The Dark Current and Multipacting Simulation Capability of OPAL - Modeling, Benchmarking and Applications

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Abstract

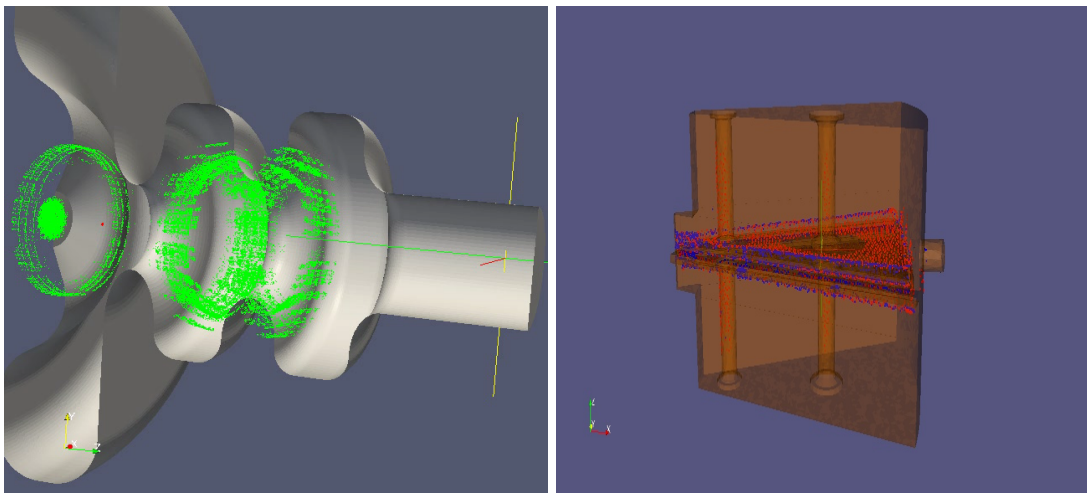
Dark current and multipacting phenomena, as observed in accelerator structures, are usually harmful to the equipment and the beam quality. These effects need to be suppressed to guarantee stable operation. Large scale simulations can be used to understand the cause and develop solutions for these phenomena.

We extend OPAL, a parallel framework for charged particle optics in accelerator structures and beam lines, with the necessary physics models to simulate multipacting phenomena. This is achieved by adding a Fowler-Nordheim field emission model and two secondary electron emission models, developed by Furman-Pivi and Vaughan respectively, as well as efficient 3D boundary geometry handling capabilities to OPAL.

In situations where the electron multiplication is very large, we have to renormalize the simulation particles in order to prevent excessive memory consumption.

Code to code comparison with the Tech-X physics library and comparison with a non-stationary multipacting theory for the classic parallel plate geometry will be presented.

Preliminary results on dark current simulations of the CTF3 electron source and first multipacting simulation in large rf-cavities for compact high intensity Cyclotrons will be presented.



BD-Palaver 15.2.2011 WBGB 019 14.00 - 15.00