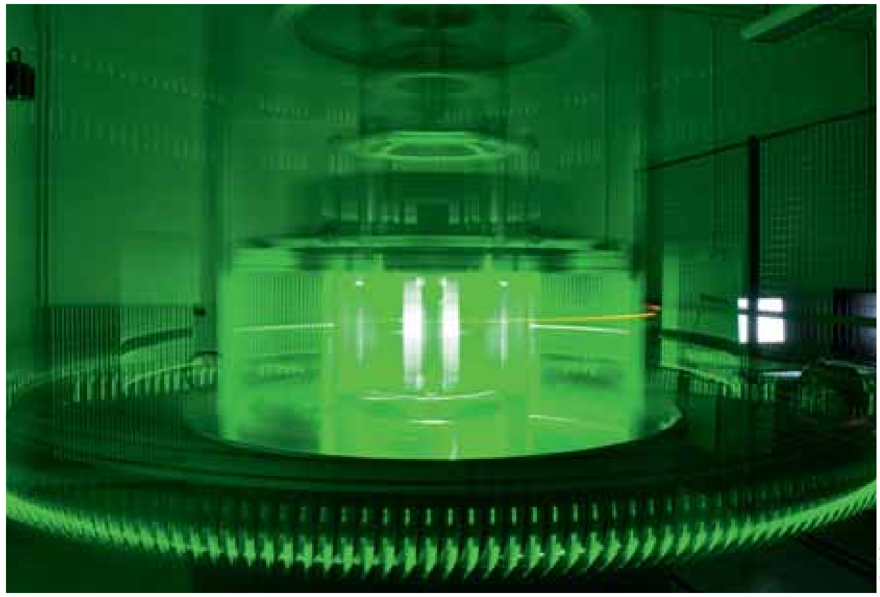
Physics A new laboratory experiment has made it possible to observe the effect of the Earth's rotation on fluids in movement, a very difficult phenomenon to isolate.



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→ Scientists observed the Coriolis force using the Giroflow rotating platform, at the center of which lies a water-filled sphere.

A Liquid **Foucault Pendulum**

BY DENIS DELBECQ

Conventional wisdom has it that water swirls down a drain in opposite directions in the Northern and Southern Hemispheres. In theory, this is a good illustration of the Coriolis force exerted by the rotation of the Earth on fluids in motion. Only in theory, though—in practice, the direction of water is unpredictable, because the force involved is so weak that it is subdued by other movements. A new experiment by French researchers at the FAST Laboratory[1] now makes it possible to observe this minute force with faultless precision. Although they are not the first to achieve this, their process, described in an article recently published in EPL[2] is the simplest analog of the famous Foucault pendulum for fluids.

Initially, the experiment was designed to study the motion of fluids in the core, oceans, and atmospheres of planets. With this goal in mind, the team of researchers attached a water-filled sphere to the "Gyroflow," a rotating platform that can spin as much as one ton of equipment and measuring instruments, at speeds up to 30 rpm. "We added microscopic beads to the water so as to measure the liquid's movements using a technique called particle image velocimetry," explains Pierre-Philippe Cortet, CNRS researcher and co-author of the study.

Viewed from onboard the platform, the water should appear motionless, as both sphere and platform rotate at the same speed. But Cortet and his team detected that the water moved, albeit very slightly.

"It's a very slow movement, at a speed of around 10 to 400 thousandths of a millimeter per second," Cortet reports. "We realized that it was caused by the Coriolis force exerted by the Earth's rotation on the liquid, which is itself rotating with the platform." More interestingly, the researchers noticed that these unexpected movements reproduced a flow pattern found in the liquid core of planets like the Earth, whose rotational axis undergoes a "precession," which shapes a cone over a cycle of 26,000 years. "According to certain models," the researcher adds, "this precession could play a role in generating terrestrial magnetism by triggering an analogous flow in the Earth's conductive liquid core, thus producing a dynamo effect." This hypothesis is being tested at the University of Maryland (US), where researchers have set up a three-meter sphere filled with liquid sodium on a rotating platform to mimic the flow patterns in the Earth's core. Meanwhile, FAST's Gyroflow experiment should shed light on how the Coriolis force helps generate the winds and currents that characterize our planet's atmosphere and oceans.

CORIOLIS FORCE The force exerted on moving objects within a rotating system.

FOUCAULT PENDULUM Conceived by the French physicist Léon Foucault in the 19th century, this mechanism consists of a heavy sphere suspended from a metal wire several meters in length. The gradual deviation of the pendulum's oscillation plane demonstrates the rotation of the Earth.

PRECESSION Periodic change in the orientation of the rotational axis of a rotating body.

01. Laboratoire Fluides, automatique et systèmes thermiques (CNRS / Université Paris Sud / Université Pierre et Marie Curie).
02. J. Boisson et al., "Earth rotation prevents exact solid-body rotation of fluids in the laboratory," *EPL*, 2012. 98 (59002).

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