

Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

The instability of sedimenting spheres in a second-order fluid

DAVID SAINTILLAN, RAMANATHAN VISHNAMPET, MechSE, University of Illinois at Urbana-Champaign — The slow sedimentation of a dilute suspension of spherical particles in a second-order fluid is investigated using theory and numerical simulations. A linear stability analysis is performed in the limit of small Deborah number, and shows that such a suspension is unstable to density fluctuations as a result of the nonlinear coupling of the settling motion of the particles under gravity with the local flow field driven by a perturbation in density. Based on this linear theory, an initially homogeneous suspension is expected to develop inhomogeneities, a prediction supported by recent experiments on sedimentation in polymeric liquids. We further confirm this prediction using weakly nonlinear large-scale numerical simulations, which indeed demonstrate the formation of large clusters in the suspensions, resulting in a strong enhancement of the mean settling speed and velocity fluctuations.

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Date submitted: 04 Aug 2011

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