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Laser Driven, Extreme Compression Science

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Extreme-compression science is blessed by a number of new techniques and facilities that are shattering previous experimental limitations: static pressures above 600 GPa, equation of state (EOS) experiments on pulsed-power machines, picosecond-resolved x-ray diffraction on free-electron lasers, and many new experiments on high-energy lasers. Our goals, using high-energy lasers, have been to push the limits of high pressure accessible to measurement and to bridge the gap between static- and dynamic-compression experiments by exploring off-Hugoniot states. I will review laser techniques for both shock- and ramp-compression experiments, and discuss a variety of diagnostics. I will present recent results including: impedance-matching Hugoniot experiments, absolute-Hugoniot implosive-shock radiography, coupled radiometry and velocimetry, ramp-compression EOS, and in-situ x-ray diffraction and absorption spectroscopy into the TPa regime. As the National Ignition Facility (NIF) transitions to a laser user facility for basic and applied science, we are transferring many of these techniques. The unprecedented quality and variety of diagnostics available, coupled with exquisite pulse-shaping predictability and control make the NIF a premier facility for extreme-compression experiments.