Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PPS001-09 会場:101 時間:5 月 27 日 10:45-11:00

A dynamo driven by zonal jets at the upper surface: applications to giant planets

A dynamo driven by zonal jets at the upper surface: applications to giant planets

Philippe CARDIN[1*], Celine GUERVILLY[1], Nathanael SCHAEFFER[1]
Philippe CARDIN[1*], Celine GUERVILLY[1], Nathanael SCHAEFFER[1]

[1]ISTerre, Grenoble, France
[1]ISTerre, Grenoble, France

We present a new possible dynamo mechanism for generating the magnetic fields of the giant planets. The mechanism relies on the presence of barotropically unstable differential rotation. We assume that zonal jet currents within the outer molecular hydrogen layer exert a drag at the top of the deep electrically conducting region. Because of the rapid rotation of the planet, this boundary forcing drives nearly geostrophic axisymmetric motions in the conducting region. For a given forcing, measured by the critical Rossby number Roc, a shear instability of the zonal flow develops in the form of a global Rossby mode. The wavenumber of the mode depends on the width of the zonal jets. For Ro > Roc, we obtain self-sustained magnetic fields at magnetic Reynolds numbers greater than 103. The propagation of the Rossby wave and its nonaxisymmetric structure are both crucial for dynamo action. The amplitude of self-sustained axisymmetric poloidal magnetic field plausibly depends on the wavenumber of the shear instability, and hence on the width of the zonal jets. For narrow jets, the poloidal magnetic field is dominated by an axial dipole (jovian type) whereas in the case of wide jets, the axisymmetric poloidal field is weak (neptunian type?).

キーワード: dynamo, Rossby waves, Shear layers
Keywords: dynamo, Rossby waves, Shear layers