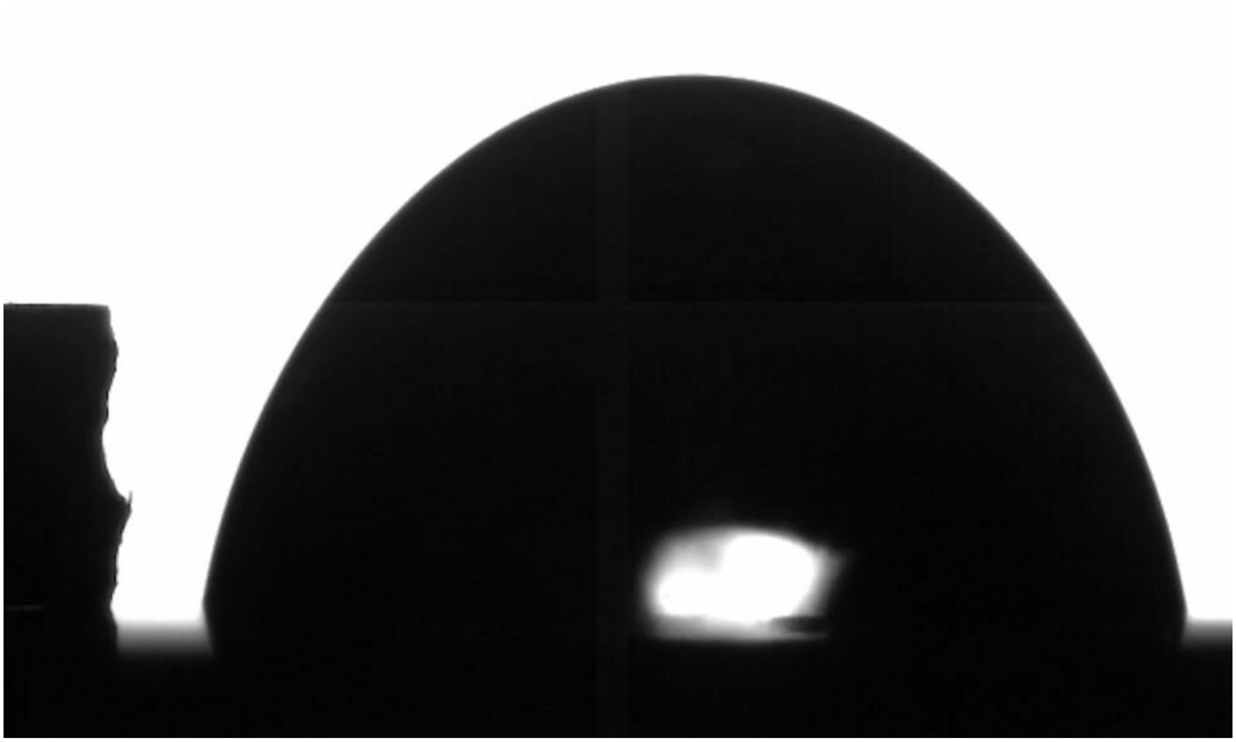
New periodic table of droplets could help solve crimes

February 25 2019



Credit: Cornell University

Liquid droplets assume complex shapes and behave in different ways, each with a distinct resonance—like a drum head or a violin string—depending on the intricate interrelationship of the liquid, the solid it lands on and the gas surrounding it.

Droplets' movements have implications for everything from manufacturing silicon chips to measuring bodily fluids, but until now there was no way of classifying their motion.

A team led by Paul Steen, professor of engineering at Cornell University, has created a periodic table of droplet motions, inspired in part by parallels between the symmetries of atomic orbitals, which determine elements' positions on the classic periodic table, and the energies that determine droplet shapes.

"The question was, can we put these in some sort of organization that allows us to make a little more sense out of them?" said Steen, lead author of "Droplet Motions Fill a Periodic Table," which published in the *Proceedings of the National Academy of Sciences*.

"The ordering is much like the periodic table of chemical elements," he said. "We go from higher energy to lower energy, left to right, top to bottom."

They also saw that the droplet motions could be classified by their distinctive shape symmetries. For example, droplets that form a star-like shape with five points would all be in one group.

"We call them motion-elements," said Steen, in a nod to the classic periodic table. Each motion element in the new table—which could conceivably have an infinite number of entries, depending on several variables—classifies a single mode of a droplet's motion. "You can use combinations of these to understand motion-molecules."

In the study, Steen's team discovered the first 35 predicted motion elements for water droplets vibrated on a surface with an angle of contact of about 60 degrees.

Potential applications for this periodic table, which could help researchers understand where a droplet comes from, could include crime-scene forensics, Steen said. Analysts could apply the table's classifications to blood and the applicable surface to identify the energies involved, and then better infer what might have caused certain spatter patterns.

"Once you recognize what a particular motion can be decomposed into, it tells you more about where it originated," he said.

More information: Paul H. Steen et al, Droplet motions fill a periodic table, *Proceedings of the National Academy of Sciences* (2019). DOI: 10.1073/pnas.1817065116

Provided by Cornell University