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Radiatively induced Richtmyer-Meshkov instability

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Laser induced Richtmyer-Meskov (RM) instabilities have previously been described. A classical RM instability can be generated using X-rays produced in a hohlraum (Mikaelian (1991)). The target is a double layer pill about 1 mm in diameter and 300 μm thick: 100 μm Be on 200 μm of SiO_2 foam ($\rho = 0.2$ g/cc). The drive generates a Mach 25 shock in the Be ablator whose initial density is about 2g/cc. The shock reaches the Be/SiO_2 interface in about 4 ns and generates a classical RM instability at this interface.

More recently Goncharov (1999) and Aglitskiy (2002) describe a RM-like instability, commonly known as "ablative RM instability". The authors are interested in the stability of the ablation front in the ablator of a direct drive ICF target. In the case of a corrugated ablation front, ablation pressure generates a rippled shock which induces a pressure perturbation leading to an instability of the ablation front. The features of the ablative RM instability are very different from those of the classical RM instability. In particular, the ablation front perturbation amplitude does not grow linearly with time but presents decaying oscillations.

We are interested here in a third situation. The target is similar to Mikaelian's, except that in Mikaelian setup the X-rays irradiates the ablator and generates a shock. In our setup, the X-rays irradiates the foam which is nearly transparent with respect to the ablator. This lead to a violent release of the ablated plasma into the foam plasma. The acceleration of the ablated plasma/foam plasma interface is an impulsion similar to the interface acceleration in a classical RM instability. Numerical simulations carried out with our FCI2 code show that the amplitude of a perturbation of the ablator/foam interface grows linearly in time with a growth rate similar to RM instability one. Another well known feature of the classical RM instability is the phase reversal of the perturbation which occurs when the velocity jump is directed from the heavy fluid to the light fluid. In our situation the phase reversal seems to be sensitive to the nature of the ablator.

References

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