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Steady streaming in bubble microfluidics DAVID HANSEN, ESAM, Northwestern University, PHILIPPE MARMOTTANT, Laboratoire de Spectrométrie Physique, Université Joseph Fourier Grenoble, France, SASCHA HILGENFELDT, ESAM and Mechanical Engineering, Northwestern University —
Ultrasound-driven microbubbles attached to a plane wall undergo a combination of transverse and volumetric oscillations, setting up a steady streaming flow constrained by both bubble and wall boundary conditions. Large flow speeds and large shear forces are obtained even for small bubble oscillation amplitudes. We solve the vorticity equation inside and outside the bubble boundary layer and derive analytical approximations for the far-field Eulerian and Lagrangian streaming. The results show that the flow can be represented by a finite number of singularities. Thus, we obtain an easy-to-use "toolbox" for analytical modeling of bubble-driven microfluidic flows in more complex situations relevant to lab- on-a-chip and bioengineering applications. We compare the theoretical flows with experimental data and find good agreement.

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