SRF2025 TOKYO

22ND INTERNATIONAL CONFERENCE ON RF SUPERCONDUCTIVITY

September 21-26, 2025

Contribution ID: **153** Contribution code: **TUP24** Type: **Poster Presentation**

Field emission analysis in SRF cavities for PIP-II using GEANT4

Tuesday 23 September 2025 14:30 (3 hours)

Field emission (FE) remains a significant hurdle for achieving optimal performance and reliability in superconducting radiofrequency (SRF) cavities used in accelerator cryomodules. A thorough understanding of the generation and propagation of FE-induced radiation is therefore essential to mitigate this problem. The absence of standardized measurement protocols further complicates the comparison of radiation data across different testing phases and facilities. This highlights the need for a precise quantitative method to diagnose and analyze FE-induced radiation. Such efforts could prove beneficial for improving cavity preparation and cleanroom assembly techniques during the prototype and production stages of Fermilab's upcoming PIP-II project. In this study, we combine radiation diagnostics with detailed Geant4 simulations to analyze FE-induced radiation, enhance diagnostic accuracy, and optimize detector positioning. This integrated approach ultimately aims at optimizing the preparation, assembly, and testing procedures for PIP-II SRF cavities to achieve FE-free cryomodules.

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Footnotes

Funding Agency

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Session Classification: Tuesday Poster Session

Track Classification: MC3: Cavities