STABILITY ISSUES IN SUPERCONDUCTING RADIO-FREQUENCY LINEAR ACCELERATORS

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Abstract

Field stability in superconducting radio-frequency (RF) cavities is critical to the performance of linear accelerators. The Spallation Neutron Source (SNS) Linac requires field stability within 1% and 1 deg of amplitude and phase, respectively, whereas the proposed International Linear Collider requires field stability one to two orders of magnitude more stringent. Field stability is affected by many factors including beam loading, Lorentz-force detuning, cryogenic system pressure and temperature stability, high-voltage system stability, thermal drift in electronics and transmission lines, timing and reference system stability, vibration-induced microphonics detuning, component aging, and the stability and robustness of the low-level RF (LLRF) control system itself. The LLRF control system must compensate for all of the sources of instability through a combination of feedback and feedforward techniques. In this paper the author will discuss stability issues drawing on examples from the recently-commissioned SNS Linac. Performance measurements, some completed and some planned, will be presented along with discussion of the techniques employed to provide the required field stability.

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