A numerical experiment of three-dimensional nonlinear magnetoconvection in a rotating spherical fluid shell

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The dynamic interaction between magnetic field and fluid flow is investigated through a numerical experiment of three-dimensional, nonlinear, thermally driven magnetoconvection in a conducting rotating spherical fluid shell to which a uniform magnetic field parallel to its spin axis is imposed. We found that confinement of magnetic flux into anti-cyclonic vortex rolls was crucial on the change of the mode of magnetoconvection which occurred when the Elsasser number (a measure of the imposed field) was 1 to 2. After the mode change, a large amount of magnetic flux produced by electromagnetic induction in fluid can be confined in the spherical shell and magnetostrophic balance (balance among pressure gradient, Coriolis and Lorentz forces) is established.