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Measurement and characterization of lift forces on drops and bubbles in microchannels CLAUDIU STAN, SLAC National Accelerator Facility, LAURA GUGLIELMINI, Center for Turbulence Research, Stanford University, AUDREY ELLERBEE, Department of Electrical Engineering, Stanford University, DANIEL CAVIEZEL, ASCOMP GmbH, Zurich, Switzerland, GEORGE WHITESIDES, Department of Chemistry and Chemical Biology, Harvard University, HOWARD STONE, Department of Mechanical and Aerospace Engineering, Princeton University — The transverse motion of drops and bubbles within liquids flowing in pipes and channels is determined by the combination of several types of hydrodynamic lift forces with external forces. In microfluidic channels, lift forces have been used to position and sort particles with high efficiency and high accuracy. We measured lift forces on drops and bubbles and discriminated between different lift mechanisms under conditions characterized by low particle capillary numbers ($0.0003 < \mathrm{Ca}_P < 0.3$) and low particle Reynolds numbers ($0.0001 < \mathrm{Re}_P < 0.1$). The measured lift forces were often much larger (up to a factor of 1000) than the predictions of analytical models of inertial and deformation-induced lift, indicating that another lift mechanism was the largest contributor to the total lift force. The systems we investigated exhibited either (i) a deformation-induced lift force enhanced by confinement effects, or (ii) a lift force for which to our best knowledge is based on physicochemical effects at the interfaces of drops and bubbles. We will present new experimental data that supports a dynamic interfacial mechanism for the second type of lift force, and discuss possible avenues for creating an analytical model for it.

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