MULTI-GROUP RADIATION TRANSPORT IN THE ABLATION PHASE OF ICF CAPSULES

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The implosion dynamics of an ICF capsule strongly depends on the detailed history of the radiation transport through the consecutive layers of the target. During the ablation phase, in the blow-off plasma and plastic ablator, the spatial- and frequency-dependent distribution of the radiative energy conditions the formation of shocks and the growth of Rayleigh-Taylor instabilities. A better understanding of the hotspot final physical state therefore requires a proper modeling of the multi-group opacities and emissivities of the capsule materials.

The CRE atomic model Spk, initially developed at Imperial College to study radiative properties of Z-pinches, was upgraded to generate multi-group opacity and emissivity tables for the target constituents. This DCA code, based on a screened hydrogenic model with n-l splitting and experimentally measured energy levels, makes use of the effective temperature scheme [1] to mimic the non-LTE conditions of the plasma. Several simple and practical methods were devised to evaluate the atomic and radiative properties of the capsule ablator, ice and fuel in plasma regimes varying from strongly degenerated and coupled to rarified and radiatively equilibrated.

In this work, we present the latest results of radiation diffusion hydrodynamics simulations performed by the RMHD framework CHIMERA using multi-group tables generated by the Spk code. The effect of varying the number of groups and the importance of group positioning are assessed. Comparison with single group simulations highlights the strong dependence of the radiation penetration depth with respect to the photon energy. We show that the newly generated tables improve the predictability of high foot design simulations and we demonstrate the influence of carbon K-shell lines absorption on the shock formation dynamics.

[1] M.Busquet et al, High Energy Density Physics 5 (2009) 270–275