Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Dynamics of a two-fluid interface in a channel in the presence of electric fields LYUDMYLA BARANNYK, Department of Mathematics, University of Idaho, DEMETRIOS PAPAGEORGIOU, Department of Mathematics, Imperial College London, PETER PETROPOULOS, Department of Mathematical Sciences, New Jersey Institute of Technology — We study the stability of the interface between two superposed fluids in a channel in the presence of a uniform electric field acting horizontally with respect to the undisturbed configuration. The two fluids are taken to be inviscid, incompressible and nonconducting, but can have different densities and permittivities. We consider the physical effects of surface tension, gravity and electrically induced forces. The approach involves the derivation of a set of nonlinear evolution equations for the interfacial shape, horizontal velocity and electric potential of the upper layer. The electric field effects enter nonlocally. Linear stability analysis reveals that the presence of the electric field causes a stabilization of the flow in the sense that it can compete with the unstable density stratification. In particular, it is shown that for given physical parameters, there exists a critical value of the voltage potential difference between electrodes, above which the electric field suppresses the Rayleigh-Taylor instability. Traveling waves are calculated and their behavior studied as the electric field increases.

Lyudmyla Barannyk
Department of Mathematics, University of Idaho

Date submitted: 04 Aug 2008 Electronic form version 1.4