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Gamma diagnostic development for ESS cryomodule prototypes in CEA Saclay

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Field emission (FE) is one of the main reasons for the degradation of superconducting cavity quality factor. Its presence can limit the ultimate performances of superconducting RF (SRF) cavities and hence the cryomodule in which they are assembled.
For these reasons, it is essential to better understand how this phenomenon is generated and evolves from the SRF cavity preparation, in the clean room, through their assembly in the cryomodule until their final test and operation on the machine.
The effort to develop diagnostics required to check for occurrence of FE, its characterization and its consequences in terms of radiation has been limited.
Due to the shielding environment in the cryomodule, the more faint radiation occurring at the FE onset remains undetected. Pulsed operation is also a cause of misreading of the dose rate with general-purpose radiation monitors. More precise diagnostic and analysis tools are required to gain more information.
We present the development of dedicated time-resolved detectors for the FE radiation which aim at improving its coverage in terms of solid angle and lower energy threshold sensitivity. We approach this topic through detailed simulation based on GEANT4 toolkit in order to analyze the interaction of FE radiation with the cavity environment and optimize the detectors with respect to their application in cryomodule or vertical test stands. We illustrate by analyzing recent cryomodule experimental test data.

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Footnotes

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