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Field Emission and Multipactor Simulations in High Gradient RF Accelerators

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Field emitted electrons play an important role in the operation of high gradient RF accelerating structures, by generating so-called dark currents, and acting as the initiators of RF Breakdown, which limits the performance in such devices. Another kind of vacuum discharge that commonly affects to the operation of lower-field RF components, for example in space applications, is the Multipactor effect. Theoretical simulations are under development for analyzing both processes in the context of HG accelerators. Mainly using CST Particle Studio, but also additional programs such as Spark3D, and a homemade multipacting simulation tool developed using MatLAB.
The results show that field emitted electrons generated in the high field regions of the accelerating cavities produce longitudinal and transversal dark currents. In the longitudinal case, the electrons are captured by the RF field and gain energy enough to produce ionizing radiation. In the transversal dark current, we observe how these electrons migrate from the iris to low field regions, pushed by the ponderomotive force, and trigger multipactor there. This phenomenon is a unique interplay between high field and low field processes which may have as a consequence that multipactor actually affects to the performance of high gradient cavities, as field emission electron seeding can reduce the timescales for the onset of multipactor.

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