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Late-Time Numerical Simulations of High-Energy-Density Targets

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In order to determine the impact of high-energy-density (HED) targets on facilities, it is often necessary to perform late-time simulations of target dynamics. The impacts can be debris and shrapnel loading on optics and diagnostics as well as radiation loading on surfaces. These simulations can be very difficult numerical tasks because of five differences as compared to conventional HED simulations. First, the need to generally run simulations $\sim 100X$ longer in time, which places demand on computational resources. Second, additional physics, such as material strength/failure and surface tension, can be required in the simulations. Third, additional parts of the target, which are only important for late-time effects, must be included in the simulations. Fourth, additional sources of input energy, e.g., unconverted laser light, must be included. Fifth, in many cases there is less symmetry in the problems because of the above effects and the simulations must be done in 3D, which also places demands on the computational resources. We discuss a range of simulations performed for HED targets fielded at the National Ignition Facility (NIF). For example, simulation of targets for the National Ignition Campaign shot at NIF must include the Al thermal mechanical package and Si cooling rings that surround the Au hohlraum.