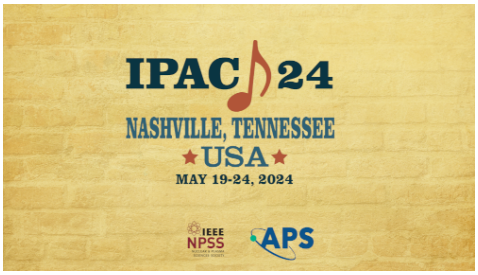

Contribution ID: **443** Contribution code: **MOPC44** Type: **Poster Presentation**

Transfer learning for field emission mitigation in CEBAF SRF cavities

Monday, 20 May 2024 16:00 (2 hours)

The Continuous Electron Beam Accelerator Facility (CEBAF) operates hundreds of superconducting radio frequency (SRF) cavities in its two linear accelerators (linacs). Field emission (FE) is an ongoing operational challenge in higher gradient SRF cavities. FE generates high levels of neutron and gamma radiation leading to damaged accelerator hardware and a radiation hazard environment. During machine development periods, we performed invasive gradient scans to record data capturing the relationship between cavity gradients and radiation levels measured throughout the linacs. However, the field emission environment at CEBAF varies considerably over time as the configuration of the radio-frequency (RF) gradients changes or due to the strengthening of existing field emitters or the abrupt appearance of new field emitters. To mitigate FE and lower the radiation levels, an artificial intelligence/machine learning (AI/ML) approach with transfer learning is needed. In this work, we mainly focus on leveraging the RF trip data gathered during CEBAF normal operation. We develop a transfer learning based surrogate model for radiation detector readings given RF cavity gradients to track the CEBAF's changing configuration and environment. Then, we could use the developed model as an optimization process for redistributing the RF gradients within a linac to mitigate field emission.

Footnotes

Funding Agency

This material is based upon work supported by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics under contract DE-AC05-06OR23177

Paper preparation format

Region represented

North America

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Session Classification: Monday Poster Session

Track Classification: MC1: Colliders and other Particle and Nuclear and Physics Accelerators: MC1.A08 Linear Accelerators