Effective potentials in crowded environments

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Effective interactions play an important role in the physics of colloidal dispersions. The most established way to tune effective potentials is by means of depletion [1,2]. More recently, effective forces modified by the spontaneous self-assembly of the co-solute have been studied, with critical Casimir-like forces being a famous example [3,4].

In this talk, we examine the effective forces generated by a co-solute which self-organizes into linear chains (see Fig. 1) or larger aggregates. We use 3D Monte Carlo simulations to calculate the effective potential between two large colloids immersed in a solution composed of depletant particles ten times smaller. These particles are modelled as patchy colloids in which a hard-core repulsion is complemented by two or more short-ranged attractive 'sticky' spots [5]. At high cosolute densities, we find that the effective potentials, despite being purely attractive, display unusual peaks. We associate these peaks 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. Our study paves the way for a new class of colloidal interactions occurring in crowded environments and biologically relevant systems.

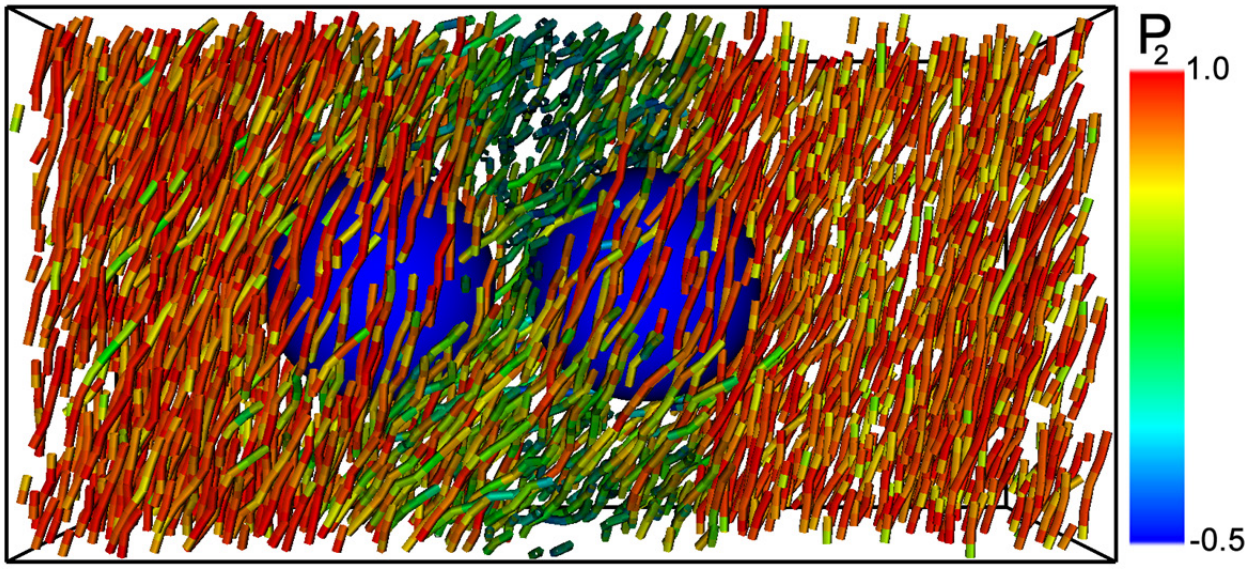

Figure 1: Snapshot of two colloids immersed in a co-solute of 2-patch particles assembled in a quasi-nematic phase. In order to improve visualization only the bonds among the co-solute particles are shown and coloured accordingly to the first orientational order parameter (P2) relative to a mean nematic director.

[1] S. Asakura and F. Oosawa, *J. Polym. Sci.*, 1958, **33**, 183.
[2] A. Vrij, *Pure Appl. Chem.*, 1976, **48**, 471.
[3] C. Hertlein, L. Helden, A. Gambassi, S. Dietrich and C. Bechinger, *Nature*, 2008, **451**, 172.
[4] N. Gnan, E. Zaccarelli and F. Sciortino, *Nat. Commun.*, 2014, **5**, 3267.
[5] E. Bianchi, J. Largo, P. Tartaglia, E. Zaccarelli and F. Sciortino, *Phys. Rev. Lett.*, 2006, **97**, 168301.