Mapping synchrotron radiation in an updated FCC-hh vacuum chamber for HE-LHC

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Introduction

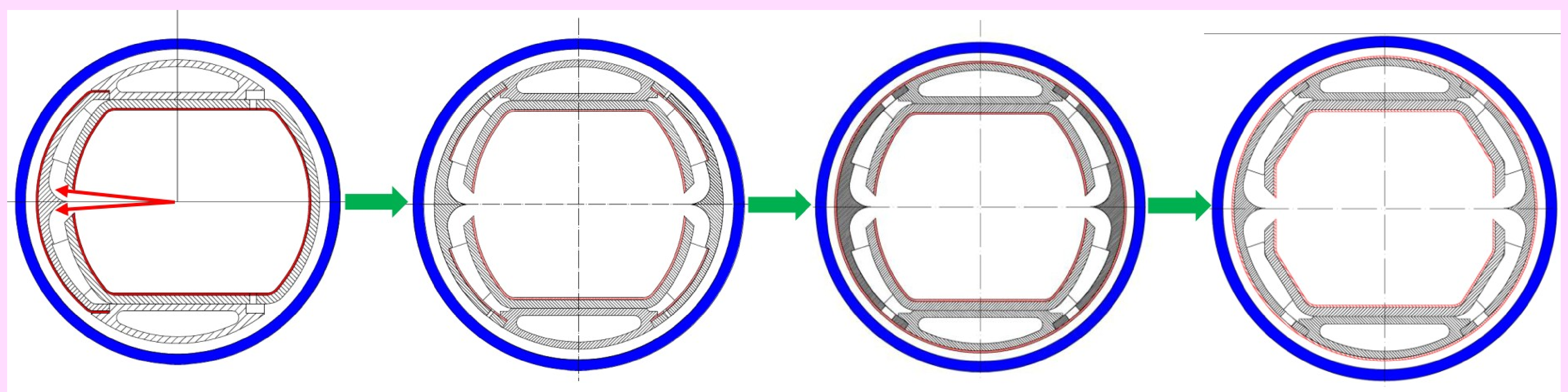
In previous work we presented a map for absorption of synchrotron radiation in the arcs of HE-LHC for two proposals for beam screen, one was the a scaled version of the LHC vacuum chamber, and the second one is the one being designed for FCC-hh. Currently it is the second one who appeared to have won the race to become baseline for the HE-LHC design, so we now focus all our energies to study it in further detail and in a more realistic fashion.

Motivation

At high proton-beam energies, beam-induced synchrotron radiation is an important source of:

- Heating
- Beam-related vacuum pressure increase
- Primary photoelectrons
  - Electron clouds

