I212-003 **Room: 303** **Time: May 19 9:30-9:45**

Critical effect of thermal boundary condition at the core-mantle interface on generation of a strong dipole magnetic field

Ataru Sakuraba[1]; Paul H. Roberts[2]

[1] Dept. of Earth and Planetary Science, Univ. of Tokyo; [2] IGPP, UCLA

During the past 15 years, many computer simulations have been carried out that aim to understand better the mechanisms in the Earth's core that generate the geomagnetic field. Because the magnetic Prandtl number (Pm) and the Ekman number (E) are much smaller than unity, the viscosity of the metallic iron alloy comprising the Earth's fluid core is thought to be too small to affect the dynamo mechanism significantly. These parameters are respectively the magnetic diffusion time and the length of day, relative to the viscous diffusion time. As computational performance advances, efforts are continually made to decrease these two nondimensional numbers towards geophysically realistic values. Recent studies have reached Ekman numbers that are O(10^{-7}) and magnetic Prandtl numbers that are O(0.1). Surprisingly, the resulting fields have not always simulated the actual geomagnetic field better. For example, Kageyama et al. (2008) reached E = 2.3 x 10^{-7} and Pm = 1 but their simulated magnetic field was not nearly as dipole-dominated as the geomagnetic field, and their convective motions possessed fine-scale, sheet-like structures. Takahashi et al. (2008) reached E = 4 x 10^{-7} and Pm = 0.2 and obtained a dipolar magnetic field but one whose intensity is weak compared those generated by simulations with larger E and larger Pm.

We present numerical results for an Earth-type dynamo that also uses small parameter values: E = 5 x 10^{-7} and Pm = 0.2. Our emphasis is laid on the thermal boundary condition at the core surface. The recent low-E and low-Pm simulations have held the temperature of the core surface constant and uniform. We argue that this isothermal condition is not only geophysically unrealistic but also suppresses the generation of large-scale, strongly dipolar magnetic fields. To demonstrate this, we have replaced the isothermal condition by one in which the outward heat flux at the core surface is specified, and assumed to be laterally uniform. We have compared the results with those obtained from an otherwise identical isothermal model. The difference in behavior is drastic. The isothermal model produces fine-scale, sheet-like convective structures and a weakly dipolar magnetic field, basically in agreement with Kageyama et al. (2008); the uniform-flux model produces a strongly dipolar magnetic field, accompanied by large-scale convective flows and wavy zonal internal magnetic fields, both of wavenumber around 6. The model simulates well the geomagnetic westward drift which dominates in the equatorial part of the core surface. The uniform-flux model allows lateral variations in temperature at the core surface that assist in driving large-scale meridional circulations and these help to sustain a strong dipole. We conclude that the isothermal boundary condition suppresses meridional circulation and leads to geophysically unrealistic results.