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Beam Dynamics for Induction Accelerators

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An induction linac uses pulsed power that is applied directly, without any intervening resonant cavities, to accelerate a charged particle pulse. Relative to an rf linac this approach allows for a large beam pipe aperture capable of transporting a large current with a long pulse duration. The mean accelerating gradient is expected to be relatively low (less than about 1.5 MV/m), but the potential efficiency of energy transfer is large. A multiple-beam induction linac is therefore a natural candidate accelerator for a heavy ion fusion (HIF) driver. However, the accelerated beams must meet stringent requirements on occupied phase space volume in order to be focused accurately and with small radius onto the fusion target. Dynamical considerations in the beam injector and linac, as well as in final compression, final focus and the fusion chamber, determine the quality of the driver beams as they approach the target. Requirements and tolerances derived from beam dynamics strongly influence the linac configuration and component design.

After a brief summary of dynamical considerations, two major topics are addressed here: transportable current limits, which determine the choice of focal system for the linac; and longitudinal control of the beams, which are potential destabilized by their interaction with the pulsed power system.

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