Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Motion of a spheroidal capsule in a simple shear flow

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- Univ. de Technologie de Compiègne — A capsule is a liquid droplet enclosed in
a thin hyperelastic membrane. Microcapsules have various biomedical applications
and can be studied as models for circulating cells, especially red blood cells. While
many numerical studies have focussed on initially-spherical capsules, the aim of this
work is to model the behavior of an ellipsoidal capsule in a simple shear flow. The
capsule wall is modeled using finite membrane elements, while the fluids are treated
using the boundary integral formulation of the Stokes equations. The viscosity ratio
between the inner and outer fluids is kept at 1. When the membrane stiffness is large
compared to the flow strength, the capsule undergoes a “tumbling” motion. As the
flow rate is increased, a transition occurs toward a “swinging” motion. In this study,
we show the influence of the ellipticity of the capsule and of the law modeling the
membrane on the behavior of the capsule. Aspect ratios ranging from 1 : 4 (oblate)
to 4 : 1 (prolate) are considered, and two membrane laws (the neo-Hookean law and
Skalak’s) are compared.

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Date submitted: 10 Aug 2009

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