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Virtual cavity probe for the real-time identification of cavity burst-noise type in superconducting radio-frequency systems

Thursday 25 September 2025 14:30 (3 hours)

Burst-noise events are primary trip sources at the China Accelerator Facility for superheavy Elements (CAFE2), characterized by a rapid burst noise in the cavity pick-up signal categorizable into three distinct types: flashover, electronic quench (E-quench), and partial E-quench. Herein, we design an algorithm identifying the burst-noise event types in real time to realize a real-time discrimination of the three types of burst-noise events. This algorithm is based on a virtual cavity probe constructed with the forward and reflected signals of the cavity and integrated into a field-programmable gate array (FPGA). Moreover, we introduce an innovative method for calibrating the transmission delay in channels. This FPGA-based low-level radio-frequency algorithm identifies the burst-noise event type in real time. Its effectiveness has been validated in the CAFE2 facility, offering valuable data support for future advancements in machine learning-based fault classification and dark-current characterization.

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Yes

Footnotes

Funding Agency

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