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Medium-Mediated Interactions Involving Suspended Particles

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MEDIUM-MEDIATED INTERACTIONS INVOLVING SUSPENDED PARTICLES

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When two particles are entrained in a medium, there arise new, effective interactions between those particles, due to the perturbation of the surrounding medium. Our interest is in establishing a basic paradigm, via a highly visual fluidic model system which allows straightforward study, and in using this model system as a design test bed for new methods of exploiting such interactions.

While the motions of suspended particles involve complex hydrodynamics, the static interactions do not. Therefore, we have measured the force of attraction (ranging from milli-Newtons to micro-Newtons) between stationary, floating Cheerios as a function of their separation. A stiff wire fixed one Cheerio in place while a second Cheerio was pulled away by the needle of a D'Arsonval Galvanometer. By finding the Galvanometer current necessary to separate the Cheerios, the force of interaction was determined (a separate experiment involving hanging weights was performed to calibrate the Galvanometer as a force measuring device).

In the limit of small separations, the first method proved unwieldy. So, a reflective cantilever was used as an 'optical lever' to measure the force of interaction. One Cheerio was fixed, as before, while the other abutted a vertical cantilever. By measuring the equilibrium deflection the cantilever (via laser light reflected off of the cantilever surface), we were able to determine the force between Cheerios.