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Laser-driven Mach waves for gigabar-range shock experiments[1]

DAMIAN SWIFT, AMY LAZICKI, FEDERICA COPPARI, Lawrence Livermore National Laboratory, ALISON SAUNDERS, University of California, Berkeley, JOSEPH NILSEN, Lawrence Livermore National Laboratory — Mach reflection offers possibilities for generating planar, supported shocks at higher pressures than are practical even with laser ablation. We have studied the formation of Mach waves by algebraic solution and hydrocode simulation for drive pressures at much than reported previously, and for realistic equations of state. We predict that Mach reflection continues to occur as the drive pressure increases, and the pressure enhancement increases monotonically with drive pressure even though the "enhancement spike" characteristic of low-pressure Mach waves disappears. The growth angle also increases monotonically with pressure, so a higher drive pressure seems always to be an advantage. However, there are conditions where the Mach wave is perturbed by reflections. We have performed trial experiments at the Omega facility, using a laser-heated halfraum to induce a Mach wave in a polystyrene cone. Pulse length and energy limitations meant that the drive was not maintained long enough to fully support the shock, but the results indicated a Mach wave of 25-30 TPa from a drive pressure of 5-6 TPa, consistent with simulations. A similar configuration should be tested at the NIF, and a Z-pinch driven configuration may be possible.

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