EXPLORING A NEW CLASS OF EFFECTIVE INTERACTIONS IN CROWDED ENVIRONMENT

Nicoletta Gnan, Institute of Complex Systems (CNR-ISC) and Department of Physics, Sapienza University of Rome
nicoletta.gnan@roma1.infn.it
Nicolas Ariel Garcia, Institute of Complex Systems (CNR-ISC)
Emanuela Zaccarelli, Institute of Complex Systems (CNR-ISC) and Department of Physics, Sapienza University of Rome

Key Words: effective interactions, self-assembly, crowding, colloidal suspensions

Colloidal suspensions are complex fluids involving many length and time scales. In order to make progress in their investigation, we often rely on coarse-grained models giving rise to effective potentials among colloidal particles, where some degrees of freedom can be traced out. In general, these amount to implicitly include the effect of the solvent and of co-solute small particles in a description for the large colloids only. By this route, it has been shown that effective forces can deeply modify the phase diagram of colloidal particles, starting with the pioneering case of depletion interactions [1]. More recently, colloidal effective interactions mediated by the spontaneous self-assembly of the co-solute have been studied, with critical Casimir-like forces being a famous example[2,3]. In this talk I will examine the effective forces generated by a co-solute which reversibly self-organizes into linear chains or larger aggregates. This is a situation different from what explored so far for colloids in solutions with polymer chains that do not self-assemble. We use 3D Monte Carlo simulations to calculate the effective potential between colloids immersed in a solution composed of depletant particles modelled as patchy colloids in which a hard-core repulsion is complemented by two or more short-ranged attractive 'sticky' spots [4]. At high cosolute densities, we find that the effective potentials, despite being purely attractive, display unusual peaks. We associate these oscillations with enhanced ordering of the co-solute, e.g. nematic for assembled linear chains, at characteristic distances, due to the confinement operated by the colloids [5]. We then show that such ordering is not exclusive of a pre-nematic behaviour but can occur with different depletant models [6]. Finally I will show that the resulting effective potentials represents a promising root for generating photonic colloidal crystals (for instance they stabilize the fcc crystal in hard-sphere colloidal solutions) which cannot be obtained with standard depletion.