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Drifting and Merging Collars in Liquid-Lined Tubes

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Lubrication theory is used to describe the evolution under surface tension and viscosity of an axisymmetric air-liquid interface in a long, liquid-lined tube. Growing liquid collars of baselength pi are formed, and are separated by draining lobes (baselength < pi). These structures and their interactions are investigated, leading to a new similarity solution to the thin-film equation. The presence of this similarity solution suggests that a draining lobe may sometimes act as a barrier, prohibiting the free flow of fluid between the two collars and hindering any potential merging of the collars. The similarity solution is investigated both numerically and analytically, and an approximate asymptotic prediction of the draining lobe is constructed. We also show that the direction of drift of a single fluid collar is dependent on the minimal height at the collar's edges, with the collar drifting in the direction of the greater minimal height.

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