Linear magnetoconvection in rotating fluid spheres permeated by a uniform axial magnetic field

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    A linear analysis of magnetoconvection in a rotating fluid sphere is carried out. A uniform magnetic field parallel to the spin axis is applied to the sphere. The critical Rayleigh number and the corresponding convection pattern are obtained under a circumstance of negligible viscous effects. We find that (1) there are five distinct convective modes, (2) the critical Rayleigh number as a function of the intensity of the uniform magnetic field has an overall minimum, and (3) there coexist a two-dimensional convective mode with a few convection columns and a three-dimensional polar convective mode characterised by a large-scale meridional convection at some circumstances of the magnetic field.