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Concept of a High-Power Linear Proton Accelerator

We present a new concept of a compact high-power linear proton accelerator with an average power of 10 MW at a kinetic beam energy of 1 GeV. Acceleration is accomplished in several stages. In each stage, the beam is recirculated a few times through the same set of SRF cavities. The energy range, cavity type, number of cavities and number of beam recirculations of each stage are optimized to simultaneously reach the voltage and power limits of the stage's SRF cavities. This minimizes the required number of costly and complex SRF cavities by allowing them to fully utilize the available RF power. The number of cavities in each section is reduced inversely proportionally to the number of passes, or recirculations, thus making the accelerator more compact. To avoid the complexity of multiple recirculating arcs and especially of multi-pass beam spreaders and recombiners, we implement the Fixed-Field Alternating-gradient arc design and adiabatic matching approach where all beam passes are transported and matched to the accelerating sections in a single beam line. Estimates of the performance parameters and of the expected gain over a conventional straight linac design are presented.

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