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Status: Project leader

High-Voltage Solid Switch (HiVoSS)

Context:

In the domain of the X-ray generation, the opportunity to perform several radiographic measurements in the microsecond range is studied in detail. The generator, based on the Induction Voltage Adder (IVA) concept, is able to deliver successive pulses with this short delay. However, the electron beam quality highly depends on the stability of high-voltage pulses (several MV) feeding the emitting cathode. While the high-quality requirements are rather easy to achieve for the first pulse, subsequent ones are much more difficult to get in shape. Indeed, the multiple oscillations due to the reflections of the preceding voltage wave in the transmission lines particularly disturb the plateau stability.

Part of the collaboration between CEA CESTA and SIAME laboratory in France aims at improving the pulses quality by limiting these reflections, and thus increasing repetition frequency of successive pulses. For this, the joint SAGE laboratory has launched a research program to study the new solid-state topologies for pulsed power applications, called HIgh-Voltage Solid Switch, HiVoSS.

Main research axis:

In this project, two main research axes are clearly identified.

The first approach is to develop a variable, controllable and modifiable resistor on a time scale of a few nanoseconds. This system placed in parallel with the inductive cell must maintain the equivalent impedance to a matched value. Integrating several solid-state components with very fast switching capabilities, this module will be capable of withstanding quite high levels, namely 20 kV and 3 kA.

The second considered solution is changing current coaxial lines, between the generator output and the inductive cell, by dispersive line with thin semiconductor layers. With an adequate attenuation rate, these improved dispersive lines minimize bounces with a limited effect on the pulses shape (especially the rising and falling edges). To choose the appropriate design, the study is focused on the construction of electrical and electromagnetic models of HV coaxial lines containing these layers.