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Multiplicity in Stable Orbits for Prolate Capsules in Simple Shear Flow[1] XIAO ZHANG, MICHAEL D. GRAHAM, University of Wisconsin-Madison — Artificial capsules have been applied in numerous fields such as bioengineering, pharmaceutics, and food industry. This work investigates the motion of a deformable prolate capsule in unbounded simple shear flow at zero Reynolds number using direct simulations. The deformability, bending stiffness, initial orientation, aspect ratio of the capsule and the viscosity ratio between the inner and outer fluids are varied over a wide parameter space. At a low viscosity ratio, a capsule with large bending stiffness always tends towards an in-plane stable orbit, either tumbling or swinging, depending on the deformability, i.e., capillary number (Ca). At a high viscosity ratio, however, a tumbling-to-rolling transition is observed for a capsule with large bending stiffness at increasing Ca. In the transition regime, the capsule is found to adopt multiple stable orbital modes including tumbling, precessing and rolling, depending on the initial orientation. This multiplicity regime becomes broader as the aspect ratio of the capsule increases, while showing an opposite dependency on the viscosity ratio. The multiplicity in stable orbits leads to a multiplicity in the rheological behavior for a dilute suspension of such capsules.

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