有限領域内の運動学的ダイナモの成長率
Growth rates of kinematic dynamos in a finite domain

*櫻庭 中[1]
*Ataru Sakuraba[1]

1. 東京大学大学院理学系研究科地球惑星科学専攻
1. Department of Earth and Planetary Science, University of Tokyo

Kinematic dynamos have been intensively studied since 1950s to get an insight into generation mechanisms of planetary magnetic fields. Even today when computer simulations of geophysically realistic dynamo models are possible, importance of that classical problem cannot be neglected because of its use in understanding basic dynamo processes. For example, a linear growth rate of a kinematic dynamo model can be an important measure to estimate a timescale of geomagnetic field recovery from a weak-field state in a reversal transition, and to understand energy transfers from fluid flow to magnetic fields and dissipation. Most of previous studies on growth rates of kinematic dynamos have assumed fluid flows extending infinitely in space such as three-dimensionally periodic ABC flows (see a review by A. Soward, Fast dynamos, in Lectures on Solar and Planetary Physics, Cambridge Univ. Press, 1994). Here we consider a cylindrical annulus model of kinematic dynamo. The flow is periodic along the azimuthal direction but finite in the radial and axial directions. The magnetic field satisfies a pseudo-vacuum boundary condition for the sake of computational simplicity. The induction equation is integrated in time from a random field and a linear growth rate is estimated after calculation of several magnetic diffusion times. A background flow is chosen so that the flow component can be represented as a few terms of trigonometric functions in the cylindrical coordinates and the kinetic helicity is antisymmetric about the equator. The growth rate can be summarized as a function of the magnetic Reynolds number, R, and the azimuthal wavenumber, m, of the background flow. In a parameter domain of $R < 1000$, we observed an increase of the growth rate as mR to the power of 2/3.

キーワード：惑星磁場、ダイナモ、電磁流体力学
Keywords: planetary magnetic field, dynamo, magnetohydrodynamics