Simulation and assessment of material mixing in an indirect-drive implosion with a hybrid fluid-PIC code

H.B. Cai[1], W.S. Zhang[1], F.J. Ge[1], B. Du[1], Z.S. Dai[1]

[1] Institute of Applied Physics and Computational Mathematics, *Beijing, China*

Hybrid fluid-PIC simulations aimed at a better understanding of the implosion physics and the material mixing into the hot spot are described. The development of a hybrid fluid-PIC code is motivated by the difficulty of modelling the material mixing by the commonly used radiation hydrodynamic simulations. Hybrid fluid-PIC techniques, which treat the ions with the traditional particle-in-cell method, and electrons with a massless fluid, are more adaptable to handle the heating of DT fuel through PdV work and the material mixing near the DT ice-gas interface and ablator-fuel interface of a compressed capsule. During implosion shock convergence, significant reactant temperature separation and a noticeable amount of material mixing are observed, both of which have important consequences for estimating neutron yield and the understanding of implosions. Physical explanations for these phenomena are discussed, with the non-equilibrium effect in the hotspot and hydrodynamic instabilities at the interface as the likely explanation, respectively. The hybrid fluid-PIC method would be helpful to test the phenomenological fluid model describing the material mixing in ICF implosion.

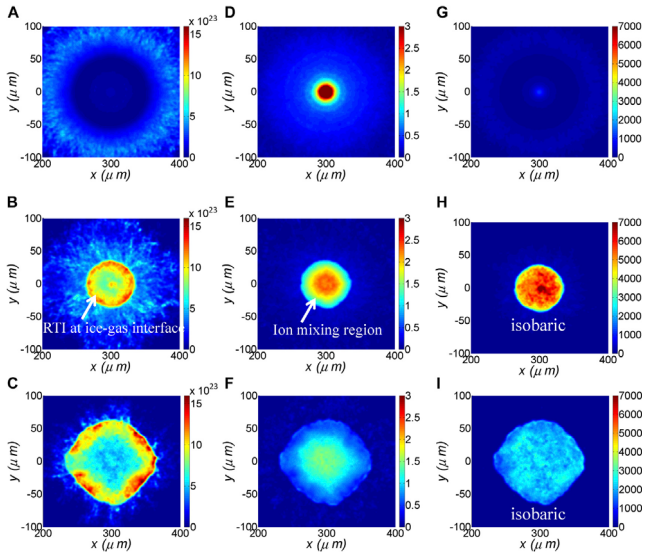

Figure. Snapshots of the 2D density (a)-(c), ion temperature (d)-(f), and pressure (g)-(i) at three typical times.

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