Laser-driven magnetic flux compression simulation with Nautilus

C.D. ZHOU, Tech-X Corporation, J. LOVERICH, A. HAKIM — The Tech-X fluid and MHD framework, Nautilus, is a finite-volume and finite-element shock-capturing code supporting both structured and unstructured meshes. Nautilus is an easy-to-access, parallel, 3D code available to the ICF community. It is incorporated with features relevant to magneto-inertial confinement fusion (MIF) simulations. Laser-driven magnetic-flux compression is an innovative approach to achieve MIF. A cylindrical target with initial seed magnetic field is compressed by energetic laser beams. The magnetic field that is "frozen-in" plasma gets compressed with the target. The resulting high magnetic field reduces electron thermal conductivity and improves alpha particle confinement, thus providing an additional thermal insulation of the fuel forming the hot spot. It reduces the energy and driver symmetry requirements for ignition. Features for MIF simulations, such as anisotropic heat conduction , laser ray tracing and energy deposition, have been demonstrated with Nautilus. We discuss our approach to determine the best algorithms for properly modeling laser-driven shock implosions with magnetic fields in conditions relevant to cylindrical MIF.

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