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Probing Dense States of Hydrogen and Oxides in Giant Planets using Multiple and Single- Shock Compression and Laser-Pulse-Heated Diamond-Anvil Cells. W.J. NELLIS, I.F. SILVERA, Harvard University — Pressures and temperatures of hydrogen on adiabats deep in gas giants are achieved using a shock wave reverberating between incompressible oxide anvils and by pulsed heating in a diamond-anvil cell. At 100 GPa in gas giants, temperature varies from ~20,000 K in hot Jupiters down to ~1,000 K in cold Jupiters. The Hugoniot curve of hydrogen crosses these adiabats at ~15 GPa and ~4,000 K for Jupiter and ~100 GPa for hot Jupiters, both at compressions of ~4 fold. Reverberating shocks and diamond cells produce compressions up to ~12 fold. Since dense hydrogen has a huge diffusion coefficient, experiments must be done sufficiently slowly that hydrogen is in thermal equilibrium and sufficiently fast that hydrogen remains in the cell. Dynamic experiments occur within this constraint. DAC experiments require heating by multiple laser pulses each of ~100 ns duration. Pressures and temperatures achieved by multiple shock compression are tuned by variation of the density of oxide anvils. An oxide ($Gd_3Ga_5O_{12}$) has been found that is stiffer than diamond above 100 GPa. This oxide will enable higher pressures and lower temperatures in metallic fluid hydrogen by multiple shock and might be representative of new oxide phases in deep interiors of giant extrasolar rocky planets. Experiments and systematics will be described.

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