PUSHING THE LIMITS: RF FIELD CONTROL AT HIGH LOADED Q

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Abstract

The superconducting cavities in an Energy-Recovery-Linac will be operated with a high loaded Q of several 10^7, possible up to 10^8. Not only has no prior control system ever stabilized the RF field in a linac cavity with such high loaded Q, but also highest field stability in amplitude and phase is required at this high loaded Q. Because of a resulting bandwidth of the cavity of only a few Hz, this presents a significant challenge: the field in the cavity extremely sensitive to any perturbation of the cavity resonance frequency due to microphonics and Lorentz force detuning. To prove that the RF field in a high loaded Q cavity can be stabilized, and that Cornell's newly developed digital control system is able to achieve this, the system was connected to a high loaded Q cavity at the JLab IR-FEL. Excellent cw field stability - about 2 x 10^{-4} rms in relative amplitude and 0.03 deg rms in phase - was achieved at a loaded Q of 2.1 x 10^7 and 1.4 x 10^8, setting a new record in high loaded Q operation of a linac cavity. Piezo tuner based cavity frequency control proved to be very effective in keeping the cavity on resonance and allowed reliable to ramp up to high gradients in less than 1 second.

NO SUBMISSION RECIEVED