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Dynamics of Oscillatory Vortex Multipoles Generated by Electromagnetic Forcing ALDO FIGUEROA, SERGIO CUEVAS, EDUARDO RAMOS, CIE-UNAM — Vortices formed by the concurrent effect on a localized magnetic field distribution and two alternate electric currents perpendicular to each other in a shallow (4mm) layer of an electrolyte are analyzed. Alternate currents with frequencies and amplitude in the range of 1-500 mHz and 80 mA, respectively, are explored. For a single dipolar magnetic field and a single electric current, the dominant structure of the flow is a pair of alternating lobes located co-linear with the generated Lorenz force. The flow presents a resonant behavior when the forcing frequency is around 10 mHz. When multipoles are used to generate the magnetic field, more complicated lobe distributions are obtained. The flow patterns were successfully described using a quasi-two-dimensional numerical model. A tridimensional numerical models corroborates the theoretical results. Flow visualization and numerical Lagrangian particle tracking indicate that multipolar flows present symmetries according to the magnetic field distributions. Although in some regions the flow patterns efficiently mix the fluid, the mixing is inhomogeneous due to symmetry conditions of the flows. Mixing is enhanced when symmetries are destroyed by the use of a random array of magnets or by injecting two electric currents.

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