Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Evolution of Electrified Films on a Porous Inclined Plane
UMA BALAKRISHNAN, University of California Santa Barbara, USHA RANGANATHAN, Indian Institute of Technology Madras — The nonlinear stability of a thin conducting film flow down a porous inclined plane, when an electric field acts normal to the plane is considered. It is assumed that the flow through the porous medium is governed by Darcy's law and the characteristic length of the pore space is much smaller than the depth of the fluid layer above. Integral Boundary Layer method is employed in obtaining a set of exact averaged equations for the film flow system. Linear stability results through normal mode analysis reveal that the destabilizing influence of the electric field is further enhanced by the porosity of the medium. Critical Reynolds number for the onset of instability decreases with the increase in the permeability of the porous plane. Weakly nonlinear stability analysis using method of multiple scales divulges the existence of zones due to supercritical stability and subcritical instability. Permanent finite-amplitude waves in the supercritical stable region are portrayed by solving the nonlinear evolution equation numerically in a periodic domain. The parameter ranges that support complex nonlinear dynamics is obtained through a combination of theoretical analysis and numerical experiments.

Uma Balakrishnan
University of California Santa Barbara

Date submitted: 08 Dec 2008 Electronic form version 1.4