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PHELIX Driven Study of the Richtmyer-Meshkov Instability in Tin in Cylindrical Geometry

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The Richtmyer-Meshkov Instability (RMI) has been extensively studied in fluids in planar geometry. Not so well studied are the effects of converging geometry. The portable LANL PHELIX capacitor bank (Vpeak = 100 kV, Ustored = 340 kJ) coupled with the LANL LANSCE multi-frame proton radiography (pRad) facility radiography makes this possible. The PHELIX pulse (tpulse ˜ 6 us, 1 < Ipeak < 5 MAmps) magnetically accelerates a cylindrical aluminum liner (R = 1.5 cm, dr = 0.6 mm) to high velocities (1.0 < v < 3.0 km/s). In a set of three experiments, the variable capacitor bank charge is used to precisely determine liner velocity, shock pressure, and thus the release state of the target making rigorous study of RMI possible. The first Crenulation experiment was fielded in 2015 at the where a thin-walled (R = 0.5 cm, dr = 1 mm) tin cylinder with single-mode perturbations (kh = 0.1, 0.2, 0.3) on the inside surface was shocked to a pure fluid state on release (P > 35 GPa). The perturbation inversion and growth was diagnosed with a 21-image pRad movie. The RMI growth rates compared well to fluid theory and calculations. The second and third Crenulation experiments were conducted in Nov/Dec 2016 with identical liner/target configurations. In the second experiment, the tin target was shocked to a mixed fluid/solid phase on release (20 > P > 35 kbar). In the third experiment, the target was shocked to solid phase on release (P < 20 kbar). In the former, a pRad movie shows traditional RMI spike evolution. In the latter, growth is mitigated by the material strength. Analysis of the growth rates, comparison to previous experiments, as well as theory and computations will be presented.

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