ION BEAM-DRIVEN TARGET EXPERIMENTS IN NDCX-I

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Experiments on ion-beam target heating use a 0.3 MeV K+ beam from the Neutralized Drift Compression Experiment (NDCX-I) accelerator at LBNL to develop a technique for heating volumetric samples of matter to high energy densities. The NDCX-I delivers a long pulse beam (several microseconds) with a power density of ~0.2 MW/cm^2 over a sampled spot size on the target of several hundred micrometers. With the addition of an imposed velocity tilt from an induction core, the NDCX-I can compress a portion of the long pulse to reach a power density of ~10 MW/cm^2 over 2 nanoseconds. Under these conditions, the free-standing sub-micron foil targets used in the experiments go through the melting and vaporization phases to reach temperatures up to 6000 K. We have developed a target chamber and a suite of target diagnostics including a fast multi-channel optical pyrometer, optical streak camera, VISAR, and high-speed gated cameras. Since the targets are thin foils of fractions of a micron in thickness we can model the initial target thermal dynamics using the equation of heat conduction for the temperature T(x,t) as function of time and the spatial dimension along the beam direction; we include cooling processes from energy flux from the surface of the foil due to evaporation, radiation, and thermionic (Richardson) emission. We will present experimental data and theoretical analysis of the ion beam-driven target experiments.

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