Using high energy laser facilities to explore matter at pressures from a kilobar to a gigabar

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A new generation of materials experiments at high pressures-densities-temperatures is now possible due to a variety of high energy density (HED) facilities and new compression techniques. These facilities will be used over the next decade to measure equation of state and transport properties of materials at multi-gigabar pressure and over 10 fold compression. I will describe recent experiments where high energy lasers were used to measure high pressure shock equation of state and transport properties of a few low Z materials (C, H2O, SiO2) from Kbar to 10's of Mbar. In general, with increasing shock pressure these materials transition from an insulator to an electronic conductor. In some materials, like diamond, this transition is coincident with the expected melt transition. In other materials, the onset of conductivity is either determined by chemistry (i.e. SiO2) or thermal activation of carriers across a band gap (H2O). In addition to shock measurements, high energy lasers are being used to isentropically compress materials to Mbar pressures. Al isentrope data will be shown as validation of the experiment and analysis techniques.

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