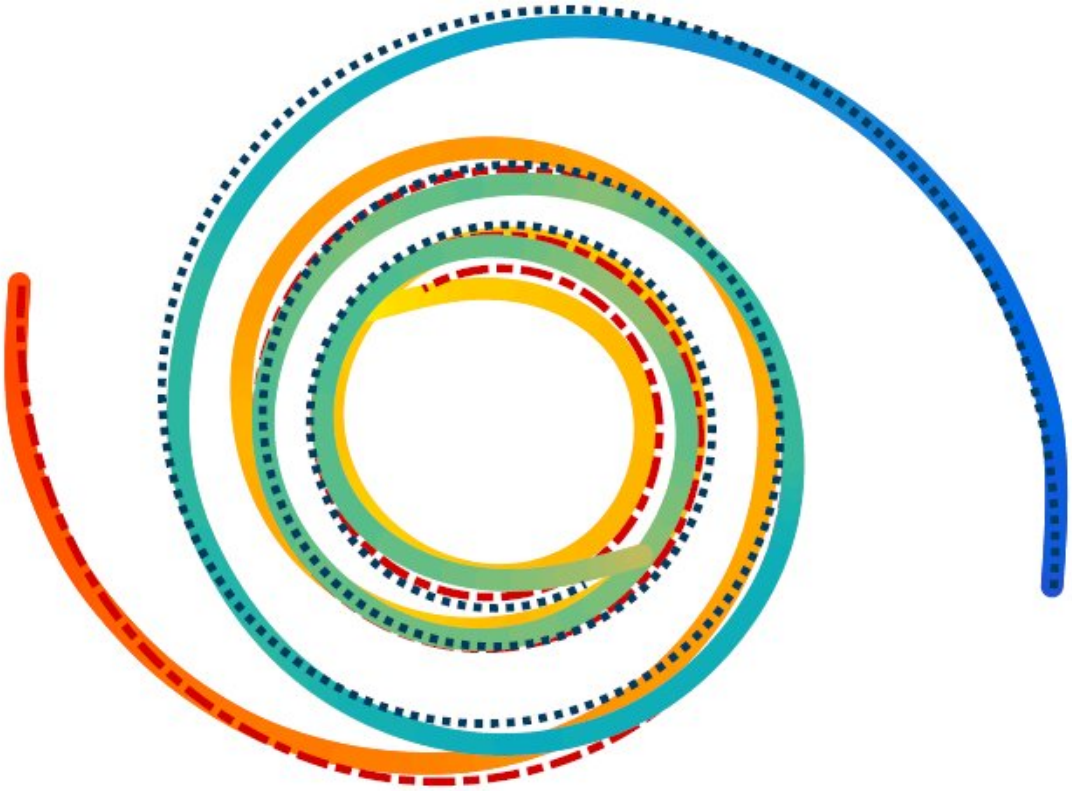
Skating droplets move in orbits

September 2 2019



Spirally shaped trajectories of the two droplets.

They look like planets: Two droplets move in orbits on an ice cold fluid surface. They attract each other, and by almost frictionless movement on their own vapour, they skate around each other. It is a fascinating mechanism that could be used for preparing and transporting biological samples with a minimum of contamination. Researchers of the

University of Twente have published a study on this subject titled "Capillary Orbits" in *Nature Communications*.

The phenomenon that floating objects attract each other and cluster together is known as the "Cheerios Effect," after the phenomenon observed in cereal bowls. But two small balls floating on the water would clearly not move in the way that is shown in this new publication due to friction. The essential difference is that the droplets, in this research, float on the vapour layer that forms between the droplet—at room temperature, initially—and the very cold liquid nitrogen beneath. The droplet skates across the surface, just like the 'water strider' insect walks over water.

Using one droplet, the effect is already remarkable, as the researchers proved in their earlier *PNAS* publication. With two droplets, it seems as though they would start behaving like bouncing billiard balls. The fact that they actually start moving in orbits has to do with surface tension. The weight of one droplet distorts the shape of the fluid surface, causing the other droplet to move. This resembles general relativity, in which the mass of one celestial object influences the orbits of others by the gravitational curvature of space-time.

The circumstances do change on the move, however, as the droplets get colder, changing the speed and interaction. Although low, friction grows, as well. From that moment on, the droplet movement can no longer be compared to planet orbits; the orbit of droplets will be spirally shaped, as the researchers show in their calculations and simulations. What happens if many droplets are released on the surface is an interesting, though complex, next step.

The way the movement of the droplet is controlled could be a way of moving vulnerable biological examples and manipulating them without the need of putting them into a container or tube, risking contamination.

The sample can even be deep-frozen on the move.

More information: Capillary orbits. *Nature Communications*. doi.org/10.1038/s41467-019-11850-1

Provided by University of Twente