Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Thermal convection in a nonlinear non-Newtonian magnetic fluid
HARALD PLEINER, Max Planck Institute for Polymer Research, Mainz, Germany, DAVID LAROZE, Max Planck Institute for Polymer Research, Mainz, Germany and Instituto de Alta Investigacion, Universidad de Tarapaca, Arica, Chile — We report theoretical and numerical results on the convection of a magnetic fluid in a viscoelastic carrier liquid. The non-Newtonian material properties are taken care of by a general hydrodynamic nonlinear viscoelastic model [1] that contains, but is more general than the standard Oldroyd and Giesekus phenomenological rheological equation for the stress tensor. We calculate the linear threshold for both idealized and rigid boundary conditions and make the comparison with the linear Oldroyd magnetic fluid [2]. In order to explore the nonlinear behavior we perform a truncated Galerkin expansion obtaining a generalized Lorenz system. We find numerically the system's stationary, periodic and chaotic regimes by investigating power spectra and Lyapunov exponents. Finally, we give a phase diagram depicting the various types of dynamical behavior as a function of the Rayleigh number and the viscoelastic material parameters.

[1] H. Pleiner, M. Liu, H.R. Brand, Rheol. Acta. 43, 502 (2004).
[2] L.M. Pérez, J. Bragard, D. Laroze, J. Martinez-Mardones, H. Pleiner, J. Mag. Mag. Mat. 323, 691 (2011).

Harald Pleiner
Max Planck Institute for Polymer Research

Date submitted: 24 Jul 2012 Electronic form version 1.4