R004-03
D 会場 ： 11/25　PM1（13:45-15:45）
14:15〜14:30:00

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Changes in core flow structures associated with polarity reversals in an MHD simulation

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The Earth's magnetic field is dominated by a dipole field which is nearly aligned with Earth's rotation axis. It is widely accepted that the geomagnetic field is sustained by fluid motions in the Earth's outer core through dynamo action. The secular variations of the geomagnetic field originating from the core have a wide range of time scales. The polarity reversal, one of the secular variations, occurs over a few thousand years and has taken place more than 400 times throughout geological history, as revealed by paleomagnetic records. Numerical geodynamo simulations have been conducted to understand the physical mechanisms underlying the polarity reversal, showing that during polarity reversals, equatorially antisymmetric flows become intensified and contribute significantly to reversals, despite being generally suppressed in rapidly rotating convection. This indicates that an enhancement of the equatorially antisymmetric flows is an important phenomenon for understanding the reversal mechanism. Our previous study has shown that the inertial force is responsible for energy transfer from symmetric to antisymmetric flows. This fact has been revealed by spectral analyses in terms of spherical harmonics. However, the specific flow structures in physical space that are responsible for such energy transfer remain unclear.

In this study, we investigate flow structures in cross-sections parallel to the equatorial plane as well as meridional cross-sections. Then, we show that energy transfer by inertial force occurs in regions where local vortices interact with large-scale zonal flow. This result is consistent with the results obtained from spectral analysis, which indicates that finer symmetric flow energy is transferred to the antisymmetric flows with a larger length scale. Furthermore, energy transfer by inertial force occurs only in either the northern or southern hemisphere, while energy input by buoyancy flux is found in the opposite hemisphere. The results suggested that the equatorially antisymmetric zonal flow consists of the flow induced by the Coriolis force from the upwelling flow in one hemisphere and that induced by inertia in the other hemisphere.