Mesoscopic modeling of active suspensions: From squirmers to chemical colloids

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Active systems generate motion due to energy consumption, usually associated to their internal internal metabolism. As a result, these systems are intrinsically out of equilibrium and their collective properties emerge from a balance between particle direct interactions and the indirect coupling to the medium in which they displace. In the case of active particles suspended in a liquid, their dynamics is affected by the liquid in which they swim. The liquid interferes with the internal mechanisms that generate particle propulsion and it is also affected by the active stresses generated by the active particles. Therefore, a consistent dynamical approach that accounts for the active particles and the liquid motion on the same footing is required to analyze particle motion and quantify their self-assembly and ability to generate intermediate and large-scale structures.

I will discuss a simplified computational approach that resolves individual model swimmers. I will analyze the dynamic cooperativity of these suspensions and the different dynamical regimes they give rise to. I will also discuss the implications of such active couplings in the rheological response of these suspensions and their qualitative differences with colloidal suspensions. The approach allows for a critical comparison with complementary, macroscopic approaches to the mechanical properties of active fluids.