EPSC Abstracts
Vol. 8, EPSC2013-974-1, 2013
European Planetary Science Congress 2013

Two Cases of Rotating Magnetoconvection; With Rotation Axis Parallel and Perpendicular to the Plane Layer

J. Brestenský (1) and T. Šoltis (2)
(1) Faculty of Mathematics, Physics and Informatics, Comenius University, Bratislava, Slovakia, (2) Geophysical Institute, Slovak Academy of Sciences, Bratislava, Slovakia
(brestensky@fmph.uniba.sk/ Fax: +421 2 65425982)

Abstract

A linear stability analysis of convection arising in a horizontal plane layer is performed. The layer is rotating about the horizontal axis like in [2] (in the case H) and about the vertical axis like in [4, 6] (in the case V), and is permeated by a homogeneous horizontal magnetic field perpendicular to the rotation axis. 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 [6].

The study is focused on effect of anisotropic diffusivities [3, 6], which are the viscosity and thermal diffusivity, on convection. Two types of anisotropies, SA and BM, are considered [6] and compared with the isotropic case of diffusion coefficients. In case H 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 [1], 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.

The investigated cases H and V are analysed also in the sense how linear convection properties correspond to dynamo scaling laws by [5].

References

[1] Braginsky, S.I. and Meytlis V.P.: Local turbulence in the Earth's core, GAFD, Vol. 55, pp. 71–87, 1990.

[2] Eltayeb I.A., Rahman M.M.: Model III revisited: Benard convection in the presence of horizontal magnetic field and rotation, Phys. Earth Planet. Inter., accepted, 2013.

[3] Ivers D.J. and Phillips C.G.: Personal communication, 2007–2012

[4] Roberts P.H. and Jones C.A.: The Onset of Magneto-convection at large Prandtl Number in a rotating Layer I. Infinite magnetic Diffusion GAFD Vol. 92, pp. 289 – 325, 2000.

[5] Soderlund K.M., King E.M., and Aurnou J.M.: The influence of magnetic fields in planetary dynamo models, Earth and Planet. Sci. Lett., Vol. 333-334, pp. 9–20, 2012.

[6] Šoltis T. and Brestenský J.: Rotating magnetoconvection with anisotropic diffusivities in the Earth's core, Phys. Earth Planet. Inter. Vol. 178, pp. 27–38, 2010.