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Principles underlying the Fourth Power Nature of Structured Shock Waves DENNIS GRADY, Applied Research Associates — Steady structured shock waves in materials including metals, glasses, compounds and solid mixtures, when represented through plots of Hugoniot stress against a measure of the strain rate through which the Hugoniot state is achieved, have consistently demonstrated a dependence to the fourth power. A perhaps deeper observation is that the product of the energy dissipated through the transition to the Hugoniot state and the time duration of the Hugoniot state event exhibits invariance independent of the Hugoniot amplitude. Invariance of the energy-time product and the fourth-power trend are to first order equivalent. Further, constancy of this energy-time product is observed in other dynamic critical state failure events including spall fracture, dynamic compaction and adiabatic shear failure. The presentation pursues the necessary background exposing the foregoing shock physics observations and explores possible statistical physics principals that may underlie the collective dynamic observations.

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