Poster 2 Renaud & Souffland

MEDIC-2F: A one-dimensional diffusive mixing model. Application to LMJ target simulations.

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In laser-driven implosion experiments, a degradation of the single shell capsule yield could be observed due to mixing between the fuel and shell. This mixing is obtained by the growth of hydrodynamic instabilities at the interface between the fuel and the shell. These processes have various origins (inner and outer shell roughness, laser drive perturbations, ...) and evolve through different ways (Rayleigh-Taylor Instability, Richtmyer-Meshkov Instability, “Feed-Through”, ...). The numerical simulations of these intrinsically three-dimensional phenomena, are still costly in term of cpu-time. We thus need an one-dimensional mixing model if we want to asses the impact of variation in the definition of the target, the holraum or the laser drive with a moderate cpu-time cost.

The main hypothesis for our mix-model is that the interpenetration is multifluid and that mass fraction and thermal exchanges could be modelled by the meaning of diffusive processes. Each fluid is in its own volume in an isothermal and a quasi-isobaric balance with the other. An additional diffusive equation calculate the mass fraction evolution of one component of the mixing. The diffusion coefficient is proportional to the length of the mixing zone and its time derivative. The thickening of the interpenetration zone is, indeed, supposed to be known from experimental data or from post-processing of two-dimensional computations results. One part of the thermal exchanges are due to the enthalpy exchanged by mass transport. Another part is due to electronic and ionic thermal conduction. All others thermal homogenization phenomena (energy loss by transverse thermal conduction, 1D average, ...) are modelled by an effective thermal conduction.

We will discuss examples of application of our model to LMJ target simulations. We focused on comparison between our one-dimensional computation results using MEDIC-2F and the corresponding 1D-averaged two-dimensional computation results obtained with the CEA hydrocode FCI2.

References

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