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Publication Date
2007-09-01

HIFAN 1677a

End-to-end Simulations of an Accelerator for Heavy Ion Beam Bunching

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Funding: This research was supported by the U. S. Department of Energy through Princeton Plasma Physics Laboratory and Lawrence Berkeley National Laboratory for the HIFS-VNL.

Longitudinal bunching factors in excess of 70 of a 300-keV, 27-mA K+ ion beam have been demonstrated in the Neutralized Drift Compression Experiment in rough agreement with LSP particle-in-cell end-to-end simulations. These simulations include both the experimental diode voltage and induction bunching module voltage waveforms in order to specify the initial beam longitudinal phase space critical to longitudinal compression. To maximize simultaneous longitudinal and transverse compression, we designed a solenoidal focusing system that compensated for the impact of the applied velocity tilt on the transverse phase space of the beam. Here, pre-formed plasma provides beam neutralization in the last one meter drift region where the beam perveance becomes large. Integrated LSP simulations, that include detailed modeling of the diode, magnetic transport, induction bunching module, plasma neutralized transport, were critical to understanding the interplay between the various accelerator components. Here, we compare simulation results with the experiment and discuss the contributions to longitudinal and transverse emittance that limit compression.

Supported by the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.