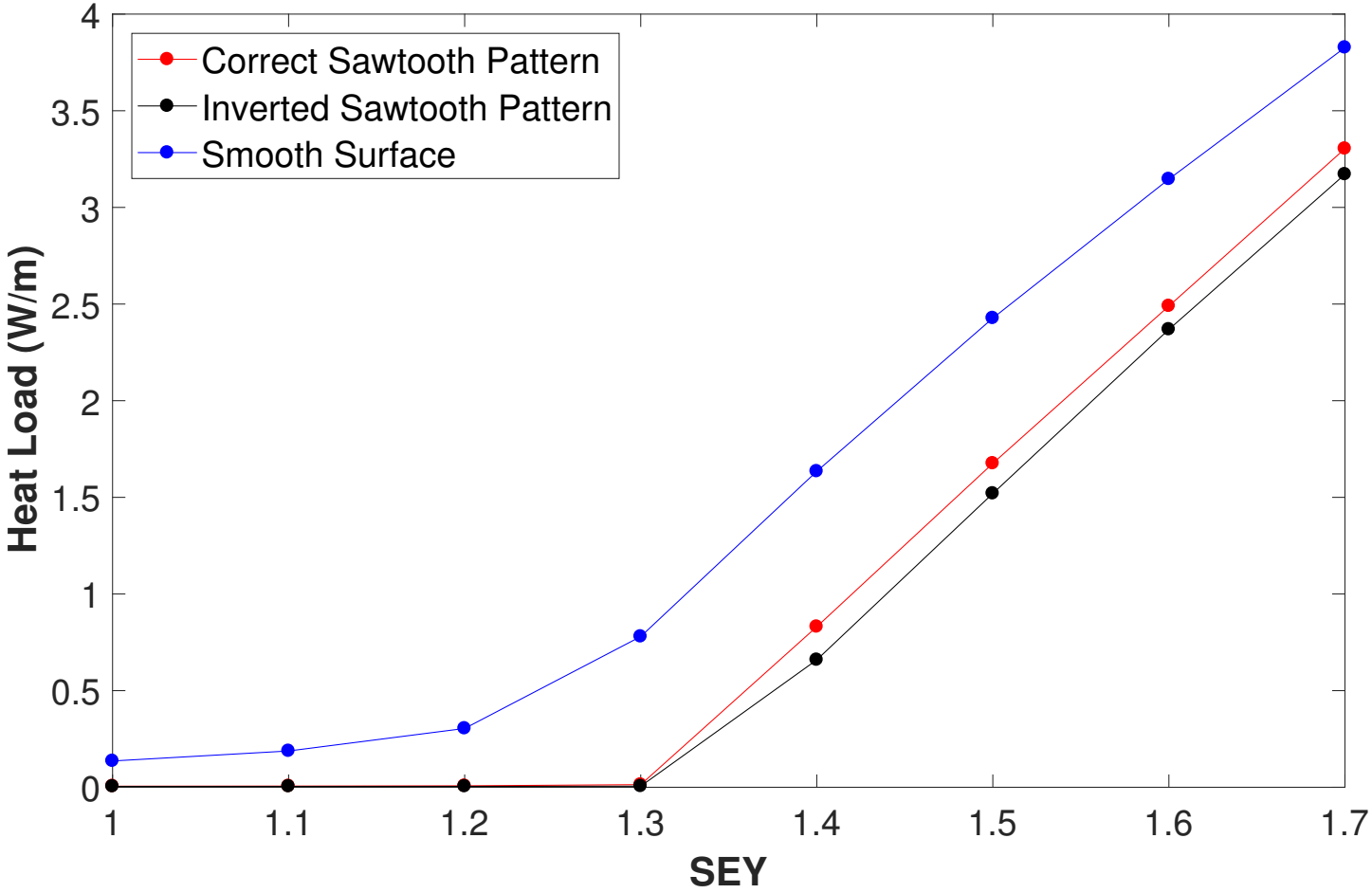


Linear Density



Heat Load

Average heat load as a function of secondary emission yield (SEY)



Future Work

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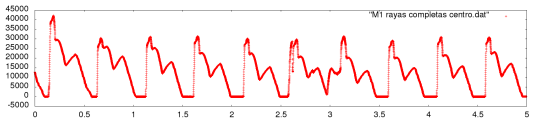
- Use a more realistic model of the sawtooth pattern



- Use different values of the surface aspect ratio and surface roughness to determine the importance of these values.
- Use filling patterns from 2017 and 2018
- Work on the quadrupoles

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