# A prolonged lifetime of planetary magnetic field generated by a subcritical dynamo

# Futoshi Takahashi[1]
[1] Tokyo Tech

Through dynamo process, convection of an electrically conducting fluid in the planetary core generates planetary-scale magnetic field. The fate of dynamo action is determined by the balance between generation and dissipation of magnetic energy. When magnetic energy generation by convective flow exceeds the Ohmic dissipation, the magnetic field is maintained and this dynamo is classified as supercritical. On the other hand, when the magnetic energy decays due to the Ohmic dissipation in spite of the presence of convection, the dynamo is subcritical. The supercritical-subcritical regime boundary is an important property of the planetary dynamo to constrain the evolution of planetary magnetic field. The Rayleigh number is conventionally used to describe the regime boundary, since it is proportional to the heat flux out from the core-mantle boundary. However, the situations can be made complicated by including effects of heat flux heterogeneity. Here, we show that even moderate heterogeneity in CMB heat flux can greatly affect dynamo action. To be remarked is that a subcritical dynamo can maintain the magnetic field with the l=m=1 heat flux heterogeneity, where l and m are degree and order of spherical harmonics. Implications of the results for planetary dynamos, such as Mars and possibly Moon, are discussed.