Abstract for an Invited Paper
for the DPP09 Meeting of
The American Physical Society

Beam dynamics of NDCX-II, a novel pulse-compressing ion accelerator[1]

ALEX FRIEDMAN, LLNL & Heavy Ion Fusion Science VNL

The near-term mission of the Heavy Ion Fusion Science Virtual National Laboratory (HIFS-VNL, a collaboration of LBNL, LLNL, and PPPL) is to study Warm Dense Matter (WDM) at ∼1 eV in thin foils heated volumetrically by ion beams. An emerging mission is ion-direct-drive target physics for inertial fusion energy. These goals (especially the WDM mission) require rapid target heating. Beam bunch compression factors exceeding 50 are routinely achieved on the Neutralized Drift Compression Experiment (NDCX) at LBNL. The next facility for this research program, NDCX-II, will employ a unique approach to ion beam acceleration and pulse compression. Using modified induction cells from the decommissioned Advanced Test Accelerator at LLNL, NDCX-II will compress pulses of singly-charged Lithium ions from ∼500 ns to ∼1 ns as they are accelerated to 3-4 MeV. The required ∼sixfold speed-up and ∼hundredfold spatial compression are to be accomplished in ∼15 m. The beam dynamics employs the strong longitudinal space charge field to halt, and then reverse, an initially imposed pulse compression. This initial compression enables efficient use of the Volt-seconds in the downstream induction cells. Those cells impose further acceleration and the head-to-tail velocity gradient that enables a final neutralized drift compression and focus onto the target. Discrete-particle simulations (1-D, 2-D, and 3-D) have been used to develop the "physics design" for NDCX-II. We present the elements of the design, and our progress toward building this machine at LBNL.

[1]This work was performed under the auspices of the USDOE by LLNL under Contract DE-AC52-07NA27344, by LBNL under Contract DE-AC02-05CH11231, and by PPPL under Contract DE-AC02-76CH03073.