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The sedimentation of flexible filaments: Shapes, trajectories, and clouds SAVERIO SPAGNOLIE, LEI LI, University of Wisconsin-Madison, HARISHANKAR MANIKANTAN, DAVID SAINTILLAN, University of Illinois at Urbana-Champaign — The dynamics of a flexible filament sedimenting in a viscous fluid (Stokes flow) are investigated. Compared to the well-studied case of sedimenting rigid rods, the introduction of filament compliance is shown to cause a significant alteration in the long-time sedimentation orientation and filament geometry. A model is developed by balancing viscous, elastic, and gravitational forces in a slender-body theory, and the filament dynamics are characterized by a dimensionless elasto-gravitation number. In the weakly flexible regime, a multiple-scale asymptotic expansion is used to obtain expressions for filament translations, rotations, and shapes, which match excellently with full numerical simulations. Furthermore, trajectories of sedimenting flexible filaments, unlike their rigid counterparts, are restricted to a cloud whose envelope is determined by the elasto-gravitation number.

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