Investigation of supersonic heat-conductivity linear waves in ablation flows

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Ablation flows relative to inertial confinement fusion (ICF) are well described by gas dynamics equations with non-linear radiative heat-conduction. Standard descriptions often assume an isothermal conduction region [1, 2]. However a local analysis in terms of linear propagating waves reveals that temperature stratification in this region gives rise to supersonic wave velocity as a consequence of nonlinear heat-conduction [3]. Such behaviours arise in the case of high heat propagation regimes. These supersonic 'heat-conductivity' waves are associated with heat flux perturbation inhomogeneities that convey perturbation inhomogeneities in temperature and density. These latters may trigger radiative heat transport instabilities [4] and destabilize the ablation front.

In the present work, we conduct numerical computations of linear perturbations in ablation flows. We drop the local hypothesis to address non-uniform and non-stationary realistic ablation flows. The entire deflagration region is modeled, and damping effects due to heat diffusion are exactly taken into account by contrast to [3]. This corresponds to the ealry stage of an ICF target implosion.. We focus on self-similar ablation flows presenting a large Mach number in the conduction zone, and possibly containing a Chapman–Jouguet point [5]. Numerical results are compared to those of the local analysis [3].

References

[1] S. Atzeni and J. Meyer-ter-Vehn, Oxford University Press (2004)

[2] Y. Saillard, P. Arnault, V. Silvert, Phys. Plasma **17**, 123302 (2010)

[3] J.M Clarisse, 44^{th} EPS Conf. Plasma Physics (2017)

[4] V. Yu. Bychenkov and W. Rozmus, Phys. Plasma **22**, 082705 (2015)

[5] J. M. Clarisse, J. L. Pfister, S. Gauthier, C. Boudesocque-Dubois, J. Fluid Mech. (*submitted*)