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Fragmentation Under Extreme Conditions: Applications to Risk Assessment and Diagnostic Development at Mega-Joule Class Laser Facilities

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The development of Mega-Joule class laser facilities (NIF, USA; LMJ, France, SG-IV, China) has driven the need to understand, predict, and control the risks associated with experimental operations due to ablation, blast, and impact hazards. These hazards potentially jeopardize a broad range of facility assets, such as Targets, Laser Optics, Diagnostics, and other Infrastructure. This presentation shall focus on the application of high-performance computer modeling and simulation (M&S) to quantify and mitigate the risk posed by blast, ablation, and impact hazards. The overall risk management strategy is discussed and the role of M&S outlined. The M&S activities fall within two broad categories, Laser-Material interaction (LM) and Hydro-Structural (HS) simulations. The LM class of simulations addresses the high energy, short time phenomena including laser energy deposition, radiation, ablation, heat-flow, and hydrodynamic motion. The HS class of simulations addresses lower energy, longer time phenomena including hydrodynamic motion, heat-flow, material failure, fracture, and fragmentation. Recent efforts to assess and improve fragmentation simulation capabilities are reviewed. Existing simulations methodologies are evaluated and compared to high fidelity fragment data. Applications to diagnostic development and experimental design are reviewed.

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