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Landau-type saturation of weakly unstable disturbances in interfacial-surfactant instability DAVID HALPERN, ALEXANDER FRENKEL, University of Alabama — We study the weakly-nonlinear limit of the previously derived coupled evolution equations for the disturbances to the position of the interface and the concentration of an insoluble surfactant, in certain longwave regimes. In general, small disturbances of the semi-infinite two-fluid shear flow always grow to be non-small, so–in contrast to a number of other similar flows–there is no regime in which the nonlinear saturation can be described by weakly-nonlinear equations*. However, for spatially periodic disturbances with the period slightly exceeding that of the marginal linear mode of the longwave instability, the saturation occurs with small amplitudes. We verify the fact that considering the interaction of the fundamental and the first overtone gives a good approximation. Next the problem is reduced to a nonlinear system of four ordinary differential equations, which is solved by using multiple time scales. The slow leading-order amplitude evolution and the saturated traveling wave are described by four coupled Landau-type equations with cubic nonlinearities. These follow from the non-secularity conditions for the diagonalized non-homogeneous linear system governing the next-order amplitude corrections, whose four-by-four coefficient matrix has a double zero eigenvalue.

*A. Frenkel and D. Halpern, http://arxiv.org/pdf/nlin.CD/0601025.

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