Nonlinear ablative Rayleigh-Taylor instability

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In ICF implosions, the final fuel assembly must consist of a low-density (tens of g/cm3), high-temperature (several keV's) DT plasma core surrounded by a high-density (hundreds of g/cm3), low-temperature (hundreds of eV's) shell to maximize the number of fusion reactions that can occur while the fuel is inertially confined. During the acceleration regime, the outer shell surface is unstable to the Rayleigh-Taylor instability (RTI), where the "bubbles" of outer light ablator plasma rise through the dense cold shell. When the compressed DT fuel begins to decelerate the imploding pusher, the inner shell surface is susceptible to the RTI, where again the bubbles of inner light DT plasma rise through the dense shell.

In this report, the nonlinear evolution of the single-mode ablative Rayleigh-Taylor instability (ARTI) of an accelerated planar target is investigated in the parameter range of interest to inertial-confinement fusion implosions. Analysis method of the bubble and spike amplitude growth in nonlinear ARTI experiments was established. The bubble acceleration and target breakup in direct-drive ARTI experiments were observed for the first time using a Kirkpatrick-Baez microscope x-ray framing camera coupled with a side-on x-ray backlighting on the Shenguang-II laser facility. The analysis suggests that the bubble acceleration that is driven by the accumulation of vorticity inside the bubble transferred by the mass ablation from the spikes, contributes to the breakup of the accelerated target.

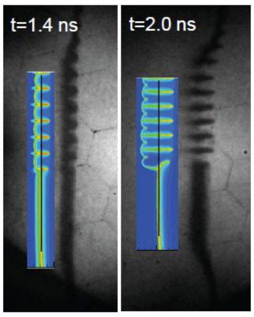

Figure 1: Comparison of nonlinear evolution of the single-mode ARTI from the experiment and the simulation

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