Hydromagnetic dynamos in rotating spherical fluid shells in dependence on the Prandtl number and stratification

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A b s t r a c t : The dependence of hydromagnetic dynamos on the thermal and viscous diffusion processes and stratification was investigated. We analyse cases when thermal and viscous diffusion processes equally affect the dynamo action and when thermal diffusion processes dominate over viscous ones. The spherical shell is considered to be stratified either uniformly or non-uniformly. In the case of non-uniform stratification, the upper thin sub-shell is stably stratified and the lower sub-shell is unstably stratified, while for uniform stratification the whole shell is unstably stratified. In all the investigated cases, the generated magnetic field is dipolar. If thermal diffusion processes dominate over viscous ones (low Prandtl numbers), neither transition to hemispherical dynamos nor weaker magnetic fields (which are less dipole dominated) take place because our magnetic Prandtl number is large enough, although the inertia becomes important. This indicates that magnetic Prandtl numbers could govern a measure of inertia for low Prandtl numbers. Dependences of dynamos on the type of stratification (uniform and non-uniform) are very weak in all the investigated cases. Consequently, there is no reason to continue in a dynamo modelling in the non-uniformly stratified shells for low Ekman numbers.

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