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Thermal Conductivity Measurement at Static High Pressure and Dynamic High Temperature

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The laboratory measurement of thermal transport dynamics at extreme conditions of pressure and temperature has been traditionally challenging. Combining static compression in a diamond anvil cell with dynamic laser heating and temperature measurement has shown promise at providing these essential data. Tracking of propagating temperature disturbances in heated, compressed samples allows direct analysis of the thermal conduction and diffusion coefficients at relevant extremes. I will discuss results for metals Fe, Pt, and Mo for which there is extensive existing experimental and theoretical study at high pressure and temperature for comparison. The importance of benchmarking studies on simple, well understood materials, and the need for careful experimental modelling, is discussed in the context of persistent disagreement over the thermal conductivity of Fe at conditions relevant to Earth's core, with direct measurements, estimates based on electrical resistivity data, and first principles calculation often yielding inconsistent values. Recent measurements, of both thermal and electrical transport, are examined using detailed finite element models of experiments to assess sources of systematic error and develop strategies for improving measurements.