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Are strongly confined colloids good models for two dimensional liquids?

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Quasi-two-dimensional (quasi-2D) colloidal hard-sphere suspensions confined in a slit geometry are widely used as two-dimensional (2D) model systems in experiments that probe the glassy relaxation dynamics of 2D systems. However, the question of to what extent these quasi-2D systems indeed represent 2D systems is rarely brought up. Here, we use computer simulations that take into account hydrodynamic interactions to show that dense quasi-2D colloidal bi-disperse hard-sphere suspensions exhibit much more rapid diffusion and relaxation than their 2D counterparts at the same area fraction. This difference is induced by the additional vertical space in the quasi-2D samples in which the small colloids can move out of the 2D plane, therefore allowing overlap between particles in the projected trajectories. Surprisingly, this difference in the dynamics can be accounted for if, instead of using the surface density, one characterizes the systems by means of a suitable structural quantity related to the radial distribution function. This implies that in the two geometries the relevant physics for glass-formation is essentially identical. Our results provide not only practical implications for 2D colloidal experiments but also interesting insights into the 3D-to-2D crossover in glass-forming systems.

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