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Swirling Flows with Heat Transfer in a Cylindrical under Axial Magnetic Field

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Abstract : The present work examine numerically the effect of axial magnetic field on mixed convection through a cylindrical cavity, filled with a liquid metal and having a rotating top and bottom disks. Effects of Richardson number (Ri = 0, 0.5, 1, and 2) and Hartman number (Ha = 0, 5, 10, and 20) on temperature and flow fields were analyzed. The basic state of this system is steady and axisymmetric, when the counter-rotation is sufficiently large, producing a free shear layer. This shear layer is unstable and different complex flows appear successively: steady states with an azimuthal wavenumber of 1; travelling waves and steady states with an azimuthal wavenumber of 2. Mixed modes and azimuthal wavenumber of 3 are also found with increasing Hartmann number. The stability diagram (Recr-Ha) corresponding to the axisymmetric-three-dimensional transition for increasing values of the axial magnetic field is obtained.

Keywords : axisymmetric, counter-rotating, instabilities, magnetohydrodynamic, magnetic field, wavenumber
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