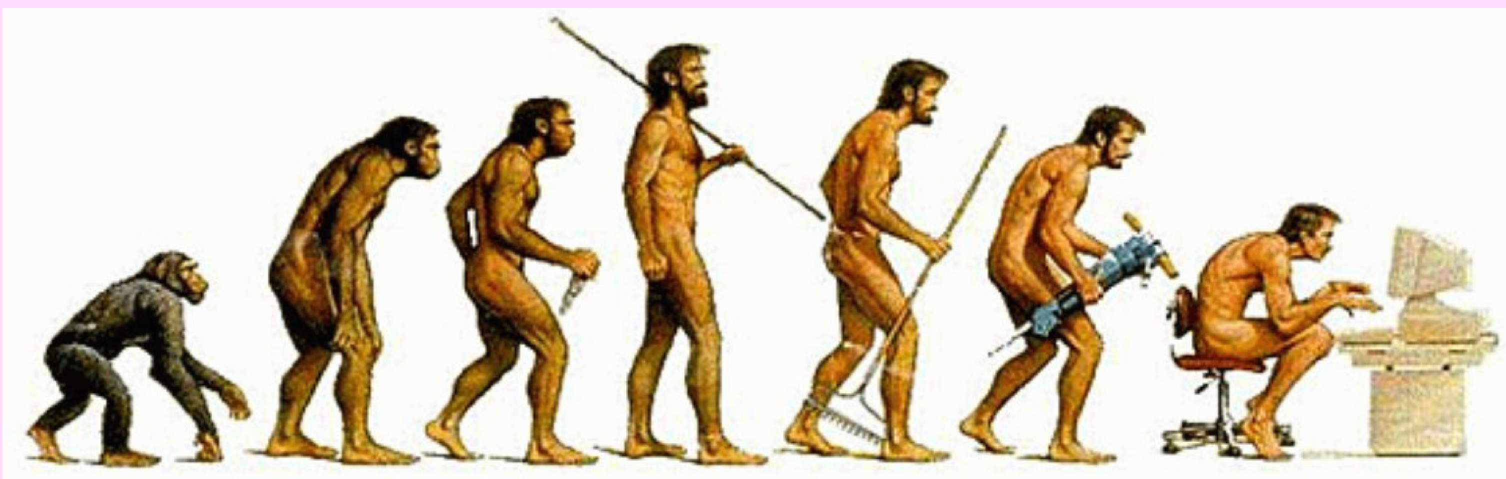
Evolution

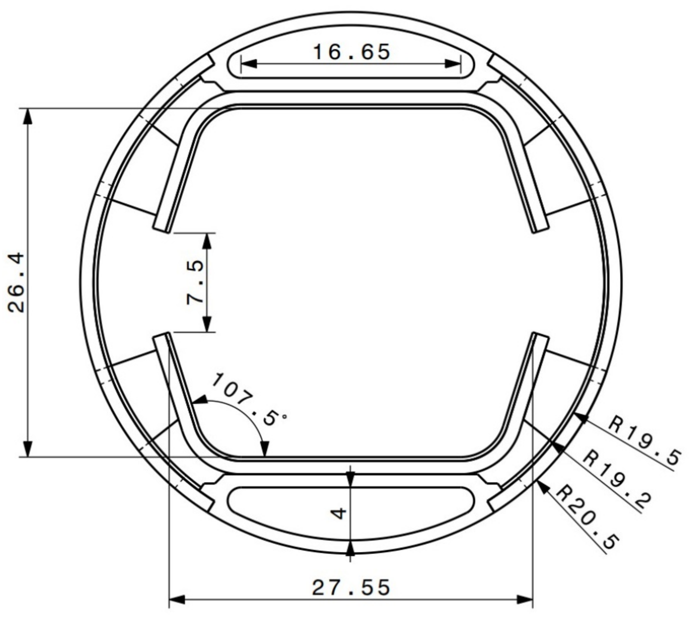


Courtesy of C. Garion, CERN

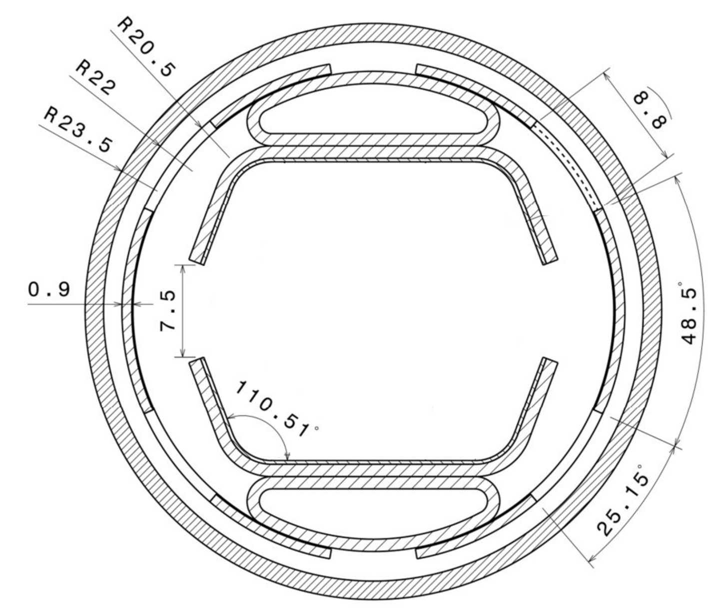
The design of FCC-hh vacuum chamber has been evolving over the years,

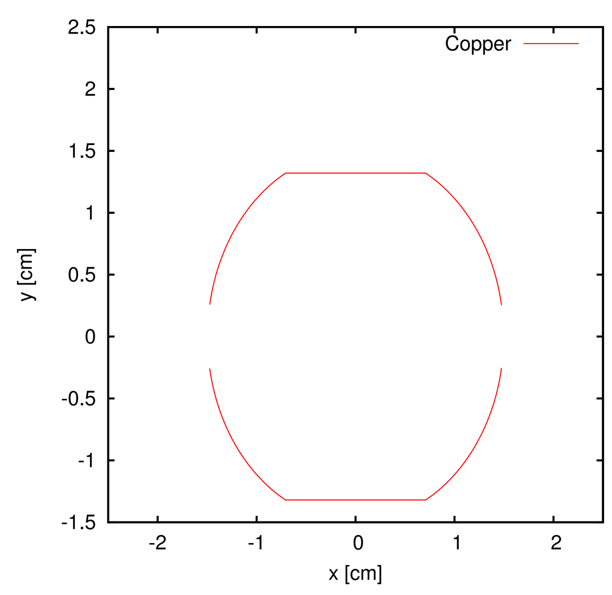
So must our model!

