地球ダイナモシミュレーションにおける電流コイルの形成

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Formation of current coil structure in high resolution geodynamo simulation

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We have performed a high resolution geodynamo simulation in which time development of a thermal convection motion of an electrically conducting fluid, confined in a rotating spherical shell (Earth's outer core) is solved by a finite difference method with the overset grid technique applied to a spherical Chimera grid system, named Yin-Yang grid. The extreme condition of the Earth's outer core as an magnetohydrodynamic (MHD) system is characterized by the smallness of the Ekman number Ek which is supposed to be of the order of 10E-15 in the real Earth. (Ek is the ratio of the rotation period and the viscous diffusion time.) Simulations with lower Ek requires higher resolution since Ek is a kind of barometer of spatial length scale to be resolved in the calculation. We have performed a geodynamo simulation with Ek of the order of 10E-7, the lowest value ever achieved in geodynamo simulations by means of massively parallel computation of 4096 processors of the Earth Simulator. In this new regime, we have found that both the convection flow and the magnetic field structures are qualitatively different from those with larger Ekman number dynamos. The convection takes the form of sheet plumes or radial sheet jets as observed in laboratory water experiments by Sumita and Olson. This sheet plume convection is an effective dynamo and the generated electric current is organized as a set of coils in the shapes of helical spring or sometimes in torus. Details of the structures and their parameter dependence will be reported in a poster by T. Miyagoshi.