

Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Magnetoviscosity and thread-like agglomerations in ferrofluids¹

PHILIP YECKO, A. CALI, Montclair State University, Montclair NJ, W.-K. LEE, Advanced Photon Source, Argonne National Laboratory, S. NUNEZ, J. PRESCOD, R. SMITH, A.D. TRUBATCH, M. VIEIRA, Montclair State University, Montclair NJ

— We report on experiments and simulations performed on small non-magnetic glass balls falling under gravity through a magnetized ferrofluid. The applied magnetic field is oriented horizontally, normal to the fall, and is uniform but its magnitude can be adjusted over a wide range. Using the Advanced Photon Source x-ray beamline at Argonne, we were able to achieve sufficient spatial and temporal resolution to track the dynamics of these $500\mu\text{m}$ diameter spheres simultaneously with an array of magnetic particle *macro-chains* – thread-like agglomerations each several mm long and $2 - 10\mu\text{m}$ thick. The enhanced drag induced by the macro-chains is enormous: up to four times larger than for unmagnetized fluid, a value greater than is predicted by the prevailing magneto-viscosity model. We provide direct visualization of a possible mechanism by which macro-chains impede the transverse motion of spheres. Numerical simulations can reproduce the observed drag, without modeling it physically, by implementing a simple magnetization dependent anisotropic viscosity.

¹Supported by NSF grant no. MPS-1016383.

Philip Yecko
Montclair State University, Montclair NJ

Date submitted: 12 Aug 2011

Electronic form version 1.4