Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

**Combinations of neck vibrations in bubble break-up** SAMUEL D. OBERDICK, LIPENG LAI, University of Chicago, KONSTANTIN S. TURITSYN, Los Alamos National Lab, WENDY W. ZHANG, University of Chicago — When an air bubble pinches off inside a liquid, the final dynamics is controlled by the initial shape asymmetries, via vibrations in the neck cross-section. Previously, we showed that, when the break-up is dominated by 1 vibrational mode, the initial shape asymmetry evolves into a smooth contact that divides the cross-section shape into side lobes. The lines of symmetry remain static over time and the average size of the side lobes decreases in discrete steps as the initial distortion size is reduced. Here we use analytics and simulation to study the contact dynamics obtained by combining 2 vibrational modes. A wide variety of intricate contact shapes are possible. When incommensurate modes are present, the lines of symmetry are destroyed. The contact shape becomes askew, i.e. the surface on opposite sides of the contact have different curvature values. When the modes are commensurate, some symmetry lines are preserved. Interference between the different vibration frequencies causes the surface distortion to vary irregularly over time. As a result, the average size of the side lobes decreases in irregular steps as the initial distortion size is reduced.

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Date submitted: 06 Aug 2009 Electronic form version 1.4