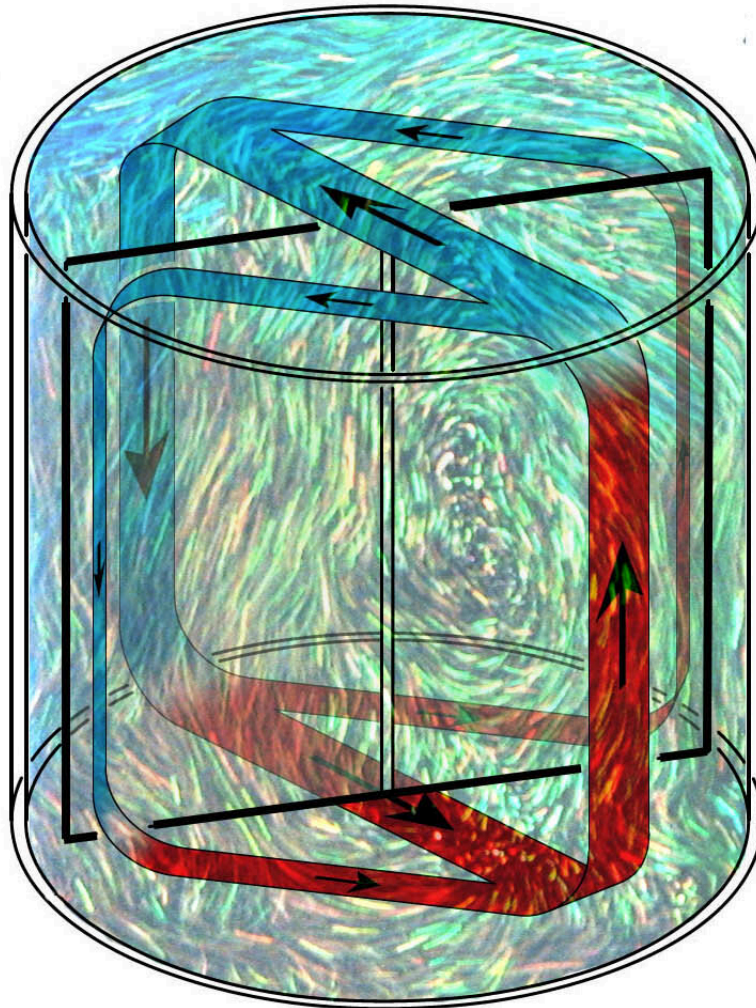


Physicists take the temperature of fluid flows and discover new role for turbulence

May 15 2023



A recent experimental study, inspired by the super-rotation of the Earth's solid core, shows when turbulence flows contained in a cylinder interact with a free body a surprisingly smooth rotation is observed. The red (warm) and blue (cold) ribbons represent water flows. Credit: Kaizhe Wang and Jun Zhang.

A team of physicists has discovered a new role for a specific type of turbulence—a finding that sheds light on fluid flows ranging from the Earth's liquid core to boiling water.

The research, which is published in the journal *Proceedings of the National Academy of Sciences*, centered on turbulent convection—the movement of fluid when heated from below.

"Our experiments reveal intricate movements between a free-moving body and thermal convective flows," says Jun Zhang, a professor of mathematics and physics at New York University and NYU Shanghai, the paper's senior author.

The study, which also included Kaizhe Wang, a researcher in NYU's Department of Physics, focused specifically on Rayleigh–Bénard convection—a type of convection driven by temperature differences.

In their experiments, conducted in the Joint Research Institute of NYU Shanghai, the paper's authors used a cylindrical container filled with water, then heated it from the bottom, creating convective flows. The resulting turbulent flows interacted with a suspended solid (a rectangular panel) that moved freely inside the container—a setting that allowed the researchers to better study how turbulent flows interact with solid structures within.

"Surprisingly, the system becomes somewhat well-behaved," notes Zhang. "We observed a smooth rotation of the flows and the free solid."

Their results showed that turbulent convection powered flows, together with the solid, can move in two directions—one clockwise and the other counterclockwise—with the co-rotational speed increasing with the intensity of the convection. More than that, their rotation can sometimes switch directions, caused by the turbulence.

"The research, inspired by the rotation of Earth's [inner core](#) as it interacts with the convective liquid core, captures the interaction between a [turbulent flow](#) and a freely moving body within the flow," explains Zhang. "The findings confirm that turbulence can be tamed by interacting with solids. It also reminds us that the power of thermal [convection](#) might play more important roles inside our planet Earth."

More information: Wang, Kaizhe et al, Persistent corotation of the large-scale flow of thermal convection and an immersed free body, *Proceedings of the National Academy of Sciences* (2023). [DOI: 10.1073/pnas.2217705120](#)

Provided by New York University

Citation: Physicists take the temperature of fluid flows and discover new role for turbulence (2023, May 15) retrieved 24 June 2024 from <https://phys.org/news/2023-05-physicists-temperature-fluid-role-turbulence.html>

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