Abstract Submitted
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Magneto-Hydrodynamic Flow of a Binary Electrolyte in a Concentric Annulus[1] MIAN QIN, HAIM BAU, University of Pennsylvania — We study theoretically the motion of an electrolyte solution confined between two concentric, metallic cylinders subjected to an electrical potential difference in the presence of an axial magnetic field. When the annulus is infinitely long, the Navier-Stokes and Nernst Planck equations admit one-dimensional, azimuthal motion. We study the stability of this azimuthal motion in the limiting case of a narrow gap. Under certain circumstances, as the potential difference between the electrodes increases, the azimuthal flow loses stability and cellular, two dimensional convection, similar to Dean's vortices, ensues. The lose of stability occurs at Dean's numbers that differ greatly from the classical values of pressure-driven flow, and the critical Dean number at the onset of instability depends on the direction of the electrical current. The results of the linear stability analysis are compared and favorably agree with finite element simulations of the nonlinear equations. When the length of the annulus is finite, secondary flows exist for all Dean's numbers. In this case, we solve numerically for the fluid motion.

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Haim Bau
University of Pennsylvania

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