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NDCX-II Experimental Plans and Target Simulations

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The NDCX-II ion induction accelerator construction project at LBNL was completed in March 2012, and the machine is currently undergoing commissioning, which is planned for completion by June 2013. The purpose of NDCX-II is to explore ion-driven High Energy Density Physics (HEDP) relevant to Inertial Fusion Energy. Using ions as drivers to create HEDP conditions has several features, including spatially uniform and volumetric energy deposition over diagnosable large material volumes (~1 mm in radius by a few to tens of microns in depth) for any material or surface; precise control over energy deposition with an intrinsic energy spread of a few per cent; a small shot-to-shot variation in energy and intensity; the ability to do energy accounting by measuring the transmitted beam; a benign environment for diagnostics (low debris and radiation background); high shot rates (~60 per hour); energy deposition that leaves the target in local thermodynamic equilibrium; and small beam induced magnetic fields. The initial configuration has an ion energy of 1.2 MeV, but a second stage is envisioned that would take the energy to 3 MeV. The beam is predicted to heat metal foils several microns thick in a timescale comparable to the hydrodynamic expansion timescale of the target for experiments that infer material properties from measurements of the rarefaction wave. Experiments using metallic foam targets several tens of microns thick that create shock waves will enable the inference of ion energy coupling into kinetic energy of fluid flow. Geometries with a tamping layer may be used to study the convergence of a tamper shock with the end-of-range shock, a process that can occur in tamped direct drive targets. We have carried out detailed hydrodynamic simulations of targets for several configurations, exploring how optical intensity measurements (from infrared to ultraviolet), laser doppler measurements (VISAR), and X-ray density measurements can be used to distinguish equations of state, and measure beam energy coupling in ion driven shock experiments.

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