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OR27 - Classifying and Mitigating Superconducting Cavity Faults in the SRF Linac of the Chinese ADS Front-End Demo Facility

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The Chinese ADS Front-end demo superconducting radio-frequency (SRF) linac, CAFe, successfully conducted a 10 mA, 200 kW continuous wave proton beam commissioning in 2021. However, the governing portion (~70%) of total beam trips was attributed to RF cavity faults. When these faults occur, an acquisition process records 8 RF waveforms using digital low-level radio-frequency (LLRF) systems. In order to address the issue, we studied the mechanisms underlying each cavity fault and analyzed time-series data to recognize several fault patterns. Our findings indicate that field emission (FE)-triggered cavity faults and transient beam-loading are the dominant causes of beam trips at CAFe. To identify and mitigate these issues, we have built a real-time classification system to identify the FE-induced Electronic-quench events. In addition we have developed and implemented several novel LLRF algorithms to suppress the cavity faults at CAFe. This study serves as a significant step towards improving the availability and reliability of the operational beam for the future China initiative Accelerator-Driven System project.

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