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Petawatt laser absorption bounded MATTHEW LEVY, LLNL, Rice Univ, SCOTT WILKS, MAX TABAK, STEPHEN LIBBY, LLNL, MATTHEW BARING, Rice Univ — The interaction of petawatt (10^{15} W) lasers with solid matter forms the basis for advanced scientific applications such as table-top relativistic particle accelerators, ultrafast charged particle imaging systems and fast ignition inertial confinement fusion. Key metrics for these applications relate to absorption, yet conditions in this regime are so nonlinear that it is often impossible to know the fraction of absorbed light f, and even the range of f is unknown. In this presentation, using a relativistic Rankine-Hugoniot-like analysis, we show how to derive the theoretical maximum and minimum of f [1]. These boundaries constrain nonlinear absorption mechanisms across the petawatt regime, forbidding high absorption values at low laser power and low absorption values at high laser power. Close agreement is shown with several dozens of published experimental data points and simulation results, helping to confirm the theory. For applications needing to circumvent the absorption bounds, these results will accelerate a shift from solid targets, towards structured and multilayer targets, and lead the development of new materials.

[1] Levy, M. C. et al. Nat. Commun. 5:4149 doi: 10.1038/ncomms5149 (2014).

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