Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Effect of vertical flow on the break-up of an underwater bubble
DANIEL C. HERBST, WENDY W. ZHANG, University of Chicago — Previously, the break-up of a fluid drop was believed to evolve towards a universal singularity, with little dependence on initial or boundary conditions. Recent studies reveal that the break-up of a bubble while it is immersed in another liquid follows a different scenario, one preserving detailed information about the initial state. When the bubble neck is nearly cylindrical, the leading-order dynamics has a simple two-dimensional form: the initial shape is advected inwards by a focusing flow in the exterior until break-up. Asymptotic analysis indicates that such a memory-preserving evolution is possible only when the vertical flow out of the minimum remains far weaker than the focusing flow within a horizontal plane. Here we explore what happens to this memory-preserving dynamics when the vertical flow becomes comparable with the horizontal flow. An axisymmetric boundary integral code is used to track the shape evolution. We alter the surface profile at break-up, in particular the upper and lower cone angles, by changing the initial neck shape. For large angles, the vertical momentum flux becomes significant and the velocity evolution is strongly coupled to the surface evolution. We also study the effect of an up-down asymmetry in the initial shape on the final break-up.

Wendy W. Zhang
University of Chicago

Date submitted: 06 Aug 2009 Electronic form version 1.4