Physikalisches Kolloquium

Universität Konstanz

Di 22.12.20
15:15 Uhr
Zoom-Meeting

Dr. Christian Scholz
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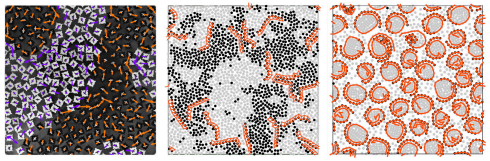

Building Blocks of Granular Molecules

Could you build a bike by putting all its parts into a shaking box and wait until the parts self-assemble? Intuition would probably tell you that this is impossible. However, evolution has achieved a similar seemingly impossible task. A variety of different molecules irreversibly self-assembled into a hierarchical complex structure, eventually creating single and multicellular organisms. The question therefore remains: Is such a process possible on a macroscopic length scale, without the complex electro- or even quantum-mechanical interactions that occur on the molecular level?

I will present a proof of concept system that demonstrates irreversible self-assembly using self-spinning granular particles called Vibrots[1,2]. A collective of these particles forms a two-dimensional chiral fluid, i.e. a fluidic system where the fundamental particles have an intrinsic chiral symmetry, in this case the sense of rotation. In such a fluid, vibrots experience an attractive interaction towards particles with equal sense of rotation. Therefore, particles with opposite sense of rotation spontaneously demix in a process similar to spinodal decomposition. This property can be used to form more complex polar particles by chaining several vibrots together into polar granular molecules. Such molecules can act as granular surfactants that control the dynamics of the chiral fluid, and, for particular shapes, self-assemble into so-called rotelles (Latin for 'little wheel'). Rotelles are active analogues of micelles, but form irreversibly through a ratchet mechanism and perform a global spinning motion that is inherited from their constituent particles.

[1] C. Scholz, M. Engel, T. Pöschel, Rotating robots move collectively and self-organize,
Nature Communications 9, 931 (2018)
[2] C. Scholz, S. Jahanshahi, A. Ldov, H. Löwen, Inertial delay of self-propelled particles,
Nature Communications 9, 5156 (2018)