

COLLOIDAL SWARMS CAN SETTLE FASTER THAN ISOLATED PARTICLES

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Key Words: Colloids, sedimentation, ultracentrifugation, protein association

Colloid sedimentation has played a seminal role in the development of statistical physics thanks to the celebrated experiments by Perrin, which gave a concrete demonstration of molecular reality. Recently, the investigation of sedimentation equilibrium has provided valuable information on a wide class of systems, ranging from simple colloids to active particles and biological fluids [1]. Yet, many aspects of the sedimentation kinetics deserve to be further investigated. Here we present some rather surprising results concerning the effect of interactions on particle settling [2]. Usually, the settling velocity of a colloidal suspension decreases with concentration: this well-known effect is called “hindered” settling. By experimenting on model colloids in which depletion forces can carefully be tuned, we conversely show that attractive interactions consistently “promote” particle settling, so much that, close to a phase-separation line, the sedimentation velocity of a moderately concentrated dispersion can even exceed its single-particle value. At larger particle volume fraction ϕ , however, hydrodynamic hindrance eventually takes over. Hence, $v(\phi)$ actually displays a non-monotonic trend that may threaten the stability of the settling front to thermal perturbations. By discussing a representative case, we show that these results are relevant to the investigation of protein weak association effects by ultracentrifugation.

References.

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