NYU physicists shine a light on particle assembly

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New York University physicists have developed a method for moving microscopic particles with the flick of a light switch. Their work, reported in the journal *Science*, relies on a blue light to prompt colloids to move and then assemble—much like birds flock and move together in flight.

The method offers the potential to enhance the design of a range of industrial products, including the architecture of electronics.

The study's authors were: Jeremie Palacci and Stefano Sacanna, post-doctoral fellows in NYU's Center for Soft Matter Research who devised the research; David Pine and Paul Chaikin, professors in NYU's Department of Physics; and Asher Preska Steinberg, an undergraduate at Brandeis University who was a summer research program participant at NYU.

The work addresses a fundamental question in nature—what causes flocks and swarms to form and move in a particular way? Schools of fish, colony formations of bacteria, or flocks of birds are examples of how this occurs in living matter. In this inquiry, the researchers focused on making artificial systems exhibit similar activity. They used colloids—small particles suspended within a fluid medium—and discovered the basic organizing principles in natural flocking and how to use this to organize inorganic matter.

This exploration is a significant one. Colloidal dispersions are composed of such everyday items such as paint, milk, gelatin, glass, and porcelain. By better understanding driven colloidal self-organization, scientists have the potential to harness these particles and create new and enhanced materials—possibilities that are now largely untapped.

To explore this, the research team developed light-activated self-propelled particles, "swimmers," from the micro-meter-sized particles in solution. To separate the effects of swimming from simple thermal motion, they created a system where the particles turn on and off with application of blue light. With the light on, the self-propelled random swimmers collide and cluster. The light also triggers a slight chemical attraction and leads the clusters to crystallize and grow until the swimmers turn in separate directions and splinter the crystals. The "living" crystals continually form, swirl, and split. When the light is extinguished, the swimmers stop and the structures dissolve into individual diffusing colloidal particles.

Using the slight magnetism of the particles allows direction of the individual swimmers as well as the crystals. With control of light, magnets, and chemical attraction, these active particles bring biological organization to the materials world.

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