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Beam trip compensation for high power superconducting RF linacand progress of CiADS

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To ensure the reliable operation of The China Initiative Accelerator Driven System (CiADS), the stringent real-time failure compensation of superconducting cavities in linac is crucial. We have developed a reinforcement learning algorithm based on segmented compensation strategy, which can achieve fast, adaptive optimization and almost instantaneous compensation scheme acquisition across diverse failure scenarios. A key-component rapid loading system was developed. Experiment results shows that the platform can restore beam energy within 20ms with an energy deviation of less than 0.5%. The above improvements will provide essential technical support for the second level failure compensation of the CiADS linac. We experimentally validated the feasibility of compensation strategy on CAFe (Verification device for CiADS linac). The online compensation experiment was carried out for the failure of cavity CM3-1 in the superconducting section. The proposed scheme successfully restored the terminal beam energy while maintaining a transmission efficiency above 99.9%, with the entire compensation process completed within 36 seconds. So far, the CiADS superconducting linac has entered the phase of mass production of equipment as well as system integration and assembly. The overall integration will be completed and the subsequent beam commissioning will be launched in September 2026.

Footnotes

Funding Agency

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