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Effect of induced currents in electrically driven vortices under strong dipolar magnetic fields[1] SERGIO CUEVAS, ALDO FIGUEROA, Center for Energy Research, National University of Mexico — A quasi-two-dimensional numerical study of electrically driven vortices in a shallow fluid layer under a dipolar magnetic field is carried out. The flow is produced by an applied Lorentz force created by the interaction of an injected DC electric current with the field produced by a permanent magnet whose dipolar moment points transversally to the fluid layer. In turn, an induced Lorentz force, usually known as Hartmann braking, appears due to the existence of induced currents created by the fluid motion. The flow is governed by two dimensionless parameters: the Reynolds number, Re, that is proportional to the magnitude of the injected current, and the Hartmann number, proportional to the magnetic field strength. When Ha is $O(1)$ or smaller, the applied force dominates and a pair of counter-rotating vortices are formed in a wide range of Re ($0.01 \leq Re \leq 100$). Under these conditions, the flow remains stable even for high values of Re. When $Ha >> 1$, Hartmann braking is dominant and the flow velocity is reduced. For a high enough Ha, the induced force can reverse the main flow direction in the zone of strong magnetic field. In such a case, a monopolar vortex appears in the latter zone, in between the pair of counter-rotating vortices produced by the applied force. Results indicate that flow destabilization can be reached by increasing Ha with intermediate values of Re.

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