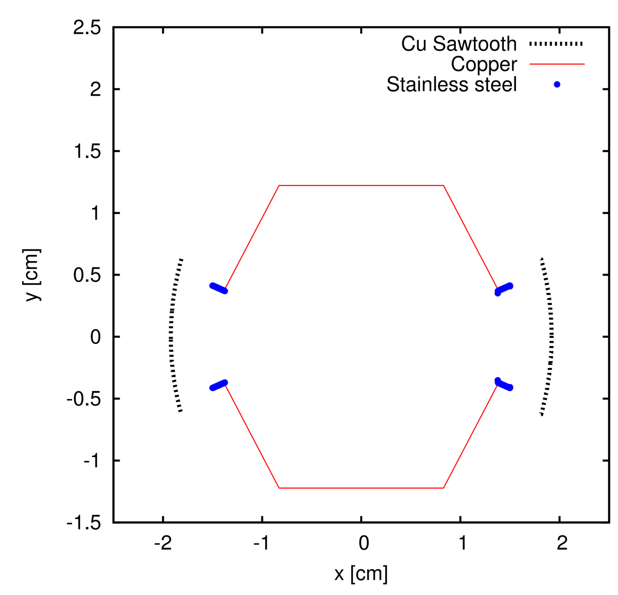




Courtesy of I. Bellafont, CERN & ALBA

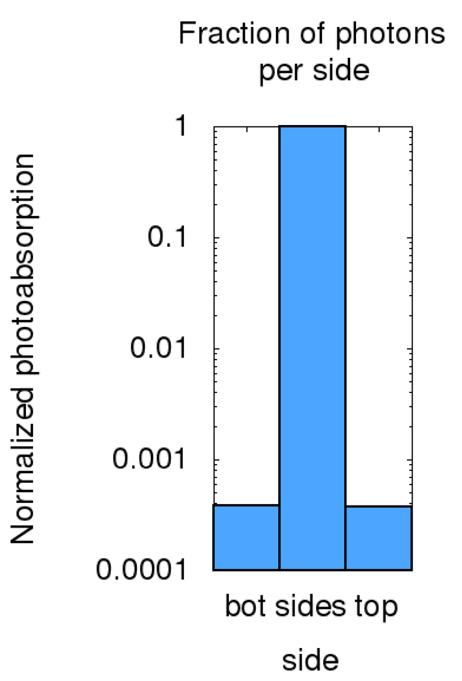




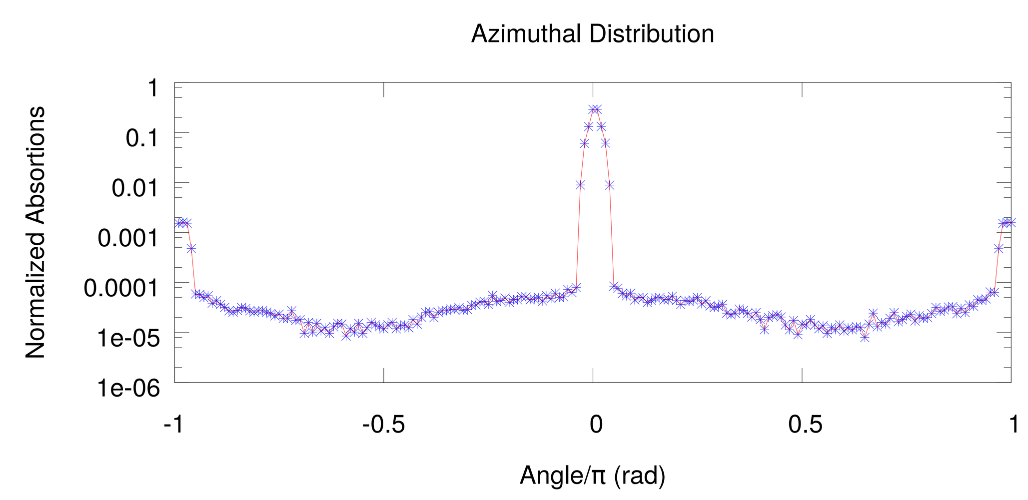


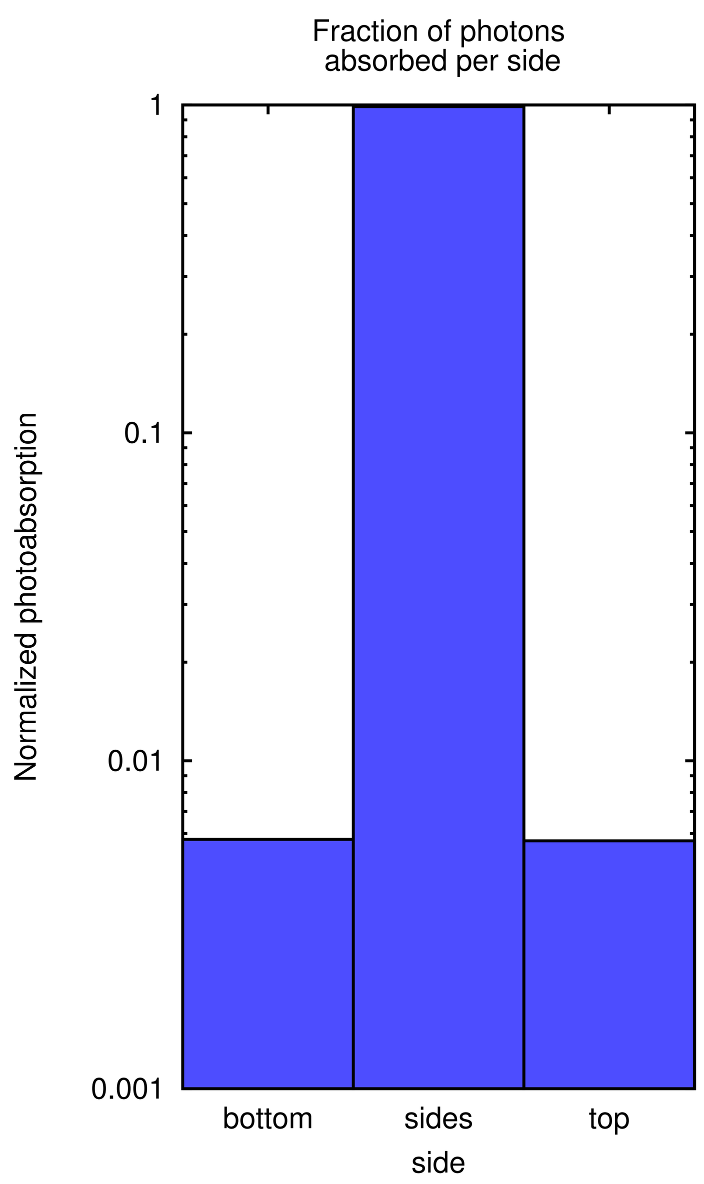
Distributions

Results from previous model



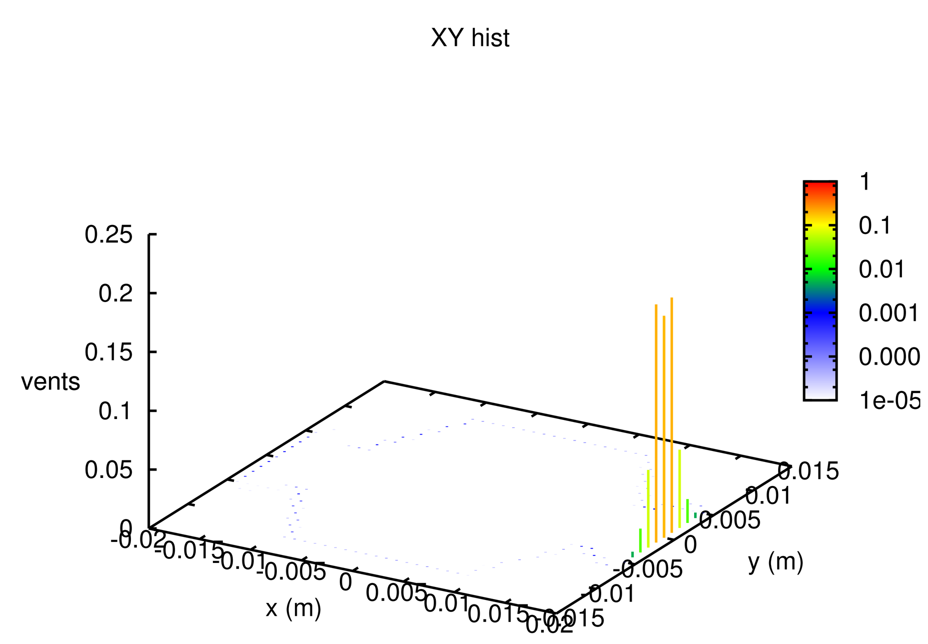
In our first model we assumed the slits were perfect absorbers, so in our first simulations, the large majority of photons escaped through them. This model is too ideal and not very reliable, since the photons are not actually absorbed but leaving the environment, there would always be a chance, however small, that they would return.





Results from the current model

This second approximation, includes the edge of the chamber, which could be of a different metal, namely stainless steel.
Although this model still has some ideal absorbers, it is much more reliable than the previous one, because the large majority of photons are actually absorbed within the environment, and just an insignificant fraction (<0.5%) of them escape through the absorbers. as we can see in the absorption histogram below.



Discussion

The first implemented model was such an extreme idealization of the effects of the slits that comparing the results between models would be most unfair. So, in this work, We are not attempting to compare the change in the photon distribution due to the change in the design of the vacuum chamber; but, instead we show that we are achieving more realistic models which will result in more reliable simulations. This is a work in progress which will be highly enriched when the dimensions, materials, and material properties are fully determined.

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