Experiments in Fluid Mechanics 2015

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Title of presentation:
Periodic sedimentation of particles in a viscous fluid

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Abstract:
Do particles setlling in a viscous fluid close to each other always disperse or simetimes stay together? To answer this question, simple experiments were performed with three millimeter-sized spherical glass beads moving in a very viscous silcon oil at the Reynolds number much smaller than unity [1]. In most cases, the beads stay close to each other for a long time and change their relative positions while falling down through the fluid. If the balls are initially kept approximately in a vertical plane, one can easily observe regularity of these oscillations. From time to time, the beads line up at a specific inclination to the vertical direction. In the center of mass frame of reference, the configurations at time T/6 are almost the mirror images of the ones at time equal zero (the mirror is vertical), except a permutation of particles. Therefore, periodic motions with the period T exist. In experiments, they are unstable and usually break up after a bit longer than 1/6 of the period. However, after some time the beads enter the periodic trajectory again. The parts of their trajectories in the center-of-mass reference frame resemble the periodic `butterfly trajectory', found numerically for extremely close spheres [2]. The results demonstrate that under certain conditions, periodic motions of sedimenting particles can be easily found in experiments.

[1] J. Nowakowski and M. L. Ekiel-Jezewska, Experiments with heavy particles in a viscous fluid: amazing oscillations, DOI: http://dx.doi.org/10.1103/APS.DFD.2014.GFM.P0061
[2] M. L. Ekiel-Jeżewska, T. Gubiec, P. Szymczak, Stokesian dynamics of close particles, Phys. Fluids, 20, 063102, 2008