Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

The shape and motion of gas bubbles in a liquid flowing through a thin annulus[1] QINGHUA LEI, Imperial College London, ZHIHUA XIE, Cardiff University, DIMITRIOS PAVLIDIS, PABLO SALINAS, Imperial College London, JEREMY VELTIN, TNO, Netherlands, ANN MUGGERIDGE, CHRISTOPHER C. PAIN, OMAR K. MATAR, MATTHEW JACKSON, Imperial College London, KRISTINE ARLAND, ATLE GYLLENSTEN, STATOIL, Norway — We study the shape and motion of gas bubbles in a liquid flowing through a horizontal or slightly-inclined thin annulus. Experimental data show that in the horizontal annulus, bubbles develop a unique tadpole shape with an elliptical cap and a highly-stretched tail, due to the confinement between the closely-spaced channel walls. As the annulus is inclined, the bubble tail tends to decrease in length, while the geometry of the cap remains almost invariant. To model the bubble evolution, the thin annulus is conceptualised as a "Hele-Shaw cell in a curvilinear space. The three-dimensional flow within the cell is represented by a gap-averaged, two-dimensional model constrained by the same dimensionless quantities. The complex bubble dynamics are solved using a mixed control-volume finite-element method combined with interface-capturing and mesh adaptation techniques. A close match to the experimental data is achieved, both qualitatively and quantitatively, by the numerical simulations. The mechanism for the elliptical cap formation is interpreted based on an analogous irrotational flow field around a circular cylinder. The shape regimes of bubbles flowing through the thin annulus are further explored based on the simulation results.

[1]Funding from STATOIL gratefully acknowledged

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Date submitted: 20 Sep 2017 Electronic form version 1.4