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Watching bubbles jump on the International Space Station

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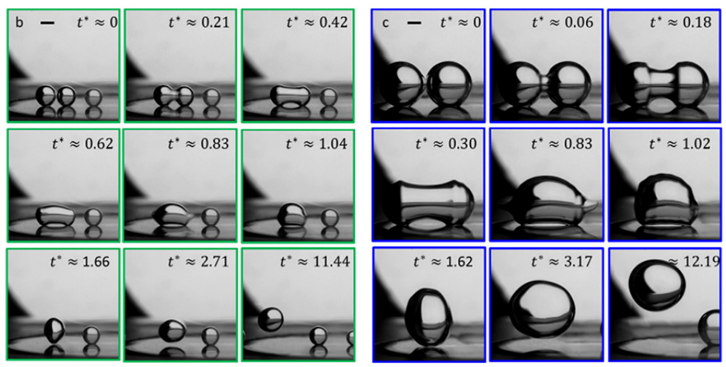
Coalescence-induced jumping is easiest to study in microgravity and has applications in orbit and on the ground.



The process of boiling begins with the formation of vapor bubbles that increase in size until the buoyant force propels them to the surface. In microgravity, the absence of buoyancy means boiling must rely on other mechanisms, and understanding them is crucial for heating and cooling technologies in satellites and spacecraft.

Raza et al. studied the coalescence-induced jumping of bubbles in microgravity aboard the International Space Station as part of the European Space Agency's Multiscale Boiling Experiment.

When bubbles form, adjacent bubbles can sometimes touch each other and coalesce. When this occurs, excess surface energy is converted to kinetic energy and the combined bubble can leap vertically. While this does happen on Earth, it is difficult to study in bubbles of larger sizes and to separate from the effect of buoyancy.

"More generally, the study of boiling under microgravity conditions allows us to avoid natural convection and leads to larger bubbles with a smaller growth rate than on Earth," said author Julien Sebilleau. "This leads to more precise results and a better understanding of effects that are normally hidden by buoyancy.

The team studied bubbles over a wide range of sizes and determined that the jumping energy of the bubbles scales with their size. They developed a model to predict the maximum height of a bubble based on its radius and drew a comparison between this behavior and similar behavior of droplets on Earth.

The authors concluded by discussing directions for future studies of this effect and applications in both space- and ground-based industries.

Source: "Coalescence-induced jumping of bubbles in shear flow in microgravity," by MD. Qaisar Raza, Moritz von Köckritz, Julien Sebilleau, Catherine Colin, Matevz Zupancic, Mattia Bucci, Tadej Troha, and Iztok Golobic, *Physics of Fluids* (2023). The article can be accessed at https://doi.org/10.1063/5.0138200.