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Microcavitation and Detachment of a Stokes Particle in Near-Wall Slow Motion

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A near-wall slow motion of a spherical particle along the wall in a fluid is studied with the reference to an example of gravity-driven sliding of the particle down an inclined surface of a tube. The particle was several millimeter in diameter with varying roughness of its surface. It was revealed experimentally that for fairly small roughnesses: (i) the particle may travel without contact with the wall under the action of lifting force of non-inertial nature (not the Magnus force); (ii) a small air cavity is formed in the narrow particle-wall gap; (iii) particle motion depends on atmospheric pressure and the liquid-air surface tension. The mechanism of appearing the cavitation lifting force for contactless motion of the sphere is as follows: in studying Stokes motion of the particle along the wall it was revealed that between the particle and the wall directly ahead the pressure is positive and behind it can be negative. When cavitation takes place, negative pressure is not realized and lifting force arises.

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