Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Numerical Studies of annular electroconvection in the weakly nonlinear regime PEICHUN TSAI, Department of Physics, University of Toronto, ZAHIR A. DAYA, Defence R&D Canada, STEPHEN W. MORRIS, Department of Physics, University of Toronto — We study 2D electrically-driven convection in an annular geometry by direct numerical simulation. The simulation models a real experiment which consists of a weakly conducting, submicron thick liquid crystal film suspended between two concentric electrodes. The film is driven to convect by imposing a sufficiently large voltage V across it. The flow is driven by a surface charge density inversion which is unstable to the electrical force. This instability is closely analogous to the mass density inversion which is unstable to the buoyancy force in conventional thermally-driven Rayleigh-Bénard convection. The important dimensionless parameters are a Rayleigh-like number R, proportional to V^2, a Prandtl-like number P, equal to the ratio of the charge and viscous relaxation times, and the radius ratio α, characterizing the annular geometry. The simulation uses a pseudo-spectral method with Chebyshev polynomials in the radial direction and Fourier modes in the azimuthal direction. We deduce the coefficient g of the leading cubic nonlinearity in the Landau amplitude equation from the computed amplitude of convection. We investigate the dependence of g on α and P and compare the results to experimental data and to linear and nonlinear theory.

Peichun Tsai
Department of Physics, University of Toronto

Date submitted: 07 Dec 2005 Electronic form version 1.4