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Phase Transitions in Aluminum Under Shockless Compression at the Z Machine JEAN-PAUL DAVIS, JUSTIN BROWN, LUKE SHULENBURGER, Sandia National Laboratories, MARCUS KNUDSON, Sandia Nat'l Lab., Inst. for Shock Physics, Washington State Univ — Aluminum 6061 alloy has been used extensively as an electrode material in shockless ramp-wave experiments at the Z Machine. Previous theoretical work suggests that the principal quasi-isentrope in aluminum should pass through two phase transitions at multi-megabar pressures, first from the ambient fcc phase to hcp at around 200 GPa, then to bcc at around 320 GPa. Previous static measurements in a diamond-anvil cell have detected the hcp phase above 200 GPa along the room-temperature isentherm. Recent laser-based dynamic compression experiments have observed both the hcp and bcc phases using X-ray diffraction. Here we present high-accuracy velocity waveform data taken on pure and alloy aluminum materials at the Z Machine under shockless compression with 200-ns rise-time to 400 GPa using copper electrodes and lithium-fluoride windows. These are compared to recent EOS tables developed at Los Alamos National Laboratory, to our own results from diffusion quantum Monte-Carlo calculations, and to multi-phase EOS models with phase-transition kinetics. We find clear evidence of a fast transition around 200 GPa as expected, and a possible suggestion of a slower transition at higher pressure.

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