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Arrested bubble 'rise' in a narrow tube[1] CATHERINE LAMSTAES, JENS EGGERS, University of Bristol — A long air bubble placed inside a vertical tube closed at the top rises by displacing the fluid above it. Bretherton, however, found that if the tube radius, R, is smaller than a critical value $R_c = 0.918\ \ell_c$, where $\ell_c = \sqrt{\gamma/\rho g}$ is the capillary length, there is no solution corresponding to steady rise. We explain this finding by studying the unsteady bubble motion for $R < R_c$. We show the minimum spacing between the bubble and the tube goes to zero like $t \propto t^{-4/5}$ in limit of large time t. This leads to a rapid slow-down of the bubble's mean speed $U \propto -t^{-2}$, giving the appearance of arrested motion. What may seem surprising is that U is negative: the bubble moves down rather than up. We explain this observation by the bubble's expansion to the walls of the tube, pushing fluid in the direction opposite to gravity.

[1]EPSRC

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