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Numerical study of dark current dynamics and reflection and transmission phenomena in a High-Gradient Backward Travelling Wave accelerating cavity using the electromagnetic simulation software CST Studio.

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High-Gradient accelerating cavities are one of the main research lines in the development of compact linear colliders. However, the operation of such cavities is currently limited by non-linear effects that are intensified at high electric fields, such as dark currents and radiation emission or RF breakdowns.

A new normal-conducting High-Gradient S-band Backward Travelling Wave accelerating cavity for medical application (v=0.38c) designed and constructed at Conseil Européen pour la Recherche Nucléaire (CERN) is being tested at Instituto de Física Corpuscular (IFIC) High Power RF Laboratory. The objective consists of studying its viability in the development of compact linear accelerators for hadrontherapy treatments in hospitals.

Due to the high surface electric field in the cavity, electrons are emitted following Fowler-Nordheim equation, also known as dark currents. The emission and dynamic of these electrons are of fundamental importance on different phenomena such as RF Breakdowns or radiation dose emission.

In this work, 3D electromagnetic numerical simulations have been performed using the computer simulation technology software CST Studio Suite. Then, the resulting EM field maps are used to study the emission and electron dynamics inside the cavity.

In addition, numerical results of the reflection and transmission phenomena have been performed when the cavity is partially filled with a plasma-like material, to simulate RF breakdowns conditions.

The simulation results are compared with experimental data and first conclusions discussed.

Topic

Modeling and Simulations

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