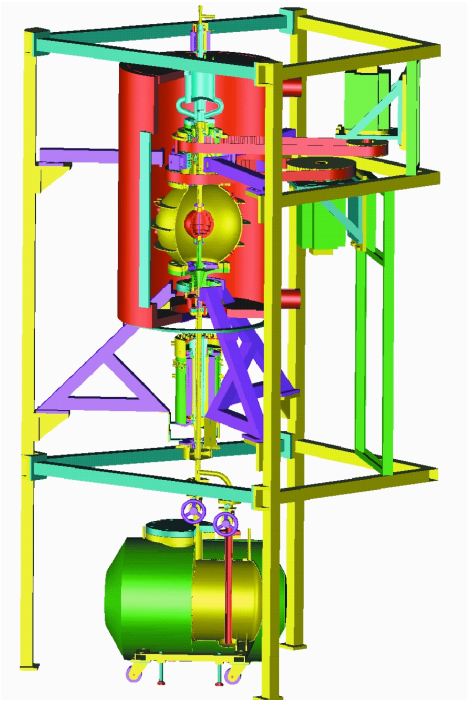
Magneto-inertial turbulence in planetary cores: assimilation of experimental data

H-C. Nataf and N. Schaeffer, *Laboratoire de Géophysique Interne et Tectonophysique, UMR5559,* CNRS-Université de Grenoble. *Contact : nataf@ujf-grenoble.fr*

We are seeking a highly motivated candidate to start a PhD in our team in September 2010. The successful candidate will be granted a 3-year graduate position by the University Joseph Fourier Grenoble 1, within the recently launched program on « Turbulence, magnetohydrodynamics and dynamo », which is funded by CNRS, Rhône-Alpes Region and several Universities in Lyon and Grenoble. The candidates should have a Masters degree and a strong background in fluid mechanics or data assimilation and an interest in planetary dynamics.



Our team has conceived and set up a unique experiment to study turbulence when both rotation and magnetic field are present. The *DTS* experiment consists of a rotating spherical Couette flow, in which 50 liters of liquid sodium are used as a working fluid and a strong permanent magnet fills the inner sphere. The fluid flow is retrieved using ultrasonic Doppler velocimetry, while the induced magnetic field is measured at the surface and inside the fluid. Measurements of electric potentials at the surface also provide valuable information.

The mean flow has been studied in great detail. The fluid near the inner sphere is entrained at rotation rates larger than the imposed rotation rate of the inner sphere (super-rotation) and obeys Ferraro's law, while farther away the flow is quasi-geostrophic. The flow thus experiences the competition between the Lorentz and Coriolis forces. Comparisons with numerical computations performed in our team are particularly enlightening, and open the way to the assimilation of experimental data within the codes.

Recent studies have shown the potential of data assimilation in both laboratory experiments and studies of the Earth magnetic field. We wish to apply these techniques to the data collected on *DTS*. The main objective is to better characterize and understand the kind of turbulence we observe. We have discovered that it is dominated by waves or modes that propagate in the azimuthal direction. Several characteristics of these waves are well reproduced in calculations of magneto-inertial modes when the observed mean flow and magnetic field are used as a base state. We need to better understand the force balance of these modes in order to extrapolate to planetary conditions.

References:

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See also: http://www-lgit.obs.ujf-grenoble.fr/users/pcardin/WEBDTS/