Reorientation of rigid objects settling under gravity in a very viscous fluid

8:00 am – 8:13 am
Presenter: Piotr Zdybel (Institute of Fundamental Technological Research, Polish Academy of Sciences)
Authors: Chandra Sekhar (Institute of Fundamental Technological Research, Polish Academy of Sciences), Harish Mirajkar (Institute of Fundamental Technological Research, Polish Academy of Sciences), Yevgen Melikhov (Institute of Fundamental Technological Research, Polish Academy of Sciences), Maria Ekiel-Jezewska (Institute of Fundamental Technological Research Polish Academy of Sciences)

Sedimentation of rigid objects with two perpendicular symmetry planes is investigated experimentally, theoretically, and numerically for the Reynolds number much smaller than unity. We select shapes that approach a stationary orientation: cones, crescent moons, arrowheads, and open rings. Shapes approaching a stationary inclination were theoretically classified as settlers by Joshi and Govindarajan, Phys. Rev. Lett. 134, 014002, 2025; the dynamics of an example of the settler was determined theoretically and numerically by Ekiel-Jezewska and Wajnryb, J. Phys. Condens. Matter 21, 204102 (2009).

In this work, the settling velocity and the rotational-translational mobility coefficients are determined. Their values are used to show the stability of the final orientation and to evaluate the characteristic reorientation times that are short enough for potential applications. Owing to the similarity principle, our experimental findings can be applied to microobjects in water-based solutions. Reorientation of particles of certain shapes described in this work is expected to lead to the formation of ordered dilute suspensions.

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Contributed Session: Particle-Laden Flows: Non-Spherical Particles
Time and date: 8:00 am – 10:49 am, Monday November 24
Location: Session K24 // George R. Brown Convention Center, 362AD
Chair: Jason Butler, University of Florida