

LCLS-II LINAC Cooldown Automation

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The upgrade of the SLAC National Accelerator Laboratory's Linac Coherent Light Source (LCLS) to LCLS-II marks a significant advancement in accelerator technology, incorporating a superconducting linear accelerator enhanced by 37 cryomodules segmented into two LINAC sections. This configuration, with 17 cryomodules upstream and 20 downstream, is uniquely supported by one of two helium refrigeration systems. A pivotal aspect of this upgrade is achieving an average cryomodule cavity quality-factor Q_0 of 2.7×10^{10} , essential for the operational efficiency of LCLS-II. A critical strategy employed to meet this requirement involves cooling the cavities slowly from room temperature and special cooling at a rapid rate of over 10 K/min through the niobium superconducting transition temperature of 9.2 K, aimed at minimizing the remnant magnetic field. This paper presents a detailed account of the first-ever implementation of a fast-cooldown process in a string of cryomodules. It elaborates on the automated functions, sequences, control logic, and machine protections that have been integrated into the system. Furthermore, it provides insights into the design decisions and valuable experiences garnered throughout the process of integration and commissioning, offering a comprehensive overview of this achievement in accelerator science.

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