Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

On the Rayleigh-Taylor unstable dynamics of three-dimensional interfacial coherent structures with time-dependent acceleration[1]

SNEZHANA ABARZHI, DESMOND L. HILL, The University of Western Australia

— Rayleigh-Taylor instability (RTI) occurs in a range of natural and industrial processes. Whereas the majority of existing studies have considered constant acceleration, RTI is in many instances driven by variable acceleration. Here we focus on RTI driven by acceleration with a power-law time-dependence, and, by applying a group theoretic method, find solutions to this classical nonlinear boundary value problem. We deduce that the dynamics is dominated by the acceleration and that the solutions depend critically on the acceleration parameters for values of the acceleration exponent greater than (-2). We find that in the early-time dynamics, the RTI growth-rate is defined by modified Bessel functions. For the late-time dynamics, we link the interface dynamics with an interfacial shear function, find a continuous family of regular asymptotic solutions and identify invariant properties of nonlinear RTI. The essentially interfacial and multi-scale character of the dynamics is also demonstrated. The velocity field is potential in the bulk, and vortical structures may appear at the interface due to interfacial shear. The multi-scale character becomes clear from the invariance properties of the dynamics. We agree with existing observations and elaborate new benchmarks for the future.

[1]The authors thank the National Science Foundation (USA) and the University of Wetsern Australia (AUS)

Snezhana Abarzhi
The University of Western Australia

Date submitted: 01 Aug 2019 Electronic form version 1.4