

Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Effects of Interfacial Translation-rotation Coupling for Confined Ferrofluids¹ ANGBO FANG, Department of Physics, Hong Kong University of Science and Technology, Clear Water Bay Road, Kowloon, Hong Kong — Ferrofluids have wide applications ranging from semiconductor fabrications to biomedical processes. The hydrodynamic spin diffusion theory for ferrofluids has been successful in explaining many experimental data, but it suffers from some fatal flaws. For example, it fails to predict the incorrect flow direction for a ferrofluid confined in a concentric cylinder channel in the presence of a rotating magnetic field. In this work we develop a method to establish the general hydrodynamic boundary conditions (BCs) for micro-polar fluids such as ferrofluids. Through a dynamic generalization of the mesoscopic diffuse interface model, we are able to obtain the surface dissipation functional, in which the interfacial translation-rotation coupling plays a significant role. The generalized hydrodynamic BCs can be obtained straightforwardly by using Onsager's variational approach. The resulted velocity profile and other quantities compares well with the experimental data, strikingly different from traditional theories. The methodology can be applied to study the hydrodynamic behavior of other structured fluids in confined channels or multi-phase flows.

¹The work is supported by a research award made by the King Abdullah University of Science and Technology.

Angbo Fang
Dept of Physics, Hong Kong University of Science and Technology,
Clear Water Bay Road, Kowloon, Hong Kong

Date submitted: 22 Nov 2010

Electronic form version 1.4