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Hydromagnetic waves in a spherical shell: experiments and numerical modelling

D. SCHMITT

LGIT, CNRS - UJF, Grenoble, France (denys.schmitt@obs.ujf-grenoble.fr)

Hydromagnetic waves within the Earth's outer core have been suggested to be one of the possible phenomena at the origin of the secular variation of the geomagnetic field. Such hydromagnetic waves have been observed in recent experiments using sodium as conducting fluid. In DTS, a spherical Couette flow experiment dedicated to the study of the magnetostrophic regime in the presence of a strong imposed dipolar magnetic field [1], they constitute the largest contribution to the fluctuations of flow velocity and induced magnetic field. Large spatial wavelengths (azimuthal numbers m up to 7) have been observed, and both possible types of symmetry for the waves have been identified from a detailed analysis of the correlation between velocity and field components at numerous locations around the sphere. Besides, a new numerical code has been developed in order to calculate the possible magneto-inertial waves or instabilities which could exist in the DTS configuration (spherical shell of incompressible conducting fluid, external dipolar magnetic field). Comparison to the geophysical case can be attempted inasmuch as the presence of the hydromagnetic waves in the DTS experiment has been first inferred from measurements of both the magnetic field and the electrical potential just above the spherical fluid cavity. In contrast with the geophysical situation however, additional observations of the velocity field and of the magnetic field within the cavity can be used to control the significance of models derived from surface observations alone.

1 - "Rotating spherical Couette flow in a dipolar magnetic field: experimental study of magneto-inertial waves", Schmitt D., Alboussière T., Brito D., Cardin P., Gagnière N., Jault D. et Nataf H.-C., Journal of Fluid Mechanics, 604 (2008) 175.