SPREADING FRONTS AND FLUCTUATIONS IN SEDIMENTATION: PART II COMPUTER SIMULATIONS

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Summary Following on from the experimental part I, Part II uses computer simulations to examine the spreading of the front and the velocity fluctuations, and how these depend on the concentration and size of the container.

The computer simulations [1] represent the flow with a limited number of Fourier modes which are driven by the fluctuations in the density of the particles. By setting the number of modes equal to the number of particles, varying between 750 and 10368, the flow is well resolved for length scales between the size of the container and the average interparticle separation.

Results for the variance of velocity of the particles scale with the size of the container and the concentration of the particles, and decay in time as heavy clusters fall to the bottom. Restricting observations to a central region, far from the sediment below and from the front above, finds the level of velocity fluctuations constant in time.

The width of the sedimentation front is found to grow linearly in time, like $1.5\phi^{1/3}V_s t$, due to heavy clusters falling out of the front. An alternative model [2] involving nonlinear hydrodynamic dispersion, which gives an alternative prediction for the width of the front as $2.85a\phi^{1/7}(V_s t/a)^{5/7}$, also agrees with the currently available numerical simulations.

References

[1] Bergougnoux L., Ghicini S., Guazzelli É., and Hinch E. J.: Spreading fronts and fluctuations in sedimentation. *Phys. Fluids.* **15**: 1875, 2003.

[2] Tee S.-Y., Mucha P. J., Cipelletti L., Manley S., Brenner M. P., Segrè P. N., and Weitz D. A.:Nonuniversal velocity fluctuations of sedimenting particles. *Phys. Rev. Lett.* **89**: 054501, 2002.