Abstract Submitted
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On the rise velocity discontinuity of a deformable bubble in unbounded viscoelastic solutions[1] JOHN TSAMOPOULOS, DIMITRIS FRAGGEDAKIS, YIANNIS DIMAKOPOULOS, Laboratory of Fluid Mechanics and Rheology, Dep. of Chemical Engineering, University of Patras — It is well-documented experimentally, but not well-understood that a bubble steadily rising in a viscoelastic solution exhibits a negative wake and a jump discontinuity in its rise velocity, when its radius exceeds a critical value. In all experiments, the bubble shape forms a cusp in its back side and in some experiments it loses axial symmetry forming a wedge. Some authors have related the velocity jump with the existence of the negative wake or even the wedge formation. We have undertaken a computational study to explore the mechanisms behind these phenomena. To this end, we have used the ePTT model and determined its rheological parameters by fitting it to experiments. Then we developed an FE code (using elliptic grid generation and the SUPG and EVSS methods) and calculated the bubble rise and deformation as its radius increases. This simultaneously affects all parameters: Bond, Archimedes and Deborah numbers. Our predictions reproduce very accurately bubble shapes and the results up to the velocity jump or, in certain cases, beyond it using arc-length continuation. The discontinuity is attributed to a hysteresis loop, but does not require the presence of a wedge in the bubble shape and the negative wake is predicted even before this jump.

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