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Ramp Compression of materials to high-pressure low-temperature states

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The thermodynamics of compression are typically examined under isothermal conditions or with shock waves, where compressions are limited by the achievable pressure or dissipative heating, respectively. A relatively new dynamic compression technique, ramp compression, enables the adiabatic compression of matter with reduced dissipative heating as compared to shock compression and potentially allows the exploration of solids to the extreme densities expected to exist in the deepest interiors of giant planets. Ramp compression is however unstable relative to a shock because sound velocities typically increase with pressure. Therefore, to ramp compress matter into the multi-Mbar pressure regime, the pressure-loading history must be gentle enough to avoid shock formation, while sufficiently intense to achieve high pressures, constraints that until now were out of reach for laboratory experiments. I will describe ramp compression experiments on the NIF laser in which the stress-density of diamond and Fe were determined to peak pressures of 50Mbar and 8Mbar, respectively. I will also present preliminary data from the new NIF x-ray diffraction platform.