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# 回転磁気流体における熱的安定性と波動
# Rotating magnetohydrodynamic waves and convection: Implications for geomagnetic secular variation

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The geomagnetic field has significantly changed on several timescales. A prominent feature of the geomagnetic secular variation is the westward motion of the non-dipole part of the field, especially clear in the Atlantic hemisphere with timescales of $10^2$ - $10^3$ years. Convection-driven MHD dynamo simulations have reproduced westward drift and also its spatial dependence. A possible mechanism causing the drift is propagation of rotating MHD waves in the Earth's core. Though the hypothesis has been proposed and discussed since 1960s, the wave properties are not fully understood.

To get insight into the mechanism, we perform a linear analysis on thermal instability in presence of rotation and an imposed magnetic field and analyze the wave properties associated with the thermal convection. Here, to treat analytically, we adopt a cylindrical annulus model with sloping boundaries, which qualitatively reproduces features in a spherical shell/sphere with magnetic fields being absent. Recently-proposed influence of thermal boundary conditions is also explored.

We find that, while the inviscid approximation gives a slow retrograde (westward)-propagating wave (MC- or MAC-Rossby wave), dissipative effects make it more various. When magnetic diffusion is much faster than thermal diffusion, convection sets in with a prograde (eastward)-propagating slow wave, whose timescale is expected to be the order of $10^9$ - $10^{10}$ years in the Earth's core. Retrograde slow waves excite when magnetic diffusion is slower than thermal diffusion. Their timescales are very long and the inviscid MC/MAC wave presents the shortest one, the order of $10^2$ - $10^3$ years. This slow mode is compatible with the observed direction and timescale of the geomagnetic drift.