RF CONTROL AND LONGITUDINAL BEAM STABILITY IN ENERGY RECOVERY LINACS

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Abstract

Most concepts for next generation light sources base on linear accelerators (linac) due to their excellent beam properties. In case of high electron energies and extreme average currents Energy Recovery Linacs (ERL) are mandatory. In this paper we investigate the rf field stability in a generic superconducting, cw operated ERL. By using rf control cavity simulations and longitudinal beam dynamics the influence of rf field stability on the energy recovery process is analyzed. Since the ERL aims for a small net beam loading cavities are operated at a high loaded quality factor. Therefore they are operated at a low bandwidth and are very susceptible to microphonics detuning. We considered the field stability under the influence of limited rf power, mechanical cavity detuning, varying beamloading, synchronization deviations and varying bunch parameters at injection into the linac. The resulting temporal and energy jitter at the linac end will be transformed in the return arc and leads to rf phase deviations on the return path. Implications of varying beam loading on the ERL performance are examined.

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