Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Oscillatory boundary layer in a dipole vortex driven by a periodic electromagnetic force SERGIO CUEVAS, ALDO FIGUEROA, EDUARDO RAMOS, Universidad Nacional Autonoma de Mexico — The laminar boundary layer flow driven by an oscillatory Lorentz force in a shallow electrolytic layer is analyzed experimentally and theoretically. The force is produced by the interaction of an injected alternate electric current and the magnetic field of a small dipole magnet, externally attached to the bottom wall of a plexiglass container. Alternate currents with frequencies and amplitudes in the range of 10-200 mHz and 1-80 mA, respectively, are explored. In planes parallel to the bottom wall, the flow displays an oscillating dipole vortex, while in planes normal to this wall shows an oscillatory boundary layer that resembles the oscillating Stokes layer. PIV measurements reveal that in each cycle vortices are created in the boundary layer in regions where the non-uniformity of the magnetic field is stronger. An approximate analytical solution of the oscillatory boundary layer, that considers the decay of the magnetic field in the normal direction, is obtained through a balance of viscous, inertial and electromagnetic forces. Additionally, a quasi-two dimensional numerical solution that reproduces the main features of the vortex flow, is presented.

Sergio Cuevas
Universidad Nacional Autonoma de Mexico

Date submitted: 07 Aug 2009 Electronic form version 1.4