

Abstract Submitted  
for the DFD09 Meeting of  
The American Physical Society

**Tank-treading, swinging, and tumbling of elastic capsules**<sup>1</sup> PROSENJIT BAGCHI, R. MURTHY KALLURI, Rutgers University — It is well known that deformable capsules, vesicles, and red blood cells undergo tank-treading or tumbling motion when freely suspended in shear flows. Recent experiments have shown the existence of a trembling or vacillating-breathing mode as well. Here we present three-dimensional simulations on the dynamics of elastic capsules in shear flow. Our objective is to investigate these different regimes of capsule dynamics, and the coupling between the shape deformation and orientation dynamics. By progressively increasing the viscosity ratio of the internal-to-external fluids at low shear rates, we predict the three distinct modes of motion: a swinging or oscillatory (OS) mode, a vacillating-breathing (VB) mode, and a pure tumbling mode (TU). We show how the coupling between the shape deformation and orientation dynamics influences the transition from the OS to VB to TU modes. At higher shear rates, we predict three new classes of transient motions during which the capsule switches from one mode to the other over time as (i) VB to OS, (ii) TU to VB to OS, and (iii) TU to VB. Phase diagrams showing various regimes are presented.

<sup>1</sup>Funded by NSF (BES-0603035, CTS-0625936)

Prosenjit Bagchi  
Rutgers University

Date submitted: 07 Aug 2009

Electronic form version 1.4