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NCCR physicists emulate gecko forces

Geckos and some spiders can climb walls with ease thanks to forces called 'van der Waals' or 'dispersion' forces. In an article in the journal ***Nature Communications***, the group of Prof. Frank Scheffold at the University of Fribourg and colleagues from the Universidad Autónoma de Madrid show for the first time that it is possible to induce and control this type of dispersion force at the nanoscale with external laser fields.

The origin of these forces can be found in naturally present, extremely fast fluctuating electric and magnetic fields. These fluctuations induce weak attractive, and sometimes also repulsive, forces between molecules and small bodies. The gecko uses the combined van der Waals forces of millions of small hairs to adhere to a surface. As these forces on each individual hair are weak, the gecko can lift his footpad from the surface using an adapted movement.

The researchers generated a laser light cloud with properties similar to the light you see when the sun shines through mist on a foggy day, albeit with a much higher intensity. In the experiment two tiny micron-size plastic beads are held in place and embedded in the light cloud (picture). The interaction force between the beads can be measured by studying precisely the relative position of the two particles with a microscope.

The higher the light intensity in the cloud, the more the two particles attract each other. Like in nature, the forces only depend on the relative distance between the particles, but not their actual position within the cloud. The strength and properties of the forces present can also be controlled by the appropriate selection of the intensity and the color of the light in the cloud.

This suggests that it should be possible to completely control interactions between small bodies in two or three dimensions. This approach could facilitate the design of nanostructured materials with tailored properties and also provide new insights into their physical properties.

About dispersion forces

Dispersion forces between small objects are ubiquitous in nature and play a key role in the behavior observed in biological fluids such as proteins, blood cells, foodstuffs or suspensions such as paints and inks. Compared to common chemical bonds these forces are relatively weak and are often not permanent. They do however strongly influence the behavior and the flow properties of nanoparticle suspensions and other complex fluids.

Article

Controlling dispersion forces between small particles with artificially created random light fields
Georges Brügger, Luis S. Froufe-Pérez, Frank Scheffold & Juan José Sáenz, *Nature Communications* 6, 7460. DOI:10.1038/ncomms8460

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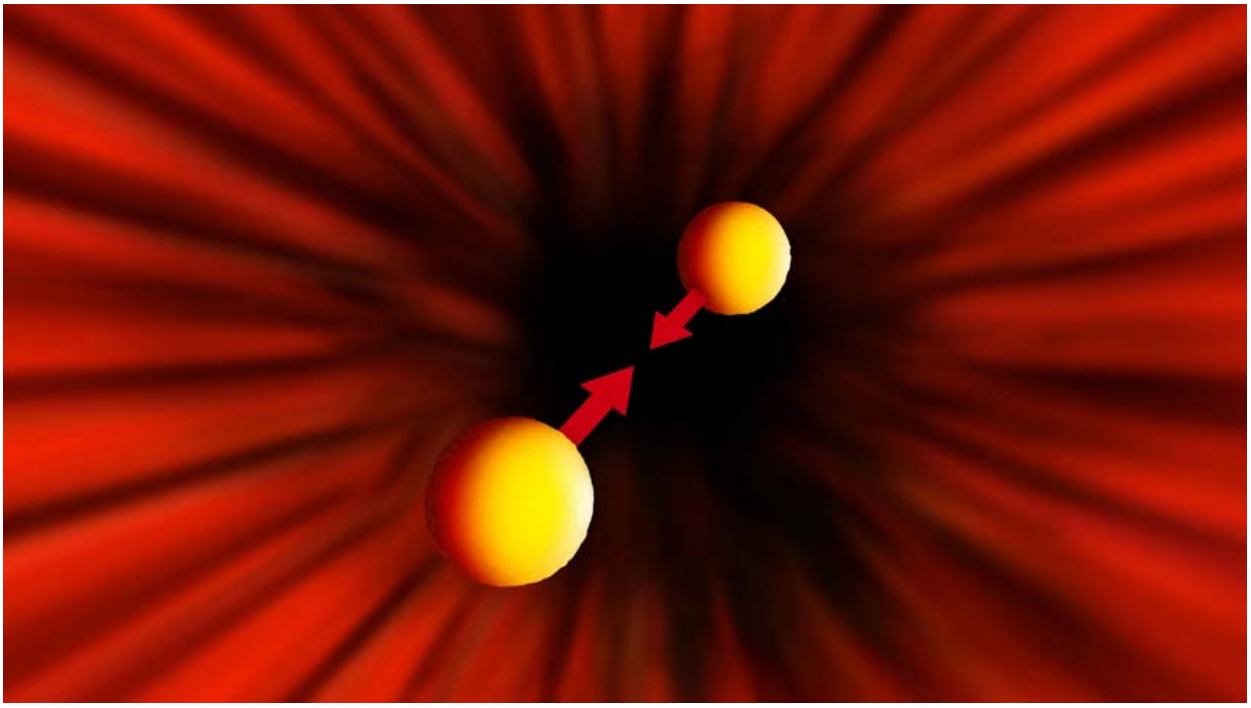

Caption: Two tiny plastic beads attract each other in a light cloud created by an external laser (scixel.es)