

Abstract Submitted
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Measurements of Inertial Torques on Sedimenting Fibers¹ RAMI HAMATI, Wesleyan Univ, ANUBHAB ROY, Indian Institute of Technology Madras, DON KOCH, Cornell Univ, GREG VOTH, Wesleyan Univ — Stokes flow solutions predict that ellipsoids sedimenting in quiescent fluid keep their initial orientation. However, preferential alignment in low Reynolds number sedimentation is easily observed. For example, sun dogs form from alignment of sedimenting ice crystals. The cause of this preferential alignment is a torque due to non-zero fluid inertia that aligns particles with a long axis in the horizontal direction. These torques are predicted analytically for slender fibers with low Reynolds number based on the fiber diameter (Re_D) by Khayat and Cox (JFM 209:435, 1989). Despite increasingly widespread use of these expressions, we did not find experimental measurements of these inertial torques at parameters where the theory was valid, so we performed a set of sedimentation experiments using fore-aft symmetric cylinders and asymmetric cylinders with their center of mass offset from their center of drag. Measured rotation rates as a function of orientation using carefully prepared glass capillaries in silicon oil show good agreement with the theory. We quantify the effect of finite tank size and compare with other experiments in water where the low Re_D condition is not met.

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