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Rotational acoustics in spherical Couette experiments

S.A. Triana (1), H.-C. Nataf (2), D. Zimmerman (1), M. Adams (1), D.P. Lathrop (1), D. Schmitt (2), P. Cardin (2), A. Richard (2), P. La Rizza (2), J.-P. Masson (2), S. Cabanes (2), and P. Roux (2)

(1) Institute for Research in Electronics and Applied Physics, Department of Physics, University of Maryland, College Park, MD 20742, USA, (2) ISTerre, Université de Grenoble 1, CNRS, F-38041 Grenoble, France (Henri-Claude.Nataf@ujf-grenoble.fr)

Helioseismologists retrieve differential rotation profiles within the Sun by inverting the splitting of acoustic modes. We have explored the idea of using a similar technique in fluid dynamics Lab experiments. Spherical Couette experiments are particularly appealing because acoustic modes in a fluid spherical shell are readily computed. Two experimental set-ups have been used for the tests: *DTS* in Grenoble, and a 30-cm diameter experiment in Maryland. In *DTS*, liquid sodium is sheared between two concentric spheres in a dipolar magnetic field. The 30-cm experiment has the same geometry but is filled with air.

The acoustic waves are generated by tapping the container, or with a loudspeaker, or from internal noise. They are recorded by pressure-sensors mounted flush on the outer sphere. In all cases, sharp spectral peaks are observed, with frequencies that match the expected values. In *DTS*, some 50 acoustic modes are observed in the 3kHz-50kHz-frequency range. Replacing sodium with argon permits to identify and remove modes that have a different origin.

We have investigated the effect of differential rotation on the acoustic modes, by spinning the inner sphere up to 30Hz. Even for this large forcing, the highest frequency modes (>40kHz) show up above the turbulent spectrum. Some of these modes are very clearly split when differential rotation is present. We will present these novel observations, and discuss the potential of the rotational acoustic method in fluid mechanics experiments.

This new technique will soon be implemented on the Maryland *BigSister* dynamo experiment, filled with 15000 litres of liquid sodium.