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Modeling microparticle movement FREE

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Modeling microparticle movement

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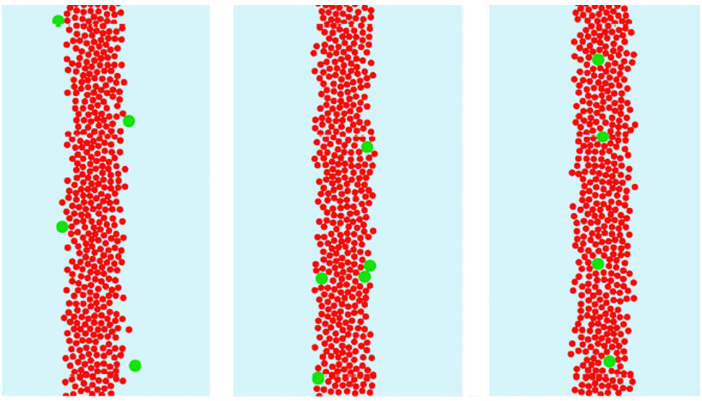
New paper describes the physics behind how micro-particles move within a colloid.



The dynamics of self-propelled particles, or micro-swimmers, within a colloidal suspension mimic the way tiny organisms swim away from a toxin or toward a tasty meal. A better understanding of this movement may lead to applications such as better targeted drug delivery. A new study by Jahanshahi et al. explores how the swimming speed of individual particles and the collective effect of multiple swimmers in a fluid may lead to surprising self-organization.

“With the only requirement of having a mixture of two species, which only differ in their swimming velocity, the system spontaneously organizes in a highly complex manner,” said Clemens Bechinger, professor of Physics at the University of Konstanz, Germany.

The research team found that in a particular type of light-activated system, swimmers may segregate in a manner analogous to a height-dependent gravitational field. Indeed, this segregation is related to a type of ‘heaviness’ of the particles, defined as the product of mass density and the maximum potential energy of the particle.

Using Brownian dynamic simulations, the researchers describe a “colloidal Brazil nut effect” to explain how the heavier particles float on top of the lighter ones based on a generalized Archimedes principle. They confirmed this theoretical prediction with experiments using light-activated self-propelled colloidal mixtures.

“This mechanism that we observed can help us separate individuals according to their swimming performance,” Clemens said. “This may be helpful for applications like autonomous microrobots that can deliver cargoes to specific sites within liquid environments.”

The article is included in *The Journal of Chemical Physics* special topic on the Chemical Physics of Active Matter.

Source: “Colloidal Brazil nut effect in microswimmer mixtures induced by motility contrast,” by Soudeh Jahanshahi, Celia Lozano, Borge ten Hagen, Clemens Bechinger, and Hartmut Löwen, *The Journal of Chemical Physics* (2019). The article can be accessed at https://doi.org/10.1063/1.5083098.