EGU21-7896, updated on 03 Dec 2021
https://doi.org/10.5194/egusphere-egu21-7896
EGU General Assembly 2021

Anisotropic diffusivities' effects in rotating magnetoconvection and geodynamo problems

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There are many examples which show how the anisotropic diffusive coefficients crucially influence geophysical and astrophysical flows and in particular flows in the Earth's outer core. Thus, many models concerning rotating magnetoconvection with anisotropy in the viscosity, thermal and magnetic diffusivities have been developed.

Different models correspond to different cases of anisotropic diffusivities. For example, we consider several anisotropic models: one with anisotropy in all diffusivities and other models with various combinations of anisotropic and isotropic diffusivities.

Firstly, all kind of anisotropies are reminded and described. Then, a thorough comparison of these anisotropies, especially of the physical differences among them is done. All physical systems with the above mentioned anisotropies are prone to the occurrence of convection and other instabilities. We show how different types of anisotropy cause a different convection and a different balance among the main forces in the Earth's Outer Core (Magnetic, Archimedean, Coriolis).

As usually, to study instabilities in such systems, we use analysis in term of normal modes and search for preferred modes. In all our models, only marginal modes with zero growth rate have so far been studied. Now, we present the bravest modes, i.e. the ones with maximum growth rate. The comparison of the modes dependent on basic input parameters - Prandtl numbers, anisotropic parameter, Ekman and Elsasser numbers - is made mainly for values corresponding to the Earth's outer core. In all our models the anisotropic diffusive coefficients are represented as diagonal tensors with two equal components different from the third one giving the chance to define simply the anisotropic parameter.

We stress how magnetoconvection problems with the anisotropy included, became more and more important among the geodynamo problems in the last years; indeed, the origin of flows necessary for dynamo action, as studied in magnetoconvection with resulting instabilities, is important, as well as the problem of the origin of magnetic fields.