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Effect of Anisotropic Diffusivities on Rotating Magnetoconvection in a Plane Layer

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A linear stability analysis of convection arising in a horizontal plane layer rotating about the horizontal axis and permeated by a homogeneous horizontal magnetic field perpendicular to the rotation axis is performed. Resulting horizontal convective rolls are inclined to the magnetic field at an angle dependent on the dimensionless numbers − the Elsasser, Ekman and Roberts numbers, and moreover on the anisotropy parameter, the ratio of horizontal and vertical diffusion coefficients (which are the viscosity and thermal diffusivity; magnetic diffusivity is considered isotropic). Two types of anisotropies, SA and BM, are considered and compared with the isotropic case of diffusion coefficients. In the stratification anisotropy, SA, of the Sa and So types, diffusivities in the horizontal directions are, respectively, smaller and greater than the vertical ones. In the BM anisotropy (by Braginsky and Meytlis), the diffusivities in the directions of rotation axis and magnetic field - in the horizontal directions are greater than in vertical direction, thus identically as in So type anisotropy. Results of this H case, the model with the horizontal rotation axis, are compared with the V case of a similar model with the vertical rotation axis. The modes of instabilities are much more sensitive to viscosity (despite its negligible smallness) and various anisotropies in the H case than in the V case.
Results indicate that the effects of anisotropic diffusivities on the Earth's core magnetoconvection and geodynamo processes should be studied more thoroughly than is usually done.