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Radiation hydrodynamics simulations of shock imaging with a betatron x-ray source at BELLA CONNOR TODD, MATTHEW TRANTHAM, ALEXANDER THOMAS, U. of Michigan, FELICIE ALBERT, Lawrence Livermore Nat. Lab., STUART MANGLES, Imperial College London, CAMERON GEDDES, Lawrence Berkeley Nat. Lab., CAROLYN KURANZ, U. of Michigan — The feasibility of high-resolution imaging of the evolution of high-energy-density hydrodynamic experiments using new laser-plasma accelerator radiation sources at the BELLA Laser is studied using CRASH, a radiation hydrodynamic simulation code. The BELLA facility features a Joule-class, femtosecond laser, which can produce a brilliant high-flux betatron x-ray source with 2–3 μm spot, well-suited to probe hydrodynamic instability experiments. CRASH simulations show that the dynamics produced by the 1 J laser with a 200 ps pulse length in a ˜40 μm spot size (irradiance of 4e14 W cm^{-2}) can launch a shock in a water stream. Changes in the phase of the x-ray beam in the material are to be recorded, allowing for greater sensitivity to small density variations compared to measurements of amplitude. Synthetic radiographs from a 3D simulation are used to illustrate the nature of the shock front development. Simulations were conducted across a range of accessible backlight energies, of which the 4-keV result is the most useful. The results from these simulations demonstrate the applicability of the BELLA laser to diagnose shock waves in high-energy-density systems.

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