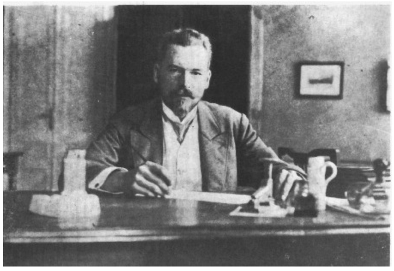

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Microscopic theory for the shear-induced structure distortion in concentrated suspensions of spherical colloids

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A major challenge in soft matter physics is to understand the repercussions of an external shear flow on the microscopic structure of colloidal suspensions. In the case of diluted suspensions of spherical colloids, a common starting point for the theoretical treatment of the problem is the two-body Smoluchowski *convection-diffusion* equation [1]. However, solving the latter equation is typically challenging even numerically, due to the *boundary-layer* behaviour shown at large separations among the colloidal particles [2].

An approximate analytical solution to the Smoluchowski convection-diffusion equation fully taking into account the boundary-layer structure, was recently found by means of matched asymptotic expansions [3]. We here show that combining this analytical solution with generalized integral equations of the liquid state, allows us to investigate the shear-induced structural distortion in concentrated regimes of packing fraction η; so far explored only by means of numerical simulations.

We consider both the case of hard spheres [4] and that of hard-core repulsive Yukawa particles [5], under shear flow. We compute the pair correlation function and extract scaling laws for its contact value. For hard spheres, our findings are in very good parameter-free agreement with numerical data from literature [6], up to $\eta \approx 0.5$. In addition, our scheme predicts (for the first time) a consistent enhancement of the structure factor $S(k)$ at $k \to 0$; upon increasing the shear rate, which we argue may signal the onset of a shear-induced phase transition from the isotropic phase to a non-uniform one.

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