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Mark Mineev-Weinstein* (mark_mw@hotmail.com), NMC, Los Alamos, and MPIPKS, Dresden.
New class of exact solutions and bubble selection in a Hele-Shaw Cell.

Pattern formation selection problems (far from equilibrium) was a long-standing challenge in theoretical physics and applied mathematics since 1950s, when pioneering experiments of Sir G.I. Taylor were conducted. The main problem was the absence of conventional mathematical tools to describe dynamics in unstable environment. In 1980s the pattern selection was resolved via the surface tension by using the “Asymptotic beyond all orders” (M. Kruskal and H. Segur, 1983), which was based on a quasiclassical technique, developed in 1960s by Pokrovsky and Khalatnikov for an electron reflection above a potential barrier.

In this talk I will report new class of solutions recently obtained with G.L. Vasconcelos (UF Pernambuco, Brazil) in a problem of a velocity and shape selection of Taylor-Saffman bubble from a continuous family of admissible solutions without using surface tension. The results are in a full agreement with experiments. This results were possible to obtain due to a remarkable and powerful integrable structure of the non-linear interface dynamics equations, which we (and others) have developed earlier. (Received January 18, 2012)