Capillary forces on colloids at fluid interfaces

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Colloidal particles, which are trapped at fluid interfaces, deform them. This gives rise to effective lateral interactions among such colloids. Under favorable conditions this capillary interaction resembles two-dimensional gravity or electrostatics. Accordingly, these systems can be described in terms of permanent or induced capillary multipoles. This provides a simple interpretation of numerous experimental observations.

In a further analogy, the presence of thermally excited capillary waves generates Casimir-like forces between the colloidal particles, but with a larger variety of possible boundary conditions as compared with the case of the standard Casimir force.

The capillary attraction among the colloids drives their collective dynamics. This dynamics exhibits an instability which is formally analogous to the gravitational instability on cosmological scales. Corresponding analytic and simulation studies are discussed.