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Drift compression and Final Focus (review)

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Igor D. Kaganovich, Edward A. Startsev, and Ronald C. Davidson
Plasma Physics Laboratory, Princeton University, Princeton, New Jersey, 08543 USA

Jean-Luc Vay, Steven M. Lidia, and Peter Seidl
Lawrence Berkeley National Laboratory, 1 Cyclotron Road, Berkeley, CA 94720

Mikhail A. Dorf and Alex Friedman
Lawrence Livermore National Laboratory, 7000 East Avenue, Livermore, CA 94550

Neutralized drift compression offers an effective means for particle beam pulse compression and current amplification. In neutralized drift compression, a linear longitudinal velocity tilt (head-to-tail gradient) is applied to the non-relativistic beam pulse, so that the beam pulse compresses as it drifts in the focusing section. The ion beam pulse current can be increased by a factor of 100 [1]. We have performed a detailed study of how the longitudinal compression of a typical NDCX-I ion beam pulse is affected by the initial errors in the acquired velocity modulation [2]. Although small parts of the beam pulse can achieve high local values of compression ratio, the acquired velocity errors cause these parts to compress at different times, limiting the overall compression of the ion beam pulse.

For ballistic beam propagation, beam space charge can be well neutralized by a background plasma, if the plasma density greatly exceeds the beam density [3]. However, in this case the beam is subject to the two-stream instability that can lead to increase in the focal spot size [4]. Alternatively, good neutralization can also be achieved by a tenuous large-volume plasma. In this scheme, electrons are commoving with the beam and are not subject to the two-stream instability. Another advantage of this focusing scheme is that enhanced collective focusing can be provided by a weak applied solenoidal magnetic field [5].

The final focus design for NDCX-II should accommodate the applied beam velocity tilt. Location and strengths of several focusing solenoids should be optimized for tight focusing. Alternatively, an achromatic focusing system can be designed for simultaneous longitudinal and transverse focusing.

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Primary author: KAGANOVICH, Igor (Princeton Plasma Physics Laboratory)

Presenter: KAGANOVICH, Igor (Princeton Plasma Physics Laboratory)

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