Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

**Nonlinear dynamics and three-dimensional stable patterns in Rayleigh-Taylor unstable condensing liquid layers: improved one- and 1.5-sided models** TAO WEI, FEI DUAN, Nanyang Technological University — Three-dimensional patterns of condensing layers suspended on cooled substrates are investigated with an introduced vapor boundary layer (VBL), to which the changes in gas composition and temperature are confined. The interfacial vapor transport equation incorporates convective and diffusive fluxes, coupled with a long-wave evolution equation for interface location. Our work extends that of Kanatani [1] on sessile evaporating films to Rayleigh-Taylor unstable condensing layers with nonlinear theory and involves effects of vapor recoil, gravity combined with buoyancy in condensate and heat flux in VBL. The general framework is termed as 1.5-sided model, which can reduce to a one-sided model. An extended 1.5-sided basic state is proposed, whose stability is investigated with linear stability analysis and nonlinear simulation. With one-sided model, finite-time rupture is found, suggesting that destabilizations of vapor recoil and negative gravity combined with buoyancy prevail over stabilizations of mass gain, thermocapillarity and surface tension. This is in sharp contrast to 1.5-sided model, in which such a layer can be stabilized by convection and diffusion of vapor on interface, and rupture is suppressed as stable pattern even with induced destabilization of thermocapillarity.

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Date submitted: 31 Jul 2016 Electronic form version 1.4