Nonlinear growth of Rayleigh Taylor Instability single mode structure under the effect of collision with a second fluid

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The Rayleigh-Taylor instability (RTI) occurring at the interface between two fluids subject to an external force pointing from heavy to light fluid is widely encountered in plasma physics, playing an important role in inertial confinement fusion, astrophysics, and geophysics. A particular case appears when the fluid is partially ionized plasma interacting through collision with a predominantly neutral background.

In this configuration, the non-linear growth of RTI structures is investigated using Goncharov's [1] potential model for a single mode RTI. It gives the temporal evolution of the position, the curvature, and the velocity of the top of the bubble or of the tip of the spike. In the case where the RTI dynamics is dominated by collisions between neutrals and ions, the terminal bubble and spike velocities are derived from the non-linear equations. Direct Numerical Simulations (DNS), with the code MHD CLOVIS [2] and electrostatic ERINNA [3], are used to justify the use of Goncharov's model in this regime and observe its limitations or transition to the classical (inertial) regime.

In the collisional regime and at any arbitrary Atwood number, the terminal velocity obtained with this model appears to agree well with DNS. As a conclusion, Goncharov's potential model applied to this particular case yields promising and unexpected results.

References

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