Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Reverse draining of a magnetic soap-film: Theory DEREK MOULTON, University of Arizona, JOHN PELESKO, University of Delaware — A vertical soap-film drains under gravity, with a growing region of very thin film, termed black film, forming at the top. This basic problem has been studied since the 1950's starting with the work of Isenberg, yet the mechanisms behind the process remain controversial. In this work, we investigate the drainage of a magnetic soap-film - that is, a film with a stable colloidal suspension of magnetic nanoparticles - placed in a magnetic field. An evolution equation is developed for the film thickness from the Navier-Stokes equations using lubrication theory. In doing this we utilize a magnetic stress tensor for an arbitrary magnetic field under the assumption of a dilute colloid. We then present analytical and numerical results for particular known magnetic fields. In the case of a strong bar magnet or current loop placed above the film, we demonstrate how the drainage may be reversed so that the region of black film forms at the bottom and grows upward.

Derek Moulton
University of Arizona

Date submitted: 05 Aug 2008 Electronic form version 1.4