MHD convection and dynamo in a spherical thin shell

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By means of computer simulation, we have studied thermal convection of a magnetohydrodynamic (MHD) fluid in a thin spherical shell, between two concentric spheres of radii r=0.9 and 1.0. The inner sphere of 0 <= r <= 0.9 is an electrical conductor in a solid state. MHD equations are solved in the outer convection layer and the magnetic diffusion equation is solved in the inner solid core. We have found, in slowly rotating states, that convection motion is organized as (i) a set of multiple ring rolls, or (ii) a single spiral roll, starting from a point and ending at its antipodal point. The diameter of the roll is the width of the shell (0.1). The rolls are dynamo: magnetic fields are generated by fluid flow in them. The simulations were performed on a full-spherical grid system, called Yin-Yang-Zhong grid.

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