Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Dynamics and shapes of ferrofluid drops under spatially uniform magnetic fields PAYAM ROWGHANIAN, FRIEDHELM SERWANE, DAVID KEALHOFER, CARL D. MEINHART, OTGER CAMPAS, University of California Santa Barbara — We study the shape and dynamics of a Newtonian ferrofluid drop immersed in a Newtonian and non-magnetic viscous fluid under the action of a uniform external magnetic field. We obtain the exact equilibrium drop shapes for arbitrary ferrofluids which describe unexplained previous experiments, characterize the extent of deviations of the exact shape from the commonly assumed ellipsoidal shape, and analyze the smoothness of highly curved tips in elongated drops. We present a comprehensive study of drop deformation for a Langevin ferrofluid. Using a computational scheme that allows fast and accurate simulations of ferrofluid drop dynamics, we show that the dynamics of drop deformation by an applied magnetic field is described up to a numerical factor by the same time scale as drop relaxation in the absence of any magnetic field. The numerical factor depends on the ratio of viscosities and the ratio of magnetic to capillary stresses, but is independent of the nature of the ferrofluid in most practical cases. Finally, we use the shape and dynamics of the magnetic drops to measure the rheology of complex fluids.

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Date submitted: 09 Aug 2016 Electronic form version 1.4