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The effect of size and shape on the capillary attraction between nearby floating objects

Attraction between floating objects is caused by capillary effects. The attraction is dubbed the Cheerios effect referring to the common observation of breakfast cereal clumping in a bowl of milk. When the objects are far from each other, multipole expansion of the meniscus deformation provides a framework for understanding the interaction. However, when the objects come close to each other, the asymptotic ordering of the multipole expansion becomes invalid. No framework exists to address this situation.

We derive an alternative framework in the limit of small distance between the objects using an asymptotic expansion in the distance. This framework allows us to investigate the effect of size and shape of the object on the attractive force. Through asymptotic analysis and simple-table-top experiments, we find that the in-plane curvature of the contact line governs the interaction. Before the objects touch, the capillary interaction rotates the objects to minimize the distance between the points of highest curvature on the contact line. After contact, the capillary interaction brings closer the points of lowest curvature on the contact line.